Section 11312 - Vertical Centrifugal Pumps

Operations and Maintenance Manual

Project:

WWTF PHASE 2 IMPROVEMENTS

TAUNTON, MA

ENGINEER:

BETA INC.

CONTRACTOR

Veolia

Hayes Pumps Inc.
66 Old Powder Mill Road
West Concord, MA 01742
Phone: 978 203 5094

Prepared By:	Nicole Fernandes
Date:	10/16/2023
Revision:	0
Veolia PO:	1000095433
HPI SO:	112681
Opppp:	A3083046

Table of Contents

IOM Notes:

1. Hard copy of IOM's will be provided and assembled as specified with approved IOM.

ORDER INFORMATION

PROJECT:	Taunton, MA WWTF Ph Improvements Vertical Centrifugal Pump Taunton, MA	
GNRL CONTRACTOR:	Veolia Water 825 West Water st Taunton, MA	PHONE: (413) 785-1947
SUPPLIER:	Hayes Pump, Inc. 66 Old Powder Mill Road West Concord, MA 01742	PHONE: (978) 369-8800 EMAIL: sales@hayespump.com
	Service/Repair	PHONE: (800) 804-7565
MANUFACTURER:	Fairbanks Morse 3601 Fairbanks Ave Kansas, KS 66106	PHONE: (913) 371-5000

REFERENCES:

Contractor's Purchase Order Number:	1000095433
Supplier's Sales Order Number:	112681
Pump S/N:	
#1 WAS	10751067/68/69
#2 WAS	10751001/2/3
#1 RAS	10750998/999, 10751000
#2 RAS	10751018/19/20

APPROVED SUBMITTALS

SHOP DRAWING REVIEW FORM AND TRANSMITTAL

DATE: **December 7, 2022**

TO: Hans Tuneblom
Northeast Region Director CPM
Veolia Water
825 West Water Street
Taunton, MA 02780

FROM: James Dyment, P.E.
Senior Associate
BETA Group, Inc.
701 George Washington Hwy
Lincoln, Rhode Island 02865

RE: City of Taunton, MA
WWTF Phase 2 Improvements
Contract S-2022-1

Shop Drawing No. 11312 REV 1 – Vertical Centrifugal Pumps (Bid Package #3)

BETA COMMENTS:

Item	Action Code	Description/Comments
1	2	**Vertical Centrifugal Pumps (Hayes Pump)** 1. Provide standard clockwise rotation at discharge position #1 for all pumps. 2. Revise general information sheet, Secondary Sludge Pump Station No.2 pump tag numbers to the following: a. WAS (WSP-4221/WSP-4222/SCP-4231) b. RAS (RSP-4211/RSP-4212/RSP-4213) 3. Revise general information sheet, Secondary Sludge Pump Station No.2 RAS parallel pump operating point to 2,700 gpm at 25 ft. 4. Revise general information sheet, RAS Pumps should include combo base with 12x12 flange suction elbow, high ring base, coupling.

Action Codes
1 - No Exception Taken
2 - Make Corrections Noted
3 - Amend and Resubmit
4 - Rejected, See Remarks

a. Installation shall proceed only when Action Code is '1' or '2'.
b. Submittals action coded '3' shall be resubmitted within time limit set in Contract.
c. Review does not relieve Contractor from responsibility of compliance with the Contract Documents.

Section 11312

Vertical Centrifugal Pumps

(Bid Package #3)

Project:

WWTF Phase 2 Improvements
City of Taunton, MA

Engineer:

Beta Inc.

SHOP DRAWING REVIEW

☐ 1 – Approved ☑ 2 – Approved as Noted

☐ 3 – Revise and Resubmit ☐ 4 - Rejected

☐ 5 – Record File Only – No Action Taken

(Above Check Designates Action Code – See Review Comments)

IMPORTANT NOTE FOR CONTRACTOR

Review is only for general compliance with the design concept and information provided in Contract Documents. Corrections and comments made on the Shop Drawings during review do not relieve the Contractor from compliance with the requirements of the plans and specifications. Review and/or approval of a specific item shall not include review or approval of an assembly of which the item is a component. No approval or correction of a Shop Drawing shall be construed as an order for extra work. The Contractor is responsible for: all quantities and dimensions to be confirmed and correlated; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all trades and subcontractors; and performing all Work in a safe and satisfactory manner.

BETA GROUP, INC. Checked By: BM

By: James Dyment Date: 12/7/2022

Hayes Pumps Inc.
66 Old Powder Mill Road
West Concord, MA 01742
Phone: 978 203 5094

Prepared By:	Tracy Santoro
Date:	11/19/2022
Revision:	1
HPI:	A3083046

Table of Contents

General Information

Equipment Information

GENERAL INFORMATION

Project Information:

SECTION: 11312 Vertical Centrifugal Pumps (Bid Package #3)

APPLICATION: Secondary Sludge Pumping Stations No. 1: Qty 3 WAS / Qty 3 RAS Pump/Motor

-WAS (WSP-4121/WSP-4122/SCP-4131): 220 gpm at 34 ft TDH

-RAS (RSP-4111/RSP-4112/RSP-4113): 3500 gpm at 23 ft TDH / 2500 gpm at 28 ft

Secondary Sludge Pumping Stations No. 2: Qty 3 WAS / Qty 3 RAS Pump/Motor

-WAS (WSP-4121/WSP-4122/SCP-4131): 220 gpm at 40 ft TDH

-RAS (RSP-4111/RSP-4112/RSP-4113): 3500 gpm at 21 ft TDH / 2500 gpm at 25 ft

DESCRIPTION: WAS Pumps: Fairbanks 4" 5442 solids handling vertically mounted pump with:

- Cast iron casing and 2 vane impeller
- 316 SS impeller and casing wear ring
- Standard mechanical seal with 300 350 BHN stainless steel shaft sleeve
- 400 series stainless steel shaft with 300 350 BHN stainless steel shaft sleeve
- 7.5 hp 1175 rpm TEFC premium efficient inverter duty rated motor (3/60/460) with winding thermostats
- Combo base with 4x4 flanged suction elbow, high ring base, coupling
- Spare Parts: Six (6) Mechanical Seals (1 per pump).
- Non Witnessed Factory Performance, Factory Hydrostatic Pressure Testing.

RAS Pumps: Fairbanks 12" 5711 solids handling vertically mounted pump with:

- Cast iron casing and 2 vane impeller
- 316 SS impeller and casing wear ring
- Standard mechanical seal with 300 350 BHN stainless steel shaft sleeve
- 400 series stainless steel shaft with 300 350 BHN stainless steel shaft sleeve
- 25 hp 890 rpm TEFC premium efficient inverter duty rated motor (3/60/460) with winding thermostats
- Combo base with 4x4 flanged suction elbow, high ring base, coupling
- Spare Parts: Six (6) Mechanical Seals (1 per pump).
- Non Witnessed Factory Performance, Factory Hydrostatic Pressure Testing.

Supplier and Service Contact Information:

HAYES PUMP, INC DIVISION
66 OLD POWDER MILL ROAD
WEST CONCORD, MA
https://hayespump.com
PHONE: 978 203 5094
GENERAL FAX: 978 369 8461
FAX: 888 778 5089

Submittal R0 Comment Responses:

1. Revise all Tag numbers on cover sheets. For example, sixth page of the submittal calls out Pump Station 1 RAS pump tag nos. then shows the PS 1 WAS pump info.
   Response: Tag numbers have been corrected.
2. Pump Station 1 WAS performance curve and setting plan incorrectly indicates the operating point as 220 gpm @ 21 TDH. Provide performance curve and setting plan with specified operating point of 220 gpm @ 34 TDH.
   Response: Operating points have been corrected.
3. Pump Station 2 WAS performance curve and setting plan incorrectly indicates the operating point as 220 gpm @ 23 TDH. Provide performance curve and setting plan with specified operating point of 220 gpm @ 40 TDH.
   Response: Operating points have been corrected.

Notes, Exceptions and Clarifications:

A. General Exclusions*:* The following optional items are not included in this quotation. If required, please contact your Hayes Pump, Inc. for pricing and availability: Unless noted otherwise, Gauges, switches, valves and other specialties not specifically called out herein. Special coatings other than those quoted. Vibration and noise tests. Equipment, labor, material required to perform field testing of pumps. Special motor specifications including high efficiency, mill and chem duty, explosion proof, internal space heaters, etc. Intrinsically safe features. Level controls or control panels. Additional lubricants other than those contained within the pump. Anchor bolts. Panels, Seal or Packing Flush Hardware, Controls, Contacts, VFDs, Starters (AC Motors), Tools, Valves, Video Equipment/Taping, Lubricants, Pressure Switches, Timers, Taxes

B. Exceptions / Clarifications / Comments**:**
   Running the pump in reverse is not recommended.
   Standard factory mechanical seal provide as mechanical seal was required for spares.
   Dolly by others.
   Installation by others.
   I&C, motor field testing by others.

Warranty:

Standard manufacturer's warranty shall be twelve (12) months from date of installation.

EQUIPMENT INFORMATION

Tag #: RSP-4111/RSP-4112/RSP-4113
Service: SECONDARY SLUDGE PUMP STATION NO. 1 RAS PUMPS

Pentair Flow Technologies
General Clarifications

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
   - Anchor bolts, nuts and washers.
   - Gauges, valves and miscellaneous fittings and adaptors.
   - Connecting piping and/or supports.
   - Maintenance lubrication, lubrication piping and related equipment.
   - System control apparatus.
   - Maintenance tools and/or storage boxes.
   - Equipment tags
   - Installation or field performance testing.
2. The following items are to be installed in the field:
   - Accessory items that are shipped separately.
3. Verification and/or conformation of the following is requested at or prior to release of this equipment.
   - Rotation and discharge position
   - Shaft lengths or elevations

Fairbanks Nijhuis Pump
Submittal Data For
Taunton Wastewater Treatment Facility
Taunton, MA

Supplier:	Hayes Pump, Inc. 66 Old Power Mill Road West Concord, MA 01742
Manufacturer:	
Pump	Fairbanks Nijhuis Pump Corporation 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000 Fax: (913) 371-2272
Project Number:	0913563
Sales Order Number	53144669
Tag:	RSP-4111/RSP-4112/RSP-4113
Service:	Secondary Sludge Pump Station No. 1 RAS Pumps
Quantity:	3
Pump Size & Model:	12” B5711C
Motor:	U S Electrical Motors P. O. Box 3946 St. Louis, MO 63136 (314) 553-2000

Fairbanks Nijhuis Pump
Table Of Contents

Fairbanks Nijhuis Pump
Included Features

- 30 HP, 900 RPM, 3/60/460V, 364VP Frame, US Electric Motor
- Variable Speed Application
- Standard Double Mechanical Seal with Stainless Steel Sleeve
- Stainless Steel Impeller Wear Ring; 190-241 BHN
- Stainless Steel Casing Wear Ring; 300-350 BHN
- Stainless Steel Packing Sleeve; 190-241 BHN
- Falk Coupling
- Certified Non-Witness Hydro Testing
- Certified Non-Witness Performance Testing
- Curve Approval
- Dynamically Balanced Cast Iron Impeller
- Contour Handhold Cover

1. Refer also to clarifications that may be included on the vendor submittal .

12" B5711 Submittal Curve

PENTAIR FAIRBANKS NIJHUIS™

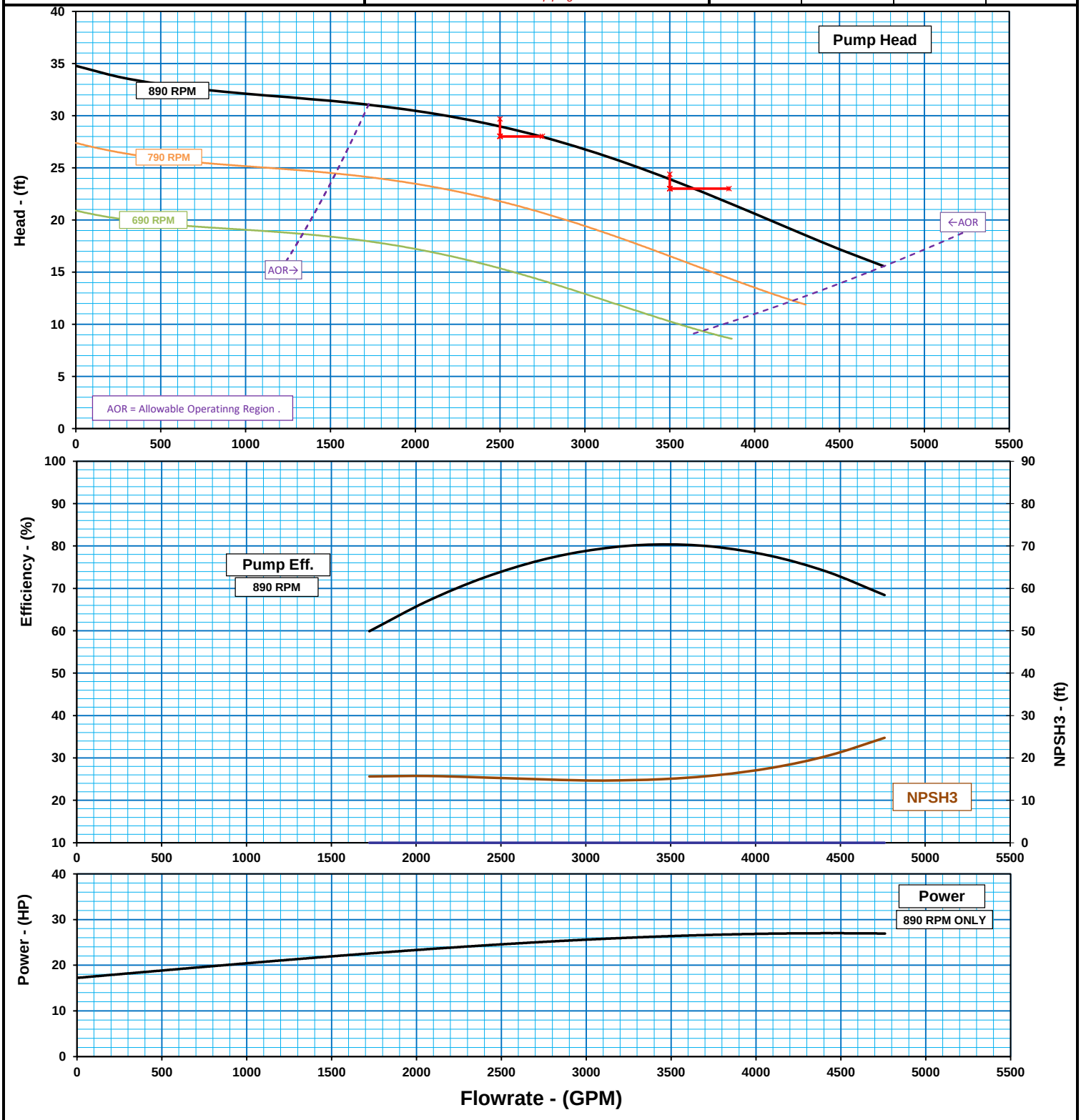
CURVE NUMBER:	0913563C
REV.	0

THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED, **PER ANSI / HI 14.6 - 2022 GRADE 1U.**

SPEED	DRIVER	DIAMETER	SPHERE
890 RPM	30 HP	13.15"	4.5"
NO. VANE	IMPELLER	DATE	BY
2	L12A1N	8/10/2022	MD

Per ANSI/HI: "For many common solids-bearing liquids, a velocity of about 1,0 m/s (3.0 ft/s) is required to prevent sedimentation in horizontal piping."

GUARANTEED VALUES			
FLOW	HEAD	PUMP EFF	HP
3500	23	-----	-----
2500	28	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----



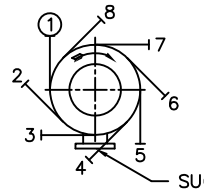
⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

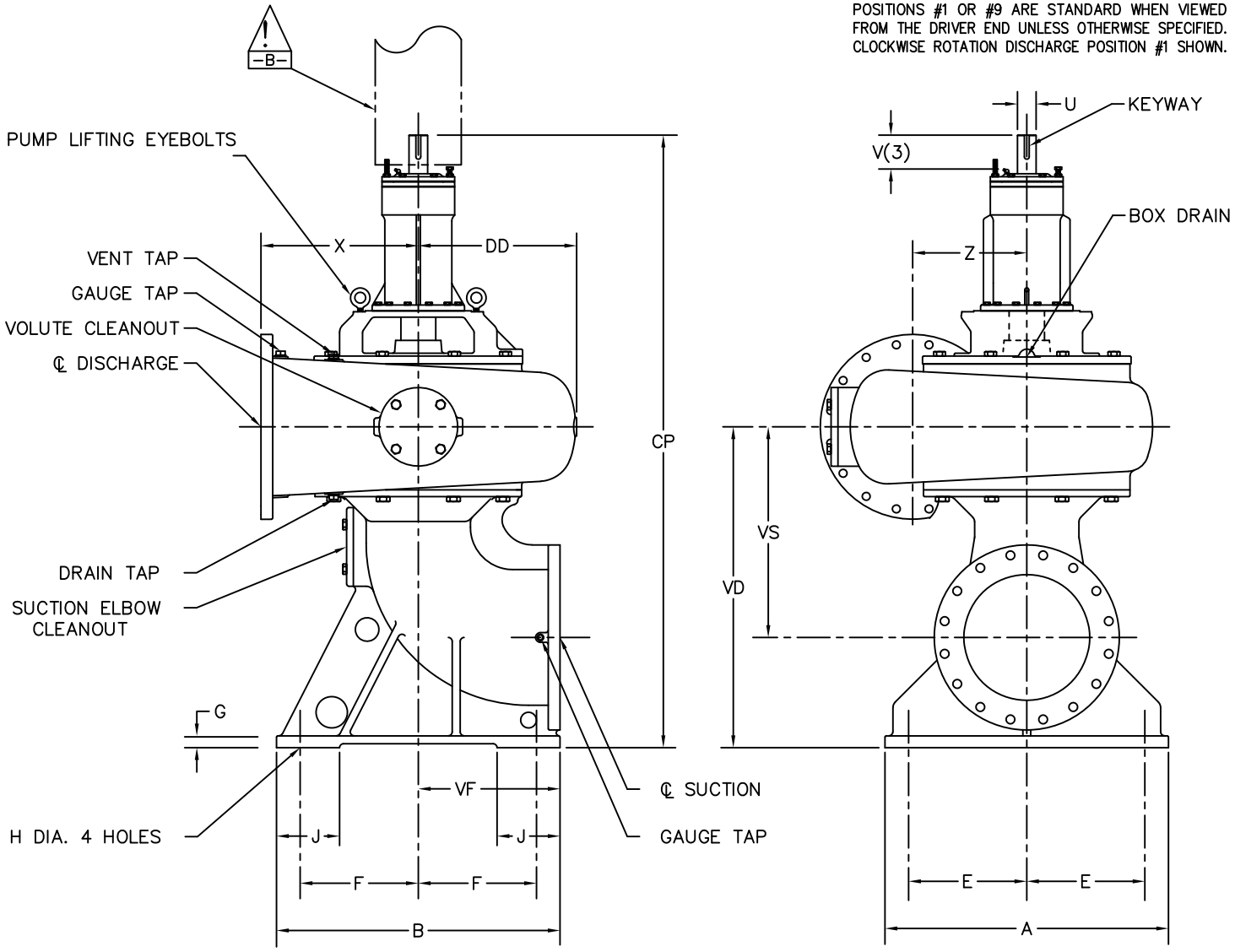
–A– SUPPLIED BY FMPC –B– SUPPLIED BY OTHERS

AVAILABLE DISCHARGE POSITIONS

CLOCKWISE



POSITIONS #1 OR #9 ARE STANDARD WHEN VIEWED FROM THE DRIVER END UNLESS OTHERWISE SPECIFIED. CLOCKWISE ROTATION DISCHARGE POSITION #1 SHOWN.



PUMP	FRAME	SUCT	DISCH	A	B	E	F	G	H	J	U	V	X	Z	CP	DD	VD	VF	VS	KEYWAY
12"B5711C	T40	12	12	30	30	13	13	1 1/4	1 1/4	4	2 3/8	4 1/4	15	10 3/4	72 7/8	14 15/16	37	19 1/4	25 1/2	5/8 X 5/16 X 2 3/4

NOTES:

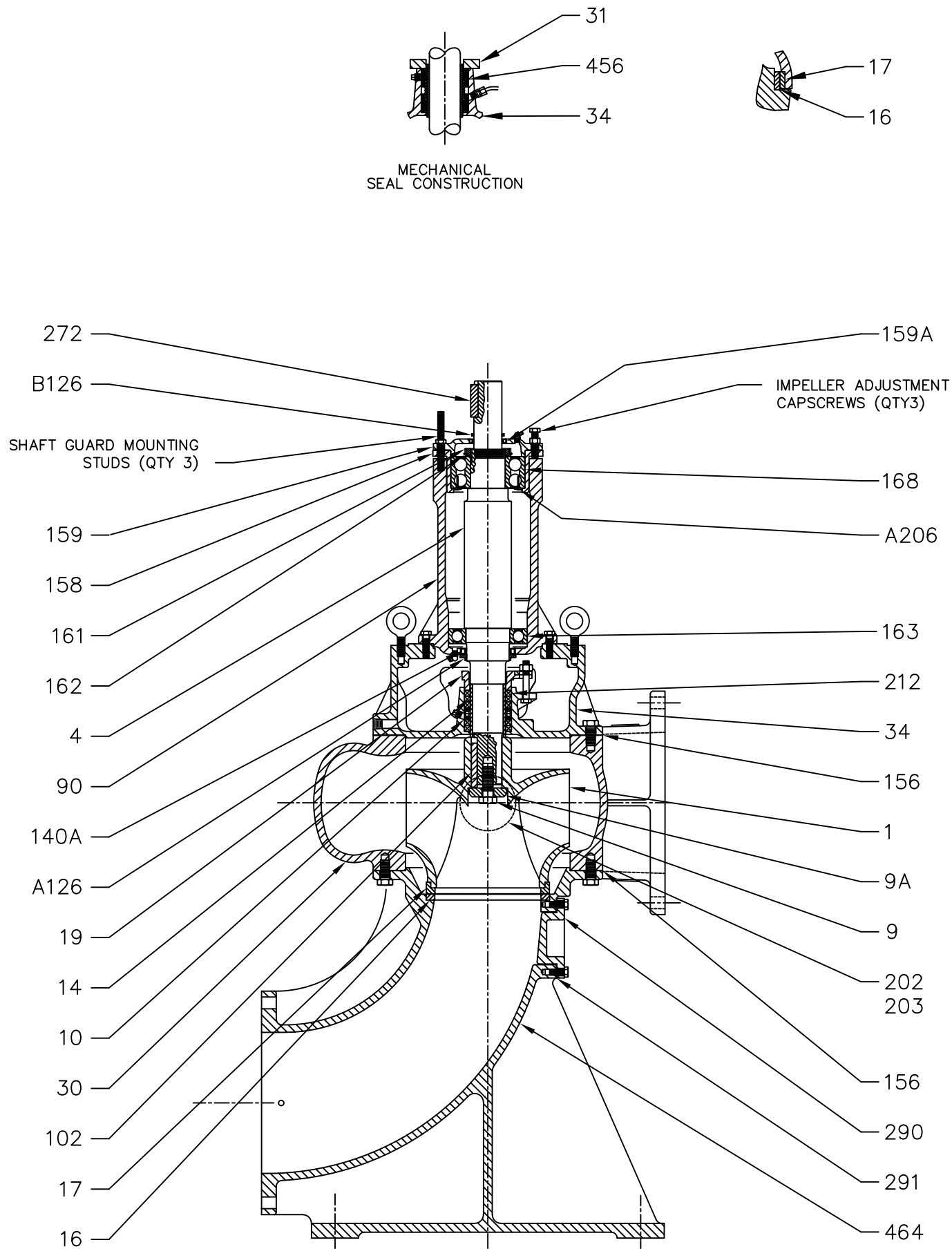
(1) ALL FLANGES ARE 125# ANSI DRILLING UNLESS NOTED.
(2) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED.
(3) DIMENSIONS REFLECT USABLE SHAFT LENGTH.
(4) BASES ARE DESIGNED TO HAVE FULL CONTACT WITH GROUT OR A SOLE PLATE GROUTED IN PLACE.
(5) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VARY DUE TO NORMAL MANUFACTURING TOLERANCES.

CUSTOMER: HAYES PUMP INC.					P.O. NO.: 133369	PENTAIR
JOB NAME: Taunton, MA Treatment Plant					TAG NAME:	BASIC PUMP DIMENSIONS 12" B5711C
PUMP SIZE AND MODEL: 12" B5711C		GPM: 3500	TDH: 23	RPM: 900	ROTATION: CW	DISCH POS: 1
MOTOR: NIDEC	HP: 30	FRAME: 364VP	PHASE: 3	HERTZ: 60	VOLTS: 460	ENCLOSURE: TEFC
CERTIFIED FOR: PROJECT: 0913563			CERTIFIED BY: JEA		DATE: 8/16/22	DWG NO 0913563SP 16 / REV NO 0

Fairbanks Nijhuis Pump
Material Specifications

Item	Description	Material	Specification
1	Impeller	Cast Iron	A48 Class 30
4	Shaft	Steel	AISI 1144
9	Bolt, Impeller	Steel	SAE Bolt Steel
9A	Washer, Impeller	Steel	A108 Grade 12L14
14	Sleeve, Shaft	Stainless Steel	A743 Gr. CA15 190-241 BHN
16	Wear Ring, Fronthead	Stainless Steel	A743 Gr. CA40 300-350 BHN
17	Wear Ring, Impeller	Stainless Steel	A743 Gr. CA15 190-241 BHN
30	Volute	Cast Iron	A48 Class 30
31	Solid Gland	Cast Iron	A48 Class 30
34	Backhead	Cast Iron	A48 Class 30
90	Frame	Cast Iron	A48 Class 30
A126	Deflector, Inner	Rubber	Commercial
B126	Deflector, Outer	Rubber	Commercial
140A	Seal, Outer Grease	Steel & Rubber	Commercial
156	Gasket, Volute	Tag Board	D1170-G3111
158	Housing, Thrust Bearing	Cast Iron	A48 Class 30
159	Cover, Thrust Bearing	Cast Iron	A48 Class 30
159A	Seal, Outer Grease	Steel & Rubber	Commercial
161	Locknut, Bearing	Steel	SAE Bolt Steel
162	Lockwasher, Bearing	Steel	AISI 1215
163	Bearing, Radial	Steel	Commercial
168	Bearing, Thrust	Steel	Commercial
202	Cover, Volute Cleanout	Cast Iron	A48 Class 30
203	Gasket, Cleanout	Rubber	Commercial
206A	Retainer, Inner Grease	Steel	Commercial
272	Key, Coupling	Steel	A108 Grade 1018
290	Cover, Fronthead Cleanout	Cast Iron	A48 Class 30
291	Gasket, Cleanout	Rubber	Commercial
456	Mechanical Seal	-	Commercial
464	Base Elbow	Cast Iron	A48 Class 30

Notes:
1. All material specifications are ASTM unless otherwise noted and are or description of chemistry only.



ASSEMBLY WITH COMBINATION BASE ELBOW
12" B5711C T40 FRAME

PENTAIR

DWG NO 0913563AP REV NO 0

Pump	
Frame Size	T40
Pump Size	12
Suction Size, Standard	12
Nominal Wear Ring Clearance	0.037
Impeller Fastener	
Size	7/8-9
Tightening Torque, lb.-ft.	150
Impeller	
Weight, lb.	104.5
Inlet Area, sq. In.	88.15
WR^2 Lb.-$Ft.^2$	15.0
Sphere Size, Maximum	4 1/2
Shaft Diameter:	
at Impeller	2 3/8
at Sleeve	2 5/8
at Thrust Bearing	2.953
at Radial Bearing	3.740
Between Bearings	4
at Coupling	2 3/8
Keyway at Coupling	5/8 X 5/16
Torsional Shaft Stiffness, lbs./rad.	2.26X106
Center to Center of Bearings	14 1/8
Thrust Bearing Number	5315
Radial Bearing Number	6219
Sealing Box:	
Mechanical Seal Type	Double
Recommended Flush Water	
Pressure, PSI	Note 2
Flow, GPM	1/2-1
Sleeve OD	3
Box ID	4
Box Depth	3 3/4
Box Inlet Tap Size, NPT	1/4
Box Outlet Tap Size, NPT	1/4
Backhead Drain Tap Size, NPT	3/4
Volute Cleanout Diameter	4 3/4
Fronthead Cleanout Diameter	4 1/2
Vent/Priming Tap Size, NPT	1
Volute Drain Tap Size, NPT	1
Gauge Tap Size	
Suction, NPT	1/2
Discharge, NPT	1/2
Hydrostatic Test Pressure, Maximum, PSI	75
Casing Working Pressure, Maximum, PSI	50
Nominal Casing Thickness	5/8
Operating Temperature, °F	150
Anchor Bolt Size Recommended	1
Minimum Diameter Opening to Install Pump	39 1/2
Shipping Weight, Basic Pump, lb.	1240

Note 1. Values shown are in inches unless otherwise noted.

Fairbanks Nijhuis Pump

Typical Pump Bearing Lubricants

Fairbanks Nijhuis Pump recommends a superior quality, NLGI No. 2, multipurpose, lithium complex grease for all pump rolling element bearing applications that require grease lubrication. The grease characteristics should include good high temperature performance, extreme pressure properties, water resistance, excellent oxidation stability, good rust protection and resistance to chemical breakdown. Fairbanks Nijhuis Pump does not recommend grease with molybdenum disulfide (moly) additives. In addition to the characteristics listed above, the grease should meet the following specification.

Specifications

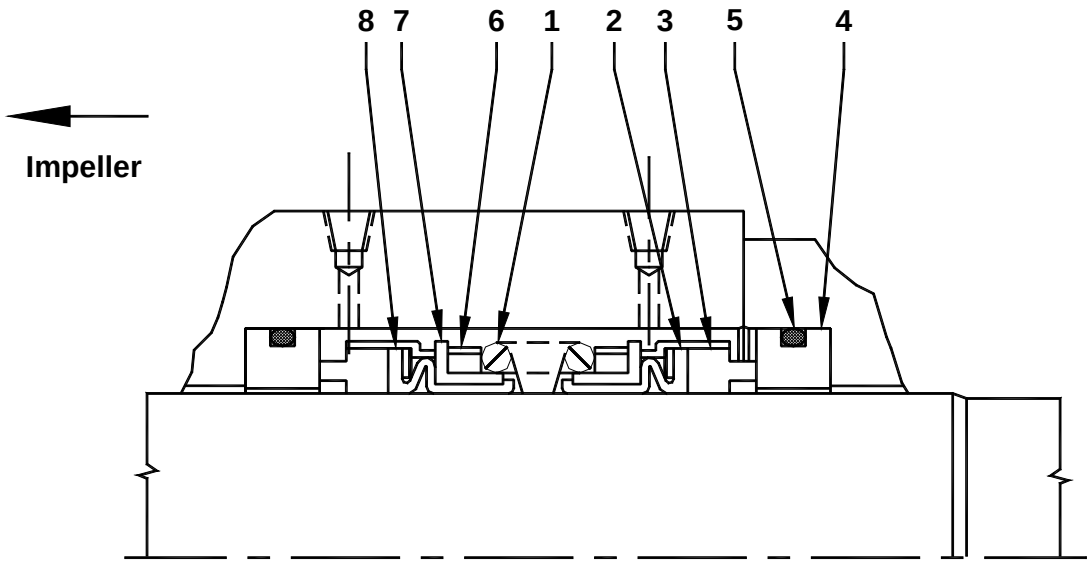
Consistency: NLGI No. 2
Dropping Point ASTM D2265 >450° F
Base fluid viscosity
SUS @ 100° F 700 to 1200
SUS @ 212° F 70 to 100
Rust Prevention ASTM 1743 Pass
Water Washout ASTM 1264 <4% @ 175° F
Four Ball EP Test ASTM D2596>40kg load wear
>250kg weld point

Fairbanks Nijhuis Pump has compiled a general list of products that meet the grease requirements above. This list is not an endorsement of any particular manufacture and should not be construed as exclusive recommendations. When choosing an alternate manufacture, customers should discuss this typical lubricant recommendation with their vendor to ensure that an equivalent grease is supplied.

Typical Products

Manufacturer	Lubricant Brand Name	NLGI No.
BP	BP Energrease® LC EP 2	2
Castrol	Pyroplex Red	2
Chevron	Delo® Greases EP	2
Exxon	Ronex® MP	2
Mobil	Mobiltith® AW2	2
Shell	Retinax® LC	2
Texaco	Starplex® 2	2
76	76 Multiplex EP	2

Fairbanks Nijhuis Pump
Typical Mechanical Seal



Item	Part	Material
1	Spring	Stainless Steel
2	Rotary Bellows	Buna-N
3	Rotary Face	Carbon
4	Stationary Seat	Ceramic
5	O-Ring	Buna-N
6	Driving Band	316 Stainless Steel
7	Retainer	18-8 Stainless Steel
8	Disc	316 Stainless Steel

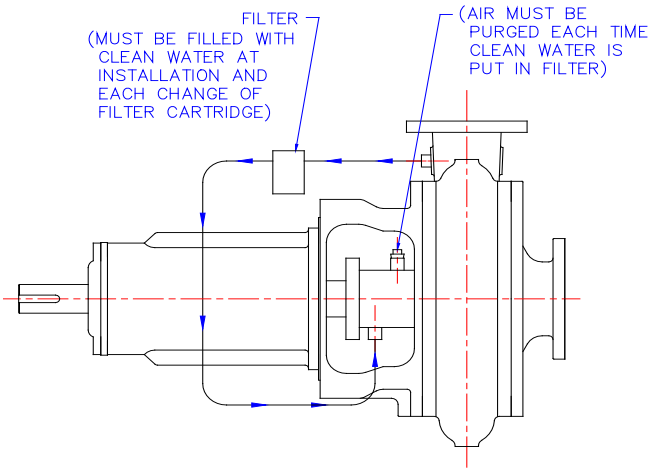


Figure A
Typical Deadhead Schematic

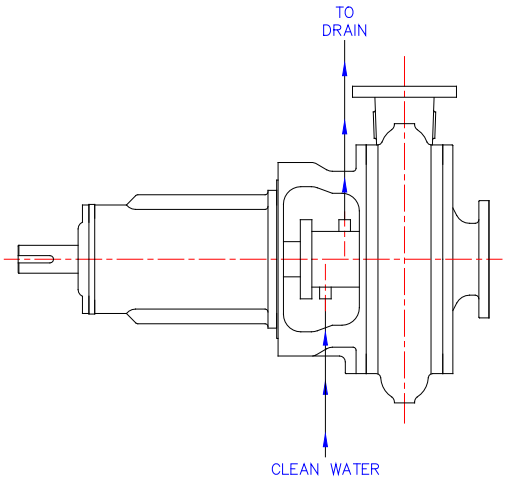


Figure B
Typical Flush Water Schematic

Fairbanks Nijhuis Pump
Furnished Spare Parts

Ref. No.	Description	Quantity
456	Mechanical Seal	3

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N69
  - **Number of Coats** One
  - **Dry Film Thickness** Standard
  - **Color** 1211 Red
  - **Surfaces to be coated** Exterior of Pump

TNEMEC

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II SERIES N69

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water.

COLORS Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH Satin

SPECIAL QUALIFICATIONS A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69F, V69F, 90E-92, 90-97, H90-97, 90G-1K97, 90-98, 91-H_2O, 94-H_2O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69F, V69F, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or 130, 215, 218, 1254

TOPCOATS 22, 46H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69 is 21 days for atmospheric service. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

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

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS **Unthinned:** 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)

HAPS **Unthinned:** 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids

THEORETICAL COVERAGE 1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

HI-BUILD EPOXOLINE® II | SERIES N69

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

PACKAGING 5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.

NET WEIGHT PER GALLON 13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA Part A: 82°F (28°C) Part B: 93°F (34°C)

HEALTH & SAFETY Paint products contain 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

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). 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

1. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon.

POT LIFE Without 44-700: 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700: 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 75°F (24°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Minimum 50°F (10°C) Maximum 135°F (57°C) The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

NIDEC MOTOR CORPORATION
8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 8/29/2022

P.O. NO.: 12588105
Order/Line NO.: 22701570 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

HOLD PRODUCTION
Horsepower ..... 00030.00~00000.00 ~ KW: 22.38
Enclosure ..... TEFC
Poles ..... 08~00 ~ RPM: 900~0
Frame Size ..... 364~VP
Phase/Frequency/Voltage.. 3~060~460
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
Customer Part Number FMB0913563A01
16.5" Base
Pricebook Thrust Value (lbs).. 7000
Customer Down Thrust (lbs) ... 1
Customer Shutoff Thrust (lbs).
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
"AK" Dimension (Inches).. NA
Shaft Dimensions:~U=1.625 ~ AH/V=4.500
KEYWAY=0.375 ~ ES=3.030
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.7 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 769 LB-FT2
Number Of Starts Per Hour: NEMA
Motor Type Code TVI4
Rotor Inertia (LB-FT²) 23.9 LB-FT²
Qty. of Bearings PE (Shaft) 1
Qty. of Bearings SE (OPP) 1
Bearing Number PE (Shaft) 7314 BEP
Bearing Number SE (OPP) 6212-2Z-J/C3

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 8/29/2022

P.O. NO.: 12588105
Order/Line NO.: 22701570 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913563A01
12588105
LINE 10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	30
Pole(s)	08
Voltage(s)	460
Frame Size	364VP
Shaft U Diameter	1.625
Outlet Box AF	3.38
Outlet Box AA	3.00

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 8/29/2022

PENTAIR PURCHASE ORDER #: 12588105 PENTAIR TAG #: FMB0913563A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X **IEEE** X **ASA** X **NEMA**

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
30	900	891	364VP	TVI4	TEFC

*Full Load Speed Tolerance Per NEMA MG1-12.46 is+/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPHERES		INSULATION CLASS	MAX. TEMP. RISE	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR		X RESIS. THERM.			
3	60	460	39	206.3	F	105 DEG C AT 1.00 SF	1.15	F	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD		PERCENT OF FULL LOAD	
91.7	93.0	92.4	77.8	74.2	65.3	176.9	139	213

VSS [X] **VHS** [ ] **NRR** [ ] **SRC** [ ] **HORIZ** [ ]

BEARINGS:

Drive End Lubrication:
[ ] Oil [X] Grease

Opposite End Lubrication:
[ ] Oil [X] Grease

PAINT: (Attach Technical Data Sheets)
[X] Factory Standard
[ ] Other _____

MOTOR NO.: 22701570

MOTOR WEIGHT: 900 LBS

ROTATION: [ ] **BI-DIRECTIONAL** [X] **CW** [ ] **CCW**

Certified by: Emil Roque Date: 8/29/2022 Revision # 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/29/2022

Pentair Purchase Order #: 12588105 Pentair Tag #: FMB0913563A01

	Required	Not Required	Description
Space Heaters:	☐	☒	Watts: _____ Voltage: _____
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Tests:	☐	☒	☐ Short commercial, unwitnessed ☐ Short commercial, witnessed ☐ Calibration Test, unwitnessed ☐ Complete initial, unwitnessed ☐ Complete initial, witnessed ☐ Sound test, unwitnessed ☐ Bump Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Reed Critical Test, unwitnessed ☐ IEEE841

Certified by: Emil Roque Date: 8/29/2022 Revision #: 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/29/2022

Pentair Purchase Order #: 12588105 Pentair Tag #: FMB0913563A01

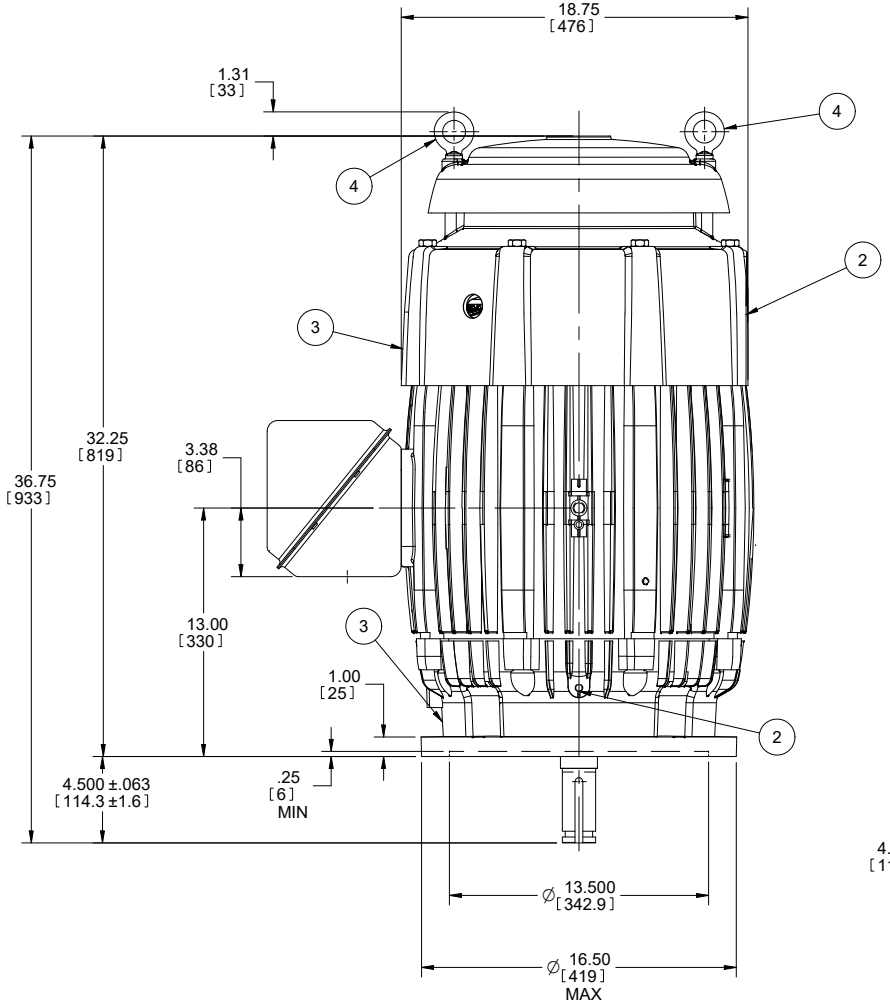
Features:

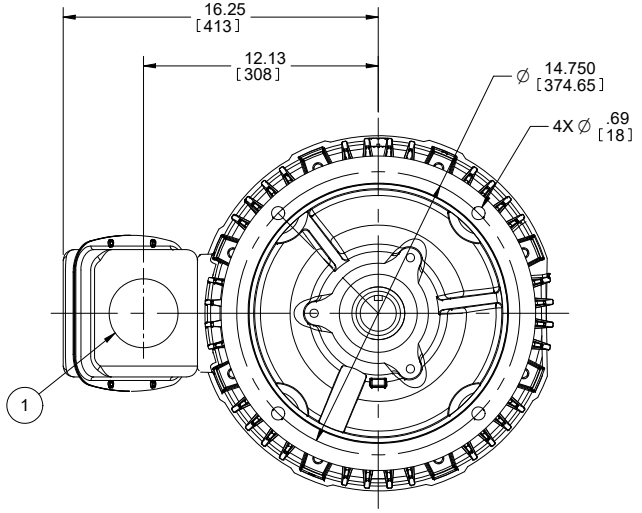
Enclosure ..... TEFC
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
16.5" Base
Pricebook Thrust Value (lbs).. 7000
Customer Down Thrust (lbs) ... 1
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque Speed
Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Shaft Dimensions:~U=1.625 ~ AH/V=4.500
KEYWAY=0.375 ~ ES=3.030
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.7 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 769 LB-FT2
Number Of Starts Per Hour: NEMA

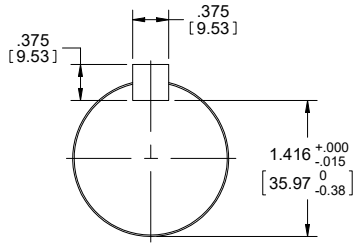
Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913563A01
12588105
LINE 10

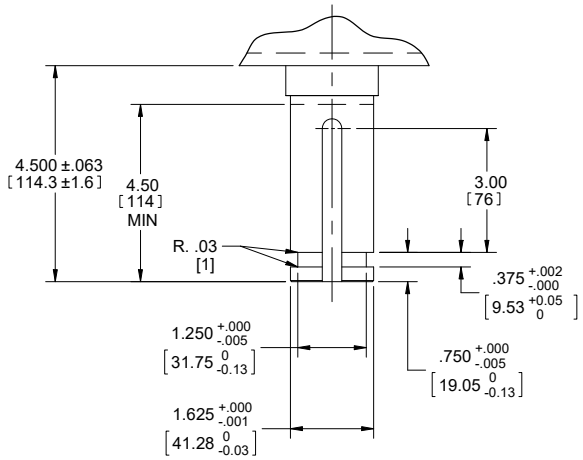
Certified by: Emil Roque Date: 8/29/2022 Revision #: 0







SHAFT DETAIL
SCALE 1:1



SHAFT DETAIL
SCALE 1:2

USER INFORMATION
CUSTOMER: PENTAIR FLOW CUSTOMER P/N: FMB0913563A01 P.O: 12588105 REF. ORDER #: 22701570-100

TOLERANCES	IN
FACE RUNOUT	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 T.I.R.
PERMISSIBLE SHAFT RUNOUT	.002 T.I.R.

NOTES:

1) MAIN BOX FOR MOTOR POWER LEADS, 3.00" SIZE CONDUIT.
   BOX VOLUME: 347 CU. IN. [5686 CU. CM.]
2) DRAINS: TOP AND BOTTOM GREASE.
3) FILL: TOP AND BOTTOM GREASE.
4) MOTOR LIFTING LUGS.
5) BEARINGS: LOWER - 7314 BEP
   UPPER - 6212-2Z-J/C3
6) ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
7) CONDUIT BOX MAY BE LOCATED IN STEPS OF 90 DEGREES STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.

CERTIFIED FOR CONSTRUCTION

RATING	30 HP [22.38 KW] 891 RPM, 460 V, 3Ø, 60HZ	REVISION DECRIPTION:	UNITS: DUAL
ENCLOSURE	TEFC	NEW	
BEARINGS	SEE (5)		
LUBRICATION	GREASE		
ROTATION FACING O.D.E.	CW		
NET WEIGHT (±10%)	900 LBS [408.23 KG]		

FRAME: 364VP
TYPE: TVI4
TITLE: DIMENSION PRINT 32
NIDEC MOTOR CORPORATION
ISSUED BY: L. ARROYO
APPROVED BY: R. MARTINEZ
REVISION DATE: 17-AUG-22
DWG NO.: 1200-8-738
REV: -
SHEET NUMBER: 1 OF 1
DWG SIZE: C

NAMEPLATE DATA

CATALOG NUMBER:				NAMEPLATE PART #:	422707-005		
MODEL		FR	364VP	TYPE	TVI4	ENCL	TEFC
SHAFT END BRG	7314 BEP - QTY 1			OPP END BRG	6212-2Z-J/C3 - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 22701570, Type: SO, Line#: 100)		
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	30	RPM	891	HP		RPM	
VOLTS	460			VOLTS			
FL AMPS	39.0			FL AMPS			
SF AMPS	44.0			SF AMPS			
SF	1.15	DESIGN	B	CODE	F		
NEMA NOM EFFICIENCY	93.0	NOM PF	77.8	KiloWatt	22.38		
GUARANTEED EFFICIENCY	91.7	MAX KVAR		HZ	60		

SF		DESIGN		CODE			
NEMA NOM EFFICIENCY		NOM PF					
GUARANTEED EFFICIENCY		MAX KVAR		HZ			

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460	AMPS	41.0
TORQUE 1	176.90LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	6-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	90-900	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	FMB0913563A01
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.06 IN/SEC	Arctic Duty	
3/4 Load Eff.	94.1	Inrush Limit	
Motor Weight (LBS)	900	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	7000	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4	GREASE LUBRICATED	Special Accessory Note 19	
Special Accessory Note 5	RECOMMENDED GREASE	Special Accessory Note 20	
Special Accessory Note 6	EXXON POLYREX-EM	Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	TVI4	364VP

ORDER NO.	22701570	LINE NO.	100

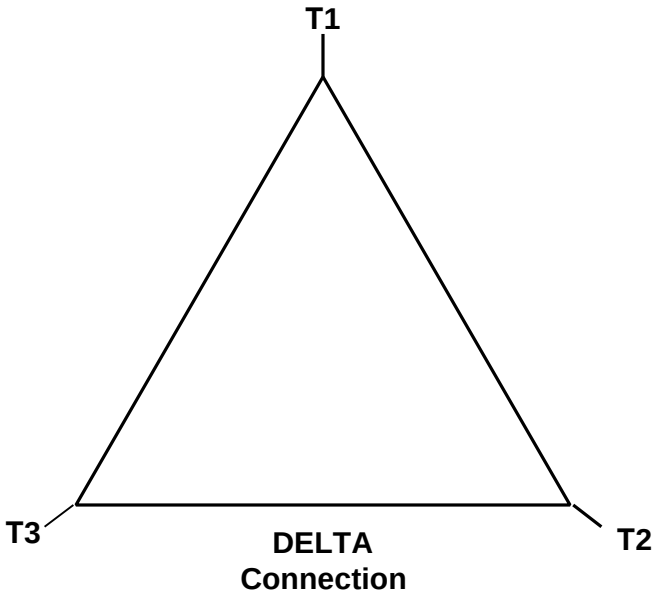
MPI:	136379
HP:	30
POLES:	8
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	92.7
FULL	93
3/4	94.1
1/2	93.9
1/4	90.9
POWER FACTOR (%):	
S.F.	78.5
FULL	77.8
3/4	74.2
1/2	65.3
1/4	44.5
NO LOAD	3.7
LOCKED ROTOR	32.3
AMPS:	
S.F.	44
FULL	39
3/4	30
1/2	22.9
1/4	17.4
NO LOAD	15.2
LOCKED ROTOR	206.3
NEMA CODE LETTER	F
NEMA DESIGN LETTER	B
FULL LOAD RPM	891
NEMA NOMINAL / EFFICIENCY (%)	93
GUARANTEED EFFICIENCY (%)	91.7
MAX KVAR	10.3
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	30
SOUND PRESSURE (DBA @ 1M)	65
TORQUES:	
BREAKDOWN{% F.L.}	213
LOCKED ROTOR{% F.L.}	139
FULL LOAD{LB-FT}	176.9

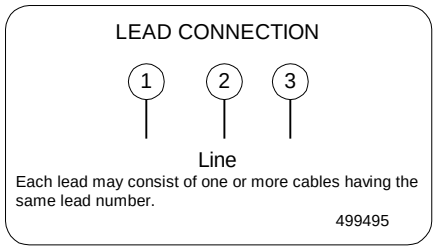
NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

Motor Wiring Diagram





To reverse direction of rotation interchange connections L1 and L2.
Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

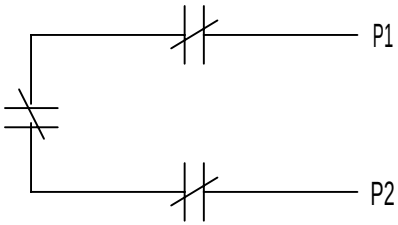
EFFECTIVE: 2/27/96
SUPERCEDES: X736618, 96441, 179879, 284138
Connection Plate: 499495
Connection Decal: 912113

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.

2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



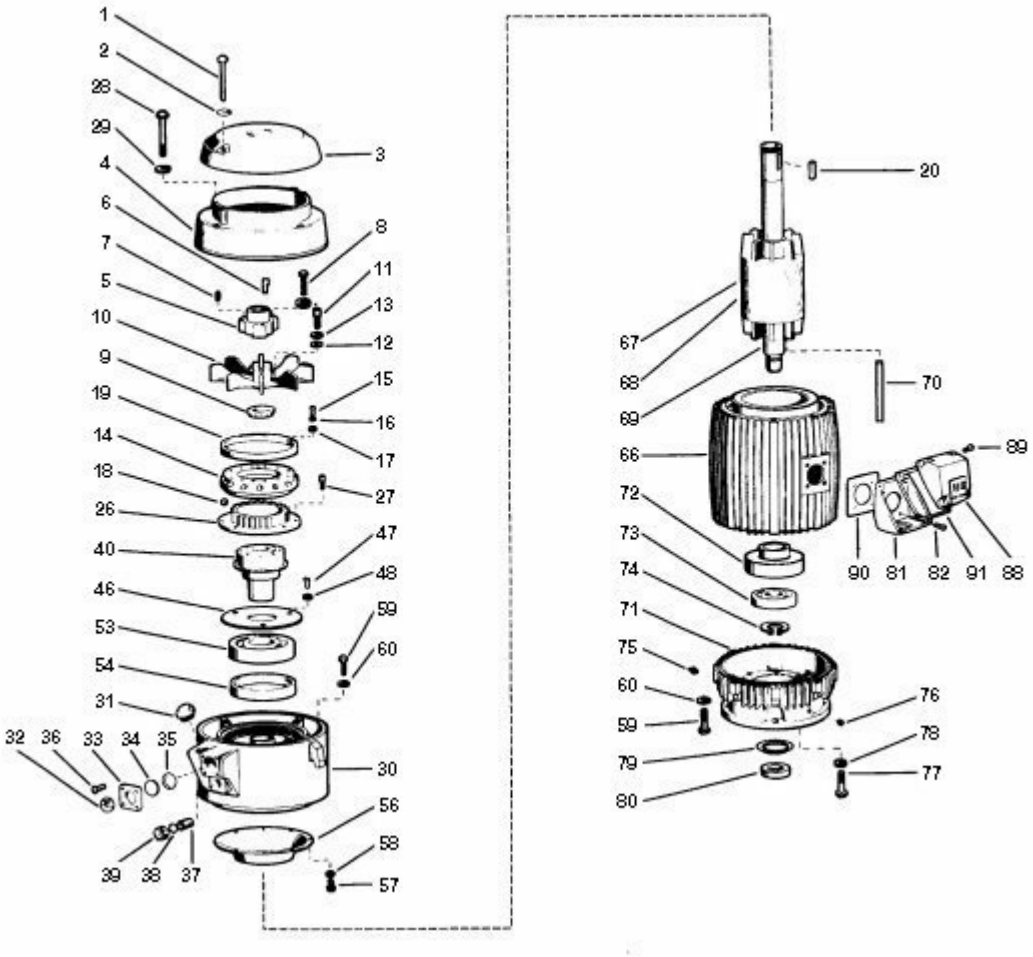
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC STL0211 - UPDATED FORMAT .	SCALE: NONE UNITS: IN TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES / mm ANGLES X°= ±1°	TITLE: CUSTOMER CONNECTION DIAGRAM ISSUED BY: R. KING APPROVED BY: C. CADE CODE: DWG NO.: 0834066	NIDEC MOTOR CORPORATION REVISION DATE: 24-FEB-11 REV: G SHEET NUMBER: 1 OF 1 DWG SIZE: A
MATERIAL: --- MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED			

RENEWAL PARTS

FRAMES 324 THRU 447 - TOTALLY ENCLOSED AND EXPLOSION PROOF MOTORS
TYPES: JU, JUE, JUS, LU, LUC, LUE, LUEI, LUS, LV4, LV9, LVC9, LVCI, LVCS, LVCS9, LVE4, LVS4, NVC4, NVC9, TU, TUC, TUCE, TUCI, TUCS, TUE, TUI, TUS, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE4, TVCE9, TVCI, TVCI4, TVCI9, TVCN9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVEI, TVI, TVI4, TVI9, TVN9, TVS, TVS4, TVS9
HOLLOSHAFT AND SOLIDSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	2	Hex Head Screws
2	2	Split Washers
3	1	Canopy Cap
4	1	Fan Cover
5	1	Drive Coupling (Holloshaft only)
6	1	Square Key
7	1	Drive Pin (444, 445 TU only)
8	1	Locking Pin and Lockwasher (LU only)
9	1	Locknut and Lockwasher
10	1	Fan
11	3	Socket Head Screws
12	3	Flat Washers
13	3	Lockwashers

ITEM NO.	QTY	NAME OF PART
14	1	Rotating Ratchet
15	6	Round Head Screws
16	6	Lockwashers
17	6	Plain Washers
18	12	Steel Balls
19	1	Ball Retaining Ring
20	1	Square Key
21-25	-	NOT USED IN THIS ASSEMBLY
26	1	Stationary Ratchet
27	2	Socket Set Screw
28	4	Hex Head Cap Scres
29	4	Split Lockwashers

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 157 & 158

FRAMES 324 THRU 447 - TOTALLY ENCLOSED AND EXPLOSION PROOF MOTORS
TYPES: JU, JUE, JUS, LU, LUC, LUE, LUEI, LUS, LV4, LV9, LVC9, LVCI, LVCS, LVCS9, LVE4, LVS4, NVC4, NVC9, TU, TUC, TUCE, TUCI, TUCS, TUE, TUI, TUS, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE4, TVCE9, TVCI, TVCI4, TVCI9, TVCN9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVEI, TVI, TVI4, TVI9, TVN9, TVS, TVS4, TVS9
HOLLOSHAFT AND SOLIDSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
30	1	Upper Bracket Assembly
31	1	Special Plug
32	1	Sight Gauge Window
33	1	Special Housing
34	1	Reflector Disc
35	2	Gasket
36	4	Screws
37	1	Pipe Nipple
38	1	Gasket
39	1	Drain Cap
40	1	Bearing Mounting
41-45	-	NOT USED IN THIS ASSEMBLY
46	1	Oil Baffle
47	3	Screws
48	3	Split Lockwashers
49	1	Dust Ring (Not Illustrated)
50	1	Gasket (Not Illustrated)
51	4	Screws (Not Illustrated)
52	4	Split Washers (Not Illustrated)
53	1	Ball Bearing (Upper) (Refer to section 775)
54	1	Bearing Spacer
55	2	Ball Bearing (Not Illustrated) (Refer to section 775)
56	1	Air Deflector
57	8	Hex Head Screws
58	8	Lockwashers

ITEM NO.	QTY	NAME OF PART
59	16	Hex Head Screws (Bracket to Stator)
60	16	Lockwashers
61-65	-	NOT USED IN THIS ASSEMBLY
66	1	Wound Stator Assembly
67	1	Rotor Assembly (includes items 68 - 70)
68	1	Rotor Core
69	1	Rotor Shaft
70	1	Square Key
71	1	Pulley End Bracket
72	1	Bearing Cap
73	1	Ball Bearing (Pulley End) (Refer to section 775)
74	1	Snap Ring
75	1	Grease Fitting
76	1	Pipe Plug
77	3	Screws (Bearing Cap)
78	3	Lockwashers
79	1	Water Deflector
80	1	Stabilizer Bushing
81	1	Outlet Box Base
82	4	Screws
83-87	-	NOT USED IN THIS ASSEMBLY
88	1	Outlet Box Cover
89	4	Screws
90	1	Gasket (TU only)
91	1	Gasket (TU only)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 157 & 158

TYPICAL REED CRITICAL FREQUENCY DATA

Note: Motor RCF Test Data can be provided at time of motor shipment through special test. Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA
CATALOG NO: NA

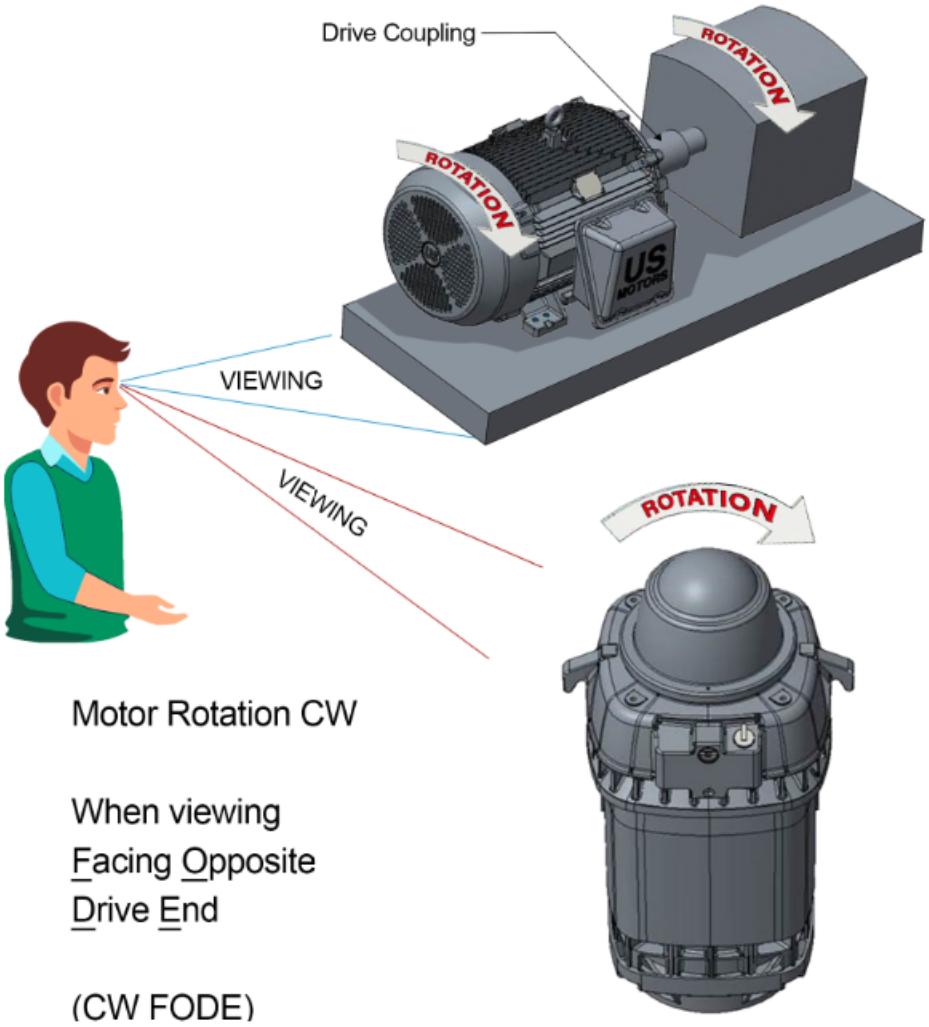
Frame: 364VP Type: TVI4

REED CRITICAL FREQUENCY:	128	HZ
CENTER OF GRAVITY:	14	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0006	IN
UNIT WEIGHT:	900	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	20%	
DATE:	8/29/2022	

DIRECTION OF ROTATION

This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with CW (clockwise) rotation as shown below. CCW rotation is available upon request.



Motor Rotation CW

When viewing
Facing Opposite
Drive End

(CW FODE)

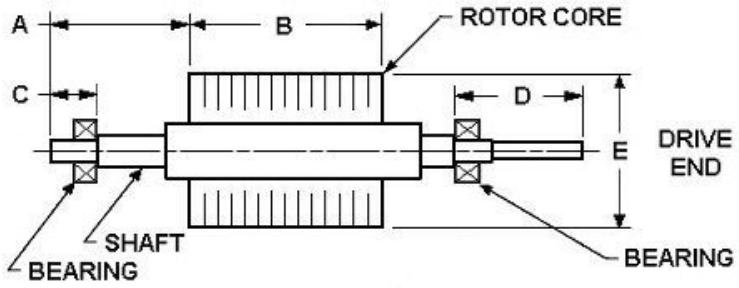
NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-288

LATERAL CRITICAL SPEED ANALYSIS DATA

ORDER NO: 22701570-100

FRAME SIZE 364VP



ROTOR DATA (dimensions in inches)			
A - ROTOR CORE LOCATION	**B - ROTOR CORE LENGTH**	**C - OPPOSITE DRIVE END BRG.**	**D - DRIVE END BRG. LOCATION**
9.125	9.250	4.91	7.88
E - ROTOR CORE DIAMETER	**SHAFT LENGTH END TO END**	**ROTOR CORE WEIGHT (lbs)**	**ROTOR ASSEMBLY WEIGHT (lbs)**
10.932	31.19	208.40	312.59
ROTOR INERTIA POLAR (lb-ft^2)	**ROTOR INERTIA TRANSVERSE (lb-ft^2)**		**SHAFT/ROTOR ASM BALANCE**
23.9	2.315		ISO 1940 G 2.5

BEARING DATA			
DRIVE END BEARING		**OPPOSITE END BEARING**	
NUMBER	**STIFFNESS (lb/in)**	**NUMBER**	**STIFFNESS (lb/in)**
7314 BEP	7.41 X 10^5	6212-2Z-J/C3	6.07 X 10^5

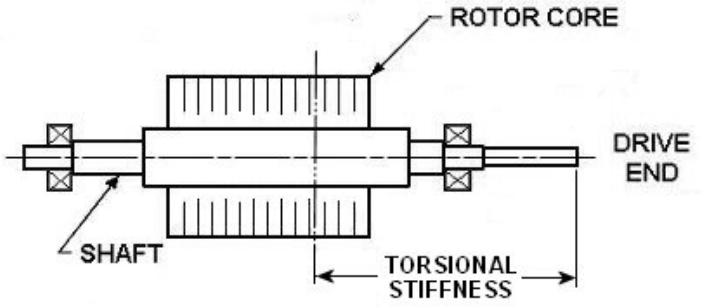
SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
171450	1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30.0 x10^6 psi	12.0 x 10^6 psi	

NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

TORSIONAL ANALYSIS DATA

ORDER NO: 22701570-100

FRAME SIZE 364VP



SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
171450	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30 x10^6 psi	12 x 10^6 psi	

MOMENT OF INERTIA - ROTOR ASSEMBLY:

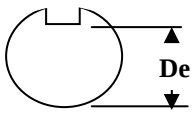
WR^2 = 23.9 **LB-FT^2**

SHAFT TORSIONAL STIFFNESS:

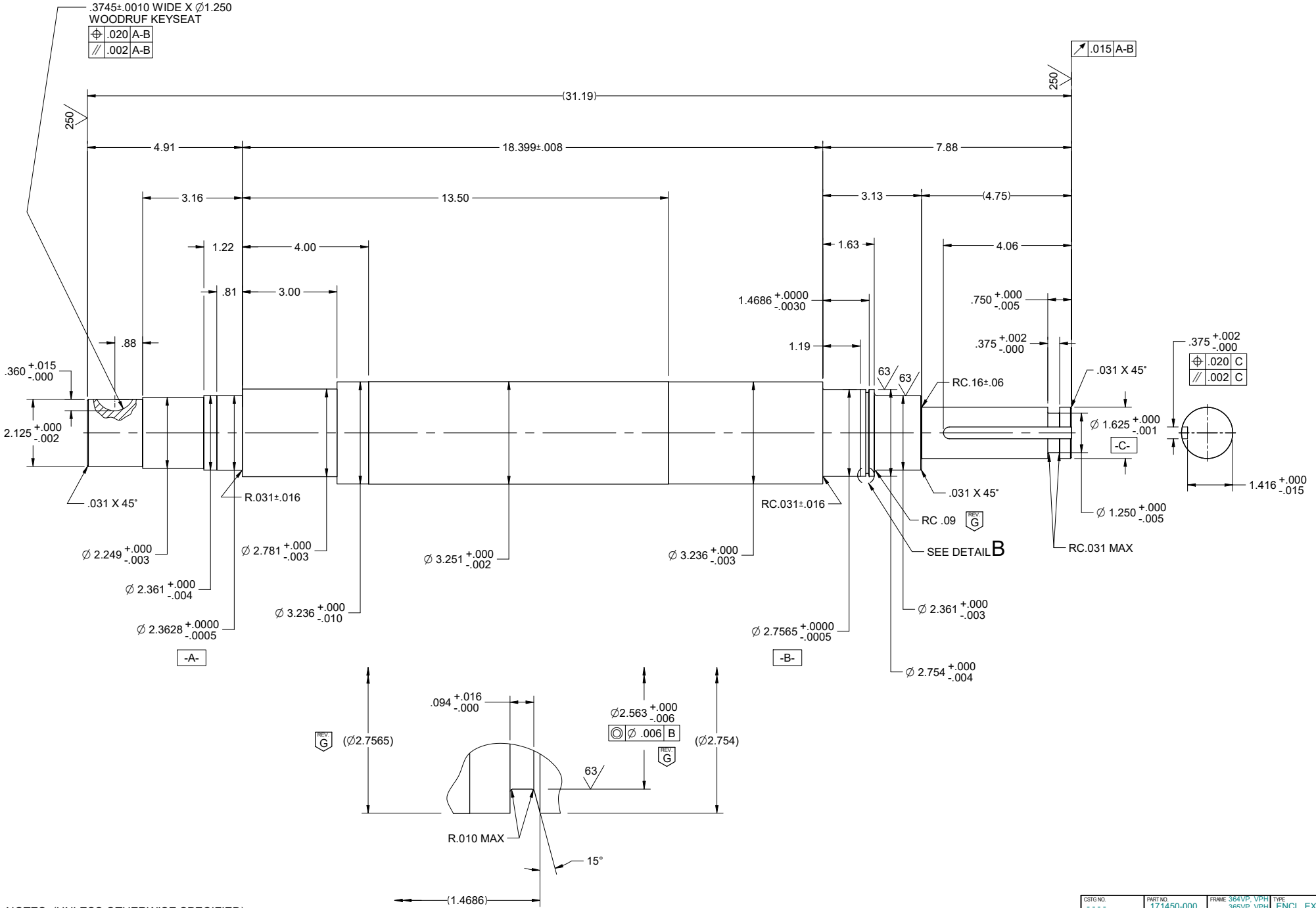
1.143 **X 10^6 LB-IN/RADIAN**

Torsional stiffness is the spring rate or constant which allows a user to determine the amount of twist or angular deflection in a shaft based on the amount of torque applied. The portion of the shaft for which the shaft stiffness has been calculated from 1/3 the length of the rotor core to the end of the drive end of the shaft (shafts with an annular keyways are measured from inboard side of the ring groove). It is the users responsibility to correct for coupling mounting effects.

SHAFT EXTENSION
De - EFFECTIVE DIAMETER WITH KEYWAY 1.416 **INCHES**



NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI



DETAIL B
SCALE 4:1

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIAMETERS TO BE ⌾ ∅ .002 A-B
2. NO AXIAL RELATIONSHIP BETWEEN KEYWAY AND KEYSEAT

CSTG NO. - - - -	PART NO. 171450-000	FRAME 364VP, VPH 365VP, VPH	TYPE ENCL, EXPL

REVISION DESCRIPTION FOR: MISC STL0213- DIMENSION 2.7565 ON DETAIL B ADDED, SYMBOL DIAMETER ADDED ON DATUM, RC.09 WAS R.09 AND NOTES ADDED	SCALE 1:2	UNITS INCHES
MATERIAL: HR STEEL, AISI 1045 MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED	TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES: .XX = ± .03, .XXX = ± .015 mm ANGLES X°= ±1°	

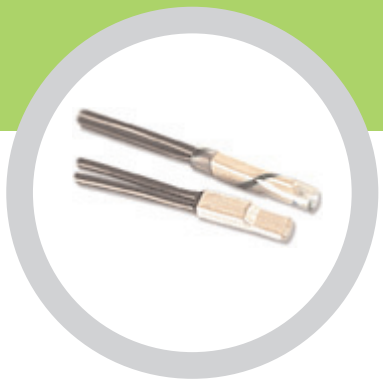
TITLE: SHAFT, ROTOR		NIDEC MOTOR CORPORATION
ISSUED BY: S. MONTALVO	APPROVED BY: J. O'BRIEN	REVISION DATE: 01-MAR-13
CODE	DWG NO. 0171450	REV G; SHEET NUMBER 1 OF 1; DWG SIZE C

44

NMCC (MAR-2011)

SOLIDEDGE

Sensata
Technologies



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performace

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation

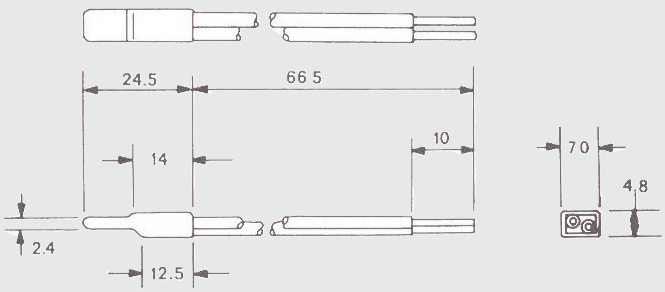
The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00



9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cmf)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5℃ in a step from 60 to 150℃.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

X : Contact material combination

Code	Stationaly contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

Type "S" is set up for Cadmium-free contact

9700 : Device Identification

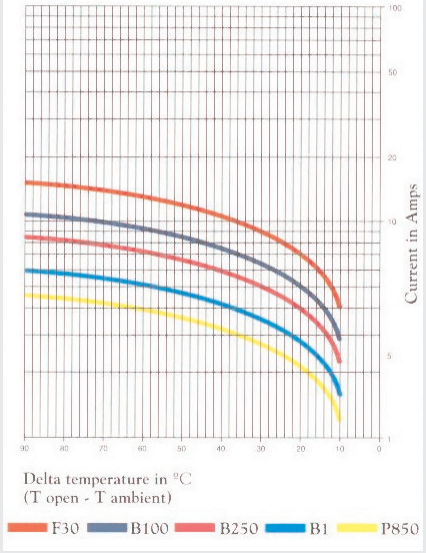
Example :
9700K01-215
Bimetal of 30ohms/cmf,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125℃-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

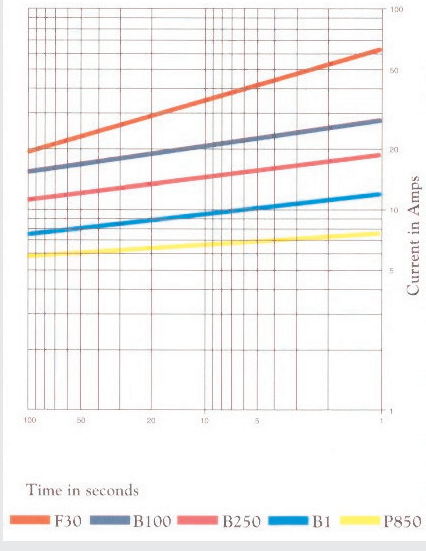
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Sensata Technologies

TECHNICAL / SALES SUPPORT

Holland
Phone +31 546 879560 Fax +31 546 879204
Italy
Phone +39 039 6568310 Fax +39 039 6568316

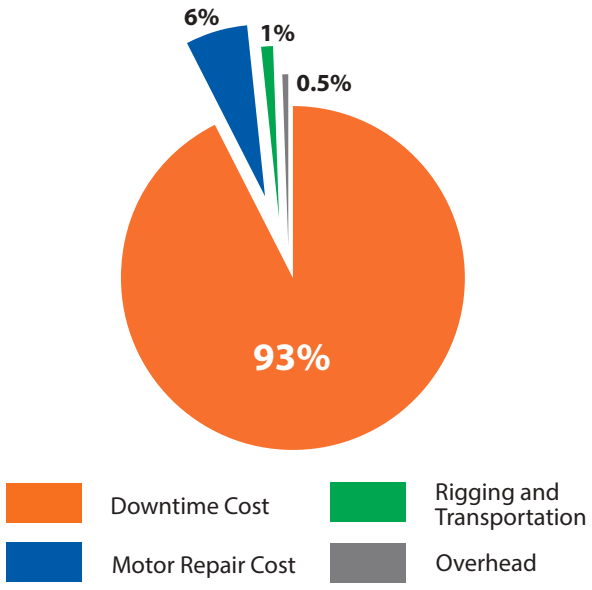
Internet: *www.sensata.com*

Email: *info-cpe@list.sensata.com*

VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.



Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

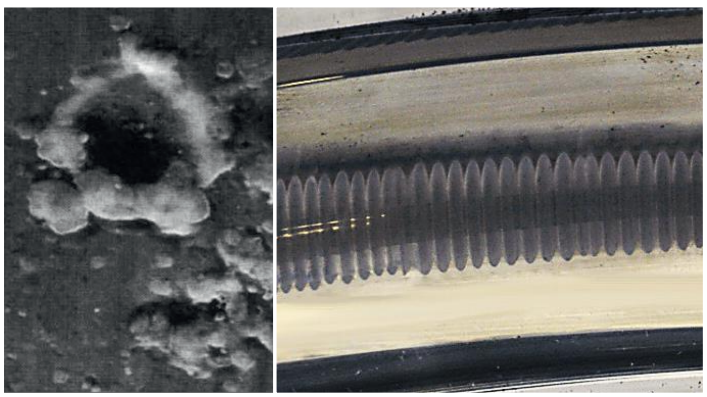
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options

Standard Mounting Clamps (-1)
Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers

Split Ring (-1A4)
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor

Bolt Through Mounting (-3FH)
Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes

Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included

Press Fit Mounting (-0A6)
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available

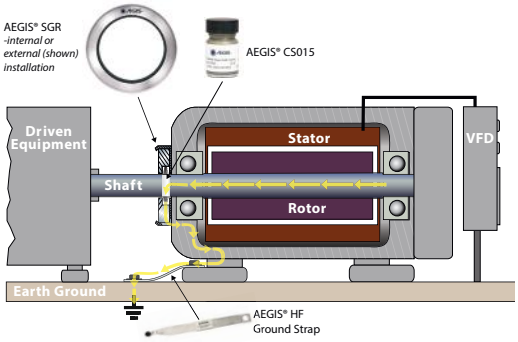
uKIT with Universal Mounting Bracket
Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy

AEGIS® PRO Series
AEGIS® PROSL, PROSLR, PROMAX, PROMR

AEGIS® Shaft Voltage Tester™
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture

Accessories
HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

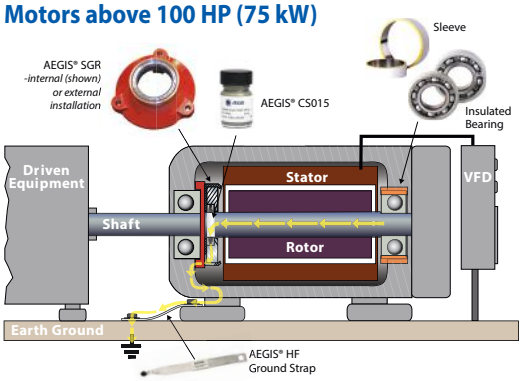
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:
LV Motors up to 500HP: AEGIS® SGR
LV Motors over 500HP: AEGIS® PRO Series
MV Motors: AEGIS® PRO Series

Electro Static Technology™
An ITW Company

www.est-aegis.com

Electro Static Technology
31 Winterbrook Road
Mechanic Falls, ME 04256 USA
Tel: (866) 738-1857
Tel: (207) 998-5140
E-Mail: sales@est-aegis.com

Formular 105-8m US 02/21

Standard
Paint
Specification

For

EM Gray

NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México

CONTENTS

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." for its superior rust inhibitive qualities and durability. The paint also has excellent resistance to various chemicals. This specification covers surface preparation and application of protective coating on motors built in the Apodaca, Nuevo Leon facility.

2.0 Unpainted Surfaces

The following surfaces will not require protective coating:

Anodized Aluminum	Grounding Pads
Brass	Machined Surfaces
Bronze	Motor Leads
Chromium Plated Metals	Porcelain Enamel Finishes
Copper	Rubber
Galvanized Steel	Stainless Steel
Glass	Vacuum Pressure Impregnated Parts

3.0 Surface Preparation (Cast Iron & Steel)

A. The foundries are required to snag, remove all sand and slag from castings. This is to be immediately followed by primer paint to insure 100% coverage. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

C. All parts are to be cleaned prior to priming or finish painting as follows:

1. If parts are dirty – wash and rise in parts washer.
2. If parts are dusty – sandblast
3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

5.0 Motor Assembly

After assembling the motor, there may be surfaces that require priming or touch-up prior to final painting. These surfaces are bracket-to-frame register fits, outlet box pads, etc.
If surfaces are oily, wash with clean paint thinner using a clean rag to prevent contamination of other surfaces.

6.0 General

A. Finished coating shall not be applied to wet or damp surfaces.
B. All coatings shall be applied in a conscientious manner and in accordance with the written application instructions of the coating manufacturer.
C. Re-application time between coats shall be in accordance with the coating manufacturer's recommendation corresponding to the conditions of temperature and humidity.
D. Hardware trim and other items not requiring coating may be removed as required for proper application of coatings. Such items shall be replaced after completion of work.
E. The dry film thickness of each coat, and of the entire system, shall follow the coating manufacturer's recommendation and this specification. The number of coats specified shall be a minimum number of coats to achieve the specified film thickness.
F. Coverage rates, as calculated by the coating manufacturer, shall be considered as the maximum allowable.
G. All spraying equipment shall be maintained in good working order, with daily inspection, and shall be in conformity with the coating manufacturer's most recent application specification.

7.0 Finish Top Coating

All motor products must be clean and free of any dirt, oil or grease on the primed surface prior to finish painting. Except where otherwise specified, thinners shall not be used. Motors will be painted with one coat unless otherwise noted. Film thickness: 2 to 4 mils.

8.0 Final Finish Inspection

Visual inspection of completed work shall be performed on the finished motor by the Quality Assurance Department. The final surface finish is to be in accordance with industry standards for comparable equipment. Any surfaces found in violation of this specification will be rejected and will require rework. Acceptance or rejection of final finish paint is the sole responsibility of the Quality Assurance Department.

9.0 Material Identification

A. Standard Primer: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III "STORAGE", item 4** for instructions.

1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila®† P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

2. Grease Lubricated Bearings

A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠WARNING

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disaasembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠WARNING

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.

B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replensihment Quantities & Lubrication Intervals

Bearing Number		Grease Replensihment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$G = 0.11 \times D \times B$

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Width of bearing in inches

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof		Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3

Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
	449 thru 5811	1801-3600	-15°C tru 40°C (104°F)	32	Synthetic Only
		1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office	

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		Synthetic Only
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4

Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	**ISO VG 32**		**ISO VG 68**		**ISO VG 150**	
	Viscosity: 130-165 SSU @ 100F		**Viscosity: 284-347 SSU @100F**		**Viscosity: 620-765 SSU @ 100F**	
	Mineral Base Oil	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV		
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120^* \text{ Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.

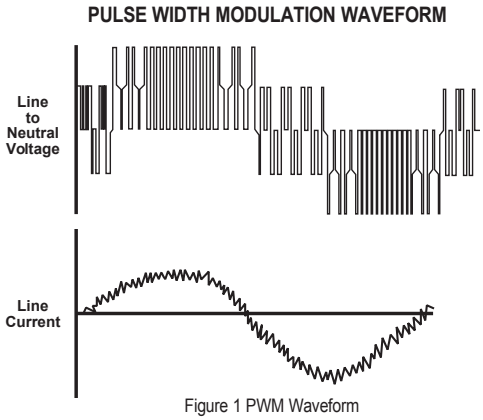


Figure 1 PWM Waveform

What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction
- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grouding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O3. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE® insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE® insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE® insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE® insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Motor / Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD.
(consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA®† 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors
All U.S. MOTORS® brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA®† Application Guide for AC Adjustable Speed Drive Systems: http://www.nema.org/stds/acadjustable.cfm#download

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA®† MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA®† frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA®† frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA®† Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA®† MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA®† frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.
- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	127 ft	400 ft	218 ft
6 Khz	90 ft	307 ft	154 ft
9 Khz	73 ft	251 ft	126 ft
12 Khz	64 ft	217 ft	109 ft
15 Khz	57 ft	194 ft	98 ft
20 Khz	49 ft	168 ft	85 ft

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficienct vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Tag #: RSP-4211/RSP-4212/RSP-4213
Service: SECONDARY SLUDGE PUMP STATION NO. 2 RAS PUMPS

Pentair Flow Technologies
General Clarifications

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
   - Anchor bolts, nuts and washers.
   - Gauges, valves and miscellaneous fittings and adaptors.
   - Connecting piping and/or supports.
   - Maintenance lubrication, lubrication piping and related equipment.
   - System control apparatus.
   - Maintenance tools and/or storage boxes.
   - Equipment tags
   - Installation or field performance testing.
2. The following items are to be installed in the field:
   - Accessory items that are shipped separately.
3. Verification and/or conformation of the following is requested at or prior to release of this equipment.
   - Rotation and discharge position
   - Shaft lengths or elevations

Fairbanks Nijhuis Pump
Submittal Data For
Taunton Wastewater Treatment Facility
Taunton, MA

Supplier:	Hayes Pump, Inc. 66 Old Power Mill Road West Concord, MA 01742
Manufacturer:	
Pump	Fairbanks Nijhuis Pump Corporation 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000 Fax: (913) 371-2272
Project Number:	0913564
Sales Order Number	53144733
Tag #:	RSP-4211/RSP-4212/RSP-4213
Service:	Secondary Sludge Pump Station No. 2 RAS Pumps
Quantity:	3
Pump Size & Model:	12” B5711C
Motor:	U S Electrical Motors P. O. Box 3946 St. Louis, MO 63136 (314) 553-2000

Fairbanks Nijhuis Pump
Table Of Contents

Fairbanks Nijhuis Pump
Included Features

- 30 HP, 900 RPM, 3/60/460V, 364VP Frame, US Electric Motor
- Variable Speed Application
- Standard Double Mechanical Seal with Stainless Steel Sleeve
- Stainless Steel Impeller Wear Ring; 190-241 BHN
- Stainless Steel Casing Wear Ring; 300-350 BHN
- Stainless Steel Packing Sleeve; 190-241 BHN
- Falk Coupling
- Certified Non-Witness Hydro Testing
- Certified Non-Witness Performance Testing
- Curve Approval
- Dynamically Balanced Cast Iron Impeller
- Contour Handhold Cover

1. Refer also to clarifications that may be included on the vendor submittal .

12" B5711 Submittal Curve

PENTAIR FAIRBANKS NIJHUIS™

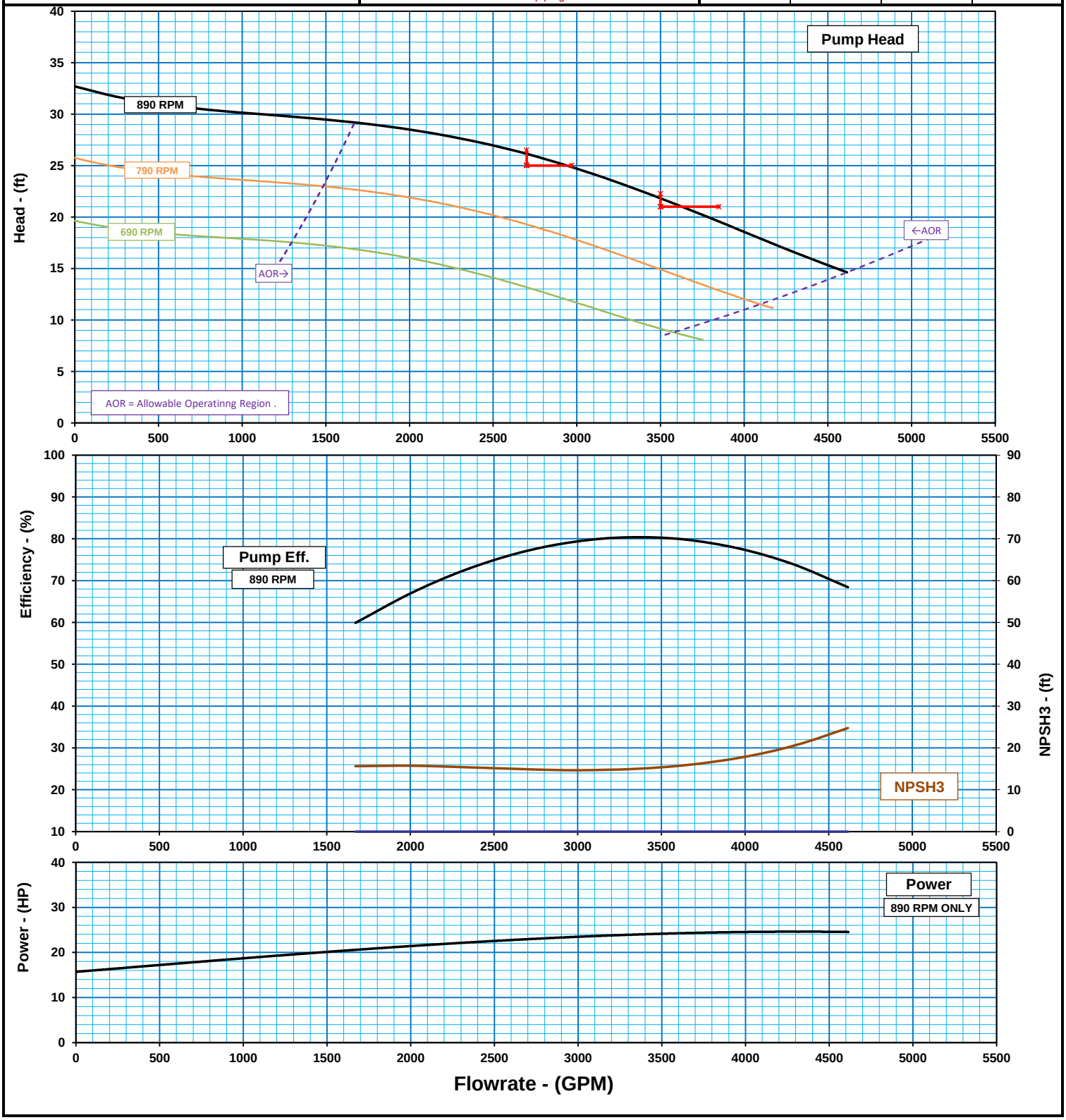
CURVE NUMBER:	0913564C
REV.	0

THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED, **PER ANSI / HI 14.6 - 2022 GRADE 1U.**

SPEED	DRIVER	DIAMETER	SPHERE
890 RPM	30 HP	AS REQ'D	4.5"
NO. VANE	**IMPELLER**	**DATE**	**BY**
2	L12A1N	8/10/2022	MD

Per ANSI/HI: "For many common solids-bearing liquids, a velocity of about 1,0 m/s (3.0 ft/s) is required to prevent sedimentation in horizontal piping."

GUARANTEED VALUES			
FLOW	HEAD	PUMP EFF	HP
3500	21	-----	-----
2700	25	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----



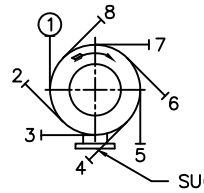
⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

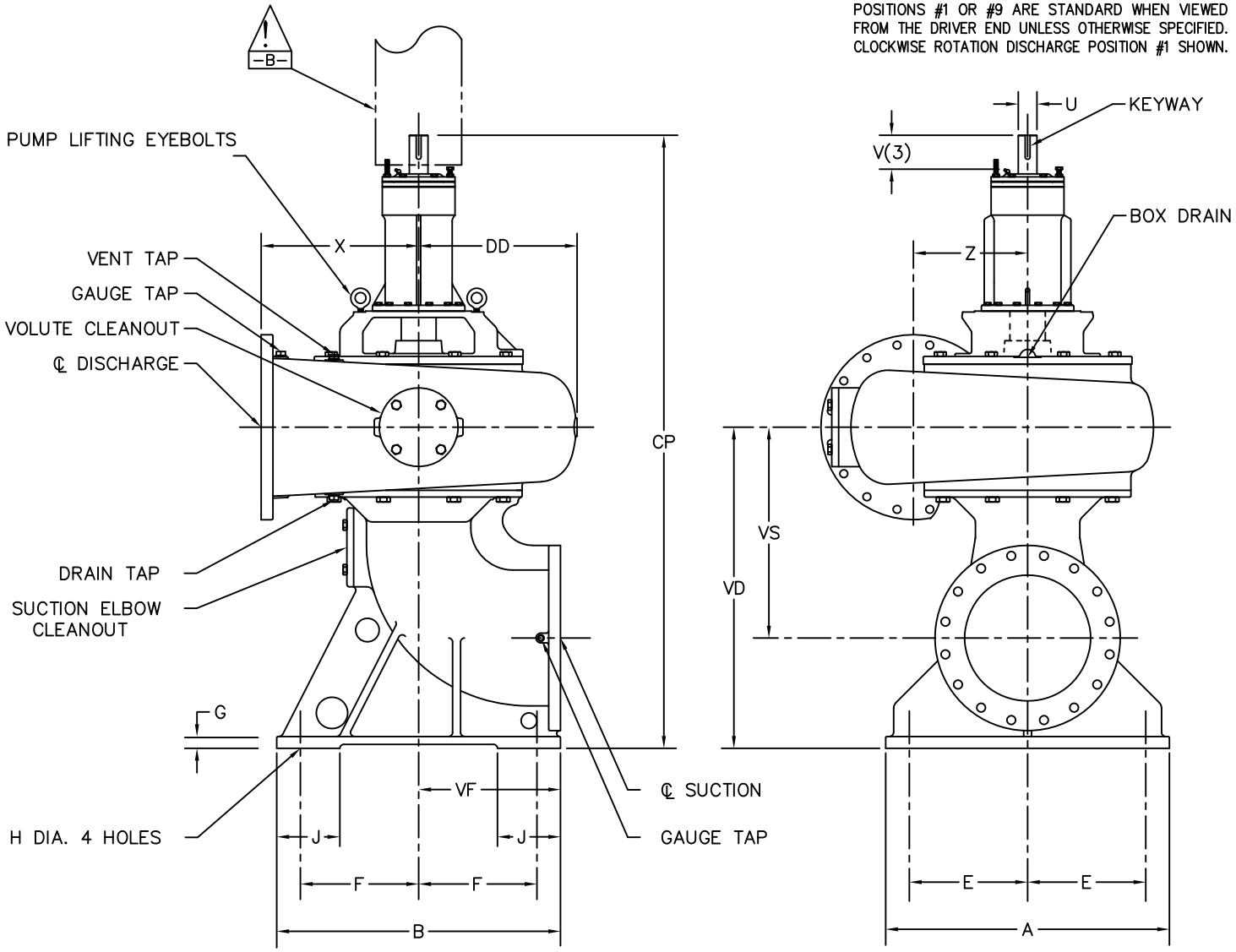
–A– SUPPLIED BY FMPC –B– SUPPLIED BY OTHERS

AVAILABLE DISCHARGE POSITIONS

CLOCKWISE



POSITIONS #1 OR #9 ARE STANDARD WHEN VIEWED FROM THE DRIVER END UNLESS OTHERWISE SPECIFIED. CLOCKWISE ROTATION DISCHARGE POSITION #1 SHOWN.



PUMP	FRAME	SUCT	DISCH	A	B	E	F	G	H	J	U	V	X	Z	CP	DD	VD	VF	VS	KEYWAY
12"B5711C	T40	12	12	30	30	13	13	1 1/4	1 1/4	4	2 3/8	4 1/4	15	10 3/4	72 7/8	14 15/16	37	19 1/4	25 1/2	5/8 X 5/16 X 2 3/4

NOTES:

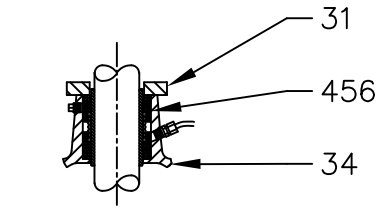
(1) ALL FLANGES ARE 125# ANSI DRILLING UNLESS NOTED.
(2) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED.
(3) DIMENSIONS REFLECT USABLE SHAFT LENGTH.
(4) BASES ARE DESIGNED TO HAVE FULL CONTACT WITH GROUT OR A SOLE PLATE GROUTED IN PLACE.
(5) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VARY DUE TO NORMAL MANUFACTURING TOLERANCES.

CUSTOMER: HAYES PUMP INC.					P.O. NO.: 133369	PENTAIR
JOB NAME: Taunton, MA Treatment Plant					TAG NAME:	BASIC PUMP DIMENSIONS 12" B5711C
PUMP SIZE AND MODEL: 12" B5711C		GPM: 3500	TDH: 23	RPM: 900	ROTATION: CW	DISCH POS: 1
MOTOR: NIDEC	HP: 30	FRAME: 364VP	PHASE: 3	HERTZ: 60	VOLTS: 460	ENCLOSURE: TEFC
CERTIFIED FOR: PROJECT: 0913564			CERTIFIED BY: JEA		DATE: 8/16/22	DWG NO 0913564SP REV NO 0

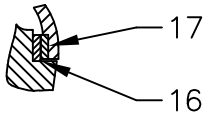
Fairbanks Nijhuis Pump
Material Specifications

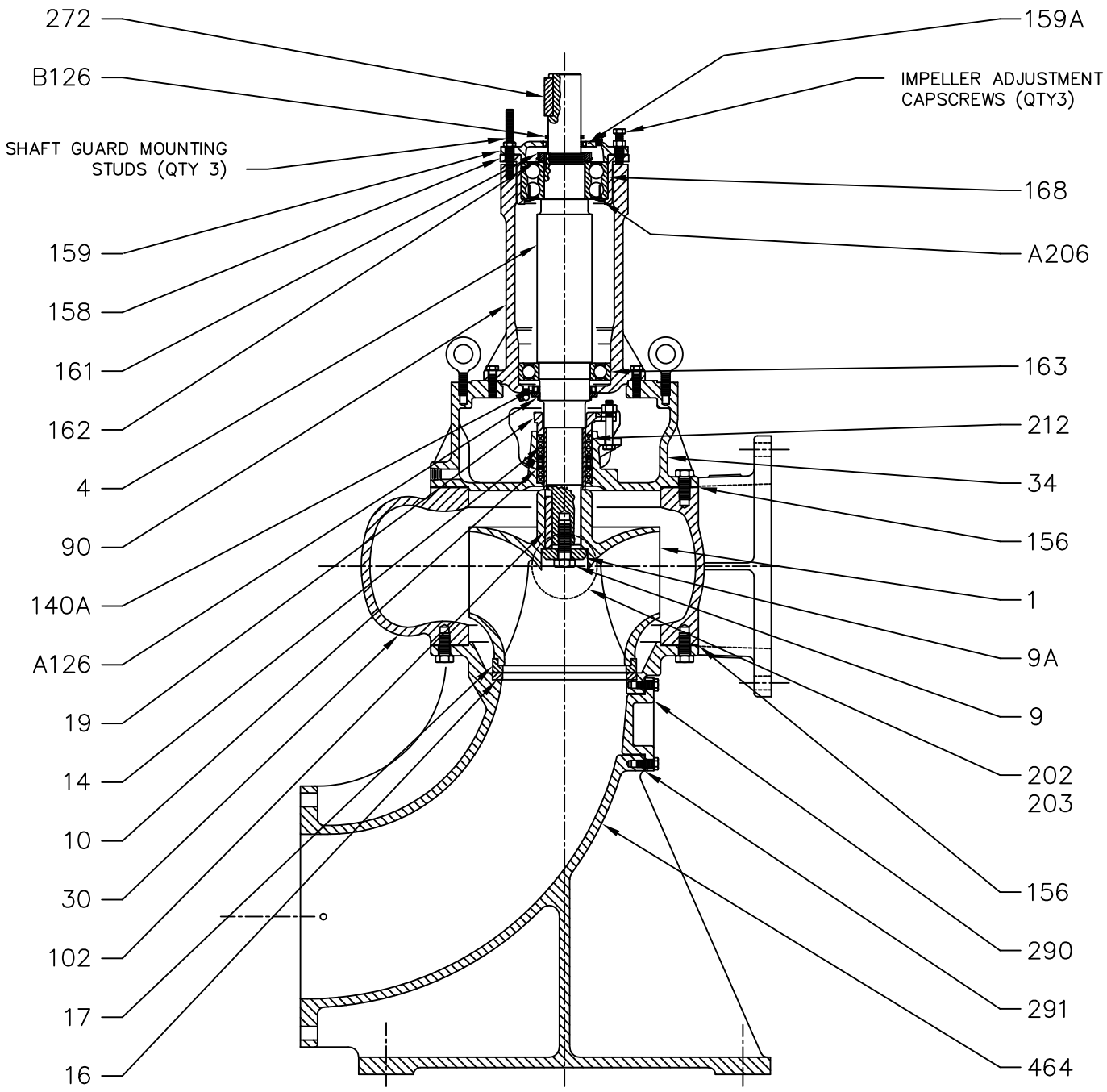
Item	Description	Material	Specification
1	Impeller	Cast Iron	A48 Class 30
4	Shaft	Steel	AISI 1144
9	Bolt, Impeller	Steel	SAE Bolt Steel
9A	Washer, Impeller	Steel	A108 Grade 12L14
14	Sleeve, Shaft	Stainless Steel	A743 Gr. CA15 190-241 BHN
16	Wear Ring, Fronthead	Stainless Steel	A743 Gr. CA40 300-350 BHN
17	Wear Ring, Impeller	Stainless Steel	A743 Gr. CA15 190-241 BHN
30	Volute	Cast Iron	A48 Class 30
31	Solid Gland	Cast Iron	A48 Class 30
34	Backhead	Cast Iron	A48 Class 30
90	Frame	Cast Iron	A48 Class 30
A126	Deflector, Inner	Rubber	Commercial
B126	Deflector, Outer	Rubber	Commercial
140A	Seal, Outer Grease	Steel & Rubber	Commercial
156	Gasket, Volute	Tag Board	D1170-G3111
158	Housing, Thrust Bearing	Cast Iron	A48 Class 30
159	Cover, Thrust Bearing	Cast Iron	A48 Class 30
159A	Seal, Outer Grease	Steel & Rubber	Commercial
161	Locknut, Bearing	Steel	SAE Bolt Steel
162	Lockwasher, Bearing	Steel	AISI 1215
163	Bearing, Radial	Steel	Commercial
168	Bearing, Thrust	Steel	Commercial
202	Cover, Volute Cleanout	Cast Iron	A48 Class 30
203	Gasket, Cleanout	Rubber	Commercial
206A	Retainer, Inner Grease	Steel	Commercial
272	Key, Coupling	Steel	A108 Grade 1018
290	Cover, Fronthead Cleanout	Cast Iron	A48 Class 30
291	Gasket, Cleanout	Rubber	Commercial
456	Mechanical Seal	-	Commercial
464	Base Elbow	Cast Iron	A48 Class 30

Notes:
1. All material specifications are ASTM unless otherwise noted and are or description of chemistry only.



MECHANICAL
SEAL CONSTRUCTION





ASSEMBLY WITH COMBINATION BASE ELBOW
12" B5711C T40 FRAME

PENTAIR

DWG NO 0913564AP 70 REV NO 0

Fairbanks Nijhuis Pump
Technical Data

Pump	
Frame Size	T40
Pump Size	12
Suction Size, Standard	12
Nominal Wear Ring Clearance	0.037
Impeller Fastener	
Size	7/8-9
Tightening Torque, lb.-ft.	150
Impeller	
Weight, lb.	104.5
Inlet Area, sq. In.	88.15
WR^2 Lb.-Ft.^{2}	15.0
Sphere Size, Maximum	4 1/2
Shaft Diameter:	
at Impeller	2 3/8
at Sleeve	2 5/8
at Thrust Bearing	2.953
at Radial Bearing	3.740
Between Bearings	4
at Coupling	2 3/8
Keyway at Coupling	5/8 X 5/16
Torsional Shaft Stiffness, lbs./rad.	2.26X106
Center to Center of Bearings	14 1/8
Thrust Bearing Number	5315
Radial Bearing Number	6219
Sealing Box:	
Mechanical Seal Type	Double
Recommended Flush Water	
Pressure, PSI	Note 2
Flow, GPM	1/2-1
Sleeve OD	3
Box ID	4
Box Depth	3 3/4
Box Inlet Tap Size, NPT	1/4
Box Outlet Tap Size, NPT	1/4
Backhead Drain Tap Size, NPT	3/4
Volute Cleanout Diameter	4 3/4
Fronthead Cleanout Diameter	4 1/2
Vent/Priming Tap Size, NPT	1
Volute Drain Tap Size, NPT	1
Gauge Tap Size	
Suction, NPT	1/2
Discharge, NPT	1/2
Hydrostatic Test Pressure, Maximum, PSI	75
Casing Working Pressure, Maximum, PSI	50
Nominal Casing Thickness	5/8
Operating Temperature, °F	150
Anchor Bolt Size Recommended	1
Minimum Diameter Opening to Install Pump	39 1/2
Shipping Weight, Basic Pump, lb.	1240

Note 1. Values shown are in inches unless otherwise noted.

Fairbanks Nijhuis Pump

Typical Pump Bearing Lubricants

Fairbanks Nijhuis Pump recommends a superior quality, NLGI No. 2, multipurpose, lithium complex grease for all pump rolling element bearing applications that require grease lubrication. The grease characteristics should include good high temperature performance, extreme pressure properties, water resistance, excellent oxidation stability, good rust protection and resistance to chemical breakdown. Fairbanks Nijhuis Pump does not recommend grease with molybdenum disulfide (moly) additives. In addition to the characteristics listed above, the grease should meet the following specification.

Specifications

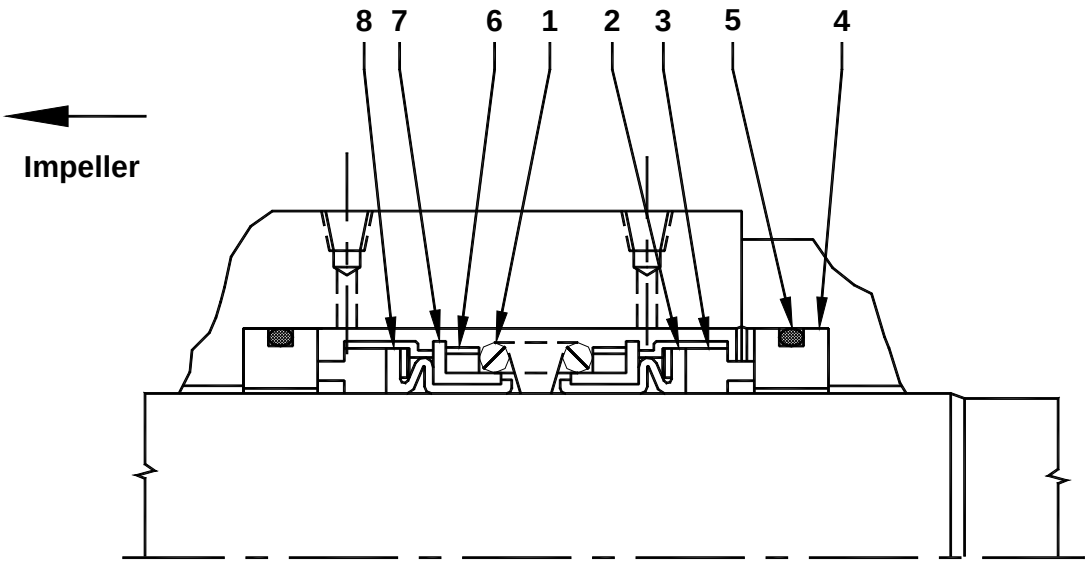
Consistency: NLGI No. 2
Dropping Point ASTM D2265 >450° F
Base fluid viscosity
SUS @ 100° F 700 to 1200
SUS @ 212° F 70 to 100
Rust Prevention ASTM 1743 Pass
Water Washout ASTM 1264 <4% @ 175° F
Four Ball EP Test ASTM D2596 >40kg load wear
>250kg weld point

Fairbanks Nijhuis Pump has compiled a general list of products that meet the grease requirements above. This list is not an endorsement of any particular manufacture and should not be construed as exclusive recommendations. When choosing an alternate manufacture, customers should discuss this typical lubricant recommendation with their vendor to ensure that an equivalent grease is supplied.

Typical Products

Manufacturer	Lubricant Brand Name	NLGI No.
BP	BP Energrease® LC EP 2	2
Castrol	Pyroplex Red	2
Chevron	Delo® Greases EP	2
Exxon	Ronex® MP	2
Mobil	Mobiltith® AW2	2
Shell	Retinax® LC	2
Texaco	Starplex® 2	2
76	76 Multiplex EP	2

Fairbanks Nijhuis Pump
Typical Mechanical Seal



Item	Part	Material
1	Spring	Stainless Steel
2	Rotary Bellows	Buna-N
3	Rotary Face	Carbon
4	Stationary Seat	Ceramic
5	O-Ring	Buna-N
6	Driving Band	316 Stainless Steel
7	Retainer	18-8 Stainless Steel
8	Disc	316 Stainless Steel

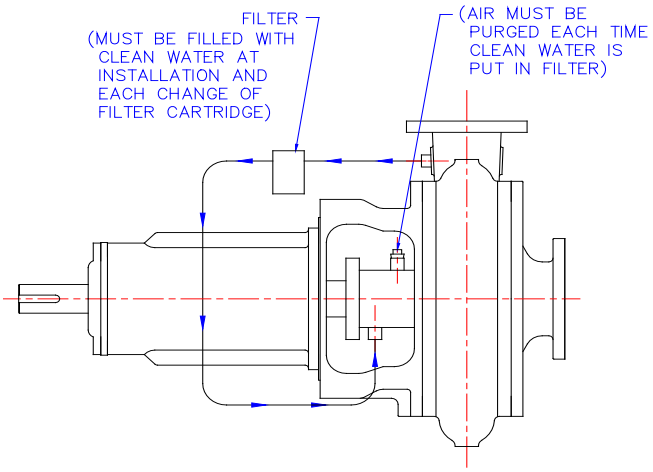


Figure A
Typical Deadhead Schematic

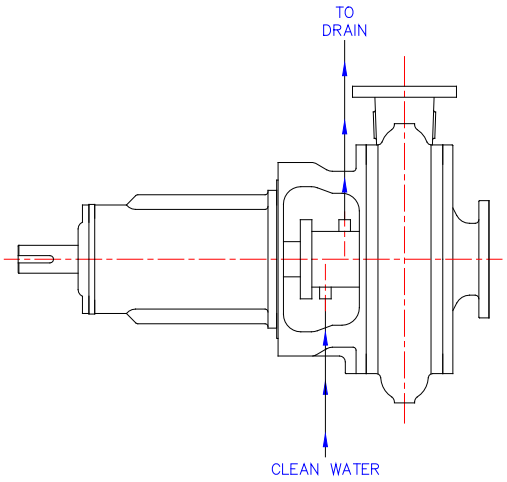


Figure B
Typical Flush Water Schematic

Fairbanks Nijhuis Pump
Furnished Spare Parts

Ref. No.	Description	Quantity
456	Mechanical Seal	3

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N140
  - **Number of Coats** One
  - **Dry Film Thickness** Standard
  - **Color** 35GR Black
  - **Surfaces to be coated** Exterior of Pump

POTA-POX® PLUS SERIES N140

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE Innovative potable water coating which offers high-build edge protection and allows for application at a wide range of temperatures (down to 35°F or 2°C with 44-700 Accelerator). For use on the interior and exterior of steel or concrete tanks, reservoirs, pipes, valves, pumps and equipment in potable water service.

COLORS 1211 Red, 1255 Beige, 00WH Tnemec White, 15BL Tank White, 35GR Black and 39BL Delft Blue. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

SPECIAL QUALIFICATIONS Certified by **NSF International** in accordance with **ANSI/NSF Std. 61.** Ambient air cured Series N140 (with or without 44-700 Epoxy Accelerator) is qualified for use on tanks and reservoirs of 1,000 gallons (3,785 L) capacity or greater, pipes 18 inches (46 cm) in diameter or greater, valves four (4) inches (10 cm) in diameter or greater and fittings four (4) inches (10 cm) in diameter or greater. Conforms to **AWWA D 102 Inside Systems No. 1 and No. 2** (with or without 44-700). Conforms to **AWWA C 210** (without 44-700). Contact your Tnemec representative for systems and additional information. A two-coat system at 4.0-6.0 dry mils (100-150 dry microns) per coat passes the performance requirements of MIL-PRF-4556F for fuel storage. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215, 217, 218

PRIMERS Self-priming, 22, 91-H_2O, 94-H_2O, L140, L140F, N140F, V140, V140F, 141

TOPCOATS **Interior:** Series 22, FC22, L140, L140F, N140, N140F, V140, V140F, 141, 406.
Exterior: Series 27, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, L140, L140F, N140, N140F, V140, V140F, 156, 157, 161, 175, 180, 181, 446, 740, 750, 1028, 1029, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N140: Immersion Service—Surface must be scarified by blasting with fine abrasive after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N140 is 21 days. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N140 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils. **Non-Immersion Service:** SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI-CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide. Fill all holes, pits, voids and cracks with 215, 217 or 218.

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

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed—A, B & 44-700 Epoxy Accelerator) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 225 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator:

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For valve applications allow 14 days cure at 75°F (24°C) prior to immersion. For pipe applications allow 30 days cure at 75°F (24°C) prior to immersion. **Ventilation:** When used in enclosed areas, provide adequate ventilation during application and cure. **Note:** Refer to product listing on www.nsf.org for specific potable water return to service information. **Note:** For faster curing and low temperature applications, add No. 44-700 Epoxy Accelerator, see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS **Unthinned:** 2.4 lbs/gallon (285 grams/litre)
Thinned 5% (#60): 2.6 lbs/gallon (311 grams/litre)
Thinned 10% (#4): 2.8 lbs/gallon (334 grams/litre) †

HAPS **Unthinned:** 2.4 lbs/gal solids **Thinned 5% (#60):** 2.4 lbs/gal solids
Thinned 10% (#4): 3.3 lbs/gal solids

THEORETICAL COVERAGE 1,070 mil sq ft/gal (27.2 m²/L at 25 microns). See APPLICATION for coverage rates. †

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

POTA-POX® PLUS | SERIES N140

PACKAGING 5 gallon (18.9L) pails and 1 gallon (3.79L) cans - Order in multiples of 2.
Reference 44-700 Epoxy Accelerator product data sheet for its packaging information.

NET WEIGHT PER GALLON 12.66 ± 0.25 lbs (5.82 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA Part A: 82°F (28°C) Part B: 80°F (27°C) 44-700: None

HEALTH & SAFETY Paint products contain 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 reach of children.

APPLICATION

COVERAGE RATES

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (225)	15.0 (375)	107 (10.0)

Note: Roller or brush application requires two or more coats to obtain recommended film thickness. Allow for overspray and surface irregularities. Wet 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. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT. †

MIXING
l. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon with No. 4 Thinner or thin up to 5% or 1/4 pint (190 mL) per gallon with No. 60 Thinner. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon. **Caution: Series N140 NSF certification is based on thinning with No. 4 or No. 60 Thinner for tanks and only No. 60 Thinner for pipe, valves and fittings.** Use of any other thinner voids ANSI/NSF Std. 61 certification.

POT LIFE
Without 44-700 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 77°F (25°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Airless Spray

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Low temperatures or longer hoses require higher pot pressure. Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
Roller: Use 3/8" or 1/2" (9.5 mm to 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Without 44-700: Min. 50°F (10°C), Max. 135°F (57°C) With 44-700: Min. 35°F (2°C), Max. 135°F (57°C)
The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

NIDEC MOTOR CORPORATION
8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 8/29/2022

P.O. NO.: 12588106
Order/Line NO.: 22701574 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

```
HOLD PRODUCTION
Horsepower ..... 00030.00~00000.00 ~ KW: 22.38
Enclosure ..... TEFC
Poles ..... 08~00 ~ RPM: 900~0
Frame Size ..... 364~VP
Phase/Frequency/Voltage.. 3~060~460
Winding Type ..... Random Wound
Service Factor ..... 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
Customer Part Number .... FMB0913564A01
16.5" Base
Pricebook Thrust Value (lbs).. 7000
Customer Down Thrust (lbs) ... 1
Customer Shutoff Thrust (lbs).
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
"AK" Dimension (Inches).. NA
Shaft Dimensions:~U=1.625 ~ AH/V=4.500
KEYWAY=0.375 ~ ES=3.030
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.7 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 769 LB-FT2
Number Of Starts Per Hour: NEMA
Motor Type Code ..... TVI4
Rotor Inertia (LB-FT²)          23.9 LB-FT²
Qty. of Bearings PE (Shaft)     1
Qty. of Bearings SE (OPP)       1
Bearing Number PE (Shaft)       7314 BEP
Bearing Number SE (OPP)         6212-2Z-J/C3
```

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 8/29/2022

P.O. NO.: 12588106
Order/Line NO.: 22701574 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913564A01
12588106
LINE 10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	30
Pole(s)	08
Voltage(s)	460
Frame Size	364VP
Shaft U Diameter	1.625
Outlet Box AF	3.38
Outlet Box AA	3.00

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 8/29/2022

PENTAIR PURCHASE ORDER #: 12588106 PENTAIR TAG #: FMB0913564A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X **IEEE** X **ASA** X **NEMA**

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
30	900	891	364VP	TVI4	TEFC

*Full Load Speed Tolerance Per NEMA MG1-12.46 is+/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPHERES		INSULATION CLASS	MAX. TEMP. RISE	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR		X RESIS. THERM.			
3	60	460	39	206.3	F	105 DEG C AT 1.00 SF	1.15	F	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD		PERCENT OF FULL LOAD	
91.7	93.0	91.0	77.8	74.2	65.3	176.9	139	213

VSS [X] **VHS** [ ] **NRR** [X] **SRC** [ ] **HORIZ** [ ]

BEARINGS:

Drive End Lubrication:
[ ] Oil [X] Grease

Opposite End Lubrication:
[ ] Oil [X] Grease

PAINT: (Attach Technical Data Sheets)
[X] Factory Standard
[ ] Other _____

MOTOR NO.: 22701574

MOTOR WEIGHT: 900 LBS

ROTATION: [ ] **BI-DIRECTIONAL** [X] **CW** [ ] **CCW**

Certified by: Emil Roque Date: 8/29/2022 Revision # 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/29/2022

Pentair Purchase Order #: 12588106 Pentair Tag #: FMB0913564A01

	Required	Not Required	Description
Space Heaters:	☐	☒	Watts: _____ Voltage: _____
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Tests:	☐	☒	☐ Short commercial, unwitnessed ☐ Short commercial, witnessed ☐ Calibration Test, unwitnessed ☐ Complete initial, unwitnessed ☐ Complete initial, witnessed ☐ Sound test, unwitnessed ☐ Bump Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Reed Critical Test, unwitnessed ☐ IEEE841

Certified by: Emil Roque Date: 8/29/2022 Revision #: 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/29/2022

Pentair Purchase Order #: 12588106 Pentair Tag #: FMB0913564A01

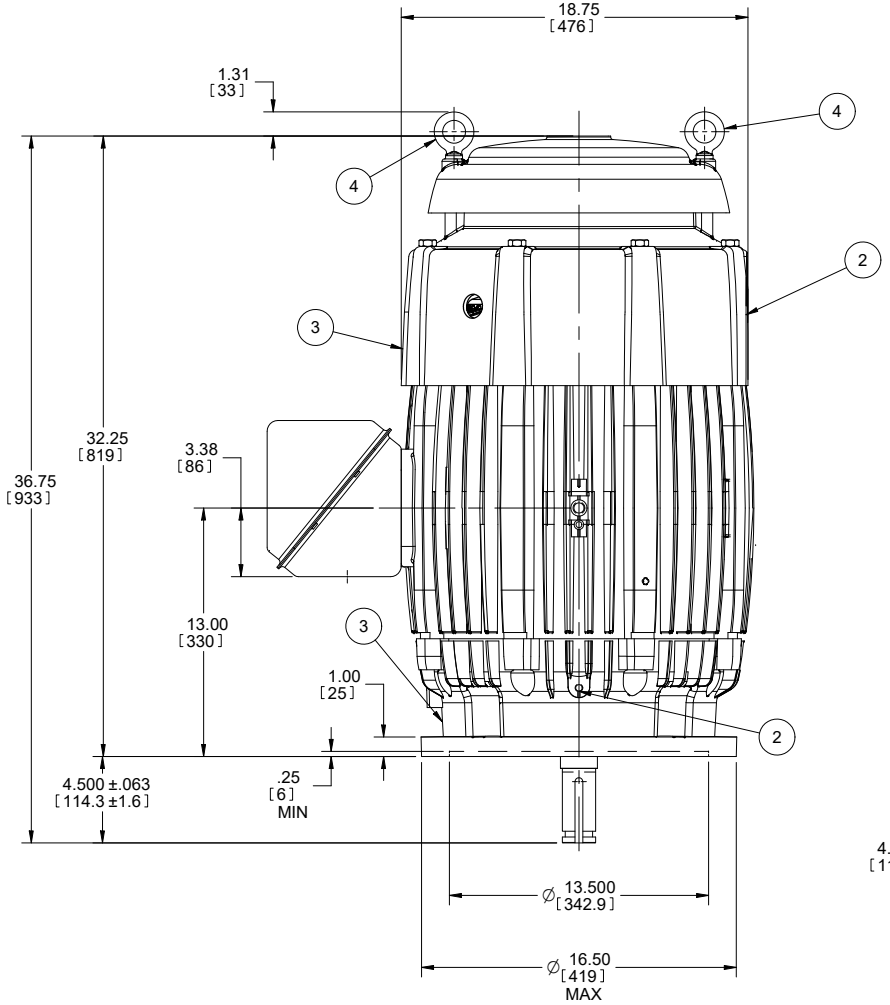
Features:

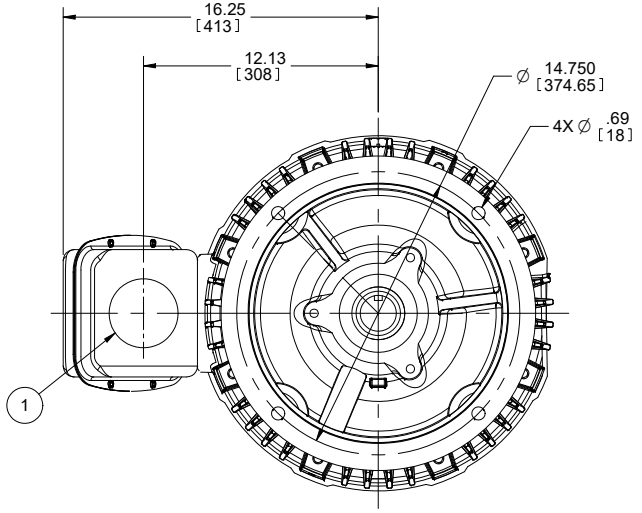
Enclosure ..... TEFC
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
16.5" Base
Pricebook Thrust Value (lbs).. 7000
Customer Down Thrust (lbs) ... 1
Inverter Duty Rating Details:
Load Type (Base Hz & Below) ..Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Shaft Dimensions:~U=1.625 ~ AH/V=4.500
KEYWAY=0.375 ~ ES=3.030
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.7 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 769 LB-FT2

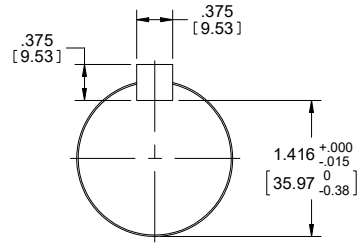
Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913564A01
12588106
LINE 10

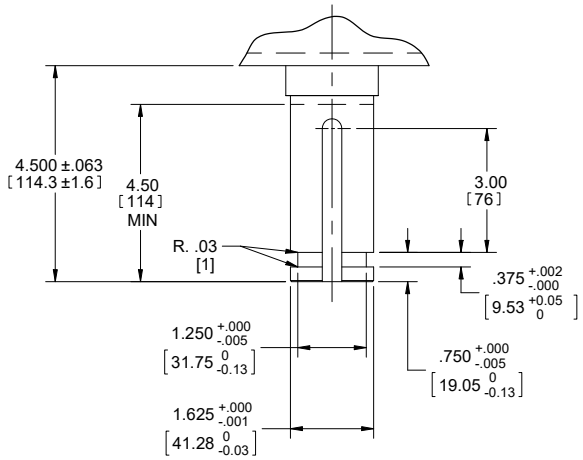
Certified by: Emil Roque Date: 8/29/2022 Revision #: 0







SHAFT DETAIL
SCALE 1:1



SHAFT DETAIL
SCALE 1:2

USER INFORMATION
CUSTOMER: PENTAIR FLOW CUSTOMER P/N: FMB0913564A01 P.O: 12588106 REF. ORDER #: 22701574-100

TOLERANCES	IN
FACE RUNOUT	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 T.I.R.
PERMISSIBLE SHAFT RUNOUT	.002 T.I.R.

NOTES:

1) MAIN BOX FOR MOTOR POWER LEADS, 3.00" SIZE CONDUIT.
   BOX VOLUME: 347 CU. IN. [5686 CU. CM.]
2) DRAINS: TOP AND BOTTOM GREASE.
3) FILL: TOP AND BOTTOM GREASE.
4) MOTOR LIFTING LUGS.
5) BEARINGS: LOWER - 7314 BEP
   UPPER - 6212-2Z-J/C3
6) ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
7) CONDUIT BOX MAY BE LOCATED IN STEPS OF 90 DEGREES STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.

CERTIFIED FOR CONSTRUCTION

RATING	30 HP [22.38 KW] 891 RPM, 460 V, 3Ø, 60HZ	REVISION DECRIPTION:	UNITS: DUAL
ENCLOSURE	TEFC	NEW	
BEARINGS	SEE (5)		
LUBRICATION	GREASE		
ROTATION FACING O.D.E.	CW		
NET WEIGHT (±10%)	900 LBS [408.23 KG]		

FRAME: 364VP
TYPE: TVI4
TITLE: DIMENSION PRINT
NIDEC MOTOR CORPORATION
ISSUED BY: L. ARROYO
APPROVED BY: R. MARTINEZ
REVISION DATE: 18-AUG-22
DWG NO.: 1200-8-739
REV: -
SHEET NUMBER: 1 OF 1
DWG SIZE: C

NAMEPLATE DATA

CATALOG NUMBER:				NAMEPLATE PART #:	422707-005		
MODEL		FR	364VP	TYPE	TVI4	ENCL	TEFC
SHAFT END BRG	7314 BEP - QTY 1			OPP END BRG	6212-2Z-J/C3 - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 22701574, Type: SO, Line#: 100)		
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	30	RPM	891	HP		RPM	
VOLTS	460			VOLTS			
FL AMPS	39.0			FL AMPS			
SF AMPS	44.0			SF AMPS			
SF	1.15	DESIGN	B	CODE	F		
NEMA NOM EFFICIENCY	93.0	NOM PF	77.8	KiloWatt	22.38		
GUARANTEED EFFICIENCY	91.7	MAX KVAR		HZ	60		

SF		DESIGN		CODE			
NEMA NOM EFFICIENCY		NOM PF					
GUARANTEED EFFICIENCY		MAX KVAR		HZ			

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460	AMPS	41.0
TORQUE 1	176.90LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	6-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	90-900	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	FMB0913564A01
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.06 IN/SEC	Arctic Duty	
3/4 Load Eff.	94.1	Inrush Limit	
Motor Weight (LBS)	900	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	7000	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4	GREASE LUBRICATED	Special Accessory Note 19	
Special Accessory Note 5	RECOMMENDED GREASE	Special Accessory Note 20	
Special Accessory Note 6	EXXON POLYREX-EM	Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	TVI4	364VP

ORDER NO.	22701574	LINE NO.	100

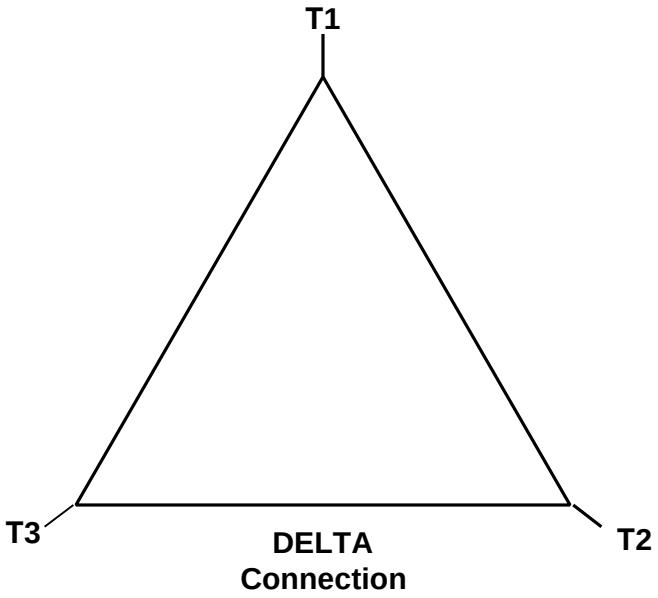
MPI:	136379
HP:	30
POLES:	8
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	92.7
FULL	93
3/4	94.1
1/2	93.9
1/4	90.9
POWER FACTOR (%):	
S.F.	78.5
FULL	77.8
3/4	74.2
1/2	65.3
1/4	44.5
NO LOAD	3.7
LOCKED ROTOR	32.3
AMPS:	
S.F.	44
FULL	39
3/4	30
1/2	22.9
1/4	17.4
NO LOAD	15.2
LOCKED ROTOR	206.3
NEMA CODE LETTER	F
NEMA DESIGN LETTER	B
FULL LOAD RPM	891
NEMA NOMINAL / EFFICIENCY (%)	93
GUARANTEED EFFICIENCY (%)	91.7
MAX KVAR	10.3
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	30
SOUND PRESSURE (DBA @ 1M)	65
TORQUES:	
BREAKDOWN{% F.L.}	213
LOCKED ROTOR{% F.L.}	139
FULL LOAD{LB-FT}	176.9

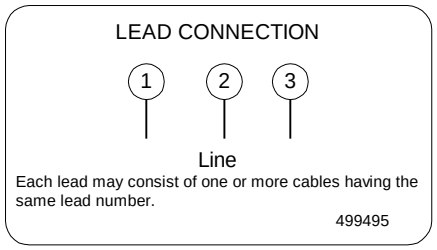
NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

Motor Wiring Diagram





To reverse direction of rotation interchange connections L1 and L2.
Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

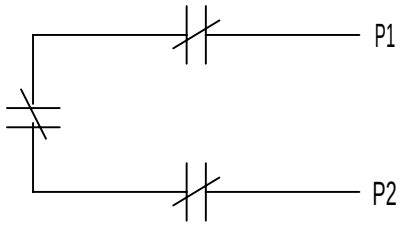
EFFECTIVE: 2/27/96
SUPERCEDES: X736618, 96441, 179879, 284138
Connection Plate: 499495
Connection Decal: 912113

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.

2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



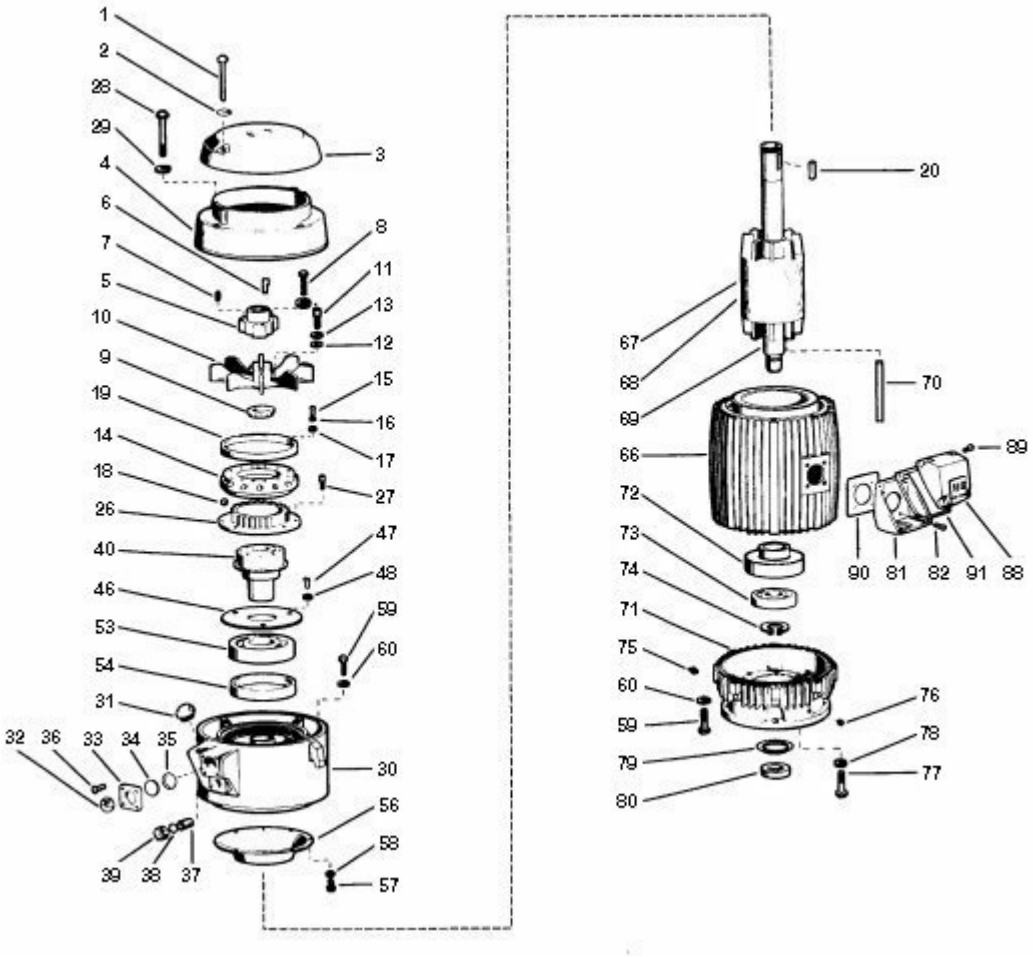
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC STL0211 - UPDATED FORMAT .	SCALE: NONE UNITS: IN TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES / mm ANGLES X°= ±1°	TITLE: CUSTOMER CONNECTION DIAGRAM ISSUED BY: R. KING APPROVED BY: C. CADE CODE: DWG NO.: 0834066	NIDEC MOTOR CORPORATION REVISION DATE: 24-FEB-11 REV: G SHEET NUMBER: 1 OF 1 DWG SIZE: A
MATERIAL: --- MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED			

RENEWAL PARTS

FRAMES 324 THRU 447 - TOTALLY ENCLOSED AND EXPLOSION PROOF MOTORS
TYPES: JU, JUE, JUS, LU, LUC, LUE, LUEI, LUS, LV4, LV9, LVC9, LVCI, LVCS, LVCS9, LVE4, LVS4, NVC4, NVC9, TU, TUC, TUCE, TUCI, TUCS, TUE, TUI, TUS, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE4, TVCE9, TVCI, TVCI4, TVCI9, TVCN9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVEI, TVI, TVI4, TVI9, TVN9, TVS, TVS4, TVS9
HOLLOSHAFT AND SOLIDSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	2	Hex Head Screws
2	2	Split Washers
3	1	Canopy Cap
4	1	Fan Cover
5	1	Drive Coupling (Holloshaft only)
6	1	Square Key
7	1	Drive Pin (444, 445 TU only)
8	1	Locking Pin and Lockwasher (LU only)
9	1	Locknut and Lockwasher
10	1	Fan
11	3	Socket Head Screws
12	3	Flat Washers
13	3	Lockwashers

ITEM NO.	QTY	NAME OF PART
14	1	Rotating Ratchet
15	6	Round Head Screws
16	6	Lockwashers
17	6	Plain Washers
18	12	Steel Balls
19	1	Ball Retaining Ring
20	1	Square Key
21-25	-	NOT USED IN THIS ASSEMBLY
26	1	Stationary Ratchet
27	2	Socket Set Screw
28	4	Hex Head Cap Scres
29	4	Split Lockwashers

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 157 & 158

FRAMES 324 THRU 447 - TOTALLY ENCLOSED AND EXPLOSION PROOF MOTORS
TYPES: JU, JUE, JUS, LU, LUC, LUE, LUEI, LUS, LV4, LV9, LVC9, LVCI, LVCS, LVCS9, LVE4, LVS4, NVC4, NVC9, TU, TUC, TUCE, TUCI, TUCS, TUE, TUI, TUS, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE4, TVCE9, TVCI, TVCI4, TVCI9, TVCN9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVEI, TVI, TVI4, TVI9, TVN9, TVS, TVS4, TVS9
HOLLOSHAFT AND SOLIDSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
30	1	Upper Bracket Assembly
31	1	Special Plug
32	1	Sight Gauge Window
33	1	Special Housing
34	1	Reflector Disc
35	2	Gasket
36	4	Screws
37	1	Pipe Nipple
38	1	Gasket
39	1	Drain Cap
40	1	Bearing Mounting
41-45	-	NOT USED IN THIS ASSEMBLY
46	1	Oil Baffle
47	3	Screws
48	3	Split Lockwashers
49	1	Dust Ring (Not Illustrated)
50	1	Gasket (Not Illustrated)
51	4	Screws (Not Illustrated)
52	4	Split Washers (Not Illustrated)
53	1	Ball Bearing (Upper) (Refer to section 775)
54	1	Bearing Spacer
55	2	Ball Bearing (Not Illustrated) (Refer to section 775)
56	1	Air Deflector
57	8	Hex Head Screws
58	8	Lockwashers

ITEM NO.	QTY	NAME OF PART
59	16	Hex Head Screws (Bracket to Stator)
60	16	Lockwashers
61-65	-	NOT USED IN THIS ASSEMBLY
66	1	Wound Stator Assembly
67	1	Rotor Assembly (includes items 68 - 70)
68	1	Rotor Core
69	1	Rotor Shaft
70	1	Square Key
71	1	Pulley End Bracket
72	1	Bearing Cap
73	1	Ball Bearing (Pulley End) (Refer to section 775)
74	1	Snap Ring
75	1	Grease Fitting
76	1	Pipe Plug
77	3	Screws (Bearing Cap)
78	3	Lockwashers
79	1	Water Deflector
80	1	Stabilizer Bushing
81	1	Outlet Box Base
82	4	Screws
83-87	-	NOT USED IN THIS ASSEMBLY
88	1	Outlet Box Cover
89	4	Screws
90	1	Gasket (TU only)
91	1	Gasket (TU only)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 157 & 158

TYPICAL REED CRITICAL FREQUENCY DATA

Note: Motor RCF Test Data can be provided at time of motor shipment through special test. Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA
CATALOG NO: NA

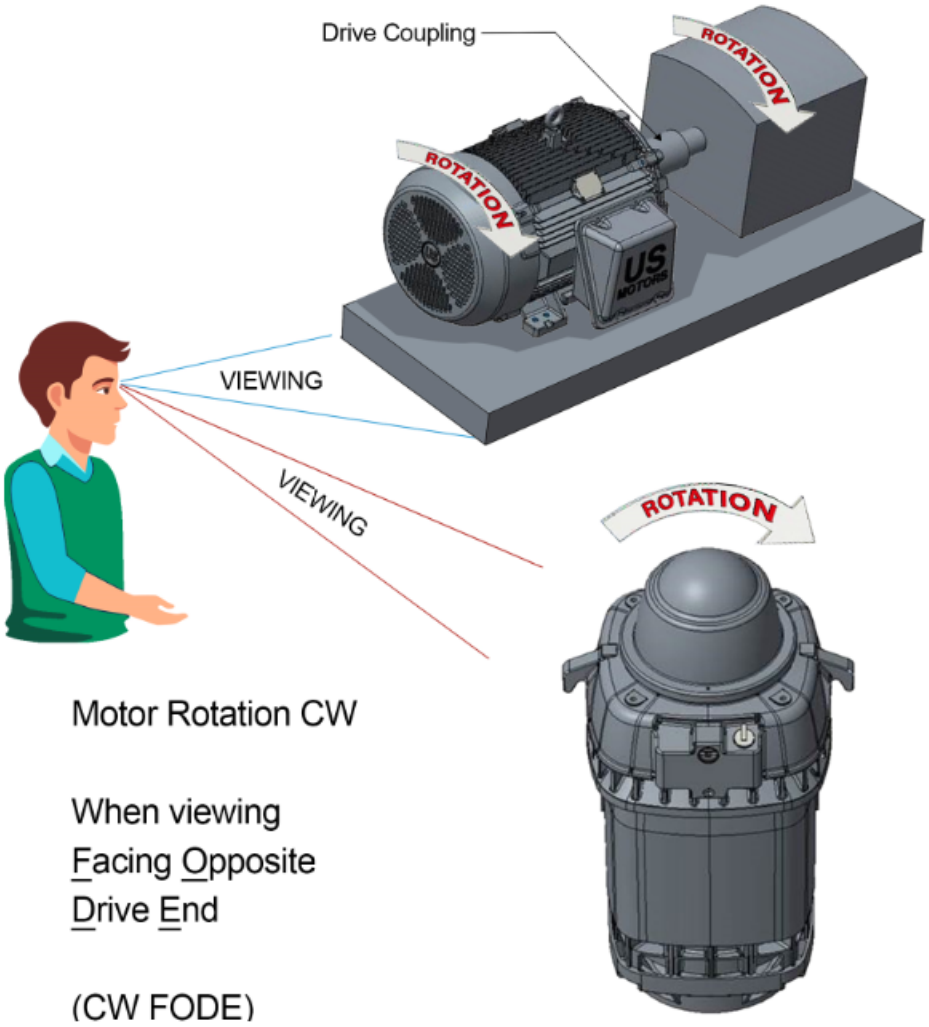
Frame: 364VP Type: TVI4

REED CRITICAL FREQUENCY:	128	HZ
CENTER OF GRAVITY:	14	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0006	IN
UNIT WEIGHT:	900	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	20%	
DATE:	8/29/2022	

DIRECTION OF ROTATION

This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with CW (clockwise) rotation as shown below. CCW rotation is available upon request.



Motor Rotation CW

When viewing
Facing Opposite
Drive End

(CW FODE)

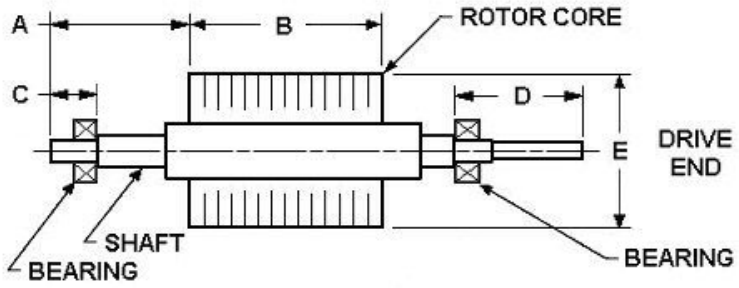
NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-288

LATERAL CRITICAL SPEED ANALYSIS DATA

ORDER NO: 22701574-100

FRAME SIZE 364VP



ROTOR DATA (dimensions in inches)			
A - ROTOR CORE LOCATION	**B - ROTOR CORE LENGTH**	**C - OPPOSITE DRIVE END BRG.**	**D - DRIVE END BRG. LOCATION**
9.125	9.250	4.91	7.88
E - ROTOR CORE DIAMETER	**SHAFT LENGTH END TO END**	**ROTOR CORE WEIGHT (lbs)**	**ROTOR ASSEMBLY WEIGHT (lbs)**
10.932	31.19	208.40	312.59
ROTOR INERTIA POLAR (lb-ft^2)	**ROTOR INERTIA TRANSVERSE (lb-ft^2)**		**SHAFT/ROTOR ASM BALANCE**
23.9	2.315		ISO 1940 G 2.5

BEARING DATA			
DRIVE END BEARING		**OPPOSITE END BEARING**	
NUMBER	**STIFFNESS (lb/in)**	**NUMBER**	**STIFFNESS (lb/in)**
7314 BEP	7.41 X 10^5	6212-2Z-J/C3	6.07 X 10^5

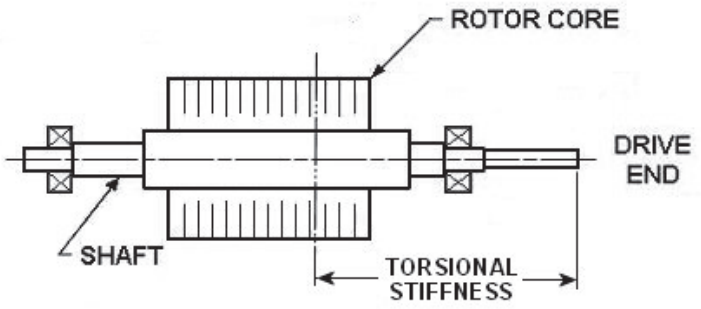
SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
171450	1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30.0 x10^6 psi	12.0 x 10^6 psi	

NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

TORSIONAL ANALYSIS DATA

ORDER NO: 22701574-100

FRAME SIZE 364VP



SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
171450	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30 x10^6 psi	12 x 10^6 psi	

MOMENT OF INERTIA - ROTOR ASSEMBLY:

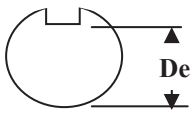
WR^2 = 23.9 **LB-FT^2**

SHAFT TORSIONAL STIFFNESS:

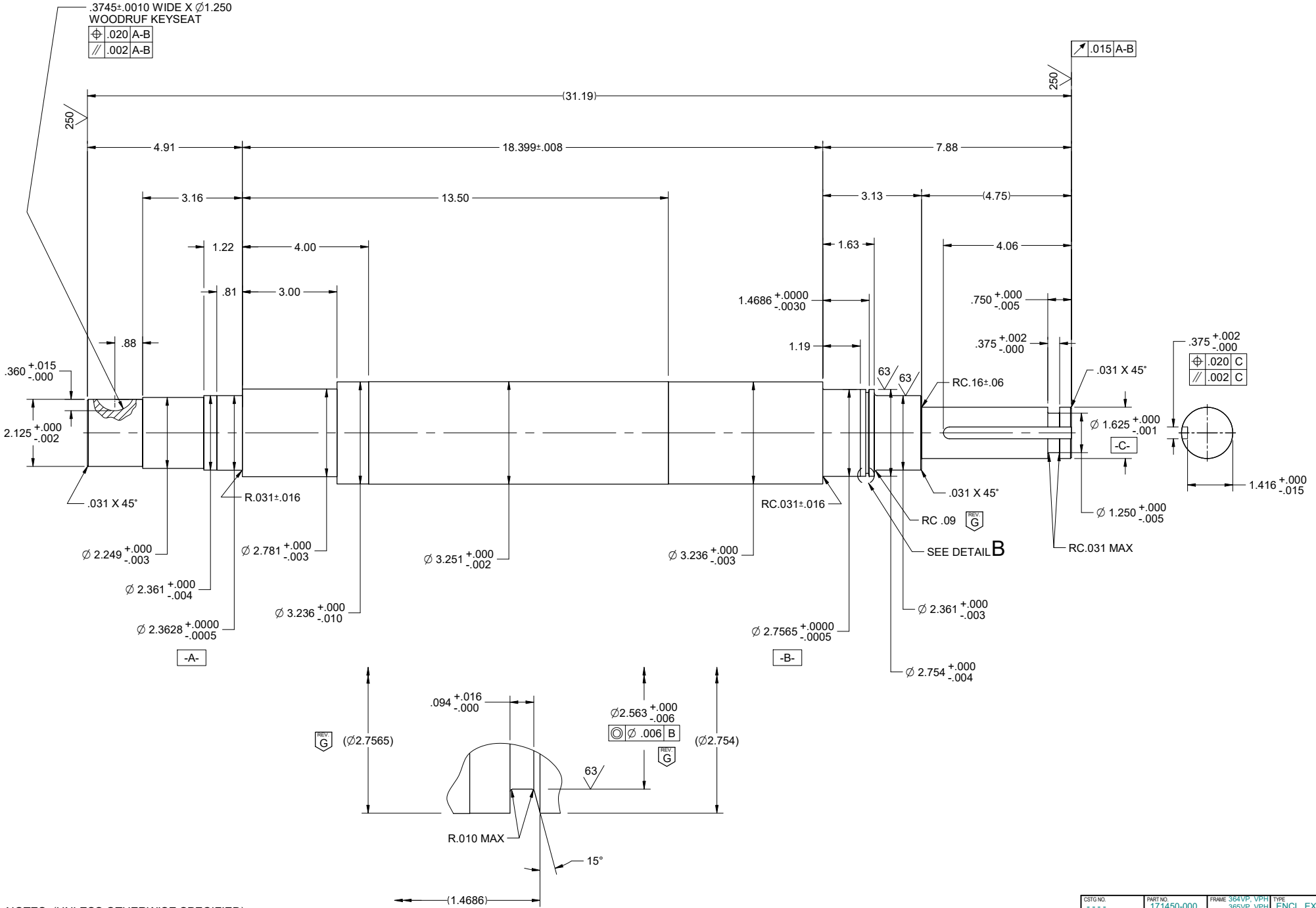
1.143 **X 10^6 LB-IN/RADIAN**

Torsional stiffness is the spring rate or constant which allows a user to determine the amount of twist or angular deflection in a shaft based on the amount of torque applied. The portion of the shaft for which the shaft stiffness has been calculated from 1/3 the length of the rotor core to the end of the drive end of the shaft (shafts with an annular keyways are measured from inboard side of the ring groove). It is the users responsibility to correct for coupling mounting effects.

SHAFT EXTENSION
De - EFFECTIVE DIAMETER WITH KEYWAY 1.416 **INCHES**



NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI



DETAIL B
SCALE 4:1

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIAMETERS TO BE ⌾ ∅ .002 A-B
2. NO AXIAL RELATIONSHIP BETWEEN KEYWAY AND KEYSEAT

REVISION DESCRIPTION FOR: MISC	SCALE 1:2	UNITS INCHES	CSTG NO. - - - -
STL0213- DIMENSION 2.7565 ON DETAIL B ADDED, SYMBOL DIAMETER ADDED ON DATUM, RC.09 WAS R.09 AND NOTES ADDED	TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)		PART NO. 171450-000
MATERIAL: HR STEEL, AISI 1045	INCHES .XX = ± .03 .XXX = ± .015	mm	FRAME 364VP, VPH 365VP, VPH
MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED	ANGLES X°= ±1°		TYPE ENCL, EXPL

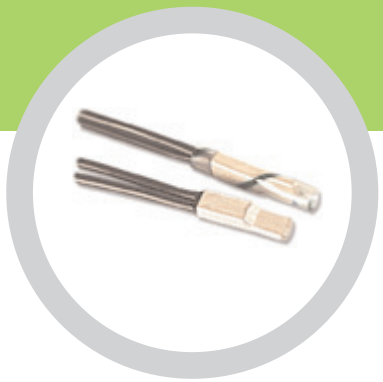
TITLE: SHAFT, ROTOR		NIDEC MOTOR CORPORATION
ISSUED BY: S. MONTALVO	APPROVED BY: J. O'BRIEN	REVISION DATE: 01-MAR-13
CODE	DWG NO. 0171450	REV G · SHEET NUMBER 1 OF 1 · DWG SIZE C

96

NMCC (MAR-2011)

SOLIDEDGE

Sensata Technologies



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performace

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation

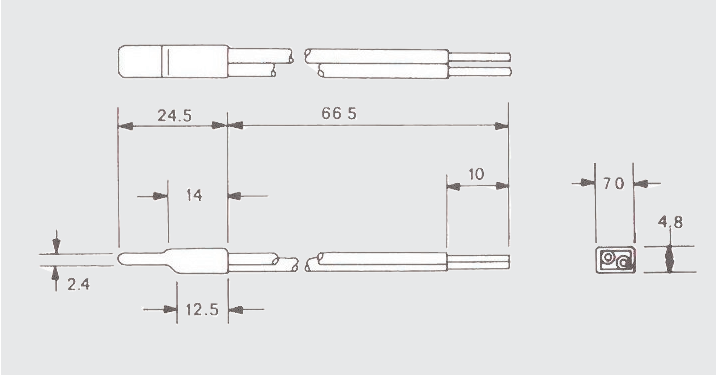
The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00



9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cmf)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5℃ in a step from 60 to 150℃.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

X : Contact material combination

Code	Stationaly contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

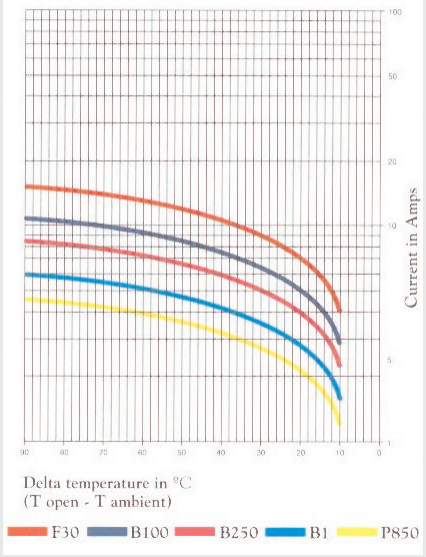
Type "S" is set up for Cadmium-free contact

Example :
9700K01-215
Bimetal of 30ohms/cmf,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125℃-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

9700 : Device Identification

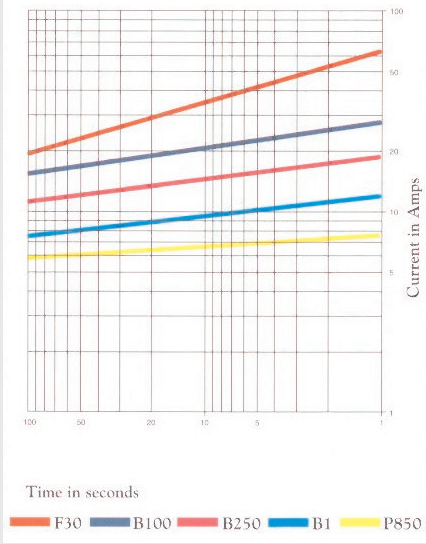
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

Sensata
Technologies

TECHNICAL / SALES SUPPORT

Holland
Phone +31 546 879560 Fax +31 546 879204
Italy
Phone +39 039 6568310 Fax +39 039 6568316

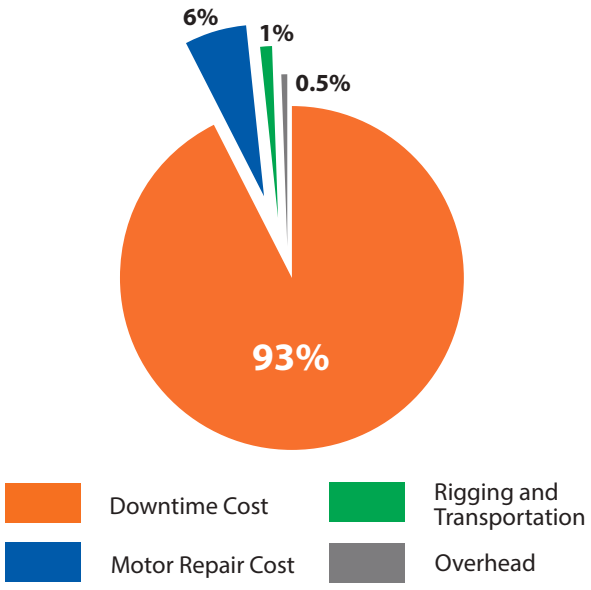
Internet: *www.sensata.com*

Email: *info-cpe@list.sensata.com*

VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.



Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

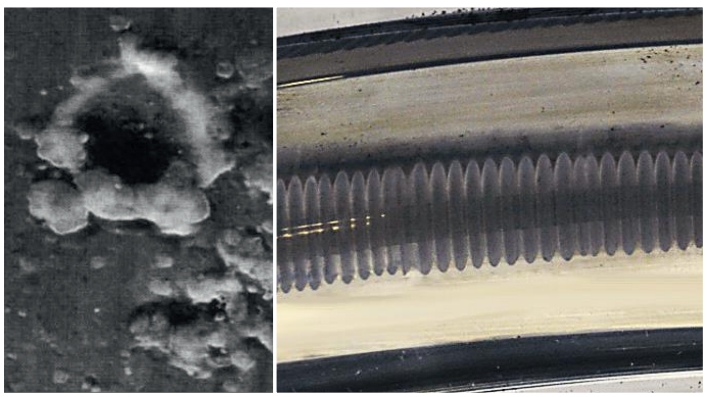
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options

Standard Mounting Clamps (-1)
Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers

Split Ring (-1A4)
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor

Bolt Through Mounting (-3FH)
Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes

Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included

Press Fit Mounting (-0A6)
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available

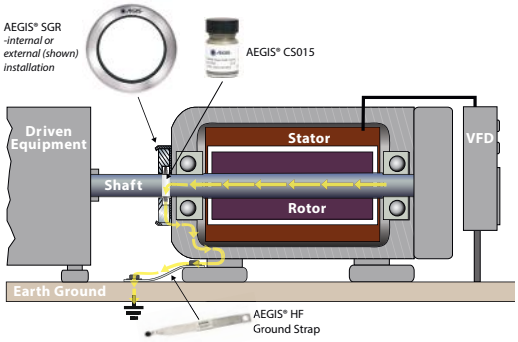
uKIT with Universal Mounting Bracket
Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy

AEGIS® PRO Series
AEGIS® PROSL, PROSLR, PROMAX, PROMR

AEGIS® Shaft Voltage Tester™
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture

Accessories
HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

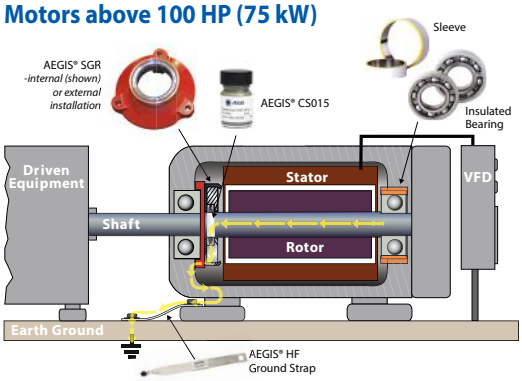
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:
LV Motors up to 500HP: AEGIS® SGR
LV Motors over 500HP: AEGIS® PRO Series
MV Motors: AEGIS® PRO Series

Electro Static Technology™
An ITW Company

www.est-aegis.com

Electro Static Technology
31 Winterbrook Road
Mechanic Falls, ME 04256 USA
Tel: (866) 738-1857
Tel: (207) 998-5140
E-Mail: sales@est-aegis.com

Formular 105-8m US 02/21

Standard
Paint
Specification

For

EM Gray

NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México

CONTENTS

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." for its superior rust inhibitive qualities and durability. The paint also has excellent resistance to various chemicals. This specification covers surface preparation and application of protective coating on motors built in the Apodaca, Nuevo Leon facility.

2.0 Unpainted Surfaces

The following surfaces will not require protective coating:

Anodized Aluminum	Grounding Pads
Brass	Machined Surfaces
Bronze	Motor Leads
Chromium Plated Metals	Porcelain Enamel Finishes
Copper	Rubber
Galvanized Steel	Stainless Steel
Glass	Vacuum Pressure Impregnated Parts

3.0 Surface Preparation (Cast Iron & Steel)

A. The foundries are required to snag, remove all sand and slag from castings. This is to be immediately followed by primer paint to insure 100% coverage. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

C. All parts are to be cleaned prior to priming or finish painting as follows:

1. If parts are dirty – wash and rise in parts washer.
2. If parts are dusty – sandblast
3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

5.0 Motor Assembly

After assembling the motor, there may be surfaces that require priming or touch-up prior to final painting. These surfaces are bracket-to-frame register fits, outlet box pads, etc.
If surfaces are oily, wash with clean paint thinner using a clean rag to prevent contamination of other surfaces.

6.0 General

A. Finished coating shall not be applied to wet or damp surfaces.
B. All coatings shall be applied in a conscientious manner and in accordance with the written application instructions of the coating manufacturer.
C. Re-application time between coats shall be in accordance with the coating manufacturer's recommendation corresponding to the conditions of temperature and humidity.
D. Hardware trim and other items not requiring coating may be removed as required for proper application of coatings. Such items shall be replaced after completion of work.
E. The dry film thickness of each coat, and of the entire system, shall follow the coating manufacturer's recommendation and this specification. The number of coats specified shall be a minimum number of coats to achieve the specified film thickness.
F. Coverage rates, as calculated by the coating manufacturer, shall be considered as the maximum allowable.
G. All spraying equipment shall be maintained in good working order, with daily inspection, and shall be in conformity with the coating manufacturer's most recent application specification.

7.0 Finish Top Coating

All motor products must be clean and free of any dirt, oil or grease on the primed surface prior to finish painting. Except where otherwise specified, thinners shall not be used. Motors will be painted with one coat unless otherwise noted. Film thickness: 2 to 4 mils.

8.0 Final Finish Inspection

Visual inspection of completed work shall be performed on the finished motor by the Quality Assurance Department. The final surface finish is to be in accordance with industry standards for comparable equipment. Any surfaces found in violation of this specification will be rejected and will require rework. Acceptance or rejection of final finish paint is the sole responsibility of the Quality Assurance Department.

9.0 Material Identification

A. Standard Primer: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III "STORAGE", item 4** for instructions.

1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila®† P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

2. Grease Lubricated Bearings

A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠WARNING

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disaasembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠WARNING

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.

B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replensihment Quantities & Lubrication Intervals

Bearing Number		Grease Replensihment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$G = 0.11 \times D \times B$

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Width of bearing in inches

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof		Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3
Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
	449 thru 5811	1801-3600	-15°C tru 40°C (104°F)	32	Synthetic Only
		1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office	

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		Synthetic Only
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4
Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	**ISO VG 32**		**ISO VG 68**		**ISO VG 150**	
	Viscosity: 130-165 SSU @ 100F		**Viscosity: 284-347 SSU @100F**		**Viscosity: 620-765 SSU @ 100F**	
	Mineral Base Oil	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV		
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120^* \text{ Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.

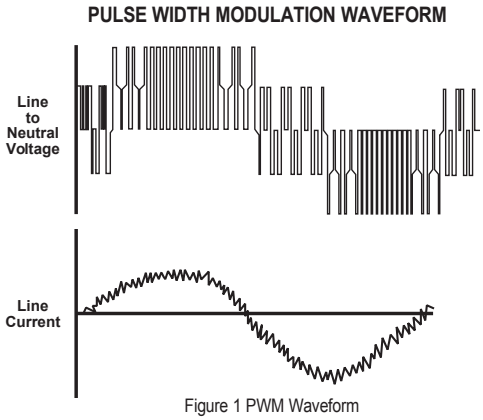


Figure 1 PWM Waveform

What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction
- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grouding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O3. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE® insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE® insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE® insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE® insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Motor / Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD.
(consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA®† 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors
All U.S. MOTORS® brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA®† Application Guide for AC Adjustable Speed Drive Systems: http://www.nema.org/stds/acadjustable.cfm#download

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA®† MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA®† frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA®† frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA®† Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA®† MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA®† frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.
- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	127 ft	400 ft	218 ft
6 Khz	90 ft	307 ft	154 ft
9 Khz	73 ft	251 ft	126 ft
12 Khz	64 ft	217 ft	109 ft
15 Khz	57 ft	194 ft	98 ft
20 Khz	49 ft	168 ft	85 ft

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficienct vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Tag #: WSP-4121/WP-4122/SCP-4131
Service: SECONDARY SLUDGE PUMP STATION NO. 1 WAS PUMPS

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
   - Anchor bolts, nuts and washers
   - Gauges, valves and miscellaneous fittings and adapters.
   - Connecting piping and/or supports
   - Maintenance lubrication piping and related equipment.
   - System control apparatus
   - Maintenance tools and/or storage boxes.
   - Equipment tags
   - Installation or field performance testing.
2. The following information is required by Pentair Flow Technologies prior to or at release of the pumps to production.
   - Verification of rotation and discharge position.
3. The following items are shipped loose for installation in the field:
   - Drivers and couplings.

Taunton Wastewater Treatment Facility
Taunton, MA

Supplier:	Hayes Pump Inc. 66 Old Power Mill Road West Concord, MA 01742
Manufacturer:	
Pump	Fairbanks Nijhuis 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000 Fax: (913) 371-2272
Project Number:	0913561
Sales Order Number:	53144699
Tag/Service:	WSP-4121/WSP-4122/SCP-4131
Service:	Secondary Sludge Pump Station No. 1 WAS Pump
Quantity:	3
Pump Size & Model:	4” B5442C
Coupling:	Falk Corporation 3001 West Canal St. Milwaukee, WI 53208-4222 (414) 342-3131 Fax: (414) 937-4359
Motor:	U S Electrical Motors P. O. Box 3946 St. Louis, MO 63136 (314) 553-2000

Pump

Coupling

Driver

- 7.5 HP, 1200 RPM, 3/60/460V, 254VHP Frame, US Electric Motor
- Variable Speed Application
- Standard Double Mechanical Seal with Stainless Steel Sleeve
- Stainless Steel Impeller Wear Ring; 300-350 BHN
- Stainless Steel Casing Wear Ring; 300-350 BHN
- Stainless Steel Packing Sleeve; 300-350 BHN
- Falk Coupling
- Certified Non-Witness Hydro Testing
- Certified Non-Witness Performance Testing
- Curve Approval
- Dynamically Balanced Cast Iron Impeller
- 4” x 4” Suction Elbow

1. Refer also to clarifications that may be included on the vendor submittal.

4" B5442 Submittal Curve

PENTAIR FAIRBANKS NIJHUIS™

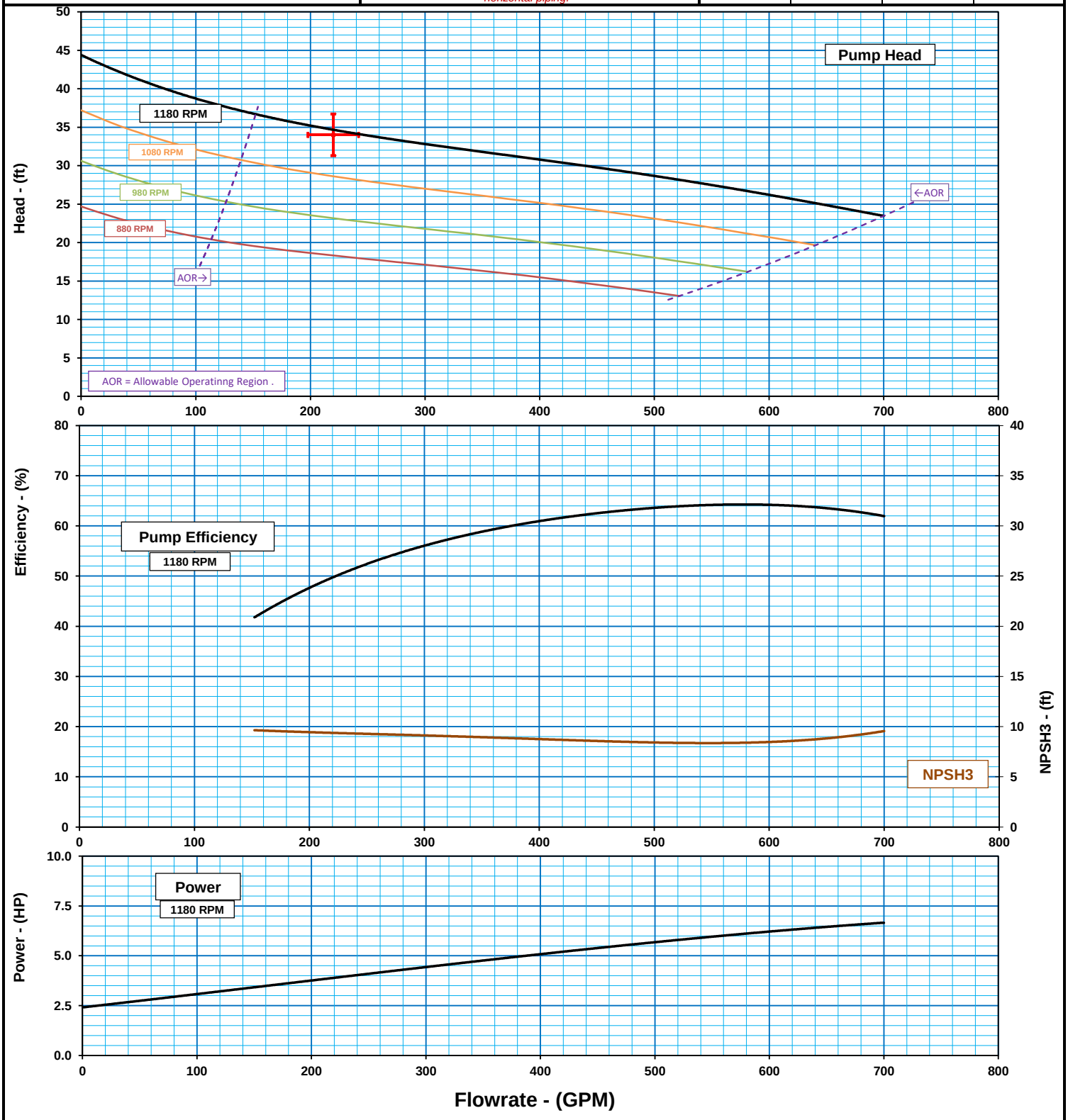
CURVE NUMBER:	0913561C
REV.	1

THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED, **PER ANSI / HI 14.6 - 2022 paragraph 14.6.3.4.1.**

SPEED	DRIVER	DIAMETER	SPHERE
1180 RPM	7.5 HP	9.25"	3.0"
NO. VANE	**IMPELLER**	**DATE**	**BY**
2	T4B1A	10/27/2022	MD

Per ANSI/HI: "For many common solids-bearing liquids, a velocity of about 1,0 m/s (3.0 ft/s) is required to prevent sedimentation in horizontal piping."

GUARANTEED VALUES			
FLOW	HEAD	PUMP EFF	HP
220	34	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----



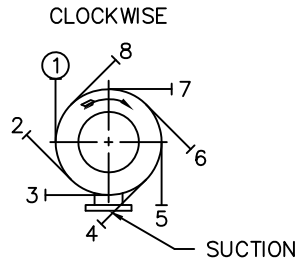
WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

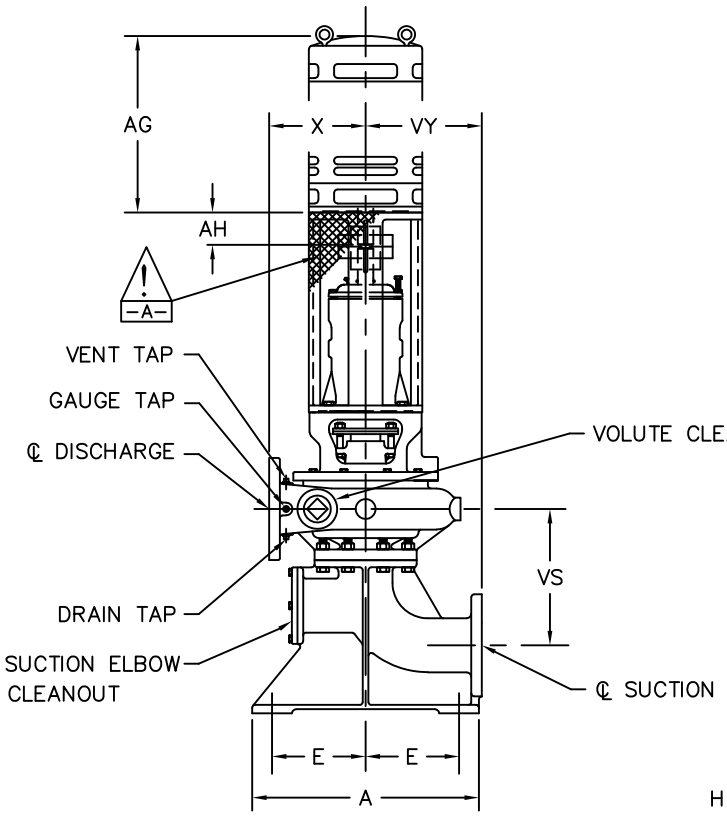
–A– SUPPLIED BY FMPC –B– SUPPLIED BY OTHERS

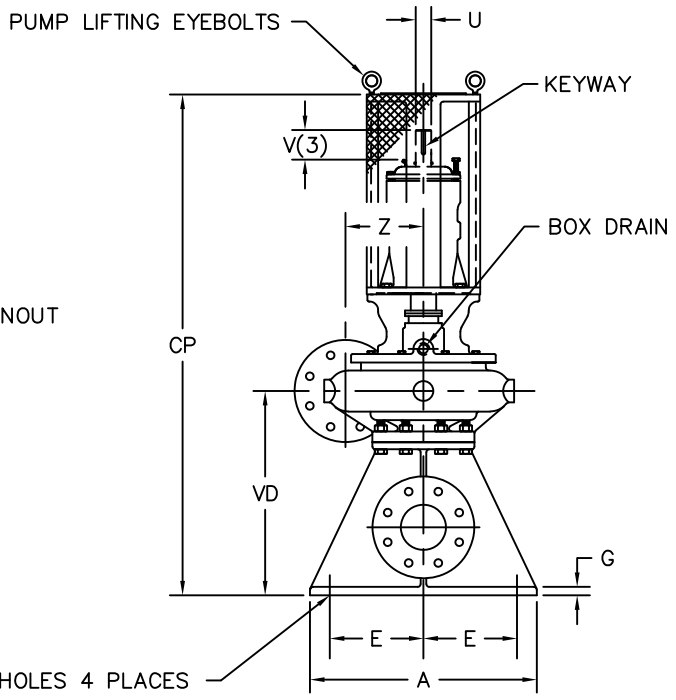
MOTOR DIMENSIONS	
AG	AH
24.63	2.75

AVAILABLE DISCHARGE POSITIONS



POSITIONS #1 OR #9 ARE STANDARD WHEN VIEWED FROM THE DRIVER END UNLESS OTHERWISE SPECIFIED. CLOCKWISE ROTATION DISCHARGE POSITION #1 SHOWN.





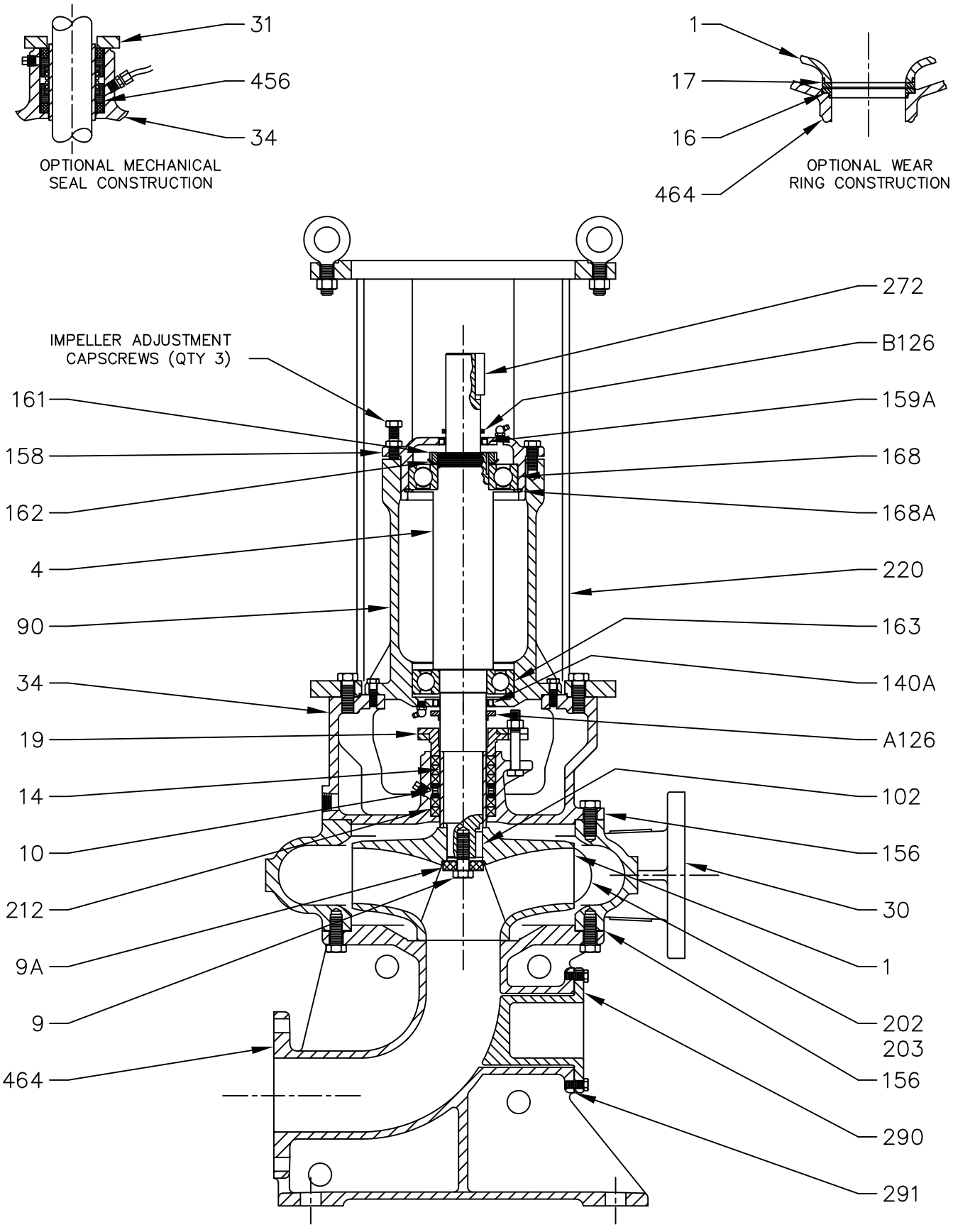
PUMP	FRAME	SUCT	DISCH	A	E	G	H	U	V	X	Z	CP		VD	VS	VY	KEYWAY
												AH=2 3/4	AH=4 1/4				
4" B5442C	T20	4	4	20	8 1/4	3/4	1 1/8	1 3/8	2 1/4	10	7 7/8	44 1/8	45 7/8	17 7/8	11 7/8	10 1/4	5/16 X 5/32 X 2

NOTES:
(1) ALL FLANGES ARE 125# ANSI DRILLING UNLESS NOTED.
(2) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED.
(3) DIMENSIONS REFLECT USABLE SHAFT LENGTH.
(4) 5400'S AND 5400K'S ARE DIMENSIONALLY IDENTICAL.
(5) BASES ARE DESIGNED TO HAVE FULL CONTACT WITH GROUT OR A SOLE PLATE GROUTED IN PLACE.
(6) VOLUTE DRAINS ARE NOT AVAILABLE ON 5441'S.
(7) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VARY DUE TO NORMAL MANUFACTURING TOLERANCES.

CUSTOMER: HAYES PUMP INC.				P.O. NO.: 133369		PENTAIR FAIRBANKS NIJHUIS
JOB NAME: TAUNTON WASTEWATER TREATMENT FACILITY			TAG NAME: WSP–4221/WSP–4222/SPC–4231			SETTING PLAN B5442C
PUMP SIZE AND MODEL: 4" B5442C		GPM: 220	TDH: 21	RPM: 1200	ROTATION: CW	DISCH POS: 1
MOTOR: NIDEC	HP: 7.5	FRAME: 254VPH	PHASE: 3	HERTZ: 60	VOLTS: 460	ENCLOSURE: TEFC
CERTIFIED FOR: PROJECT: 0913561			CERTIFIED BY: JEA		DATE: 8/15/22	DWG NO: 0913561SP REV NO: 0

Item	Description	Material	Specification[1]
1	Impeller	Cast Iron	A48 Class 30
4	Shaft	Steel	AISI 4140 or AISI 1144[2]
9	Bolt, Impeller	Steel	SAE Bolt Steel
9A	Washer, Impeller	Steel	A108 Grade 12L14
14	Sleeve, Shaft	Stainless Steel	A743 Gr. CA40 300-350 BHN
15	Base	Cast Iron	A48 Class 30
16	Wear Ring, Fronthead	Stainless Steel	A743 Gr. CA40 300-350 BHN
17	Wear Ring, Impeller	Stainless Steel	A743 Gr. CA40 300-350 BHN
30	Volute	Cast Iron	A48 Class 30
31	Solid Gland	Steel	A283 Gr. 12-D
34	Backhead	Cast Iron	A48 Class 30
44	Suction Elbow	Cast Iron	A48 Class 30
90	Frame	Cast Iron	A48 Class 30
A126	Deflector, Inner	Rubber	Commercial
B126	Deflector, Outer	Rubber	Commercial
102	Key, Impeller	Steel	A108 GR 1018
140A	Seal, Outer Grease	Steel & Rubber	Commercial
154	Gasket, Elbow	Tag Board	F104
156	Gasket, Volute	Tag Board	D1170-G3111
158	Housing, Thrust Bearing	Cast Iron	A48 Class 30
158A	Lip Seal	Steel & Rubber	Commercial
159A	Seal, Outer Grease	Steel & Rubber	Commercial
161	Locknut, Bearing	Steel	SAE Bolt Steel
162	Lockwasher, Bearing	Steel	AISI 1215
163	Bearing, Radial	Steel	Commercial
168	Bearing, Thrust	Steel	Commercial
168A	Snap Ring, Bearing	Steel	Commercial
202	Cover, Volute Cleanout	Cast Iron	A48 Class 30
203	Gasket, Cleanout	Rubber	Commercial
220	High Ring Base	Cast Iron/Steel	A48 Class 30 /A36 & A53
272	Key, Coupling	Steel	A108 Grade 1018
290	Cover, Suction Hand hole	Cast Iron	A48 Class 30
291	Gasket, Handhole	Rubber	Commercial
456	Mechanical Seal	Commercial	Commercial

[1] All material specifications are ASTM unless otherwise noted and are or description of chemistry only.
[2] Manufacturer's option.



ASSEMBLY WITH COMBINATION BASE ELBOW B5442C T20 FRAME

PENTAIR FAIRBANKS NIJHUIS

DWG NO 0913561AP REV NO 0

Pump[3]

Frame Size	T20
Pump Size	4
Suction Size, Standard	4
Nominal Wear Ring Clearance	0.020
Impeller Fastener	
Size	1/2-13
Tightening Torque, lb.-ft.	80
Impeller	
Weight, lb.	41.2
Inlet Area, sq. In.	26.22
WK^2 Lb.-$Ft.^2$	2.8
Sphere Size, Maximum	3
Shaft Diameter:	
at Impeller	1 1/4
at Sleeve	1 1/2
at Thrust Bearing	1.969
at Radial Bearing	1.969
Between Bearings	2 3/8
at Coupling	1 3/8
Keyway at Coupling	5/16 X 5/32
Torsional Shaft Stiffness, lbs./rad.	$3.7X10^5$
Center to Center of Bearings	8 3/4
Thrust Bearing Number	6310
Radial Bearing Number	6310
Sealing Box:	
Type	Double
Recommended Flush Water	
Pressure, PSI (above operating pressure)	1-10
Flow, GPM	1/2-1
Sleeve OD	1 7/8
Box ID	2 5/8
Box Depth	2 7/8
Box Inlet Tap Size, NPT	1/4
Box Outlet Tap Size, NPT	1/4
Backhead Drain Tap Size, NPT	3/4
Volute Cleanout Diameter	2 7/8
Suction Elbow Cleanout Diameter	4
Vent/Priming Tap Size, NPT	1/4
Gauge Tap Size	
Suction, NPT	1/2
Discharge, NPT	1/2
Hydrostatic Test Pressure, Maximum, PSI	90
Casing Working Pressure, Maximum, PSI	60
Nominal Casing Thickness	3/8
Operating Temperature, °F	150
Anchor Bolt Size Recommended	7/8
Minimum Diameter Opening to Install Pump	34
Shipping Weight, Basic Pump, lb.	490

[3] All dimensions are in inches unless otherwise noted.

Fairbanks Nijhuis recommends a superior quality, NLGI No. 2, multipurpose, lithium complex grease for all pump rolling element bearing applications that require grease lubrication. The grease characteristics should include good high temperature performance, extreme pressure properties, water resistance, excellent oxidation stability, good rust protection and resistance to chemical breakdown. Fairbanks Nijhuis does not recommend grease with molybdenum disulfide (moly) additives. In addition to the characteristics listed above, the grease should meet the following specification.

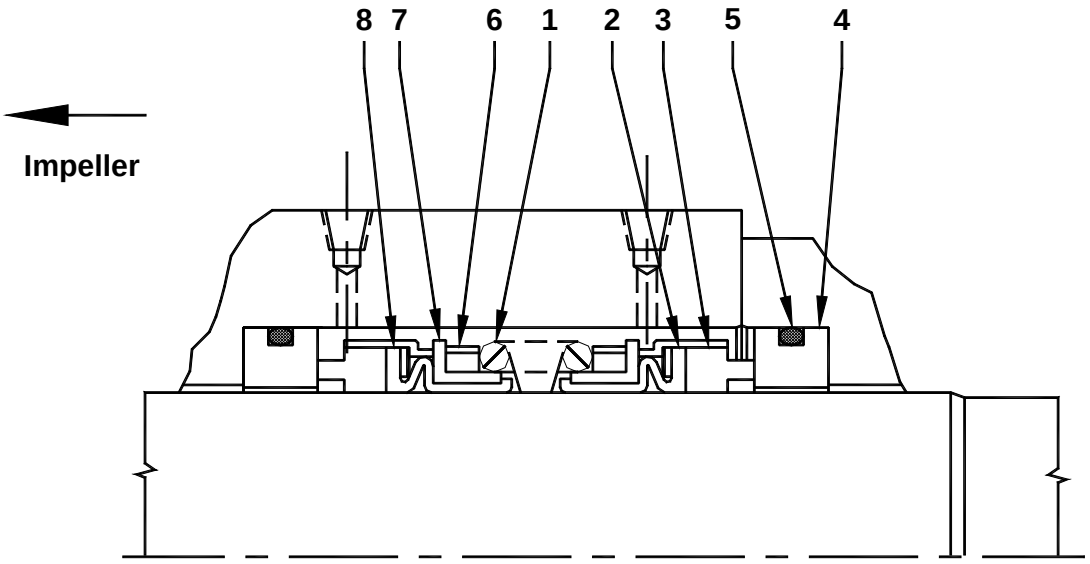
Specifications

Consistency: NLGI No. 2
Dropping Point ASTM D2265 >450° F
Base fluid viscosity
SUS @ 100° F 700 to 1200
SUS @ 212° F 70 to 100
Rust Prevention ASTM 1743 Pass
Water Washout ASTM 1264 <4% @ 175° F
Four Ball EP Test ASTM D2596>40kg load wear
>250kg weld point

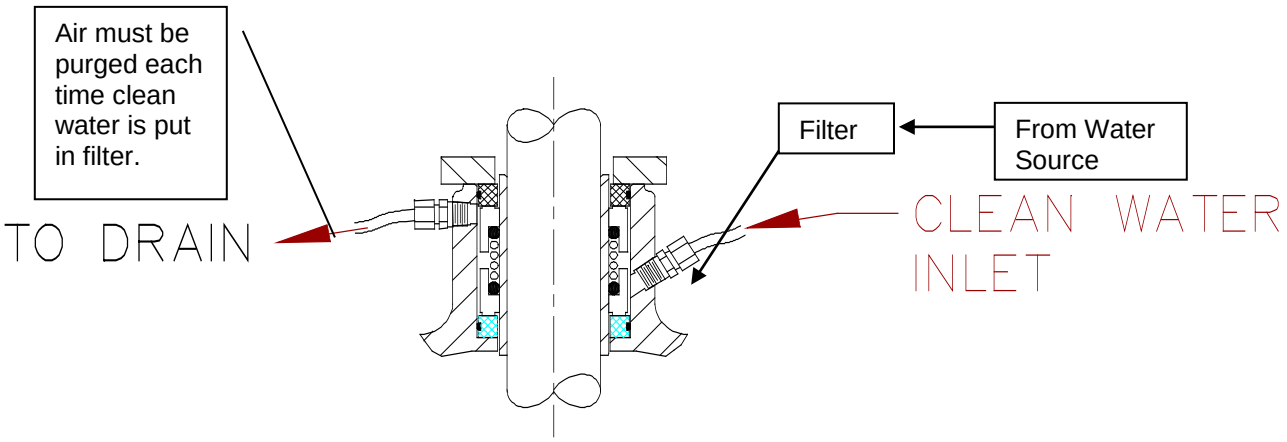
Fairbanks Nijhuis has compiled a general list of products that meet the grease requirements above. This list is not an endorsement of any particular manufacture and should not be construed as exclusive recommendations. When choosing an alternate manufacture, customers should discuss this typical lubricant recommendation with their vendor to ensure that equivalent grease is supplied.

Typical Products

Manufacturer	Lubricant Brand Name	NLGI No.
BP	BP Energrease® LC EP 2	2
Castrol	Pyroplex Red	2
Chevron	Delo® Greases EP	2
Exxon	Ronex® MP	2
Mobil	Mobiltith® AW2	2
Shell	Retinax® LC	2
Texaco	Starplex® 2	2
76	76 Multiplex EP	2



Item	Part	Material
1	Spring	Stainless Steel
2	Rotary Bellows	Buna-N
3	Rotary Face	Carbon
4	Stationary Seat	Ceramic
5	O-Ring	Buna-N
6	Driving Band	316 Stainless Steel
7	Retainer	18-8 Stainless Steel
8	Disc	316 Stainless Steel



Typical Flush Water Schematic

Ref. No.	Description	Quantity
456	Mechanical Seal	3

Exterior Paint

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning.
- **Prime Coat** Series 69
  - **Number of Coats** One
  - **Color** 1211 Red
  - **Dry Film Thickness** 3 to 5
  - **Surfaces to be coated** Exterior of Pump

TNEMEC

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II SERIES N69

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water.

COLORS Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH Satin

SPECIAL QUALIFICATIONS A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69F, V69F, 90E-92, 90-97, H90-97, 90G-1K97, 90-98, 91-H_2O, 94-H_2O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69F, V69F, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or 130, 215, 218, 1254

TOPCOATS 22, 46H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69 is 21 days for atmospheric service. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

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

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS
Unthinned: 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)

HAPS
Unthinned: 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids

THEORETICAL COVERAGE 1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

HI-BUILD EPOXOLINE® II | SERIES N69

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

PACKAGING 5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.

NET WEIGHT PER GALLON 13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA Part A: 82°F (28°C) Part B: 93°F (34°C)

HEALTH & SAFETY Paint products contain 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

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). 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

1. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon.

POT LIFE Without 44-700: 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700: 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 75°F (24°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

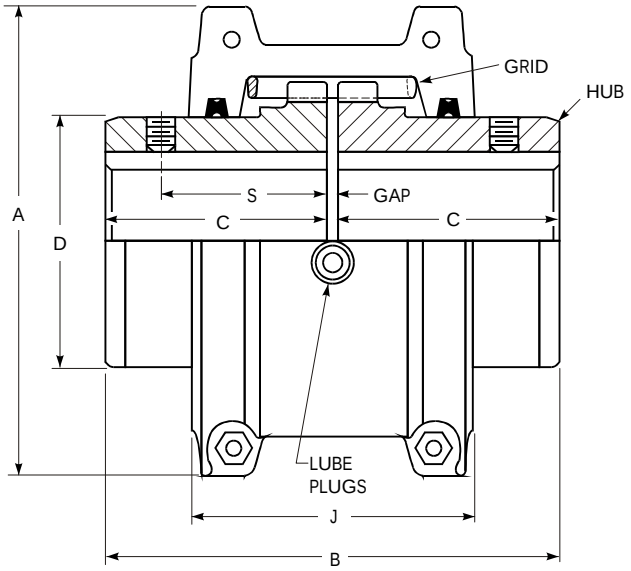
Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Minimum 50°F (10°C) Maximum 135°F (57°C) The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

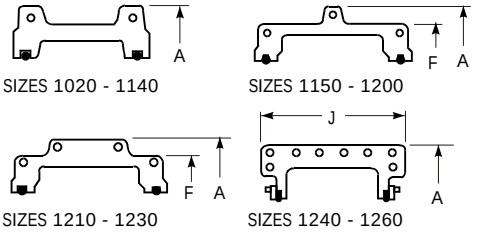
CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

Type T10

Close Coupled/Dimensions — Inches



COVER PROFILES – HORIZONTAL SPLIT



Sizes 1020 thru 1230T10 covers are cast aluminum alloy; Sizes 1240 thru 1260T10 are fabricated steel.

SIZE ★	Torque Rating (lb-in) †	Allow Speed rpm ‡	Max Bore ●	Min Bore ■	Cplg Wt With No Bore-lb	Lube Wt lb	DIMENSIONS — INCHES							
							A	B	C	D	F	J	S	Gap
1020T	460	4500	1.125	.500	4.2	.06	3.82	3.88	1.88	1.56	....	2.62	1.54	.125
1030T	1,320	4500	1.375	.500	5.7	.09	4.16	3.88	1.88	1.94	....	2.69	1.54	.125
1040T	2,200	4500	1.625	.500	7.4	.12	4.50	4.12	2.00	2.25	....	2.75	1.58	.125
1050T	3,850	4500	1.875	.750	12	.15	5.32	4.88	2.38	2.62	....	3.12	1.76	.125
1060T	6,050	4350	2.125	.750	16	.19	5.82	5.12	2.50	3.00	....	3.62	2.06	.125
1070T	8,800	4125	2.500	1.062	23	.25	6.25	6.12	3.00	3.44	....	3.75	2.12	.125
1080T	18,150	3600	3.000	1.062	39	.38	7.50	7.12	3.50	4.12	....	4.56	2.54	.125
1090T	33,000	3600	3.500	1.625	56	.56	8.31	7.88	3.88	4.88	....	4.81	2.82	.125
1100T	55,550	2440	4.000	1.625	93	.94	9.88	9.69	4.75	5.59	....	6.12	....	.188
1110T	82,500	2250	4.500	2.375	120	1.12	10.62	10.19	5.00	6.31	....	6.36	....	.188
1120T	121,000	2025	5.000	2.625	179	1.62	12.12	12.00	5.88	7.06	....	7.54	....	.250
1130T	176,000	1800	6.000	2.625	266	2.0	13.62	13.00	6.38	8.56	....	7.68	....	.250
1140T	253,000	1650	7.250	4.250	392	2.5	15.12	14.75	7.25	10.00	....	7.92	....	.250
1150T	352,000	1500	8.000	4.750	500	4.3	17.84	14.65	7.20	10.60	15.40	10.68	....	.250
1160T	495,000	1350	9.000	5.250	681	6.2	19.76	15.85	7.80	12.00	17.20	10.96	....	.250
1170T	660,000	1225	10.000	6.000	987	7.7	22.32	17.25	8.50	14.00	19.18	12.10	....	.250
1180T	915,000	1100	11.000	6.000	1365	8.3	24.80	19.05	9.40	15.50	21.84	12.64	....	.250
1190T	1,210,000	1050	12.000	7.000	1710	9.7	26.60	20.65	10.20	17.20	23.93	12.80	....	.250
1200T	1,650,000	900	13.000	7.000	2331	12.4	29.80	22.25	11.00	19.60	26.00	14.00	....	.250
1210T	2,200,000	820	14.000	7.000	3140	23.2	33.25	24.50	12.00	21.00	29.56	17.00	....	.500
1220T	2,970,000	730	15.000	8.000	3935	35.4	36.25	26.10	12.80	22.50	32.37	19.30	....	.500
1230T	3,850,000	680	16.000	8.000	4997	53.0	39.50	27.70	13.60	24.00	35.62	21.50	....	.500
1240T	4,950,000	630	17.000	10.000	6504	74.5	42.80	29.50	14.50	25.50	....	25.50	....	.500
1250T	6,600,000	580	18.500	10.000	8450	110.5	46.50	32.10	15.80	28.00	....	27.50	....	.500
1260T	8,250,000	540	20.000	10.000	10322	148.1	49.64	34.50	17.00	30.00	....	30.00	....	.500

★ Refer to Page 3 for General Information and Reference Notes.

How To Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

Table of Contents

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.

INTRODUCTION

This manual applies to Sizes 1020T thru 1140T and 20T thru 140T10 Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 20T thru 140T respectively, e.g. 1020T = 20T, 1100T = 100T, etc. These couplings are designed to operate in either the horizontal or vertical position without modification. Beginning in 1994, these couplings are being supplied with one set of inch series fasteners and one set of metric fasteners. Use either set of fasteners, depending on your preference. Refer to Page 6 for part interchangeability.

The performance and life of the couplings depend largely upon how you install and service them.

CAUTION: *Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.*

WARNING: *Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.*

LUBE FITTINGS

Cover halves have $^{1}/_{8}$ NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

LIMITED END FLOAT

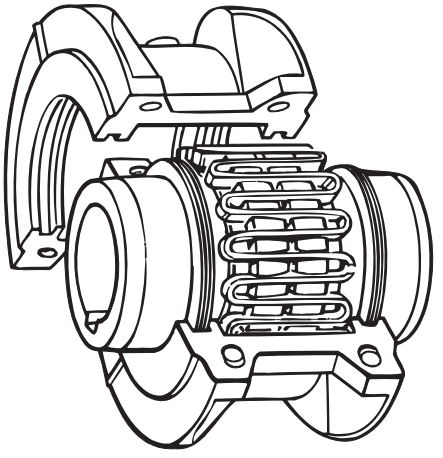
When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose and long term greases. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended. Sizes 1020T to 1090T10 are furnished with a pre-measured amount of grease for each coupling. The grease can be ordered for larger size couplings.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

TYPE T10 STEELFLEX COUPLING



Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

CAUTION: *Do not use LTG in bearings.*

MORE>

Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Min. Pump = 20° F (-7° C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — $^1/_2$

MINIMUM DROPPING POINT — with 60 stroke worked penetration value in the range of 320 to 365 — 350°F (177°C) min.

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

Packaging

14 oz. (0,4 kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 kg)PAIL, 120 lb. (54 kg) KEG & 400 lb. (181 kg) DRUMS.

General Purpose Grease

Annual Lubrication — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (-18°C to 66°C). For temperatures beyond this range (see Table 1), consult the Factory.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	**Lubricant †**	**Lubricant †**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt)	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	. . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (-7°C). If grease must be applied below 20°F (-7°C), consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS

Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 1020T thru 1090T are generally furnished for CLEARANCE FIT with setscrew over the keyway. Sizes 1100T and larger are furnished for an INTERFERENCE FIT without a setscrew.

CLEARANCE FIT HUBS — Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Do not heat clearance fit hubs. Install keys, mount hubs with flange face flush with shaft ends or as otherwise specified and tighten setscrews.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent seal damage, DO NOT heat hubs beyond a maximum temperatue of 400°F (205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

MORE>

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-343-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

WARNING: If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

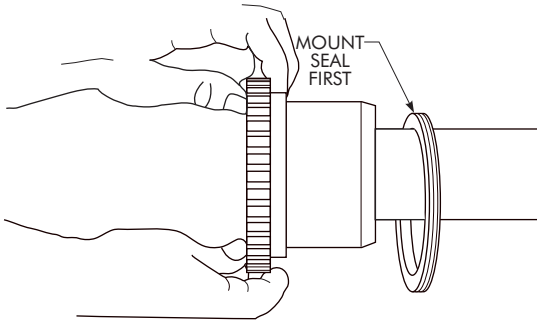
Heat hubs as instructed above. Mount hubs as quickly as possible with hub face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

Maximize Performance And Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

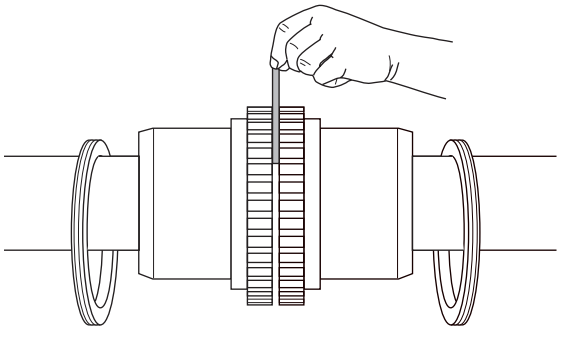
Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.

1— Mount Seals And Hubs



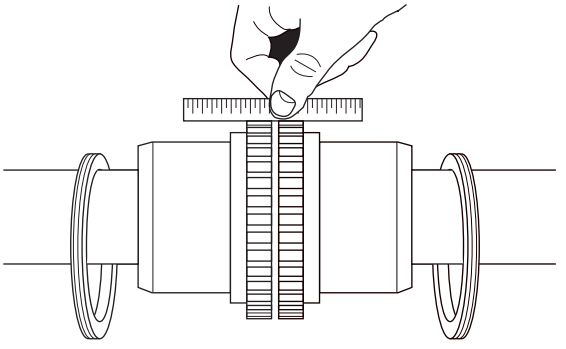
Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Heat interference fit hubs as previously instructed. Seal keyways to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft unless otherwise indicated. Tighten setscrews when furnished.

2 — Gap and Angular Alignment



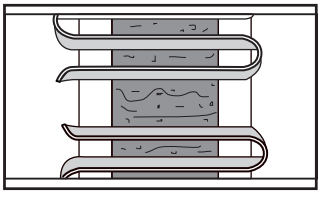
Use a spacer bar equal in thickness to the gap specified in Table 2, Page 5. Insert bar as shown below left, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR installation limits specified in Table 2.

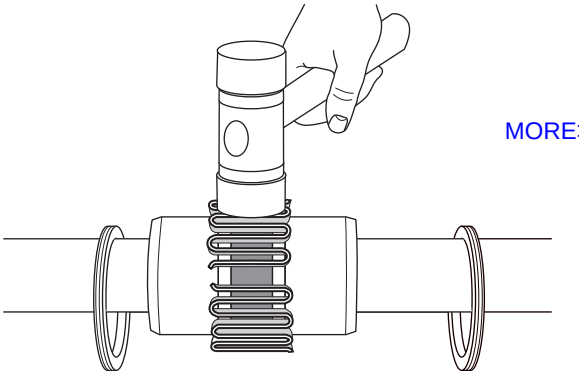
3 — Offset Alignment



Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary.

4 — Insert Grid

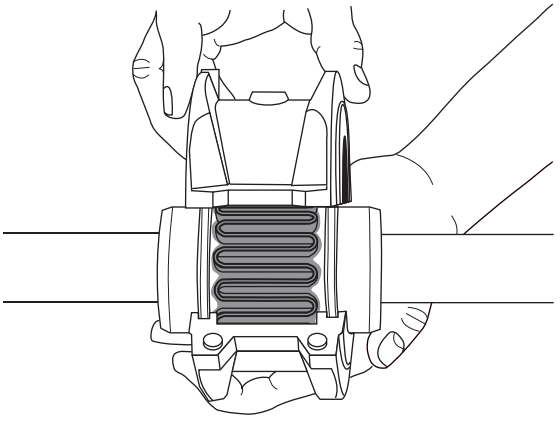


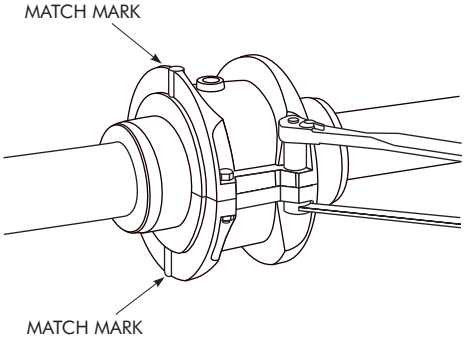


MORE>

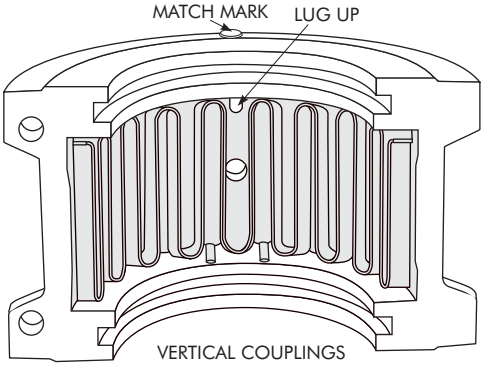
Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction (as detailed in the exploded view picture above); this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

5 — Pack With Grease And Assemble Covers





Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark



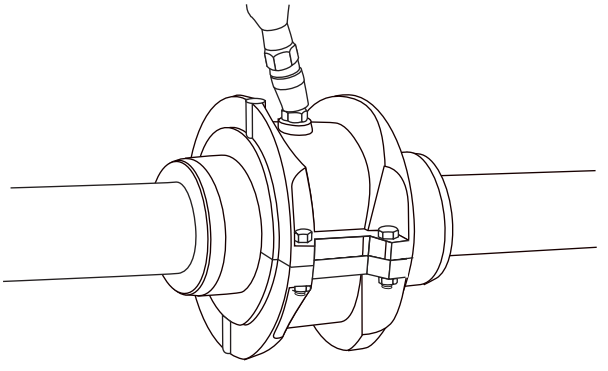
UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2. Make sure gaskets stay in position during tightening of fasteners. ***CAUTION:*** *Make certain lube plugs are installed before operating.*

ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

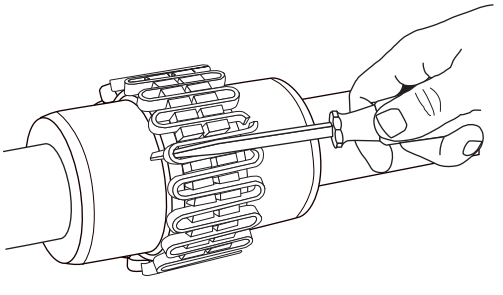
1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication



The required frequency of lubrication is directly related to the type of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relubed annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. ***CAUTION:*** Make certain all plugs have been inserted after lubricating.

Coupling Disassembly And Grid Removal



Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-343-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

TYPE T COUPLING INSTALLATION & ALIGNMENT DATA

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Maximum operating values listed in Table 2 are based on cataloged allowable rpm.

Values listed are based upon the use of the gaps listed, standard coupling components, standard assemblies and cataloged allowable speeds.

Values may be combined for an installation or operating condition.

Example: 1060T max. operating misalignment is .016" parallel plus .018" angular.

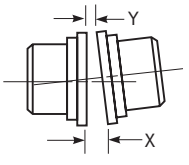
NOTE: For applications requiring greater misalignment, refer application details to Falk.

Angular misalignment is dimension X minus Y as illustrated below.

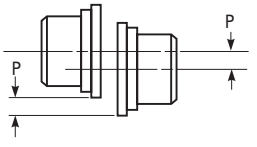
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT

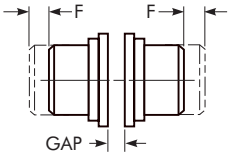


TABLE 2 — Misalignment & End Float

SIZE	Installation Limits						Operating Limits						Cover Fastener Tightening Torque Values		Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Hub Gap ± 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F						
	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	In Series Fasteners (lb-in)	Metric Fasteners (Nm)		lb	kg
1020T	.006	0,15	.003	0,08	.125	3	.012	0,30	.010	0,25	.210	5,33	100	11,3	4500	.06	0,03
1030T	.006	0,15	.003	0,08	.125	3	.012	0,30	.012	0,30	.198	5,03	100	11,3	4500	.09	0,04
1040T	.006	0,15	.003	0,08	.125	3	.012	0,30	.013	0,33	.211	5,36	100	11,3	4500	.12	0,05
1050T	.008	0,20	.004	0,10	.125	3	.016	0,41	.016	0,41	.212	5,38	200	23,6	4500	.15	0,07
1060T	.008	0,20	.005	0,13	.125	3	.016	0,41	.018	0,46	.258	6,55	200	23,6	4350	.19	0,09
1070T	.008	0,20	.005	0,13	.125	3	.016	0,41	.020	0,51	.259	6,58	200	23,6	4125	.25	0,11
1080T	.008	0,20	.006	0,15	.125	3	.016	0,41	.024	0,61	.288	7,32	200	23,6	3600	.38	0,17
1090T	.008	0,20	.007	0,18	.125	3	.016	0,41	.028	0,71	.286	7,26	200	23,6	3600	.56	0,25
1100T	.010	0,25	.008	0,20	.188	5	.020	0,51	.033	0,84	.429	10,90	312	35	2440	.94	0,43
1110T	.010	0,25	.009	0,23	.188	5	.020	0,51	.036	0,91	.429	10,90	312	35	2250	1.1	0,51
1120T	.011	0,28	.010	0,25	.250	6	.022	0,56	.040	1,02	.556	14,12	650	73	2025	1.6	0,74
1130T	.011	0,28	.012	0,30	.250	6	.022	0,56	.047	1,19	.551	14,00	650	73	1800	2.0	0,91
1140T	.011	0,28	.013	0,33	.250	6	.022	0,56	.053	1,35	.571	14,50	650	73	1650	2.5	1,14

TABLE 3 — Coupling Cover Fastener Identification

SIZE	Inch Series Fasteners				METRIC FASTENERS	
	Old Style		New Style			
1020-1070T10		SAE Grade 8 ★		SAE Grade 8		Property Class 10.9
1080-1090T10		SAE Grade 8		SAE Grade 8		Property Class 10.9
1100-1140T10		SAE Grade 5		SAE Grade 5		Property Class 8.8

★ Older style covers, Sizes 1020T10 thru 1070T10 must utilize socket head cap screws and locknuts held by the cover.

PARTS IDENTIFICATION

All coupling parts have identifying part numbers as shown below. Parts 3 and 4 (Hubs and Grids), are the same for both Type T10 and T20 couplings. All other coupling parts are unique to Type T10. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER.

PARTS INTERCHANGEABILITY

Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

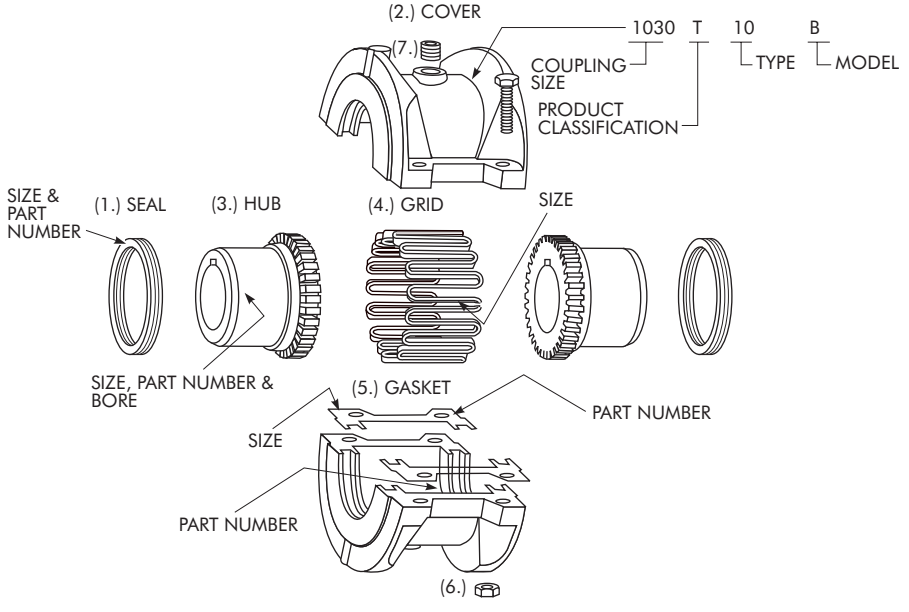
GRIDS — Size 1020T thru 1140T Steelflex couplings use blue grids. Older models, 20T thru 140T, use orange grids.

CAUTION: *Blue grids may be used in all applications, but DO NOT substitute orange grids for blue.*

COVERS — ***CAUTION:*** *DO NOT mix cover halves of different designs. Sizes 1020T thru 1070T10 covers have been manufactured in several different two-rib designs and 80T thru 140T covers have been manufactured with two and three ribs.*

HARDWARE — Older style covers, Sizes 1020T10 thru 1070T10, utilized socket head cap screws with captured locknuts. The new style covers use hex head cap screws (either inch or metric) and unrestrained locknuts. Specify either inch series SOCKET head or metric series HEX head cap screws when ordering replacement parts.

PART NUMBER LOCATION



PART DESCRIPTION

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10) — Coupling may be supplied with one set each of inch series fasteners and metric fasteners.
7. Lube Plug

ORDER INFORMATION

1. Identify part(s) required by name above.
2. Furnish the following information.

   EXAMPLE:
   Coupling Size: 1030
   Coupling Type: T10
   Model: B
   Bore: 1.375
   Keyway: .375 x .187
3. Price parts from Price List 422-110 and appropriate discount sheet.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

Introduction

Adequate lubrication is essential for satisfactory operation. This manual provides a list of typical lubricants and specifications for general purpose and long term greases.

The use of general purpose grease requires re-lubrication of the coupling at least annually. By initially using Falk long term grease (LTG), re-lubrication will not be required again until the connected equipment is stopped for servicing.

Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk LTG was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLG1 #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with Falk Long Term grease (LTG) will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 rating).

CAUTION: Do not use LTG in bearings.

Specifications

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — –20°F (–29°C) to 250°F (121°C). Min. Pump = 20°F (–7°C)

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C)

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425-84 Centrifuge Test) — K36 = 2/24 maximum, very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — 1/2

CONSISTENCY (ASTM D-217) — 60 stroke worked penetration value in the range of 315 to 360 measured at 77°F (25°C)

MINIMUM DROPPING POINT — 350°F (177°C) min.

MINIMUM TIMKEN EP O.K. LOAD — 40 lb (18 kg).

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

INSPECTION — When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean the grease from the coupling and repack with fresh LTG. Install coupling using new gasket as instructed in the appropriate installation manual.

Packaging

14 oz CARTRIDGES — For use in standard industrial lubrication guns.

35 lb PAILS — Ideal for larger size couplings or many smaller sizes.

120 lb KEG — For plants with many small couplings or large size couplings. Best for hand packing.

400 lb DRUMS — For plants with a pressurized lubrication system.

CASE LOTS — 10 pack – 14 oz cartridges, 60 – 14 oz cartridges.

General Purpose Grease

ANNUAL LUBRICATION — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0° to 150°F (–18° to 66°C) For temperatures beyond this range, consult the Factory.

If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals; more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 265 to 295.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties, equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed in Table 1 are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases

Ambient Temperature Range	0°F to 150°F (–18°C to +66°C)	–30°F to 100° F –34°C to +38°C)
Manufacturer	**Lubricant**	**Lubricant**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt) Corp.	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	. . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (7°C). If grease must be applied below 20°F (7°C), consult The Falk Corporation. Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-343-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

NIDEC MOTOR CORPORATION
8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 9/1/2022

P.O. NO.: 12587654
Order/Line NO.: 22701648 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

```
HOLD PRODUCTION
Horsepower ..............  00007.50~00000.00  ~ KW: 5.595
Enclosure ...............  TEFC
Poles ...................  06~00  ~ RPM: 1200~0
Frame Size ..............  254~VPH
Phase/Frequency/Voltage..  3~060~460
Winding Type ............  Random Wound
Service Factor ..........  1.15
Insulation Class ........  Class "F" ~ Insulife 2000
Altitude In Feet (Max) ..  3300 Ft.(1000 M)
Ambient In Degree C (Max)  +40 C
Efficiency Class ........  Premium Efficiency
Application .............  Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
Customer Part Number ....  FMB0913561A01
12" Base
Pricebook Thrust Value (lbs).. 3800
Customer Down Thrust (lbs) ... 1
Customer Shutoff Thrust (lbs).
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
"AK" Dimension (Inches).. NA
Shaft Dimensions:~U=1.125 ~ AH/V=2.750
KEYWAY=0.250 ~ ES=1.280
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method .........  Direct-On-Line Start
Duty Cycle ..............  Continuous Duty
Efficiency Value ........  91.0 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 104 LB-FT2
Number Of Starts Per Hour: NEMA
Motor Type Code .............  TVI4
Rotor Inertia (LB-FT²)          3.06 LB-FT²
Qty. of Bearings PE (Shaft)     1
Qty. of Bearings SE (OPP)       1
Bearing Number PE (Shaft)       7310 BEP
Bearing Number SE (OPP)         6207-2Z-J/C3
```

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 9/1/2022

P.O. NO.: 12587654
Order/Line NO.: 22701648 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913561A01
12587654
LINE 10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	7.5
Pole(s)	06
Voltage(s)	460
Frame Size	254VPH
Shaft U Diameter	1.125
Outlet Box AF	2.03
Outlet Box AA	1.25

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 9/1/2022

PENTAIR PURCHASE ORDER #: 12587654 PENTAIR TAG #: FMB0913561A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X **IEEE** X **ASA** X **NEMA**

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
7.5	1200	1180	254VPH	TVI4	TEFC

*Full Load Speed Tolerance Per NEMA MG1-12.46 is+/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPHERES		INSULATION CLASS	MAX. TEMP. RISE	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR		X ____RESIS. ____THERM.			
3	60	460	9.2	52.5	F	105 DEG C AT 1.00 SF	1.15	F	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD		PERCENT OF FULL LOAD	
89.5	90.2	89.5	84.1	81.5	74.4	33.4	174	255

VSS [X] **VHS** [ ] **NRR** [ ] **SRC** [ ] **HORIZ** [ ]

BEARINGS:

Drive End Lubrication:
[ ] Oil [X] Grease

Opposite End Lubrication:
[ ] Oil [X] Grease

PAINT: (Attach Technical Data Sheets)
[X] Factory Standard
[ ] Other _____

MOTOR NO.: 22701648

MOTOR WEIGHT: 265 LBS

ROTATION: [ ] **BI-DIRECTIONAL** [X] **CW** [ ] **CCW**

Certified by: *Sharon Corcoro* Date: 9/1/2022 Revision # 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 9/1/2022

Pentair Purchase Order #: 12587654 Pentair Tag #: FMB0913561A01

	Required	Not Required	Description
Space Heaters:	☐	☒	Watts: _____ Voltage: _____
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Tests:	☐	☒	☐ Short commercial, unwitnessed ☐ Short commercial, witnessed ☐ Calibration Test, unwitnessed ☐ Complete initial, unwitnessed ☐ Complete initial, witnessed ☐ Sound test, unwitnessed ☐ Bump Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Reed Critical Test, unwitnessed ☐ IEEE841

Certified by: *Sharon Corcoro* Date: 9/1/2022 Revision #: 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 9/1/2022

Pentair Purchase Order #: 12587654 Pentair Tag #: FMB0913561A01

Features:

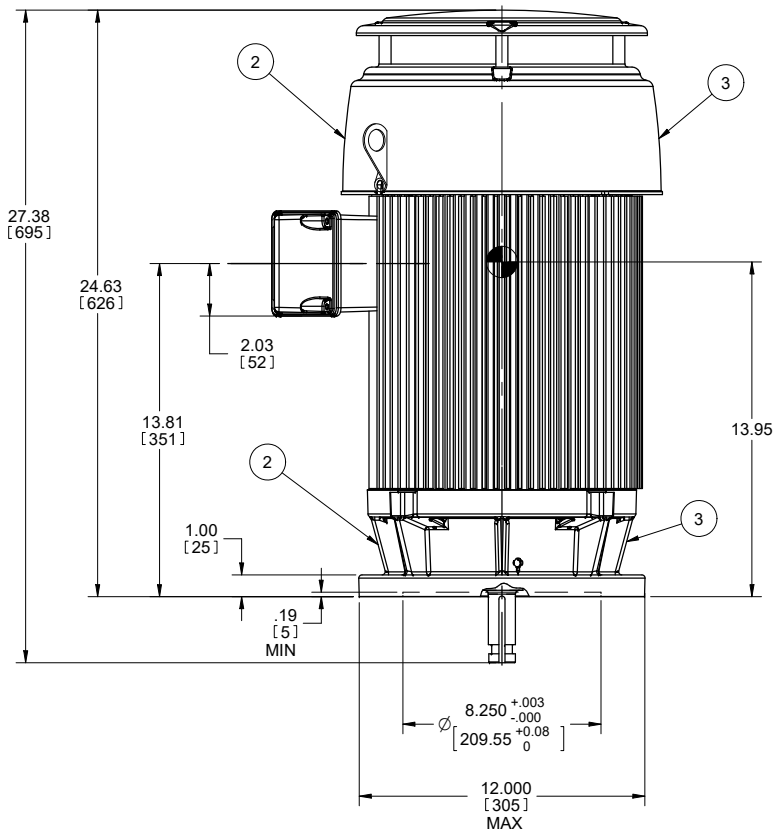
Enclosure ..... TEFC
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
12" Base
Pricebook Thrust Value (lbs).. 3800
Customer Down Thrust (lbs) ... 1
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Shaft Dimensions:~U=1.125 ~ AH/V=2.750
KEYWAY=0.250 ~ ES=1.280
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.0 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 104 LB-FT2

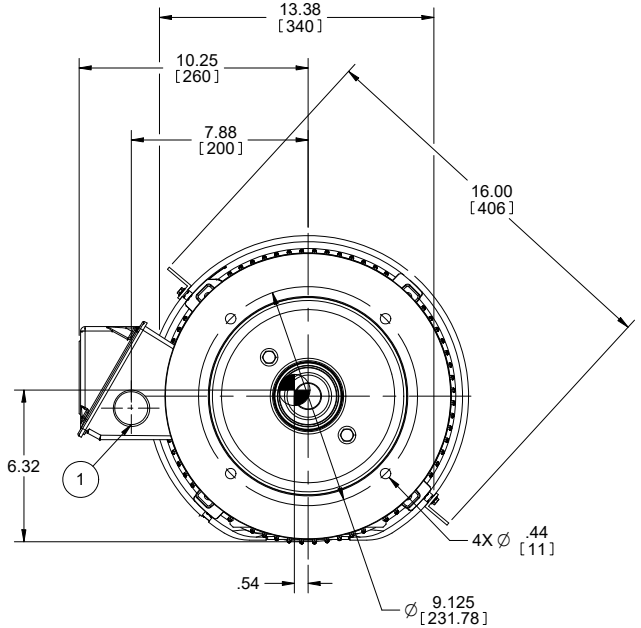
Accessories:

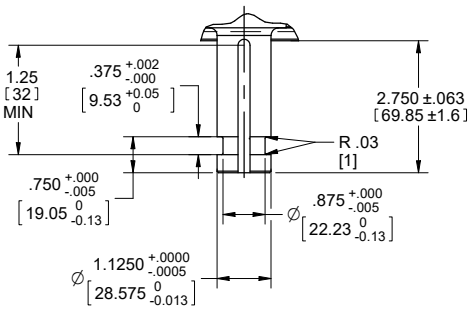
Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913561A01
12587654
LINE 10

Certified by: Sharon Corcoro Date: 9/1/2022 Revision #: 0

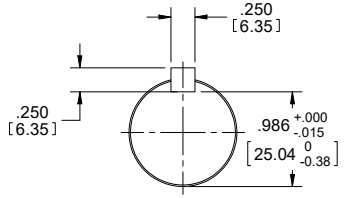
FN015/012020







SHAFT DETAIL



USER INFORMATION
CUSTOMER: PENTAIR FLOW TECHNOLOGIES LLC
CUSTOMER P/N: FMB0913561A01
P.O: 12587654
REF. ORDER #:22701648-100

TOLERANCES	
FACE RUNOUT	.004 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.004 T.I.R.
PERMISSIBLE SHAFT RUNOUT	.002 T.I.R.

NOTES:

1) MAIN BOX FOR MOTOR POWER LEADS, 1.25" CONDUIT CONNECTION.
   BOX VOLUME: 60 CU. IN. [983 CU. CM.]
2) DRAINS: TOP AND BOTTOM GREASE.
3) FILL: TOP AND BOTTOM GREASE.
4) BEARINGS: LOWER - 7310 BEP
   UPPER - 6207-2Z-J/C3
5) TAG: FMB0913561A01
   12587654
   LINE 10
6) ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
7) CONDUIT OPENING MAY BE LOCATED IN STEPS OF 180 DEGREES. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
8) CLASS F INSULATION, S.F.=1.15
9) ⊕ DENOTES CENTER OF GRAVITY

CERTIFIED FOR CONSTRUCTION

RATING	7.5 HP [5.516 KW] 1180 RPM, 460V, 3Ø, 60HZ
ENCLOSURE	TEFC
BEARINGS	SEE NOTE 4
LUBRICATION	SEE NOTES 2 AND 3
ROTATION FACING O.D.E.	CW
NET WEIGHT (±10%)	265 LBS [120 KG]

REVISION DECRIPTION: DUAL
NEW.

FRAME: 254VPH
TYPE: TVI4
TITLE: DIMENSION PRINT
NIDEC MOTOR CORPORATION
ISSUED BY: L. ARROYO
APPROVED BY: M. TREJO
REVISION DATE: 30-AUG-22
DWG NO.: 09-2408-04
REV: -
SHEET NUMBER: 1 OF 1
DWG SIZE: C

NAMEPLATE DATA

CATALOG NUMBER:				NAMEPLATE PART #:	422707-005		
MODEL		FR	254VPH	TYPE	TVI4	ENCL	TEFC
SHAFT END BRG	7310 BEP - QTY 1			OPP END BRG	6207-2Z-J/C3 - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 22701648, Type: SO, Line#: 100)		
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	7.5	RPM	1180	HP		RPM	
VOLTS	460			VOLTS			
FL AMPS	9.2			FL AMPS			
SF AMPS	10.5			SF AMPS			
SF	1.15	DESIGN	B	CODE	F		
NEMA NOM EFFICIENCY	91.0	NOM PF	84.1	KiloWatt	5.60		
GUARANTEED EFFICIENCY	89.5	MAX KVAR		HZ	60		

SF		DESIGN		CODE			
NEMA NOM EFFICIENCY		NOM PF					
GUARANTEED EFFICIENCY		MAX KVAR		HZ			

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460	AMPS	9.7
TORQUE 1	33.40LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	6-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	120-1200	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	FMB0913561A01
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	92.1	Inrush Limit	
Motor Weight (LBS)	265	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	3800	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4	GREASE LUBRICATED	Special Accessory Note 19	
Special Accessory Note 5	RECOMMENDED GREASE	Special Accessory Note 20	
Special Accessory Note 6	EXXON POLYREX-EM	Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	TVI4	254VPH

ORDER NO.	22701648	LINE NO.	100

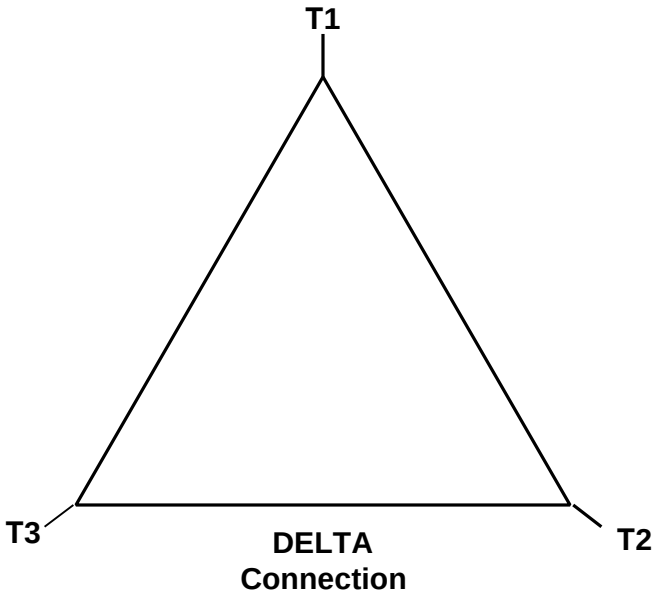
MPI:	42188
HP:	7.5
POLES:	6
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	90.9
FULL	91
3/4	92.1
1/2	91.6
1/4	87.4
POWER FACTOR (%):	
S.F.	84.8
FULL	84.1
3/4	81.5
1/2	74.4
1/4	54.4
NO LOAD	7
LOCKED ROTOR	40.7
AMPS:	
S.F.	10.5
FULL	9.2
3/4	7
1/2	5.2
1/4	3.7
NO LOAD	3
LOCKED ROTOR	52.5
NEMA CODE LETTER	F
NEMA DESIGN LETTER	B
FULL LOAD RPM	1180
NEMA NOMINAL / EFFICIENCY (%)	91
GUARANTEED EFFICIENCY (%)	89.5
MAX KVAR	2
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	30
SOUND PRESSURE (DBA @ 1M)	60
TORQUES:	
BREAKDOWN{% F.L.}	255
LOCKED ROTOR{% F.L.}	174
FULL LOAD{LB-FT}	33.4

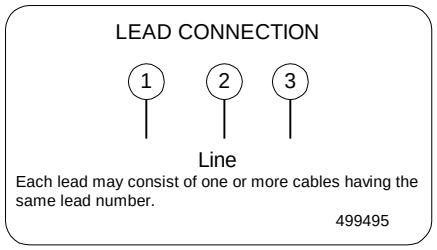
NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

Motor Wiring Diagram





To reverse direction of rotation interchange connections L1 and L2.
Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

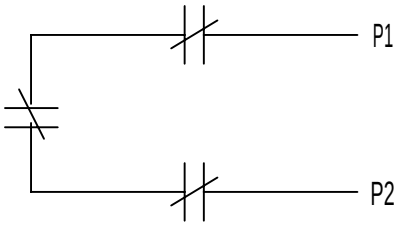
EFFECTIVE: 2/27/96
SUPERCEDES: X736618, 96441, 179879, 284138
Connection Plate: 499495
Connection Decal: 912113

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.

2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



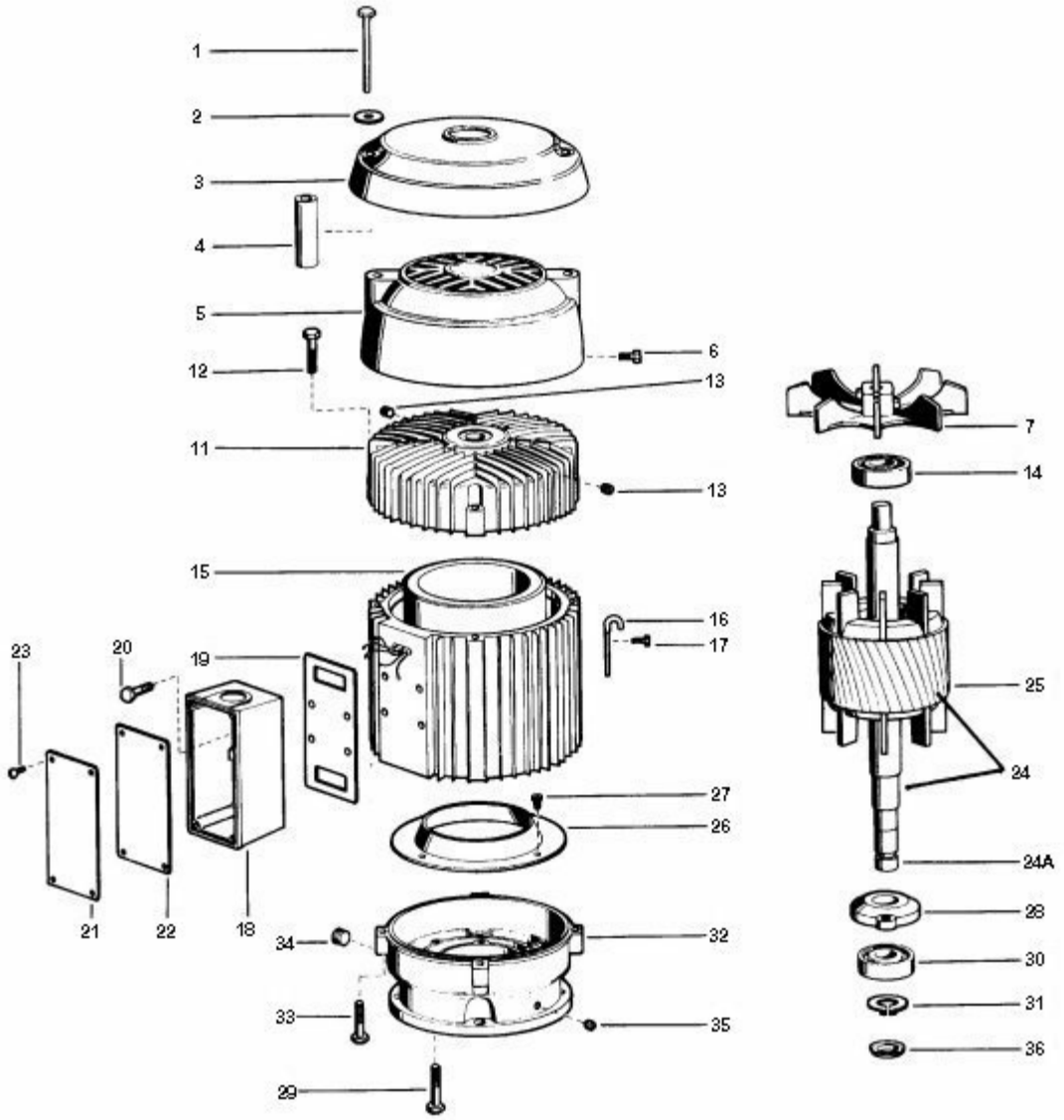
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC STL0211 - UPDATED FORMAT .	SCALE: NONE UNITS: IN TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES / mm ANGLES X°= ±1°	TITLE: CUSTOMER CONNECTION DIAGRAM ISSUED BY: R. KING APPROVED BY: C. CADE CODE: DWG NO.: 0834066	NIDEC MOTOR CORPORATION REVISION DATE: 24-FEB-11 REV: G SHEET NUMBER: 1 OF 1 DWG SIZE: A
MATERIAL: --- MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED			

RENEWAL PARTS

FRAMES 182 THRU 365 - OPEN DRIPPROOF, TOTALLY ENCLOSED AND EXPLOSION PROOF
TYPES: AV, AV9, AVE, AVI, LV, LV4, LV9, LVC4, LVC9, LVCS4, LVCS9, LVE, LVE4, LVE9, LVI4, LVS4, LVS9, NVC4, NVC9, NVCE, NVCS, NVE, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE9, TVCI, TVCI4, TVCI9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVI, TVI4, TVI9, TVS, TVS4, TVS9
SOLIDSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	3	Screw (Used on 213 thru 256, type AV & TV)
2	3	Washer (Canopy Cap) (Used on 254 thru 256, type AV & TV)
3	1	Canopy Cap (Not used on frames 182 - 184 types AV, TV, & LV, frames 213 - 215 type LV, frames 284-286 types TV & LV
4	3	Spacer (Used on frames 213 thru 256, type AV & TV)
5	1	Fan Cover
6	4	Screw (Qty. 8 Hex Nut on frame 280 & up)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 155 & 156

FRAMES 182 THRU 365 - OPEN DRIPPROOF, TOTALLY ENCLOSED AND EXPLOSION PROOF
TYPES: AV, AV9, AVE, AVI, LV, LV4, LV9, LVC4, LVC9, LVCS4, LVCS9, LVE, LVE4, LVE9, LVI4, LVS4, LVS9, NVC4, NVC9, NVCE, NVCS, NVE, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE9, TVCI, TVCI4, TVCI9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVI, TVI4, TVI9, TVS, TVS4, TVS9
SOLIDSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
7	1	Fan
8	2	Screw (Fan) (Not Illustrated)
9	2	Washer (Fan) (Not Illustrated) (Used on frames 182 thru 256, types AV, TV & LV)
10	2	Square Nut (Fan) (Not Illustrated) (Used on frames 182 thru 256, types AV, TV & LV)
11	1	Bracket (Upper)
12	4	Screw (Used on frames 182-184, types AV, TV, & LV, frames 213-256 types AV & TV)
13	1	Pipe Plug (Not used on frames 324 thru 326)
14	1	Bearing (Upper) (Refer to section 775)
	1	Bearing Cap (Upper) (Not Illustrated) (Not used on frames 182 thru 256, types AV & TV)
	3	Screw (Not used on frames 182 thru 256, types AV & TV)
15	1	Wound Stator Assembly
16	2	Lifting Hook (Eyebolt on some units)
17	4	Screw (Lifting Hook) (Used on frames 182-184, types AV, TV, & LV, frames 213-256 types AV & TV)
18	1	Outlet Box Base
19	4	Gasket (Used on frames 180 thru 250, type AV & TV, frames 280 thru 360 type TV)
20	1	Screw (Outlet Box Base)
21	1	Outlet Box Cover
22	1	Gasket (Not used on type LV)
23	4	Screen (Outlet Box Base)
24	1	Rotor Assembly (Includes items 24A & 25)
24A	1	Shaft
25	1	Rotor Core
26	1	Air Deflector (Not used on frames 180 thru 250, type LV, frames 280 thru 320 type AV)

ITEM NO.	QTY	NAME OF PART
27	1	Screw (Air Deflector) (Not used on frames 180 thru 250, type LV, frames 280 thru 320 type AV)
28	1	Bearing Cap (Lower) (Qty. 2 on frame 180 type LV)
29	2	Screw (Bearing Cap (Qty. 3 on TV & LV)
30	1	Bearing (Lower) (Refer to section 775)
31	1	Snap Ring (Not used on frames 180 thru 210, type LV)
32	1	Unimount Bracket
33	4	Screw (Qty. 8 on frame 280 and up)
34	1	Pipe Plug (Fill) (Not used on frame 280 thru 360, type TV & LV)
35	1	Pipe Plug (Drain)
36	1	Water Deflector (Not used on frame 180, type LV)
	1	Pipe Nipple (Fill) (Not Illustrated) (Not used on frame 180, type AV, TV & LV)
	1	Pipe Coupling (Fill) (Not Illustrated) (Not used on frame 180, type AV, TV & LV)
	1	Grease Fitting (Qty. 2 on frame 280 thru 360) (Not used on frame 180)
	1	Fan Grill (Used on frames 210 thru 250, type LV, frame 280, type TV & LV)
	4	Stud (Qty. 8 on frame 320 & up) (Not Illustrated) (Not used on frame 180; frame 210 & 250 types AV & TV)
	8	Hex Nut (Not Illustrated) (Not used on frame 180; frame 210 & 250 types AV & TV)
	1	Pipe Nipple, drain (Not Illustrated) (Not used on frames 180 thru 210, type AV, TV & LV)
	1	Pipe Cap, Drain (Not Illustrated) (Not used on frames 180 thru 210, type AV, TV & LV)
	1	Woodruff Key (Fan) (Not Illustrated) (Used on frames 320 thru 360, types TV & LV)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 155 & 156

TYPICAL REED CRITICAL FREQUENCY DATA

Note: Motor RCF Test Data can be provided at time of motor shipment through special test. Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA
CATALOG NO: NA

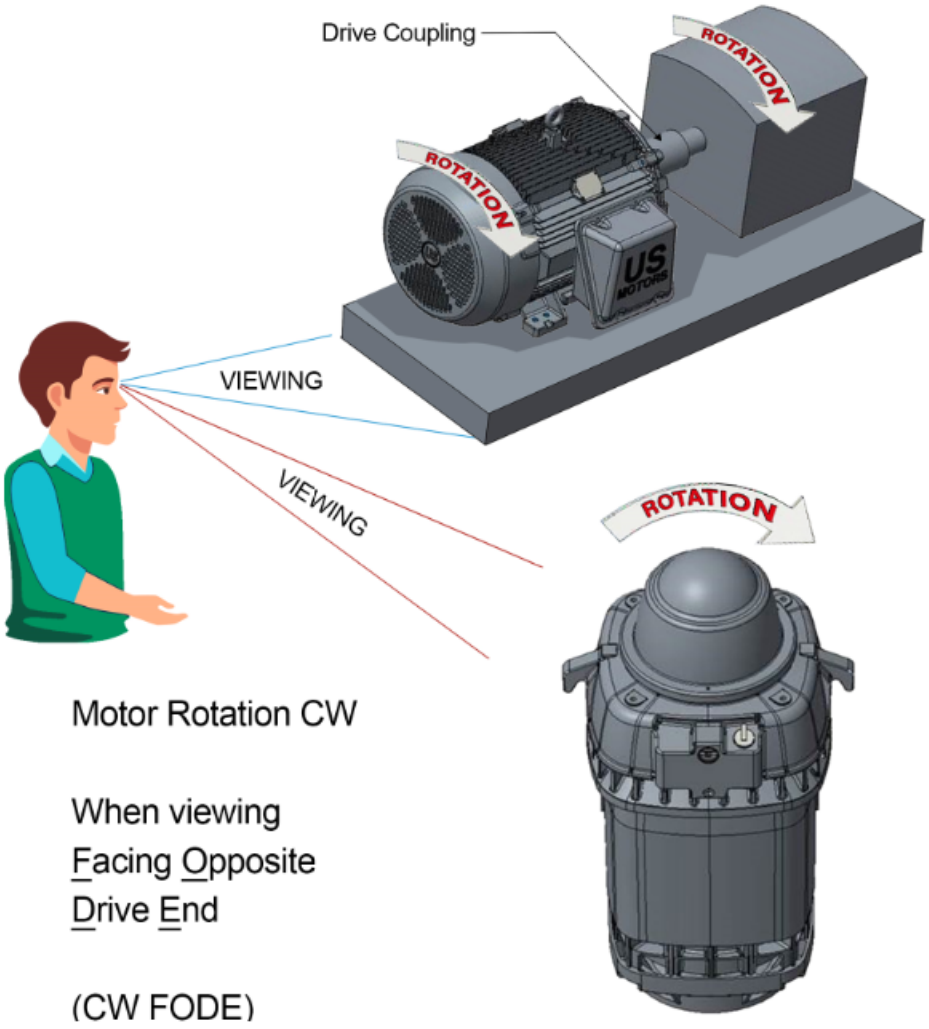
Frame: 254VPH Type: TVI4

REED CRITICAL FREQUENCY:	77	HZ
CENTER OF GRAVITY:	11	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0017	IN
UNIT WEIGHT:	265	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	20%	
DATE:	9/1/2022	

DIRECTION OF ROTATION

This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with CW (clockwise) rotation as shown below. CCW rotation is available upon request.



Motor Rotation CW

When viewing
Facing Opposite
Drive End

(CW FODE)

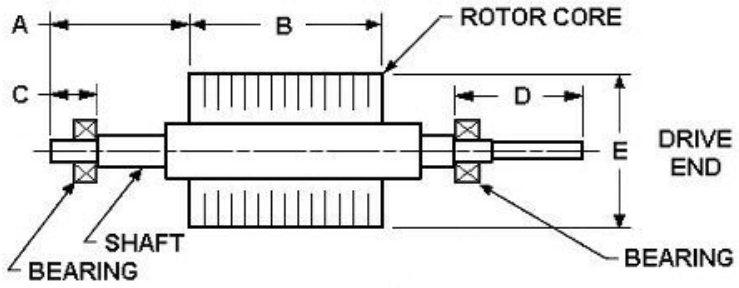
NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-288

LATERAL CRITICAL SPEED ANALYSIS DATA

ORDER NO: 22701648-100

FRAME SIZE 254VPH-65



ROTOR DATA (dimensions in inches)

A - ROTOR CORE LOCATION	B - ROTOR CORE LENGTH	C - OPPOSITE DRIVE END BRG.	D - DRIVE END BRG. LOCATION
7.438	5.50	3.50	5.500
E - ROTOR CORE DIAMETER	**SHAFT LENGTH END TO END**	**ROTOR CORE WEIGHT (lbs)**	**ROTOR ASSEMBLY WEIGHT (lbs)**
7.466	23.52	57	90
ROTOR INERTIA POLAR (lb-ft^2)	**ROTOR INERTIA TRANSVERSE (lb-ft^2)**		**SHAFT/ROTOR ASM BALANCE**
3.06	1.53		ISO 1940 G 2.5

BEARING DATA

DRIVE END BEARING		OPPOSITE END BEARING	
NUMBER	**STIFFNESS (lb/in)**	**NUMBER**	**STIFFNESS (lb/in)**
7310	0.433 X 10^6	6207	0.414 X 10^6

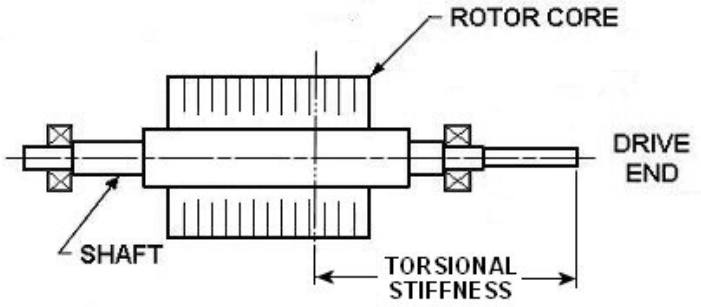
SHAFT DATA

DRAWING NO.	MATERIAL	DENSITY	YIELD
390433	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30.0 x10^6 psi	12.0 x 10^6 psi	

TORSIONAL ANALYSIS DATA

ORDER NO: 22701648-100

FRAME SIZE 254VPH-65



SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
390433	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30 x10^6 psi	12 x 10^6 psi	

MOMENT OF INERTIA - ROTOR ASSEMBLY:

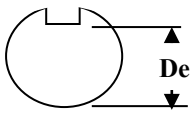
WR^2 = 3.06 **LB-FT^2**

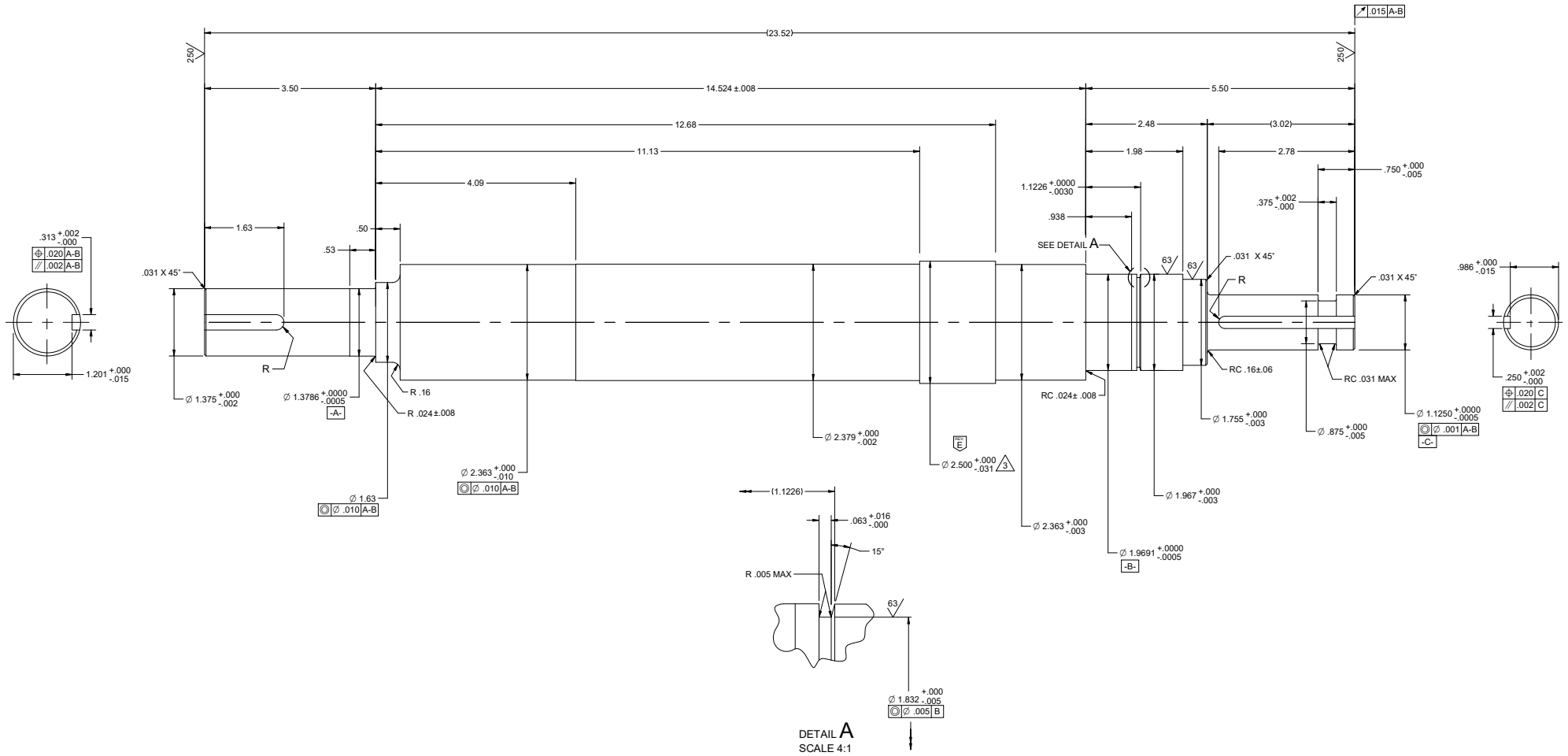
SHAFT TORSIONAL STIFFNESS:

3.7276 **X 10^5 LB-IN/RADIAN**

Torsional stiffness is the spring rate or constant which allows a user to determine the amount of twist or angular deflection in a shaft based on the amount of torque applied. The portion of the shaft for which the shaft stiffness has been calculated from 1/3 the length of the rotor core to the end of the drive end of the shaft (shafts with an annular keyways are measured from inboard side of the ring groove). It is the users responsibility to correct for coupling mounting effects.

SHAFT EXTENSION
De - EFFECTIVE DIAMETER WITH KEYWAY 0.986 **INCHES**





DETAIL A
SCALE 4:1

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIAMETERS TO BE: Ø .002 A-B
2. NO AXIAL RELATIONSHIP BETWEEN KEYWAYS

3 ROUGH STOCK PERMISSIBLE MUST BE SCALE FREE

ITEMS AND MATERIALS SPECIFIED HEREIN MUST COMPLY WITH THE EUROPEAN REDUCTION OF HAZARDOUS SUBSTANCES (RoHS 2) (DIRECTIVE 2011/65/EU, REGULATIONS (EC) NO. 1907/2006 ("REACH") AS OF 1 JUNE 2007 AND ALL SUBSEQUENT UPDATES. PLEASE REFER TO THE OFFICIAL EU DOCUMENTS FOR COMPLETE DEFINITION, RESTRICTIONS, AND LIMITS FOR EACH SUBSTANCE.

NIDEC CONFIDENTIAL
NIDEC MOTOR CORPORATION 07-APR-16

REVISION DESCRIPTION FOR: 15703295
DIAMETER 2.500 +.000/-.031 WAS 2.531 +.000/-.003

MATERIAL: HR STEEL, AISI 1045

SCALE: 1:1
UNITS: INCHES

TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)

INCHES	mm
.XX = ± .03	
.XXX = ± .015	

ANGLES X° = ±1°

CSTC NO.	PART NO.	FRAME	TYPE
- - - -	390433-000	254VP	ENCL

TITLE: SHAFT, ROTOR

NIDEC MOTOR CORPORATION

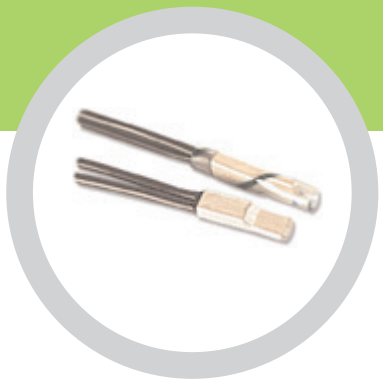
ISSUED BY	APPROVED BY	REVISION DATE
G. MARTINEZ	N. SIFUENTES	10-FEB-17

CODE	DWG NO.	REV	SHEET NUMBER	DWG SIZE
	0390433	E	1 OF 1	D

NMCD (OCT-2013)

SOLIDEDGE

Sensata Technologies



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performace

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation

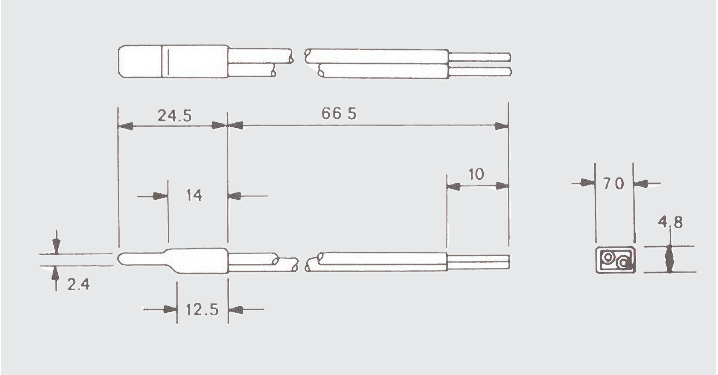
The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00



9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cmf)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5℃ in a step from 60 to 150℃.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

X : Contact material combination

Code	Stationaly contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

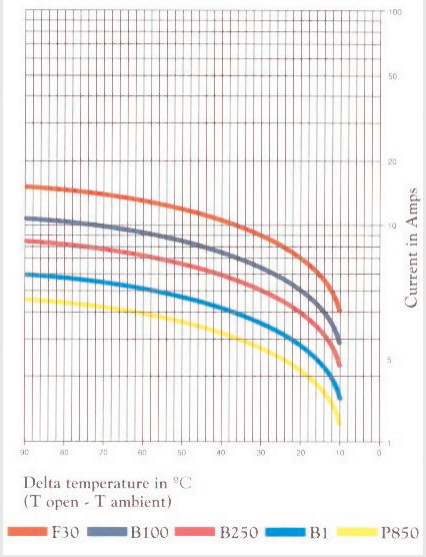
Type "S" is set up for Cadmium-free contact

Example :
9700K01-215
Bimetal of 30ohms/cmf,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125℃-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

9700 : Device Identification

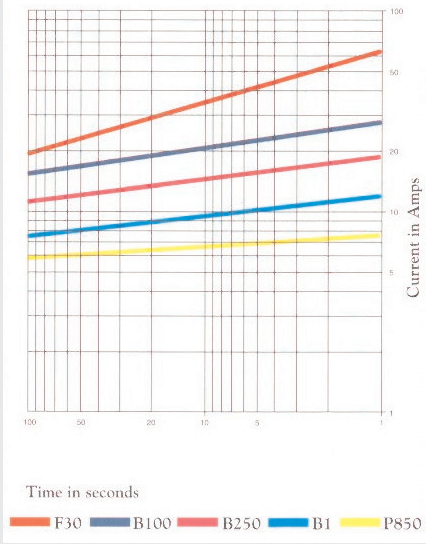
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

Sensata
Technologies

TECHNICAL / SALES SUPPORT

Holland
Phone +31 546 879560 Fax +31 546 879204
Italy
Phone +39 039 6568310 Fax +39 039 6568316

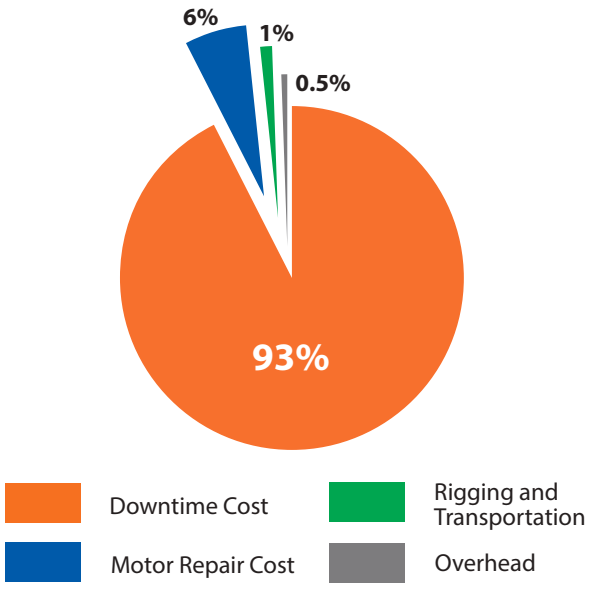
Internet: *www.sensata.com*

Email: *info-cpe@list.sensata.com*

VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.



Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

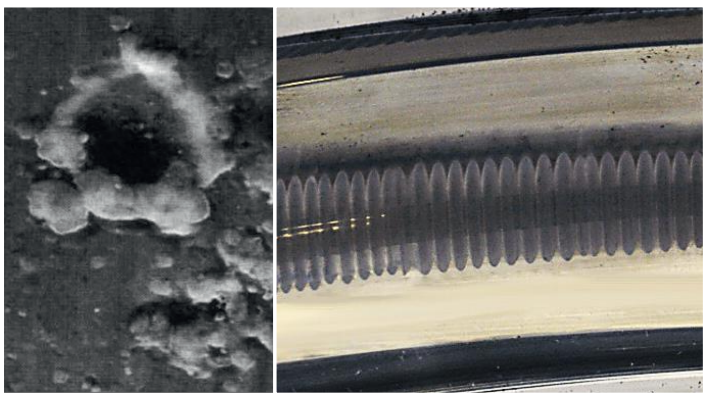
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options

Standard Mounting Clamps (-1)
Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers

Split Ring (-1A4)
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor

Bolt Through Mounting (-3FH)
Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes

Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included

Press Fit Mounting (-0A6)
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available

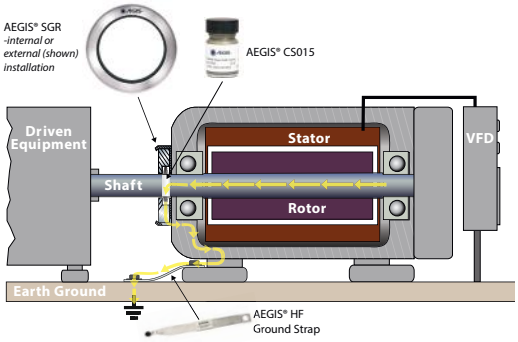
uKIT with Universal Mounting Bracket
Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy

AEGIS® PRO Series
AEGIS® PROSL, PROSLR, PROMAX, PROMR

AEGIS® Shaft Voltage Tester™
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture

Accessories
HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

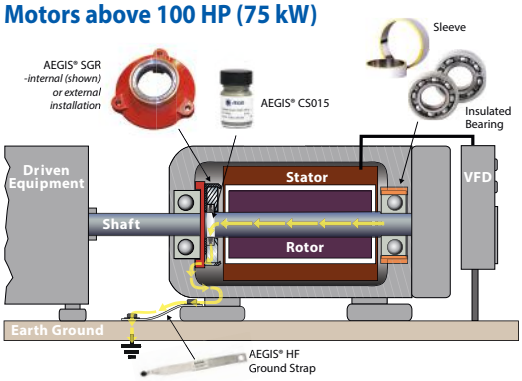
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:
LV Motors up to 500HP: AEGIS® SGR
LV Motors over 500HP: AEGIS® PRO Series
MV Motors: AEGIS® PRO Series

Electro Static Technology™
An ITW Company

www.est-aegis.com

Electro Static Technology
31 Winterbrook Road
Mechanic Falls, ME 04256 USA
Tel: (866) 738-1857
Tel: (207) 998-5140
E-Mail: sales@est-aegis.com

Formular 105-8m US 02/21

Standard
Paint
Specification

For

EM Gray

NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México

CONTENTS

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." for its superior rust inhibitive qualities and durability. The paint also has excellent resistance to various chemicals. This specification covers surface preparation and application of protective coating on motors built in the Apodaca, Nuevo Leon facility.

2.0 Unpainted Surfaces

The following surfaces will not require protective coating:

Anodized Aluminum	Grounding Pads
Brass	Machined Surfaces
Bronze	Motor Leads
Chromium Plated Metals	Porcelain Enamel Finishes
Copper	Rubber
Galvanized Steel	Stainless Steel
Glass	Vacuum Pressure Impregnated Parts

3.0 Surface Preparation (Cast Iron & Steel)

A. The foundries are required to snag, remove all sand and slag from castings. This is to be immediately followed by primer paint to insure 100% coverage. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

C. All parts are to be cleaned prior to priming or finish painting as follows:

1. If parts are dirty – wash and rise in parts washer.
2. If parts are dusty – sandblast
3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

5.0 Motor Assembly

After assembling the motor, there may be surfaces that require priming or touch-up prior to final painting. These surfaces are bracket-to-frame register fits, outlet box pads, etc.
If surfaces are oily, wash with clean paint thinner using a clean rag to prevent contamination of other surfaces.

6.0 General

A. Finished coating shall not be applied to wet or damp surfaces.
B. All coatings shall be applied in a conscientious manner and in accordance with the written application instructions of the coating manufacturer.
C. Re-application time between coats shall be in accordance with the coating manufacturer's recommendation corresponding to the conditions of temperature and humidity.
D. Hardware trim and other items not requiring coating may be removed as required for proper application of coatings. Such items shall be replaced after completion of work.
E. The dry film thickness of each coat, and of the entire system, shall follow the coating manufacturer's recommendation and this specification. The number of coats specified shall be a minimum number of coats to achieve the specified film thickness.
F. Coverage rates, as calculated by the coating manufacturer, shall be considered as the maximum allowable.
G. All spraying equipment shall be maintained in good working order, with daily inspection, and shall be in conformity with the coating manufacturer's most recent application specification.

7.0 Finish Top Coating

All motor products must be clean and free of any dirt, oil or grease on the primed surface prior to finish painting. Except where otherwise specified, thinners shall not be used. Motors will be painted with one coat unless otherwise noted. Film thickness: 2 to 4 mils.

8.0 Final Finish Inspection

Visual inspection of completed work shall be performed on the finished motor by the Quality Assurance Department. The final surface finish is to be in accordance with industry standards for comparable equipment. Any surfaces found in violation of this specification will be rejected and will require rework. Acceptance or rejection of final finish paint is the sole responsibility of the Quality Assurance Department.

9.0 Material Identification

A. Standard Primer: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III "STORAGE", item 4** for instructions.

1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila®† P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

2. Grease Lubricated Bearings

A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠WARNING

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disaasembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠WARNING

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.

B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replensihment Quantities & Lubrication Intervals

Bearing Number		Grease Replensihment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$G = 0.11 \times D \times B$

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Width of bearing in inches

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof		Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3
Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
	449 thru 5811	1801-3600	-15°C tru 40°C (104°F)	32	Synthetic Only
		1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office	

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		Synthetic Only
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4
Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	**ISO VG 32**		**ISO VG 68**		**ISO VG 150**	
	Viscosity: 130-165 SSU @ 100F		**Viscosity: 284-347 SSU @100F**		**Viscosity: 620-765 SSU @ 100F**	
	Mineral Base Oil	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV		
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120^* \text{ Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.

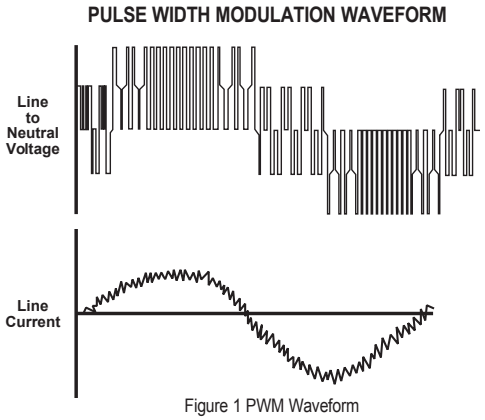


Figure 1 PWM Waveform

What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction
- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grouding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O3. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE® insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE® insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE® insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE® insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Motor / Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD.
(consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA®† 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors
All U.S. MOTORS® brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA®† Application Guide for AC Adjustable Speed Drive Systems: http://www.nema.org/stds/acadjustable.cfm#download

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA®† MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA®† frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA®† frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA®† Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA®† MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA®† frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.
- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	127 ft	400 ft	218 ft
6 Khz	90 ft	307 ft	154 ft
9 Khz	73 ft	251 ft	126 ft
12 Khz	64 ft	217 ft	109 ft
15 Khz	57 ft	194 ft	98 ft
20 Khz	49 ft	168 ft	85 ft

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficienct vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Tag #: WSP-4221/WSP-4222/SCP-4231
Service: SECONDARY SLUDGE PUMP STATION NO. 2 WAS PUMPS

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
   - Anchor bolts, nuts and washers
   - Gauges, valves and miscellaneous fittings and adapters.
   - Connecting piping and/or supports
   - Maintenance lubrication piping and related equipment.
   - System control apparatus
   - Maintenance tools and/or storage boxes.
   - Equipment tags
   - Installation or field performance testing.
2. The following information is required by Pentair Flow Technologies prior to or at release of the pumps to production.
   - Verification of rotation and discharge position.
3. The following items are shipped loose for installation in the field:
   - Drivers and couplings.

Taunton Wastewater Treatment Facility
Taunton, MA

Supplier:	Hayes Pump Inc. 66 Old Power Mill Road West Concord, MA 01742
Manufacturer:	
Pump	Fairbanks Nijhuis 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000 Fax: (913) 371-2272
Project Number:	0913562
Sales Order Number:	53144827
Tag:	WSP-4221/WSP-4222/SCP-4231
Service:	Secondary Sludge Pump Station No. 2 WAS Pumps
Quantity:	3
Pump Size & Model:	4” B5442C
Coupling:	Falk Corporation 3001 West Canal St. Milwaukee, WI 53208-4222 (414) 342-3131 Fax: (414) 937-4359
Motor:	U S Electrical Motors P. O. Box 3946 St. Louis, MO 63136 (314) 553-2000

Pump

Coupling

Driver

- 7.5 HP, 1200 RPM, 3/60/460V, 254VHP Frame, US Electric Motor
- Variable Speed Application
- Standard Double Mechanical Seal with Stainless Steel Sleeve
- Stainless Steel Impeller Wear Ring; 300-350 BHN
- Stainless Steel Casing Wear Ring; 300-350 BHN
- Stainless Steel Packing Sleeve; 300-350 BHN
- Falk Coupling
- Certified Non-Witness Hydro Testing
- Certified Non-Witness Performance Testing
- Curve Approval
- Dynamically Balanced Cast Iron Impeller
- 4” x 4” Suction Elbow

1. Refer also to clarifications that may be included on the vendor submittal.

4" B5442 Submittal Curve

PENTAIR FAIRBANKS NIJHUIS™

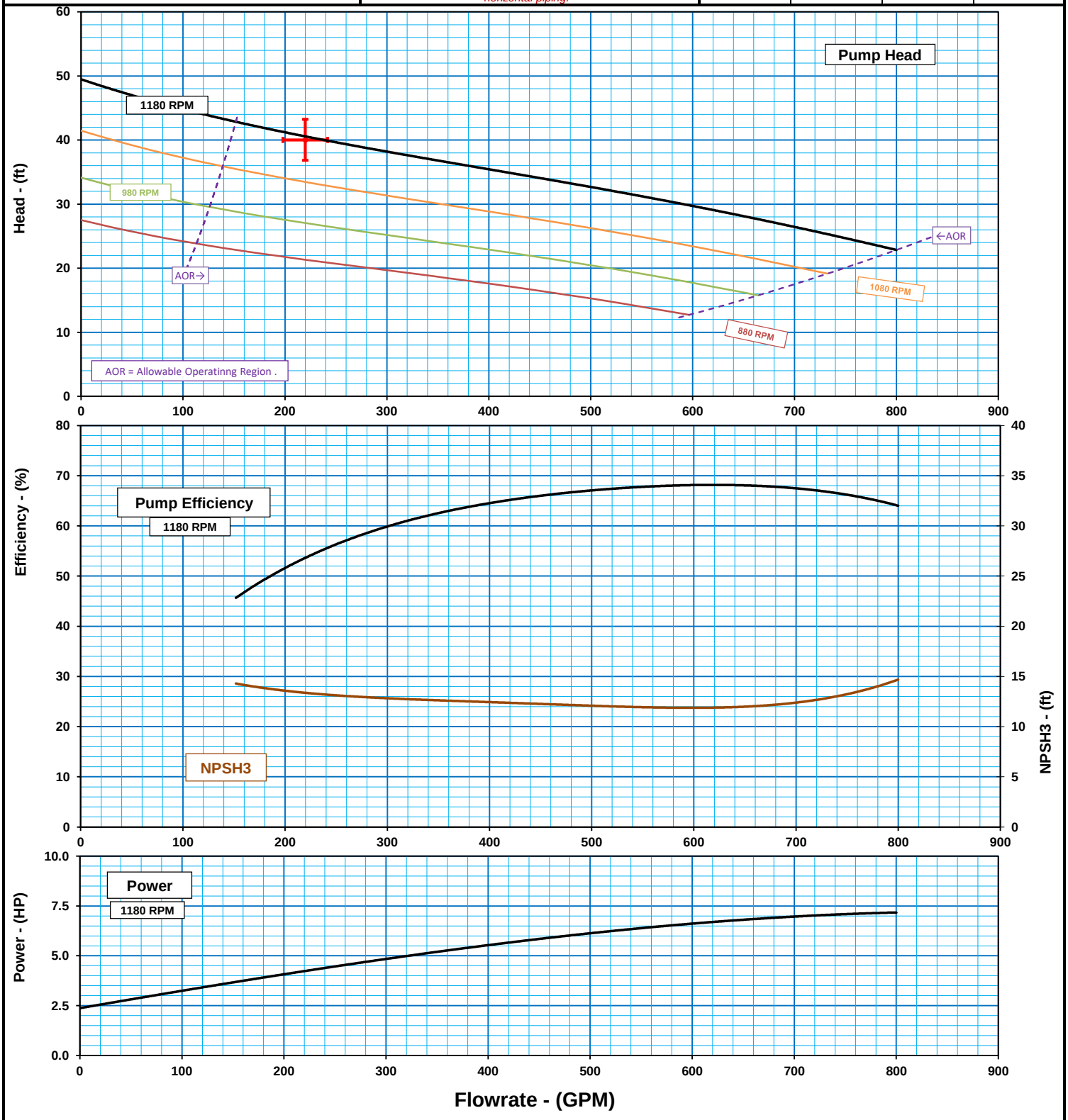
CURVE NUMBER:	0913562C
REV.	1

THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED, **PER ANSI / HI 14.6 - 2022 paragraph 14.6.3.4.1.**

SPEED	DRIVER	DIAMETER	SPHERE
1180 RPM	7.5 HP	9.75"	3.0"
NO. VANE	**IMPELLER**	**DATE**	**BY**
2	T4B1A	10/27/2022	MD

Per ANSI/HI: "For many common solids-bearing liquids, a velocity of about 1,0 m/s (3.0 ft/s) is required to prevent sedimentation in horizontal piping."

GUARANTEED VALUES			
FLOW	HEAD	PUMP EFF	HP
220	40	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----



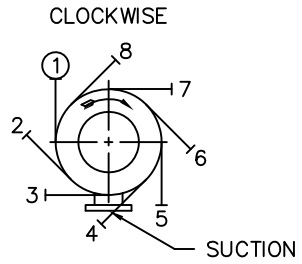
⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

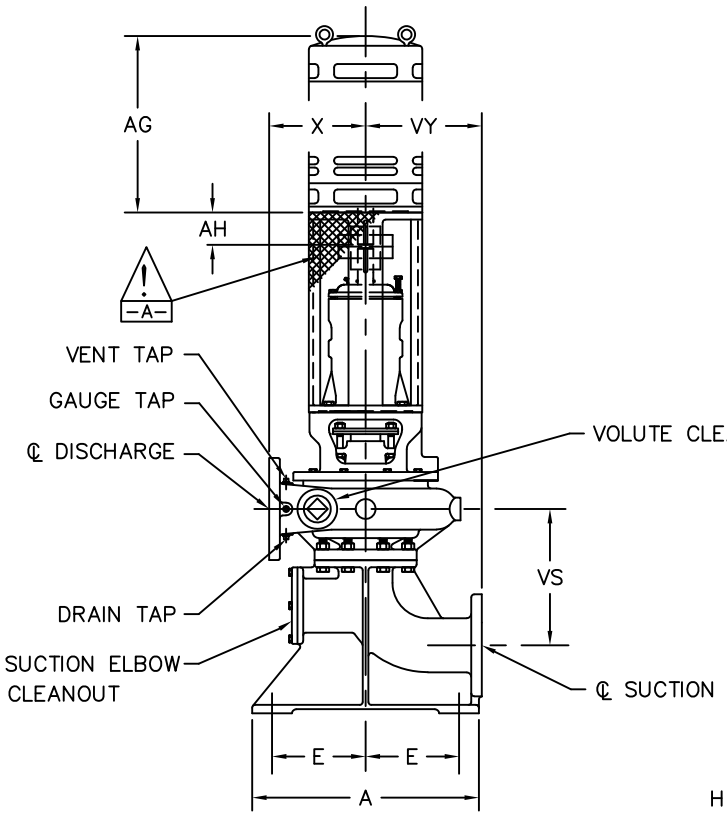
–A– SUPPLIED BY FMPC –B– SUPPLIED BY OTHERS

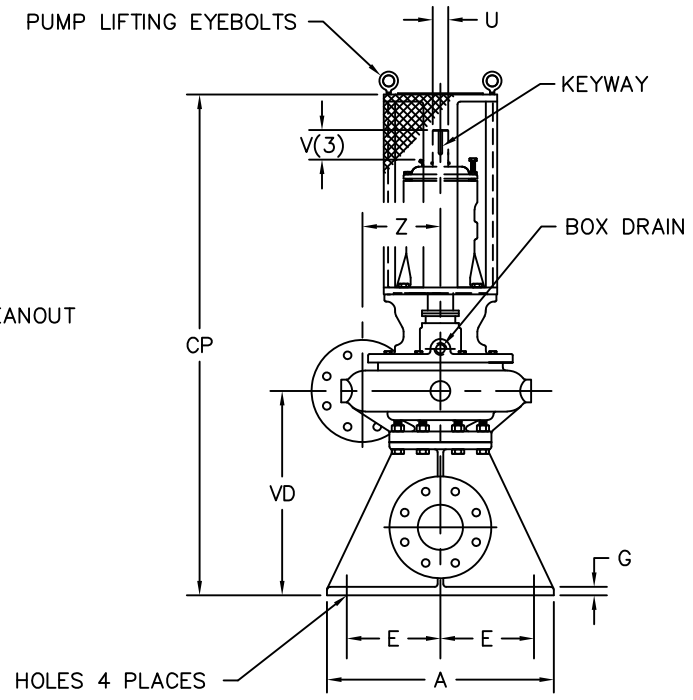
MOTOR DIMENSIONS	
AG	AH
24.63	2.75

AVAILABLE DISCHARGE POSITIONS



POSITIONS #1 OR #9 ARE STANDARD WHEN VIEWED FROM THE DRIVER END UNLESS OTHERWISE SPECIFIED. CLOCKWISE ROTATION DISCHARGE POSITION #1 SHOWN.





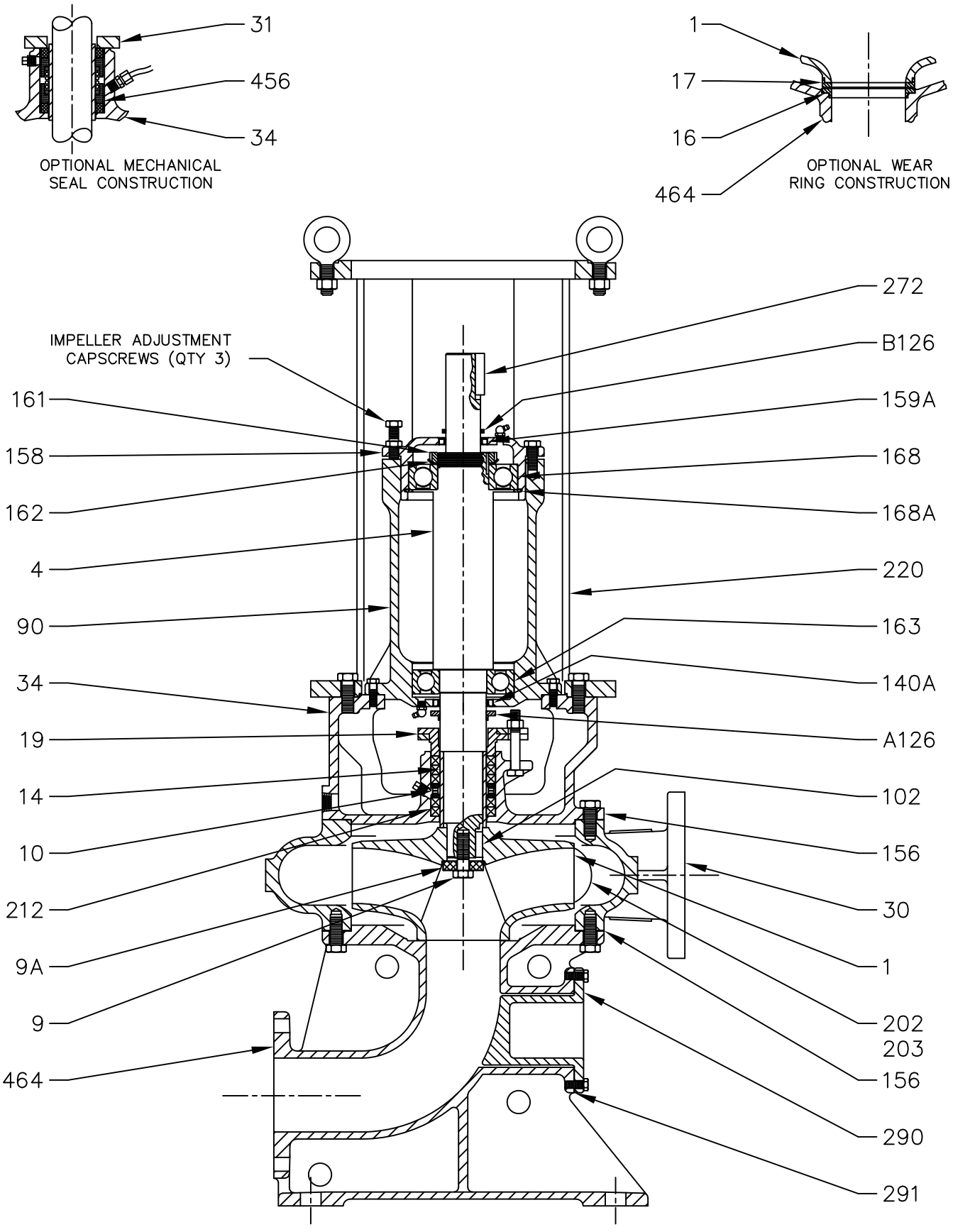
PUMP	FRAME	SUCT	DISCH	A	E	G	H	U	V	X	Z	CP		VD	VS	VY	KEYWAY
												AH=2 3/4	AH=4 1/4				
4" B5442C	T20	4	4	20	8 1/4	3/4	1 1/8	1 3/8	2 1/4	10	7 7/8	44 1/8	45 7/8	17 7/8	11 7/8	10 1/4	5/16 X 5/32 X 2

NOTES:
(1) ALL FLANGES ARE 125# ANSI DRILLING UNLESS NOTED.
(2) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED.
(3) DIMENSIONS REFLECT USABLE SHAFT LENGTH.
(4) 5400'S AND 5400K'S ARE DIMENSIONALLY IDENTICAL.
(5) BASES ARE DESIGNED TO HAVE FULL CONTACT WITH GROUT OR A SOLE PLATE GROUTED IN PLACE.
(6) VOLUTE DRAINS ARE NOT AVAILABLE ON 5441'S.
(7) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VARY DUE TO NORMAL MANUFACTURING TOLERANCES.

CUSTOMER: HAYES PUMP INC.				P.O. NO.: 133369		PENTAIR FAIRBANKS NIJHUIS
JOB NAME: TAUNTON WASTEWATER TREATMENT FACILITY			TAG NAME: WSP–4221/WSP–4222/SPC–4231			SETTING PLAN B5442C
PUMP SIZE AND MODEL: 4" B5442C		GPM: 220	TDH: 21	RPM: 1200	ROTATION: CW	DISCH POS: 1
MOTOR: NIDEC	HP: 7.5	FRAME: 254VPH	PHASE: 3	HERTZ: 60	VOLTS: 460	ENCLOSURE: TEFC
CERTIFIED FOR: PROJECT: 0913562			CERTIFIED BY: JEA		DATE: 8/15/22	DWG NO: 0913562SP (181) REV NO: 0

Item	Description	Material	Specification[1]
1	Impeller	Cast Iron	A48 Class 30
4	Shaft	Steel	AISI 4140 or AISI 1144[2]
9	Bolt, Impeller	Steel	SAE Bolt Steel
9A	Washer, Impeller	Steel	A108 Grade 12L14
14	Sleeve, Shaft	Stainless Steel	A743 Gr. CA40 300-350 BHN
15	Base	Cast Iron	A48 Class 30
16	Wear Ring, Fronthead	Stainless Steel	A743 Gr. CA40 300-350 BHN
17	Wear Ring, Impeller	Stainless Steel	A743 Gr. CA40 300-350 BHN
30	Volute	Cast Iron	A48 Class 30
31	Solid Gland	Steel	A283 Gr. 12-D
34	Backhead	Cast Iron	A48 Class 30
44	Suction Elbow	Cast Iron	A48 Class 30
90	Frame	Cast Iron	A48 Class 30
A126	Deflector, Inner	Rubber	Commercial
B126	Deflector, Outer	Rubber	Commercial
102	Key, Impeller	Steel	A108 GR 1018
140A	Seal, Outer Grease	Steel & Rubber	Commercial
154	Gasket, Elbow	Tag Board	F104
156	Gasket, Volute	Tag Board	D1170-G3111
158	Housing, Thrust Bearing	Cast Iron	A48 Class 30
158A	Lip Seal	Steel & Rubber	Commercial
159A	Seal, Outer Grease	Steel & Rubber	Commercial
161	Locknut, Bearing	Steel	SAE Bolt Steel
162	Lockwasher, Bearing	Steel	AISI 1215
163	Bearing, Radial	Steel	Commercial
168	Bearing, Thrust	Steel	Commercial
168A	Snap Ring, Bearing	Steel	Commercial
202	Cover, Volute Cleanout	Cast Iron	A48 Class 30
203	Gasket, Cleanout	Rubber	Commercial
220	High Ring Base	Cast Iron/Steel	A48 Class 30 /A36 & A53
272	Key, Coupling	Steel	A108 Grade 1018
290	Cover, Suction Hand hole	Cast Iron	A48 Class 30
291	Gasket, Handhole	Rubber	Commercial
456	Mechanical Seal	Commercial	Commercial

[1] All material specifications are ASTM unless otherwise noted and are or description of chemistry only.
[2] Manufacturer's option.



ASSEMBLY WITH COMBINATION BASE ELBOW B5442C T20 FRAME

PENTAIR FAIRBANKS NIJHUIS

DWG NO 0913562AP REV NO 0

Pump[3]

Frame Size	T20
Pump Size	4
Suction Size, Standard	4
Nominal Wear Ring Clearance	0.020
Impeller Fastener	
Size	1/2-13
Tightening Torque, lb.-ft.	80
Impeller	
Weight, lb.	41.2
Inlet Area, sq. In.	26.22
WK^2 Lb.-$Ft.^2$	2.8
Sphere Size, Maximum	3
Shaft Diameter:	
at Impeller	1 1/4
at Sleeve	1 1/2
at Thrust Bearing	1.969
at Radial Bearing	1.969
Between Bearings	2 3/8
at Coupling	1 3/8
Keyway at Coupling	5/16 X 5/32
Torsional Shaft Stiffness, lbs./rad.	$3.7X10^5$
Center to Center of Bearings	8 3/4
Thrust Bearing Number	6310
Radial Bearing Number	6310
Sealing Box:	
Type	Double
Recommended Flush Water	
Pressure, PSI (above operating pressure)	1-10
Flow, GPM	1/2-1
Sleeve OD	1 7/8
Box ID	2 5/8
Box Depth	2 7/8
Box Inlet Tap Size, NPT	1/4
Box Outlet Tap Size, NPT	1/4
Backhead Drain Tap Size, NPT	3/4
Volute Cleanout Diameter	2 7/8
Suction Elbow Cleanout Diameter	4
Vent/Priming Tap Size, NPT	1/4
Gauge Tap Size	
Suction, NPT	1/2
Discharge, NPT	1/2
Hydrostatic Test Pressure, Maximum, PSI	90
Casing Working Pressure, Maximum, PSI	60
Nominal Casing Thickness	3/8
Operating Temperature, °F	150
Anchor Bolt Size Recommended	7/8
Minimum Diameter Opening to Install Pump	34
Shipping Weight, Basic Pump, lb.	490

[3] All dimensions are in inches unless otherwise noted.

Fairbanks Nijhuis recommends a superior quality, NLGI No. 2, multipurpose, lithium complex grease for all pump rolling element bearing applications that require grease lubrication. The grease characteristics should include good high temperature performance, extreme pressure properties, water resistance, excellent oxidation stability, good rust protection and resistance to chemical breakdown. Fairbanks Nijhuis does not recommend grease with molybdenum disulfide (moly) additives. In addition to the characteristics listed above, the grease should meet the following specification.

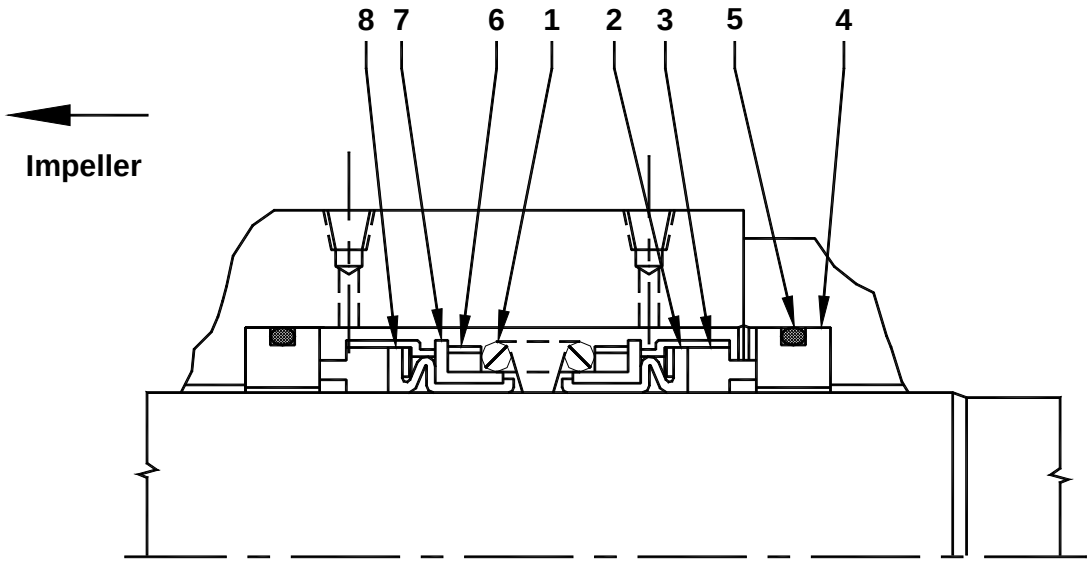
Specifications

Consistency: NLGI No. 2
Dropping Point ASTM D2265 >450° F
Base fluid viscosity
SUS @ 100° F 700 to 1200
SUS @ 212° F 70 to 100
Rust Prevention ASTM 1743 Pass
Water Washout ASTM 1264 <4% @ 175° F
Four Ball EP Test ASTM D2596>40kg load wear
>250kg weld point

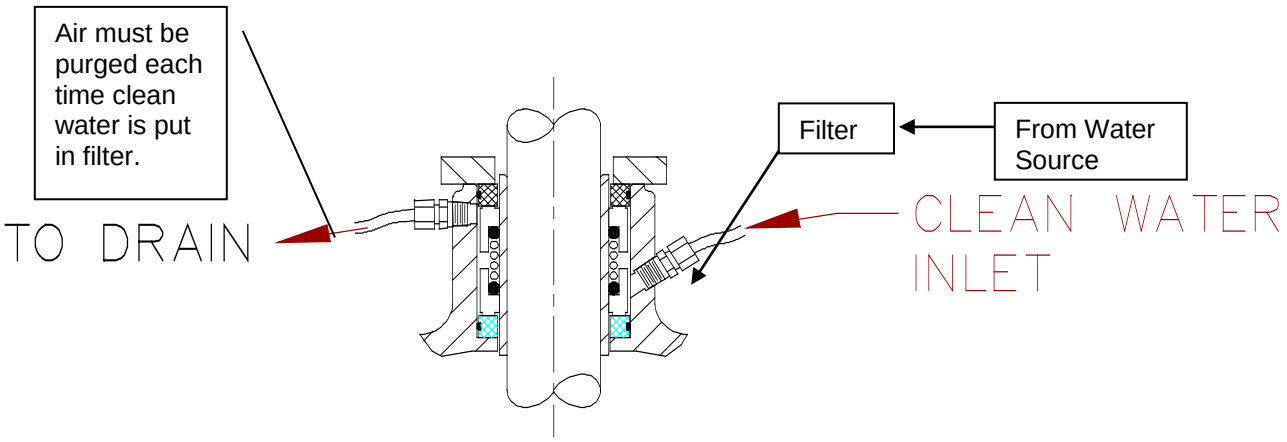
Fairbanks Nijhuis has compiled a general list of products that meet the grease requirements above. This list is not an endorsement of any particular manufacture and should not be construed as exclusive recommendations. When choosing an alternate manufacture, customers should discuss this typical lubricant recommendation with their vendor to ensure that equivalent grease is supplied.

Typical Products

Manufacturer	Lubricant Brand Name	NLGI No.
BP	BP Energrease® LC EP 2	2
Castrol	Pyroplex Red	2
Chevron	Delo® Greases EP	2
Exxon	Ronex® MP	2
Mobil	Mobiltith® AW2	2
Shell	Retinax® LC	2
Texaco	Starplex® 2	2
76	76 Multiplex EP	2



Item	Part	Material
1	Spring	Stainless Steel
2	Rotary Bellows	Buna-N
3	Rotary Face	Carbon
4	Stationary Seat	Ceramic
5	O-Ring	Buna-N
6	Driving Band	316 Stainless Steel
7	Retainer	18-8 Stainless Steel
8	Disc	316 Stainless Steel



Typical Flush Water Schematic

Ref. No.	Description	Quantity
456	Mechanical Seal	3

Exterior Paint

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning.
- **Prime Coat** Series 69
  - **Number of Coats** One
  - **Color** 1211 Red
  - **Dry Film Thickness** 3 to 5
  - **Surfaces to be coated** Exterior of Pump

TNEMEC

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II SERIES N69

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water.

COLORS Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH Satin

SPECIAL QUALIFICATIONS A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69F, V69F, 90E-92, 90-97, H90-97, 90G-1K97, 90-98, 91-H_2O, 94-H_2O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69F, V69F, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or 130, 215, 218, 1254

TOPCOATS 22, 46H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69 is 21 days for atmospheric service. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

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

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS
Unthinned: 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)

HAPS
Unthinned: 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids

THEORETICAL COVERAGE 1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

HI-BUILD EPOXOLINE® II | SERIES N69

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

PACKAGING 5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.

NET WEIGHT PER GALLON 13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA Part A: 82°F (28°C) Part B: 93°F (34°C)

HEALTH & SAFETY Paint products contain 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

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). 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

1. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon.

POT LIFE Without 44-700: 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700: 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 75°F (24°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

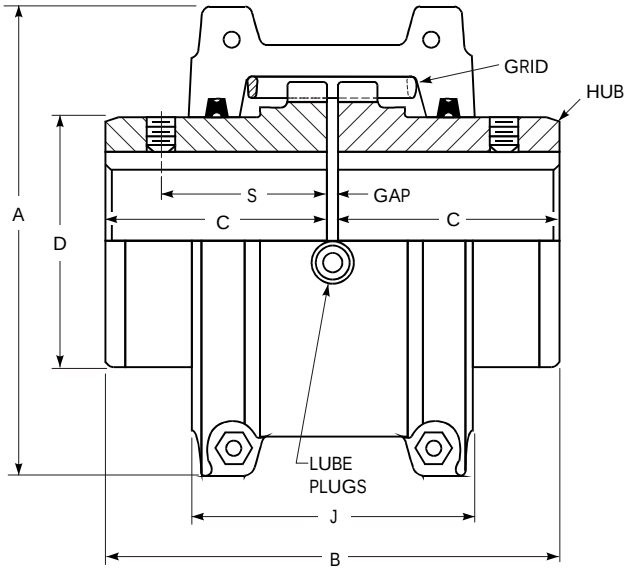
Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Minimum 50°F (10°C) Maximum 135°F (57°C) The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

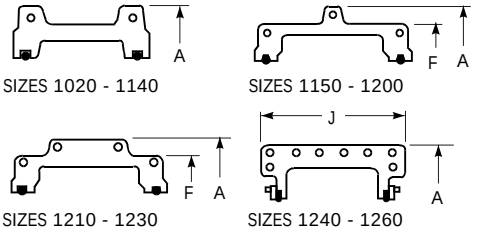
CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

Type T10

Close Coupled/Dimensions — Inches



COVER PROFILES – HORIZONTAL SPLIT



Sizes 1020 thru 1230T10 covers are cast aluminum alloy; Sizes 1240 thru 1260T10 are fabricated steel.

SIZE ★	Torque Rating (lb-in) †	Allow Speed rpm ‡	Max Bore ●	Min Bore ■	Cplg Wt With No Bore-lb	Lube Wt lb	DIMENSIONS — INCHES							
							A	B	C	D	F	J	S	Gap
1020T	460	4500	1.125	.500	4.2	.06	3.82	3.88	1.88	1.56	....	2.62	1.54	.125
1030T	1,320	4500	1.375	.500	5.7	.09	4.16	3.88	1.88	1.94	....	2.69	1.54	.125
1040T	2,200	4500	1.625	.500	7.4	.12	4.50	4.12	2.00	2.25	....	2.75	1.58	.125
1050T	3,850	4500	1.875	.750	12	.15	5.32	4.88	2.38	2.62	....	3.12	1.76	.125
1060T	6,050	4350	2.125	.750	16	.19	5.82	5.12	2.50	3.00	....	3.62	2.06	.125
1070T	8,800	4125	2.500	1.062	23	.25	6.25	6.12	3.00	3.44	....	3.75	2.12	.125
1080T	18,150	3600	3.000	1.062	39	.38	7.50	7.12	3.50	4.12	....	4.56	2.54	.125
1090T	33,000	3600	3.500	1.625	56	.56	8.31	7.88	3.88	4.88	....	4.81	2.82	.125
1100T	55,550	2440	4.000	1.625	93	.94	9.88	9.69	4.75	5.59	....	6.12	....	.188
1110T	82,500	2250	4.500	2.375	120	1.12	10.62	10.19	5.00	6.31	....	6.36	....	.188
1120T	121,000	2025	5.000	2.625	179	1.62	12.12	12.00	5.88	7.06	....	7.54	....	.250
1130T	176,000	1800	6.000	2.625	266	2.0	13.62	13.00	6.38	8.56	....	7.68	....	.250
1140T	253,000	1650	7.250	4.250	392	2.5	15.12	14.75	7.25	10.00	....	7.92	....	.250
1150T	352,000	1500	8.000	4.750	500	4.3	17.84	14.65	7.20	10.60	15.40	10.68	....	.250
1160T	495,000	1350	9.000	5.250	681	6.2	19.76	15.85	7.80	12.00	17.20	10.96	....	.250
1170T	660,000	1225	10.000	6.000	987	7.7	22.32	17.25	8.50	14.00	19.18	12.10	....	.250
1180T	915,000	1100	11.000	6.000	1365	8.3	24.80	19.05	9.40	15.50	21.84	12.64	....	.250
1190T	1,210,000	1050	12.000	7.000	1710	9.7	26.60	20.65	10.20	17.20	23.93	12.80	....	.250
1200T	1,650,000	900	13.000	7.000	2331	12.4	29.80	22.25	11.00	19.60	26.00	14.00	....	.250
1210T	2,200,000	820	14.000	7.000	3140	23.2	33.25	24.50	12.00	21.00	29.56	17.00	....	.500
1220T	2,970,000	730	15.000	8.000	3935	35.4	36.25	26.10	12.80	22.50	32.37	19.30	....	.500
1230T	3,850,000	680	16.000	8.000	4997	53.0	39.50	27.70	13.60	24.00	35.62	21.50	....	.500
1240T	4,950,000	630	17.000	10.000	6504	74.5	42.80	29.50	14.50	25.50	....	25.50	....	.500
1250T	6,600,000	580	18.500	10.000	8450	110.5	46.50	32.10	15.80	28.00	....	27.50	....	.500
1260T	8,250,000	540	20.000	10.000	10322	148.1	49.64	34.50	17.00	30.00	....	30.00	....	.500

★ Refer to Page 3 for General Information and Reference Notes.

How To Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

Table of Contents

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.

INTRODUCTION

This manual applies to Sizes 1020T thru 1140T and 20T thru 140T10 Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 20T thru 140T respectively, e.g. 1020T = 20T, 1100T = 100T, etc. These couplings are designed to operate in either the horizontal or vertical position without modification. Beginning in 1994, these couplings are being supplied with one set of inch series fasteners and one set of metric fasteners. Use either set of fasteners, depending on your preference. Refer to Page 6 for part interchangeability.

The performance and life of the couplings depend largely upon how you install and service them.

CAUTION: *Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.*

WARNING: *Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.*

LUBE FITTINGS

Cover halves have $^{1}/_{8}$ NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

LIMITED END FLOAT

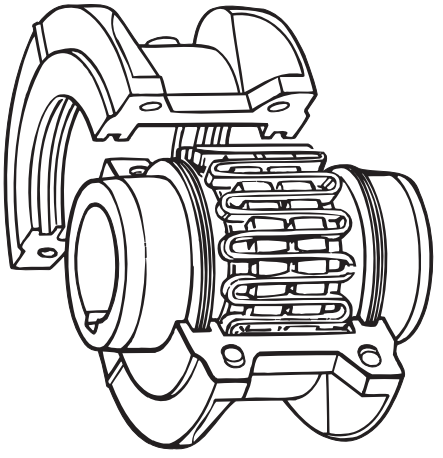
When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose and long term greases. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended. Sizes 1020T to 1090T10 are furnished with a pre-measured amount of grease for each coupling. The grease can be ordered for larger size couplings.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

TYPE T10 STEELFLEX COUPLING



Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

CAUTION: *Do not use LTG in bearings.*

MORE>

Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Min. Pump = 20° F (-7° C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — $^1/_2$

MINIMUM DROPPING POINT — with 60 stroke worked penetration value in the range of 320 to 365 — 350°F (177°C) min.

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

Packaging

14 oz. (0,4 kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 kg)PAIL, 120 lb. (54 kg) KEG & 400 lb. (181 kg) DRUMS.

General Purpose Grease

Annual Lubrication — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (-18°C to 66°C). For temperatures beyond this range (see Table 1), consult the Factory.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	**Lubricant †**	**Lubricant †**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt)	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	. . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (-7°C). If grease must be applied below 20°F (-7°C), consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS

Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 1020T thru 1090T are generally furnished for CLEARANCE FIT with setscrew over the keyway. Sizes 1100T and larger are furnished for an INTERFERENCE FIT without a setscrew.

CLEARANCE FIT HUBS — Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Do not heat clearance fit hubs. Install keys, mount hubs with flange face flush with shaft ends or as otherwise specified and tighten setscrews.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent seal damage, DO NOT heat hubs beyond a maximum temperatue of 400°F (205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

MORE>

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

WARNING: If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

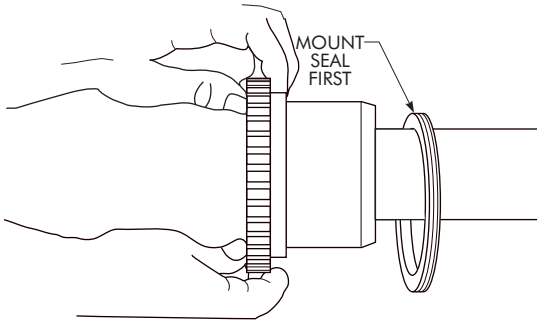
Heat hubs as instructed above. Mount hubs as quickly as possible with hub face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

Maximize Performance And Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

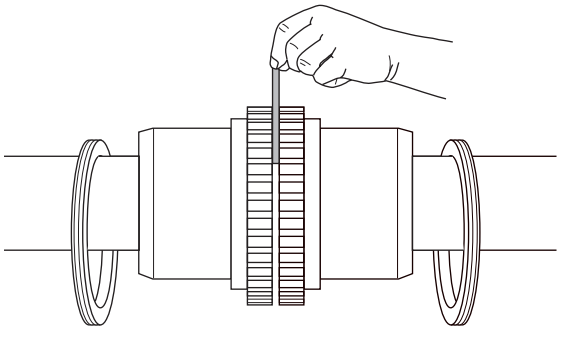
Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.

1— Mount Seals And Hubs



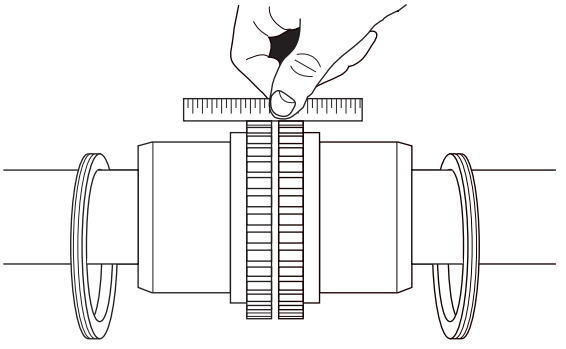
Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Heat interference fit hubs as previously instructed. Seal keyways to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft unless otherwise indicated. Tighten setscrews when furnished.

2 — Gap and Angular Alignment



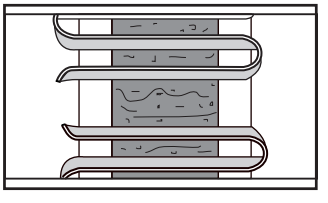
Use a spacer bar equal in thickness to the gap specified in Table 2, Page 5. Insert bar as shown below left, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR installation limits specified in Table 2.

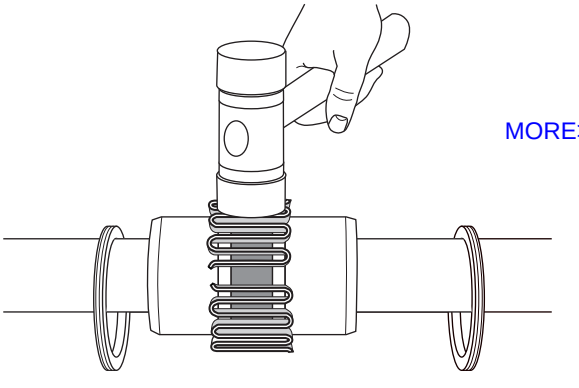
3 — Offset Alignment



Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary.

4 — Insert Grid

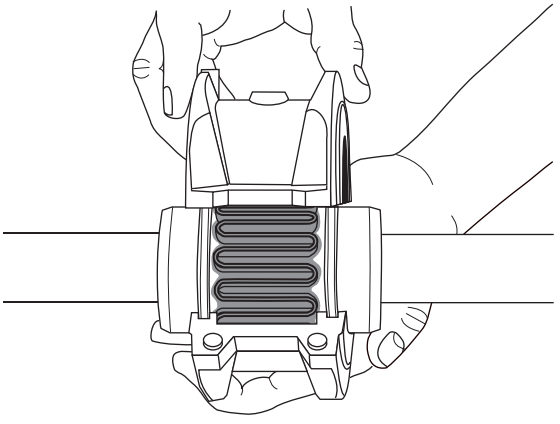


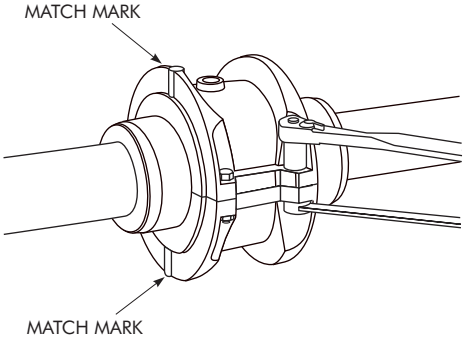


MORE>

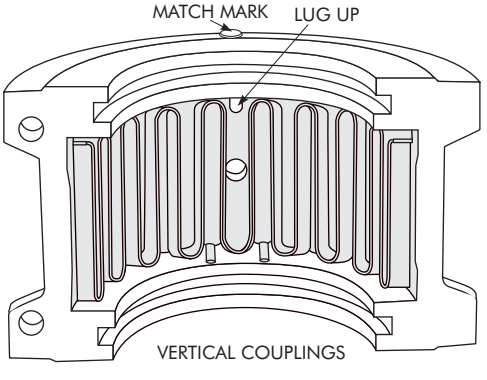
Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction (as detailed in the exploded view picture above); this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

5 — Pack With Grease And Assemble Covers





Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark



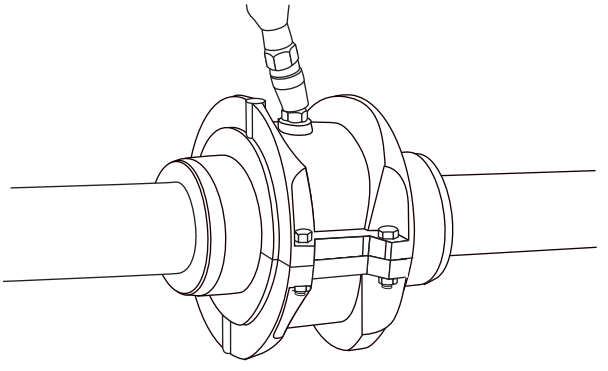
UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2. Make sure gaskets stay in position during tightening of fasteners. ***CAUTION:*** *Make certain lube plugs are installed before operating.*

ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

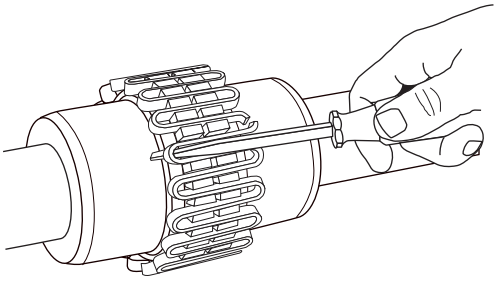
1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication



The required frequency of lubrication is directly related to the type of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relubed annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. ***CAUTION:*** Make certain all plugs have been inserted after lubricating.

Coupling Disassembly And Grid Removal



Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

TYPE T COUPLING INSTALLATION & ALIGNMENT DATA

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Maximum operating values listed in Table 2 are based on cataloged allowable rpm.

Values listed are based upon the use of the gaps listed, standard coupling components, standard assemblies and cataloged allowable speeds.

Values may be combined for an installation or operating condition.

Example: 1060T max. operating misalignment is .016" parallel plus .018" angular.

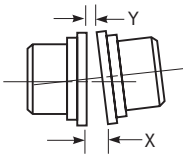
NOTE: For applications requiring greater misalignment, refer application details to Falk.

Angular misalignment is dimension X minus Y as illustrated below.

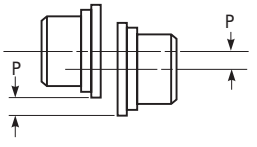
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT

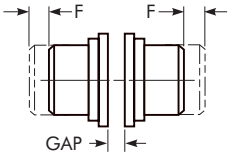


TABLE 2 — Misalignment & End Float

SIZE	Installation Limits						Operating Limits						Cover Fastener Tightening Torque Values		Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Hub Gap ± 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F						
	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	In Series Fasteners (lb-in)	Metric Fasteners (Nm)		lb	kg
1020T	.006	0,15	.003	0,08	.125	3	.012	0,30	.010	0,25	.210	5,33	100	11,3	4500	.06	0,03
1030T	.006	0,15	.003	0,08	.125	3	.012	0,30	.012	0,30	.198	5,03	100	11,3	4500	.09	0,04
1040T	.006	0,15	.003	0,08	.125	3	.012	0,30	.013	0,33	.211	5,36	100	11,3	4500	.12	0,05
1050T	.008	0,20	.004	0,10	.125	3	.016	0,41	.016	0,41	.212	5,38	200	23,6	4500	.15	0,07
1060T	.008	0,20	.005	0,13	.125	3	.016	0,41	.018	0,46	.258	6,55	200	23,6	4350	.19	0,09
1070T	.008	0,20	.005	0,13	.125	3	.016	0,41	.020	0,51	.259	6,58	200	23,6	4125	.25	0,11
1080T	.008	0,20	.006	0,15	.125	3	.016	0,41	.024	0,61	.288	7,32	200	23,6	3600	.38	0,17
1090T	.008	0,20	.007	0,18	.125	3	.016	0,41	.028	0,71	.286	7,26	200	23,6	3600	.56	0,25
1100T	.010	0,25	.008	0,20	.188	5	.020	0,51	.033	0,84	.429	10,90	312	35	2440	.94	0,43
1110T	.010	0,25	.009	0,23	.188	5	.020	0,51	.036	0,91	.429	10,90	312	35	2250	1.1	0,51
1120T	.011	0,28	.010	0,25	.250	6	.022	0,56	.040	1,02	.556	14,12	650	73	2025	1.6	0,74
1130T	.011	0,28	.012	0,30	.250	6	.022	0,56	.047	1,19	.551	14,00	650	73	1800	2.0	0,91
1140T	.011	0,28	.013	0,33	.250	6	.022	0,56	.053	1,35	.571	14,50	650	73	1650	2.5	1,14

TABLE 3 — Coupling Cover Fastener Identification

SIZE	Inch Series Fasteners				METRIC FASTENERS	
	Old Style		New Style			
1020-1070T10		SAE Grade 8 ★		SAE Grade 8		Property Class 10.9
1080-1090T10		SAE Grade 8		SAE Grade 8		Property Class 10.9
1100-1140T10		SAE Grade 5		SAE Grade 5		Property Class 8.8

★ Older style covers, Sizes 1020T10 thru 1070T10 must utilize socket head cap screws and locknuts held by the cover.

PARTS IDENTIFICATION

All coupling parts have identifying part numbers as shown below. Parts 3 and 4 (Hubs and Grids), are the same for both Type T10 and T20 couplings. All other coupling parts are unique to Type T10. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER.

PARTS INTERCHANGEABILITY

Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

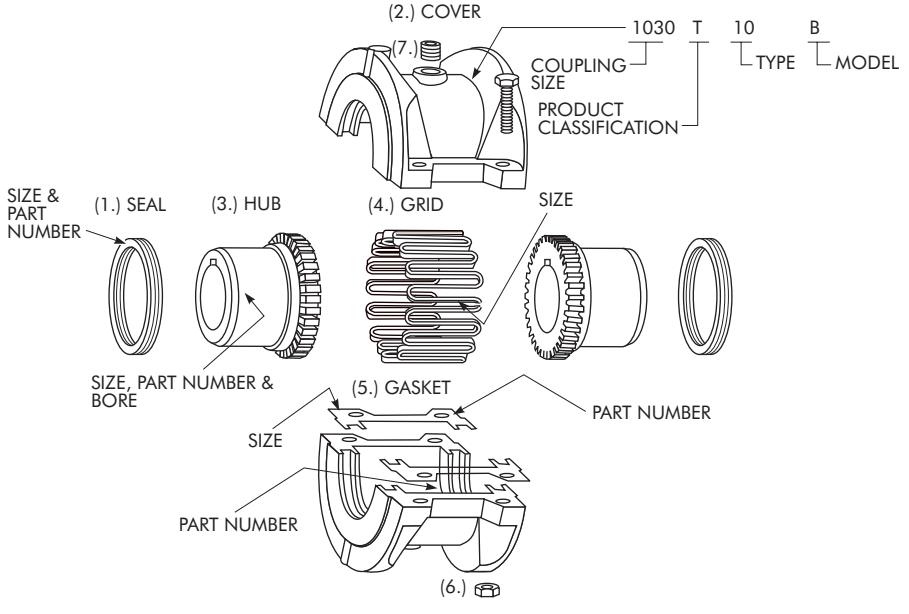
GRIDS — Size 1020T thru 1140T Steelflex couplings use blue grids. Older models, 20T thru 140T, use orange grids.

CAUTION: *Blue grids may be used in all applications, but DO NOT substitute orange grids for blue.*

COVERS — ***CAUTION:*** *DO NOT mix cover halves of different designs. Sizes 1020T thru 1070T10 covers have been manufactured in several different two-rib designs and 80T thru 140T covers have been manufactured with two and three ribs.*

HARDWARE — Older style covers, Sizes 1020T10 thru 1070T10, utilized socket head cap screws with captured locknuts. The new style covers use hex head cap screws (either inch or metric) and unrestrained locknuts. Specify either inch series SOCKET head or metric series HEX head cap screws when ordering replacement parts.

PART NUMBER LOCATION



PART DESCRIPTION

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10) — Coupling may be supplied with one set each of inch series fasteners and metric fasteners.
7. Lube Plug

ORDER INFORMATION

1. Identify part(s) required by name above.
2. Furnish the following information.

   EXAMPLE:
   Coupling Size: 1030
   Coupling Type: T10
   Model: B
   Bore: 1.375
   Keyway: .375 x .187
3. Price parts from Price List 422-110 and appropriate discount sheet.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

Introduction

Adequate lubrication is essential for satisfactory operation. This manual provides a list of typical lubricants and specifications for general purpose and long term greases.

The use of general purpose grease requires re-lubrication of the coupling at least annually. By initially using Falk long term grease (LTG), re-lubrication will not be required again until the connected equipment is stopped for servicing.

Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

LONG TERM LTG GREASE

Falk LTG was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLG1 #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with Falk Long Term grease (LTG) will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 rating).

CAUTION: Do not use LTG in bearings.

Specifications

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — –20°F (–29°C) to 250°F (121°C). Min. Pump = 20°F (–7°C)

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C)

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425-84 Centrifuge Test) — K36 = 2/24 maximum, very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — 1/2

CONSISTENCY (ASTM D-217) — 60 stroke worked penetration value in the range of 315 to 360 measured at 77°F (25°C)

MINIMUM DROPPING POINT — 350°F (177°C) min.

MINIMUM TIMKEN EP O.K. LOAD — 40 lb (18 kg).

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

INSPECTION — When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean the grease from the coupling and repack with fresh LTG. Install coupling using new gasket as instructed in the appropriate installation manual.

Packaging

14 oz CARTRIDGES — For use in standard industrial lubrication guns.

35 lb PAILS — Ideal for larger size couplings or many smaller sizes.

120 lb KEG — For plants with many small couplings or large size couplings. Best for hand packing.

400 lb DRUMS — For plants with a pressurized lubrication system.

CASE LOTS — 10 pack – 14 oz cartridges, 60 – 14 oz cartridges.

General Purpose Grease

ANNUAL LUBRICATION — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0° to 150°F (–18° to 66°C) For temperatures beyond this range, consult the Factory.

If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals; more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 265 to 295.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties, equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed in Table 1 are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases

Ambient Temperature Range	0°F to 150°F (–18°C to +66°C)	–30°F to 100° F –34°C to +38°C)
Manufacturer	**Lubricant**	**Lubricant**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt) Corp.	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	. . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (7°C). If grease must be applied below 20°F (7°C), consult The Falk Corporation. Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

NIDEC MOTOR CORPORATION
8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 9/1/2022

P.O. NO.: 12587655
Order/Line NO.: 22701649 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

```
HOLD PRODUCTION
Horsepower ..............  00007.50~00000.00  ~ KW: 5.595
Enclosure ...............  TEFC
Poles ...................  06~00  ~ RPM: 1200~0
Frame Size ..............  254~VPH
Phase/Frequency/Voltage..  3~060~460
Winding Type ............  Random Wound
Service Factor ..........  1.15
Insulation Class ........  Class "F" ~ Insulife 2000
Altitude In Feet (Max) ..  3300 Ft.(1000 M)
Ambient In Degree C (Max)  +40 C
Efficiency Class ........  Premium Efficiency
Application .............  Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
Customer Part Number ....  FMB0913562A01
12" Base
Pricebook Thrust Value (lbs).. 3800
Customer Down Thrust (lbs) ... 1
Customer Shutoff Thrust (lbs).
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
"AK" Dimension (Inches).. NA
Shaft Dimensions:~U=1.125 ~ AH/V=2.750
KEYWAY=0.250 ~ ES=1.280
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method .........  Direct-On-Line Start
Duty Cycle ..............  Continuous Duty
Efficiency Value ........  91.0 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 104 LB-FT2
Number Of Starts Per Hour: NEMA
Motor Type Code .............  TVI4
Rotor Inertia (LB-FT²)          3.06 LB-FT²
Qty. of Bearings PE (Shaft)     1
Qty. of Bearings SE (OPP)       1
Bearing Number PE (Shaft)       7310 BEP
Bearing Number SE (OPP)         6207-2Z-J/C3
```

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 9/1/2022

P.O. NO.: 12587655
Order/Line NO.: 22701649 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518
ATTN: SHILO

Model Number: NA
Catalog Number:
VSS High Thrust TEFC Config.
CONF,MOTOR,VSS-HT TEFC

REVISIONS:
(NONE)

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Accessories:

Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913562A01
12587655
LINE 10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	7.5
Pole(s)	06
Voltage(s)	460
Frame Size	254VPH
Shaft U Diameter	1.125
Outlet Box AF	2.03
Outlet Box AA	1.25

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 9/1/2022

PENTAIR PURCHASE ORDER #: 12587655 PENTAIR TAG #: FMB0913562A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X **IEEE** X **ASA** X **NEMA**

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
7.5	1200	1180	254VPH	TVI4	TEFC

*Full Load Speed Tolerance Per NEMA MG1-12.46 is+/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPHERES		INSULATION CLASS	MAX. TEMP. RISE	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR		X RESIS. / THERM.			
3	60	460	9.2	52.5	F	105 DEG C AT 1.00 SF	1.15	F	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD		PERCENT OF FULL LOAD	
89.5	90.2	89.5	84.1	81.5	74.4	33.4	174	255

VSS [X] **VHS** [ ] **NRR** [ ] **SRC** [ ] **HORIZ** [ ]

BEARINGS:

Drive End Lubrication:
[ ] Oil [X] Grease

Opposite End Lubrication:
[ ] Oil [X] Grease

PAINT: (Attach Technical Data Sheets)
[X] Factory Standard
[ ] Other _____

MOTOR NO.: 22701649

MOTOR WEIGHT: 265 LBS

ROTATION: [ ] **BI-DIRECTIONAL** [X] **CW** [ ] **CCW**

Certified by: *Sharon Corcoro* Date: 9/1/2022 Revision # 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 9/1/2022

Pentair Purchase Order #: 12587655 Pentair Tag #: FMB0913562A01

	Required	Not Required	Description
Space Heaters:	☐	☒	Watts: _____ Voltage: _____
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity Per Motor: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ Quantity _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Tests:	☐	☒	☐ Short commercial, unwitnessed ☐ Short commercial, witnessed ☐ Calibration Test, unwitnessed ☐ Complete initial, unwitnessed ☐ Complete initial, witnessed ☐ Sound test, unwitnessed ☐ Bump Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Reed Critical Test, unwitnessed ☐ IEEE841

Certified by: *Sharon Corcoro* Date: 9/1/2022 Revision #: 0

FN015/012020

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 9/1/2022

Pentair Purchase Order #: 12587655 Pentair Tag #: FMB0913562A01

Features:

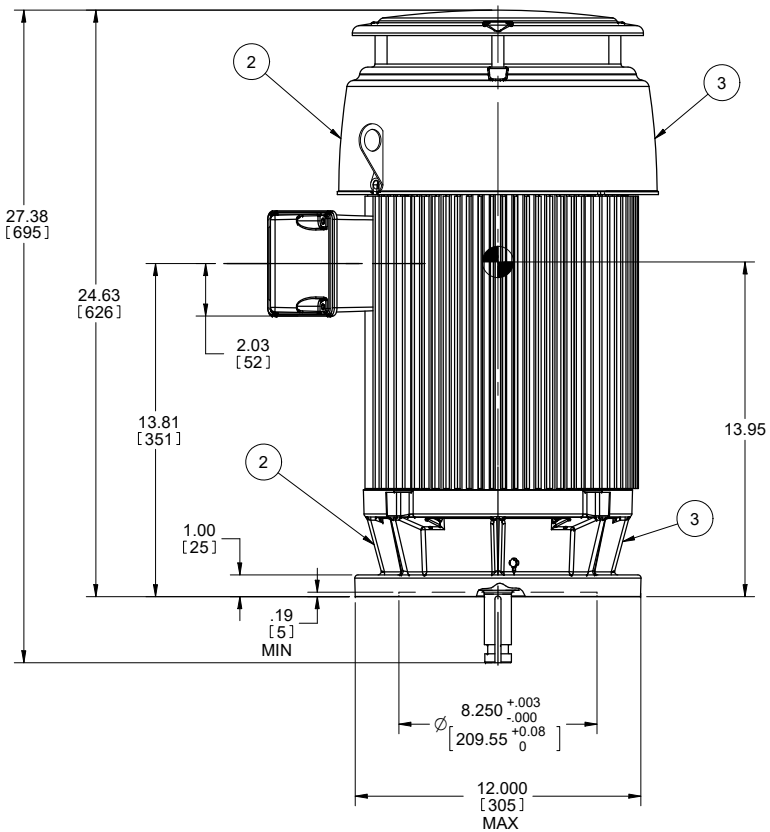
Enclosure ..... TEFC
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
12" Base
Pricebook Thrust Value (lbs).. 3800
Customer Down Thrust (lbs) ... 1
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Shaft Dimensions:~U=1.125 ~ AH/V=2.750
KEYWAY=0.250 ~ ES=1.280
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 91.0 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 104 LB-FT2

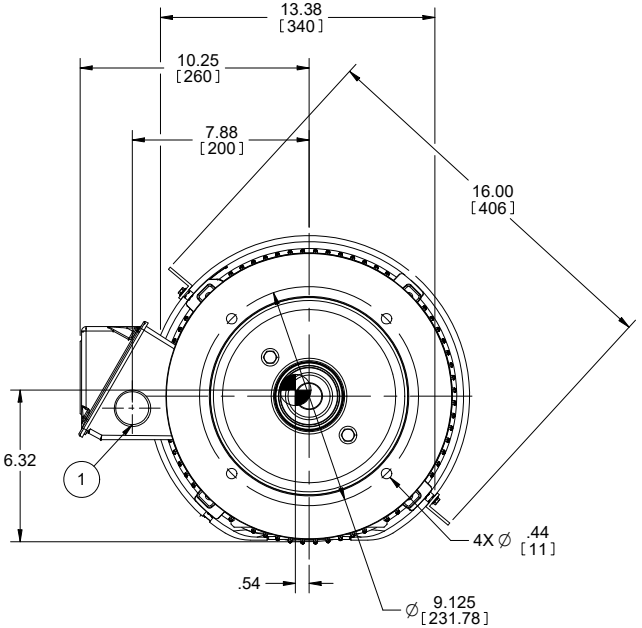
Accessories:

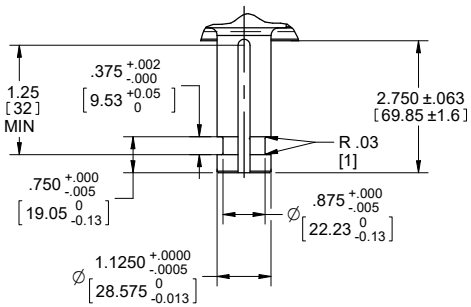
Clockwise Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913562A01
12587655
LINE 10

Certified by: Sharon Corcoro Date: 9/1/2022 Revision #: 0

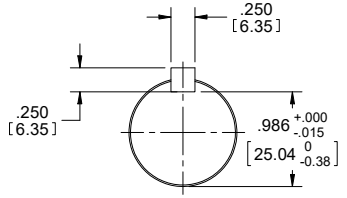
FN015/012020







SHAFT DETAIL



USER INFORMATION
CUSTOMER: PENTAIR FLOW TECHNOLOGIES LLC
CUSTOMER P/N: FMB0913562A01
P.O: 12587655
REF. ORDER #:22701649-100

TOLERANCES	
FACE RUNOUT	.004 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.004 T.I.R.
PERMISSIBLE SHAFT RUNOUT	.002 T.I.R.

NOTES:

1) MAIN BOX FOR MOTOR POWER LEADS, 1.25" CONDUIT CONNECTION.
   BOX VOLUME: 60 CU. IN. [983 CU. CM.]
2) DRAINS: TOP AND BOTTOM GREASE.
3) FILL: TOP AND BOTTOM GREASE.
4) BEARINGS: LOWER - 7310 BEP
   UPPER - 6207-2Z-J/C3
5) TAG: FMB0913562A01
   12587655
   LINE 10
6) ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
7) CONDUIT OPENING MAY BE LOCATED IN STEPS OF 180 DEGREES. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
8) CLASS F INSULATION, S.F.=1.15
9) ⊕ DENOTES CENTER OF GRAVITY

CERTIFIED FOR CONSTRUCTION

RATING	7.5 HP [5.516 KW] 1180 RPM, 460V, 3Ø, 60HZ
ENCLOSURE	TEFC
BEARINGS	SEE NOTE 4
LUBRICATION	SEE NOTES 2 AND 3
ROTATION FACING O.D.E.	CW
NET WEIGHT (±10%)	265 LBS [120 KG]

REVISION DECRIPTION: DUAL
NEW.

FRAME: 254VPH
TYPE: TVI4
TITLE: DIMENSION PRINT 206
NIDEC MOTOR CORPORATION
ISSUED BY: L. ARROYO
APPROVED BY: M. TREJO
REVISION DATE: 30-AUG-22
DWG NO.: 09-2408-05
REV: -
SHEET NUMBER: 1 OF 1
DWG SIZE: C

NAMEPLATE DATA

CATALOG NUMBER:				NAMEPLATE PART #:	422707-005		
MODEL		FR	254VPH	TYPE	TVI4	ENCL	TEFC
SHAFT END BRG	7310 BEP - QTY 1			OPP END BRG	6207-2Z-J/C3 - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 22701649, Type: SO, Line#: 100)		
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	7.5	RPM	1180	HP		RPM	
VOLTS	460			VOLTS			
FL AMPS	9.2			FL AMPS			
SF AMPS	10.5			SF AMPS			
SF	1.15	DESIGN	B	CODE	F	SF		DESIGN		CODE	
NEMA NOM EFFICIENCY	91.0	NOM PF	84.1	KiloWatt	5.60	NEMA NOM EFFICIENCY		NOM PF	
GUARANTEED EFFICIENCY	89.5	MAX KVAR		HZ	60	GUARANTEED EFFICIENCY		MAX KVAR		HZ	

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460	AMPS	9.7
TORQUE 1	33.40LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	6-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	120-1200	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	FMB0913562A01
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	92.1	Inrush Limit	
Motor Weight (LBS)	265	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	3800	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4	GREASE LUBRICATED	Special Accessory Note 19	
Special Accessory Note 5	RECOMMENDED GREASE	Special Accessory Note 20	
Special Accessory Note 6	EXXON POLYREX-EM	Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	TVI4	254VPH

ORDER NO.	22701649	LINE NO.	100

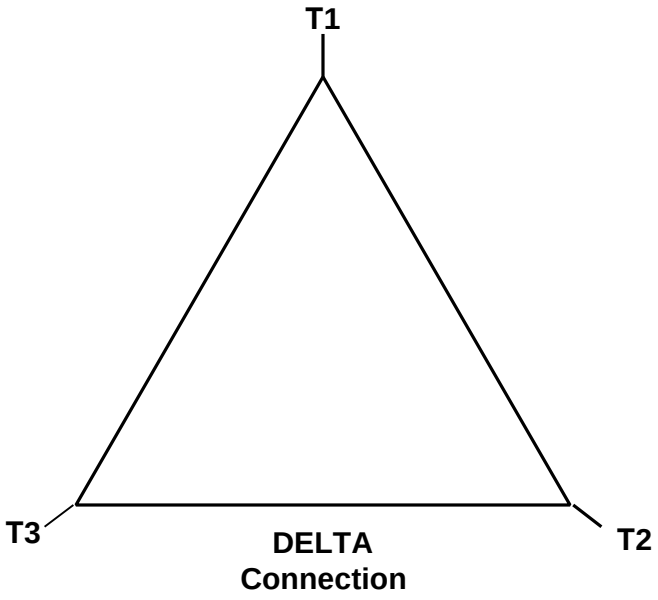
MPI:	42188
HP:	7.5
POLES:	6
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	90.9
FULL	91
3/4	92.1
1/2	91.6
1/4	87.4
POWER FACTOR (%):	
S.F.	84.8
FULL	84.1
3/4	81.5
1/2	74.4
1/4	54.4
NO LOAD	7
LOCKED ROTOR	40.7
AMPS:	
S.F.	10.5
FULL	9.2
3/4	7
1/2	5.2
1/4	3.7
NO LOAD	3
LOCKED ROTOR	52.5
NEMA CODE LETTER	F
NEMA DESIGN LETTER	B
FULL LOAD RPM	1180
NEMA NOMINAL / EFFICIENCY (%)	91
GUARANTEED EFFICIENCY (%)	89.5
MAX KVAR	2
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	30
SOUND PRESSURE (DBA @ 1M)	60
TORQUES:	
BREAKDOWN{% F.L.}	255
LOCKED ROTOR{% F.L.}	174
FULL LOAD{LB-FT}	33.4

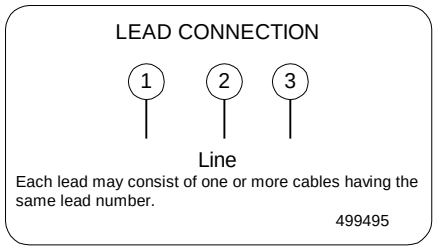
NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

Motor Wiring Diagram





To reverse direction of rotation interchange connections L1 and L2.
Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

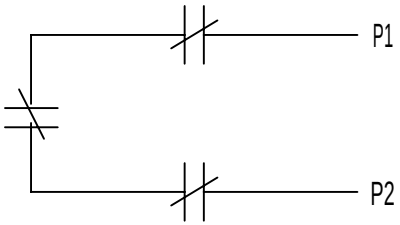
EFFECTIVE: 2/27/96
SUPERCEDES: X736618, 96441, 179879, 284138
Connection Plate: 499495
Connection Decal: 912113

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.

2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



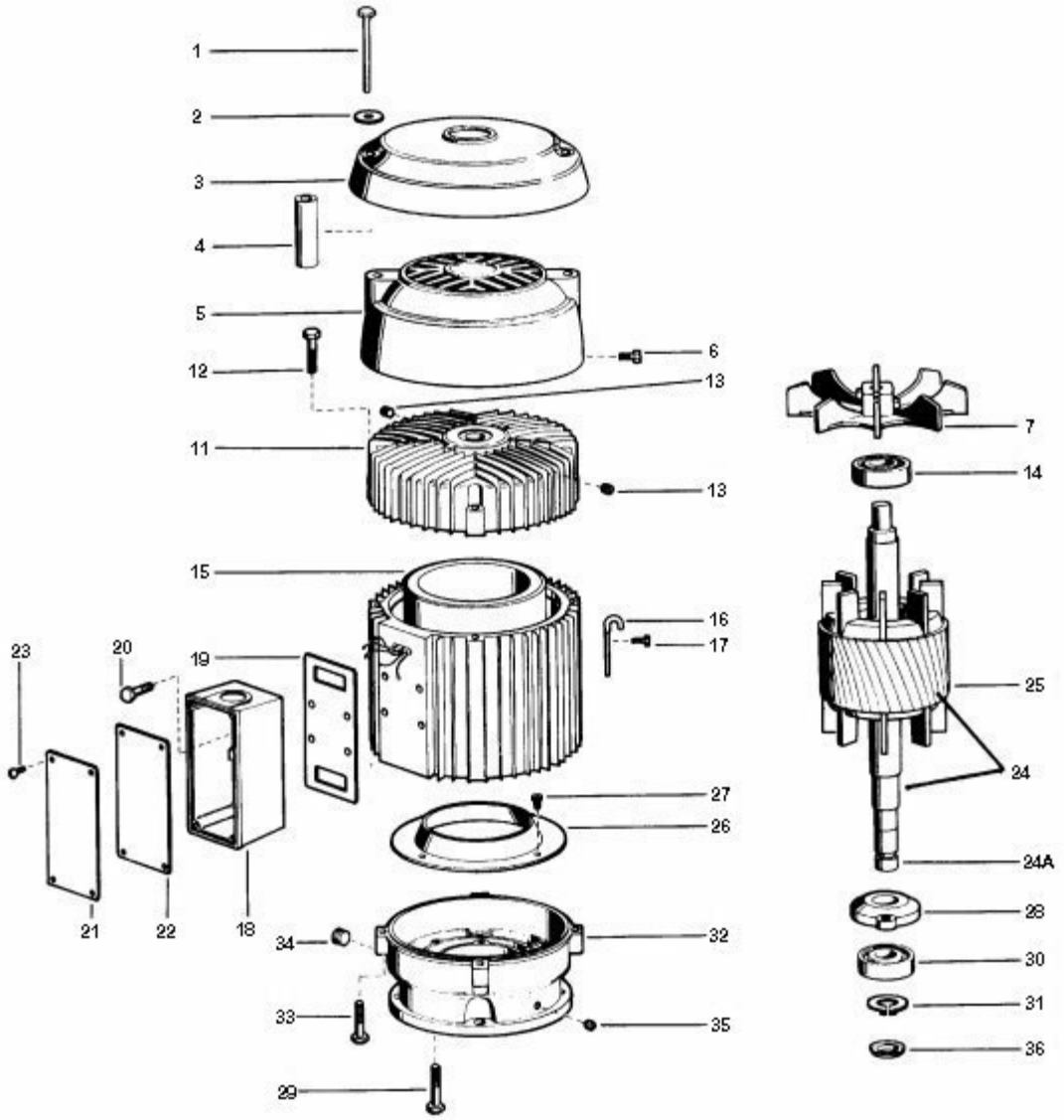
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC STL0211 - UPDATED FORMAT .	SCALE: NONE UNITS: IN TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES / mm ANGLES X°= ±1°	TITLE: CUSTOMER CONNECTION DIAGRAM ISSUED BY: R. KING APPROVED BY: C. CADE CODE: DWG NO.: 0834066	NIDEC MOTOR CORPORATION REVISION DATE: 24-FEB-11 REV: G SHEET NUMBER: 1 OF 1 DWG SIZE: A
MATERIAL: --- MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED			

RENEWAL PARTS

FRAMES 182 THRU 365 - OPEN DRIPPROOF, TOTALLY ENCLOSED AND EXPLOSION PROOF
TYPES: AV, AV9, AVE, AVI, LV, LV4, LV9, LVC4, LVC9, LVCS4, LVCS9, LVE, LVE4, LVE9, LVI4, LVS4, LVS9, NVC4, NVC9, NVCE, NVCS, NVE, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE9, TVCI, TVCI4, TVCI9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVI, TVI4, TVI9, TVS, TVS4, TVS9
SOLIDSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	3	Screw (Used on 213 thru 256, type AV & TV)
2	3	Washer (Canopy Cap) (Used on 254 thru 256, type AV & TV)
3	1	Canopy Cap (Not used on frames 182 - 184 types AV, TV, & LV, frames 213 - 215 type LV, frames 284-286 types TV & LV
4	3	Spacer (Used on frames 213 thru 256, type AV & TV)
5	1	Fan Cover
6	4	Screw (Qty. 8 Hex Nut on frame 280 & up)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 155 & 156

FRAMES 182 THRU 365 - OPEN DRIPPROOF, TOTALLY ENCLOSED AND EXPLOSION PROOF
TYPES: AV, AV9, AVE, AVI, LV, LV4, LV9, LVC4, LVC9, LVCS4, LVCS9, LVE, LVE4, LVE9, LVI4, LVS4, LVS9, NVC4, NVC9, NVCE, NVCS, NVE, TV, TV4, TV9, TVC, TVC4, TVC9, TVCE, TVCE9, TVCI, TVCI4, TVCI9, TVCS, TVCS4, TVCS9, TVE, TVE4, TVE9, TVI, TVI4, TVI9, TVS, TVS4, TVS9
SOLIDSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
7	1	Fan
8	2	Screw (Fan) (Not Illustrated)
9	2	Washer (Fan) (Not Illustrated) (Used on frames 182 thru 256, types AV, TV & LV)
10	2	Square Nut (Fan) (Not Illustrated) (Used on frames 182 thru 256, types AV, TV & LV)
11	1	Bracket (Upper)
12	4	Screw (Used on frames 182-184, types AV, TV, & LV, frames 213-256 types AV & TV)
13	1	Pipe Plug (Not used on frames 324 thru 326)
14	1	Bearing (Upper) (Refer to section 775)
	1	Bearing Cap (Upper) (Not Illustrated) (Not used on frames 182 thru 256, types AV & TV)
	3	Screw (Not used on frames 182 thru 256, types AV & TV)
15	1	Wound Stator Assembly
16	2	Lifting Hook (Eyebolt on some units)
17	4	Screw (Lifting Hook) (Used on frames 182-184, types AV, TV, & LV, frames 213-256 types AV & TV)
18	1	Outlet Box Base
19	4	Gasket (Used on frames 180 thru 250, type AV & TV, frames 280 thru 360 type TV)
20	1	Screw (Outlet Box Base)
21	1	Outlet Box Cover
22	1	Gasket (Not used on type LV)
23	4	Screen (Outlet Box Base)
24	1	Rotor Assembly (Includes items 24A & 25)
24A	1	Shaft
25	1	Rotor Core
26	1	Air Deflector (Not used on frames 180 thru 250, type LV, frames 280 thru 320 type AV)

ITEM NO.	QTY	NAME OF PART
27	1	Screw (Air Deflector) (Not used on frames 180 thru 250, type LV, frames 280 thru 320 type AV)
28	1	Bearing Cap (Lower) (Qty. 2 on frame 180 type LV)
29	2	Screw (Bearing Cap (Qty. 3 on TV & LV)
30	1	Bearing (Lower) (Refer to section 775)
31	1	Snap Ring (Not used on frames 180 thru 210, type LV)
32	1	Unimount Bracket
33	4	Screw (Qty. 8 on frame 280 and up)
34	1	Pipe Plug (Fill) (Not used on frame 280 thru 360, type TV & LV)
35	1	Pipe Plug (Drain)
36	1	Water Deflector (Not used on frame 180, type LV)
	1	Pipe Nipple (Fill) (Not Illustrated) (Not used on frame 180, type AV, TV & LV)
	1	Pipe Coupling (Fill) (Not Illustrated) (Not used on frame 180, type AV, TV & LV)
	1	Grease Fitting (Qty. 2 on frame 280 thru 360) (Not used on frame 180)
	1	Fan Grill (Used on frames 210 thru 250, type LV, frame 280, type TV & LV)
	4	Stud (Qty. 8 on frame 320 & up) (Not Illustrated) (Not used on frame 180; frame 210 & 250 types AV & TV)
	8	Hex Nut (Not Illustrated) (Not used on frame 180; frame 210 & 250 types AV & TV)
	1	Pipe Nipple, drain (Not Illustrated) (Not used on frames 180 thru 210, type AV, TV & LV)
	1	Pipe Cap, Drain (Not Illustrated) (Not used on frames 180 thru 210, type AV, TV & LV)
	1	Woodruff Key (Fan) (Not Illustrated) (Used on frames 320 thru 360, types TV & LV)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 155 & 156

TYPICAL REED CRITICAL FREQUENCY DATA

Note: Motor RCF Test Data can be provided at time of motor shipment through special test. Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA
CATALOG NO: NA

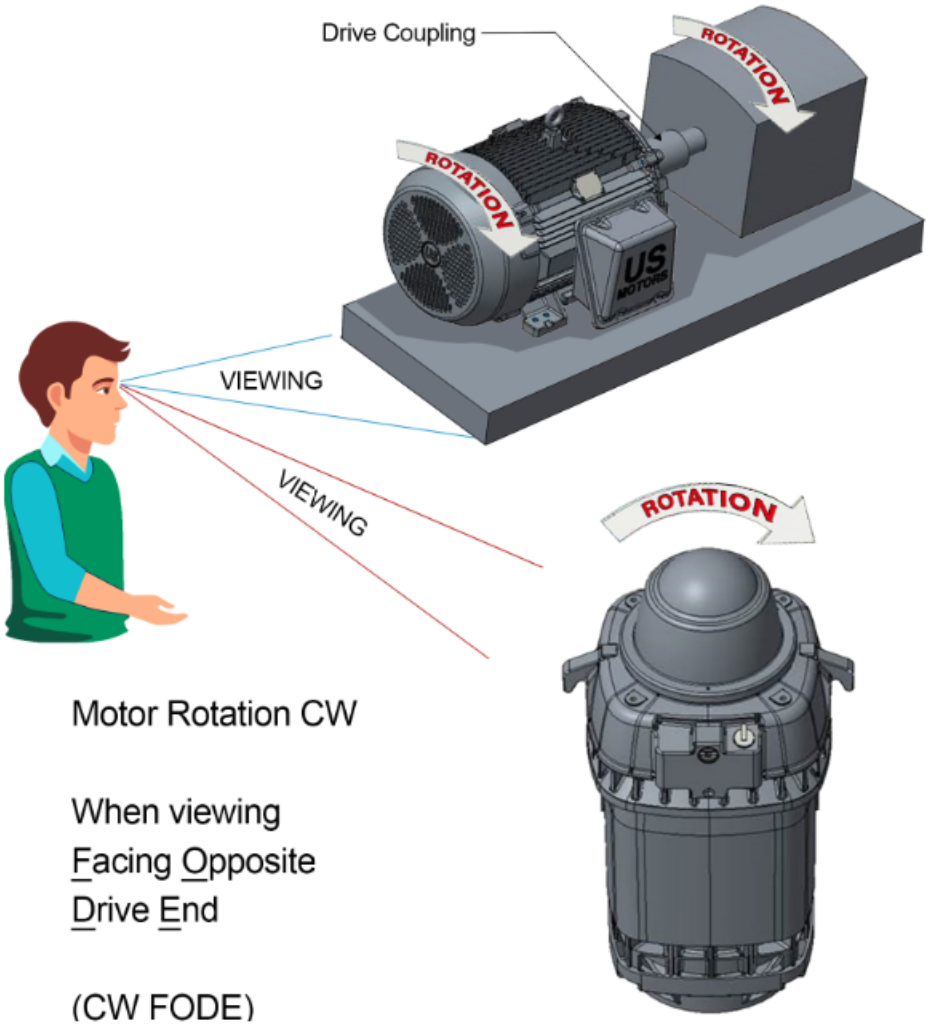
Frame: 254VPH Type: TVI4

REED CRITICAL FREQUENCY:	77	HZ
CENTER OF GRAVITY:	11	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0017	IN
UNIT WEIGHT:	265	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	20%	
DATE:	9/1/2022	

DIRECTION OF ROTATION

This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with CW (clockwise) rotation as shown below. CCW rotation is available upon request.



Motor Rotation CW

When viewing
Facing Opposite
Drive End

(CW FODE)

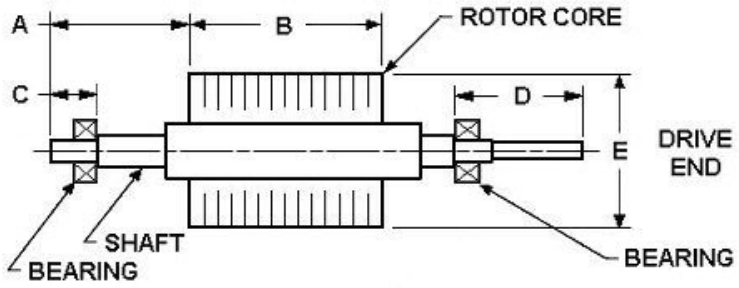
NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-288

LATERAL CRITICAL SPEED ANALYSIS DATA

ORDER NO: 22701649-100

FRAME SIZE 254VPH-65



ROTOR DATA (dimensions in inches)

A - ROTOR CORE LOCATION	B - ROTOR CORE LENGTH	C - OPPOSITE DRIVE END BRG.	D - DRIVE END BRG. LOCATION
7.438	5.50	3.50	5.500
E - ROTOR CORE DIAMETER	**SHAFT LENGTH END TO END**	**ROTOR CORE WEIGHT (lbs)**	**ROTOR ASSEMBLY WEIGHT (lbs)**
7.466	23.52	57	90
ROTOR INERTIA POLAR (lb-ft^2)	**ROTOR INERTIA TRANSVERSE (lb-ft^2)**		**SHAFT/ROTOR ASM BALANCE**
3.06	1.53		ISO 1940 G 2.5

BEARING DATA

DRIVE END BEARING		OPPOSITE END BEARING	
NUMBER	**STIFFNESS (lb/in)**	**NUMBER**	**STIFFNESS (lb/in)**
7310	0.433 X 10^6	6207	0.414 X 10^6

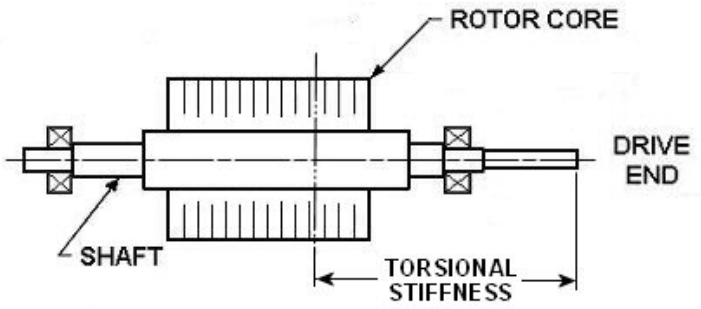
SHAFT DATA

DRAWING NO.	MATERIAL	DENSITY	YIELD
390433	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30.0 x10^6 psi	12.0 x 10^6 psi	

TORSIONAL ANALYSIS DATA

ORDER NO: 22701649-100

FRAME SIZE 254VPH-65



SHAFT DATA			
DRAWING NO.	**MATERIAL**	**DENSITY**	**YIELD**
390433	AISI 1040 –1045 HR	.283 LBS/IN^3	45,000 psi
TENSILE	**YOUNG'S MODULUS**	**SHEAR MODULUS**	
82,000 psi	30 x10^6 psi	12 x 10^6 psi	

MOMENT OF INERTIA - ROTOR ASSEMBLY:

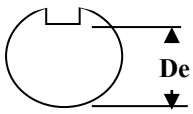
WR^2 = 3.06 **LB-FT^2**

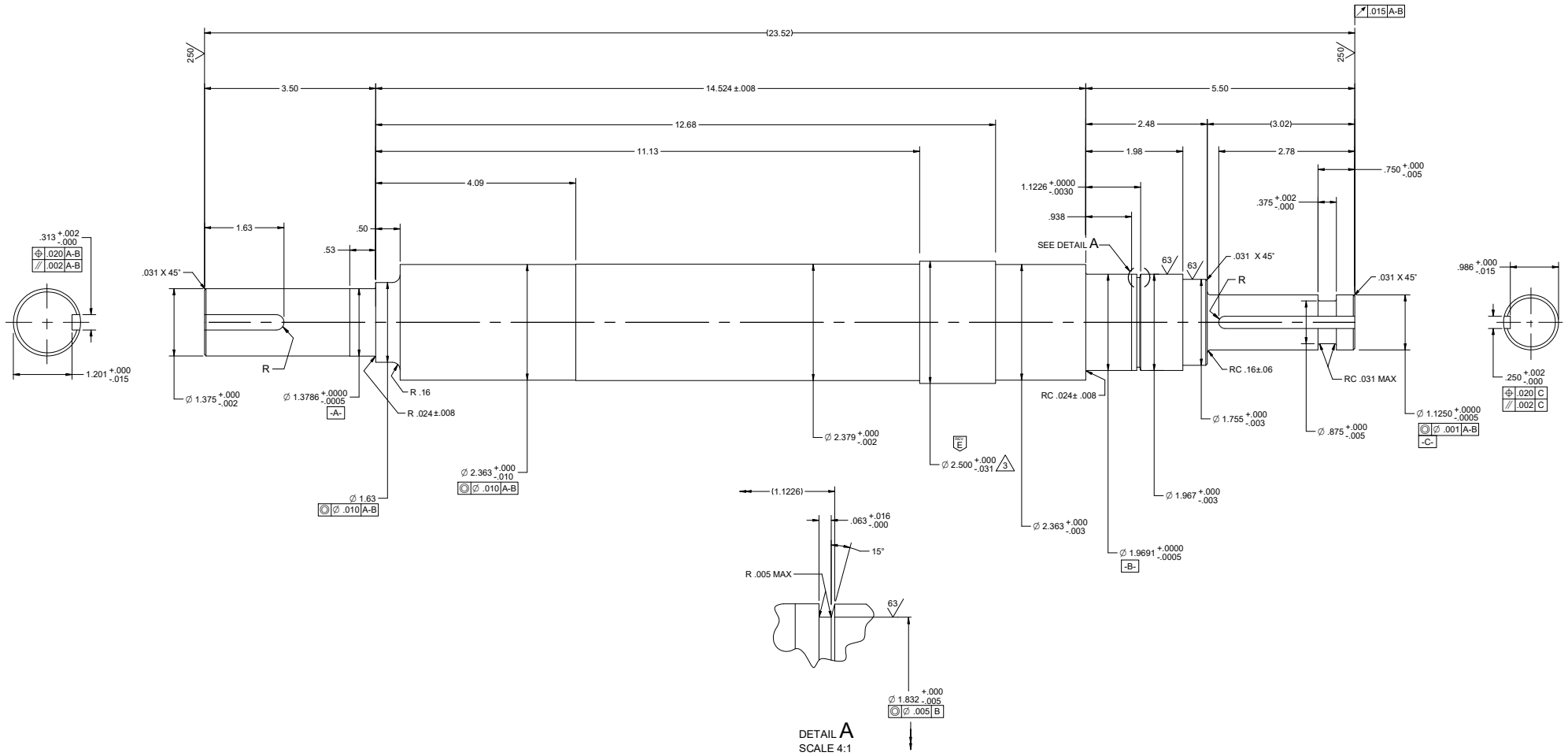
SHAFT TORSIONAL STIFFNESS:

3.7276 **X 10^5 LB-IN/RADIAN**

Torsional stiffness is the spring rate or constant which allows a user to determine the amount of twist or angular deflection in a shaft based on the amount of torque applied. The portion of the shaft for which the shaft stiffness has been calculated from 1/3 the length of the rotor core to the end of the drive end of the shaft (shafts with an annular keyways are measured from inboard side of the ring groove). It is the users responsibility to correct for coupling mounting effects.

SHAFT EXTENSION
De - EFFECTIVE DIAMETER WITH KEYWAY 0.986 **INCHES**





NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIAMETERS TO BE: Ø .002 A-B
2. NO AXIAL RELATIONSHIP BETWEEN KEYWAYS

3 ROUGH STOCK PERMISSIBLE MUST BE SCALE FREE

ITEMS AND MATERIALS SPECIFIED HEREIN MUST COMPLY WITH THE EUROPEAN REDUCTION OF HAZARDOUS SUBSTANCES (RoHS 2) (DIRECTIVE 2011/65/EU, REGULATIONS (EC) NO. 1907/2006 ("REACH") AS OF 1 JUNE 2007 AND ALL SUBSEQUENT UPDATES. PLEASE REFER TO THE OFFICIAL EU DOCUMENTS FOR COMPLETE DEFINITION, RESTRICTIONS, AND LIMITS FOR EACH SUBSTANCE.

NIDEC CONFIDENTIAL
NIDEC MOTOR CORPORATION 07-APR-16

REVISION DESCRIPTION FOR: 15703295
DIAMETER 2.500 +.000/-.031 WAS 2.531 +.000/-.003

MATERIAL: HR STEEL, AISI 1045

SCALE: 1:1
UNITS: INCHES

TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)

INCHES	mm
.XX = ± .03	
.XXX = ± .015	

ANGLES X° = ±1°

CSTC NO.	PART NO.	FRAME	TYPE
- - - - -	390433-000	254VP	ENCL

TITLE: SHAFT, ROTOR

NIDEC MOTOR CORPORATION

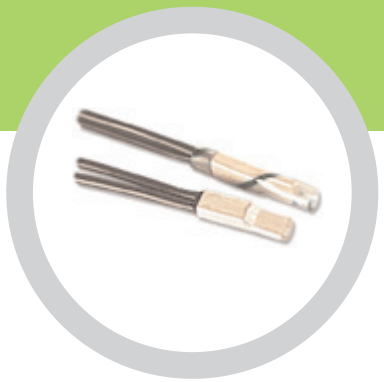
ISSUED BY	APPROVED BY	REVISION DATE
G. MARTINEZ	N. SIFUENTES	10-FEB-17

CODE	DWG NO.	REV	SHEET NUMBER	DWG SIZE
	0390433	E	1 OF 1	D

NMCD (OCT-2013)

SOLIDEDGE

Sensata Technologies



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performace

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation

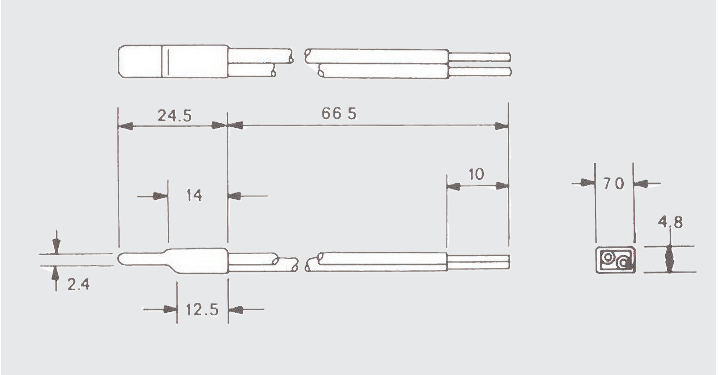
The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00



9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cmf)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5℃ in a step from 60 to 150℃.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

X : Contact material combination

Code	Stationaly contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

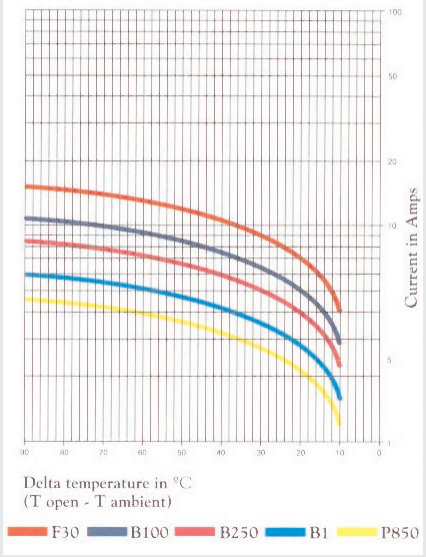
Type "S" is set up for Cadmium-free contact

Example :
9700K01-215
Bimetal of 30ohms/cmf,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125℃-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

9700 : Device Identification

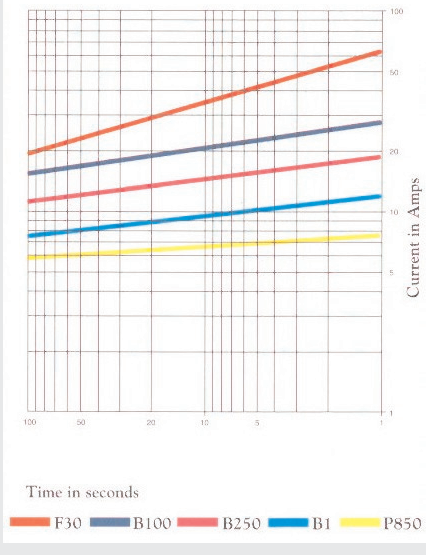
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

Sensata
Technologies

TECHNICAL / SALES SUPPORT

Holland
Phone +31 546 879560 Fax +31 546 879204
Italy
Phone +39 039 6568310 Fax +39 039 6568316

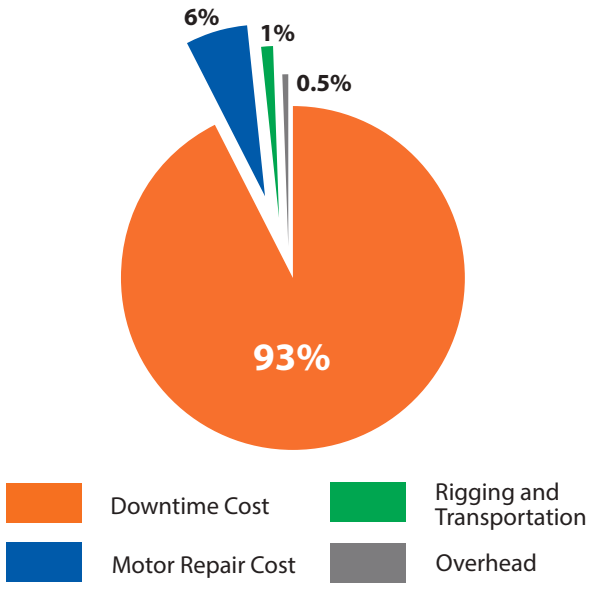
Internet: *www.sensata.com*

Email: *info-cpe@list.sensata.com*

VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.



Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

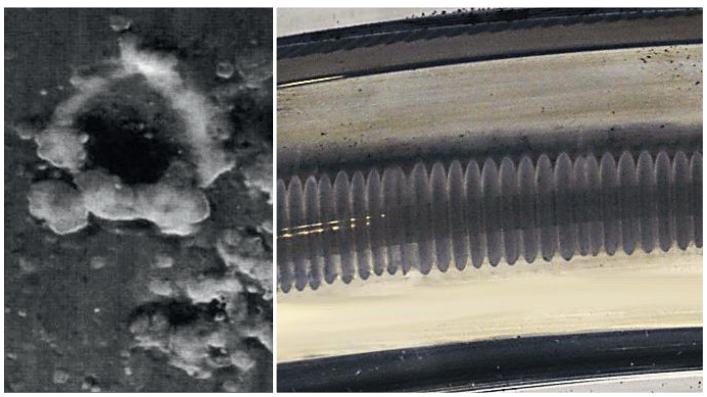
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options

Standard Mounting Clamps (-1)
Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers

Split Ring (-1A4)
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor

Bolt Through Mounting (-3FH)
Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes

Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included

Press Fit Mounting (-0A6)
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available

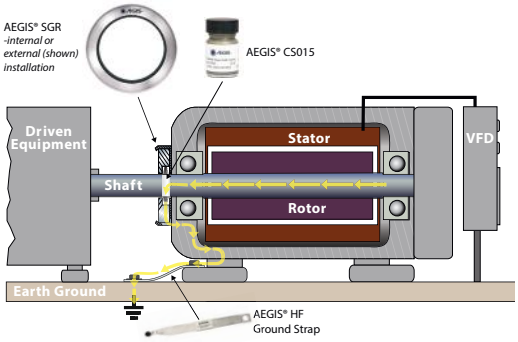
uKIT with Universal Mounting Bracket
Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy

AEGIS® PRO Series
AEGIS® PROSL, PROSLR, PROMAX, PROMR

AEGIS® Shaft Voltage Tester™
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture

Accessories
HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

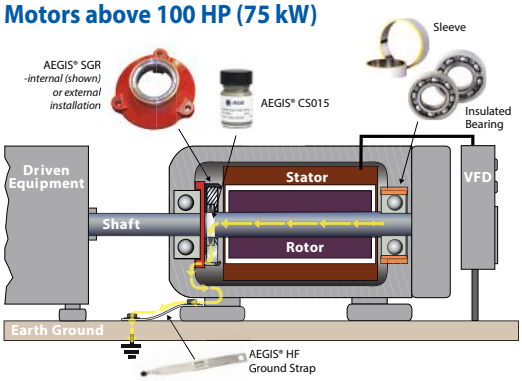
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:
LV Motors up to 500HP: AEGIS® SGR
LV Motors over 500HP: AEGIS® PRO Series
MV Motors: AEGIS® PRO Series

Electro Static Technology™
An ITW Company

www.est-aegis.com

Electro Static Technology
31 Winterbrook Road
Mechanic Falls, ME 04256 USA
Tel: (866) 738-1857
Tel: (207) 998-5140
E-Mail: sales@est-aegis.com

Formular 105-8m US 02/21

Standard
Paint
Specification

For

EM Gray

NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México

CONTENTS

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." for its superior rust inhibitive qualities and durability. The paint also has excellent resistance to various chemicals. This specification covers surface preparation and application of protective coating on motors built in the Apodaca, Nuevo Leon facility.

2.0 Unpainted Surfaces

The following surfaces will not require protective coating:

Anodized Aluminum	Grounding Pads
Brass	Machined Surfaces
Bronze	Motor Leads
Chromium Plated Metals	Porcelain Enamel Finishes
Copper	Rubber
Galvanized Steel	Stainless Steel
Glass	Vacuum Pressure Impregnated Parts

3.0 Surface Preparation (Cast Iron & Steel)

A. The foundries are required to snag, remove all sand and slag from castings. This is to be immediately followed by primer paint to insure 100% coverage. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

C. All parts are to be cleaned prior to priming or finish painting as follows:

1. If parts are dirty – wash and rise in parts washer.
2. If parts are dusty – sandblast
3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

5.0 Motor Assembly

After assembling the motor, there may be surfaces that require priming or touch-up prior to final painting. These surfaces are bracket-to-frame register fits, outlet box pads, etc.
If surfaces are oily, wash with clean paint thinner using a clean rag to prevent contamination of other surfaces.

6.0 General

A. Finished coating shall not be applied to wet or damp surfaces.
B. All coatings shall be applied in a conscientious manner and in accordance with the written application instructions of the coating manufacturer.
C. Re-application time between coats shall be in accordance with the coating manufacturer's recommendation corresponding to the conditions of temperature and humidity.
D. Hardware trim and other items not requiring coating may be removed as required for proper application of coatings. Such items shall be replaced after completion of work.
E. The dry film thickness of each coat, and of the entire system, shall follow the coating manufacturer's recommendation and this specification. The number of coats specified shall be a minimum number of coats to achieve the specified film thickness.
F. Coverage rates, as calculated by the coating manufacturer, shall be considered as the maximum allowable.
G. All spraying equipment shall be maintained in good working order, with daily inspection, and shall be in conformity with the coating manufacturer's most recent application specification.

7.0 Finish Top Coating

All motor products must be clean and free of any dirt, oil or grease on the primed surface prior to finish painting. Except where otherwise specified, thinners shall not be used. Motors will be painted with one coat unless otherwise noted. Film thickness: 2 to 4 mils.

8.0 Final Finish Inspection

Visual inspection of completed work shall be performed on the finished motor by the Quality Assurance Department. The final surface finish is to be in accordance with industry standards for comparable equipment. Any surfaces found in violation of this specification will be rejected and will require rework. Acceptance or rejection of final finish paint is the sole responsibility of the Quality Assurance Department.

9.0 Material Identification

A. Standard Primer: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III "STORAGE", item 4** for instructions.

1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila®† P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

2. Grease Lubricated Bearings

A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠WARNING

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disaasembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠WARNING

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.

B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replensihment Quantities & Lubrication Intervals

Bearing Number		Grease Replensihment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$G = 0.11 \times D \times B$

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Width of bearing in inches

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof		Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3

Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
	449 thru 5811	1801-3600	-15°C tru 40°C (104°F)	32	Synthetic Only
		1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office	

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Dripproof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		Synthetic Only
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4

Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	**ISO VG 32**		**ISO VG 68**		**ISO VG 150**	
	Viscosity: 130-165 SSU @ 100F		**Viscosity: 284-347 SSU @100F**		**Viscosity: 620-765 SSU @ 100F**	
	Mineral Base Oil	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV		
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120^* \text{ Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.

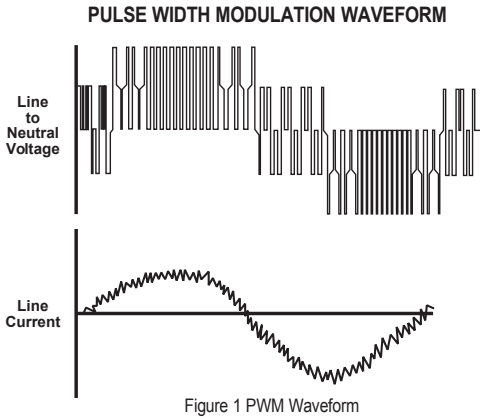


Figure 1 PWM Waveform

What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction
- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grouding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O3. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE® insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE® insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE® insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE® insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Motor / Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD.
(consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA®† 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors
All U.S. MOTORS® brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA®† Application Guide for AC Adjustable Speed Drive Systems: http://www.nema.org/stds/acadjustable.cfm#download

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA®† MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA®† frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA®† frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA®† Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA®† MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA®† frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.
- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	127 ft	400 ft	218 ft
6 Khz	90 ft	307 ft	154 ft
9 Khz	73 ft	251 ft	126 ft
12 Khz	64 ft	217 ft	109 ft
15 Khz	57 ft	194 ft	98 ft
20 Khz	49 ft	168 ft	85 ft

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficienct vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

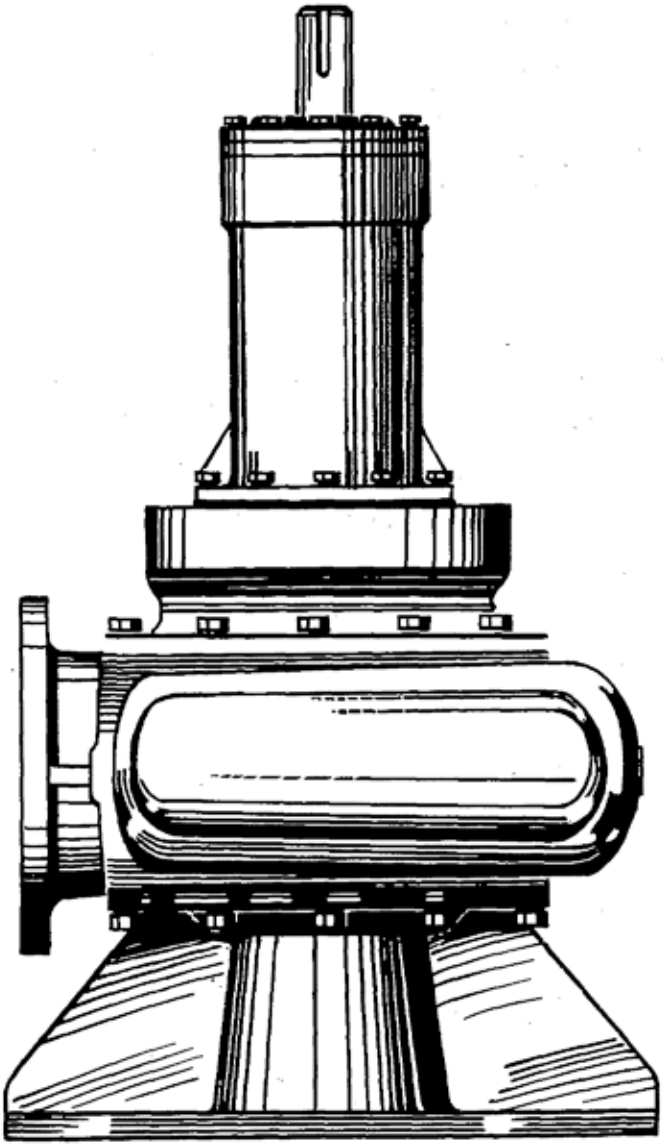
* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

EQUIPMENT IOM

FAIRBANKS 5700
INSTALLATION AND OPERATION MANUAL

PENTAIR

FAIRBANKS NIJHUIS®



B5700 SERIES
ANGLE FLOW PUMPS
INSTALLATION, OPERATION AND MAINTENANCE MANUAL

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

Part # FM-03-509 | © 2015 Pentair Ltd. | 03/19/15

THIS PAGE INTENTIONALLY LEFT BLANK

10″-16″ B5700
TABLE OF CONTENTS

Congratulations! You are the owner of one of the finest pumps commercially available. If you give it the proper care as outlined and recommended by this manual, it will provide you with reliable service and long life ...

B5700 ANGLE FLOW PUMPS

Your Fairbanks Morse B5700 is a heavy duty angleflow pump ideally suited for large sewage treatment plants, industrial waste, storm water, dry dock, and numerous other high volume applications. Standard construction includes corrosion resistant renewable wearing rings and shaft sleeves, cast iron wetted parts and heavy duty bearings for long life.

This manual applies to:

B5711 Vertical pumps — using a driver independently mounted from the pump and flexible shafting

B5721 Horizontal pumps — mounted on a common baseplate with the driver

B5741 Vertical close coupled pumps — using a high ring base between the pump and driver

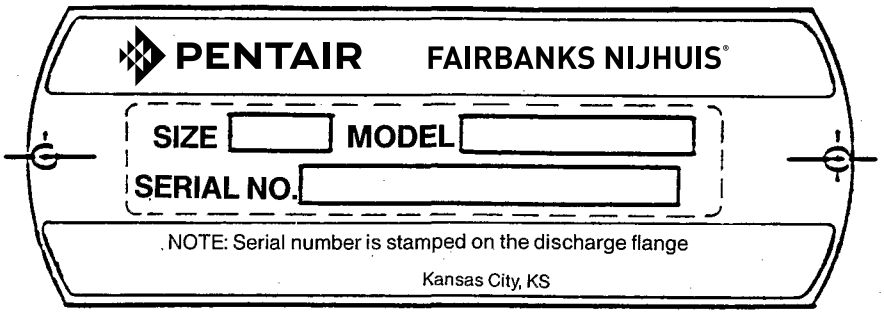
PUMP IDENTIFICATION

Example: 12" B5711

- Low Head
- Vertical pump, driven by flexible shafting (2 indicates horizontal base mounted and 4 indicates vertical pump with a high ring base to mount the motor directly on the pump)
- Figure (model)
- Discharge Size (inches)

Carefully record all of the following data from your pump nameplate. It will aid in obtaining the correct replacement parts for your pump.

PUMP



DRIVER

MANUFACTURER: _____

H.P.:_____, SERIAL NUMBER: _____

FRAME:_____SPEED: _____VOLTAGE: _____

To obtain additional data on hydraulics and pump selection and operation, we suggest you obtain both of the following reference books:

1. Fairbanks Morse "Hydraulic Handbook" available from the factory.
2. Hydraulic Institute Standards

   Hydraulic Institute
   1230 Keith Building
   Cleveland, Ohio 44115

SERIAL NO

RAS 1: 10750998 - 10751000

RAS 2: 10751018 - 10751020

CAUTION NOTES AND STORAGE OF PUMPS

These instructions apply to the pump only. They are intended to be general and not specific. If your operating conditions ever change, always refer to the factory for reapplication. Always refer to the manuals provided by manufacturers of the accessory equipment for their separate instructions.

CAUTION
IMPORTANT SAFETY NOTICE

The installation, use and operation of this type of equipment is affected by various federal, state and local laws and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of equipment is the responsibility of the equipment owner and all necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

WARNING
CALIFORNIA PROPOSITION 65 WARNING

This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

STORAGE OF PUMPS

If the equipment is not to be immediately installed and operated, store it in a clean, dry, well ventilated place, free from vibrations, moisture, and rapid or wide variations in temperature.

SPECIAL INSTRUCTIONS:

Rotate the shaft for several revolutions at least once every two weeks to:

1. Coat the bearing with lubricant
2. Retard oxidation or corrosion and
3. Prevent possible false brinelling.

MECHANICAL SEAL PUMPS: Pour at least 4 ounces of mineral oil into the seal housing and drain the oil just prior to start up.

CONSIDER A UNIT IN STORAGE WHEN:

1. It has been delivered to the jobsite and is awaiting installation.
2. It has been installed but operation is delayed pending completion of construction.
3. There are long (30 days or more) periods between operation cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

NOTE: Preservation requirements vary depending on the length of storage and the climatic environment. Long term preservation requires treatment of bearings, machined surfaces and wetted surfaces with grease or preservative oils, covering of pump nozzles with barrier material and wrapping of the shaft, frame and stuffing box with grease proof barrier material. Contact Fairbanks Morse for specific instructions if the pump will be stored for a period of 3 months or longer. Improper storage and preservation could damage the equipment which would result in non-warranty covered restoration requirements or non-warranty covered product failures.

THIS PAGE INTENTIONALLY LEFT BLANK

INTRODUCTION

This manual contains information which is the result of carefully conducted engineering and research efforts. It is designed to supply adequate instructions for the safe and efficient installation, operation and maintenance of your pump. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or unnecessary damage to the pump.

Variations exist in both the equipment used with these pumps and in the particular installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual. The manual contains general rules for installation, operation and maintenance of the pump.

Observe all caution or danger tags attached to the equipment or included in this manual.

INSTALLATION

1. GENERAL

CAUTION: CAREFULLY READ ALL SECTIONS OF THIS MANUAL AND ALL OTHER INSTRUCTION MANUALS PROVIDED BY MANUFACTURERS OF OTHER EQUIPMENT SUPPLIED WITH THIS PUMP.

Upon receipt of the shipment, unpack and inspect the pump and driver assemblies and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Report immediately to the factory, and to the transportation company involved, any missing parts or damage incurred during shipment, and file your "damaged and/or lost in shipment" claim with the carrier.

Horizontal pump and driver assemblies mounted on a structural steel base are aligned at the factory. However, alignment may be disturbed in transit or during installation. It must be checked after the unit is leveled on the foundation, after the grouting has set and the foundation bolts are tightened, and after piping is completed.

Tapped mounting blocks are furnished with some horizontal pumps when the driver is to be field mounted. After the alignment of the driver is completed, the mounting blocks must be welded to the base and the alignment rechecked.

When the pump and driver are mounted on separate base structures, the pump should be leveled and aligned first, and then the driver leveled and lined up with the pump. With separate bases, a flexible shaft between pump and driver must be used.

The installation of a vertical pump is essentially the same as for the horizontal configuration. Foundation, piping and alignment adjustments are accomplished using the same basic techniques.

2. NET POSITIVE SUCTION HEAD (NPSH)

NPSH can be defined as the head (energy) that causes liquid to flow through the suction pipe and enter the eye of the impeller.

NPSH is expressed in two values: (1) NPSH required (NPSHR) and, (2) NPSH available (NPSHA). IT IS ESSENTIAL THAT NPSHA ALWAYS BE GREATER THAN NPSHR TO PREVENT CAVITATION, VIBRATION, WEAR AND UNSTABLE OPERATION.

NPSHR is a function of the pump design and therefore varies with the make, size, capacity and speed of the pump. The value for your pump can be obtained from your pump performance curve or the factory.

NPSHA is a function of your system and may be calculated as follows:

A. *When the source of liquid is above the pump:*
NPSHA = barometric pressure (feet) + static suction head (feet) − friction losses in suction piping (feet) − vapor pressure of liquid (feet)

B. When the source of liquid is below the pump:
NPSHA = barometric pressure (feet) − static suction lift (feet) − friction losses in suction piping (feet) − vapor pressure of liquid (feet)

The datum evalation plane for vertical pumps is the horizontal plane through the lowest point of the impeller suction vane. The datum elevation plane for horizontal pumps is the horizontal plane through the impeller center line.

3. MINIMUM SUBMERGENCE OF SUCTION PIPE AND PIT DESIGN

Generally, it is required that an evenly distributed flow of non-aerated water be supplied to the pump suction. Improper wet well design or insufficient suction pipe submergence can result in intake vortexing which reduces the pump's performance and can cause severe damage to the pump.

We recommend that you secure the advice of a qualified Consulting Engineer for the analysis and design of the wet well. Significant engineering data on wet well design is provided in the Hydraulic Institute Standards.

Upon request, Fairbanks Morse will review plans and give general comments on the installation, but will not approve such plans for a specific installation and will accept no responsibility or liability for the performance of the pump intake structure.

4. LOCATION AND HANDLING

The pump should be installed as near the fluid as possible so a short direct suction pipe can be used to keep suction losses at a minimum. If possible, locate the pump so the fluid will flow to the suction opening by gravity. The discharge piping should be direct and with as few elbows and fittings as possible. The total net positive suction head available (NPSHA), which includes the suction lift and pipe friction losses, must be greater than the net positive suction head required (NPSHR) by the pump.

The pump and driver should be located in an area that will permit periodic inspection and maintenance. Head room and access room should be provided and all units should be installed in a dry location with adequate drainage.

WARNING: DO NOT PICK UP THE COMPLETE UNIT BY THE DRIVER OR PUMP SHAFTS OR EYE BOLTS.

To lift a horizontal mounted unit, a chain or suitable lifting device should be attached to each corner of the base. Vertical mounted units may be lifted by using a sling through the motor high ring base, or by the eye bolts when provided in the pump casing. The individual driver may be lifted using the proper eye bolts provided by the manufacturer, but these should not be used to lift the assembled unit.

5. FOUNDATION

The pump foundation should have a level surface and be of sufficient mass to prevent vibration and form a permanent rigid support for the unit. The most satisfactory foundations are concrete with anchor bolts of adequate size imbedded in the foundation in pipe sleeves with an inside diameter 2½ times larger than the bolt diameter. This will allow for final accurate positioning of the unit.

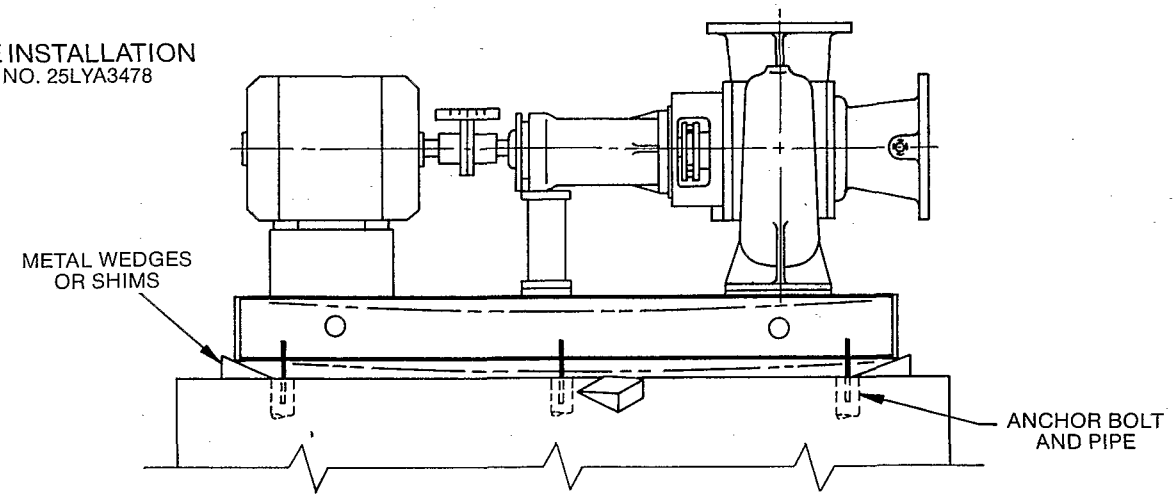
Recommended anchor bolt design is available from the factory.

6. LEVELING OF THE UNIT

Lower the unit onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base. On all units, horizontal or vertical, always disconnect the coupling halves and never reconnect them until all the alignment operations are complete.

Set the base on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

BASE PLATE INSTALLATION
DRAWING NO. 25LYA3478



6. LEVELING OF THE UNIT (continued)

Adjust the metal shims or wedges until the shaft of the pump and driver are level or vertical as appropriate and until pump and driver shaft are aligned with each other. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shims are in firm contact with the base.

Tighten the foundation bolts snugly, but not too firmly, and recheck the shafts for alignment before grouting.

CAUTION: THE PUMP AND THE DRIVER MOUNTING SURFACES ARE PARALLEL WHEN MANUFACTURED, AND THE PUMPS AND THE DRIVERS ARE ALIGNED AT THE FACTORY BEFORE SHIPMENT. DO NOT DISTORT THE BASE BY APPLYING UNDUE FORCES DURING THE ALIGNMENT PROCESS.

7. GROUTING

When the alignment is correct, the unit should be grouted using a high grade nonshrinking grout. The entire base should be filled with grout. Be sure to fill all gaps and voids.

Do not fill the pipe sleeves with grout.

If leveling nuts are used, make sure they are not imbedded in grout. Provide access in the grout to the leveling nuts so that they can be backed off after the grout has cured.

Allow the grout to fully cure before backing off the leveling nuts (if used) and firmly tightening the foundation bolts. Then recheck the alignment before connecting the piping.

8. PIPING

CAUTION: ALL PIPING CONNECTIONS MUST BE MADE WITH THE PIPE IN A FREE SUPPORTED STATE AND WITHOUT THE NEED TO APPLY VERTICAL OR SIDE PRESSURE TO OBTAIN ALIGNMENT OF THE PIPING WITH THE PUMP FLANGE.

CAUTION: AFTER ALL THE PIPING IS CONNECTED, THE PUMP AND DRIVER ALIGNMENT MUST BE RECHECKED.

All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pump casing. The weight of the piping and the contained liquid must be considered in support design. The suction and discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. ANY FLEXIBLE JOINTS INSTALLED IN THE PIPING MUST BE EQUIPPED WITH TENSION RODS TO ABSORB PIPING AXIAL THRUST.

The suction pipe must be air tight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. The discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line and a closing valve in the suction line. The check valve, between the pump and closing valve, protects the pump from water hammer and prevents reverse rotation in the event of power failure. The closing valves are used in priming, starting and when the pump is shut down. The pump must never be throttled by the use of a valve in the suction line.

9. AUXILIARY PIPING CONNECTIONS AND GAUGES

In addition to the primary piping connections, your pump may require connections to the water seal ring, mechanical seal and seal filter (see the "stuffing box" and "mechanical seal" sections of this manual), stuffing box drain, discharge and suction flange pressure gauges, or baseplate drain connections. All these lines and gauges should now be installed.

10. FINAL COUPLING ALIGNMENT

The final coupling alignment must be made after the piping has been connected. If realignment is requied, disconnect the piping first, then proceed with alignment. Reconnect the piping after alignment has been completed, and recheck the alignment before connecting the coupling.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

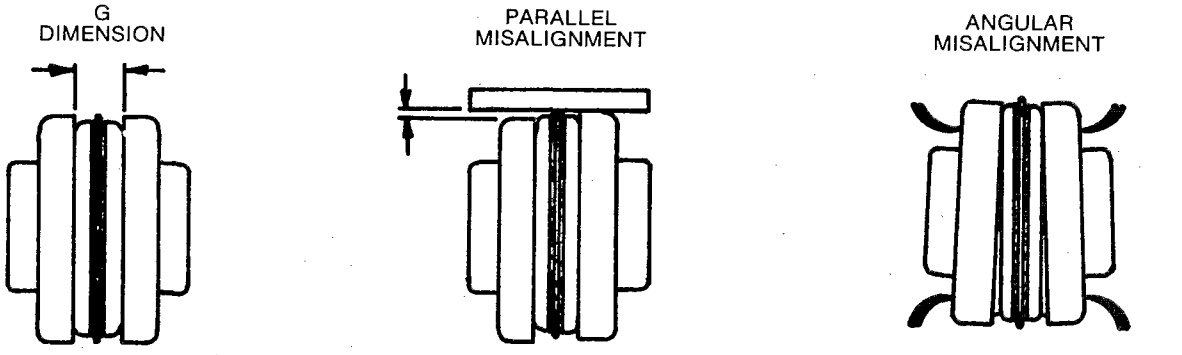
Fairbanks Morse pumps are supplied with several different types of commercial couplings. The following instructions apply to units supplied with a Woods coupling. If your unit has a different make coupling, a loose leaf instruction sheet will be attached to this manual and should be thoroughly studied before proceeding.

NOTE: FOR MAXIMUM LIFE, KEEP MISALIGNMENT VALUES AS NEAR TO ZERO AS POSSIBLE.

MAXIMUM ALLOWABLE MISALIGNMENT — WOODS COUPLINGS (Dimensions In Inches)

Sleeve Size	G Dimension	Types E & N		Type H*	
		Parallel	Angular	Parallel	Angular
4	5/8	.005	.021	—	—
5	3/4	.007	.028	—	—
6	7/8	.007	.035	.005	.008
7	1	.010	.040	.006	.010
8	1 1/8	.010	.047	.007	.012
9	1 7/16	.012	.054	.008	.014
10	1 5/8	.012	.064	.010	.016
11	1 7/8	.016	.075	.011	.018
12	2 5/16	.016	.087	.012	.021
13	2 11/16	.020	.092	.015	.025
14	3 1/4	.022	.121	.017	.030
16	4 3/4	.031	.165	—	—

The coupling type is printed on the sleeve.
*Type H sleeves SHOULD NOT be used as direct replacements for EPDM or Neoprene sleeves.



TYPICAL COUPLING ALIGNMENT

24LYA3477

A. Use a blunt screwdriver to slip the wire ring out of its groove and remove the two piece sleeve.

   Check the G dimension. If it is not as listed in the preceeding table, loosen one flange of the coupling and reposition it to achieve the specified G dimension.

   (NOTE: On a sleeve bearing electric motor, the armature should be at it's electrical center when the G dimension is measured.)

B. Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling **DO NOT ROTATE THE COUPLING.** If the maximum offset exceeds the figure shown under "Parallel" in the preceeding table, realign the coupling.

10. FINAL COUPLING ALIGNMENT (continued)

C. Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions. **DO NOT ROTATE THE COUPLING.** The difference between the maximum and minimum must not exceed the figure shown under "Angular" in the preceeding table. If a correction is required, you must recheck the parallel alignment.

D. If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

WARNING: CHECK SAFETY CODES, AND ALWAYS INSTALL PROTECTIVE GUARD OR SHIELD AS REQUIRED BY THE VARIOUS FEDERAL, STATE AND LOCAL LAWS AND THE REGULATIONS CONCERNING OSHA.

WARNING: COUPLING SLEEVES MAY BE THROWN FROM THE ASSEMBLY WHEN SUBJECTED TO A SEVERE SHOCK LOAD.

11. DOWELLING

A. Horizontal Pumps

After the piping is connected and the final coupling alignment completed, the pump and driver should be drilled, reamed and dowelled to the baseplate using a minimum of two dowels each for the pump and driver.

B. Close Coupled Pumps

After the final coupling alignment is completed, the motor should be drilled, reamed and dowelled to the high ring base.

12. FLEXIBLE SHAFTING ALIGNMENT

WARNING: THE WEIGHT OF THE INTERMEDIATE VERTICAL SHAFTING MUST NOT BE SUPPORTED BY THE PUMP BEARINGS. IF THE WEIGHT OF THE SHAFTING CANNOT BE SUPPORTED BY THE DRIVER BEARINGS, A SPECIAL THRUST BEARING SHOULD BE INSTALLED BELOW THE DRIVER.

For installation and alignment of intermediate flexible shafting, refer to the manufacturer's manual.

13. ROTATION

Before connecting the coupling halves, bump start the driver and verify rotation is in the proper direction. The correct pump rotation is indicated by a directional arrow on the pump casing.

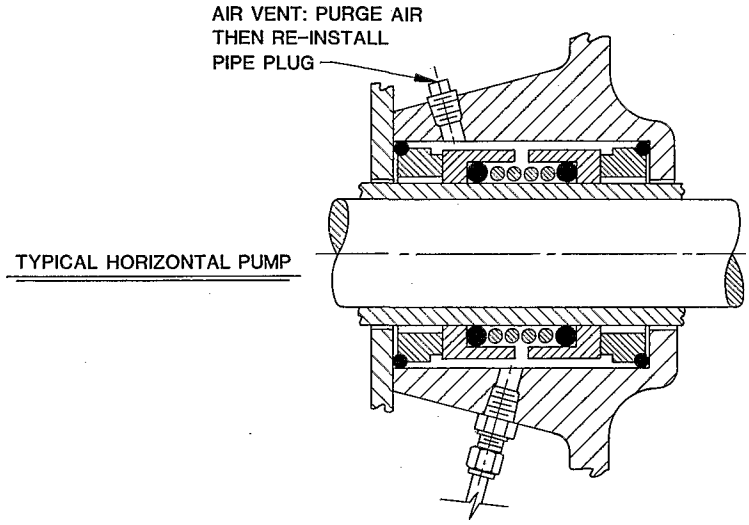
14. MECHANICAL SEALS

CAUTION: DRY OPERATION OF THE PUMP MAY CAUSE DAMAGE TO THE MECHANICAL SEAL AND IMPELLER.

Optional double face mechanical seals having two sealing surfaces are supplied when specified. The seal manufacturer's instructions furnished with pump must be followed.

The double mechanical seals must be lubricated and cooled by clean or filtered liquid supplied to the bottom (lowest) seal housing pipe connection.. Before starting the pump, all air and oil used for storage protection must be vented out through the upper (highest) seal housing pipe connection.

TYPICAL DOUBLE FACE MECHANICAL SEAL



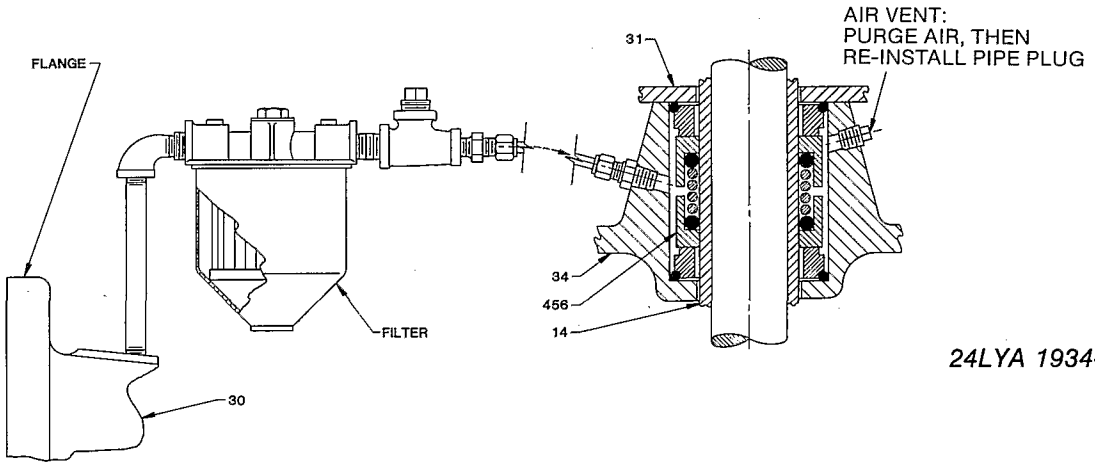
If an outside source of seal liquid is used, a pressure of 0 to 10 PSI higher than maximum pump discharge pressure must be maintained in the seal housing.

For operation of mechanical seals at higher pressures, circulation of the liquid may be required. Refer to the seal manufacturer's instructions for specifics.

15. OPTIONAL FILTER SYSTEM FOR MECHANICAL SEAL

Some small loss of seal box fluid will occur due to vaporization of the fluid film between the seal faces, therefore, a filter capable of trapping particles larger than 25 microns is recommended for all dead-headed seals. Install the filter in the primary line between the ¼" volute discharge tap and the seal housing connection. Either ¼" or ⅜" tubing may be used. Under normal conditions, replace the filter element ever 3-4 months. If the pumped fluid contains minerals or particles which tend to precipitate, a separate seal liquid source may be required.

OPTIONAL DEADHEADED FILTER SYSTEM FOR MECHANICAL SEAL



24LYA 1934-104

OPERATION

This section contains general rules for operation of B5700 Solids Handling Pumps. Variations may exist in a particular installation between the pumps, the drivers and the accessory equipment. Therefore, specific operating instructions are not within the scope of this manual.

CAUTION: BEFORE STARTING OR OPERATING THE PUMP, READ THIS ENTIRE MANUAL, AND ESPECIALLY COMPLY WITH THE FOLLOWING INSTRUCTIONS:

A. BEFORE STARTING THE PUMP, ROTATE THE UNIT OR ASSEMBLY BY HAND TO ASSURE ALL MOVING PARTS ARE FREE.

B. BEFORE STARTING THE PUMP, INSTALL CLOSED GUARDS AROUND ALL EXPOSED ROTATING PARTS.

C. OBSERVE ALL CAUTION OR DANGER TAGS ATTACHED TO THE EQUIPMENT.

D. NEVER RUN THE PUMP DRY AS THE INTERNAL PARTS ARE WATER LUBRICATED. RUNNING DRY MAY RESULT IN PUMP SEIZURE.

E. BEFORE STARTING THE PUMP, FILL THE CASING AND SUCTION LINE WITH LIQUID. THE PUMP MAY BE PRIMED BY USING AN EJECTOR OR VACUUM PUMP.

F. BEFORE STARTING A MECHANICAL SEAL PUMP, TURN ON THE SEAL WATER, VENT THE SEAL HOUSING AND CONFIRM SEAL WATER IS AT SUFFICIENT PRESSURE.

G. BEFORE STARTING A PACKED BOX PUMP, ADJUST THE PACKING GLAND SO THERE IS SUFFICIENT LEAKAGE TO LUBRICATE THE PACKING AND ASSURE A COOL STUFFING BOX (SEE MAINTENANCE INSTRUCTIONS).

H. IF EXCESSIVE VIBRATION OR NOISE OCCURS DURING OPERATION, SHUT THE PUMP DOWN AND CONSULT A FAIRBANKS NIJHUIS REPRESENTATIVE.

1. OPERATING AT REDUCED CAPACITY

In a typical application covering a wide range of flow rates, a variable speed driver is often used to adjust pump capacity. This intent is taken into consideration by Fairbanks Nijhuis when selecting the pump and impeller trim. Although these pumps are applicable over a wide range of operating conditions, care should be exercised when doing so, especially when the actual conditions differ from the sold-for conditions. You should always contact your nearest Fairbanks Nijhuis distributor or factory before operating the pumps at any condition other than that for which they were sold.

2. PRIMING

Since the pumped medium is used to lubricate various internal parts, running a centrifugal pump dry can result in extensive damage and possible seizing. Therefore, it is imperative that the pump be primed prior to initial start-up and that the prime be maintained throughout subsequent start-stop cycles.

The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

A. Positive suction head –

1. Open the vent at the highest point on the pump casing.
2. Open all suction valves.
3. Allow the liquid to flow from the vent hole until all air bubbles are vented and then close the vent.
4. The pump is now primed.

B. Negative suction head —

1. Install the priming system on the vent at the highest point of the pump casing.
2. Close the discharge valve.
3. Open the suction valve.
4. Start the priming system.
5. Run the priming system until a continuous stream of liquid flows through the vent line, and then close the valve to the vent.
6. The pump is now primed.

3. STARTING THE PUMP

A. After the pump is primed, and with the discharge valve closed and the suction valve open, start the driver according to the driver manufacturer's instructions.

B. Open the discharge valve slowly to prevent water hammer.

C. Immediately after the pump has been started, check bearing temperature, stuffing box lubrication and operation, and pump noise level. Continue to monitor those values for the first several hours of operation.

4. BEARING OPERATING TEMPERATURE

These pumps are designed to operate over a wide ambient temperate range. The bearing temperature, when measured on the outside surface of the bearing housing, should normally be around 130° with ambient temperature of 70°F. High speed operation may have higher bearing temperatures but these temperatures should not exceed 190°F. Temperatures in excess of 190°F may indicate a lack of lubricant, or bearing problems. If the temperature exceeds 190°F, the pump should be stopped and the cause determined and corrected.

5. TROUBLESHOOTING OPERATING PROBLEMS

If you have followed the installation and start up procedures outlined in this manual, your pump should provide reliable service and long life. However, if operating problems do occur, significant time and expense can be saved if you use the following check list to eliminate the most common causes of those problems.

INSUFFICIENT DISCHARGE PRESSURE OR FLOW

1. Pump not primed.
2. Speed too low. Check driver.
3. Discharge head too high.
4. Suction lift too high.
5. Wrong direction of rotation.
6. Air leaks into suction piping, stuffing box or gaskets.
7. Impeller passage partially plugged.
8. Impeller damaged.
9. Impeller running clearance too large.
10. Insufficient suction line submergence.
11. Air in liquid.
12. Impeller diameter too small.
13. Insufficient net positive suction head.

LOSS OF SUCTION DURING OPERATION

1. Suction line leaks.
2. Water seal line to packing box is plugged.
3. Suction lift too high.
4. Air or gases in liquid.
5. Air leaks into suction piping, stuffing box or gaskets.
6. Wrong direction of rotation.
7. Insufficient suction line submergence.

VIBRATION OR NOISE

1. Misalignment between driver and pump.
2. Foundation bolts loose or defect in grouting or foundation.
3. Mechanical defects:
   Shaft bent.
   Rotating element binds.
4. Head lower than rating, pumps too much liquid.
5. Pipe strain — improperly supported or aligned.
6. Pump running at shut-off condition.
7. Insufficient suction line submergence.
8. Air in liquid.
9. Impeller passages plugged.

OVER-HEATING

1. Bearings:
   Excessive grease.
   Shaft bent.
   Rotating element binds.
   Pipe strain.
   Insufficient bearing lubrication.
   Incorrect type grease.
2. Packing box:
   Packing gland too tight.
   Water seal line plugged.
   Air not vented out of mechanical seal.
   Flushing water not circulating for mechanical seal.

EXCESSIVE POWER CONSUMPTION

1. Speed too high.
2. Head lower than rating, pumps too much liquid.
3. Specific gravity or viscosity of liquid pumped is too high.
4. Mechanical defects:
   Shaft bent.
   Rotating element binds.
5. Misalignment.
6. System head lower than design.
7. Incorrect diameter impeller.

1. MAINTENANCE HISTORY

DATE	MAINTENANCE PERFORMED	PART(S) USED	SYMBOL NUMBER(S)

2. INSPECTION AND PREVENTATIVE MAINTENANCE REQUIREMENTS

To assure satisfactory operation of the pump, daily inspection and periodic maintenance are required. We suggest that an inspection and maintenance log be kept and that the inspector immediately report any problems. A guide for preventative maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspection and service.

ITEM	ACTION REQUIRED	FREQUENCY (HOURS OF OPERATION)
Packing Box	Inspect for excess leakage. Adjust gland and replace packing	150 Hours As Necessary
Mechanical Seal Filter	Replace or Clean	4,000 Hours
Pump Alignment	Check for change in alignment.	ANNUALLY
Vibration	Check for change in vibration	ANNUALLY
Bearings	Lubricate	Every 2,000 hours of operation, but at least once a year

3. BEARING LUBRICATION

Standard B5700 pumps are furnished with grease lubricated bearings.

Under normal operating conditions, the bearings must be lubricated after every 2,000 hours of running time, but at least once a year regardless of total operating hours.

CAUTION: ANY APPLICATION WITH ABNORMAL HEAT, MOISTURE, DUST, ETC., MAY REQUIRE A CHANGE IN THIS SCHEDULE AND YOU SHOULD REFER TO A LUBRICATION ENGINEER OR THE FACTORY FOR SPECIFIC INSTRUCTIONS.

CAUTION: THE GREASES RECOMMENDED IN THIS MANUAL WILL PROVIDE SATISFACTORY LUBRICATION OVER A WIDE TEMPERATURE RANGE. THERE IS, HOWEVER, A PRACTICAL LIMIT AND OPERATION OF THE PUMP SHOULD BE DISCONTINUED AND THE FACTORY CONSULTED IF THE TEMPERATURE, WHEN MEASURED ON THE OUTSIDE OF THE BEARING HOUSING, EXCEEDS 190°F.

RECOMMENDED GREASE: N.L.G.I. No. 2 lithium base multi-purpose with a mineral oil viscosity of 950-1250 SUS at 100°F., and 30-82 SUS at 210°F.

Proceed as follows for bearing lubrication:

WARNING: EXTREME CARE SHOULD BE EXERCISED AND STEPS TAKEN TO INSURE THAT THE DRIVER CANNOT BE ACCIDENTALLY STARTED. KEEP HANDS, FINGERS, CLOTHING AND ANY TOOLS AWAY FROM THE COUPLING. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY.

A. Stop the unit. Remove the grease drain plug and connect a grease gun to the lubrication fittings.
B. Start the unit and inject grease until the old grease is relieved through the drain opening. Check for blockage by caked grease and remove the blockage with a mechanical probe.
C. Immediately after lubrication, bearing teamperatures may rise above the normal level. Continue running the unit until bearing temperatures stabilize at the normal level and grease stops seeping at the grease drain opening.
D. Stop the unit, remove the grease gun, wipe off the relieved grease, and replace the plug.
E. Start the unit and resume normal operation.

4. STUFFING BOX

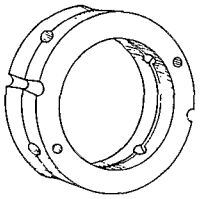
The stuffing boxes on Fairbanks Morse pumps are packed at the factory. All packing is subject to wear and should be given regular inspections. Generally, packed box pumps should be checked for excessive leakage every 150 hours of operation and the glands should be readjusted if necessary.

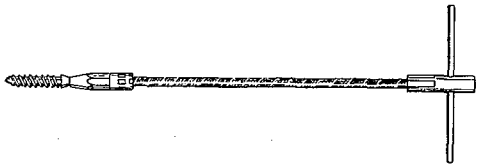
Adjustment is accomplished by lightly tightening the gland nuts, and then loosening them so they can be adjusted with finger pressure to allow a small flow of liquid to lubricate the packing. If the flow of liquid has increased and cannot be reduced by a slight tightening of the gland, replace the packing and/or shaft sleeve.

CAUTION: DO NOT TIGHTEN THE GLAND TO STOP ALL LEAKAGE. LEAKAGE IS NECESSARY TO INSURE THE COOLING, FLUSHING AND LUBRICATION OF THE PACKING AND TO PREVENT SHAFT SLEEVE DAMAGE.

The stuffing box is fitted with a water seal ring. The sealing chamber should be connected to a source of clear, fresh water. The recommended water pressure is 5 psi above the maximum pump discharge pressure.

If water is not available, grease lubrication is acceptable.





5. PACKING REPLACEMENT

Use genuine Fairbanks Morse replacement packing. The replacement procedure should be as follows:

A. Stop the pump.

B. Unbolt and remove the gland.

C. Use a flexible Packing Tool* with a hook attachement for removal of the packing, and with a wood screw attachment for removal of the water seal ring. The water seal ring contains several holes for the packing tool.

Note the location of the water seal ring relative to the number of packing rings on each side of the water seal ring.

*The Packing Tool can be purchased from the factory.

D. Clean the packing box and shaft sleeve.

E. Inspect the shaft sleeve for wear or rough finish and replace the sleeve with a genuine Fairbanks Morse sleeve if necessary.

F. Install the new packing and water seal ring in the following order: 3 rings packing, water seal ring, two rings packing.

CAUTION: STAGGER THE PACKING END JOINTS 180° AND FIRMLY SEAT EACH RING OF PACKING AS YOU INSTALL IT.

The following table gives the pertinent stuffing box, water seal ring and packing dimensions.

PUMP SIZE FRAME SIZE	10" and 12" T40	14" and 16" T60
Stuffing Box O.D. Sleeve	3	3⅝
I.D. Box	4	4⅝
Box Depth	3¾	3¾
Packing Size	½	½
Rings of Packing Per Box	5	5
Water Seal Ring Width	1	1

G. Reinstall the gland and tighten the gland nuts.

H. Loosen the gland nuts so they can be adjusted with finger pressure to obtain the correct leakage for lubrication after start up.

6. WEAR RING ALLOWABLE CLEARANCE

B5700 pumps use radial wear rings. We recommend ring replacement with genuine Fairbanks Morse wear rings when the clearance exceeds the values given below, or when deterioration of pump performance becomes noticeable.

PUMP SIZE	10″ and 12″	14″ and 16″
Maximum impeller ring to suction head ring diametral clearance	0.090	0.120

7. PUMP DISASSEMBLY — ALL B5700 MODELS

CAUTION: READ THIS ENTIRE DISASSEMBLY PROCEDURE AND REFER TO THE SECTIONAL DRAWINGS IN THIS MANUAL BEFORE PROCEEDING.

Major maintenance beyond lubrication and replacement or adjustment of the packing will require disassembly of the pump. The following are step-by-step instructions.

A. Lock out the power to the driver and close the suction and discharge valves. Drain the pump, disconnect and remove the coupling or flexible shafting and the thrust bearing deflector (126B). Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication, grease lines, etc.)

B. Remove the capscrews holding the frame adapter (34) to the volute (30), but leave in the capscrews that hold the frame adapter (34) to the frame (90).

C. Install an eyebolt of adequate strength in the tapped (coupling) end of the shaft (4) and remove the frame (90) and rotating assembly from the volute (30).

CAUTION: THE USE OF A CRANE OR HOIST OF ADEQUATE CAPACITY IS RECOMMENDED.

D. Support the frame and rotating assembly in a horizontal position and remove the impeller capscrew (9) and impeller washer (9A). Because the impeller capscrew (9) is installed with Loctite, it may be necessary to heat the capscrew to approximately 450°F. to break the bond.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT REISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.

E. Remove the impeller (1) and the impeller key (102) from the shaft (4). The impeller (1) and shaft (4) have a straight bore with close tolerance fits, and it will be necessary to use a wheel puller or similar device. Also, because the impeller is installed wih Loctite, it may be necessary to heat the impeller (1) hub to approximately 450° F. to break the bond.

CAUTION: CARE SHOULD BE TAKEN NOT TO DAMAGE THE IMPELLER WHEN USING A PULLER OR SIMILAR DEVICE. ATTACH THE PULLER OR OTHER EQUIPMENT AT THE IMPELLER VANE AREA ONLY, DO NOT USE THE IMPELLER SHROUD.

F. If the impeller (17) or fronthead (16) wear rings require replacement, they should be replaced with genuine Fairbanks Morse wear rings.

The wear rings (16 and 17) are secured by a press fit and Loctite. The rings may be removed by heating them to approximately 450° F. to break the Loctite bond, and then tapping them with a brass or copper mallet. If heating fails to affect removal, the rings may be ground off.

WARNING: TO PREVENT POSIBLE SERIOUS PERSONAL INJURY, EXTREME CARE SHOULD BE EXERCISED TO SELECT THE PROPER GRINDING EQUIPMENT, AND APPROVED SAFETY GLASSES MUST BE WORN WHEN GRINDING.

7. PUMP DISASSEMBLY (continued)

G. If your pump uses packing (212), loosen the packing box gland (19).

If your pump uses a mechanical seal (456), remove the two bolts securing the solid gland (31) to the frame adapter (34) and slide the solid gland (31) away from the frame adapter (34).

H. Remove the capscrews that secure the frame adapter (34) to the frame (90) and remove the frame adapter (34) and radial bearing deflector (126A).

On pumps equipped with a mechanical seal (456), remove the mechanical seal (456) and solid gland (31) from the shaft/shaft sleeve assembly.

On pumps equipped with packing (212), remove the gland (19), packing (212) and water seal ring (10) from the frame adapter (34).

I. Remove the capscrews that secure the thrust bearing housing (139) and thrust bearing housing cover (159) to the frame (90).

J. Remove the shaft assembly from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4) in Step C of these instructions.

CAUTION: THE USE OF A CRANE OR HOIST OF ADEQUATE CAPACITY IS RECOMMENDED.

K. Remove the thrust bearing housing cover (159) and slide the thrust bearing housing (139) away from the thrust bearings (168).

L. Remove the bearing locknut (161) and lockwasher (162). Use a bearing puller or similar device to remove the radial (163) and thrust (168) bearings.

Remove the thrust bearing grease retainer (206B).

Remove the radial bearing grease retainer (206A) on the 14" and 16" pumps (T60 frame). The 10" and 12" pumps (T40 frame) have no separate grease retainer.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY AND DAMAGE TO THE BEARING, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.

CAUTION: BECAUSE OF POSSIBLE DAMAGE OR CONTAMINATION DURING REMOVAL, BEARINGS AND GREASE RETAINERS SHOULD NOT BE REUSED AND NEW BEARINGS AND GREASE RETAINERS SHOULD ALWAYS BE INSTALLED.

M. The shaft sleeve (14) is secured with Loctite. Heat it to approximately 450°F to break the Loctite bond.

Remove the shaft sleeve (14) from the shaft (4).

N. Remove the lip seal (159A) from thrust bearing housing cover (159), and the lip seal (140A) from the frame (90).

CAUTION: BECAUSE OF POSSIBLE DAMAGE DURING DISASSEMBLY, LIP SEALS SHOULD NOT BE REUSED AND NEW LIP SEALS SHOULD ALWAYS BE INSTALLED.

O. The pump disassembly is now complete. All parts should be thoroughly cleaned and inspected for wear or damage and replaced if required.

8. PUMP ASSEMBLY

CAUTION: READ THIS ENTIRE ASSEMBLY PROCEDURE BEFORE STARTING.

The following are step-by-step instructions for assembly of the pump and are essentially the reverse order of the instructions for disassembly.

8. PUMP ASSEMBLY (continued)

Thoroughly clean all parts to remove all oil, grease and any foreign material. Inspect for wear or damage and replace if required. Remove all parts to a clean and dust-free location for assembly. Gaskets, lip seals, grease retainers and bearings should not be reused and should always be replaced with genuine Fairbanks Nijhuis® replacement parts.

A. Install the lip seals (140A and 159A) in the fram (90) and thrust bearing housing cover (159).

B. Preheat the thrust bearing (168) (two thrust bearings on the T60 frame) and radial bearing (163) in an oil bath or oven.

CAUTION: WHEN HEATING BEARINGS DO NOT EXCEED 250° F.

C. On 14" and 16" (T60 frame) pumps, install the radial bearing grease retainer (206A) on the shaft (4). On 10" and 12" (T40 frame) pumps have nonradial bearing grease retainers.

D. Install the radial (163) bearing on the shaft (4). On 10" and 12" (T40 frame) pumps, see the sectional drawings for proper bearing shield position.

WARNING: TO PREVENT DAMAGE TO THE BEARINGS, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.

E. Slide the thrust bearing housing (139) over the shaft (4).

F. Install the thrust bearing grease retainer (206B) on the shaft (4).

G. Install the thrust bearings (168) on the shaft (4) in a back-to-back position on 14" and 16" pumps. See the sectional drawings in this manual for proper bearing configuration.

The 10" and 12" pumps are equipped with a single double-row thrust bearing which will accept thrust in both directions.

Install the bearing lockwasher (162) and bearing locknut (161) on the shaft (4).

H. Pack the radial (163) and thrust (168) bearings 1/2 full with the recommended grease. (Refer to the bearing lubrication instructions in the maintenance section of this manual for specific grease recommendations.)

I. Slide the thrust bearing housing (139) over the thrust bearings (168) and install the thrust bearing cover (140).

J. Install the shaft and bearing assembly in the frame (90) and secure the thrust bearing housing (139) and thrust bearing housing cover (140) to the frame (90) with the cap screws.

K. Install the shaft sleeve (14) as follows:

CAUTION: TO ENSURE PROPER BONDING, THOROUGHLY CLEAN ALL MATING PARTS WITH SOLVENT TO REMOVE ALL GREASE, OIL, DIRT, ETC.

Apply a bead of Loctite® No. 609 completely around the shaft on the impeller end of the shaft/shaft sleeve fit. Slide the shaft sleeve (14) part way onto the shaft (4) and rotate it at least one full revolution to evenly spread the Loctite, then slide the shaft sleeve (14) over the shaft (4), until it butts firmly against the shaft shoulder.

CAUTION: ALLOW THE LOCTITE TO CURE FOR TWO HOURS BEFORE OPERATING PUMP.

L. Install the deflectors (126A and 126B) on the shaft.

M. If your pump uses a mechanical seal (456), follow these instructions and read the seal manufacturer's instructions before proceeding.

Apply a light coat of grease to the shaft sleeve (14) on the shaft sleeve/shaft assembly. Slide the solid gland (31) and mechanical seal element (456) over the shaft sleeve (14) being careful not to damage the mechanical seal (456).

CAUTION: THE GLAND AND ROTATING ELEMENT MUST BE FAR ENOUGH ONTO THE SHAFT (4) SO AS NOT TO INTERFERE WITH THE FRAME ADAPTER (34) INSTALLATION.

8. PUMP ASSEMBLY (continued)

Install the mechanical seal stationary seat (456) in the frame adapter (34). Carefully, so as not to damage the stationary seat, slide the frame adapter (34) over the shaft sleeve (14) and secure the frame adapter (34) to the frame (90) with the capscrews.

N. If your pump uses packing (212) slide the frame adapter (34) over the shaft sleeve (14) and secure the frame adapter (34) to the frame (90) with the capscrews.

O. If the impeller (17) or fronthead (16) wear rings are being replaced, they should be replaced with genuine Fairbanks Morse wear rings. Install the wear rings as follows:

CAUTION: TO ENSURE PROPER BONDING, THOROUGHLY CLEAN ALL MATING PARTS WITH SOLVENT TO REMOVE ALL GREASE, OIL, DIRT, ETC.

P. Apply a bead of Loctite No. 290 completely around the middle of the impeller (17) and fronthead (16) wearing ring fit, and pres the wear rings in place.

CAUTION: TO AVOID DISTORTION AND ENSURE PROPER INSTALLATION, BE CAREFUL TO PRESS THE WEARING RINGS EVENLY AND COMPLETELY IN PLACE. THEY SHOULD BE FIRMLY BUTTED AGAINST THE CORRESPONDING IMPELLER OR FRONTHEAD SHOULDER AT THE BOTTOM OF THE RING FIT.

Q. Thoroughly clean the impeller bore, the end of the shaft, and the shaft and capscrew threads to make sure that they are free from oil, dirt, and any foreign matter.

Inspect and measure the impeller bore, the shaft fit diameter, the key and the keyway for wear. Measure in several locations along the length of the fit. If wear is noticed and the clearance between the shaft and the impeller exceeds 0.003" anywhere along the length of the impeller bore, contact the factory for instructions for rework or replacement of the components.

Apply a sufficient amount of Loctite No. 609 to the shaft and to the impeller bore to cover the entire impeller fit area. Install the impeller key (102) in the shaft (4). Slide the impeller (1) in place, making sure it butts firmly against the shaft sleeve. Apply 3 or 4 drops of Loctite No. 609 to the capscrew threads, and with the impeller washer (9A) in place, install the capscrew and torque to the values shown in the following table.

Pump Size - Figure	Impeller Capscrew Size	Torque Foot-Pounds
10" or 12" B57x1	7/8 - 9	150
14" or 16" B57x1	1 1/4 - 7	350

CAUTION: THESE CAPSCREW TORQUE VALUES ARE FOR SAE GRADE 8 STEEL CAPSCREWS ONLY. IF OTHER MATERIAL IS USED, CONSULT WITH THE FAIRBANKS MORSE ENGINEERING DEPARTMENT FOR PROPER TORQUE VALUES.

R. Install a new volute gasket (156) and assemble the fronthead (33) to the volute (3) with the capscrews.

Install the handhole covers (202 and 290) with new gaskets (203 and 291) and secure with the capscrews.

S. Install a new volute gasket (156) and assemble the volute/fronthead assembly to the frame adapter/frame assembly with the capscrews.

T. If your pump uses packing (21), slide the packing (212) and water seal ring (10) into the stuffing box on the frame adapter (34) and install the gland (19). For packing adjustment procedures, refer to the packing replacement instructions in the maintenance section of this manual.

If your pump uses a mechanical seal (456); complete the mechanial seal installation.

Following seal manufacturers instructions and secure gland (31) with cap screws to the adapter.

U. Install all grease lines, mechanical seal lines etc.

V. The pump assembly is now complete.

ORDERING PARTS

When ordering parts, give pump serial number, size, and figure number and a complete description and item number of each part. Refer to the drawing and parts list in the back of this manual. You may order parts from your local Fairbanks Morse Distributor or directly from the factory. Consult your local telephone yellow pages for the office nearest you.

RETURNING PARTS

All materials or parts returned to the factory must have prior approval and a "Returned Goods Tag".

Contact your nearest Fairbanks Morse distributor for the Returned Goods Tag listing the material to be returned and reasons for the return. All material to be returned should be carefully packed to avoid damage in route from rough handling or exposure to weather. The "Returned Goods Tag" will give shipping instructions. All material is to be returned freight prepaid.

Fairbanks Morse makes improvements on its products from time to time and reserves the right to furnish improved parts for repairs. A part that is received and is not identical in appearance, or has a different symbol from the original part, may be interchangeable. Examine the part carefully before contacting your Fairbanks Morse representative. The parts should never be returned to the factory without first obtaining proper authorization from your Fairbanks Morse representative.

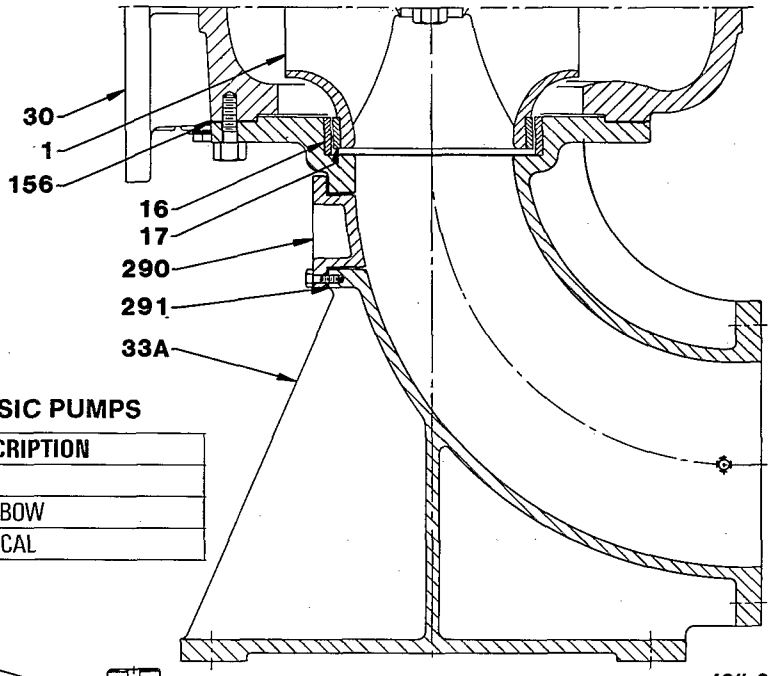
RECOMMENDED SPARE PARTS

FOR NORMAL DUTY	
REF. NO.	DESCRIPTION
14	Sleeve, Shaft
16	Wear Ring, Fronthead (If On Original Construction)
17	Wear Ring, Impeller (If On Original Construction)
126A	Deflector, Inner
126B	Deflector, Outer
140A	Seal, Grease
159A	Seal, Grease
163	Bearing, Radial
168	Bearing, Thrust
206A	Retainer, Grease, Rad. Brg (T-60)
206B	Retainer, Grease, Thrst. Brg (T-40 & T-60)
212	Packing
	Gaskets, Complete Set

FOR SEVERE DUTY ADD THE FOLLOWING:	
REF. NO.	DESCRIPTION
1	Impeller
4	Shaft

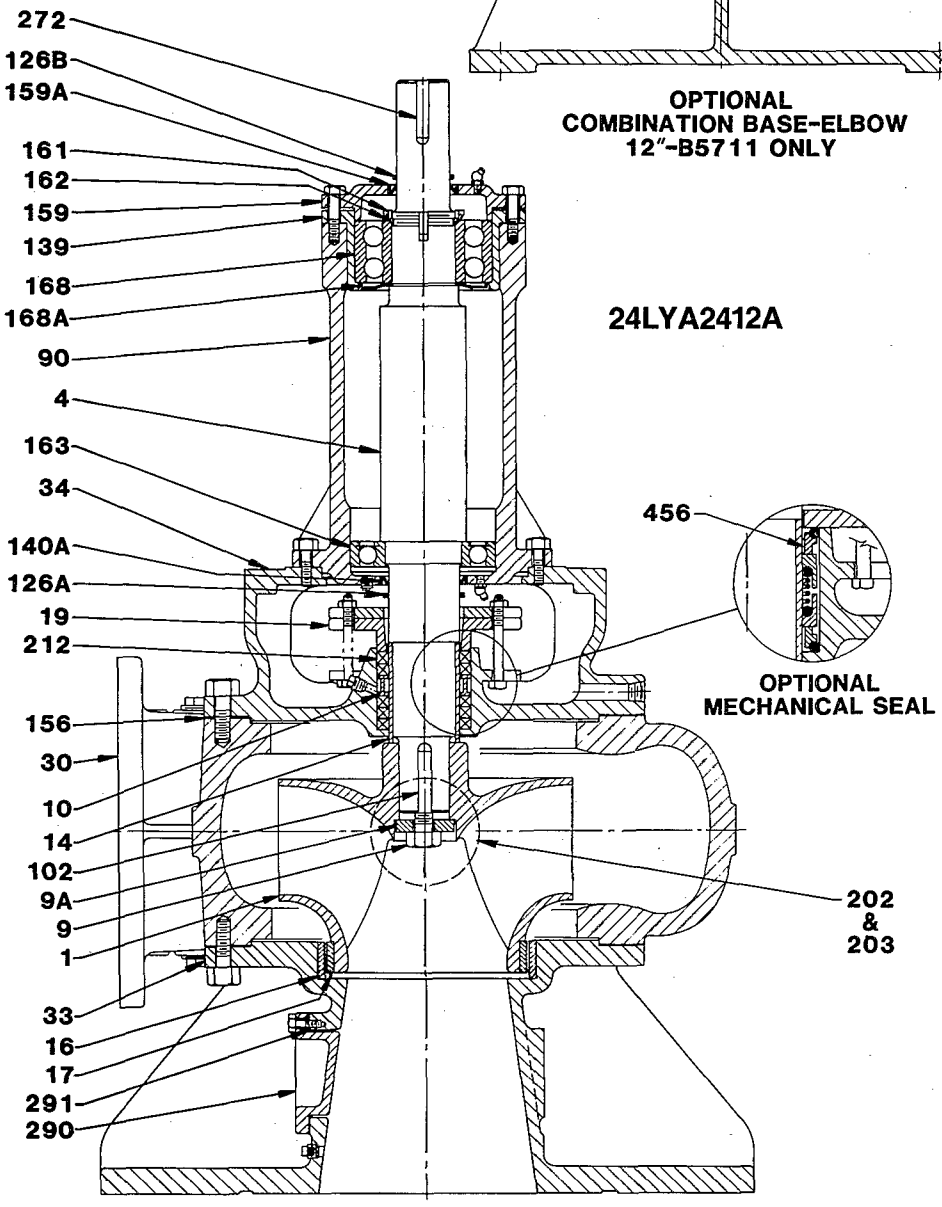
THIS PAGE INTENTIONALLY LEFT BLANK

SECTIONAL DRAWING
10" & 12" B5711 — T40 FRAME



OPTIONS TO BASIC PUMPS

REF. NO.	DESCRIPTION
31	SOLID GLAND
33A	COMB BASE/ELBOW
456	SEAL, MECHANICAL



OPTIONAL
COMBINATION BASE-ELBOW
12"-B5711 ONLY

10" & 12" B5711 — T40 FRAME
PARTS LIST

REF. NO.	DESCRIPTION
1	IMPELLER
4	SHAFT
9	CAPSCREW, IMPELLER
9A	WASHER, IMPELLER
10	RING, WATER SEAL
14	SLEEVE, SHAFT
16	WEAR RING, FRONTHEAD
17	WEAR RING, IMPELLER
19	GLAND HALF
30	VOLUTE
33	FRONTHEAD
34	ADAPTER, FRAME
90	FRAME
102	KEY, IMPELLER
126A	DEFLECTOR, RADIAL BEARING
126B	DEFLECTOR, THRUST BEARING
139	HOUSING, THRUST BEARING
140A	LIP SEAL
156	GASKET, VOLUTE
159	COVER, THRUST BEARING HOUSING
159A	LIP SEAL
161	LOCKNUT, BEARING
162	LOCKWASHER, BEARING
163	BEARING, RADIAL
168	BEARING, THRUST
202	COVER, VOLUTE HANDHOLD
203	GASKET, VOLUTE HANDHOLE COVER
206A	RETAINER, RADIAL GREASE
206B	RETAINER, THRUST GREASE
212	PACKING
272	KEY, COUPLING
290	COVER, HANDHOLE
291	GASKET, HANDHOLE

FAIRBANKS 5440
INSTALLATION AND OPERATION MANUAL

PENTAIR

FAIRBANKS NIJHUIS™

MODELS 5410, 5420 AND 5440
SOLIDS HANDLING PUMPS
INSTALLATION, OPERATION AND MAINTENANCE MANUAL

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

Part #FM-03-501 | © 2015 Pentair Ltd. | 03/19/15

LOSS OR DAMAGE IN TRANSIT:

Immediately upon receipt, a complete inspection and accounting against the packing list should be made of all major components, and accompanying boxes or pallets. All material is shipped F.O.B. our factory or our vendor's shipping point unless optional contractual arrangements are made. Under these terms, any claims for loss or damage in transit should be immediately directed to the delivering freight carrier. Fairbanks Nijhuis® will assist the customer in receiving fair compensation, but assumes no responsibility to mediate such claims. This policy includes shipments wherein Fairbanks Nijhuis pays freight costs as part of the sales terms.

If there is any indication of oil leakage from the motor oil chamber, advise the factory immediately and request instructions for proper handling.

PUMP/MOTOR IDENTIFICATION:

Carefully record all of the following data from your pump/motor nameplate. It will aid in obtaining the correct replacement parts for your pump. In addition to the nameplate, the pump serial number is also stamped on the discharge flange.

SERIAL NO
WAS 1: 10751067, 10751068 & 10751069
WAS 2: 10751001, 10751002 & 10751003

Pump:

Serial Number_____

Size_____ Model No._____

GPM_____ Head_____(feet)

BHP_____ RPM_____

Pump Weight_____ (lbs.)_____

Motor:

Horsepower_____

Serial Number_____

Motor Frame_____

Full Load Speed_____

Full Load Amps_____

ph/Hz/V_____/_____/_____

Motor Weight_____

Motor Identification Number_____

Date Placed in Service_____

INTRODUCTION:

Congratulations! You are the new owner of the finest pump commercially available. If you give it the proper care as outlined and recommended by this manual, it will provide you with reliable service and long life.

CALIFORNIA PROPOSITION 65 WARNING:

WARNING:

This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

IMPORTANT:

Read this complete manual and manuals for all component equipment before assembly or installation is started. It contains information that is the result of engineering and research efforts. It is designed to supply adequate instructions for the installation, operation and maintenance of your pump. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or unnecessary damage to the pump.

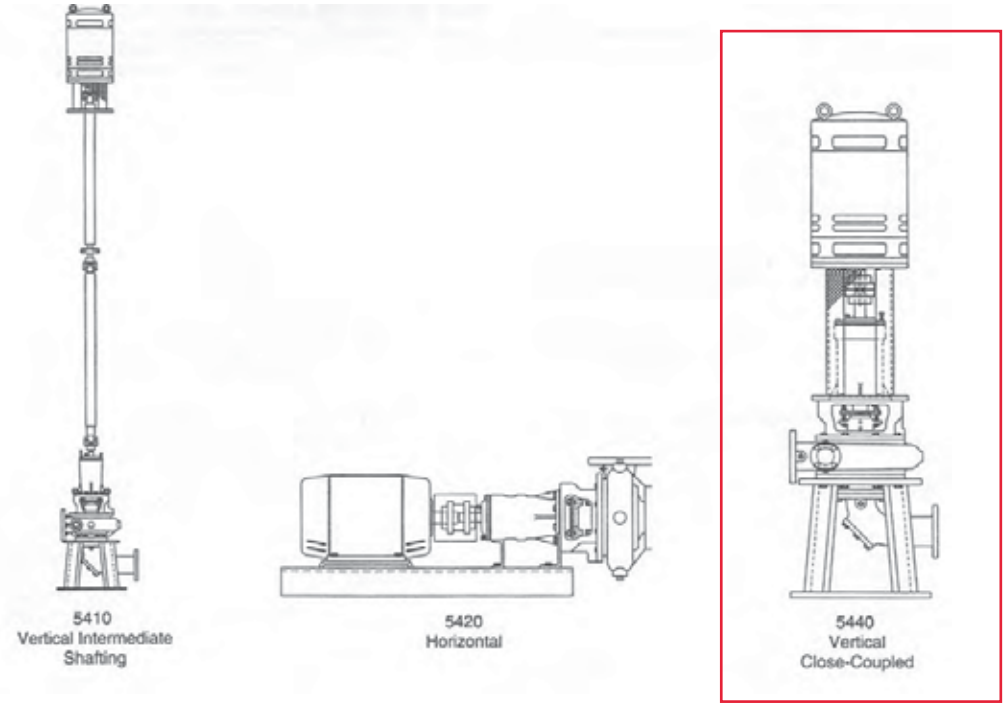
This manual applies to the pump installation, operation and maintenance. It is intended to be general and not specific. If your operating conditions ever change, always refer to the factory for reapplication. Always refer to the manuals provided by manufacturers of the accessory equipment for their separate instructions.

This manual contains installation, operation and maintenance instructions for Fairbanks Nijhuis series 5410, 5420 and 5440 solids handling pumps.

Variations exist in both the equipment used with these pumps and in the particular installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual. The manual contains general rules for installation, operation and maintenance of the pump. If there are questions regarding the pump or its application that are not covered in this manual, please contact the factory as follows: Fairbanks Nijhuis, 3501 Fairbanks Avenue, Kansas City, Kansas 66106, Phone 913-371-5000, Fax 913-748-4025.

To obtain additional data on hydraulics and pump selection and operation, we suggest you purchase both of the following reference books:

1. The Fairbanks Nijhuis *Hydraulic Handbook* available from the Kansas City factory.
2. *Hydraulic Institute Standards* from the Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054-3802



5400, 5700 and 2400 Solids Handling
PRESTART-UP AND START-UP CHECKLIST

Contractor_____ Pump Serial Number_____

Project Name_____ Pump Model Number _____

Procedure	Yes	No	N/A	Comments
1. Shipment				
Was there any damage in transit? (List)	☐	☐	☐	_____
Were all items received? (List)	☐	☐	☐	_____
2. Storage				
Has equipment been protected from the elements?	☐	☐	☐	_____
Was equipment subject to flooding?	☐	☐	☐	_____
Have storage instructions been followed?	☐	☐	☐	_____
3. Installation				
Were retaining fasteners, used in shipping, removed prior to installation?	☐	☐	☐	_____
Is grouting under base properly compacted?	☐	☐	☐	_____
Is grouting of the nonshrink type?	☐	☐	☐	_____
Have proper anchor bolts been used?	☐	☐	☐	_____
Have the bolts been properly tightened?	☐	☐	☐	_____
Have both the suction and discharge been checked for pipe strain?	☐	☐	☐	_____
Are lube lines and seal water lines properly installed?	☐	☐	☐	_____
Are accessory items, RTD's, bearing temp detectors, vibration sensors, etc. mounted and properly installed?	☐	☐	☐	_____
Are lube lines purged of air and lubricant added (pump and driver)	☐	☐	☐	_____
Are all safety guards in place?	☐	☐	☐	_____
Have impellers been checked for proper clearance?	☐	☐	☐	_____
4. Alignment				
Has the alignment of driver to pump been checked?	☐	☐	☐	_____
Have indicator readings been taken? (List)	☐	☐	☐	_____
5. Rotation				
Has the rotation of the drives been checked for correctness?	☐	☐	☐	_____
Has the coupling been turned to assure free rotation of pump and motor?	☐	☐	☐	_____
6. System				
Has the system been checked to ensure that it is free of foreign matter and purged of air which could be damaging to the pump?	☐	☐	☐	_____
Is liquid available to the pump?	☐	☐	☐	_____
Has assurance been obtained from responsible parties that all piping is secure and that the routing of flow has been established and is correct?	☐	☐	☐	_____
7. Start-Up				
Has flow been established? Flow rate:_____ GPM	☐	☐	☐	_____
Have gauge readings been taken? Suction pressure:_____psi Discharge pressure:_____psi	☐	☐	☐	_____
Has packing been adjusted to ensure proper lubrication of packing?	☐	☐	☐	_____
If pumps are equipped with mechanical seals, is the lubricating seal water pressure a constant 10 to 15 psi, above the discharge of the pump?	☐	☐	☐	_____
Is excessive vibration present?	☐	☐	☐	_____
Is bearing operating temperature excessive?	☐	☐	☐	_____
8. Safety				
Have all safety labels been read and understood?	☐	☐	☐	_____

Name_____ Date_____

SAFETY:

Safety should be of utmost importance when in close proximity of this pumping equipment. Before attempting to operate this equipment, you should read this manual in its entirety, taking special notice of all CAUTIONS, WARNINGS and/or DANGER notifications.These warnings apply to pumps supplied by Fairbanks Nijhuis. Refer to the manuals supplied by the manufacturer of accessory items for additional warnings before operating this equipment.

The words DANGER, WARNING and CAUTION have different connotations and are generally defined as follows:

DANGER:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:

WARNING indicates a potentially hazardous situation which, if not avoided, will result in a serious injury.

CAUTION:

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or may indicate that improper practices will result in equipment malfunction or failure. It may also be used to alert against unsafe practices.

IMPORTANT:

Another notation will appear throughout this manual. IMPORTANT indicates the highlight or accent of specific information.

The installation, use and operation of this type of equipment is affected by various federal, state and local laws, and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of equipment is the responsibility of the equipment owner and all necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

DANGER:

Do not attempt to service the pump until the electrical power has been disconnected and it has been verified that the pump cannot start. Because many installations use automatic starting equipment, the pump unit may start at any time without warning. Proper precautions should be taken to avoid injury as a result of automatic starting of the equipment.

DANGER:

This product has been designed specifically for operation in water or sewage. Do not use with other liquids without first consulting the factory.

WARNING:

Do not attempt to try to clean the pump with bare hands. The pumped material may contain items that may present health hazards such as needles and other sharp objects. Always wear heavy puncture-resistant gloves.

WARNING:

Before attempting to service this pump:

1. Familiarize yourself with this manual.
2. Disconnect or lock out the power source to ensure the pump will not start. Confirm power source disconnect with appropriate electrical test equipment.
3. Close the discharge valve, and if present, the suction valve.

After the pump has been installed, make certain that the pump and all piping connections are tight and are properly supported prior to start-up and operation.

WARNING:

Certain procedures in disassembly and assembly require parts be heated to high temperatures. Heat-resistant gloves must be worn when handling heated parts. Heated parts can cause severe personal injury.

After the pump has been set and grouted in place and is ready for operation, the following steps should be followed:

1. **Reinstall the packing, seal water ring and gland. Adjust in accordance with this manual. Flush the mineral oil out of the mechanical seal if unit is so equipped.**

2. **Remove bearing housing covers and remove one-half of the grease in bearing housings. Remove all grease relief fittings and grease relief nipples from upper and lower bearing housings.**
3. **Start the pump per start-up instructions and permit grease to be purged from each bearing housing. Do not install grease relief piping until purging has completely stopped after the pump has been operating for at least eight (8) hours. Observe bearing temperatures, and stop and start the pump or run it at reduced speed until temperatures stabilize within the specified limits.**
4. **Stop the pump, wipe any grease off the shaft and bearing frame and place the pump in service per instructions in this manual.**

DANGER:

Do not attempt to clean the pump until electrical power has been disconnected and it has been verified that the pump cannot start.

INTRODUCTION:

GENERAL:

The Model 5410, 5420 and 5440 pumps consist of several components. The following is a list of those major parts (or component assemblies) and a brief description of their design and function.

IMPELLER:

The impeller is a solids handling type of one piece construction, single suction, enclosed radial flow design with well-rounded leading vanes and tapered toward the trailing edge for a circular flow pattern. Waterways through the impeller have extremely smooth contours, free of sharp corners, so as to minimize rags or stringy, fibrous material from catching or clogging. The impeller is balanced and secured to the shaft by means of a bolt, impeller washer and key. The arrangement is such that the impeller cannot be loosened from torque in either forward or reverse rotation.

VOLUTE:

The volute is matched to the impeller and made of close-grained cast iron. The volute is of one-piece circular constant flow, equalizing pressure design with smooth fluid passages large enough to pass any size solid that can pass through the impeller and has a flange discharge.

FRONTHEAD:

5411, 5421 and 5441 pump frontheads are cast integrally with the volute. Model 4" 541XC and 4" 544XC pumps have a fronthead cast integrally with a combination base elbow as standard. All other models have a separately cast fronthead which directs flow to the eye of the impeller.

BACKHEAD:

Cast as a separate piece, the backhead houses the sealing box which is designed to accept conventional packing or standard mechanical seals without requiring remachining. Casting is tapped so that packing leakage can be piped directly to a drain.

FRAME/BEARING/SHAFT:

Bearing frame is machined for accurate and permanent bearing alignment and houses the bearing/shaft assembly. The shaft is accurately machined along its entire length and precision ground at bearing locations. A renewable shaft sleeve protects the shaft where it passes through the sealing box area.

541X/544X BASE AND ELBOW :

Pumps are mounted on rigid bases which are open to allow for access to the suction elbow. Bases bolt directly to the volute. Suction elbows include a cleanout opening and have flat-faced flanges conforming to ANSI drilling standards.

541XC/544XC COMBINATION BASE ELBOW :

Base and elbow are integrally cast as one piece with a flat-faced suction flange conforming to ANSI drilling standards. A hand-hole cleanout is located 180° from the suction flange.

5420 BASE:

Fabricated steel base supports the pump and driver and is designed with large access openings to facilitate grouting.

COUPLING GUARDS:

All 5410, 5420 and 5440 pumps are furnished with coupling guards.

NET POSITIVE SUCTION HEAD (NPSH):

NPSH can be defined as the head (energy that causes liquid to flow through the suction pipe and enter the eye of the impeller). NPSH is expressed in two values:

1. NPSH required (NPSHR)
2. NPSH available (NPSHA)

It is essential that NPSHA always be greater than NPSHR to prevent cavitation, vibration, wear and unstable operation.

NPSHR is a function of pump design and therefore varies with the make, size, capacity and speed of the pump. The value for your pump can be obtained from your pump performance curve. NPSHA is a function of your system and may be calculated as follows:

1. When the source of liquid is above the pump: NPSHA = barometric pressure (feet) + static suction head (feet) - friction losses in suction piping (feet) - vapor pressure of liquid (feet).
2. When the source of liquid is below the pump: NPSHA = barometric pressure (feet) - static suction lift (feet) - friction losses in suction piping (feet) - vapor pressure of liquid (feet).

Note: Suction head or suction lift on vertical pumps is measured from the datum elevation plane which is the horizontal plane that passes through the lowest point on the impeller suction vane.

LOCATION AND HANDLING:
The pump should be installed as near to the fluid as possible so a short direct suction pipe can be used to keep suction losses to a minimum. If possible, locate the pump so fluid will flow to the suction opening by gravity. Discharge piping should be direct and with as few elbows and fittings as possible.

Pump and driver should be located in an area that will permit periodic inspection and maintenance. Head and access room should be provided, and all units should be installed in a dry location with adequate drainage.

FOUNDATION:
Pump foundations should have a level surface and be of sufficient mass to prevent vibration and form a permanent rigid support. The most satisfactory foundations are concrete with anchor bolts of adequate size imbedded in the foundation in pipe sleeves with an inside diameter of 2-1/2 times larger than the bolt diameter, which will allow for final accurate positioning of the unit. Recommended anchor bolt design is available from the factory.

INSTALLATION:

GENERAL:

WARNING:

Do not pick up the complete unit by the driver eye bolts or a pump shaft eyebolt.

IMPORTANT:

Pump and driver alignment should be checked throughout the piping and grouting procedures. Once piping connections have been made and grouting completed, alignment corrections are difficult.

GROUTING:
When alignment is correct, the unit should be grouted using a high grade nonshrinking grout. The base is designed to be completely filled with grout.

CAUTION:

Damaging vibration may result if the baseplate is not solidly in contact with the grout bed.

Do not fill the anchor bolt pipe sleeves with grout.

If leveling devices are used, make sure they are not imbedded in grout. Provide access in the grout to the leveling devices (if used) so that they can be backed off or removed after the grout has cured.

Allow the grout to fully cure. Back off leveling nuts (if used) and remove shims and/or wedges. Firmly tighten the foundation bolts so the base is solidly against the grout bed. All pockets and/or holes left by removal of leveling devices are to be filled with grout. Recheck alignment before connecting the piping.

PIPING:

CAUTION:

All piping connections must be made with the pipe in a free supported state, and without the need to apply vertical or side pressure to obtain alignment of the piping with the pump flange.

All piping should be independently supported near the pump so the pipe strain will not be transmitted to the pump casing. Weight of the pipe and contained liquid must be considered in support design. Suction and discharge piping should be one or two sizes larger than the pump suction and discharge sizes, especially where piping is of considerable length. Flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust.

Suction pipe must be airtight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. Discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line and a closing valve in the suction line. The check valve, between the pump and closing valve, protects the pump from water hammer and prevents reverse rotation in the event of power failure. Closing valves are used in priming, starting and when the pump is shut down. Pumps must never be throttled by use of a valve in the suction line.

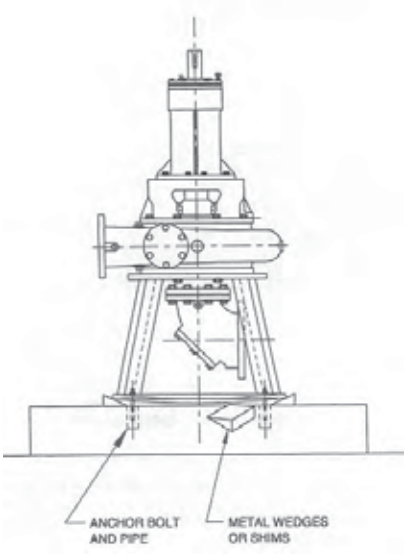
AUXILIARY PIPING CONNECTIONS:
In addition to primary piping connections, your pump may require connections to the water seal ring, stuffing box drain, baseplate drain, discharge pressure gauges or mechanical seals (if provided). All these connections should now be installed. (Refer to Mechanical Seal section of this manual.)

NOTE: For satisfactory pump operation and life, auxiliary pipe lines must be kept clean.

ROTATION:
Before connecting the motor to the pump, bump start the driver and verify rotation is in the proper direction. Correct pump rotation is indicated by a directional arrow on the pump casing.

VIBRATION AND NOISE LEVELS:
After installation is complete and the pump is put into normal service, a baseline measurement of noise and vibration levels should be made for future reference. Periodic checks should be made, as changes in either of these could indicate problems. Early detection can save expensive repairs and downtime. Refer to Troubleshooting in the operation section of this manual for simple causes and remedies.

Vibration and noise level measurements should be made with the equipment in its normal operating mode, with no unusual background noise present.



INSTALLATION 5410:

LEVELING OF THE PUMP:
Lower the pump onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base.

Set the base on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

Adjust the metal shims or wedges until the shaft of the pump is vertical. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow the same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shim are in firm contact with the base.

Tighten the foundation bolts snugly, but not too firmly and with a good quality machinist's level check that the shaft is vertical in two vertical planes. Refer to the Grouting section.

FLEXIBLE SHAFT AND DRIVER:

CAUTION:

Carefully read the manufacturer's installation instructions supplied with the shafting and driver.

Refer to the unit setting plan supplied with your pump.

Install flexible shafting per installation instructions as provided by the shafting manufacturer.

The driver is normally mounted on a high ring base. This base should be mounted on a level foundation and grouted in place. Refer to the Grouting section of this manual.

The high ring base should be leveled prior to grouting. Check the level on the machined surface of the high ring base in two horizontal planes using a good quality machinist's level.

INSTALLATION 5420:

LEVELING OF THE PUMP:

Lower the unit onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base. Disconnect the coupling halves.

Set the base on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

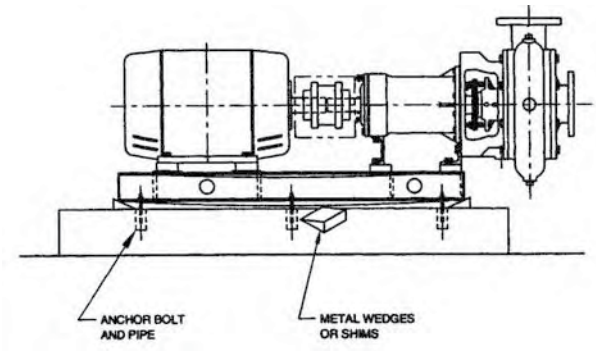
Adjust the metal shims or wedges until the shaft of the pump and driver are level. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow the same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shims are in firm contact with the base.

Tighten the foundation bolts snugly, but not too firmly, and recheck the shafts for being level before grouting. Motor and pump shafts should also be in close alignment prior to grouting. If not in close alignment, determine the cause for misalignment and correct. Refer to the Grouting section.

IMPORTANT:

Pump and driver alignment should be checked throughout the piping and grouting procedures. Once piping connections have been made and grouting completed, alignment corrections are difficult.



FINAL COUPLING ALIGNMENT:

CAUTION:

Check safety codes, and always install protective guard or shield as required by the various federal, state and local laws and the regulations concerning OSHA.

The final coupling alignment must be made after the piping has been connected. Realign as required. If sufficient adjustment is not achieved, piping may have to be disconnected to properly align the coupling. Reconnect the piping and recheck coupling alignment.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

Fairbanks Nijhuis pumps may be supplied with one of several different types of commercial couplings. Refer to coupling drawings and alignment tables in this manual and/or the coupling manufacturer's installation and alignment instructions which may be supplied with the pump.

PERIODIC ALIGNMENT CHECK:

Coupling misalignment can occur because of shifts in grouting and/or foundations, or because of large objects going through the pump causing shock loading conditions.

Coupling alignment should be checked periodically for changes. Coupling misalignment can lead to or cause bearing failure, coupling failure, shaft breakage and high power consumption.

Refer to the coupling alignment tolerances found in this manual or the coupling manufacturer's alignment instructions that may have been supplied with the pump.

V-BELT DRIVE:
Pumps coupled to its driver by means of V-belts and sheaves may have been shipped separately from the drive components. Refer to the driver manufacturer's literature for installation, operation and maintenance instructions.

INSTALLATION 5440:

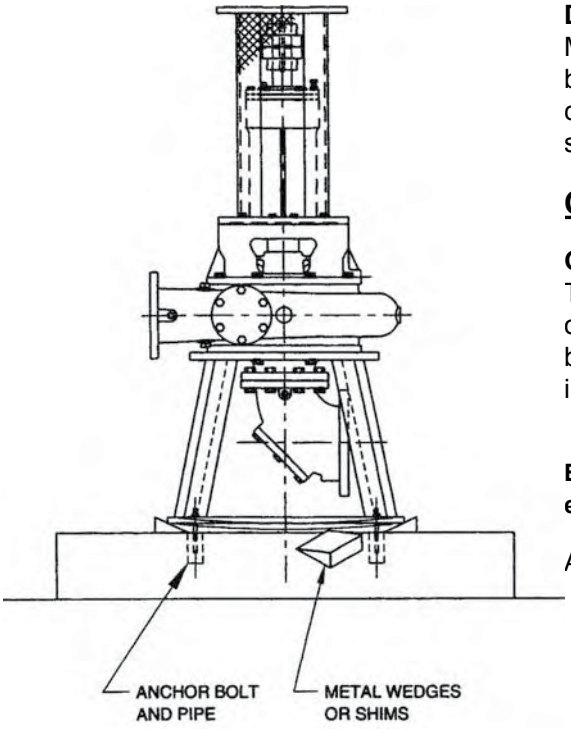
LEVELING OF THE PUMP:
Lower the pump onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base. Disconnect the coupling halves.

Set the base on metal shim or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

Adjust the metal shims or wedges until the shaft of the pump is vertical. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow the same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shims are in firm contact with the base.

Tighten the foundation bolts snugly, but not too firmly, and with a good quality machinist's level check that the shaft is vertical in two vertical planes. Refer to the Grouting section.



DRIVER INSTALLATION:
Mount the driver on the driver pedestal and secure with proper bolting. Units are self-aligning. If you experience difficulty with the coupling connection, contact the factory for assistance prior to starting the pump.

OPERATION:

GENERAL:
This section contains applicable start-up and break-in procedures for operation. Because variations may exist in a particular installation between pumps, drivers and accessory equipment, specific operating instructions are not within the scope of this manual.

CAUTION:

Before starting or operating the pump, read this entire manual and especially comply with the following instructions:

A. Before starting the pump:
   1. Rotate the shaft by hand to assure all moving parts are free.
   2. Install guards around all exposed rotating parts.
   3. Fill the casing and suction line with liquid. The pump may be primed by using a priming system.

B. Observe all caution or danger tags attached to the equipment.
C. Never run the pump dry as the close running fits within the pump are lubricated by the liquid. Running dry may result in pump seizure.
D. If excessive vibration or noise occurs during operation, shut the pump down and consult the Troubleshooting guide or a Fairbanks Nijhuis representative.

WET WELL DESIGN:
It is required that an evenly distributed flow of nonaerated water be supplied to the pump suction. Improper wet well or sump design, or insufficient suction pipe submergence can result in vortexing which reduces the pump's performance and can cause severe damage to the pump.

NORMAL OPERATING PROCEDURES:

Monitor the following during running cycles:

A. Unit vibration or noise.
B. Driver lubrication.
C. Pump lubrication.
D. Packing box leakage.

Check the following before normal start-up:

A. Driver lubrication (refer to driver operating manual)
B. General condition of all equipment.

PRIMING:

The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

A. Positive suction head.
   1. Open the vent on the highest point of the pump casing.
   2. Open all suction valves.
   3. Allow liquid to flow from the vent hole until all air bubbles are vented, then close the vent.
   4. Pump is now primed.

B. Negative suction head.
   1. Install the priming system on the vent at the highest point of the pump casing.
   2. Close the discharge valve.
   3. Open the suction valve.
   4. Start the priming system.
   5. Run the priming system until a continuous stream flows through the suction line, then close the vent valve.
   6. The pump is now primed.

STARTING THE PUMP:

A. After the pump is primed, the discharge valve closed, and the suction valve open, start the driver according to the driver manufacturer's instruction.
B. Open the discharge valve slowly to prevent water hammer.
C. Immediately after the pump has been started, check bearing temperature, stuffing box lubrication and operation, and pump noise level. Continue to monitor these values for the first several hours of operation.

BEARING OPERATING TEMPERATURE

These pumps are designed to operate over a wide ambient temperature. The temperature, when measured on the outside surface of the bearing housing, should not exceed 190° F . Temperatures in excess of 190° F may indicate a lack of lubricant or bearing problems. If temperatures exceed this limit, the pump should be stopped and the cause investigated and corrected.

REGULATING/CONTROL PROCEDURE:

Pump stations are usually designed to have the pumps started and stopped automatically using a controller. Since this is a function of station design, the operators should be thoroughly familiar with the system's operating parameters and the use of the controller.

STOPPING THE PUMP:

A. Disconnect the electrical power and lock out the power to the driver.

DANGER:

B. Check power source with appropriate electrical test equipment to ensure driver cannot accidentally start.

EMERGENCY PROCEDURES:

Many installations are equipped with emergency shutoff switches near the pump location. These locations should be plainly marked and be readily accessible at all times.

The control panel (if used) may be equipped with an emergency stop button or switch.

IMPORTANT:

The operator or persons working around the equipment should be familiar with locations of emergency shutoff points.

A. Emergency Start-up.
   1. Open the suction valve.
   2. Start the driver.
   3. Open the discharge valve.

B. Emergency Shut-down.
   1. Shut off the power at the nearest switch.

OPERATING AT REDUCED CAPACITY:
Typical applications cover a wide range of flow rates, and a variable speed driver is often used to adjust the pump capacity, which is taken into consideration by Fairbanks Nijhuis when selecting the pump and impeller trim. Although these pumps are applicable over a wide range of operating conditions, care should be exercised when doing so, especially when actual conditions differ from sold conditions. Always contact your nearest Fairbanks Nijhuis distributor or factory before operating the pumps at any condition other than that for which they were sold.

SEASONAL OPERATING INSTRUCTIONS:
If the pump is located in an area that is subject to below freezing temperatures for extended periods of time and will not be operated enough to prevent freezing, it should be drained to prevent damage to the casing.

TROUBLESHOOTING:

If you have followed the installation and start-up procedures outlined in this manual, your pump should provide reliable service and long life. However, if operating problems occur, significant time and expense can be saved if you use the following checklist to eliminate the most common causes of those problems. Common problems are listed below with suggested remedies shown.

INSUFFICIENT DISCHARGE	
Symptom	Remedy
1. Pump not primed.	Prime pump. Evacuate all the air.
2. Speed too low.	Check drive speed and voltage.
3. System discharge head too high.	Change system. Raise wet well level. Install larger impeller and driver.
4. Suction lift too high.	Increase submergence. Lower pump. Change system.
5. Wrong direction of rotation.	Reverse any two motor lead connections. Check driver O&M.
6. Air leaks into suction piping, stuffing box or gaskets.	Check flange connections for proper seal. Tighten connections.
7. Impeller passage partially plugged.	Clean impeller passages.
8. Impeller damaged.	Check and repair or replace.
9. Impeller diameter too small.	Replace impeller with larger diameter. Check driver HP.
10. Insufficient suction line submergence.	Increase submergence.
11. Air in liquid.	Increase submergence to prevent vortexing.
12. Insufficient net positive suction head.	Increase submergence. Lower pump. Change system.

LOSS OF SUCTION	
Symptom	Remedy
1. Suction line leaks.	Tighten flange connections and check to be sure they are sealed.
2. Water seal line to packing box is plugged.	Unplug the line. Provide clear water source.
3. Suction lift too high.	Increase submergence. Lower pump. Reduce suction line losses.
4. Air or gases in liquid.	Increase submergence to prevent vortexing.
5. Air leaks into suction piping, stuffing box or gasket.	Check connections and tighten.
6. Wrong direction of rotation.	Reverse any two motor lead connections. Check driver O&M.

EXCESSIVE POWER CONSUMPTION	
Symptom	Remedy
1. Speed too high.	Check driver speed and voltage.
2. Head lower than rating–pumps too much liquid.	Change system. Reduce pump speed. Trim impeller.
3. Specific gravity or viscosity of liquid is too high.	Reduce pump capacity.
4. Mechanical defects. a. Shaft bent. b. Rotating element binds.	 Replace shaft. Determine cause and correct.
5. Misalignment.	Check motor/pump to base connections. Realign coupling.
6. System head lower than design.	Change system. Reduce pump speed. Trim impeller.
7. Incorrect impeller diameter.	Determine correct impeller diameter and replace or trim impeller.
8. Packing gland too tight.	Adjust packing gland.

VIBRATION OR NOISE	
Symptom	Remedy
1. Misalignment between drive and pump.	Realign driver and pump.
2. Foundation bolts loose or defect in grouting.	Tighten foundation bolts and/or regrout.
3. Mechanical defects. a. Shaft bent. b. Rotating element binds.	 Replace shaft. Determine cause and correct.
4. Head lower than rating–pumps too much liquid.	Increase system head. Reduce pump speed. Trim impeller.
5. Pipe strain.	Improperly supported or aligned. Check pipe supports and adjust or realign.
6. Pump running at shut-off condition.	Open discharge valve. Check for obstructions.
7. Insufficient suction line submergence.	Increase submergence.
8. Air in liquid.	Increase submergence to prevent vortexing.
9. Impeller passages plugged.	Clean impeller passages.

OVERHEATING	
Symptom	Remedy
1. Bearing.	
a. Excessive lubricant.	Drain lubricant as necessary.
b. Shaft bent.	Replace shaft.
c. Rotating element binds.	Determine cause and correct.
d. Pipe strain.	Check pipe supports.
e. Insufficient bearing lubrication.	Add lubricant.
f. Incorrect type of lubricant.	Check the lubricant used. Refer to Maintenance section for recommended lubricants.
2. Packing box.	
a. Packing gland too tight.	Adjust packing gland.
b. Water seal line plugged.	Clean seal line. Provide source of clean liquid.

MAINTENANCE, PREVENTIVE:

CAUTION:

Carefully read this section before attempting any maintenance procedure. Refer to accessory equipment manuals that may have been included.

To assure satisfactory operation of the pumps, routine inspection and periodic maintenance are required. It is suggested that an inspection and maintenance log be kept and the inspector immediately report any problems. A guide for preventive maintenance for normal applications is shown below. Usual application with abnormal heat, moisture, dust, etc. may require more frequent inspection and service.

Item	Action Required
Seal Box	Check every 150 hours for proper operation. Adjust or replace packing as necessary; or replace mechanical seal if so equipped.
Bearings	Lubricate every 2000 hours or at least once a year.
Mechanical Seal Filter	Clean or replace at least once a year.
Pump Alignment	Check for changes on an annual basis.
Pump Vibration Level	Check for changes on an annual basis.
Pump Noise Level	Check for changes on an annual basis.

STUFFING BOX:
The stuffing box is equipped with either packing or a mechanical seal. Generally, pumps should be checked for leakage every 150 hours of operation.

PACKING REPLACEMENT:
Use Fairbanks Nijhuis replacement packing. The replacement procedure should be as follows:

A. Stop the pump.

DANGER:

Extreme care should be exercised and steps taken to ensure that the driver cannot be accidentally started. Keep hands, fingers, clothing and any tools away from the coupling. Failure to do so could result in serious personal injury.

B. Unbolt and remove the gland.
C. Use a flexible Packing Tool* with a hook attachment for removal of the packing and a wood screw attachment for removal of the water seal ring. The water seal ring contains several holes for the packing tool.

Note the location of the water seal ring relative to the number of packing rings on each side of the water seal ring.

*The Packing Tool can be purchased from industrial supply or hardware stores. It is not considered a special tool.

D. Clean the packing box and shaft sleeve.
E. Inspect the shaft sleeve for wear or rough finish and replace the sleeve with a Fairbanks Nijhuis sleeve if necessary.
F. Install the new packing and water seal ring.

IMPORTANT:

Stagger the packing end joints 180 degrees and firmly seat each ring of packing as you install it.

Refer to the technical data section (Table #2) in this manual for pertinent packing box dimensions.

G. Slide the packing (212) and water seal ring (10) into the stuffing box on the backhead (34) and install the guard.
H. Reinstall the gland and tighten the gland nuts.
I. Loosen the gland nuts so they can be adjusted with finger pressure to obtain the correct leakage for lubrication after start-up.

PACKING ADJUSTMENT:
Adjustment is accomplished by lightly tightening the gland nuts and then loosening them so they can be adjusted with finger pressure to allow a small flow of liquid to lubricate the packing.

Adjust the packing according to the following procedure:

A. Start the pump and observe the leakage from the stuffing box.
B. The correct amount of flow from the gland should be a stream about 1/8" diameter.
C. Tighten or loosen the gland nuts until the correct amount of leakage is obtained.
D. After installing new packing, it may be necessary to readjust the gland several times before the packing is correctly adjusted.

IMPORTANT:

Do not tighten the gland to stop all leakage. Leakage is necessary to ensure the cooling, flushing and lubrication of the packing and to prevent shaft sleeve damage.

Connect piping from the backhead taps to a suitable drain. Check periodically to ensure the drain is working properly.

E. The stuffing box should be inspected every 150 hours for excessive leakage. If the flow of liquid has increased and cannot be reduced by a slight tightening of the gland, replace the packing and/or shaft sleeve.

EXTERNAL WATER FLUSH:
If the pump is handling abrasive material, it is recommended that an external water line be connected to the stuffing box and water injected through the water seal ring.

A flow rate of 2–3 gpm at a pressure of 5–10 psi above the pump discharge pressure should be used.

MECHANICAL SEAL REPLACEMENT:
Refer to the Mechanical Seal section of this manual for general information, including removal and installation procedures.

BEARING LUBRICATION:
Under normal operating conditions, the bearings must be lubricated every 2000 hours of running time or at least once a year regardless of total operating hours.

IMPORTANT:

Any application with abnormal heat, moisture, dust, etc. may require a change in this schedule, and you should refer to a lubrication engineer or the factory for specific instructions.

CAUTION:

Grease recommendations in this manual will provide satisfactory lubrication over a wide temperature range. There is, however, a practical limit and operation of the pump that should be discontinued and the factory consulted if temperatures measured on the outside of the bearing housing exceed 190 degrees F.

GREASE RECOMMENDATIONS:
Recommended grease is a N.L.G.I., No. 2 lithium based multipurpose with a mineral oil viscosity of 950–1250 SUS at 100 degrees F, and 80–82 SUS at 210 degrees F. Suggested greases meeting this specification are listed below:

Manufacturer	Brand Name
Atlantic Richfield	ARCO M/P #2
Chevron	Dura-Lith
Exxon	Ronex or MP #2
Gulf	Gulf Crown #2
Sinclair	Litholine MP #2
Texaco	Marfak 958 or MP #2

Estimated quantities of grease for each bearing is 4 – 5 ounces. An experienced mechanic will be able to determine the correct amount of grease.

Proceed as follows during lubrication:

DANGER:

Extreme care should be exercised and steps taken to ensure the driver cannot be accidentally started. Keep hands, fingers, clothing and any tools away from the coupling. Failure to do so could result in serious personal injury.

A. Stop the unit, remove the grease drain plug and connect a grease gun to the lubrication fitting.
B. Start the unit and inject grease until the old grease is relieved through the drain opening.
   1. If the grease does not relieve at the drain, check for blockage with a mechanical probe.
   2. Immediately after lubrication, bearing temperatures may rise above normal level.
C. Continue running the unit until bearing temperatures stabilize at the normal level and grease stops seeping at the grease drain opening.
D. Stop the unit, remove the grease gun, wipe off the relieved grease and replace the plug.
E. Resume normal operation.

IMPELLER RUNNING CLEARANCE:
As the impeller and fronthead wear, the clearance increases causing internal leakage, decreasing pump performance.

The clearance can be adjusted to compensate for wear. Refer to the data section of this manual for nominal impeller clearances. If the desired clearance cannot be obtained, it may be necessary to rebuild the pump.

The clearance may be checked by removing the suction hand-hole cover and placing a feeler (thickness) gauge between the impeller and the fronthead. (Refer to the impeller adjustment drawing illustrations.)

WARNING:

Pumped media may contain items that present health hazards, such as needles and other sharp objects. Always wear puncture-resistant gloves.

T20, T30 AND T40 FRAME PUMPS:

Back off the jackscrews and tighten the capscrews at the bearing housing until the impeller just contacts the fronthead.

NOTE: If the pump is equipped with other than packing or a double mechanical seal, it will be necessary to loosen the seal lock collar to allow movement in the shaft.

Measure the gap between the housing and frame.

Loosen the capscrews and tighten each jackscrew in a crisscross method, 1/8 of a turn at a time until the gap between bearing housing and frame is increased by the amount of required impeller distance.

IMPORTANT:

If the gap is not as specified, repeat this entire procedure until the proper clearance is achieved. Tighten the locknuts to ensure that the jacksrews will remain in the proper position.

T60 and T80 Frame Pumps:

Back off the stud locknuts and capscrews holding the thrust bearing cover (159) and thrust bearing housing (158) to the frame (90).

NOTE: If the pump is equipped with other than packing or a double mechanical seal, it will be necessary to loosen the seal lock collar to allow movement of the shaft.

Measure the gap between the thrust bearing housing (158) and the frame (90).

Adjust the shim pack (186A) thickness between the thrust bearing housing (158) and the frame (90) to achieve the correct impeller clearance.

Tighten the stud nuts and capscrews against the O-rings. Do not compress the O-rings by more than 50%. Recheck the impeller clearance.

IMPORTANT:

If the gap is not as specified, repeat this entire procedure until the proper clearance is achieved.

Tighten the locknuts to the stud nuts to ensure the housing will remain in proper position.

CLEANING THE PUMP

If the pump becomes clogged, it will be necessary to stop the pump and clean out the impeller and volute area. Proceed according to the following instruction:

A. Stop the pump and lock out the controls so that the pump cannot accidentally start.

DANGER:

Lock out the power and ensure the pump cannot be accidentally started. Check with appropriate test equipment to verify the pump cannot start.

B. Unbolt and remove the cleanout covers in the volute and elbow (if so equipped). Use a hose or long handle to loosen and remove debris. If the material cannot be loosened by a hose, use a scraper and loosen and then flush with a hose.

WARNING:

Do not attempt to clean the pump with bare hands. Pumped media may contain items that present health hazards, such as needles and other sharp objects. Always wear puncture-resistant gloves.

C. Install new gaskets and replace the cleanout covers.
D. Return to normal operating cycle.

MAINTENANCE, CORRECTIVE:

Major corrective maintenance will require disassembly of the pump. The following are step-by-step instructions:

TIME REQUIREMENTS:
Estimated time to replace packing is 1–2 man hours. Mechanical seal replacement time is approximately four (4) man hours. Complete disassembly and reassembly of the complete pump is estimated at 6 – 8 hours.

MAINTENANCE QUALIFICATIONS:
The pump described by this manual is designed to be maintained by a mechanic experienced with rotating machinery, using normal mechanics tools.

PUMP DISASSEMBLY:

CAUTION:

Read this entire disassembly procedure and refer to the sectional drawings in this manual before proceeding.

A. Prepare the pump for disassembly according to the following procedure:
   1. Lock out the power to the driver.

DANGER:

Check power source with appropriate electrical test equipment to ensure driver cannot accidentally start.

   2. Close suction and discharge valves.
   3. Drain the pump
   4. **5410 Construction:**
      Remove the shaft guard and disconnect the shafting at the pump flange. Remove the pump half shaft connecting flange and the coupling key (272).
      5420 and 5440 Construction:
      Remove the coupling guard and coupling.
   5. Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication lines, grease lines, etc.)
   6. If the volute (30) or fronthead (33) must be removed for any reason, disconnect the suction and discharge piping.
   7. **5410 and 5440 Construction:**
      Remove the capscrews securing the volute (30) to the base (15) and the capscrews securing the elbow (44) to the fronthead (33).
      5420 Construction:
      Remove the capscrews holding the pump to the base.
   8. Remove the pump less the base to a convenient work area.

WARNING:

The use of a crane or hoist of adequate capacity is required.

B. Remove the capscrews holding the backhead (34) to the volute (30) but leave in the capscrews that hold the backhead (34) to the frame (90). On 5420 horizontal pumps, also remove the capscrews that hold the mounting feet (A28 and B28) to the pump.
C. Install an eyebolt of adequate strength in the tapped (coupling) end of the shaft (4). Remove the frame (90) and rotating assembly from the volute (30).
D. Support the frame and rotating assembly in a horizontal position.
   1. Remove the impeller capscrew (9) and impeller washer (9A). On 10" 5410, 5420 and 5440 remove impeller nut (9).
   2. Because the impeller capscrew or impeller nut (9) is installed with Loctite®, it will be necessary to heat the capscrew to approximately 450 degrees F to break the bond.

WARNING:

To prevent possible serious personal injury, heat-resistant gloves must be worn when handling heated parts.

   3. On 10" 5410, 5420 and 5440 only, remove the capscrews that secures the impeller seal ring (1A) to the impeller (1).

E. Remove the impeller (1) from the shaft (4). Impeller and shaft have a close tolerance, so it will be necessary to use a pulling device.

CAUTION:

Care should be taken not to damage the impeller when using a puller or similar device. Attach the puller or other equipment at the impeller vane area only. Do not use the impeller shroud.

Because the impeller is installed with Loctite®, it will be necessary to heat the impeller (1) hub to approximately 450 degrees F to break the bond.

F. Loosen the packing gland (19). For pumps with mechanical seals, refer to the Mechanical Seal section of this manual.
G. Remove the capscrews that secure the backhead (34) to the frame (90). Remove the packing (212) (refer to Mechanical Seal section of this manual if a mechanical seal is used), seal water ring (10), gland (19) and radial bearing deflector (A126).
H. Remove the thrust bearing deflector (B126). On 10" 5410, 5420 and 5440 pumps only, remove the impeller seal ring (1A).
I. Shaft Assembly:
T20 and T30 Frame Construction:
Remove the capscrews and jackscrews that secure the thrust bearing housing (158) to the frame (90) and remove the shaft assembly from the frame (90) using the eyebolt installed in tapped (coupling) end of shaft (4).
Remove the radial bearing (163) from the shaft (4) using a bearing puller.
Remove the thrust bearing snap ring (168A) and the thrust bearing housing (158).

Remove the thrust bearing locknut (161) and lock washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller.

T40 Frame Construction:
Remove the capscrews and jackscrews that secure the thrust bearing housing cover (159) and thrust bearing housing (158) to the frame (90). Remove the thrust bearing housing cover (159) and remove the shaft assembly from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Remove the radial bearing (163) from the shaft (4) using a bearing puller.

Remove the thrust bearing housing (158).

Remove the thrust bearing locknut (161) and lock washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller. Remove the thrust bearing grease retainer (A206).

T60 Frame Construction:
Remove the capscrews that secure the thrust bearing housing cover (159), capscrew O-rings and thrust bearing housing (158) to the frame (90). Remove the thrust bearing housing cover (159).

Remove the shaft assembly and impeller adjustment shims (186A) from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Remove the radial bearing (163) from the shaft (4) using a bearing puller. Remove the radial bearing grease retainer (B206).

Remove the thrust bearing housing (158) from the shaft (4).

Remove the thrust bearing locknut (161) and lock washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller. Remove the thrust bearing grease retainer (A206).

T80 and 10" 5410, 5420 and 5440 Frame Construction:
Remove the capscrews that secure the thrust bearing housing cover (159), capscrew O-rings and thrust bearing housing (158) to the frame (90). Remove the thrust bearing housing cover (159) and bearing adjustment shims.

Remove the capscrews that hold the radial bearing housing cover (140) to the radial bearing housing (139) and remove the radial bearing housing cover (140).

Remove the shaft assembly and impeller adjustment shims (186A) from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Slide the radial bearing housing (139) up off the radial bearing (163) so that the radial bearing can be removed from the shaft (4) using a bearing puller. Remove the radial bearing housing (139) from the shaft (4).

Remove the thrust bearing housing (158) from the shaft (4).

Remove the thrust bearing locknut (161) and lock washer (162) and then remove the two thrust bearings (A168 and B168) from the shaft (4) using a bearing puller. (10" 54X0 uses a double row ball bearing.)

CAUTION:

To prevent possible serious personal injury and damage to the bearings, whenever possible pressure should be applied to the inner bearing race only.

IMPORTANT:

Because of possible damage or contamination during removal, bearings and grease retainers should not be reused and new bearings and grease retainers should always be installed.

J. The shaft sleeve (14) is secured with Loctite® and needs to be heated to approximately 450 degrees F to break the bond. Remove the shaft sleeve (14) from the shaft (4).

WARNING:

To prevent possible serious injury, heat-resistant gloves must be worn when handling heated parts.

K. Remove the lip seal (159A) from the thrust bearing housing (158) on T20 and T30 frames.
Remove the lip seal (158A) from the thrust bearing housing (158) on T80 and 10" 54X0 frames.
Remove lip seal (159A) from the thrust bearing cover (159) on T40, T60, T80 and 10" 54X0 frames.
Remove lip seal (140A) from the frame (90) on T20, T30, T40 and T60 frames.
Remove lip seal (140A) from the radial bearing housing cover (140) and lip seal (139A) from the radial bearing housing (139) on T80 and 10" 54X0 frames.

IMPORTANT:

Because of possible damage during disassembly, lip seals should not be reused and new lip seals should always be installed.

L. **5410 and 5440 Construction:**
Remove the capscrews holding the volute (30) and fronthead (33) to the base (15) and remove the volute (30).
Remove the capscrews holding the fronthead (33) to the elbow (44) and remove the fronthead (33).
5420 Construction:
Remove the volute (30) by removing the capscrews holding it to the fronthead (33).

M. Pump disassembly is now complete. All parts should be thoroughly cleaned and inspected for wear or damage and replaced if required.

PUMP ASSEMBLY:

CAUTION:

Read this entire assembly procedure and refer to the sectional drawings in this manual before proceeding.

The following step-by-step instructions for assembly of the pump are essentially the reverse order of the instructions for disassembly. All new or cleaned parts should be moved to a dust-free location for assembly. Gaskets, lip seals, and bearings should not be reused and should always be replaced with Fairbanks Nijhuis replacement parts.

A. **5410 and 5440 Construction:**
Using a new volute gasket (156) between the volute (30) and fronthead (33) install them on the base (15) and secure with capscrews.
Install a new elbow gasket (154) on the suction elbow (44) and secure the elbow to the fronthead (33) with capscrews.
Connect the discharge piping to the volute (30).
Using new cleanout cover gaskets (203 and 291) install the volute cleanout cover (202) and suction elbow cleanout cover (290) securing with capscrews.
5420 Construction:
Using a new volute gasket (156) between the volute (30) and fronthead (33), secure the volute with capscrews.

Connect the discharge piping to the volute (30).
Using a new cleanout cover gasket (203), install the volute cleanout cover (202) securing with capscrews.

B. Install lip seal (159A) on the thrust bearing housing (158) for T20 and T30 frames.
Install lip seal (158A) on the thrust bearing housing (158) for T80 and 10" 54X0 frames. Install lip seal (159A) on the thrust bearing cover (159) for T40, T60, T80 and 10" 54X0 frames.
Install lip seal (140A) on the frame (90) for T20, T30, T40 and T60 frames.
Install lip seal (140A) on the radial bearing housing cover (140) and lip seal (139A) on the radial bearing housing (139) for T80 and 10" 54X0 frames.
C. Install the shaft sleeve (14) onto the shaft (4):

NOTE: To ensure proper bonding, thoroughly clean all mating surfaces with solvent to remove all grease, oil, dirt, etc.

1. Apply a bead of Loctite® No. 609 completely around the shaft (4) on the impeller end of the shaft/sleeve fit.
2. Slide the shaft sleeve (14) partway onto the shaft (4) while rotating it at least one full revolution to evenly spread the Loctite.
3. Continue sliding the sleeve over the shaft until it butts firmly against the shaft shoulder.

NOTE: Allow the Loctite to cure for two (2) hours prior to operating the pump.

D. Shaft Assembly:
Preheat thrust bearings (168) and radial bearings (163) in an oil bath or oven.

IMPORTANT:

When heating bearings do not exceed 250 degrees F.
Pack the radial bearing (163) and thrust bearing (168) half full of grease. Refer to the bearing lubricating instruction in the maintenance section of the manual for specific grease recommendations.
Pressure should be applied to the inner bearing race only, to prevent damage.

CAUTION:

To prevent possible serious personal injury, heat-resistant gloves must be worn when handling heated parts.

T20 AND T30 FRAME CONSTRUCTION:
Slide the thrust bearing (168) on the shaft (4) and secure with the lock washer (162) and locknut (161).

Fill the upper portion of the thrust bearing housing (158) with grease and slide it over the thrust bearing (168). Install the thrust bearing snap ring (168A) in the thrust bearing housing.

Slide the radial bearing (163) on the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly into the frame (90). Secure the thrust bearing housing (158) to the frame with capscrews. Install the jackscrews but do not tighten until the assembly is completed.

T40 FRAME CONSTRUCTION:
Install the thrust bearing grease retainer (A206) on the thrust bearing (168) and slide it on the shaft (4), securing it with lock-washer (162) and locknut (161). Bearing arrangement is to be back-to-back for pumps using (2) single row contact bearings for the thrust bearing.

Install the thrust bearing housing (158) over the thrust bearing (168).

Slide the radial bearing (163) over the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly into the frame (90).

Fill the thrust bearing housing cover (159) with grease and slide it over the shaft and secure to the frame with capscrews. Install the jackscrews but do not tighten until the assembly is completed.

T60 FRAME CONSTRUCTION:
Install the thrust bearing grease retainer (A206) on the thrust bearing (168) and slide it on the shaft (4), securing it with lock-washer (162) and locknut (161). Bearing arrangement is to be back-to-back for pumps using (2) single row contact bearings for the thrust bearing.

Slide the thrust bearing housing (158) over the impeller end of the shaft and up over the thrust bearing (168).

Install the radial bearing grease retainer (B206) on the radial bearing (163) and slide it on the shaft (4). Using the

eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly into the frame (90). Install impeller adjustment shims between the frame (90) and the thrust bearing housing (158) required for correct impeller clearance. (Refer to Impeller Running Clearance section of this manual.) Fill the thrust bearing housing cover (159) with grease and slide it over the shaft and secure to the frame with capscrews.

T80 AND 10" 54X0 FRAME CONSTRUCTION:
Slide thrust bearings (A168 and B168 respectively) onto the shaft (4) and secure with lock washer (162) and locknut (161). (10" 54X0 uses a double row ball bearing.)

Fill the lower portion of the thrust bearing housing (158) with grease and slide it over the impeller end of the shaft and up over the thrust bearing (168).

Fill the upper portion of the radial bearing housing (139) with grease and slide it over the shaft (4).

Slide the radial bearing (163) over the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly into the frame (90). Install impeller adjustment shims between the frame (90) and the thrust bearing housing (158) required for correct impeller clearance. (Refer to Impeller Running Clearance section of the manual.)

Fill the lower portion of the radial bearing housing cover (140) with grease and slide it over the shaft (4), securing to the radial bearing housing (139) with capscrews. Fill the upper portion of the thrust bearing housing cover (159) with grease and slide it over the shaft (4). A clearance of 0.008" to 0.010" is required between the thrust bearings. Install shims (186A) between the thrust bearing housing (158) and the thrust bearing housing cover (159) to achieve this clearance.

Set bearing clearance as follows:

1. Measure the gap between the thrust bearing housing cover (159) and the thrust bearing housing (158) with a feeler gauge. Record the value obtained.
2. Total shim thickness must be equal to the measured gap plus the 0.008" to 0.010" required clearance. Example: If the measured gap is 0.005", total shim thickness should be 0.005" plus 0.008" to 0.010", or 0.013" to 0.015".
3. After shim(s) (186A) are installed, tighten the capscrews which secure the thrust bearing housing cover (159) and thrust bearing housing (158) to the frame (90).
4. Bearing clearance should be checked as follows:
   A. Attach a dial indicator to the bearing housing cover (159) or the frame (90) and position the indicator stem against the end of the shaft (4).
   B. With the shaft as far as possible toward the impeller end of the pump, set the dial indicator to read “zero”.

IMPORTANT:

Do not force the shaft. Apply only enough force to move the rotating assembly.

   C. Push the shaft (4) as far as possible toward the coupling end of the pump and read the total end-play on the dial indicator. To assure a correct end-play reading, push the shaft (4) back toward the impeller end of the pump to check that the indicator returns to “zero”.
   D. Total end-play must be 0.008" to 0.010"; if not, adjust the thickness of the thrust bearing cover shim(s) (186A) by the required amount and recheck the clearance.
5. After the clearance is set, remove the capscrews, securing the thrust bearing housing (158) and cover (159) to the frame (90) and install O-rings on the capscrews and reinstall.
   E. Install the thrust bearing deflector (B126) and radial bearing deflector (A126) on the shaft (4). On 10" 54X0 pumps only, install the impeller seal ring (1A).
   F. Install the backhead (34) to the frame (90) and secure with capscrews.
   G. Install the packing (212) and seal water ring (10) into the stuffing box in the reverse order in which they were removed. (For pumps using a mechanical seal, refer to the Mechanical Seal section of this manual.)
   H. Install the gland (19) and hand tighten the gland bolts.
   I. Install the impeller (1), impeller washer (9A) and impeller capscrew (9) according to the following procedure. (Note that the 10" 54X0 uses an impeller nut (9) in lieu of a capscrew.)
      1. Thoroughly clean the impeller bore, the end of the shaft, shaft threads and capscrew threads to ensure they are free from oil, dirt or any foreign matter.
      2. Inspect and measure the impeller bore, shaft fit diameter, key and keyway for wear. Measure in several locations along the length of the fit. If the clearance between the shaft and impeller exceed

0.003" anywhere along the lengths of the impeller bore, contact the factory for instructions for rework or replacement of components.
3. Apply a sufficient amount of Loctite® No. 609 to shaft and impeller bore to cover the entire impeller fit area.
4. Install the impeller key (102) in the shaft (4).
5. Slide the impeller (1) over the shaft, ensuring it butts firmly against the shaft sleeve.
6. Apply three or four drops of Loctite No. 609 to the impeller capscrew (or impeller nut) threads and install on shaft with the impeller washer (9A) in place. Impeller fastener torque values are shown in Table #3 in the technical data section of this manual. (Torque values are for SAE grade 8 steel only. If other materials are used, consult the factory for proper torque values.)

NOTE: To prevent the impeller from turning, use a board wedged in the vanes using care not to damage the vanes in any way.

J. On 5420 pumps, if the mounting feet were removed, install them at this time.
K. Install a new volute gasket (156) on the volute (30) and assemble the complete frame/rotating assembly onto the volute, securing with capscrews.
L. Install all gauges and auxiliary piping such as stuffing box lubrication lines, grease lines, etc.
M. Refer to the Impeller Running Clearance section of this manual for instruction on adjustment and set the proper clearance.
N. Install the coupling key (272) and pump coupling half on the shaft (4). Reconnect to drive coupling half on flexible drive shaft.
O. Install all shaft and coupling guards.
P. The pump assembly is now complete. Refer to Operation section of this manual.

WEAR RINGS:

REPLACING EXISTING RINGS:
An impeller wear ring (17) and/or a fronthead wear ring (16) may have been supplied with your pump. If either or both of these require replacement due to wear, the following procedures should be followed:

Wear Ring Removal:
A. If the wear ring requires replacement, it can be removed by heating it to 350 – 400 degrees F to break the Loctite® bond.

CAUTION:

To prevent possible serious personal injury, heat-resistant gloves must be worn when handling heated parts.

B. The ring may also be ground off if heating fails to affect removal.

IMPORTANT:

Care should be used to avoid damage to the ring set.

Wear Ring Installation:
Because of the required close tolerances, replacement wear rings should be obtained from Fairbanks Nijhuis or their authorized representative.

IMPORTANT:

To ensure proper bonding, thoroughly clean all mating parts with solvent to remove all grease, oil, dirt, etc.

A. Apply a bead of Loctite No. 504 to the impeller completely around the middle of the wear ring fit and press the wear ring in place.
B. Apply a bead of Loctite No. 504 to the fronthead completely around the middle of the wear ring fit and press the wear ring into place.

CAUTION:

To avoid distortion and ensure proper installation, be careful to press the wear rings evenly and completely into place. They should be firmly butted against the corresponding impeller or fronthead shoulder at the bottom of the wear ring fit.

Adding Wear Rings:
It is possible to add either or both impeller or fronthead wear rings to pumps that were not so originally equipped from the factory. This work should be done by a qualified machinist experienced in similar machining work. Contact the factory for parts, instructions and correct matching dimensions.

COUPLING REMOVAL AND INSTALLATION:

Refer to the coupling manufacturer's literature supplied with the pump.

MECHANICAL SEALS:
Mechanical seals covered by these instructions, when properly installed, will give satisfactory performance. To ensure proper installation, these instructions should be read carefully.

Refer to the Technical Data Drawing section of this manual for suggested seal water piping systems: clean water source water flush seal system; deadhead seal water piping system.

DOUBLE MECHANICAL SEALS:
Standard double mechanical seals consist of two stationary seats with O-ring seals and a single spring rotating assembly with O-ring sealing and drive or O-ring sealing and elastomer drive ring.

Removal:
By this time the frame assembly with backhead should have been removed to a clean work area.

A. Remove the capscrews that secure the backhead (34) to the frame (90) and carefully slide it off the shaft sleeve.
B. Remove the solid gland bolts and remove the gland (31).
C. Remove the upper stationary seat (456A).
D. Remove the seal rotating element (456).
E. Remove the lower stationary seat (456A).
F. Inspect all components for damage prior to reassembly. This should include the shaft sleeve. Replace the damaged part(s) or replace with a complete new seal.

Installation:
A. Remove any burrs or nicks on the sleeve (14) and apply a light coat of liquid soap or liquid detergent.

CAUTION:

Seal faces are lapped and polished to a mirror finish. It is imperative that sealing faces be handled with care and kept perfectly clean. DO NOT touch the sealing faces.

B. Slide the solid gland (31), mechanical seal upper stationary seat (456A) and mechanical seal rotating element (456) over the shaft sleeve (14), being careful not to damage the mechanical seal faces.

CAUTION:

The gland, stationary seat and rotating element must be far enough onto the shaft (4) so as not to interfere with the installation of the backhead (34).

C. Thoroughly clean the sealing box and install the lower mechanical seal stationary seat (456A). Use even pressure to install the seat.
D. Carefully, so as not to damage the stationary seat (456A), slide the backhead (34) over the shaft (4) and shaft sleeve (14) and secure to the frame (90) with capscrews.
E. Without touching the seal faces and using a slight twisting action, push the upper stationary seat and rotating element into the backhead (34) sealing box.
F. When the seal spring can easily be compressed by hand into the sealing box, secure the gland (31) with capscrews to the backhead.

CARTRIDGE TYPE SEAL:
The cartridge type seal consists of a preassembled seal assembly, which reduces handling of fragile seal faces.

Removal:
By this time the frame assembly with backhead should have been moved to a clean work area.

A. Loosen the retainer clips and rotate 90 degrees and tighten the setscrews to secure the seal lock ring to the gland.

B. Loosen the setscrews that secure the lock ring to the sleeve.
C. Loosen the bolts securing the seal gland to the backhead (34) and the capscrews that secure the backhead to the frame (90).
D. Carefully remove the backhead (34).
E. Slide the entire seal assembly from the shaft sleeve (14).
F. Inspect all parts of the seal for signs of wear. If wear is present, replace the entire seal. If only the seal O-rings need to be replaced, refer to the factory for instructions.

Seal Installation:

A. Remove any burrs or nicks on the sleeve (14) and apply a light coat of liquid soap or liquid detergent.
B. Install the seal over the sleeve (14).
C. Install the backhead (34) and secure to the frame (90) with capscrews.
D. Slide the seal assembly into the sealing box of the backhead (34) and secure with gland bolts.
E. Secure the seal lock ring to the sleeve using the setscrews provided.
F. Loosen the setscrews holding the retainer clips in place and rotate 90 degrees and retighten the setscrews. These clips will be used again if the seal is removed for any reason.

OPERATION:

Special operating techniques are not required when using pumps equipped with mechanical seals. However, there are certain precautions that should be taken.

A. Pumps should never be operated, even to test electrical connections, until the operator knows that there is fluid in the sealing box. In order to check for fluid in the sealing box, loosen seal water piping at the box. Tighten piping only after fluid has started flowing.
   Running the seal with an air bound sealing box is the same as running it without fluid. If the seal is set up for deadhead operation, fill the filter, piping and sealing box with clear liquid and vent all air out of the topmost sealing box pipe plug.
B. Some seals will leak slightly when first run. This leakage should cease within a very short period of time.

ROUTINE MAINTENANCE:

Required maintenance at a very minimum as follows:

A. Periodically (150 hours of operation) check to see that the pumped liquid is going through the sealing box out to the wet well or drain.
B. Check that the gland bolts have not loosened and that the gland is flush with the sealing box.
C. Occasionally (4000 hours of operation) clean out the filter on deadhead systems. System must be purged of air and filled with clear liquid as indicated in Operation.

REPAIR PARTS:

Ordering Parts:

When ordering parts, give pump serial number, size, model number, a complete description and item number of each part. Refer to the drawing and parts list in the back of this manual. You may order parts from your local Fairbanks Nijhuis distributor. Consult your local telephone yellow pages under “Pumps” for the office nearest you.

You may also contact Fairbanks Nijhuis directly as follows:

Fairbanks Nijhuis
3501 Fairbanks Avenue
P. O. Box 6999
Kansas City, KS 66106-0999
Phone 913-371-5000
Fax 913-748-4025

Returning Parts:

All materials or parts returned to the factory must have prior approval and a “Returned Goods Tag”, listing the material to be returned and the reasons for the return. All material to be returned should be carefully packed to avoid damage in route from rough handling or exposure to weather. Contact the factory for shipping instructions. All material is to be returned freight prepaid.

Fairbanks Nijhuis makes improvements on its products from time to time and reserves the right to furnish improved parts for repairs. A part that is received and is not identical in appearance, or has a different symbol from the original part, may be interchangeable. Examine the part carefully before contacting your Fairbanks Nijhuis representative. The parts should never be returned to the factory without first obtaining proper authorization from your Fairbanks Nijhuis representative.

SERVICE:

Warranty Service:

For Warranty Service contact the facility from which your pump was shipped. Shipping facility address is:

Kansas City, Kansas
Fairbanks Nijhuis
P. O. Box 6999
3501 Fairbanks Avenue
Kansas City, KS 66106-0999
Phone 913-371-5000
Fax 913-748-4025

Service After Warranty:

For service after warranty on this pump or any other pumping equipment contact:

Pump Services Group – 1-800-648-PUMP or write:

Pump Services Group
Fairbanks Nijhuis
P. O. Box 6999
3501 Fairbanks Avenue
Kansas City, KS 66106-0999
Phone 913-371-5000
Fax 913-748-4025

TECHNICAL DATA

Table #1

Pump	Nominal Impeller Clearance
2" 54 x 1	.010 - .020
3" 54 x 1	.010 - .020
4" 54 x 1	.010 - .020
2" 54 x 2	.010 - .020
3" 54 x 2	.010 - .020
4" 54 x 2	.010 - .020
4" 54 x 2CLV	.010 - .020
3" 54 x 3	.010 - .020
4" 54 x 3	.010 - .020
5" 54 x 3	.010 - .020
6" 54 x 3	.015 - .025
4" 54 x 4	.010 - .020
5" 54 x 4	.010 - .020
6" 54 x 4	.015 - .025
8" 54 x 4	.015 - .025
4" 54 x 5	.008 - .015
6" 54 x 5	.015 - .025
8" 54 x 5	.015 - .025
10" 54 x 5	.020 - .030
5" 54 x 6	.020 - .030
6" 54 x 6	.020 - .030
8" 54 x 6	.020 - .030

Table #2

Stuffing Box Item	Frame Size					10" 5410
	T20	T30	T40	T60	T80	
# Rings Packing Per Box	5	5	5	5	5	5
Packing Size	3/8	1/2	1/2	1/2	5/8	5/8
Seal Water Ring Width	3/4	1	1	1	1-1/4	1-1/4
Shaft Sleeve O.D.	1-7/8	2-1/2	3	3-5/8	4-1/2	8
Box I.D.	2-5/8	3-1/2	4	4-5/8	5-3/4	9-1/4
Box Depth	2-7/8	3-1/2	3-3/4	3-3/4	5	4-3/4

Table #3

Pump Size & Model	Pump Frame	Impeller Fastener Size	Tightening Torque (lb. - ft.)
All 54X1 & 54X2	T20	1/2 - 13	80
All 54X3	T30	5/8 - 11	120
All 54X4	T40	3/4 - 10	200
All 54X5	T40 & T60	7/8 - 9	240
10" 54X5	T80	1-1/4 - 7	240
5" & 8" 54X6	T40 & T60	7/8 - 9	240
6" 54X6	T60	1-1/4 - 7	240
6" & 8" 54X6	T60	1-1/4 - 7	240
10" 54X0	---	7/8 - 9	240

FALK COUPLING ALIGNMENT DATA

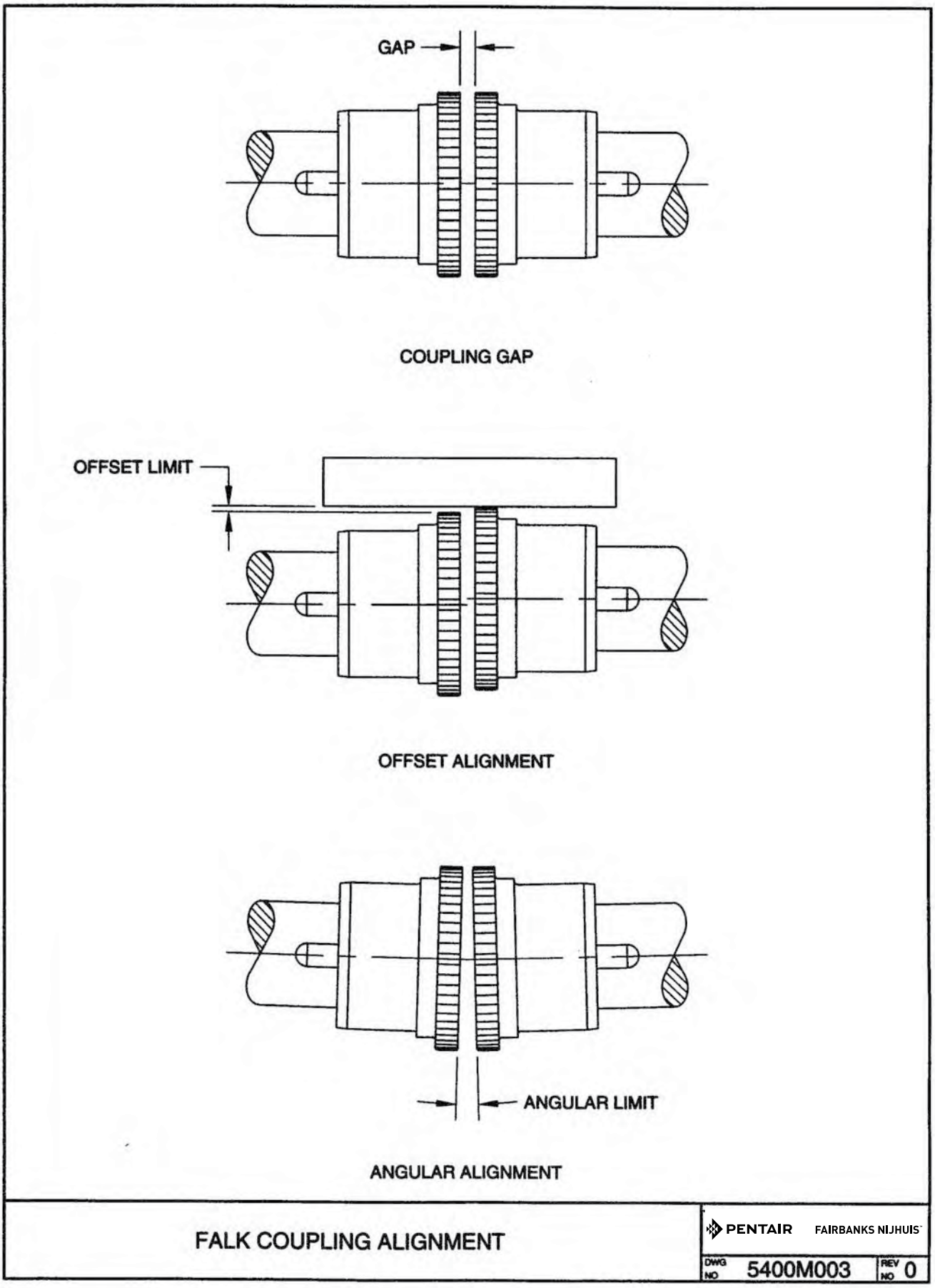
Size	Gap (Inches)	Installation Alignment Limits		Fastener Torque (lb./in.)
		Offset (Maximum) (Inches)	Angular (Maximum) (Inches)	
1020T	.125	.006	.003	100
1030T	.125	.006	.003	100
1040T	.125	.006	.003	100
1050T	.125	.008	.004	200
1060T	.125	.008	.005	200
1070T	.125	.008	.005	200
1080T	.125	.008	.006	200
1090T	.125	.008	.007	200
1100T	.188	.010	.008	260
1110T	.188	.010	.009	260
1120T	.250	.011	.010	650
1130T	.250	.011	.012	650
1140T	.250	.011	.013	650

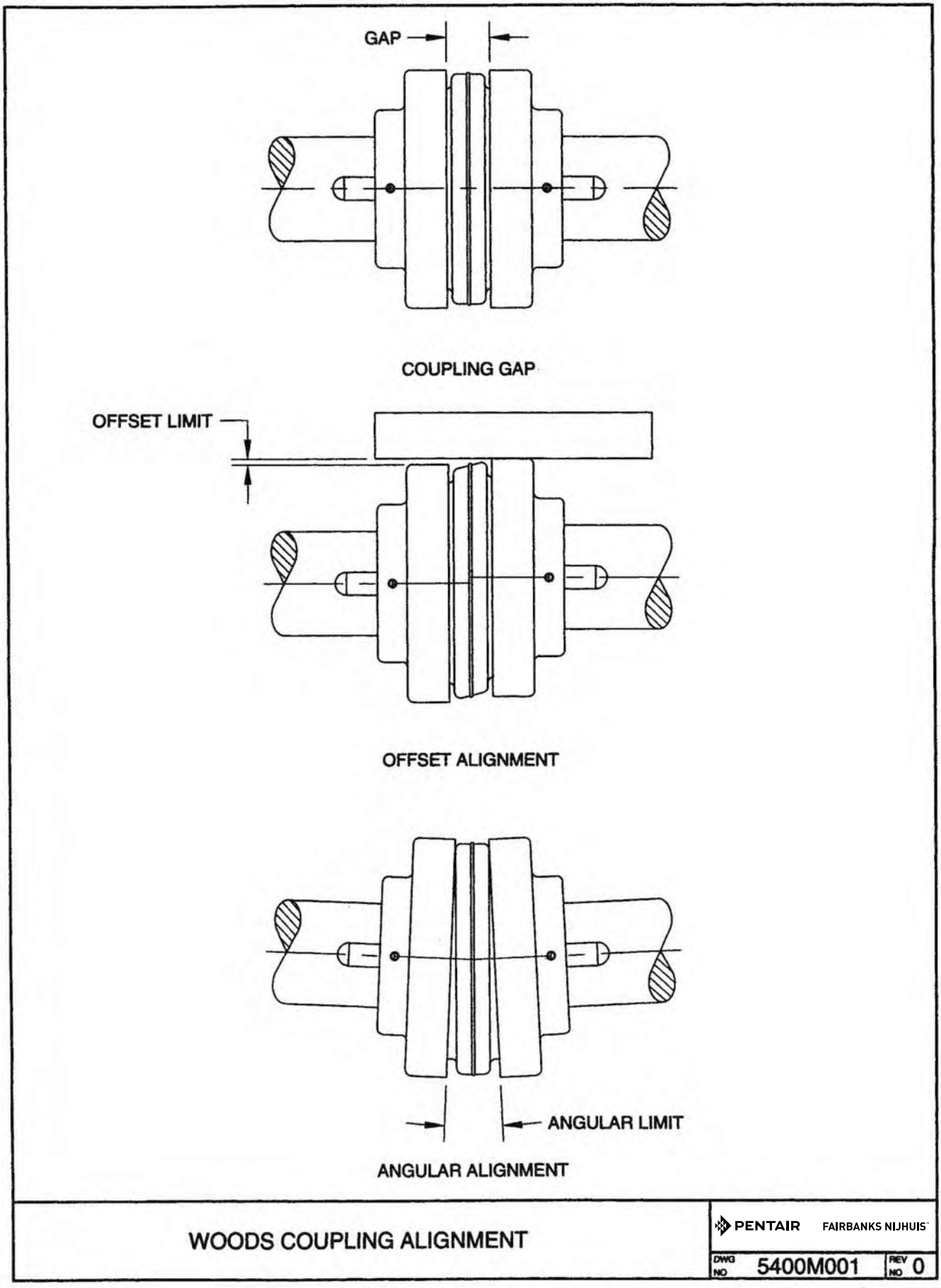
T1

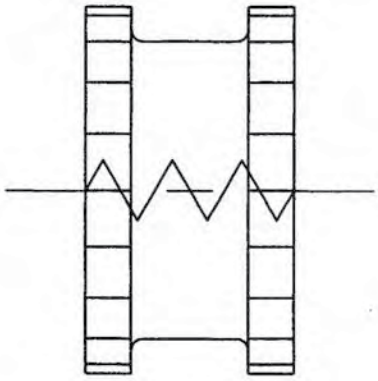
WOODS COUPLING ALIGNMENT DATA

Size	Sleeve Type	Gap (Inches)	Installation Alignment Limits		Fastener Torque (lb./in.)
			Offset (Maximum) (Inches)	Angular (Maximum) (Inches)	
5S	JES	.750	.015	.056	155
6S	JES	.875	.015	.070	155
7S	JES	1.000	.020	.081	155
8S	JES	1.125	.020	.094	275
9S	JES	1.437	.025	.109	275
10S	JES	1.625	.025	.128	275
11S	E	1.875	.032	.151	275

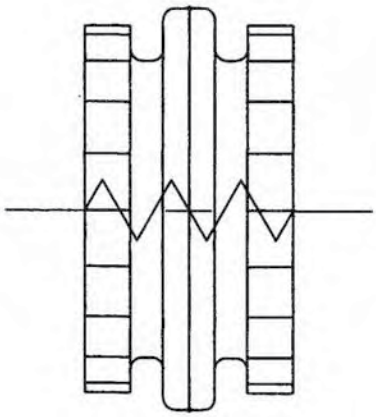
T2


GAP
COUPLING GAP
OFFSET LIMIT
OFFSET ALIGNMENT
ANGULAR LIMIT
ANGULAR ALIGNMENT
FALK COUPLING ALIGNMENT
PENTAIR
FAIRBANKS NIJHUIS
DWG NO 5400M003
REV NO 0


GAP
COUPLING GAP
OFFSET LIMIT
OFFSET ALIGNMENT
ANGULAR LIMIT
ANGULAR ALIGNMENT
WOODS COUPLING ALIGNMENT
PENTAIR
FAIRBANKS NIJHUIS
DWG NO 5400M001
REV NO 0



TYPE JES

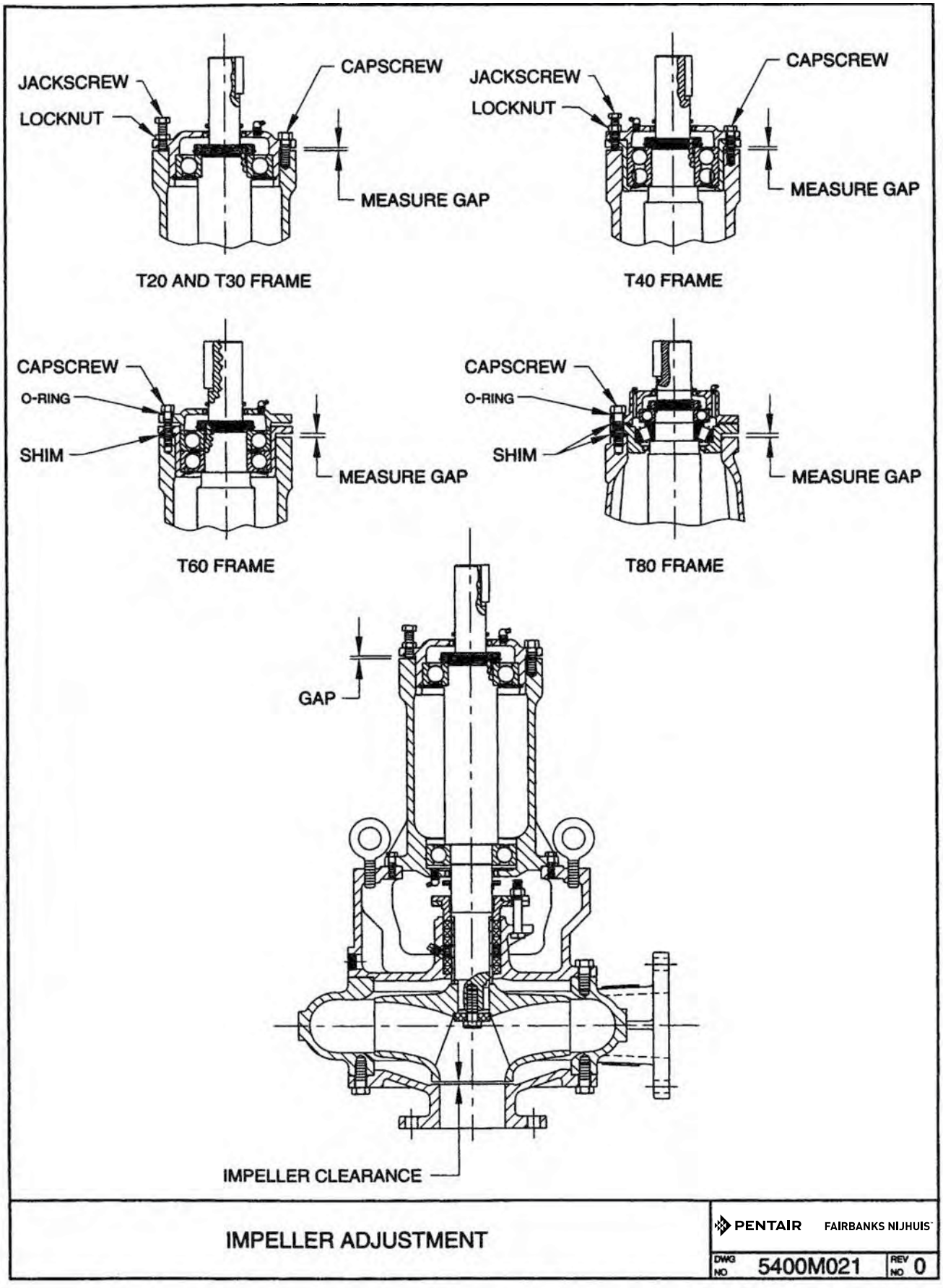


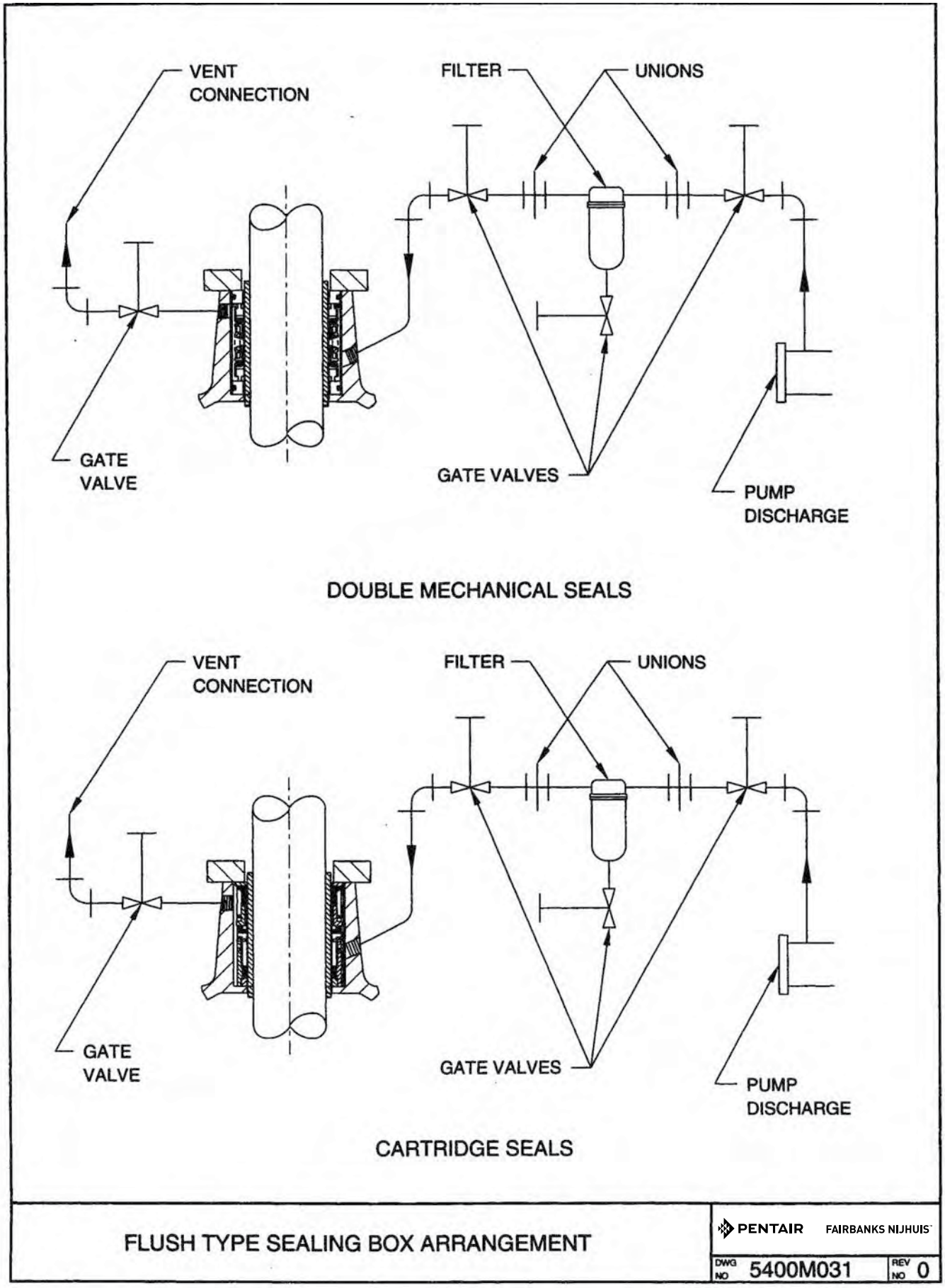
TYPE E

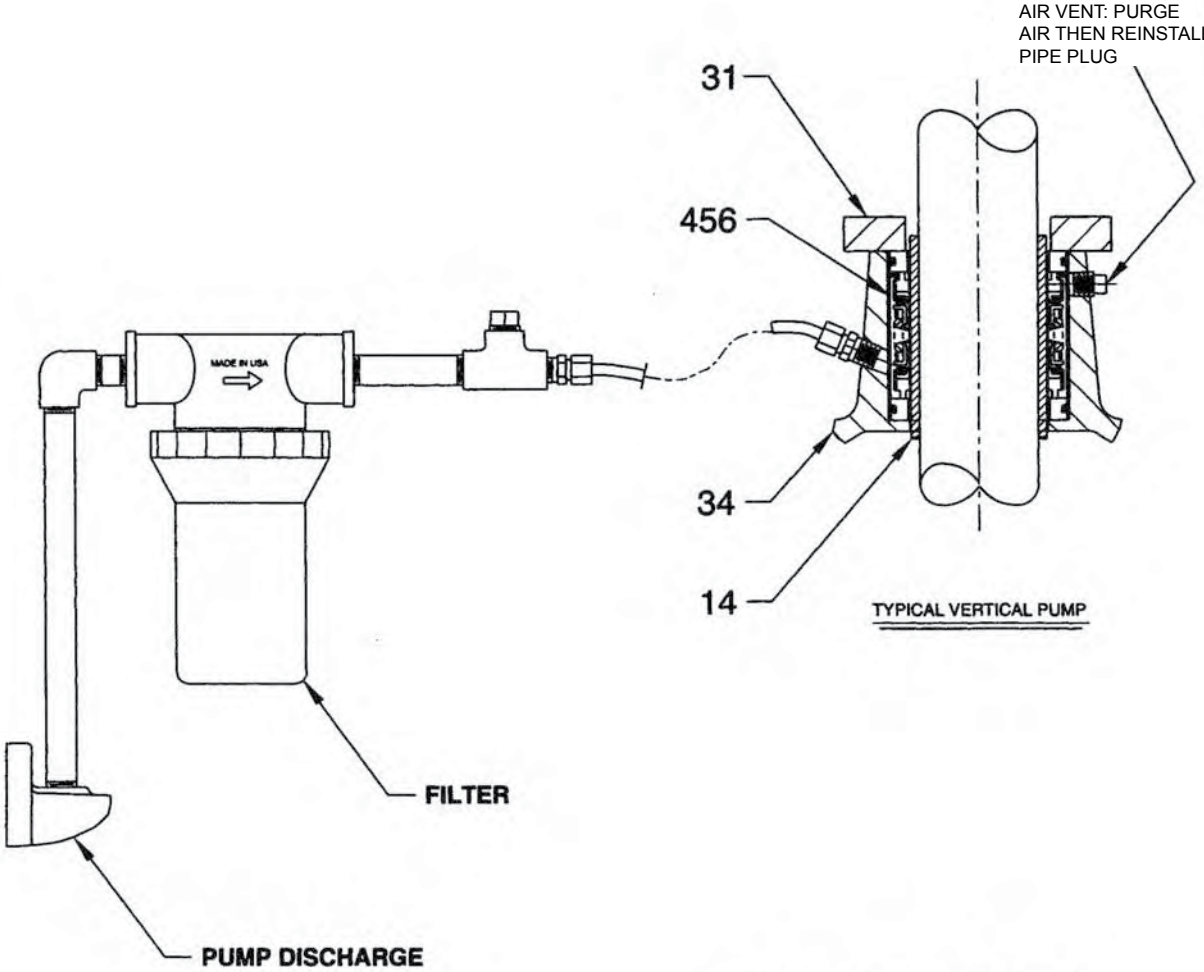
NOTE:

1. TYPE JES SLEEVES ARE MOULDED EPDM RUBBER AND ARE A ONE PIECE SPLIT CONSTRUCTION.
2. TYPE E SLEEVES ARE TWO PIECE MOULDED EDPM RUBBER SECURED BY A RETAINING RING.

COUPLING SLEEVES	PENTAIR FAIRBANKS NIJHUIS
	DWG NO 5400M005 REV NO 0


JACKSCREW
LOCKNUT
CAPSCREW
MEASURE GAP
T20 AND T30 FRAME
JACKSCREW
LOCKNUT
CAPSCREW
MEASURE GAP
T40 FRAME
CAPSCREW
O-RING
SHIM
MEASURE GAP
T60 FRAME
CAPSCREW
O-RING
SHIM
MEASURE GAP
T80 FRAME
GAP
IMPELLER CLEARANCE
IMPELLER ADJUSTMENT
PENTAIR
FAIRBANKS NIJHUIS
DWG NO 5400M021
REV NO 0


VENT CONNECTION
FILTER
UNIONS
GATE VALVE
GATE VALVES
PUMP DISCHARGE
DOUBLE MECHANICAL SEALS
VENT CONNECTION
FILTER
UNIONS
GATE VALVE
GATE VALVES
PUMP DISCHARGE
CARTRIDGE SEALS
FLUSH TYPE SEALING BOX ARRANGEMENT
PENTAIR FAIRBANKS NIJHUIS
DWG NO 5400M031
REV NO 0



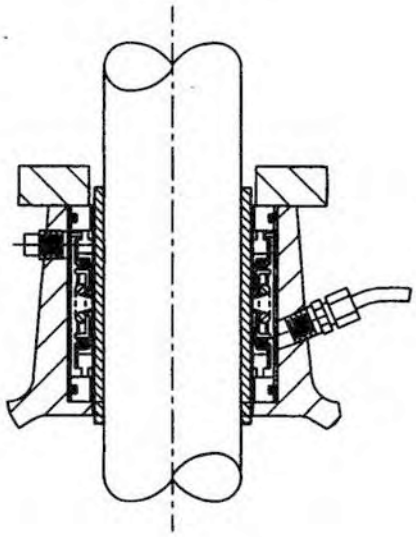
REF. NO.	DESCRIPTION
14	SLEEVE, SHAFT
31	GLAND
34	ADAPTER
456	MECHANICAL SEAL

NOTE:
1. THIS OPTIONAL FILTER SYSTEM MAY BE USED WHEN:
   A. DISCHARGE PRESSURE IS LESS THAN 60 PSI.
   B. SEAL HOUSING TEMPERATURE IS LESS THAN 160°F.

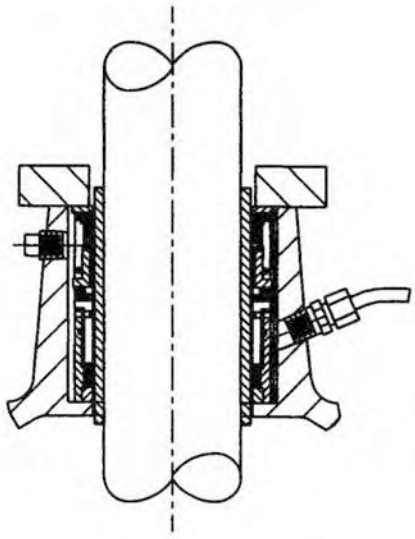
DEADHEADED FILTER SYSTEM

PENTAIR FAIRBANKS NIJHUIS

DWG NO 5400M033 REV NO 0



DOUBLE MECHANICAL SEAL

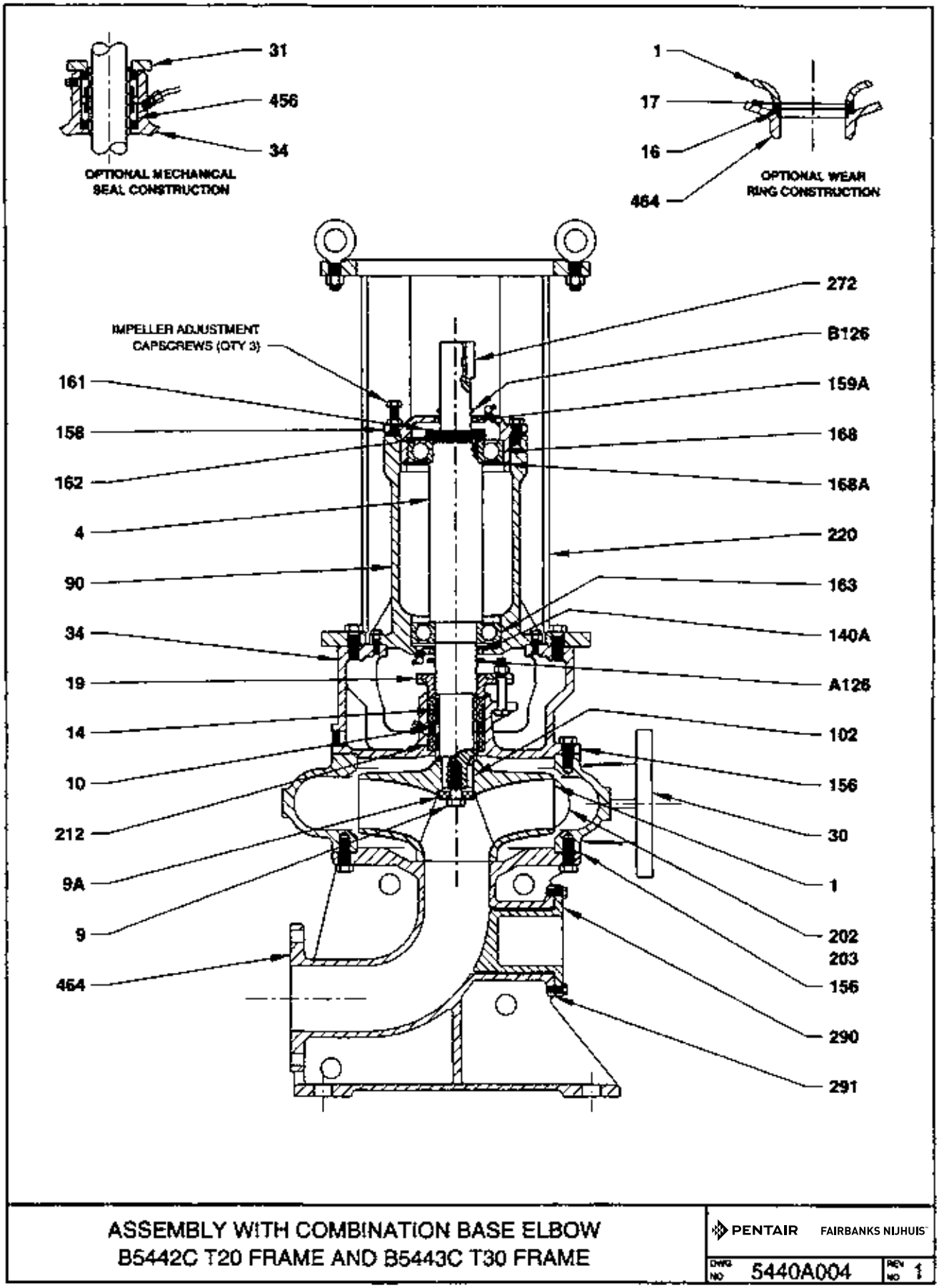


CARTRIDGE MECHANICAL SEALS

TYPICAL MECHANICAL SEALS

PENTAIR FAIRBANKS NIJHUIS

DWG NO 5400M035 REV NO 0


31
456
34
OPTIONAL MECHANICAL SEAL CONSTRUCTION
1
17
16
464
OPTIONAL WEAR RING CONSTRUCTION
IMPELLER ADJUSTMENT CAPSCREWS (QTY 3)
161
158
162
4
90
34
19
14
10
212
9A
9
464
272
B126
159A
168
168A
220
163
140A
A126
102
156
30
1
202
203
156
290
291
ASSEMBLY WITH COMBINATION BASE ELBOW
B5442C T20 FRAME AND B5443C T30 FRAME
PENTAIR FAIRBANKS NIJHUIS
DWG NO 5440A004
REV NO 1

5441 Through 5446 Parts List	
Part No.	**Description**
1	Impeller
4	Shaft
9	Bolt, Impeller
9A	Washer, Impeller
10	Ring, Water Seal
14	Sleeve, Shaft
15	Base
16	Wear Ring, Fronthead
17	Wear Ring, Impeller
19	Gland Half, Interlocking
30	Volute
31	Gland, Solid
33	Fronthead
34	Backhead
44	Elbow, Suction
90	Frame, Bearing
102	Key, Impeller
A126	Deflector, Inner
B126	Deflector, Outer
139	Housing, Radial Bearing
139A	Lip Seal
140	Cover, Bearing Housing
140A	Seal, Inner Grease
154	Gasket, Elbow
156	Gasket, Volute
158	Housing, Thrust Bearing
158A	Lip Seal
159	Cover, Thrust Bearing Housing
159A	Seal, Outer Grease
161	Locknut, Bearing
162	Lockwasher, Bearing
163	Bearing, Radial
168	Bearing, Thrust
A168	Bearing, Thrust
B168	Bearing, Thrust
168A	Snap Ring, Bearing
186A	Shims, Impeller Adjustment
202	Cover, Volute Handhole
203	Gasket, Volute Handhole Cover
A206	Retainer, Inner Grease
B206	Retainer, Outer Grease
212	Packing
220	High Ring Base, with Coupling Guard
272	Key, Coupling
290	Cover, Suction Handhole
291	Gasket, Suction Handhole Cover
456	Seal, Mechanical
464	Elbow, Combination Base Suction

Fairbanks Nijhuis Standard Pump Warranty

Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller; however, to the extent possible, Seller will assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid. Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated. If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped EXW (Domestic Shipments) or FCA (International Shipments) Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing.

The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced, whichever is greater. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired.

Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service.

This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired. Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, incidental, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

The above warranty shall not apply to any equipment which may be separately covered by any alternate or special warranties.

MOTOR INSTALLATION AND OPERATION MANUAL

Vertical High Thrust Motors

INSTALLATION, OPERATION
AND MAINTENANCE MANUAL

NIDEC MOTOR CORPORATION

Countless Solutions. Expert Support.

Safety First

High voltage and rotating parts can cause serious injury or loss of life. Installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2®†, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Disconnect all power to motor and accessories prior to initiating any installation, maintenance, or repairs. Also ensure that driven equipment connected to the motor shaft will not cause the motor to rotate (wind milling of fans, water flowing back through pump, etc.).
2. Avoid contact with rotating parts.
3. Act with care in accordance with this manual's prescribed procedures in handling and installing this equipment.
4. Be sure unit and accessories are electrically grounded and proper electrical installation wiring and controls are used in accordance with local and national electrical codes. Refer to "National Electrical Code Handbook" - NFPA No. 70. Employ qualified electricians.
5. Be sure equipment is property enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.
6. Be sure shaft key is fully captive before unit is energized.
7. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause over speed.
8. Avoid extended exposure to equipment with high noise levels.
9. Observe good safety habits at all times and use care to avoid injury to yourself or damage to equipment.
10. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.
11. Observe all special instructions attached to the equipment. Remove shipping fixtures if so equipped before energizing unit.
12. Check motor and driven equipment for proper rotation and phase sequence prior to coupling. Also check if a unidirectional motor is supplied and note proper rotation.
13. Electric motors can retain a lethal charge even after being shut off. Certain accessories (space heaters, etc.) are normally energized when the motor is turned off. Other accessories such as power factor correction capacitors, surge capacitors, etc. can retain an electrical charge after being shut off and disconnected.
14. Do not apply power correction capacitors to motors rated for operation with variable frequency drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult drive supplier for further information.

† All marks shown within this document are properties of their respective owners.

Table of Contents

I. Shipment

Prior to shipment, all motors undergo extensive mechanical and electrical testing, and are thoroughly inspected. Upon receipt of the motor, carefully inspect the unit for any signs of damage that may have occurred during shipment. Should such damage be evident, unpack the motor at once in the presence of a claims adjuster and immediately report all damage and breakage to the transportation company.

When contacting Nidec Motor Corporation (NMC) concerning the motor, be sure to include the complete motor identification number, frame, and type which appear on the nameplate.

II. Handling

The equipment needed to handle the motor includes a hoist and spreader bar arrangement (see Figure 1) of sufficient strength to lift the motor safely. The spreader bar should have the lifting rings or hooks positioned to equal the span of the lifting lugs or eyebolts. The lifting lugs or eyebolts are intended to lift the motor weight only.

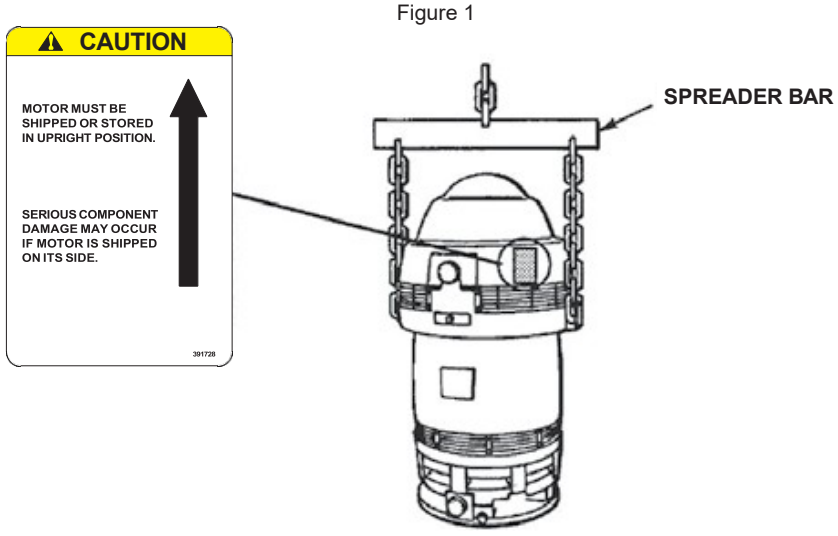
⚠WARNING

Lifting the motor by other means can result in damage to the motor or injury to personnel.

⚠ CAUTION

Do not move motor with oil sumps filled. Sloshing action of oil in sumps can result in oil leaks and motor damage.

Figure 1



III. Storage

1) When To Put A Motor In Storage

If a motor is not put into immediate service (one month or less), or if it is taken out of service for a prolonged period, special storage precautions should be taken to prevent damage. The following schedule is recommended as a guide to determine storage needs.

A. Out of service or in storage less than one month - no special precautions except that space heaters, if supplied, must be energized at any time the motor is not running.

B. Out of service or in storage for more than one month but less than six months - store per items 2A, B, C, D, E, F(2), and G, items 3A, B, and C, and item 4.

C. Out of service or in storage for six months or more - all recommendations.

2) Storage Preparation

A. Where possible, motors should be stored indoors in a clean, dry area.

B. When indoor storage is not possible, the motors must be covered with a tarpaulin. This cover should extend to the ground; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation. Care must also be taken to protect the motor from flooding or from harmful chemical vapors.

NOTICE

Immediately remove any shrink wrap used during shipping.
Never wrap any motor in plastic for storage. This can turn the motor into a moisture trap causing severe damage not covered by Nidec Motor Corporation's limited warranty.

C. Whether indoors or out, the area of storage should be free from excessive ambient vibration which can cause bearing damage.

D. Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must be taken to prevent insects, such as dauber wasps, from gaining access to the interior of the motor.

E. Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. If necessary, re-coat the surfaces with a rust preventative material, such as Rust Veto®† No. 342 (manufactured by E.F. Houghton Co.) or an equivalent. The condition of the coating should be checked periodically and surfaces re-coated as needed.

F. Bearings:

1) When storage time is 6 months or more, grease lubricated cavities must be completely filled with lubricant. Remove the drain plug and fill cavity with grease until grease begins to purge from drain opening. Refer to section **IX. "LUBRICATION"** and/or review motor's lubrication nameplate for correct lubricant.

⚠ CAUTION

Do not re-grease bearings with drain closed or with unit running.

2) Oil lubricated motors are shipped without oil. When storage time exceeds one (1) month, the oil sumps must be filled to the maximum capacity as indicated on the oil chamber sight gauge window. Refer to motor lubrication nameplate or Section IX “Lubrication” for proper oil.

NOTE: Motor must not be moved with oil in reservoir. Drain oil before moving to prevent sloshing and possible damage. With a clean cloth, wipe any excess oil from the threads of the drain plug and the inside of the drain hole. Apply Gasoila®† P/N SS08 or equivalent thread sealant to the threads of the drain plug and replace the plug in the oil drain hole. Refill oil when motor has been moved to the new location.

G. To prevent moisture accumulation, some form of heating must be utilized. This heating should maintain the winding temperature at a minimum of 5° above ambient. If space heaters are supplied, they should be energized. If none are available, single phase or “trickle” heating may be utilized by energizing one phase of the motor’s winding with a low voltage. Request the required voltage and transformer capacity from Nidec Motor Corporation. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing filtered warm air into the motor.

3) Periodic Maintenance

A. Oil should be inspected monthly for evidence of moisture or oxidation. The oil must be replaced whenever contamination is noted or every twelve months, whichever occurs first. It is important to wipe excess oil from the threads of the drain plug and the drain hole and to coat the plug threads with Gasoila®† P/N SS08 or equivalent thread sealant before replacing the drain plug.

B. Grease lubricated bearings must be inspected once a month for moisture and oxidation by purging a small quantity of grease through the drain. If any contamination is present, the grease must be completely removed and replaced.

C. All motors must have the shaft rotated once a month to maintain a lubricant film on the bearing races and journals.

D. Insulation Testing:

Two tests are used to evaluate the condition of the winding insulation. The first of these is the one minute insulation resistance test (IR_1) and the second is the polarization index test (PI), which can also be referred to as a dielectric absorption test. The results of either of these tests can be skewed by factors such as the winding temperature and its relation to the dew point temperature at the time the test was conducted. The PI test is less sensitive to these factors than the IR_1 test, but its results can still be affected significantly. Due to these factors, the most reliable method for evaluating the condition of the winding insulation is to maintain a record of periodic measurements, accumulated over months or years of service, for one or both of these tests. It is important that these tests be conducted under similar conditions of the winding insulation is to maintain a record of periodic measurements, accumulated over months or years of service, for one or both of these tests. It is important that these tests be conducted under similar conditions of winding temperature, dew point temperature, voltage magnitude and duration, and relative humidity. If a downward trend develops in the historical data for either test, or if the readings from both tests drop below a minimum acceptable value, have an authorized electrical apparatus service shop thoroughly clean and dry the winding, and retreat, if necessary.

1. The recommended procedure for the IR_1 test is as follows:

(1) Disconnect all external accessories or equipment that have leads connected to the winding and connect them to a common ground. Connect all other accessories that are in contact with the winding to a common ground.

⚠WARNING

Failure to have accessories grounded during this test can lead to the accumulation of a hazardous charge on the accessories.

(2) Using a megohmmeter, apply DC voltage at the level noted below for 1 minute and take a reading of the insulation resistance between the motor leads and ground.

Rated Motor Voltage	Recommended DC Test Voltage
UP to 1000 (inclusive)	500 VDC
1001 to 2500 (inclusive)	500 to 1000 VDC
2501 to 5000 (inclusive)	500 to 2500 VDC
5001 and up	500 to 5000 VDC

⚠WARNING

Follow appropriate safety procedures during and after high voltage testing. Refer to the instruction manual for the test equipment. Make sure the winding insulation is discharged before beginning the test. The winding insulation will retain a potentially dangerous charge after the DC voltage source is removed, so use proper procedures to discharge the winding insulation at the end of the test. Refer to IEEE 43™ Standard for additional safety information.

(3) The reading should be corrected to a 40°C base temperature by utilizing the formula:

$$R_{40C} = K_T R_T$$

Where:

R_{40C} = insulation resistance (in megohms) corrected to 40°C

K_T = insulation resistance temperature coefficient at temperature T°C

R_T = measured insulation resistance (in megohms) at temperature T°C

The value of K_T can be approximated by using the formula:

$$K_T = (0.5)^{(40-T)/10}$$

Where:

T = the winding temperature in °C that the insulation resistance was measured at

The recommended procedure for the PI test is as follows:

(1) Perform steps 1 and 2 from the IR_1 test procedure. Heed the safety warnings given in the IR_1 test procedure.

(2) With DC voltage still being applied by the megohmmeter, taken an additional reading of insulation resistance between the motor leads and ground 10 minutes after the DC voltage was initially applied. To minimize measurement errors, the variation in winding temperature between the 1 minute and 10 minute readings should be kept to a minimum.

(3) Obtain the polarization index by taking the ratio of the 10 minute resistance reading to the 1 minute resistance reading.

If historical data from previous IR_1 and / or PI tests is available, then a comparison of the present test result to previous tests can be used to evaluate the condition of the insulation. To minimize error, all readings that are compared should be taken at test voltages, winding temperatures, and relative humidity that are similar as possible. If a downward trend in the readings develops over time, have an authorized electrical apparatus service shop thoroughly clean and dry the winding and, if necessary, retreat the winding. Then, repeat the test and re-check results before returning the motor service.

If historical data from previous IR_1 or PI tests is not available, then compare readings from the present test to the recommended minimum values listed below. If the readings from both tests fall below the minimum, have an authorized electrical apparatus service shop thoroughly clean and dry the winding and, if necessary, retreat the winding. Then, repeat the tests and re-check results before turning the motor to service.

The recommended minimum value for the 1 minute insulation resistance reading corrected to 40°C is:

Rated Motor Voltage	Minimum Insulation Resistance
Up to 999 (inclusive)	5 Megohms
1000 and up	100 Megohms

The recommended minimum value for the polarization index is 2.0 if the 1 minute insulation resistance reading corrected to 40°C is above 5000 megohms, however, the polarization index may not be meaningful. In such cases, the polarization index may be disregarded as a measure of insulation condition.

Refer any question to the Nidec Motor Corporation Product Service Department.

For more information, refer to the IEEE 43™ Standard.

4. Start-up Preparations After Storage

A. Motor should be thoroughly inspected and cleaned to restore to an “As Shipped” condition.

B. Motor which has been subjected to vibration must be disassembled and each bearing inspected for damage.

C. When storage time has been six (6) months or more, oil and/or grease must be completely changed using lubricants and methods recommended on the motor's lubrication plate, or in **Section IX - “LUBRICATION”**

D. The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in **Section III., item 3.**

E. Contact Nidec Motor Corporation Product Service Department prior to start-up if storage time has exceeded one year.

IV. Installation Location

When selecting a location for the motor and driven unit, keep the following items in mind:

1) The location should be clean, dry, well-ventilated, properly drained, and provide accessibility for inspection, lubrication, and maintenance. Ambient vibration should be kept to a minimum. Outdoor installations on open drip proof motors require protection from the elements.

2) The location should provide adequate space for motor removal without shifting the driven unit.

3) Temperature rise of a standard motor is based upon operation at an altitude not exceeding 3300 feet (1000 meters) above sea level, and a maximum ambient temperature of 40°C unless specified otherwise on nameplate. See NEMA®† MG-1 20.28 for usual service conditions.

4) To avoid condensation inside the motor, it should not be stored or operated in areas subject to rapid temperature changes unless it is energized or protected by space heaters.

5) The motor should not be installed in close proximity to any combustible material or where flammable gases maybe present, unless it is specifically built for that environment and is U.L. labeled accordingly.

6) Oil lubricated motors must be mounted within one degree of true vertical. Failure to do so will result in oil leakage and possibly bearing failure.

7) Recommended Minimum Installation Clearances

This is a general guide and cannot cover all circumstances. Unusual arrangements should have inquiries to Nidec Motor Corporation Product Service Department. Unusual arrangements might include high ambient, limited ventilation, or a large number of motors in a conned space.
The distance to the wall is at the side or end of the motor. The distance to another motor is considered as surface to surface and for side-by-side arrangements. This recommendation considers all motors to be mounted in the same orientation (e.g. all main conduit boxes facing east).

Speed	Distance to Wall	Distance to Another Motor
3600 RPM	2 x motor width	2 x motor width
1800 RPM or Less	1 x motor width	

V. Initial Installation

⚠ CAUTION

Any rotating component removed to facilitate installation of motor should be witness marked to assist in reassembly as not to affect the overall motor balance. All loosened or removed parts must be reassembled and tightened to original specifications.

1. General

Reliable, trouble free operation of a motor and driven unit depends on a properly designed foundation and base plus good alignment. If the motor and driven unit are not installed properly, the following may result:

* Noisy Operation
* Bearing damage or failure
* Excessive vibration
* Motor failure

2. Shaft Alignment

Shaft Alignment Tolerances					
"Coupling Type"	"Base Foot Flatness"	"Base Coplanarity"		"Offset Misalignment(inch)"	"Angular Misalignment(inch)"
"Vertical Motors"	Flexible Coupling			0.002	0.00035/inch of Spacer Length
	Rigid Couplings		Short Coupling	0.0008	0.0004/foot of Coupling Diameter
			Hollow Shafts	0.0005	

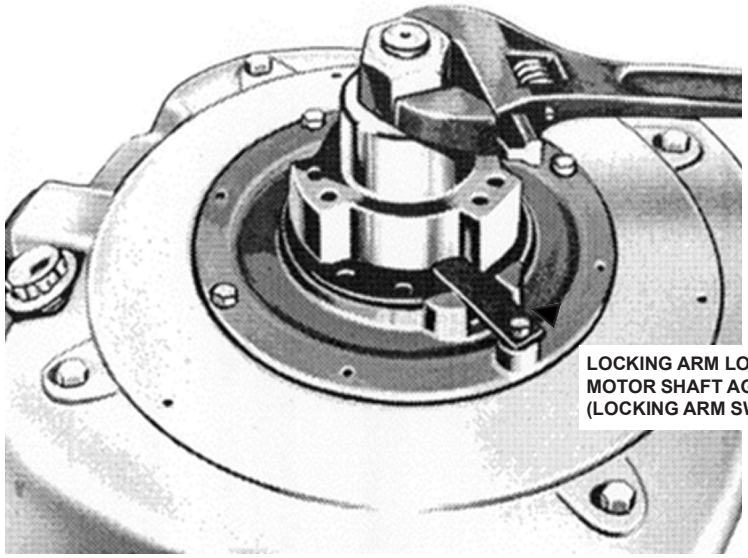
3. Pump Shaft Adjustment (HOLLOSHAFT® motors only)

To facilitate axial pump shaft adjustment, a locking feature is provided to lock the motor shaft against rotation. The two types of locking features are as follows:

A. Locking arm (Figure 2) - The locking arm is bolted to a stationary part and is pinned (for best results use arm in tension) or interferes with a rotating part (when locking arm is not in use it should be moved out of the way and bolted in place). A non-reverse ratchet functions as a locking device. Motors supplied with a non-reverse ratchet are not equipped with a locking arm.

B. Pinning through mating holes - Holes are provided in both a stationary and rotating part which line up allowing insertion of a pin.

Figure 2



⚠WARNING

Locking device must be disengaged prior to starting motor or motor damage and/or injury to personnel can result.

⚠ CAUTION

Care should be exercised when lowering the motor over the pump shaft so that the oil retaining tube in the lower bracket is not damaged (applies only to motors with oil lubricated lower bearing).

4. Drive Coupling (HOLLOSHAFT® units only).

The drive coupling may be utilized in one of two ways:

A. Bolted type (Figure 3) - Hold down bolts are installed (some motors require removal of driving pins to allow installation of hold down bolts) in the drive coupling to prevent upward movement of the pump shaft. This will allow momentary upthrust from the pump to be taken by the motor's guide bearing.

⚠WARNING

Failure to tighten coupling and non-reverse ratchet bolts to required torque values can cause bolts to break, resulting in equipment damage or injury to personnel.

⚠WARNING

Failure to tighten coupling and non-reverse ratchet bolts to the required torque values shall cause bolts to break, resulting in equipment damage or injury to personnel.

Figure 3

Bolted Coupling

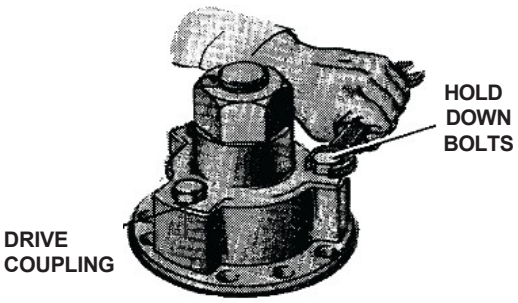
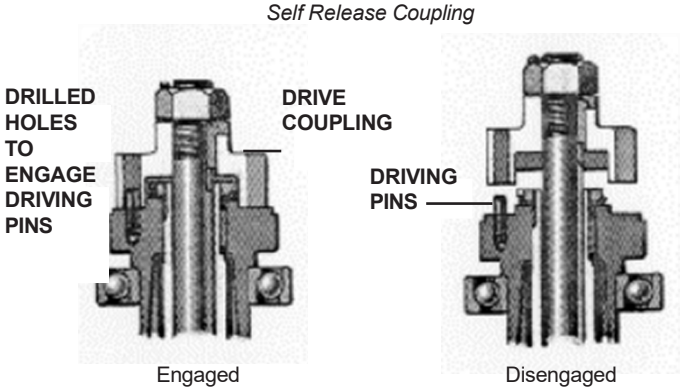


Figure 4

Self Release Coupling



Adjusting Nut Locking Screw

B. Self-release type (Figure 4) - Driving pins are used to engage the drive coupling with the rotor. A power reversal may unscrew the joints of the pump shafting, causing the shafting to lengthen and buckle or break if the shafting is restrained. The self-release coupling will lift out of engagement with partial unscrewing of the shafting, thus stopping further rotation of the pump. The following items must be followed for proper functioning of the self-release coupling:

- The pump shaft adjusting nut must be properly secured to the drive coupling with a locking screw
- The drive coupling should not bind on the driving pins
- The drive coupling must not be bolted down
- The pump shaft must be concentric to the motor shaft to prevent rubbing of the pump shaft inside the motor shaft
- There must be no potential for upthrust in the application
- Do not use the self-release feature in conjunction with a lower steady bushing, as friction between the parts can damage the line shafting and/or bushing
- Due to the possibility of sparking as the parts separate, the self-release feature must not be used in an environment where explosive gases or dust may be present

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary, and all power locked out before manually re-coupling.

5. Water Cooling For Bearing Oil Reservoir.

If the motor is equipped with cooling coils in the oil reservoir, a minimum water supply of 4 GPM must be maintained at a maximum of 125 PSI with a 32°C (90°F) maximum inlet temperature. External water connections must be self draining to prevent cooling coil rupture at freezing temperatures. Use clean, noncorrosive water only. If corrosive conditions exist and are specified at time of motor order, special corrosion resistant fittings can be supplied.

6. Electrical Connection

Refer to the motor nameplate for power supply requirements and to the connection diagram on the motor. Be sure connections are tight. Check carefully and assure that they agree with the connection diagram, then insulate all connections to be sure that they will not short against each other or to ground. Be sure the motor is grounded to guard against possible electrical shock. Refer to the National Electrical Code Handbook (NFPA No. 70) and to local electrical codes for proper wiring, protection, and wire sizing. Be sure proper starting equipment and protective devices are used for every motor. For assistance, contact the motor starter manufacturer.

Part Winding Starters: Part winding starters used with part winding start motors should have the timer set at a minimum time consistent with the power company requirements. The recommended maximum time on part winding is two seconds. Setting the timer for longer periods can cause permanent damage to the motor and may void the warranty. Note that motor may or may not start on part winding start connection.

7. Direction Of Rotation

As a standard, motors that are equipped with a non-reverse ratchet are designed to operate in a counterclockwise direction as viewed from the top of the motor. Also, some high speed motors have unidirectional ventilating fans. When the motor has a unidirectional ventilating fan, the direction of rotation is indicated by an arrow mounted on the motor and by a warning plate mounted near the main nameplate.

⚠ CAUTION

*Apply power **momentarily** to observe the direction of rotation for which the leads are connected. Motor damage may occur if power is applied for more than ten seconds while rotation is locked against the non-reverse ratchet. The motor should be uncoupled from the driven equipment during this procedure to assure driven equipment is not damaged by reverse rotation. Couplings (if installed) should be properly secured.*

For a 3 phase motor, to reverse the direction of rotation (if the motor is not operating in the correct direction), interchange any two of the three power leads on the motor. For a 1 phase motor, if the motor is not operating in the correct direction, follow the instructions on the connection plate attached to the motor in order to reverse the direction of rotation. For both 1 and 3 phase motors, be sure that the power is off and steps are taken to prevent accidental starting of the motor before attempting to change electrical connection.

8. Spring-Preloaded Thrust Bearings

Motors built with spherical roller thrust bearings (bearing number 29xxx) at any speed or tandem angular contact thrust bearings (bearing number 7xxx) on large 3600 or 3000 RPM (2-pole) motors have preload springs which maintain a minimum thrust load at all times to prevent bearing skidding. These motors require a minimum external thrust load sufficient to compress the springs to properly seat the thrust bearing and to relieve the lower guide bearing of axial spring thrust. Refer to motor's minimum thrust nameplate for required thrust.

⚠ CAUTION

Do not run a motor which has bearing preload springs without thrust load for more than fifteen (15) minutes as bearing damage can result.

9. Initial Start

After installation is completed, but before motor is put into regular service, make an initial start as follows:

A. Ensure that motor and control device connections agree with wiring diagrams.

B. Ensure that voltage, phase, and frequency of line circuit (power supply) agree with motor nameplate.

C. Check insulation resistance according to Section III "STORAGE" item 3.

D. Check all foundation, base, non-reverse ratchet (if applicable), and coupling bolts (if applicable) to ensure they are tight.

E. If motor has been in storage, either before or after installation, refer to Section III "STORAGE" Item 4 for preparations.

F. Motors are tested with oil at our manufacturing facility then drained prior to shipment.

Note: A small amount of residual oil and rust inhibitor will remain in the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation. Check oil lubricated units to be certain that bearing housings have been filled to between the "MAX" and "MIN" levels on the sight gauge windows with the correct lubricant. Refer to Section IX "LUBRICATION" for proper oils.

G. Check for proper or desired rotation. See item 7 of this section for details.

H. Ensure that all protective devices are connected and operating property, and that all outlet accessory, and access covers have been returned to their original intended position.

I. Start motor at lowest possible load and monitor to be sure that no unusual condition develops.

⚠WARNING

All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.

J. When checks are satisfactory to this point, increase load slowly up to rated load and monitor unit for satisfactory operation.

VI. Normal Operation

Start the motor in accordance with standard instructions for the starting equipment used.

1. General Maintenance

   Regular, routine maintenance is the best assurance of trouble-free, long-life motor operation. It prevents costly shutdown and repairs. Major elements of a controlled maintenance program are:

   A. Trained personnel who have a working knowledge of rotational equipment and have read this manual.

   B. Systematic records which contain at least the following:

      1. Complete nameplate data
      2. Prints (wiring diagrams, certified outline dimensions)
      3. Alignment data
      4. Results of regular inspection, including vibration and bearing temperature data, as applicable
      5. Documentation of any repairs
      6. Lubrication data:
         - Method of application
         - Types of lubricants for wet, dry, hot, or adverse locations
         - Maintenance cycle by location (some require more frequent lubrication)

2. Inspection and Cleaning

   Stop the motor before cleaning. ***CAUTION: Assure against accidental starting of the motor.*** Clean the motor inside and out regularly. The frequency of cleaning depends upon actual conditions existing around the motor. Use the following procedures as they apply:

   A. Wipe off dirt, dust, oil, water, or other liquids from external surfaces of motor. These materials can work into or be carried into the motor windings and may cause overheating or insulation breakdown.

   B. Remove dirt, dust, or debris from ventilating air inlets. Never allow dirt to accumulate near air inlets. Never operate motor with air passages blocked.

   C. Clean motors internally by blowing with clean, dry, compressed air at 40 to 60 PSI. If conditions warrant, use a vacuum cleaner.

⚠ CAUTION

When using compressed air, always use proper eye protection to prevent accidental eye injury.

   D. When dirt and dust are solidly packed, or windings are coated with oil or greasy grime, disassemble the motor and clean with solvent. Use only high-flash naphtha, mineral spirits, or Stoddard solvent. Wipe with solvent dampened cloth, or use suitable soft bristled brush. DO NOT SOAK. Oven dry (150 - 175°F) solvent cleaned windings thoroughly before reassembly.

   E. After cleaning and drying the windings, check the Insulation resistance per Section III, Item 3.

   The above C, D, and E items require disassembly of the motor to properly clean the inner motor components and MUST be performed by a fully qualified Motor Repair/Service Shop

VII. Non-Reverse Ratchet

Units featuring non-reverse ratchets are refine-balanced by attaching weights to the rotating ratchet. If the ratchet is removed, it should be marked and reassembled in the same position to retain proper balance.

VIII. Endplay Adjustment

The term endplay is defined as the total axial float of the rotor. Should the motor be disassembled for any reason, the rotor endplay must be adjusted. Care must be taken to ensure that end play is within the proper range. Use one of the following procedures, depending upon the type of thrust bearing to set and play:

⚠ CAUTION

Excessive endplay can allow the thrust bearing to separate when units are run with zero thrust or momentary up thrust, resulting in thrust bearing failure. Insufficient endplay may cause the bearings to load against each other, resulting in extreme heat and rapid failure of both the guide and thrust bearings.

End play is defined as the amount of free axial travel that the rotor has when thrusted in both directions. To prevent both preloading of the guide bearing and excessive end float, end play should be adjusted to be within an acceptable range. Required end play depends upon the location of the thrust bearing (whether it is in the lower or upper end of the motor).

Angular Contact Thrust Bearing(s) (7XXX) in Lower End of Motor

APPLICABLE FRAMES	APPLICABLE TYPES	END PLAY SETTING
182 THRU 286	TU, TV4, LU, LV4, EU, EV4, NU, NV4, AU, AV4	.015 - .020
324 THRU 365	TU, TV4, LU, LV4, EU, EV4, NU, NV4	.020 - .025

Adjust end play by adding shims above the upper guide bearing. End play should be rechecked after addition of shims to verify setting. Turn rotor by hand to ensure that components are not rubbing and unit turns freely.

Note: Motors with opposed thrust bearings (e.g. 7XXX Back-to-Back mounted) or with a single double-row angular contact bearing (i.e. 5XXX) or a single Conrad deep-groove bearing (6XXX) in the lower end of the motor do not require shimming. End play on these motors is controlled entirely by the internal clearance in the lower bearing(s).

Angular Contact Brg(s) (7XXX) or Spherical Roller Thrust Brg (29XXX) in Upper End of Motor

APPLICABLE FRAMES	APPLICABLE TYPES	END PLAY SETTING
324 THRU 365	RU, RV4	.005 to .008
404 & UP	RU, RV4, HU, HV4, TU, TV4, LU, LV4, EU, EV4, NU, NV4, JU, JV4	
449	JV, JV3	
6808 & UP	HV, RV	

Adjust end play by turning the locknut above the bearing mounting until the lower bearing contacts the bearing cap fingers and then back of the locknut until the required end play is achieved and secure with lock washer tab. Turn rotor assembly by hand to ensure that components are not rubbing and unit turns freely. Prick punch the end of the shaft and locknut for permanent identification of end play setting at the factory.

Notes;
1 . Use of hydraulic jacking means or hoists can be useful in adjusting end play on units with spring preloaded bearings or large rotors. Use caution as excessive hydraulic force can cause deflection of parts which can then lead to a false end play reading and highly preloaded bearings.

1. Spherical Roller Thrust Bearings and Angular Contact Bearings (With Springs).

Setting the correct end play on units with spring-preloaded spherical roller or angular contact thrust bearings requires a controlled assembly method, due to various deflections internal to the motor and friction of locknut threads from spring force. An end play setting of .005 to .008 inches is required to allow the lower guide bearing to return to an unloaded position when external thrust is applied to the motor (see Figure 5). End play can be properly adjusted by the following recommended procedure:

A. Place spring retainer (without springs) and lower thrust washer of bearing into upper bearing bore.

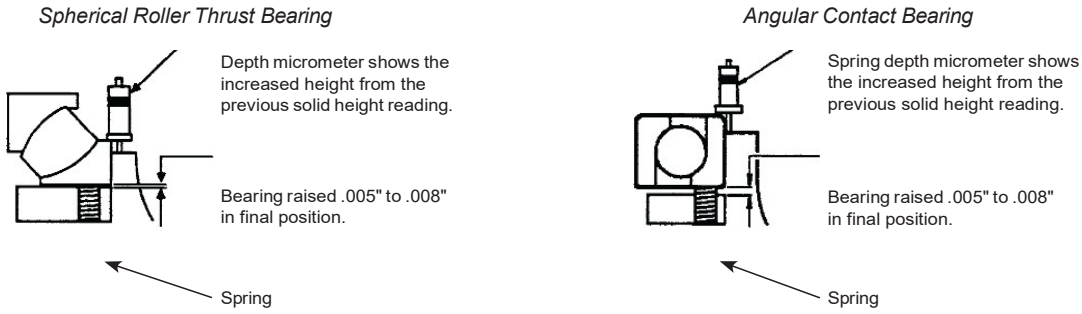
B. Using a depth micrometer, measure the distance between the top and lower thrust washer and the faced surface on top of the bearing housing (see Figure 5). Record dimension to three decimals.

C. Add .005 to .008 inches to the recorded dimension to obtain the correct endplay range for the unit.

D. Reassemble bearing with springs. Motor is now ready to set and play. Several acceptable methods for setting endplay are following.

NOTE: Certain motor builds require removal of the fabricated steel or cast aluminum oil baffle to provide access for depth micrometer measurements.

Figure 5



2. Angular Contact Ball Bearings (Without Springs)

A. No preliminary measurements are required to set and play. End play may be set by any of the following methods described in this section.

B. To correctly adjust the endplay setting, a dial indicator should be positioned to read the shaft axial movement. (See figure 7 for location and dial indicator). The rotor adjusting locknut should be turned until no further upward movement of the shaft is indicated. The locknut is then loosened until .005 to .008” endplay is obtained. Lock the locknut with lock washer.

⚠ CAUTION

Care should be taken to ensure that the locknut is not over-tightened, as this can lead to an erroneous end play setting (due to deflection of parts) and bearing damage may result.

C. Motors that have two opposed angular contact bearings that are locked for up and downthrust do not require endplay adjustment. The shaft, however, should be set to the original 'AH' (shaft extension length) to prevent the guide bearing from taking thrust.

END PLAY ADJUSTMENT METHODS

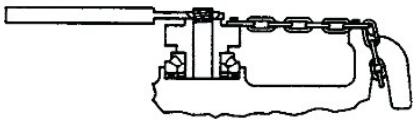
1. Method 1 (refer to Figures 6 & 7)

This method requires the user to install a bolted chain from the bearing mount back to a lifting lug. Rotate the locknut with a spanner wrench (and bar extension) until dial indicator shows no movement on end of shaft. The locknut should then be loosened until proper endplay is obtained, lock the locknut with lock washer. (See Figure 7 for location of dial indicator.)

NOTE: This is the lowest cost of the three methods and requires the least amount of equipment. This method, however, may be less desirable than Method 2 as considerable locknut torque may be encountered on units with bearing preload springs.

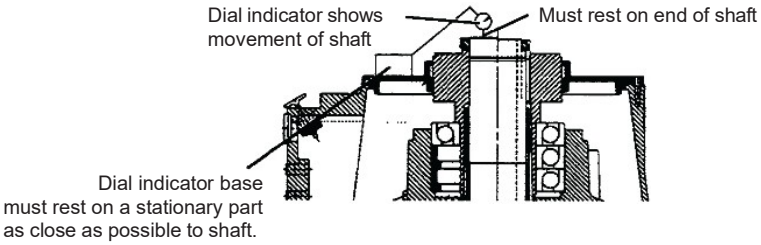
Special equipment required:
- Locking bolts
- 3/4" chain
- Spanner wrench with extension
- Dial indicator
- Depth micrometer

Figure 6 (Method 1)



Mounting springs are compressed and rotor is lifted by locknut

Figure 7 (Method 1 & 3)



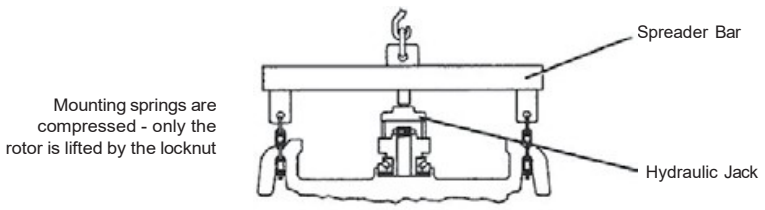
2. Method 2 (refer to Figure 8 - Utilized on spring Loaded Bearings Only)

This method utilizes a spreader bar and chains to wrap around lifting lugs, a hydraulic jack (five ton), and crane to lift the spreader bar. The hydraulic jack is supported by two steel blocks of equal thickness on top of the bearing mounting with the jack pushing against the spreader bar. On large motors, the rotor can be lifted by placing a second jack below the motor shaft to allow the locknut to be turned easily.

NOTE: This method utilizes typical shop equipment and tools. Endplay settings can be checked quickly on larger vertical motor products. The locknut lifts rotor weight only.

Equipment required:
- Large spreader bar with chains and locking bolts
- Overhead crane
- Spanner wrench
- 5-ton hydraulic jack
- Depth micrometer
- Metal blocks
- Dial indicator

Figure 8 (Method 2)



3. Method 3 (refer to Figure 9)

This method uses a one inch thick steel disc with a center hole for the shaft end bolt and two threaded hydraulic jacks connected to a single pump. Apply load to hydraulic jacks until dial indicator shows no movement on end of shaft. (See Figure 7 for location of dial indicator). The shaft locknut should be positioned and the pressure from hydraulic jack relieved until proper endplay is obtained.

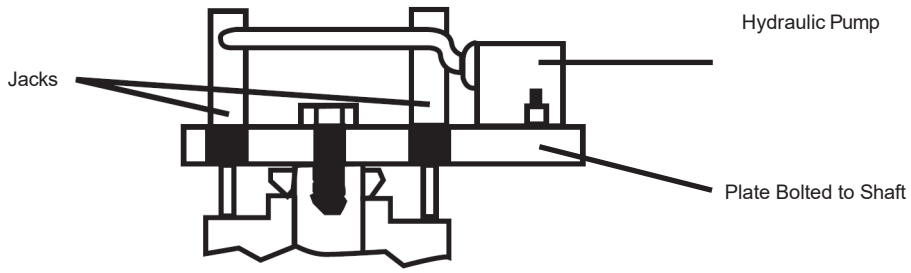
⚠ CAUTION

Use of excessive hydraulic pressure can damage bearings.

NOTE: This method is directly usable on solid shaft motors and can be used on most HOLLOSHAFT® motors with the use of a long threaded rod and plate. It is easy to apply and settings can be checked quickly, especially in field service. The locknut does not see any force and can be turned easily.

Equipment required:
- Fixture with hydraulic jacks
- Dial indicator
- Spanner wrench

Figure 9 (Method 3)



Mounting springs are compressed and rotor is lifted by the fixture. The locknut is turned for adjustment.

⚠ CAUTION

After setting endplay, run unit for three to five minutes, then stop and verify the endplay setting. Readjust as necessary. All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.

IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III "STORAGE", item 4** for instructions.

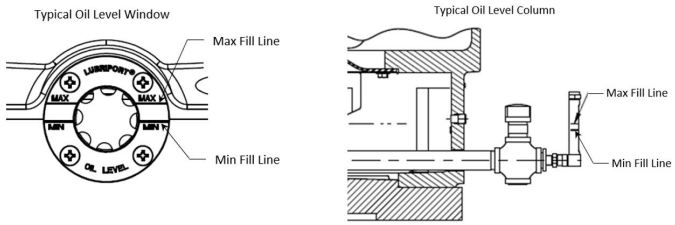
1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 and 5 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. Figure 10 illustrates a typical oil level window or column to confirm oil fill. Oil level should be confirmed with motor off and should be not be above the max fill line or below the min fill line. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila®† P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 7 for the approximate quantity of oil required.

Figure 10



2. Grease Lubricated Bearings

A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠WARNING

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 and 6 for recommended greases).

⚠WARNING

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disassembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠WARNING

Over greasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against over greasing.

B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1

Recommended Grease Replenishment Quantities & Lubrication Intervals

Bearing Number		Grease Replenishment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	8 Months	1 Year	1 Year
08 thru 12	07 thru 09	0.4	4 Months	8 Months	1 Year
13 thru 15	10 thru 11	0.6	3 Months	6 Months	6 Months
16 thru 20	12 thru 15	1.0	1 Month	4 Months	6 Months
21 thru 28	16 thru 20	1.8	Not Available	2 Months	4 Months

Table 2

Recommended Grease (Chevron Black Pearl Grease EP NLGI #2120 LB KEG) Replenishment Quantities & Lubrication Intervals for Vertical Aerator Motors (also applies to 52xx & 53xx bearings)

Enclosure	Frame	Poles	Lower (Thrust Bearing)	Re-greasing Intervals (hours)
TEFC	184	4	3208-A	2000
		n/a		n/a
	215	4	3211-A	1700
		6		2400
		n/a		n/a
	256	4	3212-A	1600
		6		2200
		8		2200
	286	4	3213-A	1600
		6		2200
		8		2200
	326	4	3216-A	1300
		6		1800
		8		1800
	365	4	3217-A	1300
		6		1800
		8		1800
	405	4	3316-A	1100
		6		1600
		8		1600
	447	4	3316-A	1100
		6		1600
		8		1600

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

G = 0.11 x D x B

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Width of bearing in inches

Table 2
Recommended Greases

Motor Enclosure	Grease Manufacturer	Product Name
Totally-Enclosed	Exxon Mobil Corporation	Mobilith SHC 100
	Shell Oil Company	Gadus S5 V100 2
	Total	Multis Complex S2 A
	Kluber Lubrication	Kluberplex BEM 41-132
	Engineered Lubricants Co	ENLUBE PAO-LITH-500-2
Open and Weather-Protected	Exxon Mobil Corporation	Polyrex EM
	Shell Oil Company	Dolium R
	Cheveron Corporation	SRI #2
	Phillips 66	Polytac Grease 2
	Texaco, Inc.	Polystar RB2
	Total	Altis EM 2
	Engineered Lubricants Co	ENLUBE EM-50

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3

Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Drip proof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic
			41°C thru 50°C (105-122°F)	68	Synthetic Only
	449 thru 5811	1801-3600	-15°C thru 40°C (104°F)	32	Synthetic Only
		1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office	

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	**Frame Size**	**Speed (RPM)**	**Ambient Temperature**	**ISO VG**	**Base Oil Type**
Open Drip proof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		Synthetic Only
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4

Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	**ISO VG 32**		**ISO VG 68**		**ISO VG 150**	
	Viscosity: 130-165 SSU @ 100F		**Viscosity: 284-347 SSU @100F**		**Viscosity: 620-765 SSU @ 100F**	
	Mineral Base Oil	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**	**Mineral Base Oil**	**Synthetic Base Oil**
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5 Recommended Food Grade Oils (NSF HI)

Company	ISO VG32	ISOVG46	ISOVG68	ISOVG100	ISO VG150
	130-165 SSU @ 100F	190-235 SSU @ 100F	284-34 7 SSU @ 100F	415-510 SSU @ l00F	620-765 SSU @ 100F
Exxon Mobil	Mobil SHC Cibus 32	Mobil SHC Cibus 46	Mobil SHC Cibus 68	None listed	Mobil SHC Cibus 150
Petro Canada	Purity AW32	Purity AW46	Purity AW68	Purity AW100	None listed
Shell	Cassida Fluid HF 32	Cassida Fluid HF 46	Cassida Fluid HF 68	Cassida Fluid HF 100	None listed
Chevron	Lubricating Oil FM 32	Lubricating Oil FM 46	Lubricating Oil FM 68	Lubricating Oil FM 100	None listed
Ultrachem Inc. • Omnilube	FGH 2032 Synthetic	FGH 2046 Synthetic	FGH 2068 Synthetic	FGH 2100 Synthetic	FGH 2150 Synthetic

Table 6 Recommended Food Grade Greases (NSF HI)

Company	Grease
Exxon Mobil	Mobilgrease EAL 102
Keystone	Nevastane HT/AW2
Shell	Cassida Grease EPS 2
Petro-Canada	Purity FG 2

Table 7 Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	RU, RV4	24	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV		
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

X. Fundamental Troubleshooting - Problem Analysis

This chart can reduce work and time spent on motor analysis. Always check the chat first before starting motor disassembly, as what appears to be a motor problem may often be located elsewhere. For additional information, consult our website at *www.usmotors.com.*

SYMPTOM	POSSIBLE CAUSE	ANALYSIS
Motor fails to start	Defective power supply	Check voltage across all phases above disconnection switch
	Blown or defective primary fuses	
	Blown or defective secondary fuses	Check voltage below fuses (all phases) with disconnect closed
	Open control circuit	Push reset button
	Overload trips are open	
	Defective holding coil in magnetic switch	Push start button and allow sufficient time for operation of time and delay, if used, the check voltage across magnetic holding coil. If correct voltage is measured, coil is defective. If no voltage is measured, control circuit is open
	Loose or poor connections in control circuits	Make visual inspection of all connections in control switch
	Magnetic switch closes	Open manual disconnect switch, close magnetic by hand, and examine contractors and springs
	Poor switch closes	
	Opens circuit in control panel	Check voltage at T1, T2, & T3
	Open circuit leads to motor	Check voltage at leads in outlet box
	Leads improperly connected	Check lead numbers and connections
Motor fails to come up to speed	Low or incorrect voltage	Check voltage at T1, T2, & T3 in control panel and at motor leads in outlet box
	Incorrect connection at motor	Check for proper lead connections at motor and compare with connection diagram on motor
	Overload - Mechanical	Check impeller setting. Check for a tight or locked shaft
	Overload - Hydraulic	Check impeller setting. Check GPM against pump capacity and head
Motor Vibrates	Head shaft misaligned	Remove top drive coupling and check alignment of motor to pump
	Worn line shaft bearings or bent line shaft	Disconnect motor from pump and run motor only to determine source of vibration
	Hydraulic disturbance in discharge piping	Check isolation joint in discharge piping near pump head
	Ambient Vibration	Check base vibration level with motor stopped
	System Natural Frequency (Resonance)	Revise rigidity of support structure
Motor Noisy	Worn thrust bearing	Remove dust cover, rotate rotor by hand, and make visual examination of balls and races. Bearing noise is commonly accompanied by a high frequency vibration and/or increased temperature
	Electrical noise	Most motors are electrically noisy during the starting period. This noise should diminish as motor reaches full speed

SYMPTOM	POSSIBLE CAUSE	ANALYSIS
Motor overheating (Check with thermocouple or by resistance methods. Do not depend on hand.)	Overload	Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.
	Motor intake or exhaust blocked or clogged	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped
	Unbalanced voltage	Check voltage to all phases. Refer to Appendix A
	Open stator windings	Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases
	Over / Under Voltage	Check voltage and compare to nameplate voltage
	Ground	Locate with test lamp or insulation tester and repair
	Improper connections	Re-check connections
Bearing Overheating Generally, bearing temperatures (as measured by a trip sensitive RTD or thermocouple touching the bearing outer race) should not exceed 90°C when using mineral-based lubricants or 120°C when using synthetic-based lubricants	Misalignment	Check alignment
	Incorrect oil, or oil level too high or too low	Refill with proper oil. Verify oil level is correct
	Excessive thrust	Reduce thrust from driven machine
	Bearing over-greased	Relieve bearing cavity of grease to level specified in lubrication section
	Motor overloaded	Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.
	Motor intake or exhaust blocked or clogged	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped
Bearing oil leaking around the drain plug	Insufficient sealant applied to drain plug threads	Remove drain plug and drain existing oil from sump. With a clean cloth, wipe excess oil from the plug threads and the threads in the drain hole. Apply Gasolia Thread Sealant P/N SS08 to the threads of the plug and replace. Fill sump with new oil to the proper level.

XI. Spare Parts

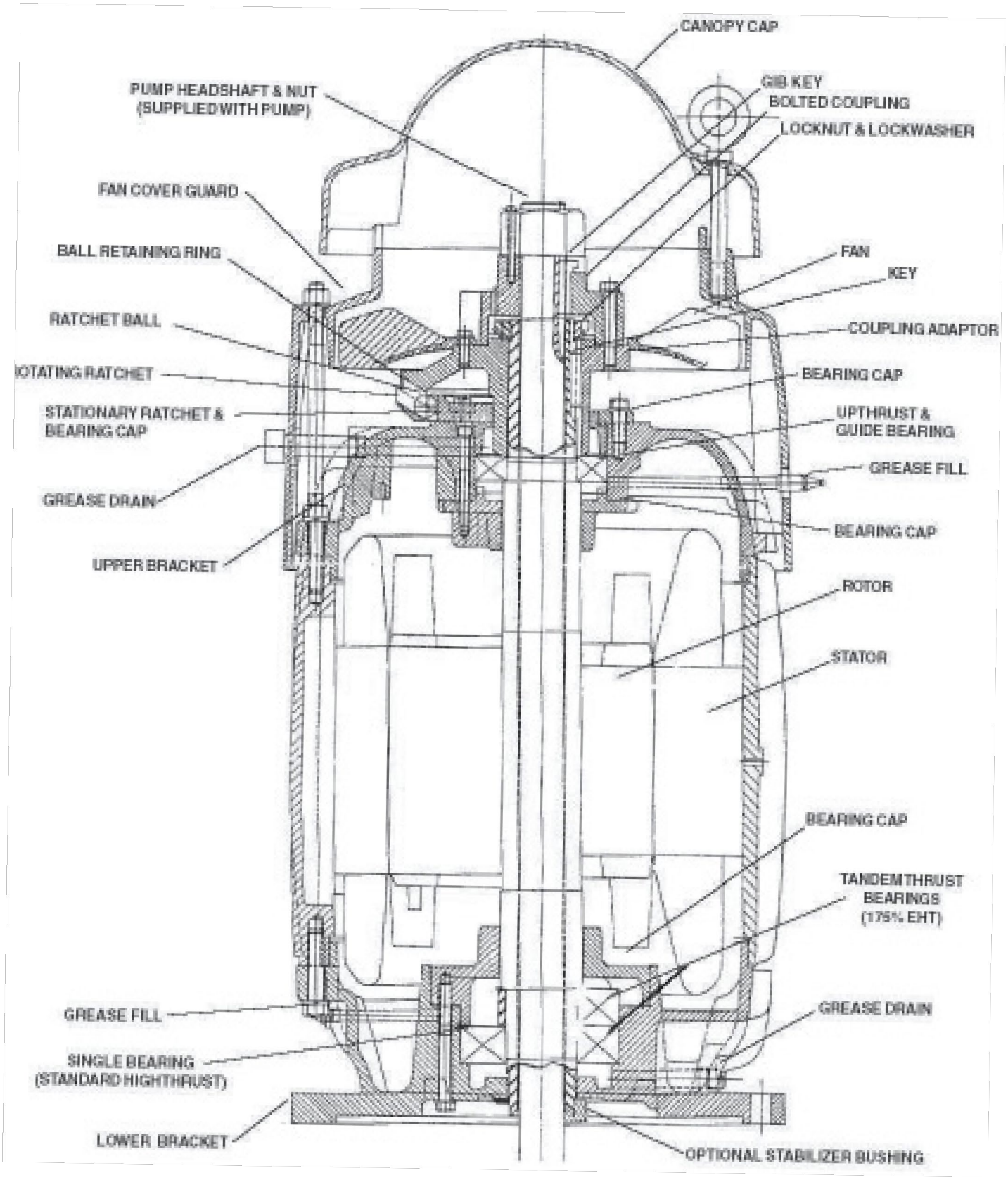
A parts list is available for your unit and will be furnished upon request. Parts may be obtained from local Nidec Motor Corporation distributors and authorized service shops, or through Nidec Motor Corporation distribution center.

Nidec Motor Corporation
710 Venture Drive
Suite 100
Southaven, MS 38672
Phone (662) 342-6910
Fax (662) 342-7350

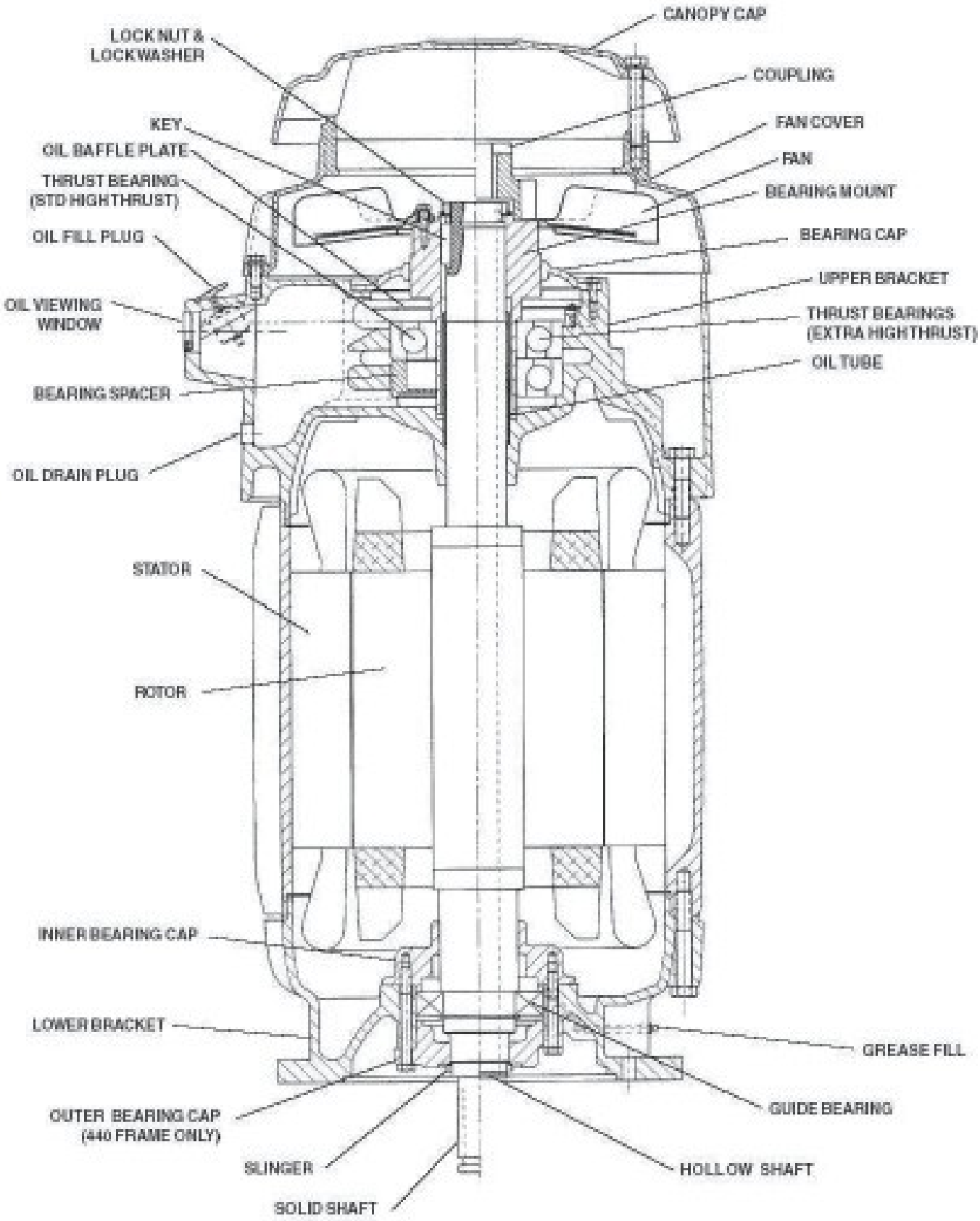
Drawings for many standard designs are supplied on the following pages. Most of the parts should be easy to identify. If, however, there is some deviation from your machine, consult Nidec Motor Corporation Product Service Department.

XII. Index Cut Away Views and Explosion Views

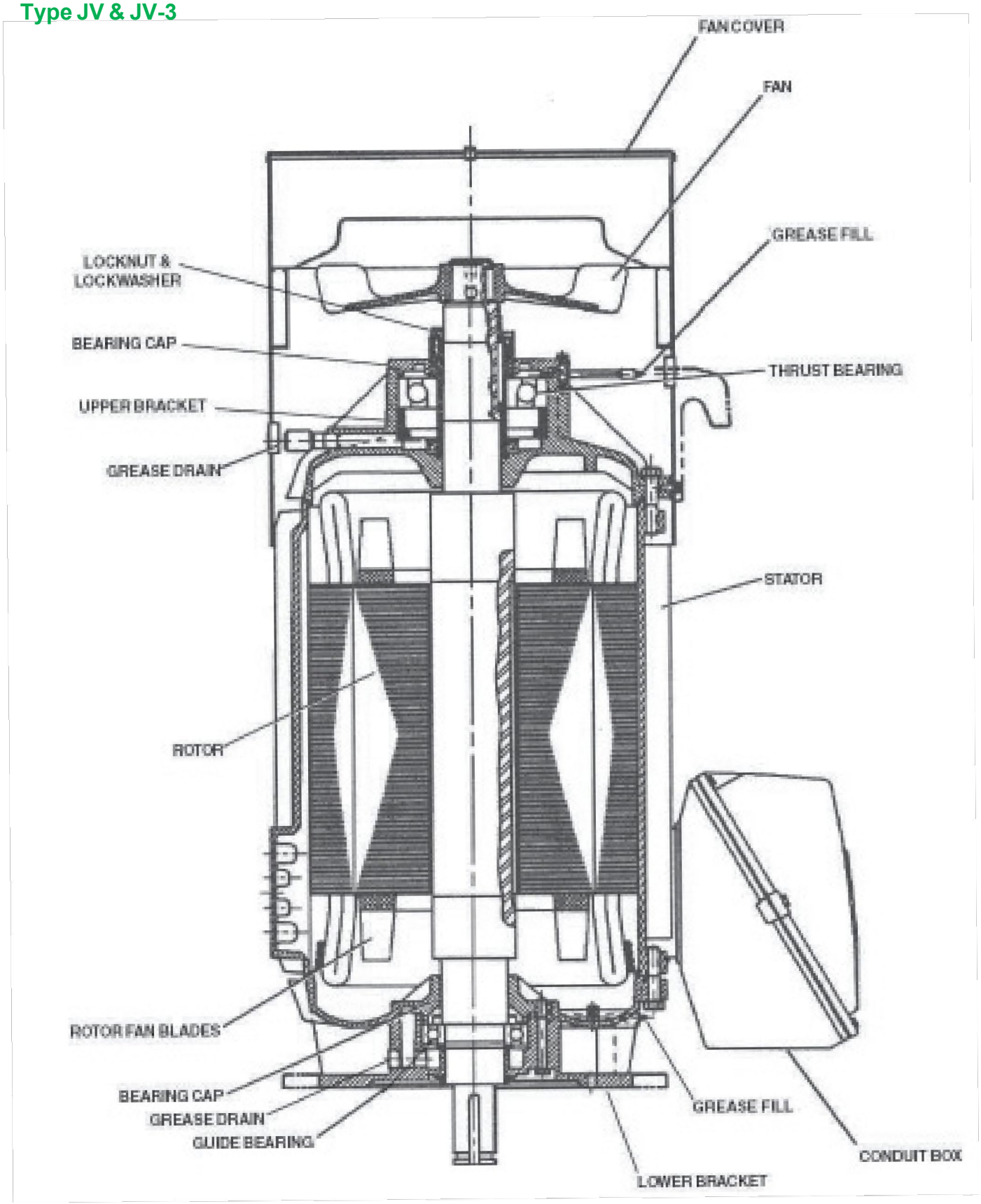
280, 320, 360 Frames, Type LU
320, 360 Frames, Type TU



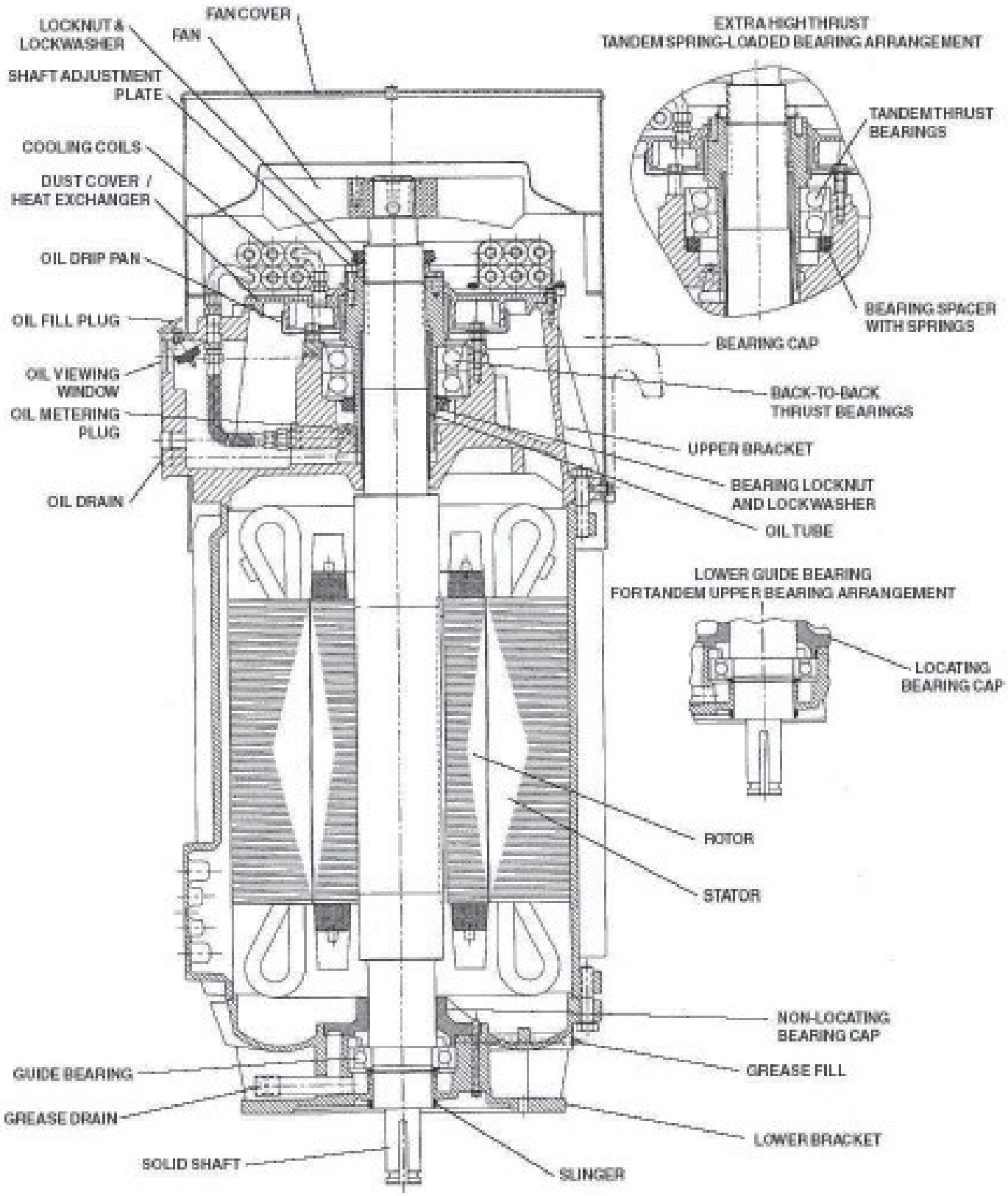
400 Thru 440 Frame
Types TU, LU, TV-4 and LV-4 High Thrust



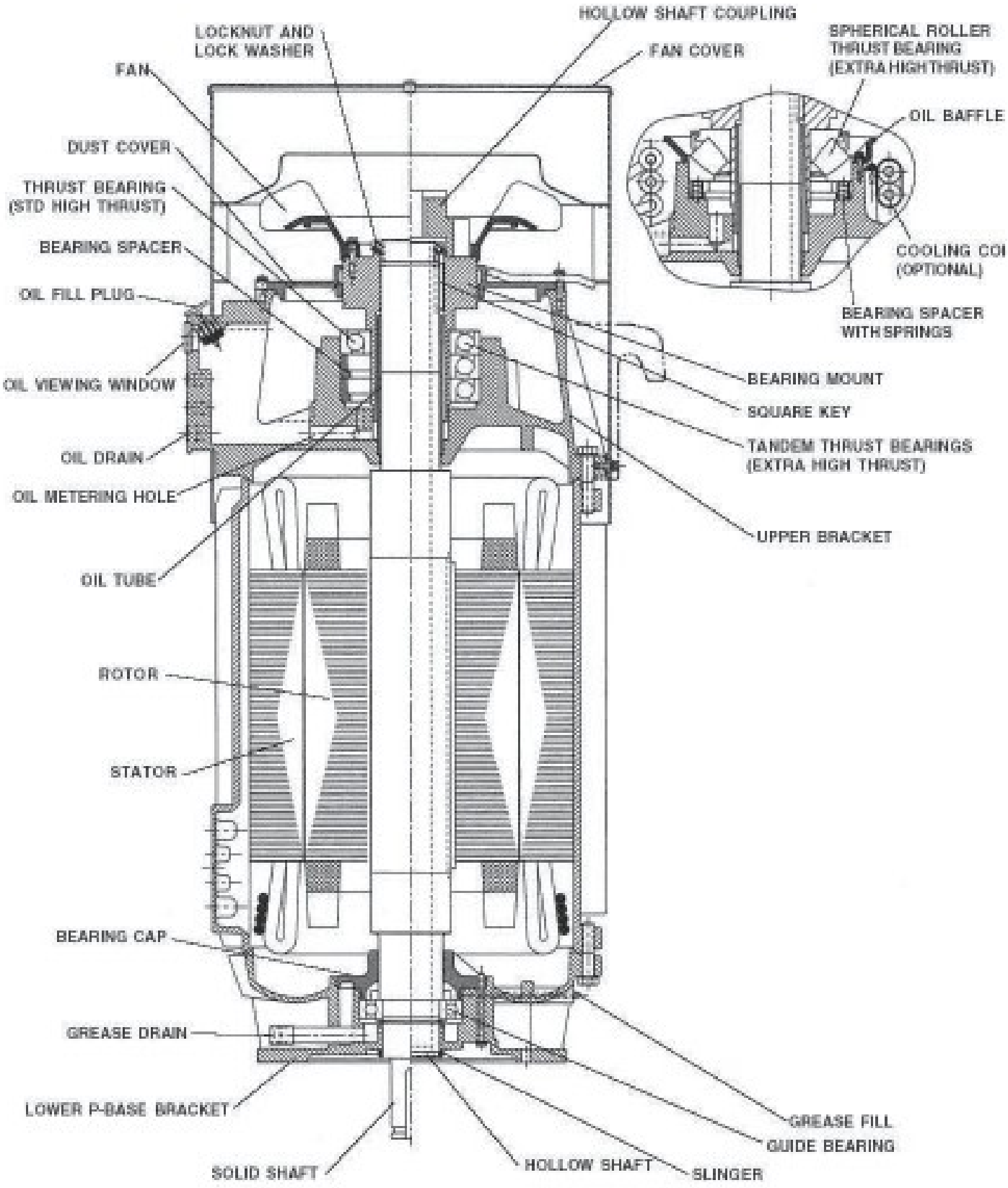
449 Frame
Type JV & JV-3



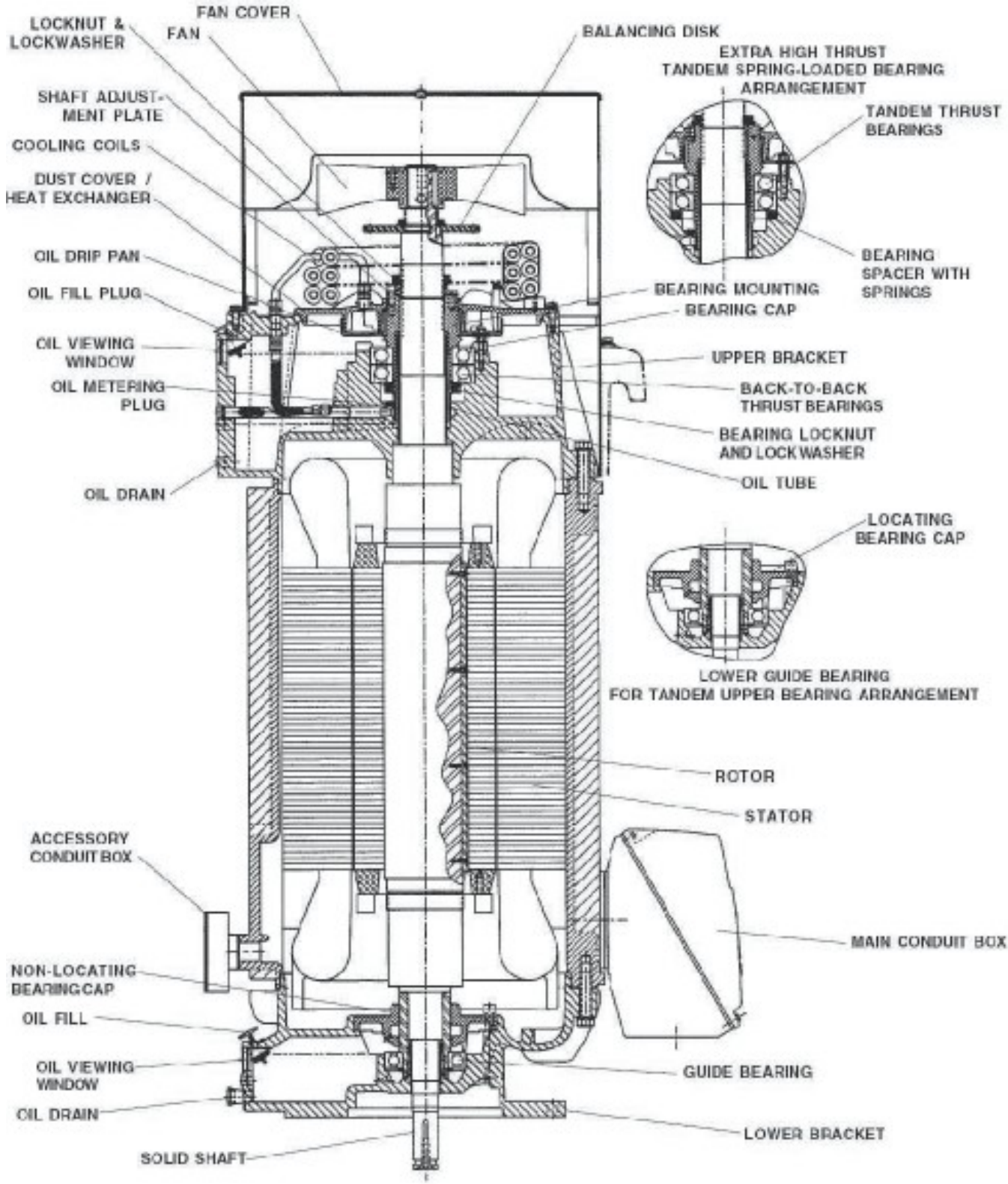
449 Frame
Type JV-4 (2 Pole)



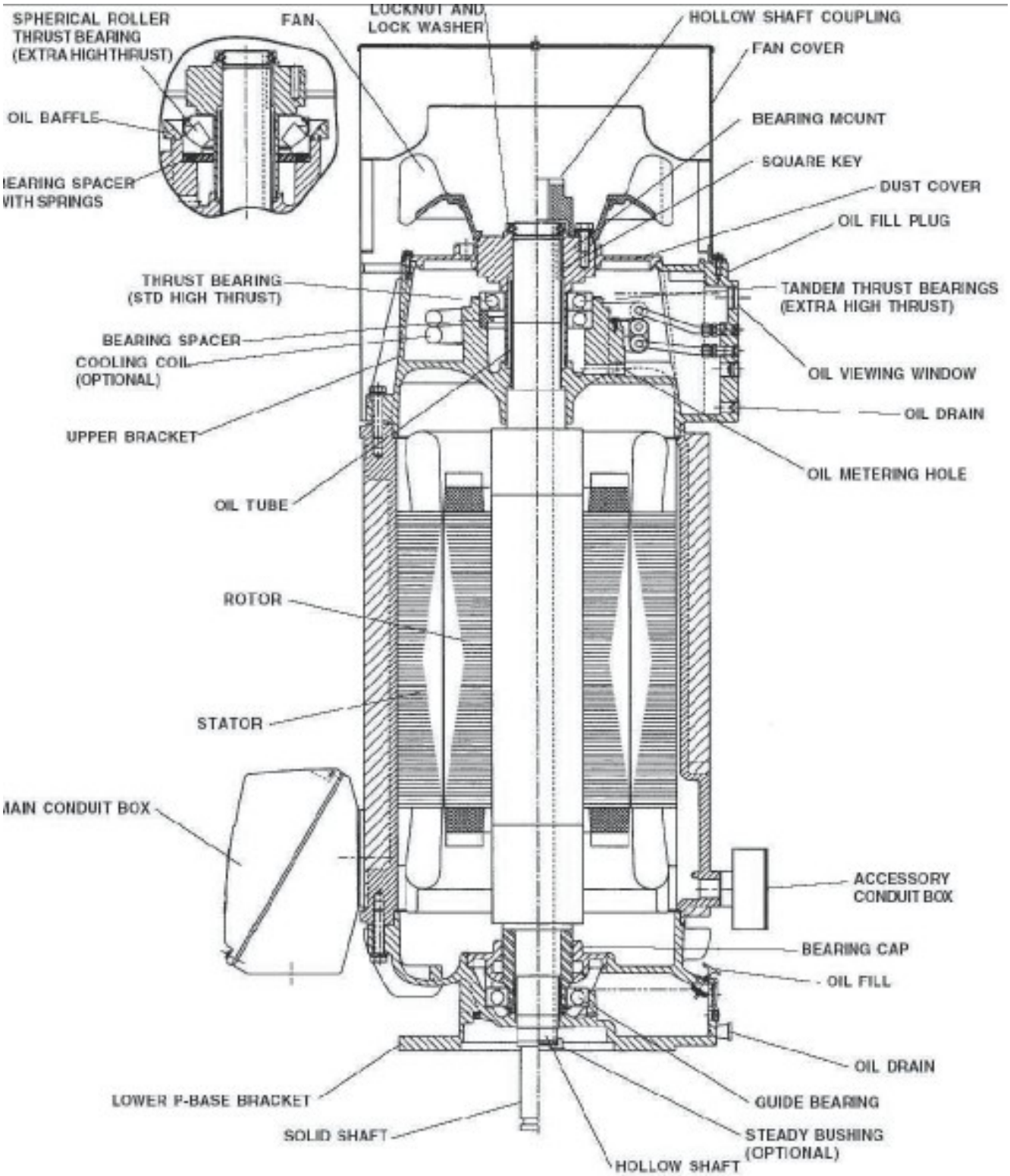
449 Frame
Type JU and JV-4 (4 Pole & Slower)



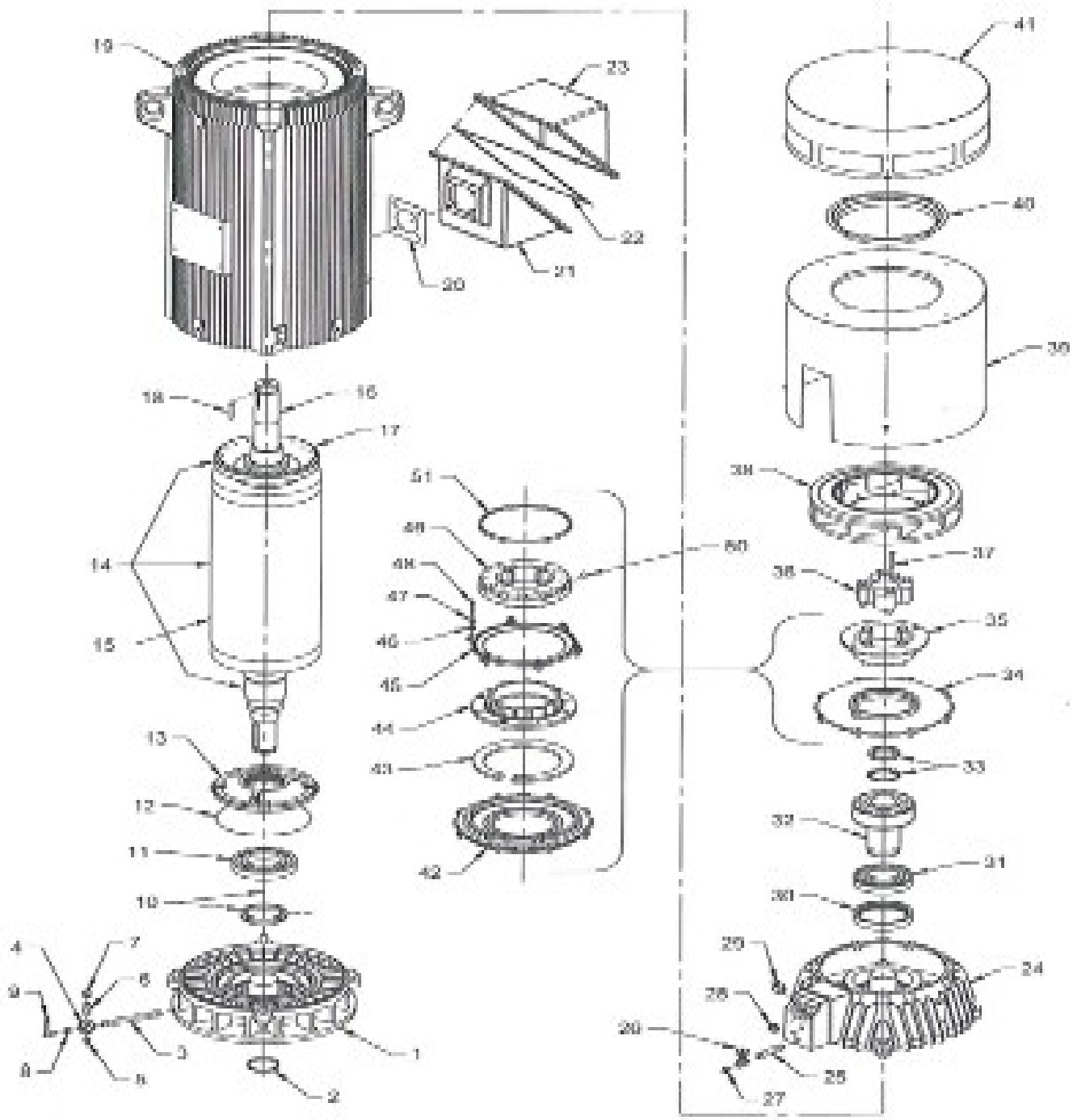
5800 Frame
JV-4 & EV-4 (2 Pole)



5807 - 5811 Frame
Type JU, and JV-4, EU, EV-4 (4 Pole & Slower)



5812 Frame
Type JU, JV4

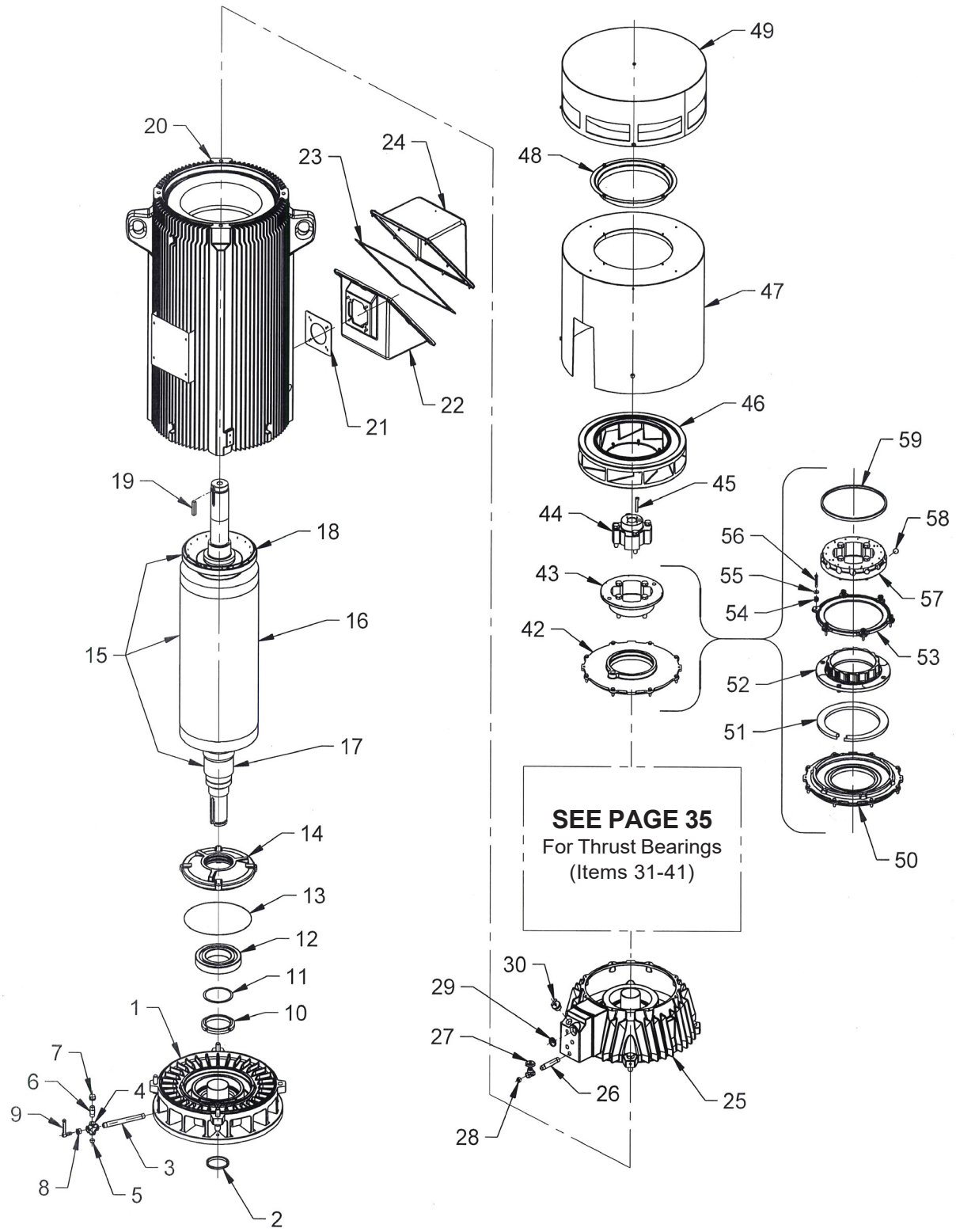


5812 Frame
Type JU, JV4

ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Tee (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Cap (Lower Oil Fill)
8	1	Reducer Bushing
9	1	Oil Sight Gauge Window
10	1	Locknut and Set Screws
11	1	Lower Bearing
12	1	O-Ring
13	1	Lower Bearing Cap
14	1	Rotor Assembly
15	1	Rotor Core
16	1	Rotor Shaft
17	1	Rotor Fan
18	1	Square Key (Bearing Mounting to Shaft)
19	1	Stator Assembly
20	1	Gasket (Outlet Box Base to Stator)
21	1	Outlet Box Base
22	1	Gasket (Outlet Box Cover to Base)
23	1	Outlet Box Cover
24	1	Upper Bracket
25	1	Pipe Nipple (Upper Oil Drain)
26	1	Gate Valve (Upper Oil Drain)
27	1	Pipe Plug (Upper Oil Drain)

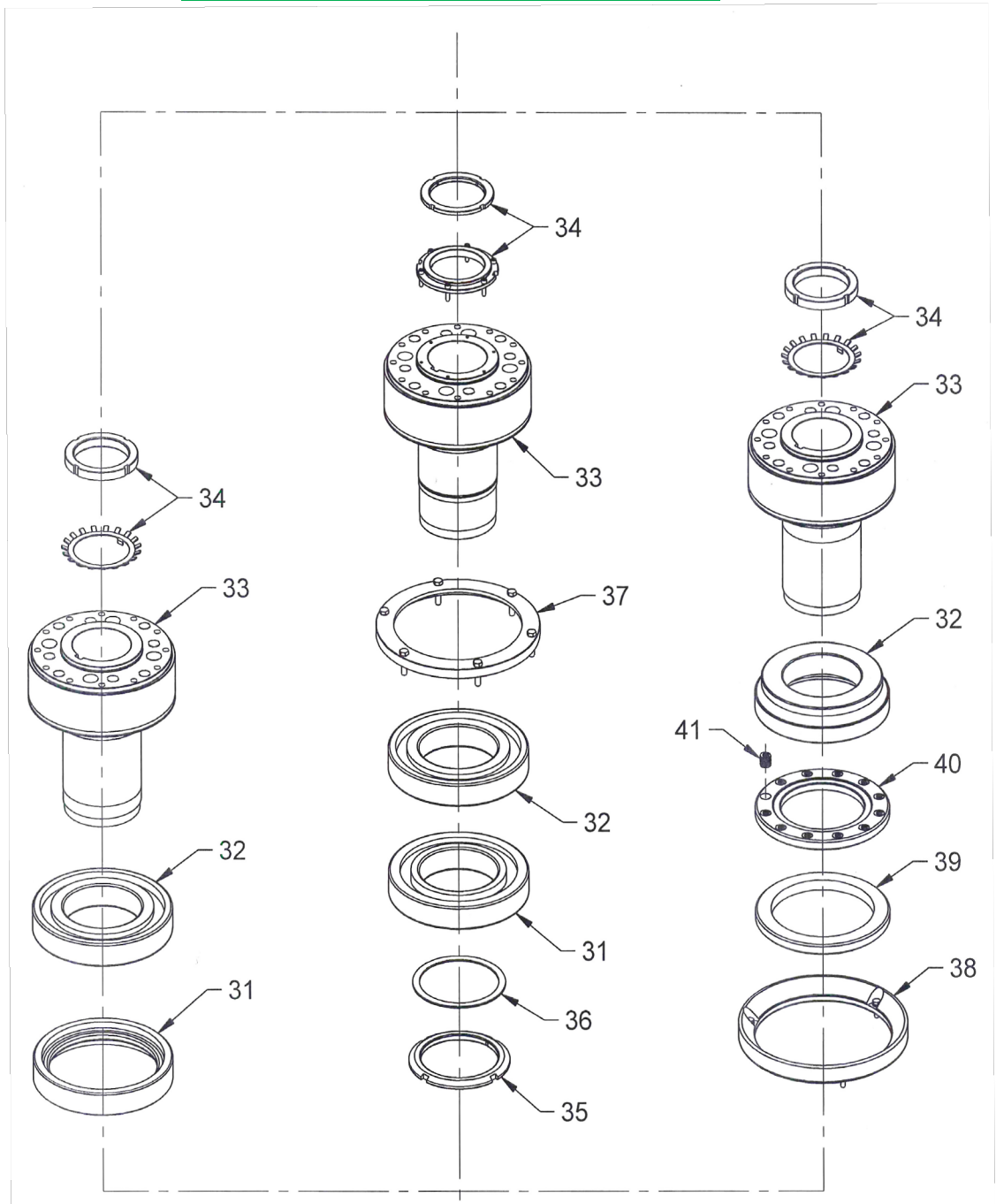
ITEM NO.	QTY	NAME OF PART
28	1	Oil Sight Gauge Window
29	1	Oil Fill Plug (Expanding)
30	1	Bearing Spacer (or Tandem Thrust Bearing)
31	1	Upper Thrust Bearing
32	1	Bearing Mounting
33	1	Locknut and Lockwasher (Brg Mtg to Shaft)
34	1	Dust Cover (Only on Units Without Ratchet)
35	1	Fan Adaptor (Only on Units Without Ratchet)
36	1	Thrust Coupling (Only on Hollowshaft)
37	1	Gib Key (Only on Hollowshaft)
38	1	Fan
39	1	Fan Cover
40	1	Air Deflector
41	1	Canopy Cap
42	1	Ratchet Adaptor (Only on Units With Ratchet)
43	1	Connection Spring (Only on Units With Ratchet)
44	1	Stationary Ratchet (Only on Units With Ratchet)
45	1	Pressure Plate (Only on Units With Ratchet)
46	6	Die Spring (Only on Units With Ratchet)
47	6	Plain Washer (Only on Units With Ratchet)
48	6	Screw (Only on Units With Ratchet)
49	1	Rotating Ratchet (Only on Units With Ratchet)
50	14	Ratchet Ball (Only on Units With Ratchet)
51	1	Ball Retaining Ring (Only on Units With Ratchet)

6812 Frame Type JU and JV4



5812 and 6812 Frame Type JU and JV4

THRUST BEARING DETAILS



SINGLE OR TANDEM ANGULAR CONTACT BEARINGS

BACK TO BACK ANGULAR CONTACT BEARINGS

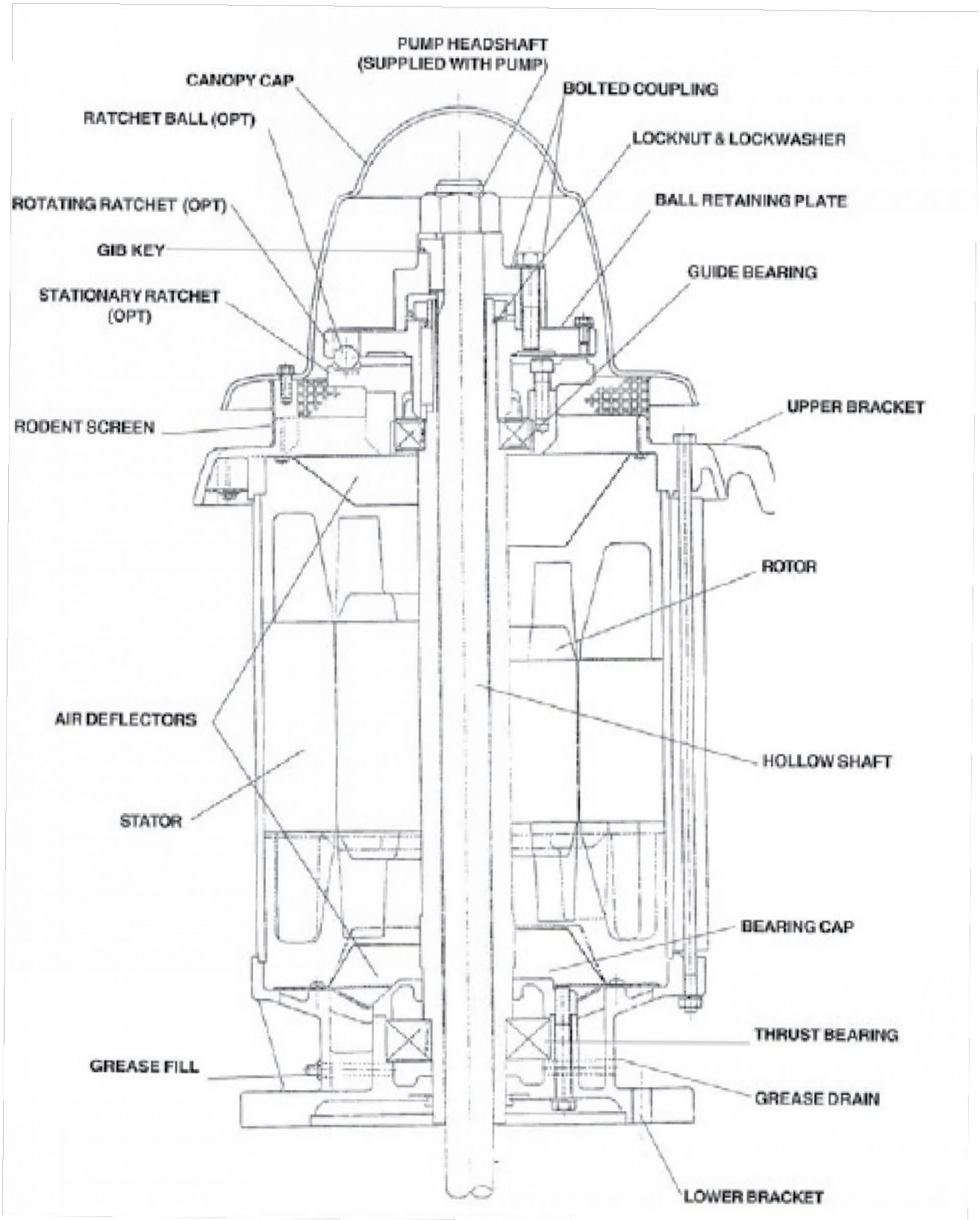
SPHERICAL ROLLER THRUST BEARINGS

5812 Frame Type JU, and JV4
6812 Frame Type JU and JV4

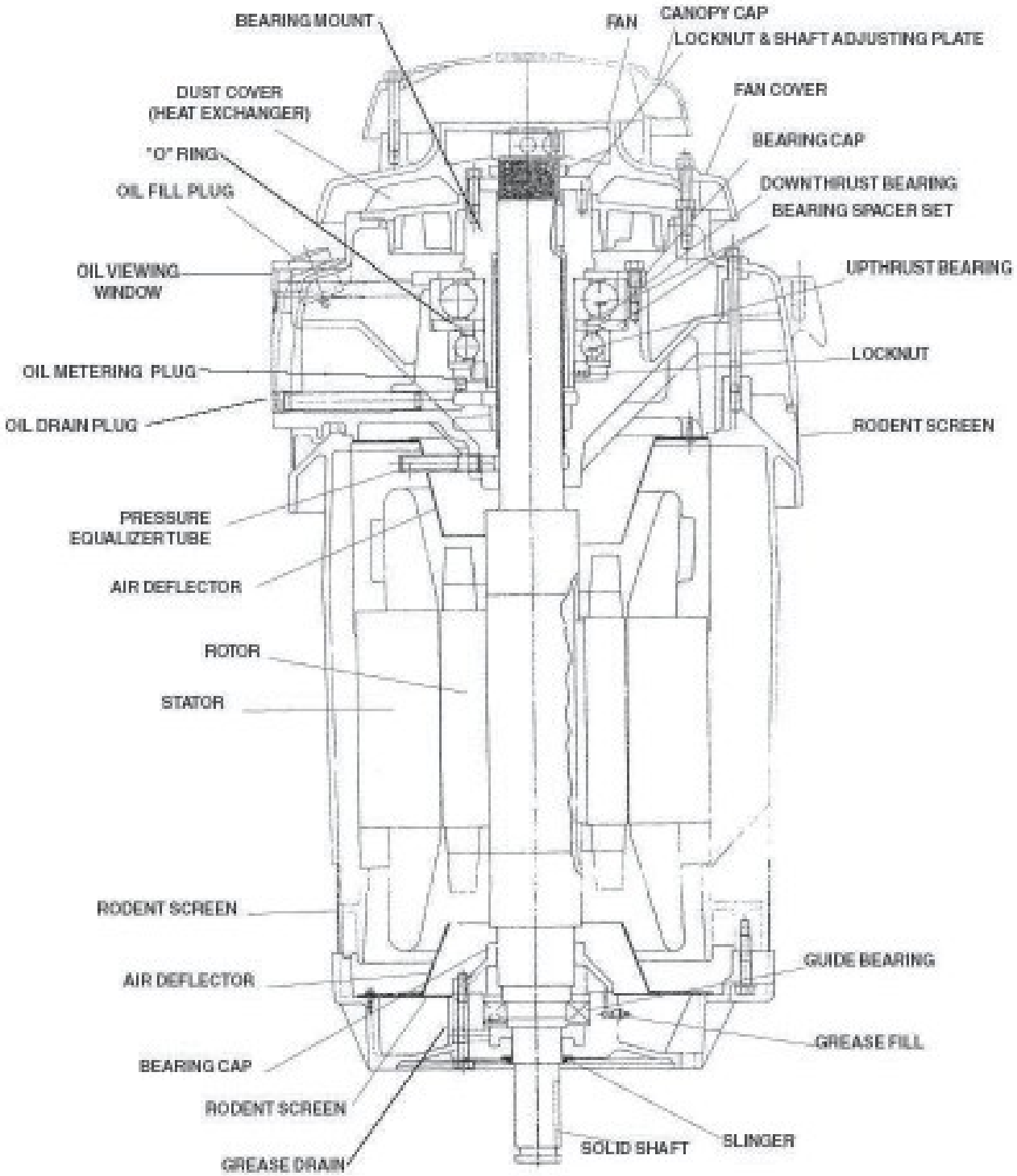
ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Tee (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Cap (Lower Oil Fill)
8	1	Reducer Bushing
9	1	Oil Sight Gauge Window
10	1	Locknut and Set Screws
11	1	Insulated Washer (When Supplied)
12	1	Lower Bearing
13	1	O-Ring
14	1	Lower Bearing Cap
15	1	Rotor Assembly
16	1	Rotor Core
17	1	Rotor Shaft
18	1	Rotor Fan
19	1	Square Key (Bearing Mounting to Shaft)
20	1	Stator Assembly
21	1	Gasket (Outlet Box Base to Stator)
22	1	Outlet Box Base
23	1	Gasket (Outlet Box Cover to Base)
24	1	Outlet Box Cover
25	1	Upper Bracket
26	1	Pipe Nipple (Upper Oil Drain)
27	1	Gate Valve (Upper Oil Drain)
28	1	Pipe Plug (Upper Oil Drain)
29	1	OIl Sight Gauge Window
30	1	Oil Fill Plug (Expanding)

ITEM NO.	QTY	NAME OF PART
31	1	Bearing Spacer (or Tandem Thrust Bearing)
32	1	Upper Thrust Bearing
33	1	Bearing Mounting
34	1	Locknut and Lockwasher (Brg Mtg to Shaft)
35	1	Locknut and Set Screws (Back-to-Back Brgs.)
36	1	Bearing Spacer (Insul.)(Back-to-Back Brgs.)
37	1	Bearing Cap (Clamping)(Back-to-Back Brgs.)
38	1	Oil Baffle (EHT Bearing)
39	1	Bearing Support (EHT Bearing)(When Supplied)
40	1	Bearing Spacer (EHT Bearing)
41	As Req'd	Die Spring (EHT Bearing)
42	1	Dust Cover (Only on Units Without Ratchet
43	1	Fan Adaptor (Only on Units Without Ratchet
44	1	Thrust Coupling (Only on Hollowshaft)
45	1	Gib Key (Only on Hollowshaft)
46	1	Fan
47	1	Fan Cover
48	1	Air Deflector
49	1	Canopy Cap
50	1	Ratchet Adaptor (Only on Units With Ratchet)
51	1	Connection Spring (Only on Units With Ratchet)
52	1	Stationary Ratchet (Only on Units With Ratchet)
53	1	Pressure Plate (Only on Units With Ratchet)
54	6	Die Spring (Only on Units With Ratchet)
55	6	Plain Washer (Only on Units With Ratchet)
56	6	Screw (Only on Units With Ratchet)
57	1	Rotating Ratchet (Only on Units With Ratchet)
58	As Req'd	Ratchet Ball (Only on Units With Ratchet)
59	1	Ball Retaining Ring (Only on Units With Ratchet)

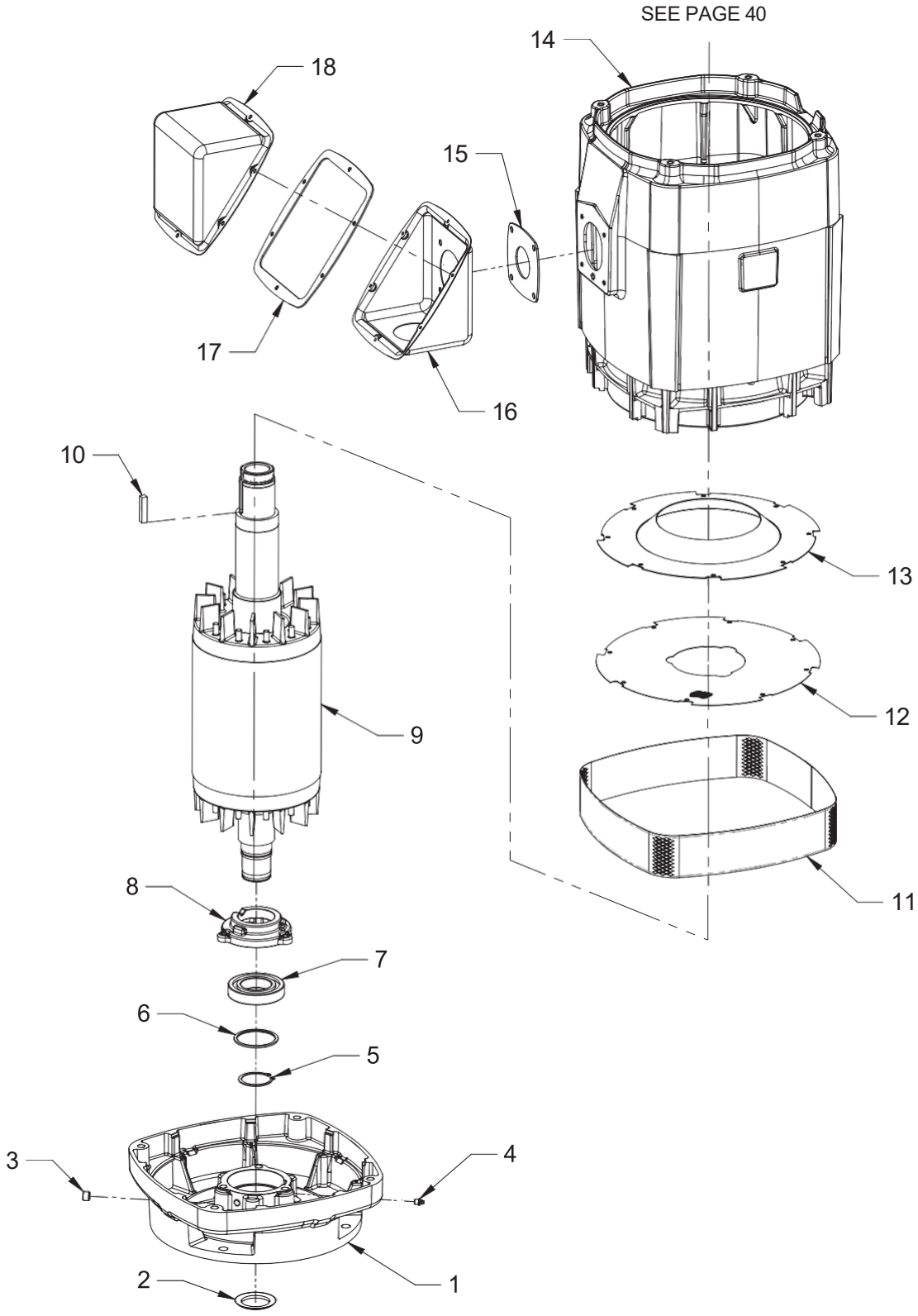
250 and 280 Frames
Type AU High Thrust



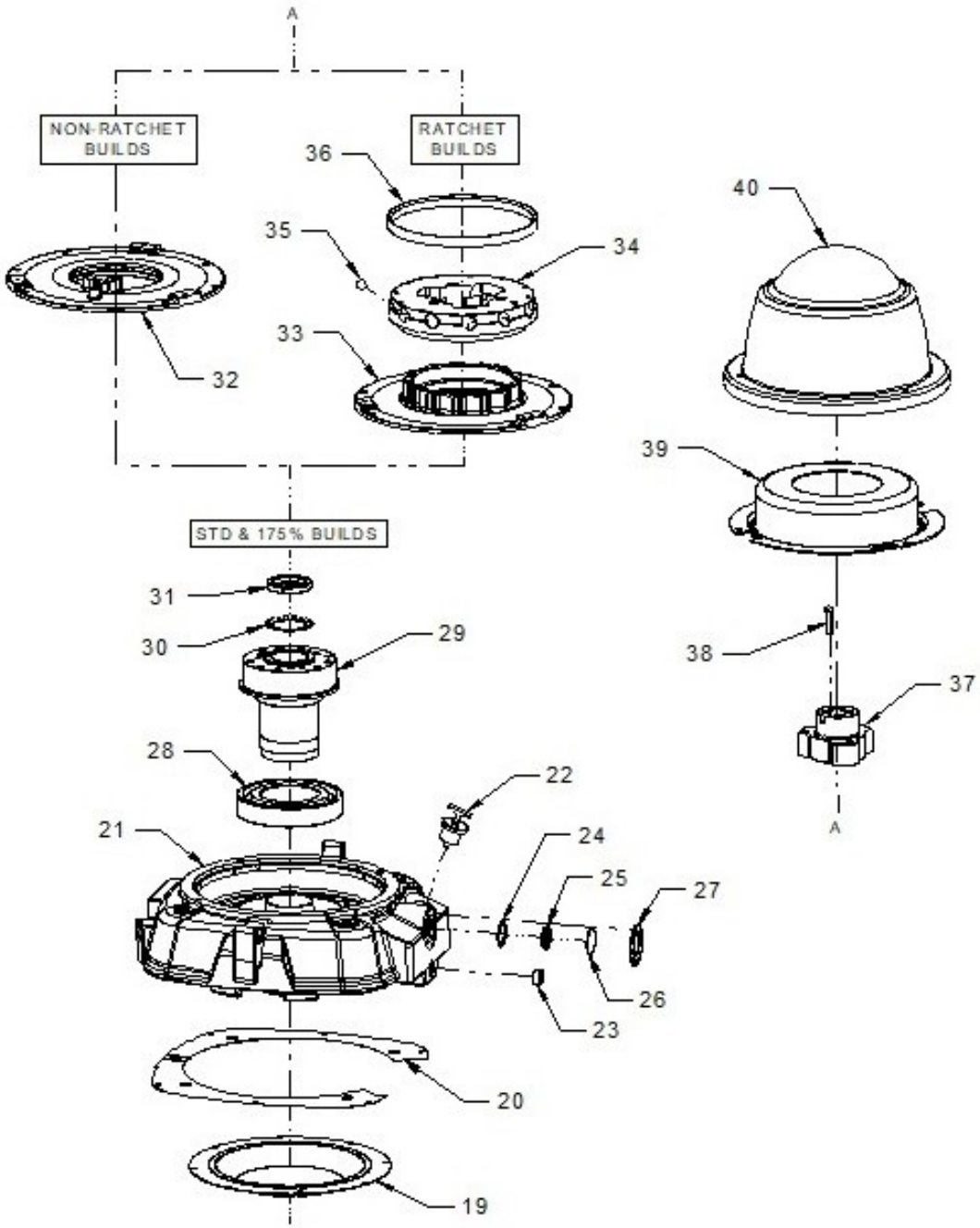
440 Frame, Type RV-4
(2 Pole)



320 Thru 440 Frames
Type RU - High Thrust



320 Thru 400 Frames
Type RU - High Thrust



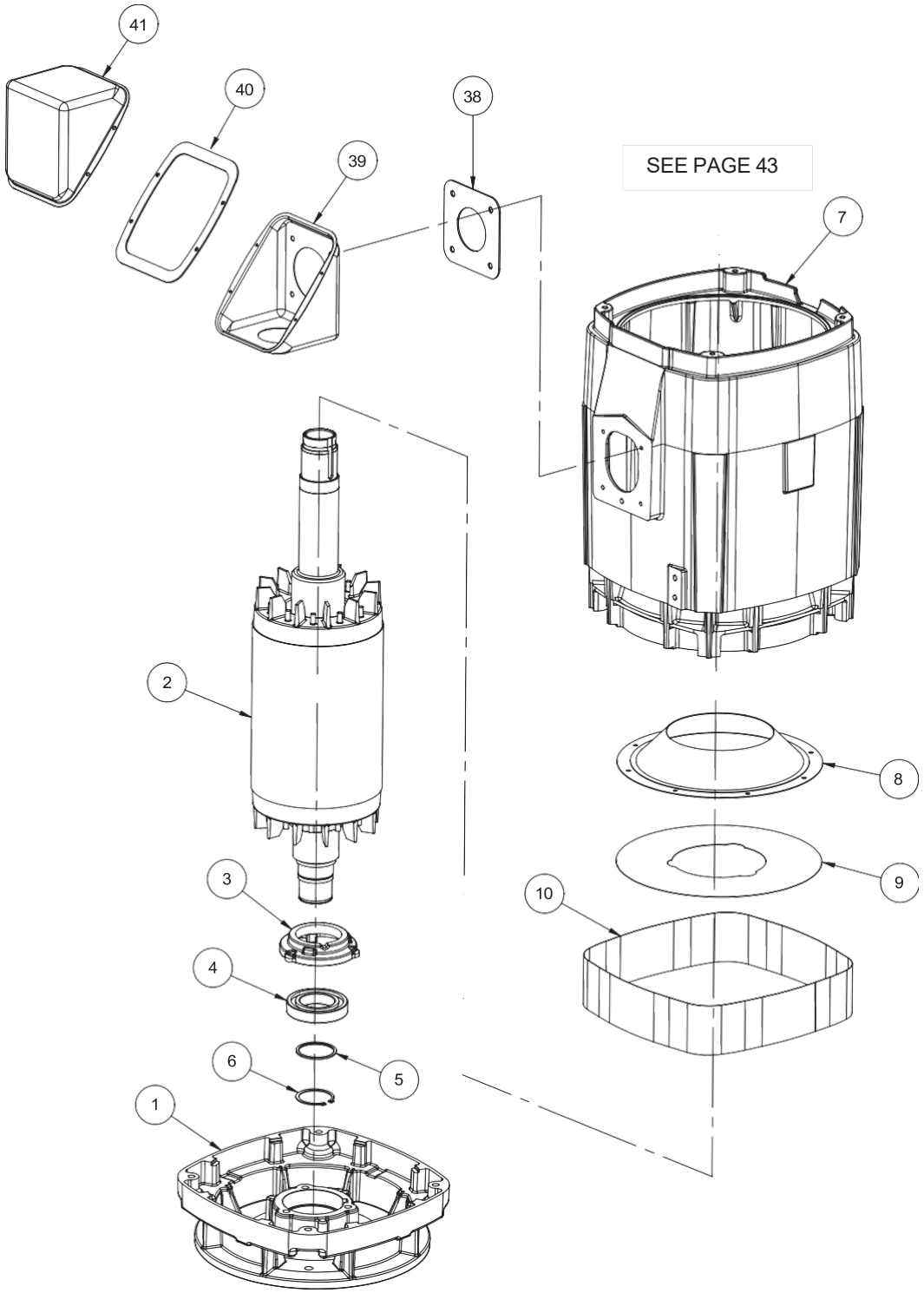
SEE PAGE 39

320 Thru 400 Frames
Type RU - High Thrust

ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Water Deflector
3	1	Pipe Plug
4	1	Zerk Fitting Grease
5	1	Spacer Washer
6	1	Snap Ring
7	1	Lower Bearing
8	1	Lower Bearing Cap
9	1	Rotor Assembly
10	1	Key
11	1	Lower Screen Int ake (Ext ernal)
12	1	Lower Screen Intake (Internal)
13	1	Lower Air Deflector
14	1	Stator Assembly
15	1	Gasket Outlet Box (Frame and Box)
16	1	Outlet Base
17	1	Gasket Outlet Box (Base and Cover)
18	1	Cover Outlet Box
19	1	Upper Air Deflector
20	1	Upper Screen

ITEM NO.	QTY	NAME OF PART
21	1	Upper Bracket
22	1	Oil Fill Plug (Expanding)
23	1	Uppe r Plug (Oil Drain)
24	1	O-Ring Sight Gauge Window
25	1	Deflector Sight Gauge Window
26	1	Glass Sight Gauge Window
27	1	Cover Sight Gauge Window
28	-	Upper Bearing (Qty 1 or 2)
29	1	Bearing Mount
30	1	Upper Lockwasher
31	1	Upper Lock Nut
32	1	Dust Cover (Only on Units Without Ratchet)
33	1	Ratchet Adaptor (Only on Units With Ratchet)
34	1	Stationary Rat chet (Only on Units With Ratchet)
35	1	Ratchet Ball (Only on Units With Ratchet)
36	1	Ball Retaining Ring (Only on Units With Ratchet)
37	1	Thrust Coupling (Only on Hollowshaft)
38	1	Gib Key (Only on Hollowshaft)
39	1	Uppe r Baffle
40	1	Canopy Cap

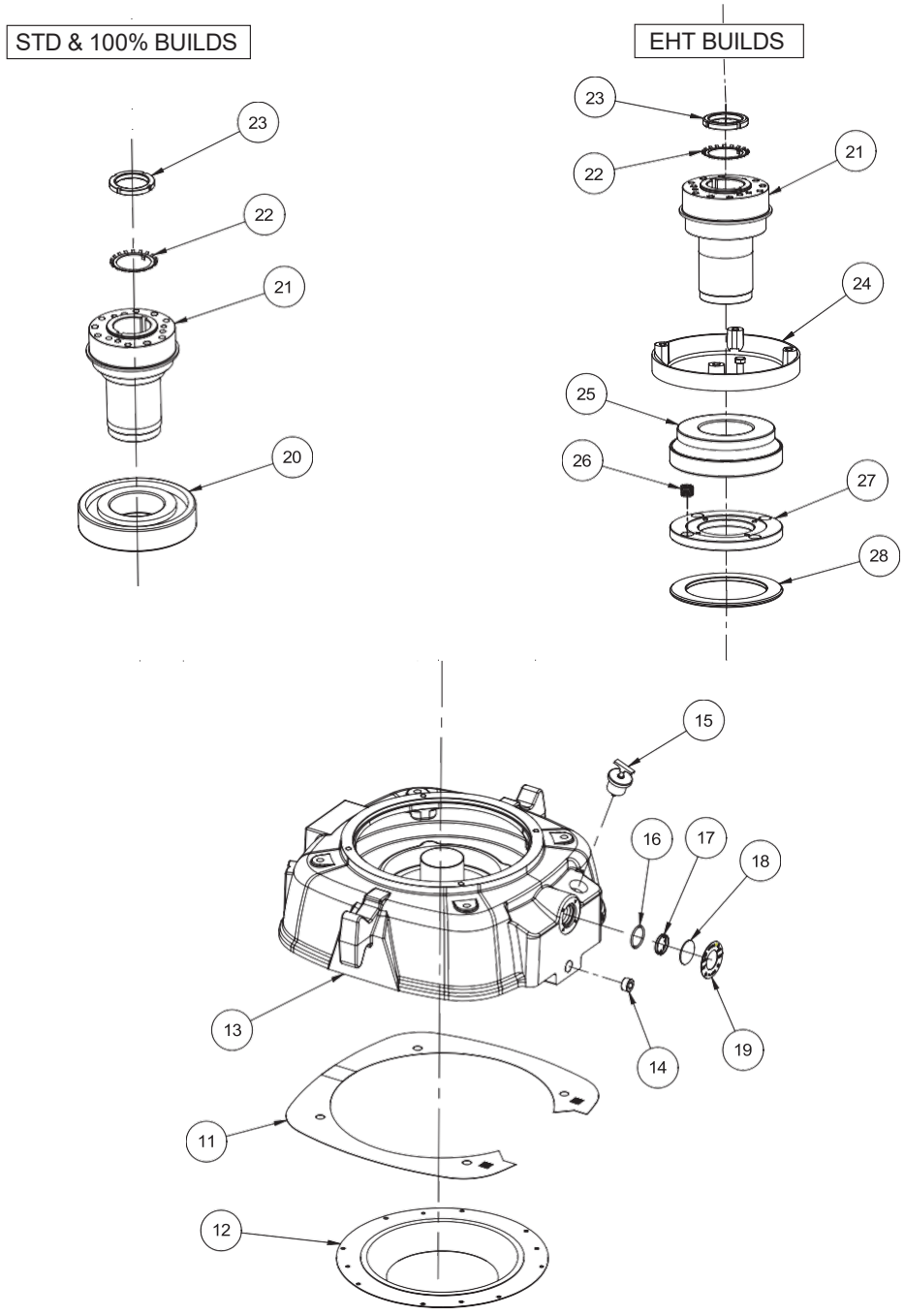
440 Frame
Type RU - High Thrust



440 Frame
Type RU - High Thrust

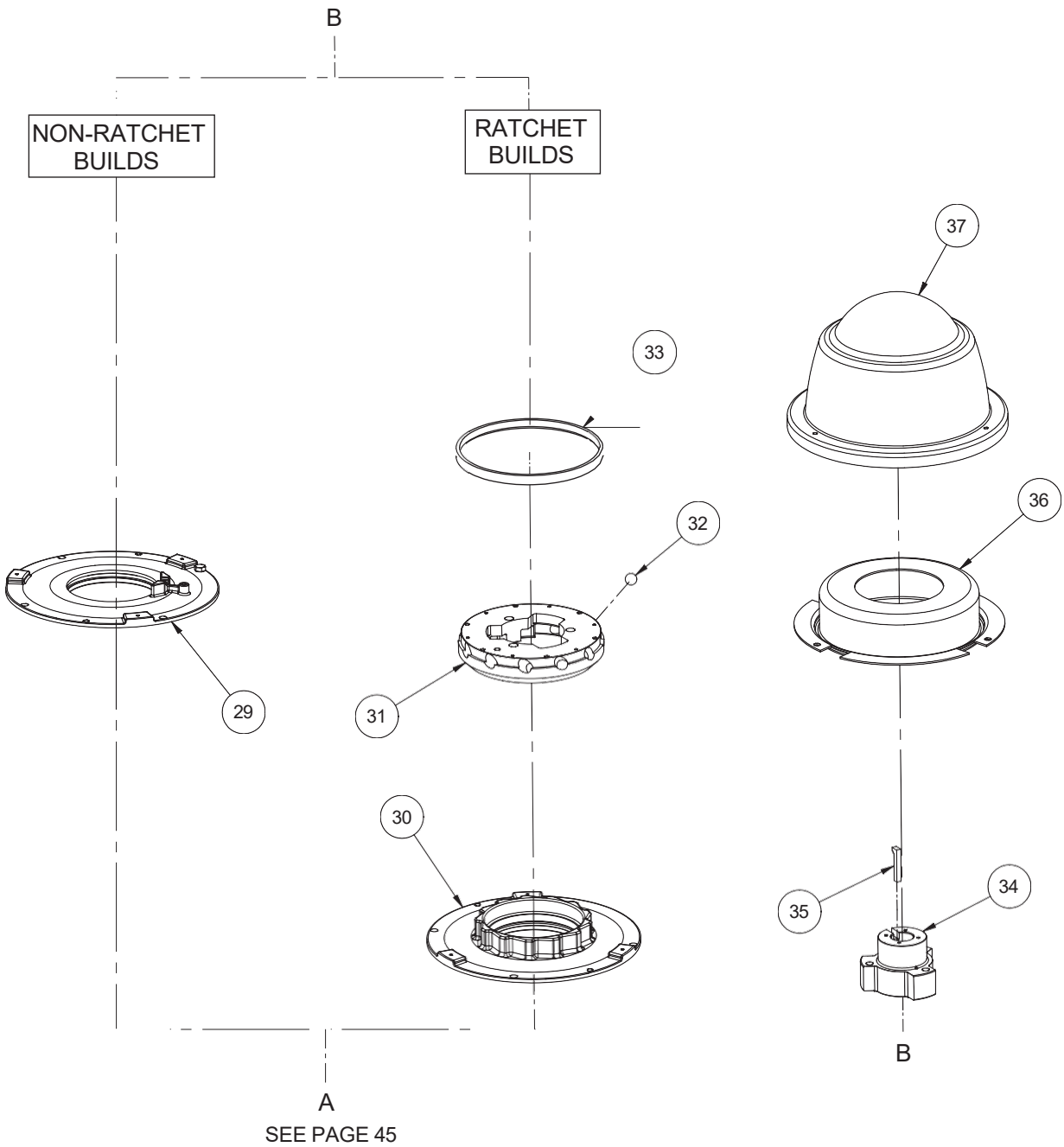
SEE PAGE 44

A



SEE PAGE 42

440 Frame
Type RU - High Thrust



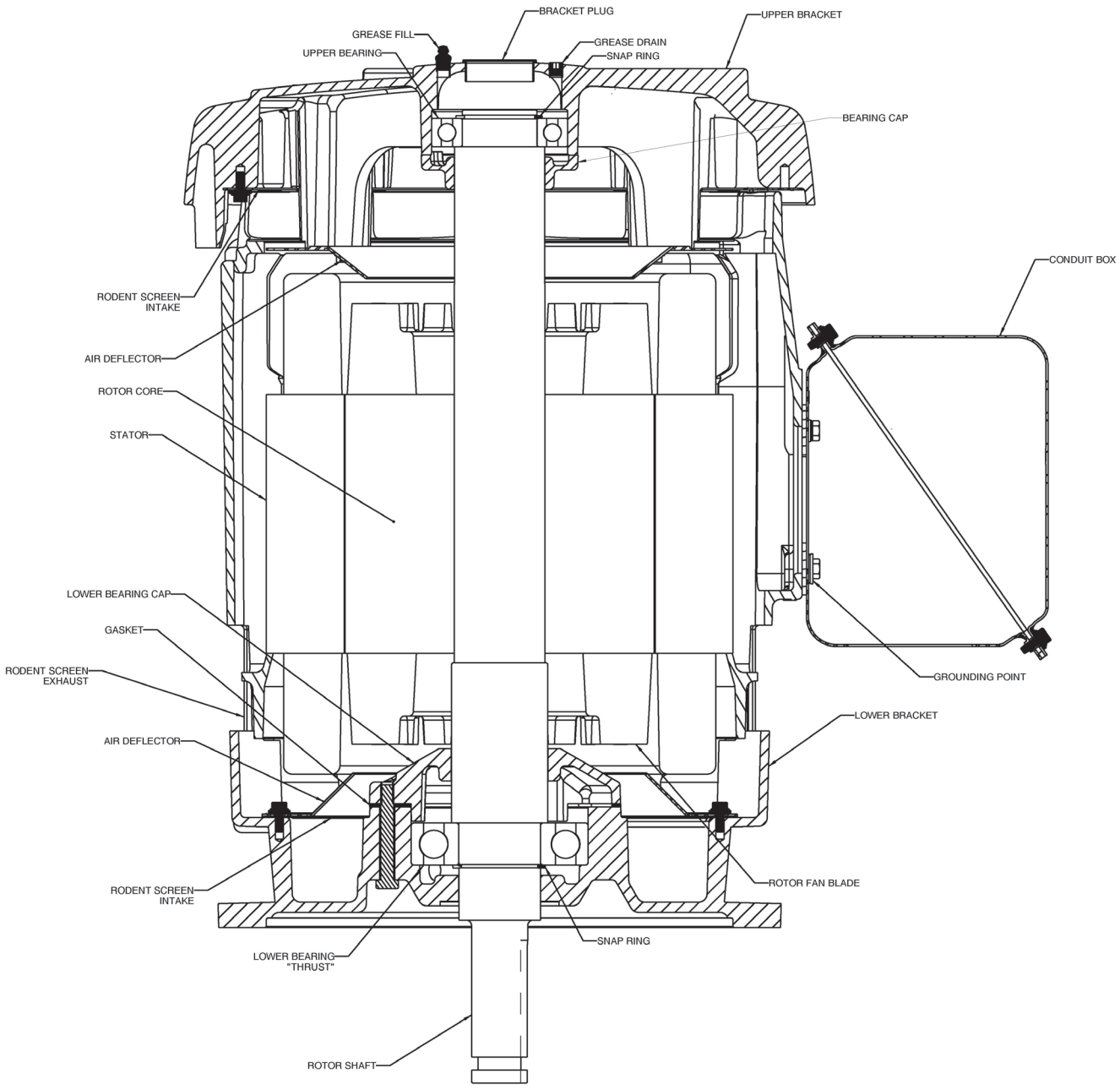
SEE PAGE 45

440 Frame
Type RU - High Thrust

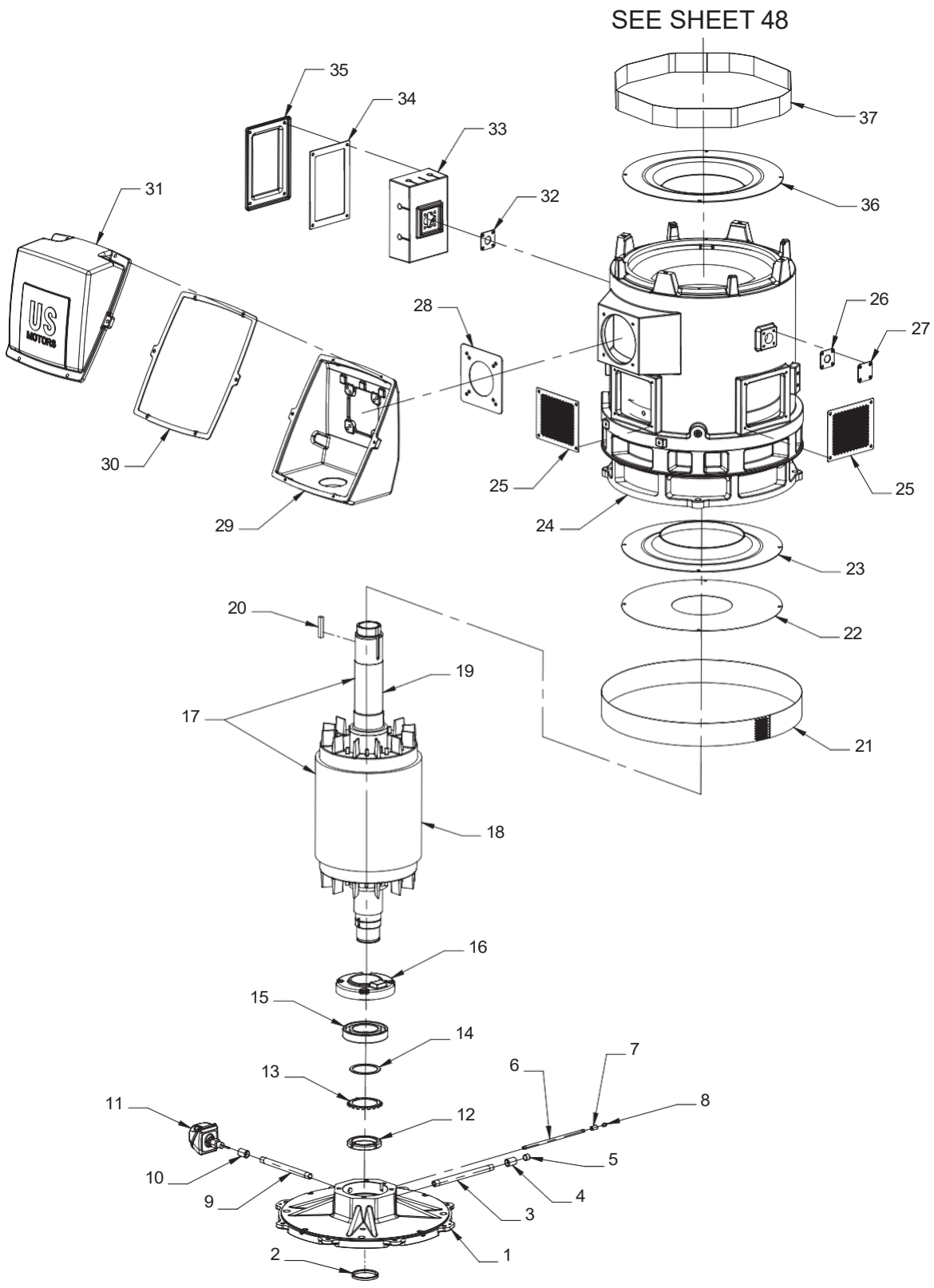
ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Rotor Assembly
3	1	Lower Bearing Cap
4	1	Lower Bearing
5	1	Spacer washer
6	1	Snap Ring
7	1	Stator Assembly
8	1	Lower Air Deflector
9	1	Lower Screen Intake (Internal)
10	1	Lower Screen Intake (External)
11	1	Upper Screen
12	1	Upper Air Deflector
13	1	Upper Bracket
14	1	Upper Plug (Oil Drain)
15	1	Oil Fill Plug (Expanding)
16	1	O-Ring Sight Gauge Window
17	1	Deflector Sight Gauge Window
18	1	Glass Sight Gauge Window
19	1	Cover Sight Gauge Window

ITEM NO.	QTY	NAME OF PART
20	-	Upper Bearing (Qty 1 or 2)
21	1	Bearing Mount
22	1	Upper Lockwasher
23	1	Upper Lock Nut
24	1	Oil Baffle (EHT Bearing)
25	1	Upper Thrust Bearing (EHT)
26	As Req'd	Die Spring (EHT Bearing)
27	1	Bearing Spacer (EHT Bearing)
28	1	Bearing Support (EHT Bearing)
29	1	Dust Cover (Only on Units Without Ratchet)
30	1	Ratchet Adaptor (Only on Units With Ratchet)
31	1	Stationary Rat chet (Only on Units With Ratchet)
32	1	Ratchet Ball (Only on Units With Ratchet)
33	1	Ball Retaining Ri ng (Only on Units With Ratchet)
34	1	Thrust Coupling (Only on Hollowshaft)
35	1	Gib Key (Only on Hollowshaft)
36	1	Upper Baffle
37	1	Canopy Cap
38	1	Gasket Outlet Box (Frame and Box)
39	1	Outlet Base
40	1	Gasket Outlet Box (Base and Cover)
41	1	Cover Outlet Box

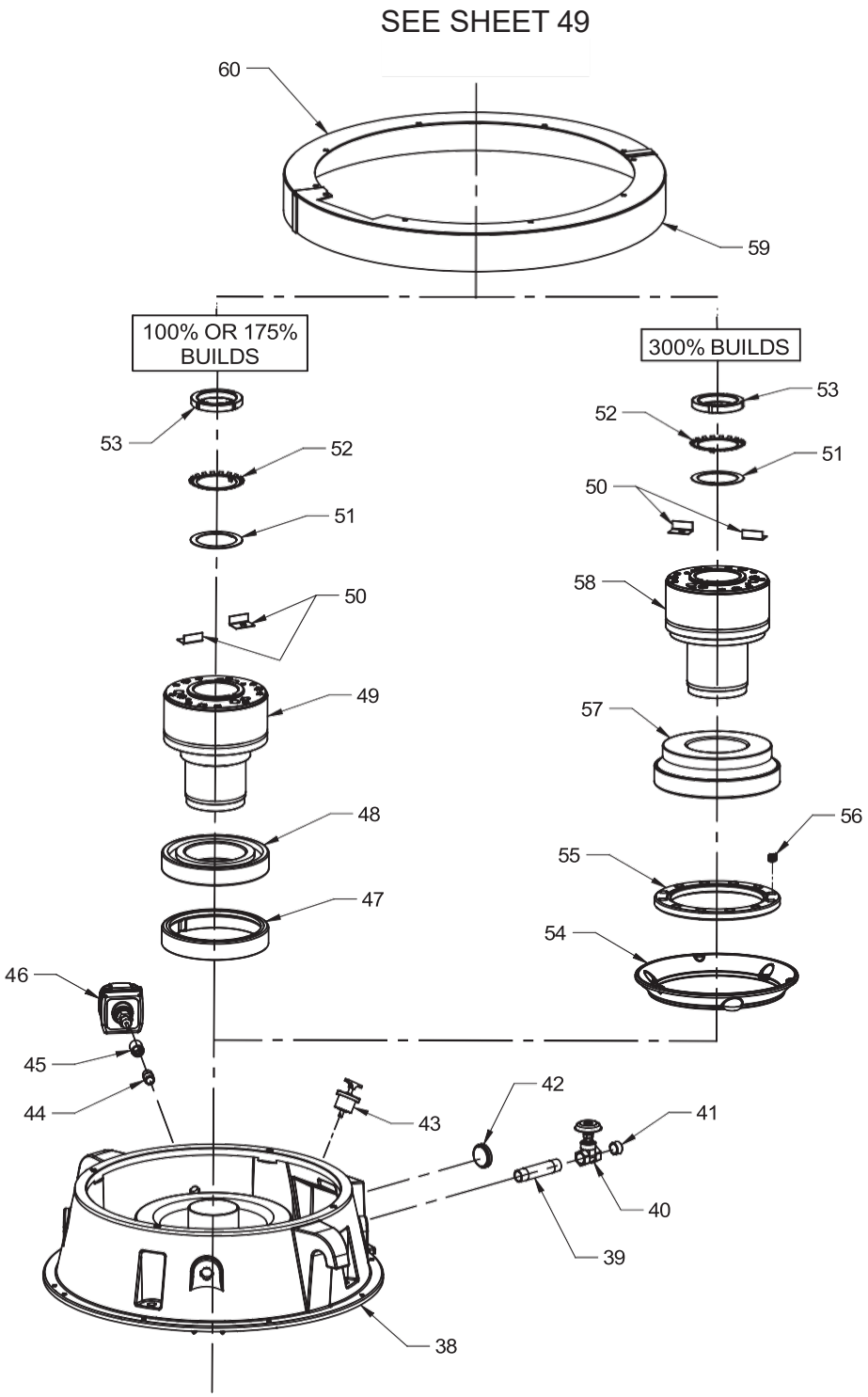
320 - 440 Frame
Type RV - Normal Thrust



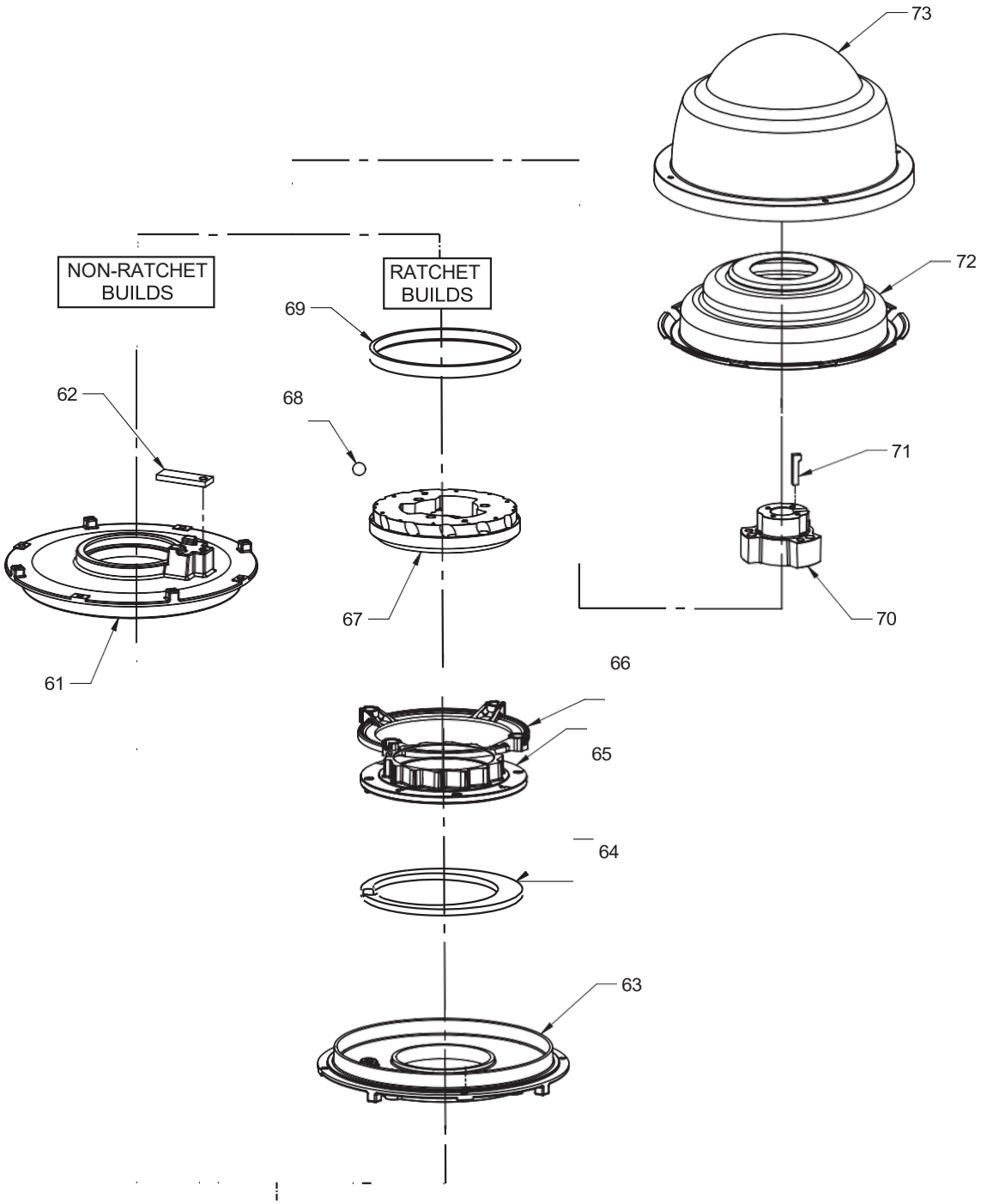
449 Frame (WPI)
Type RU and RV4



449 Frame (WPI)
Type RU and RV4



449 Frame (WPI)
Type RU and RV4



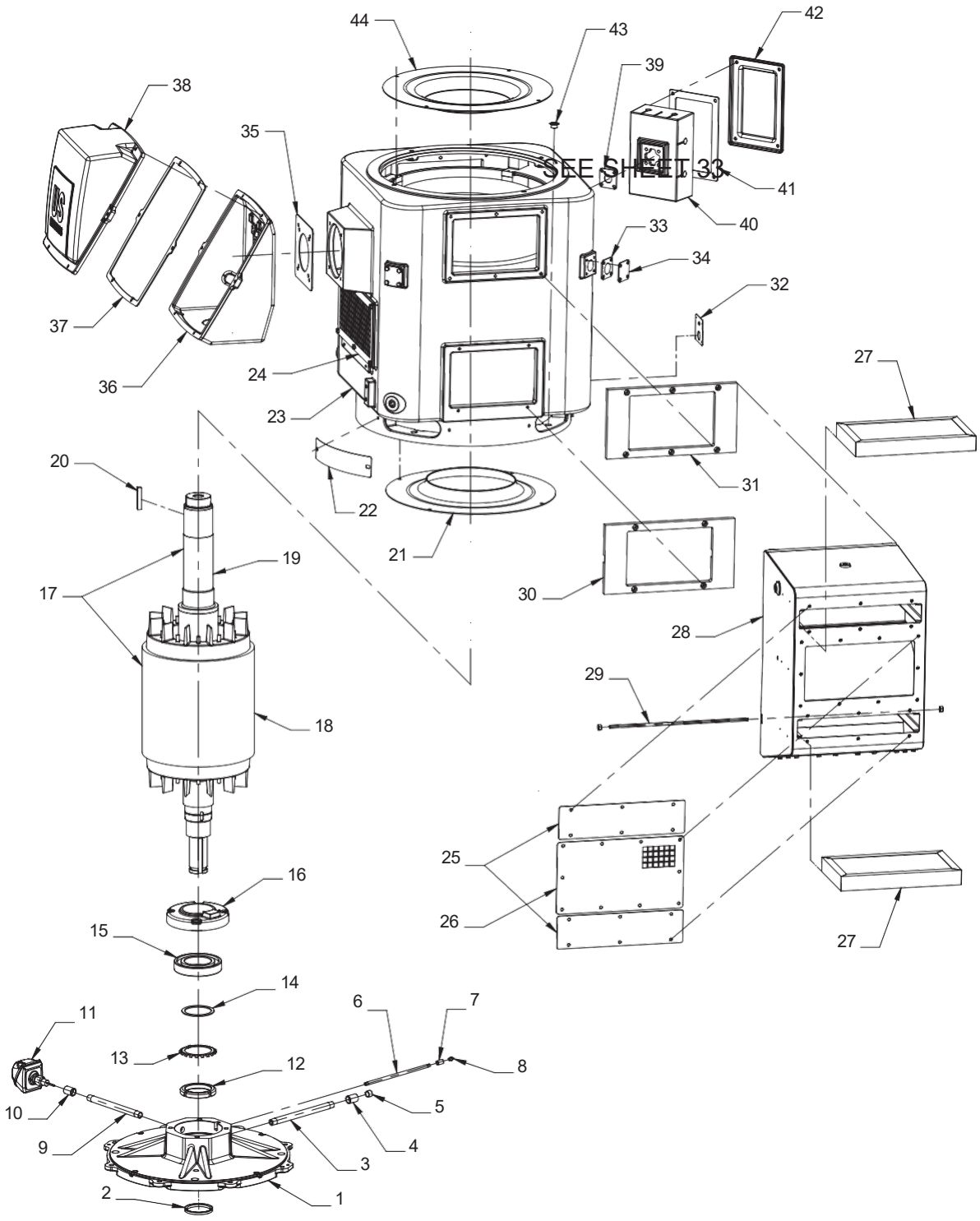
449 Frame (WPI)
Type RU and RV4

ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Coupling (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Coupling (Lower Oil Fill)
8	1	Pipe Plug (Lower Oil Fill)
9	As Req'd	Pipe Coupling (Lower Bearing Temp. Detector)
10	As Req'd	Pipe Coupling (Lower Bearing Temp. Detector)
11	As Req'd	Condulet Head (Lower Bearing Temp. Detector)
12	1	Lower Lock Nut
13	1	Lower Lock Washer
14	As Req'd	Lower Insulation Washer
15	1	Lower Bearing
16	1	Lower Bearing Cap
17	1	Rotor Assembly
18	1	Rotor Core
19	1	Rotor Shaft
20	1	Square Key (Bearing Mounting to Shaft)
21	1	Screen Lower Exhaust
22	1	Screen Lower Intake
23	1	Lower Air Deflector
24	1	Stator Assembly
25	4	Exhaust Screens
26	3	Gasket (Outlet Box Base to Stator)
27	3	Cover (Outlet Box To Stator)
28	1	Gasket (Outlet Box Base to Stator)
29	1	Outlet Box Base
30	1	Gasket (Outlet Box Base to Cover)
31	As Req'd	Outlet Box Cover
32	As Req'd	Gasket (Separate Outlet Box to Frame)
33	As Req'd	Base (Outlet Box)
34	As Req'd	Gasket (Separate Outlet Box Base to Cover)
35	As Req'd	Cover (Separate Outlet Box Cover)
36	1	Upper Air Deflector
37	1	Upper Screen Exhaust

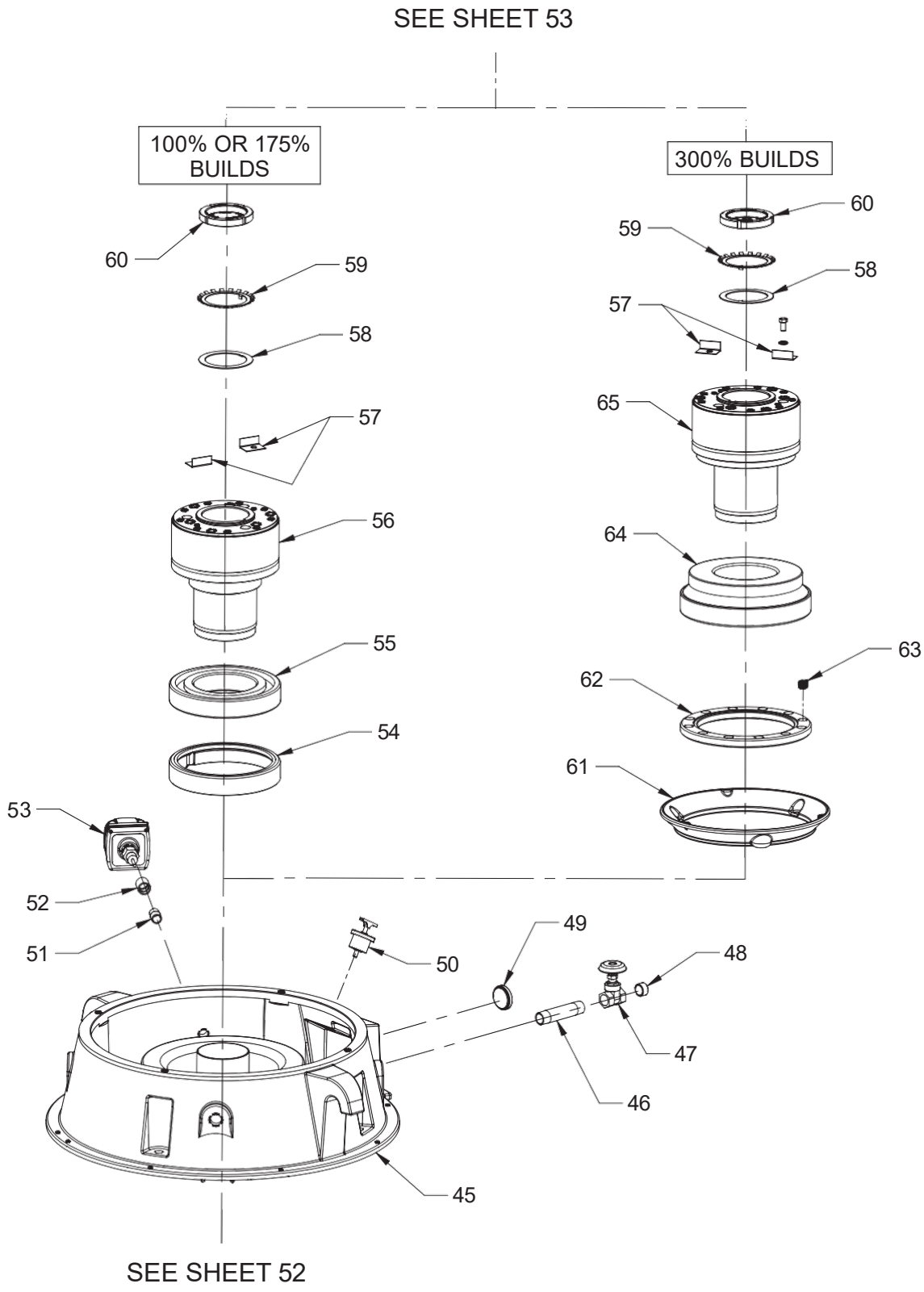
ITEM NO.	QTY	NAME OF PART
38	1	Upper Bracket
39	1	Pipe Nipple (Upper Oil Drain)
40	1	Gate Valve (Upper Oil Drain)
41	1	Pipe Plug (Upper Oil Drain)
42	1	Oil Sight Gauge Window
43	1	Oil Fill Plug (Expanding)
44	As Req'd	Pipe Coupling (Upper Bearing Temp. Detector)
45	As Req'd	Pipe Coupling (Upper Bearing Temp. Detector)
46	As Req'd	Condulet Head (Upper Bearing Temp. Detector)
47	1	Bearing Spacer (or Tandem Thrust Bearing)
48	1	Upper Thrust Bearing
49	1	Bearing Mounting
50	2	Mounting Brackets (RV4 Only)
51	1	Washer (Bearing Mount)
52	1	Lockwasher (Brg Mtg to Shaft)
53	1	Locknut (Brg Mtg to Shaft)
54	1	Oil Baffle (EHT Bearing)
55	1	Bearing Spacer (EHT Bearing)
56	As Req'd	Die Spring (EHT Bearing)
57	1	Bearing (EHT Bearing)(When Supplied)
58	1	Bearing Mount (EHT Bearing)
59	1	Cover (Non-Oil Arm)
60	1	Cover (Oil Arm)
61	1	Dust Cover (Only on Units Without Ratchet)
62	1	Locking Arm (RU Only)
63	1	Ratchet Adaptor (Only on Units With Ratchet)
64	1	Connection Spring (Only on Units With Ratchet)
65	1	Stationary Ratchet (Only on Units With Ratchet)
66	1	Pressure Plate (Only on Units With Ratchet)
67	1	Rotating Ratchet (Only on Units With Ratchet)
68	As Req'd	Ratchet Ball (Only on Units With Ratchet)
69	1	Ball Retaining Ring (Only on Units With Ratchet)
70	1	Thrust Coupling (Only on Hollowshaft)
71	1	Gib Key (Only on Hollowshaft)
72	1	Baffle Upper
73	1	Canopy Cap

449 Frame (WPII)
Type RU and RV4

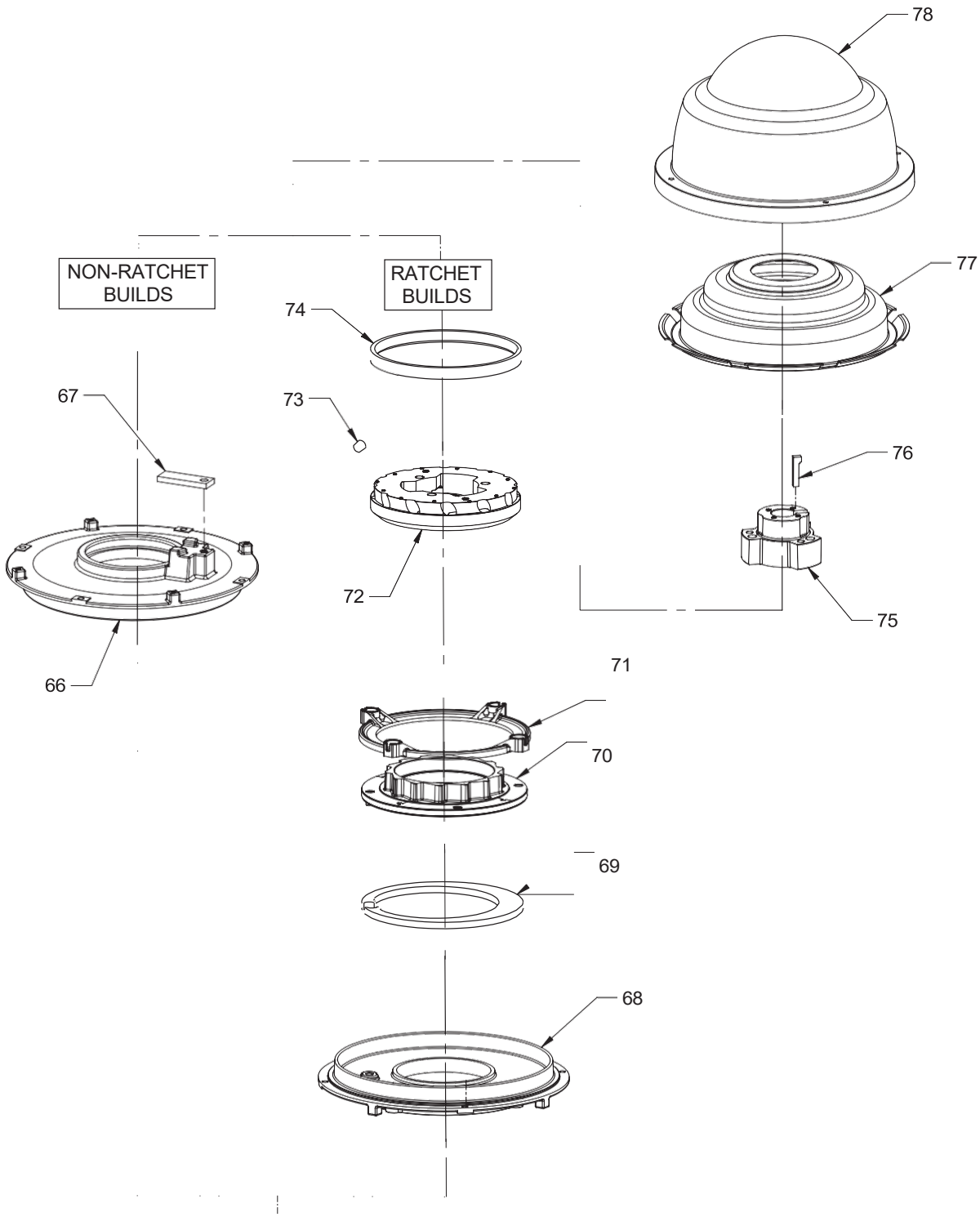
SEE SHEET 52



449 Frame (WPII)
Type RU and RV4



449 Frame (WPII)
Type RU and RV4



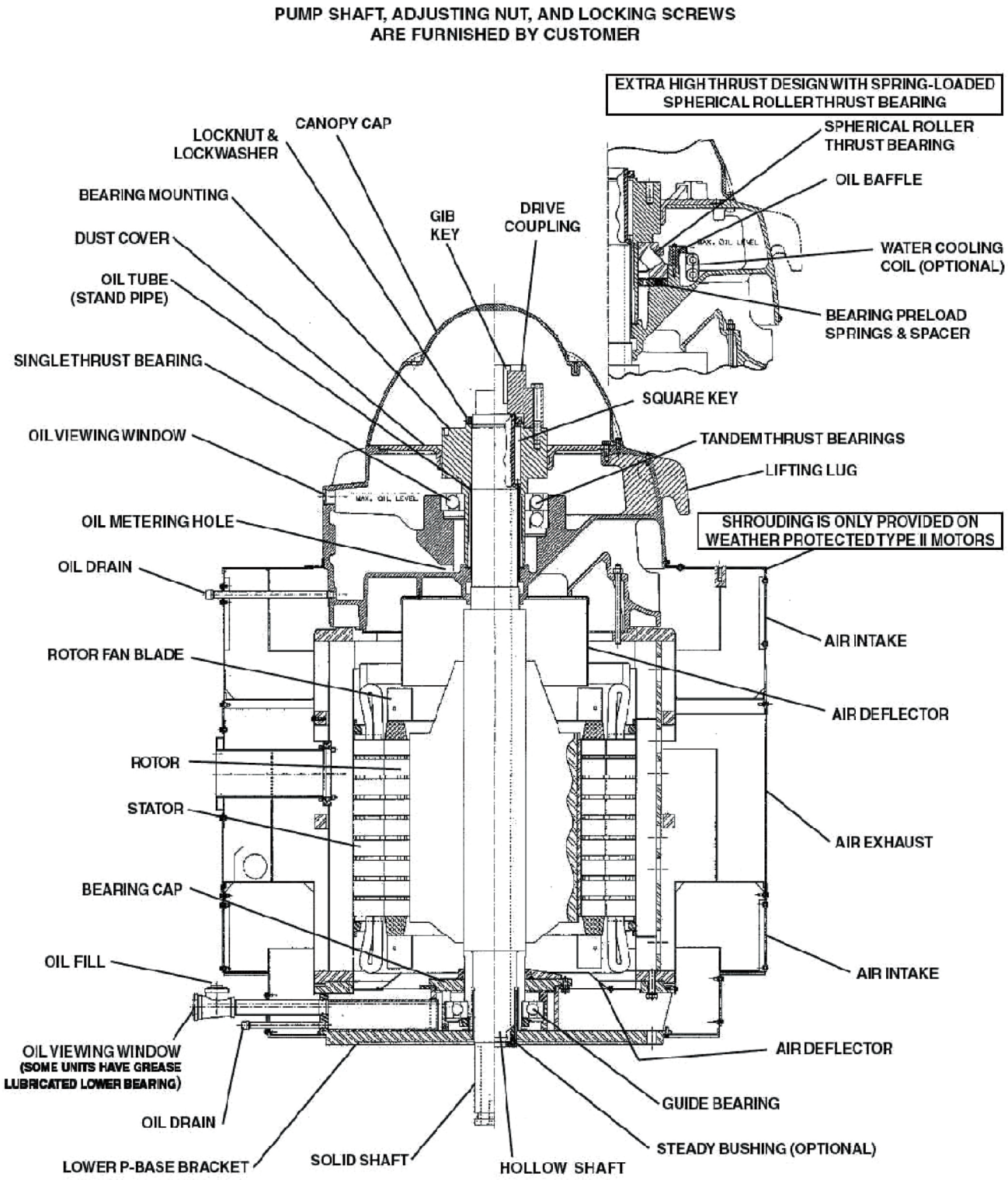
SEE SHEET 52

449 Frame (WPII)
Type RU and RV4

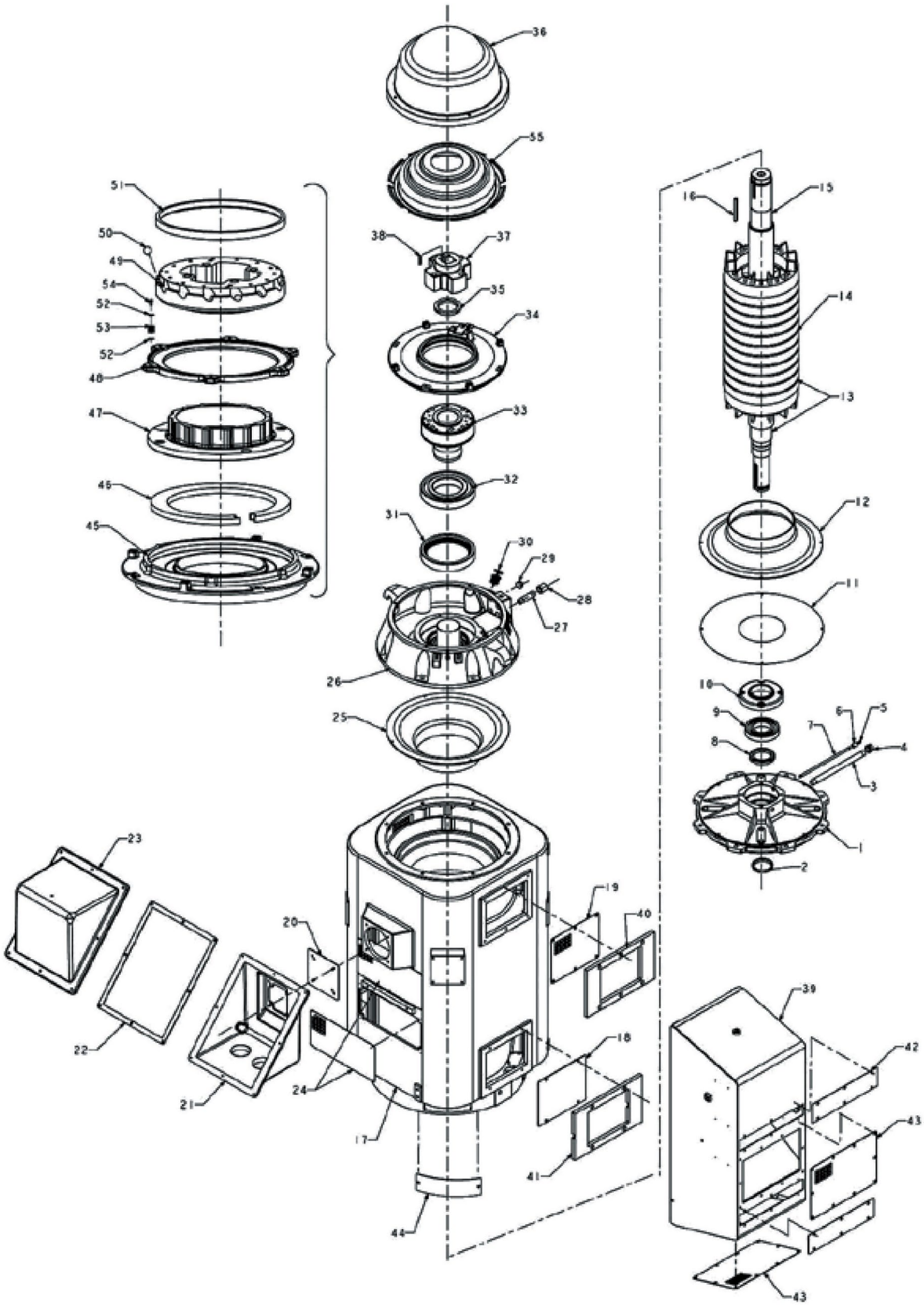
ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Coupling (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Coupling (Lower Oil Fill)
8	1	Pipe Plug (Lower Oil Fill)
9	As Req'd	Pipe Coupling (Lower Bearing Temp. Detector)
10	As Req'd	Pipe Coupling (Lower Bearing Temp. Detector)
11	As Req'd	Condulet Head (Lower Bearing Temp. Detector)
12	1	Lower Lock Nut
13	1	Lower Lock Washer
14	As Req'd	Lower Insulation Washer
15	1	Lower Bearing
16	1	Lower Bearing Cap
17	1	Rotor Assembly
18	1	Rotor Core
19	1	Rotor Shaft
20	1	Square Key (Bearing Mounting to Shaft)
21	1	Screen Lower Exhaust
22	1	Screen Lower Intake
23	1	Lower Air Deflector
24	1	Stator Assembly
25	4	Filter Cover
26	2	Intake Screen
27	2	Filter
28	2	WPII Cover
29	2	Threaded Rod (Cover Mounting)
30	2	Lower Plate
31	2	Upper Plate
32	1	Cover Plate
33	3	Gasket (Outlet Box Base to Stator)
34	3	Cover (Outlet Box To Stator)
35	1	Gasket (Outlet Box Base to Stator)
36	1	Outlet Box Base
37	1	Gasket (Outlet Box Base to Cover)
38	As Req'd	Outlet Box Cover
39	As Req'd	Gasket (Separate Outlet Box to Frame)

ITEM NO.	QTY	NAME OF PART
40	As Req'd	Base (Outlet Box)
41	As Req'd	Gasket (Separate Outlet Box Base to Cover)
42	As Req'd	Cover (Separate Outlet Box Cover)
43	1	Plug
44	1	Upper Air Deflector
45	1	Upper Bracket
46	1	Pipe Nipple (Upper Oil Drain)
47	1	Gate Valve (Upper Oil Drain)
48	1	Pipe Plug (Upper Oil Drain)
49	1	Oil Sight Gauge Window
50	1	Oil Fill Plug (Expanding)
51	As Req'd	Pipe Coupling (Upper Bearing Temp.Detector)
52	As Req'd	Pipe Coupling (Upper Bearing Temp. Detector)
53	As Req'd	Condulet Head (Upper Bearing Temp. Detector)
54	1	Bearing Spacer (or Tandem Thrust Bearing)
55	1	Upper Thrust Bearing
56	1	Bearing Mounting
57	2	Mounting Brackets (RV4 Only)
58	1	Washer (Bearing Mount)
59	1	Lockwasher (Brg Mtg to Shaft)
60	1	Locknut (Brg Mtg to Shaft)
61	1	Oil Baffle (EHT Bearing)
62	1	Bearing Spacer (EHT Bearing)
63	As Req'd	Die Spring (EHT Bearing)
64	1	Bearing (EHT Bearing)(When Supplied)
65	1	Bearing Mount (EHT Bearing)
66	1	Dust Cover (Only on Units Without Ratchet)
67	1	Locking Arm (RU Only)
68	1	Ratchet Adaptor (Only on Units With Ratchet)
69	1	Connection Spring (Only on Units With Ratchet)
70	1	Stationary Ratchet (Only on Units With Ratchet)
71	1	Pressure Plate (Only on Units With Ratchet)
72	1	Rotating Ratchet (Only on Units With Ratchet)
73	As Req'd	Ratchet Ball (Only on Units With Ratchet)
74	1	Ball Retaining Ring (Only on Units With Ratchet)
75	1	Thrust Coupling (Only on Hollowshaft)
76	1	Gib Key (Only on Hollowshaft)
77	1	Baffle Upper
78	1	Canopy Cap

5000 - 6800 Frame, Type HU & HV4
8000 Frame, Type RU & RV (4 Pole and Slower)



5000 and 5800 Frame WPII
Type RU and RV-4

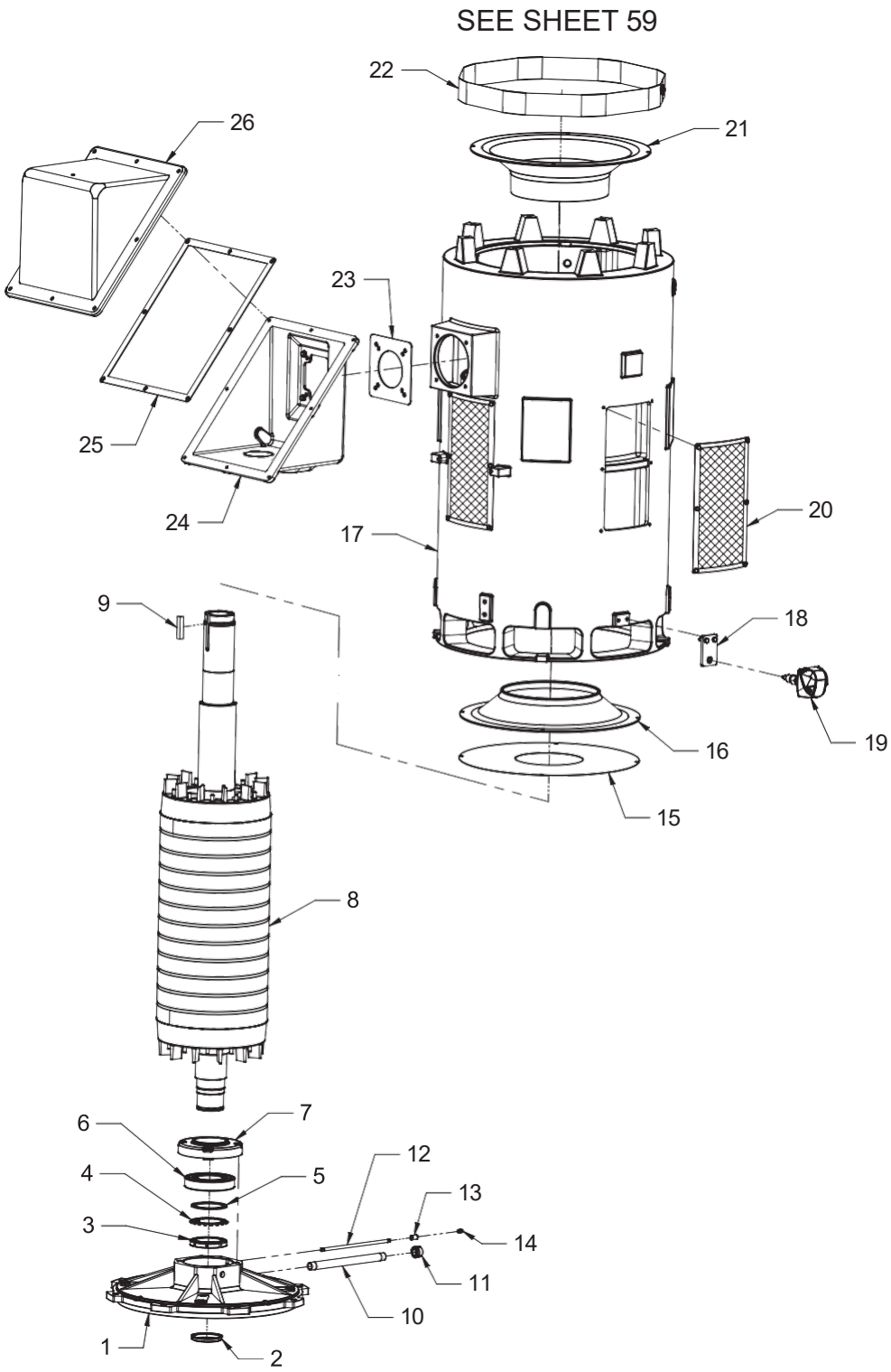


5000 and 5800 Frame
Type RU and RV-4

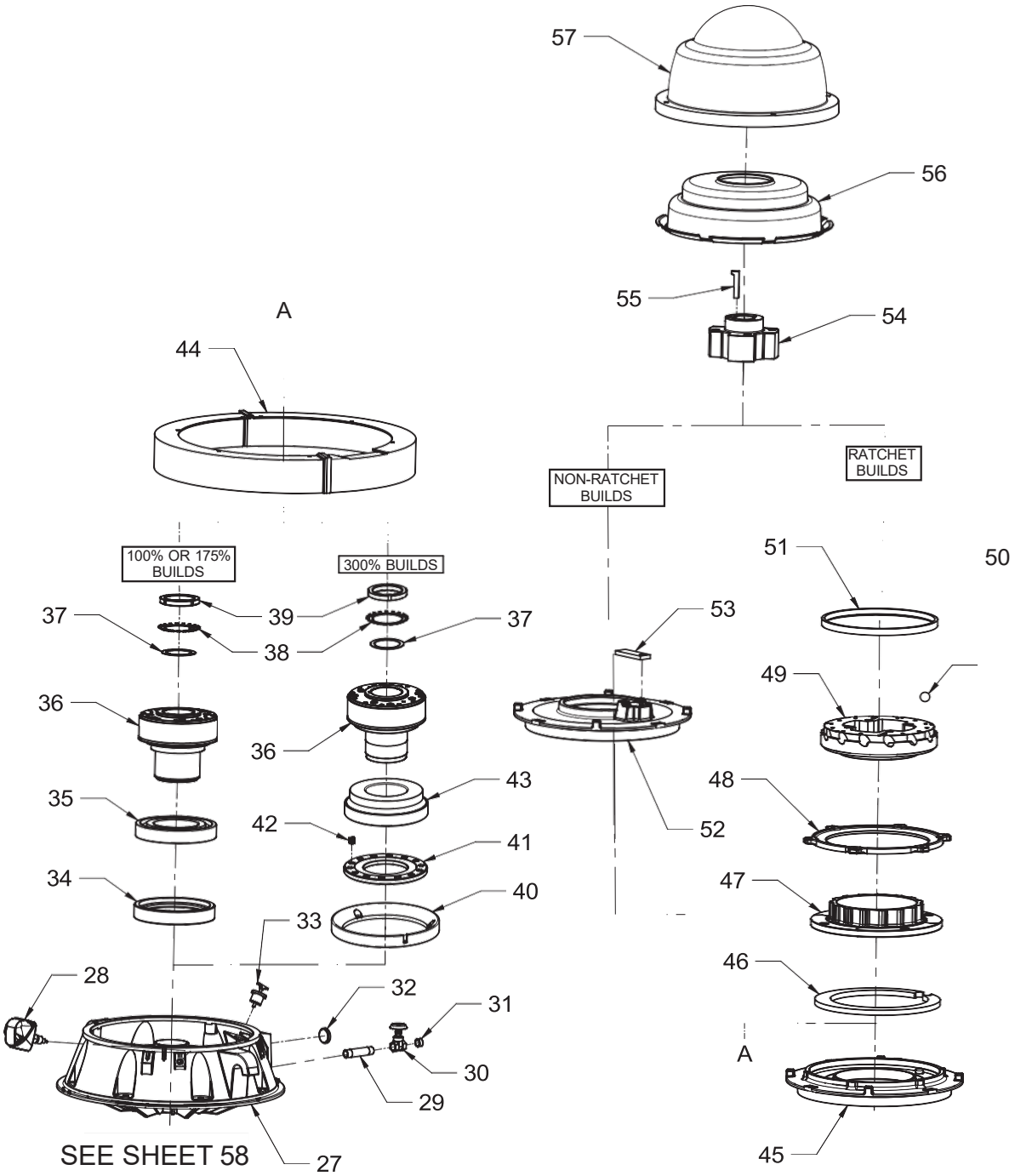
ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Grease Drain)
4	1	Pipe Cap (Lower Grease Drain)
5	1	Grease Zerk Fitting
6	1	Pipe Coupling (Lower Grease Fill)
7	1	Pipe Nipple (Lower Grease Fill)
8	1	Locknut and Lockwasher (Lower Bearing)
9	1	Lower Bearing
10	1	Lower Bearing Cap
11	1	Lower Intake Screen (Only on WP-1)
12	1	Lower Air Deflector
13	1	Rotor Assembly
14	1	Rotor Core
15	1	Rotor Shaft
16	1	Square Key (Bearing Mounting to Shaft)
17	1	Stator Assembly
18	1	Lower Air Intake Cover (Only on WP-1)
19	1	Upper Air Intake Screen (Only on WP-1)
20	1	Gasket (Outlet Box Base to Stator)
21	1	Outlet Box Base
22	1	Gasket (Outlet Box Cover to Base)
23	1	Outlet Box Cover
24	2-(5008) 4-(5012) 4-(5813)	Exhaust Screen
25	1	Upper Air Deflector
26	1	Upper Bracket
27	1	Pipe Nipple (Oil Drain)
28	1	Pipe Cap (Oil Drain)
29	1	Oil Sight Gauge Window
30	1	Oil Fill Plug (Expanding)
31	1	Bearing Spacer (or Tandem Thrust Bearing)

ITEM NO.	QTY	NAME OF PART
32	1	Upper Thrust Bearing
33	1	Bearing Mounting
34	1	Dust Cover (Only on Units Without Ratchet)
35	1	Locknut and Lockwasher (Brg Mtg to Shaft)
36	1	Canopy Cap
37	1	Thrust Coupling (Only on Hollowshaft)
38	1	Gib Key (Only on Hollowshaft)
39	2	WP2 Intake Box (Only on WP-2)
40	2	Upper Adapter Flange (Only on WP-2)
41	2	Lower Adapter Flange (Only on WP-2)
42	4	Filter Access Cover (Only on WP-2)
43	4	Intake Screen (Only on WP-2)
44	4	Cover (Flange Access) (Only on WP-2)
45	1	Ratchet Adaptor (Only on Units With Ratchet)
46	1	Connection Spring (Only on Units With Ratchet)
47	1	Stationary Ratchet (Only on Units With Ratchet)
48	1	Pressure Plate (Only on Units With Ratchet)
49	1	Rotating Ratchet (Only on Units With Ratchet)
50	12-(5008) 14-(5012) 16-(5813)	Ratchet Ball (Only on Units With Ratchet)
51	1	Ball Retaining Ring (Only on Units With Ratchet)
52	4-(5008) 12-(5012) 8-(5813)	Plain Washer (Only on Units With Ratchet)
53	4-(5008) 6-(5012) 8-(5813)	Die Spring (Only on Units With Ratchet)
54	4-(5008) 6-(5012) 8-(5813)	Screw (Only on Units With Ratchet)
55	1	Pressurization Baffle (5000 Frame Only)

5000 Frame ODP/WPI
Type RU & RV4 - High Thrust



5000 Frame ODP/WPI
Type RU, RV4 - High Thrust

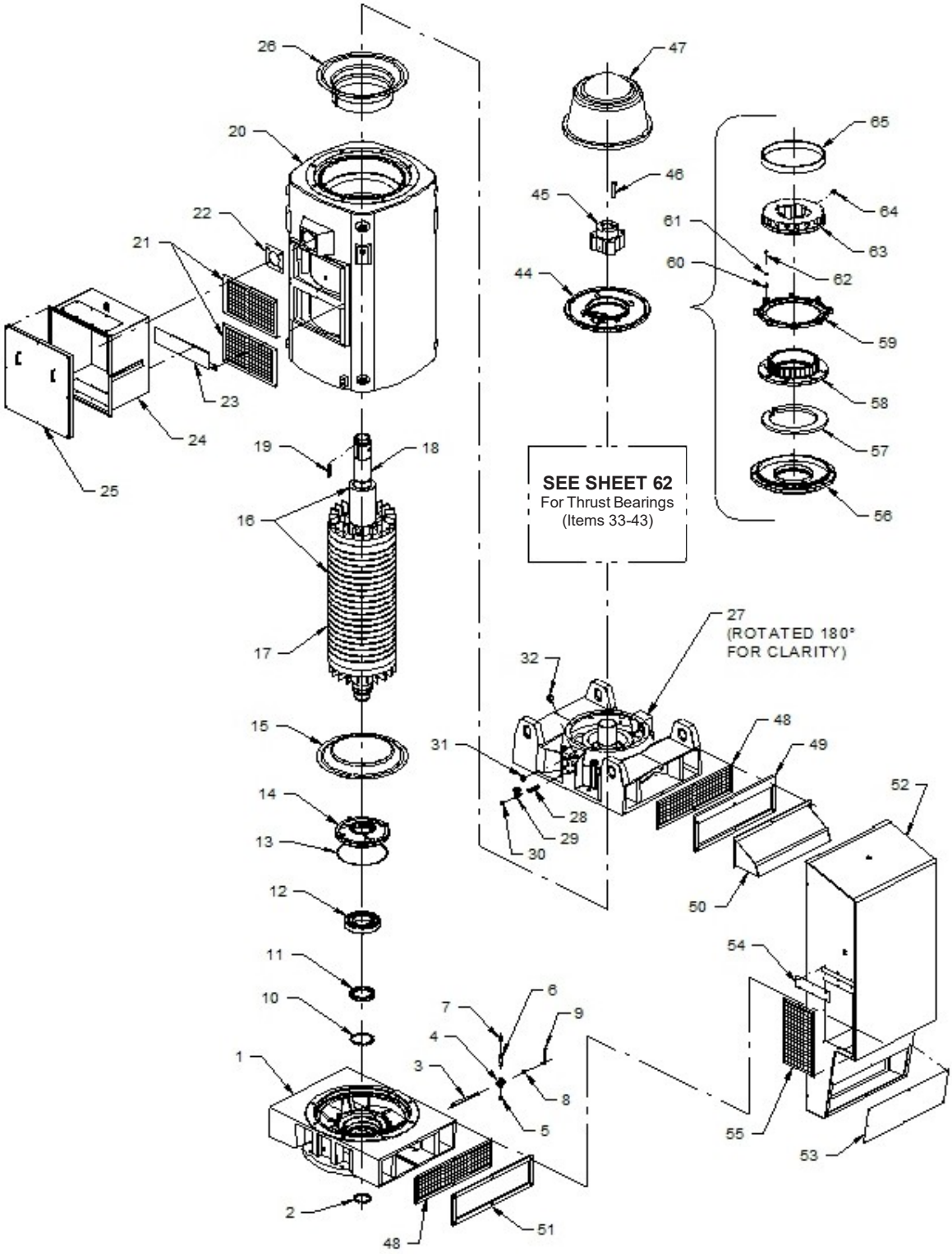


5000 Frame ODP/WPI
Type RU and RV4 - High Thrust

ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Water Deflector
3	1	Lock Nut Lower
4	1	Lock Washer Lower
5	1	Spacer Wshr Insul. {Only for Insul Lower Brg)
6	1	Bearing Lower
7	1	Bearing Cap
8	1	Rotor assembly
9	1	Upper Bearing Mount Key
10	1	Coupling Lower Grease Drain
11	1	Nipple Lower Grease Drain
12	1	Coupling Lower Grease Fill
13	1	Nipple Lower Grease Fill
14	1	Lower Grease Fill Fitting
15	1	Screen Lower
16	1	Air Deflector Lower
17	1	Stator assembly
18	1	BTD mounting Plate
19	1	BTD Housing Lower
20	4	Screen Exhaust
21	1	Upper Air Deflector
22	1	Screen Upper Intake
23	1	Gasket Outlet box
24	1	Cover Outlet Box
25	1	Gasket Outlet Box
26	1	Cover Outlet Box
27	1	Lower Bracket Assembly
28	2	WPII Cover
29	2	Threaded Rod (Cover Mounting)

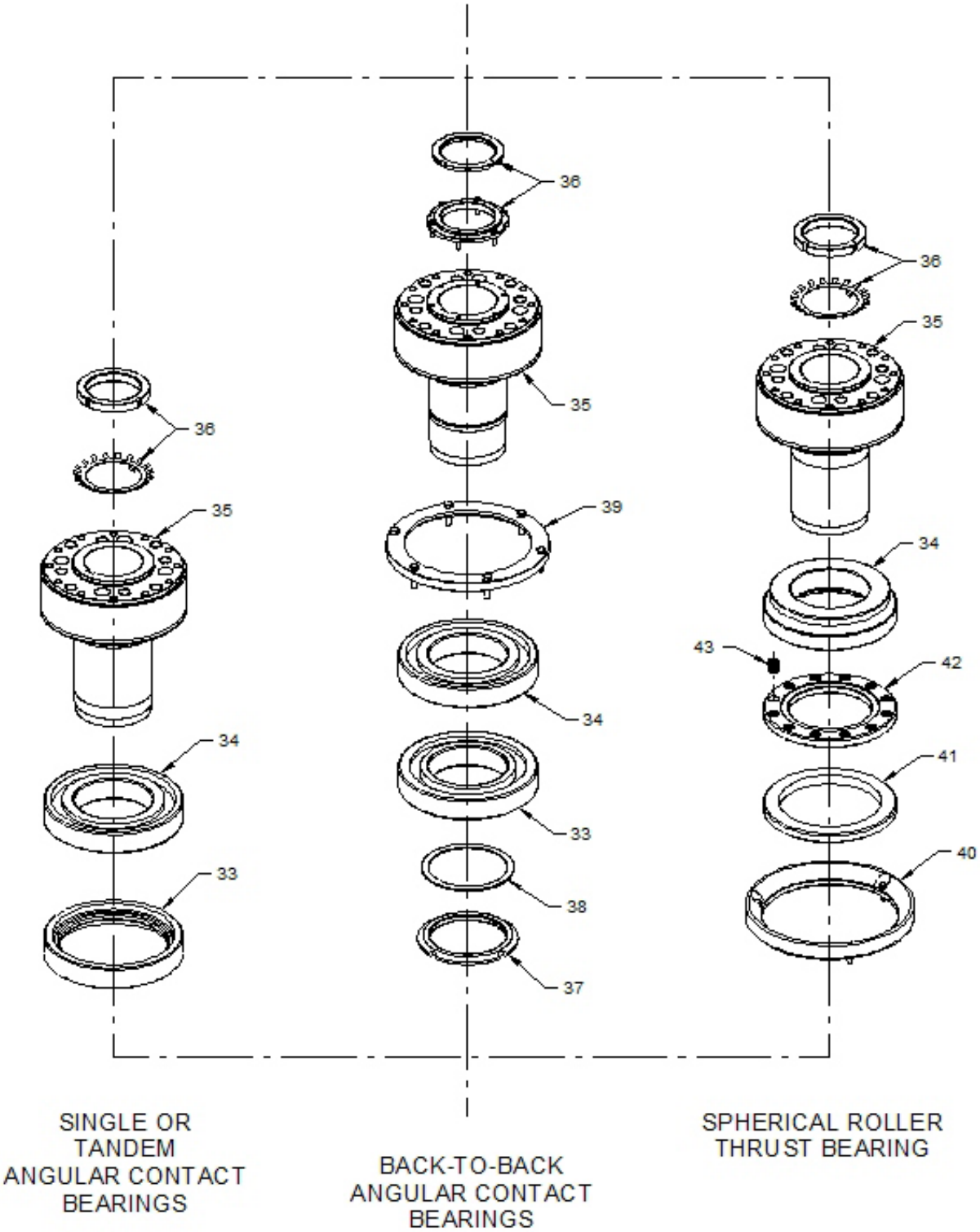
ITEM NO.	QTY	NAME OF PART
28	1	BTD Housing Upper
29	1	Oil Tube Drain Upper
30	1	Oil Gate Valve Upper
31	1	Plug Upper Gate Valve
32	1	Sight Gauge Window
33	1	Oil Fill Plug
34	1	Spacer Bearing
35	1	Bearing Upper
36	1	Bearing Mount
37	1	Spacer Wshr Insul. (Only for Insul Upper Brg)
38	1	Lockwasher Upper
39	1	Lock Nut Upper
40	1	Ring Upper Spherical Brg
41	1	Pressure Plate Spherical Brg
42	12	Spring
43	1	Bearing Spherical
44	1	Cover Upper
45	1	Cover Non-Reversing Ratchet
46	1	Pressure Plate Non-reversing Ratchet
47	1	Stationary Ratchet
48	1	Locking Ring Non-Reversing Ratchet
49	1	Rotataing Rat chet Non-reversing Ratchet
so	12	Ball Non-Reversing Ratchet
51	1	Ring Securing Balls
52	1	Dust Ring
53	1	Locking Arm
54	1	Coupling
55	1	Gib Key
56	1	Baffle
57	1	Canopy Cap

6813 Frame
Type RU, RV-4



6813 Frame Type RU, RV-4

THRUST BEARING DETAILS

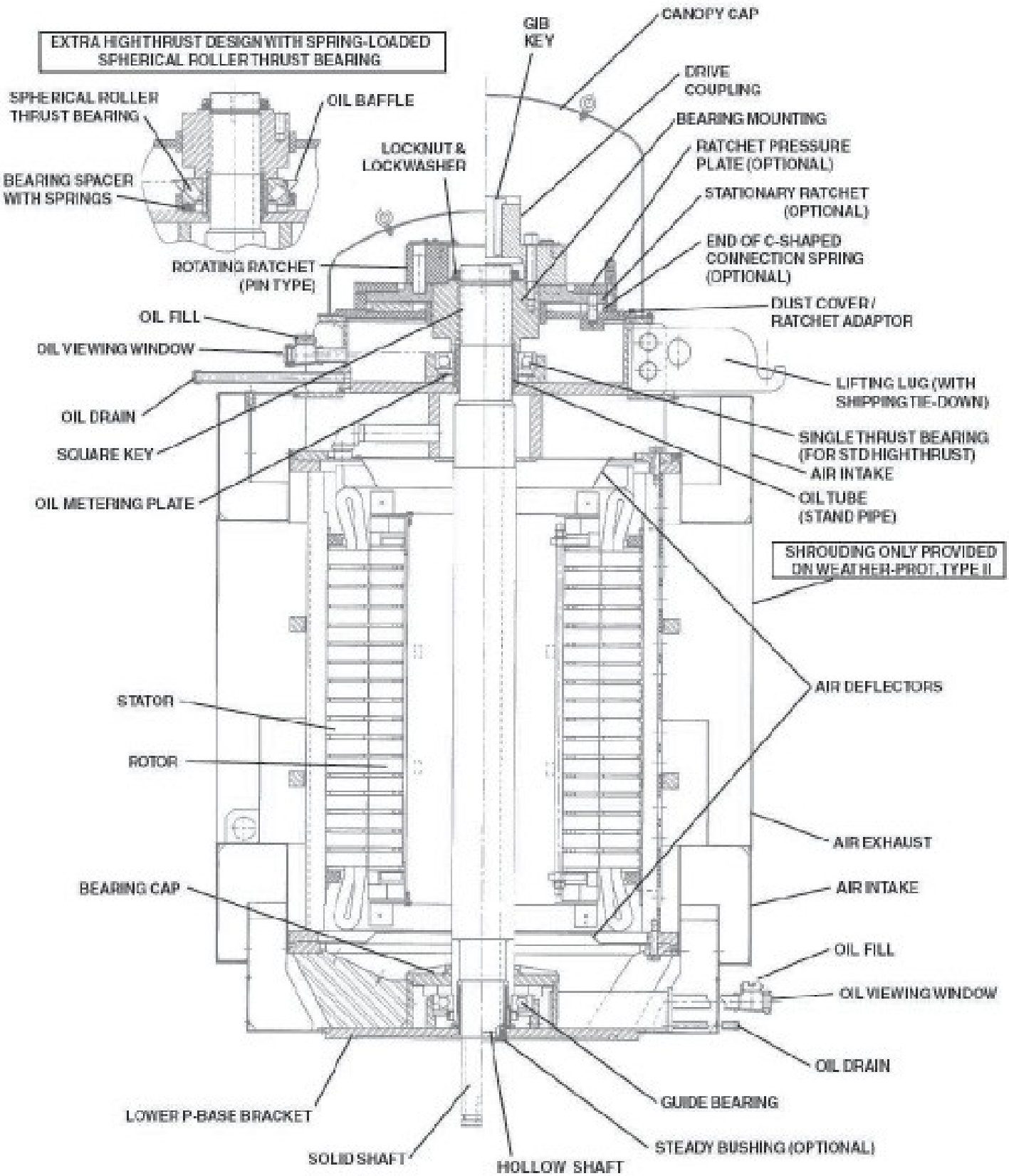


6813 Frame
Type RU and RV-4

ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Tee (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Cap (Lower Oil Fill)
8	1	Reducer Bushing
9	1	Oil Sight Gauge Window
10	1	Lockwasher (Lower Bearing)
11	1	Locknut (Lower Bearing)
12	1	Lower Bearing
13	1	O-Ring
14	1	Lower Bearing Cap
15	1	Lower Air Deflector
16	1	Rotor Assembly
17	1	Rotor Core
18	1	Rotor Shaft
19	1	Square Key (Bearing Mounting to Shaft)
20	1	Stator Assembly
21	4	Exhaust Screens
22	1	Gasket (Outlet Box Base to Stator)
23	1	Mounting Bracket (Outlet Box To Stator)
24	1	Outlet Box Base
25	1	Outlet Box Cover
26	1	Upper Air Deflector
27	1	Upper Bracket
28	1	Pipe Nipple (Upper Oil Drain)
29	1	Gate Valve (Upper Oil Drain)
30	1	Pipe Plug (Upper Oil Drain)
31	1	Oil Sight Gauge Window
32	1	Oil Fill Plug (Expanding)
33	1	Bearing Spacer (or Tandem Thrust Bearing)

ITEM NO.	QTY	NAME OF PART
34	1	Upper Thrust Bearing
35	1	Bearing Mounting
36	1	Locknut and Lockwasher (Brg Mtg to Shaft)
37	1	Locknut and Set Screws (Back-to-Back Brgs.)
38	1	Bearing Spacer (Insul.)(Back-to-Back Brgs.)
39	1	Bearing Cap (Clamping)(Back-to-Back Brgs.)
40	1	Oil Baffle (EHT Bearing)
41	1	Bearing Support (EHT Bearing)(When Supplied)
42	1	Bearing Spacer (EHT Bearing)
43	As Req'd	Die Spring (EHT Bearing)
44	1	Dust Cover (Only on Units Without Ratchet)
45	1	Thrust Coupling (Only on Hollowshaft)
46	1	Gib Key (Only on Hollowshaft)
47	1	Fan Cover
48	4	Bracket Screen (Upper and Lower)
49	2	Upper Flange Adaptor (Only On WP-2)
50	2	Upper Air Scoop (Only On WP-1)
51	2	Lower Flange Adaptor (Only On WP-2)
52	2	WP-2 Intake Box (Only On WP-2)
53	2	Access Cover (Only On WP-2)
54	4	Filter Access Cover (Only On WP-2)
55	4	Intake Screen (Only On WP-2)
56	1	Ratchet Adaptor (Only on Units With Ratchet)
57	1	Connection Spring (Only on Units With Ratchet)
58	1	Stationary Ratchet (Only on Units With Ratchet)
59	1	Pressure Plate (Only on Units With Ratchet)
60	6	Die Spring (Only on Units With Ratchet)
61	6	Plain Washer (Only on Units With Ratchet)
62	6	Screw (Only on Units With Ratchet)
63	1	Rotating Ratchet (Only on Units With Ratchet)
64	As Req'd	Ratchet Ball (Only on Units With Ratchet)
65	1	Ball Retaining Ring (Only on Units With Ratchet)

9600 Frame
Types RU and RV-4



Installation Record

Nameplate and Installation Information

SERIAL NUMBER OR MODEL NUMBER.....
HORSEPOWER.....
MOTOR RPM.....
PHASE.....
FREQUENCY.....
AMPS..... _____ AT VOLTS
DESIGN.....
FRAME.....
DATE PURCHASED. ..... P.C. NUMBER
DATE INSTALLED.....
LOCATION OF JOB SITE.....
MACHINE OR INSTALLATION NUMBER.....
PURCHASED FROM.....
MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION....

INSULATION TO GROUND READING AT TIME OF INSTALLATION....

RECORD OF MAINTENANCE

GRADE AND TYPE OF LUBRICANT USED.....

DATE OF LAST RELUBRICATION	INSULATION RESISTANCE		OVERHAUL OR REPAIR	
	DATE	MEGOHMS	DATE	ACTION

Table 6: Threaded Fastener Torque Requirements

All threaded fasteners used for rigid joints (cast iron and low carbon steel) in products of Nidec Motor Corporation, are to be tightened to the torque values listed in the following tabulation. Values are based upon dry assembly.

Diameter of Fastener	Number of Threads Per Inch	Grade 5 Fasteners	Grade 2 Fasteners
#6	32	16 lb-in	10 lb-in
	40	18	12
#8	32	30	19
	36	31	20
#10	24	43	27
	32	49	31
#12	24	66	37
	28	72	40
1/4"	20	96	66
	28	120	76
5/16"	18	16 lb-ft	11 lb-ft
	24	18	12
3/8"	16	29	20
	24	34	23
7/16"	14	46	30
	20	52	35
1/2"	13	70	50
	20	71	55
9/16"	12	102	
	18	117	
5/8"	11	140	
	18	165	
3/4"	10	249	
	16	284	
7/8"	9	401	
	14	446	
1"	8	601	
	14	666	
1-1/8"	7	742	
	12	860	
1-1/4"	7	1046	
	12	1196	
1-3/8"	6	1371	
	12	1611	
1-1/2"	6	1820	
	12	2110	

Table 7: TEFC, WPI, WPII Motor Weights (lbs.)

Motor Weight with Pallet*		TEFC	WPI	WPII
Frame Size	182	200	150	
	184	200	150	
	213	300	300	
	215	300	300	
	254	450	400	
	256	450	400	
	284	650	450	
	286	650	450	
	324	800	800	
	326	800	800	
	364	1050	900	
	365	1050	900	
	404	1600	1200	
	405	1600	1200	
	444	2000	1700	
	445	1650	1800	
	447	2400	2300	
	449	4000	3600	4300
	5006		3400	3300
	5007		3400	3700
	5008	4100	4500	4800
	5009		3700	4000
	5012		5900	6400

Motor Weight with Pallet*		TEFC	WPI	WPII
Frame Size	5807	6000		
	5808		4500	4500
	5809	7100	4800	5000
	5810		5100	5500
	5811	8000		
	5812	10400		
	5813		10300	11100
	6808		8000	8900
	6810		9600	10600
	6812	16800		
	6813		19300	20400
	8004		11000	
	8006		11700	12500
	8007		12200	13000
	8008		12800	13600
	8009		13900	14700
	8010		14800	15700
	8011		15800	16700
	8012		16400	17200
	9603		15900	16700
	9604		17000	17800
	9605		18100	18900
	9606		19200	20000

*** Refer to Nameplate for Actual Motor Weight and Section II for Handling/Lifting**

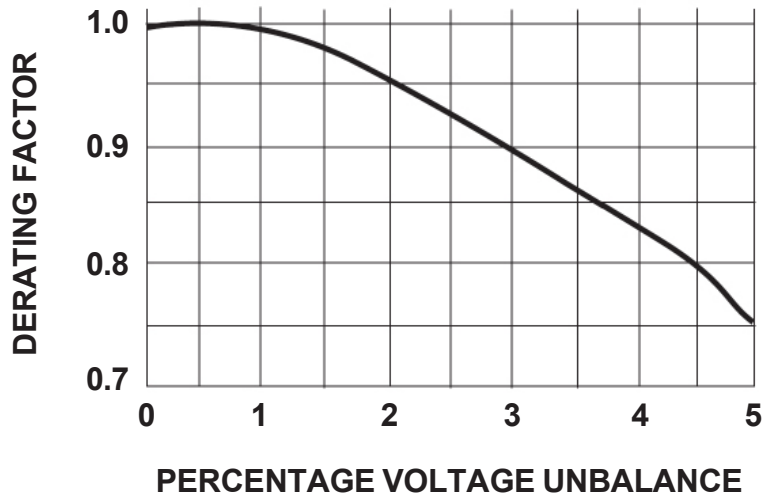
Appendices

Effects of Unbalanced Line Voltage

A potential cause of premature motor failure is unbalanced line (supply) voltage. Three phase motors produce useful work when they efficiently convert electrical energy into mechanical energy. This is accomplished when each phase of the supply voltage is of equal strength and works in harmony to produce a rotating magnetic field within the motor.

When the value of supply voltage leg to leg is not equal (e.g. 460-460-460), the risk of unbalanced line voltage is present. If this voltage unbalance exceeds about 1%, excessive temperature rise will result. Unless the motor HP capacity is derated to compensate, the motor will run hot resulting in degradation of the insulation system and bearing lubricant.

From NEMA®† MG-1, 14.36: Derating factors due to unbalanced line voltage



EXAMPLE: Field ratings of Phase A - 480 v, Phase B = 460 v, Phase C = 450 v

As a rule of thumb, the percentage increase in temperature rise will be about two times the square of the percentage voltage unbalance. In this case, the average voltage (480+460+450) is equal to 463 volts. The maximum deviation between legs is 17 volts (480-463 volts).

The Percentage voltage unbalance is determined as follows: 17 / 463 x 100 = 3.7%. The temperature rise will then increase $(3.7)^2$ x 2 = 27%. This condition will reduce the typical life of your motor to less than 25% of its design life. Should this condition be present, call your electric utility and resolve your unbalanced supply condition.

Other areas of motor performance will also be affected - e.g., loss of torque capacity, change in full load RPM, greatly unbalanced current draw at normal operating speed. Refer to NEMA®† MG-1 section 14.36 for details.

Motors Applied to Variable Frequency Drives (VFD's)

Electrical motors can be detrimentally affected when applied with variable frequency drives (VFD's). The non-sinusoidal waveforms of VFD's have harmonic content which causes additional motor heating; and high voltage peaks and short rise times, which result in increased insulation stress, especially when long power cable lengths are used. Standard motors utilized with VFD's must be limited to those application considerations defined in **NEMA MG-1 Part 30.**

NEMA MG-1 Part 31 defines performance and application considerations for Definite-Purpose Inverter Fed motors. To ensure satisfactory performance and reliability, Nidec Motor Corporation offers and recommends nameplated inverter duty motor products which meet the requirements of NEMA MG-1 Part 1. The use of non-inverter duty motors may result in unsatisfactory performance or premature failure, which may not be warrantable under the Terms and Conditions of Sale. Contact your Nidec Motor Corporation Field Sales Engineer for technical assistance in motor selection, application and warranty details.

Electric Motor Load Test Using the Watt Hour Meter

In the analysis of electric motors, it is desirable to conduct an accurate load check on a particular installation to determine whether the motor is operating within the rating and horsepower for which it was designed. Since most pumps installations have their own watt hour meters, accurate readings will permit a load check via the following formula:

K = Disc constant (watts per revolution of disc per hour). This is typically found on the meter face.

R = Revolutions of disc in watt meter within the time of the test.

T = Time of test, in seconds.

Transformer Ratio = Stated on meter face. Must be included where current transformers are used with watt meters.

To obtain input kilowatts:

$$\textbf{Input KW} = \frac{\textbf{K} \times \textbf{R} \times \textbf{3.6}}{\textbf{T}}$$

To obtain input horsepower:

$$\textbf{Input HP} = \frac{\textbf{K} \times \textbf{R} \times \textbf{4.83} \times \textbf{Transformer Ratio}}{\textbf{T}}$$

The watt hour meter measures power consumed over a period of time. It is necessary to establish the rate at which power is being consumed by the work being done. We establish this rate by counting the revolutions of the disc in a given time. Here is the typical example of a load check:

GIVEN

- Pump motor to be load checked is rated 100 HP, 1800 HP, 3-Phase, 60 Hz, 1.15 service factor, 91.0 Percent Efficiency
- Disc constant (K) found on face of meter = 40
- Transformer ratio found on face of meter = 3

DATA FOUND FROM TESTS

With stopwatch, disc was observed to revolve 10 times in exactly 49 seconds. Therefore, R=10; T=49.

THUS

$$\textbf{Input HP} = \frac{\textbf{40} \times \textbf{10} \times \textbf{4.83} \times \textbf{3}}{\textbf{49}}$$

Output HP = **Input HP** x **Motor Efficiency**
Output HP = **118.29** x **91%** = **107.54**

CONCLUSION

The output HP (107.54) is greater than output HP shown on nameplate (100 HP) but is well within the 1.15 service factor which applies to this motor.