FUSION
FLUID EQUIPMENT

Pro Series Mixers

Installation, Operations, and Maintenance Manual for Closed Tank Application

- For additional O & M support go to our YouTube Channel - FusionFluidEquipment

Table of Contents

Safety

Safety is a top priority at your company and ours. Maintain a safe working environment by fully understanding your surrounding environment, the equipment you are working with, and by following recommended safety guidelines. Industrial equipment requires use of caution, care, and common-sense during installation, operation, and maintenance procedures. Mixing equipment contains pinch points, rotating parts, and heavy components that can pose dangers if not handled properly and cautiously. Use all necessary personal and mechanical safety devices when installing, operating, and maintaining this and other equipment. The precautions outlined here are not intended to cover all potential hazards in the field or related to this equipment. Contact your Fusion rep or the factory if uncertainties arise.

- Read and understand all instructions and supplemental component manuals before installing and operating this mixer. A manual for your mixer's motor is available online from the manufacturer, achieved by locating the motor's nameplate and specifications.
- Take time to prepare and preplan all actions after reading all instructions to ensure a successful and safe installation.
- Installation, operation, and maintenance should only be performed by qualified personnel.
- Develop a safety checklist to ensure that proper caution is used during operation and maintenance.
- Check that all safety devices are properly placed and functional before starting the equipment.
- Keep all guards and safety devices installed and stay clear of any rotating parts. Never touch rotating parts.
- Before performing any maintenance tasks, always disconnect all power sources. Follow proper Lock Out-Tag Out (LOTO) procedures before proceeding.
- Check and maintain equipment on a regular, scheduled basis to ensure safety and longevity of mixer.
- Before modifying your mixing equipment in any way, always consult with a Fusion representative first. Modification to the equipment without factory authorized parts and procedures may cause the mixer to become unsafe and unstable, may decrease the performance or mechanical stability, and/or void the warranty.

USE CARE. MULTIPLE HAZARDS EXIST.

Unpack & Inspection

CAUTION: HEAVY COMPONENTS. HANDLE PROPERLY

Inspection should be done upon receipt of the mixer as well as before installation and during maintenance. Be sure to use caution when unpacking and handling the mixer. The mixer drive or shaft should never be lifted from a single point. The mixer shaft should never be used in the process of moving, lifting, or positioning the mixer as this may bend shaft.

Check to make sure that all components were received. Fusion mixers may be shipped in multiple packages. Typically, your shipment should contain:

- Mixer drive
- Mixer Shaft
- Mechanical Shaft Seal (if equipped)
- Mixing Impellers (may be welded to shaft)
- Mount - (Clamp Mount, Cup Plate, Fixed Plate, Angle Risers, or Pedestal)

Be sure that all components are accounted for before discarding packaging. Components may be imbedded in packing materials. Your Packing slip can be used to verify that all components were received.

Check to ensure that the equipment has arrived undamaged. Visually inspect all components for obvious damage. Check the mixer shaft to assure that it is straight and free from galling on mating surfaces. Confirm that impellers appear symmetrical and that the blades have only the intended bends.

Inspect the hollow bore in the bearing housing of the mixer drive. It should be free of galling or burs. Inspect any couplings and impeller hubs to make sure they are free of dings and dents on mating faces. If you proceed to install the mixer shaft with these defects, the shaft may bind or vibrate causing further damage to your mixer and may make it unsafe to operate. This may not be covered under warranty.

Storage

Mixer should be stored in a cool, dry environment. Humid conditions can damage the motor windings, output bearings, and lubrication. The mixer shaft and impellers should be stored such that they are completely supported and no heavy items are stacked on them. Do not store the mixer near vibrating machinery. All of these factors may deteriorate your mixer.

For long storage periods, rotate the motor and drive assembly, and the mixer shaft once a month. If a gearbox is present, it should be stored in its actual mounting position in accordance with the specified oil level, in a clean and dry temperature-controlled area. If applicable, remove mechanical seal and carefully store in a safe place. Apply rust preventatives as desired. Be sure to change any lubricants before installation and recommissioning. Consult component manuals for Motor & Gearbox for long term storage.

Installation – Pro Series Closed Tank

Before any actual installation, develop a plan for the mounting location. Mounting the mixer in a baffled tank will provide the best mixing performance. There is no equivalent substitute that will provide the level of performance of mixing in a baffled tank. If the installation of baffles in your tank is not a possibility, then angle-offset your mixer. Correct angle-offset mounting will provide acceptable mixing performance where baffles are not an option. If none of these options are a possibility, then contact the factory for a suggested mounting location. Center mounting your mixer in the middle of the tank will cause vortexing, thus resulting in the WORST mixing performance. Center mounting without baffles will also reduce the lifetime and mechanical integrity of the mixer. **DO NOT** center mount the mixer vertically unless authorized by the factory. **See Mounting Guidelines section for more information.**

Confirm that your tank nozzle and mixer support structure are suitable for the weight and dynamic loads from the mixer. Loading information can be found on your approval drawing, by contacting your Fusion representative, or by contacting the factory. Consult the tank fabricator to confirm the tank is capable of supporting these loads. Fusion is not responsible for damage resulting from inadequate tank design or mount design.

Industrial process equipment requires use of caution, care, and common-sense during installation. Take care to preplan all actions after reading the instructions to ensure a successful and safe installation of your Pro Series mixer.

USE CARE. MULTIPLE HAZARDS EXIST

Installation Process Overview

- Mount the Mixer
- Begin Seal Installation (if equipped)
- Shaft Installation
- Complete Seal Installation (if equipped)
- Impeller Installation
- Electrical Installation

Mount the Mixer

Mount the mixer to the desired location. Be careful, as there are several pinch points in the mounting hardware, couplings, hubs, flanges, etc. **Make sure there is adequate clearance between impeller and the side wall of tank to account for shaft deflection.**

Recommended Tightening Torques

Tighten all of the hardware to the torque specifications in the table below. These average torque values should be used as a guide and not as absolute values:

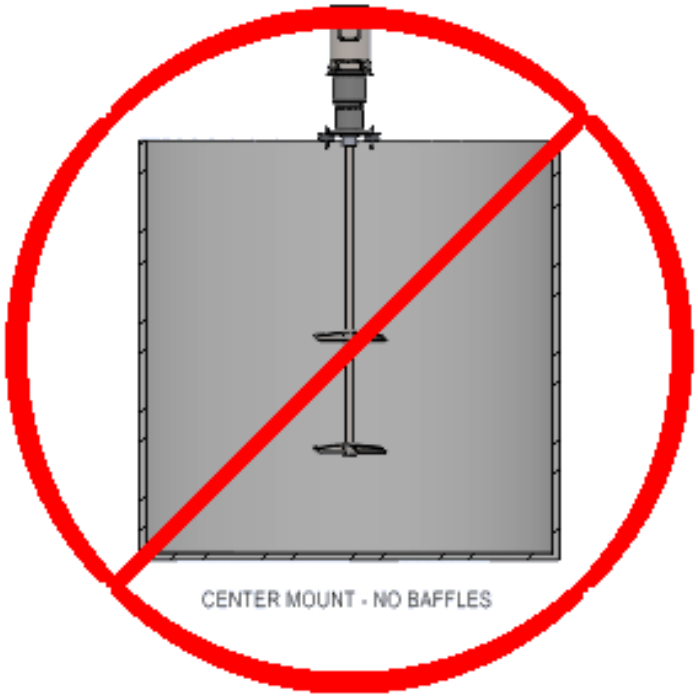
Torque Specifications:						
BOLT SIZE	18-8 & 304 STAINLESS (uncoated/no lube)		316 STAINLESS (uncoated/no lube)		Gr5 / Gr8 STEEL (uncoated/no lube)	
1/4"-20	57	*in-lbs*	60	*in-lbs*	75	*in-lbs*
5/16"-18	103	*in-lbs*	108	*in-lbs*	165	*in-lbs*
3/8"-16	189	*in-lbs*	198	*in-lbs*	300	*in-lbs*
7/16"-14	308	*in-lbs*	322	*in-lbs*	480	*in-lbs*
1/2"-13	36	FT-LBS	38	FT-LBS	61	FT-LBS
9/16"-12	48	FT-LBS	51	FT-LBS	88	FT-LBS
5/8"-11	81	FT-LBS	84	FT-LBS	121	FT-LBS
3/4"-10	114	FT-LBS	118	FT-LBS	215	FT-LBS
7/8"-9	178	FT-LBS	186	FT-LBS	251	FT-LBS
1"-8	269	FT-LBS	281	FT-LBS	375	FT-LBS
1-1/4"-7	492	FT-LBS	513	FT-LBS	750	FT-LBS

Note: These values are provided for reference only. Every torquing situation needs to be evaluated as small differences can have significant impact on torque. These numbers assume clean, uncoated, non-lubricated stainless threads. In general, lubricated threads require less torque, while coated threads may require more or less. Dirty threads will require more torque.

1) **ALL BOLTS SHOULD BE TIGHTENED TO TORQUE SPECIFICATIONS AFTER 12 HOURS OF SERVICE AND AT EACH SCHEDULED SHUT DOWN.**
2) USE OF SERVICE REMOVEABLE THREAD-LOCKER RECOMMENDED (BLUE 242 LOCTITE OR SIMILAR).
3) Use of service removeable thread-locker recommended (Blue 242 Loctite or similar). *NOTE: Some thread-locking compounds act as a lubricant, requiring torque settings to be adjusted. Follow manufacturer's instructions for this adjustment.*
4) CONVERSION FACTOR:
   Torque values are shown as dry values (no lube or thread locker). For a typical lubricated thread torque value multiply by 80%. For use of thread locker follow manufacturer's instructions for torque adjustment.

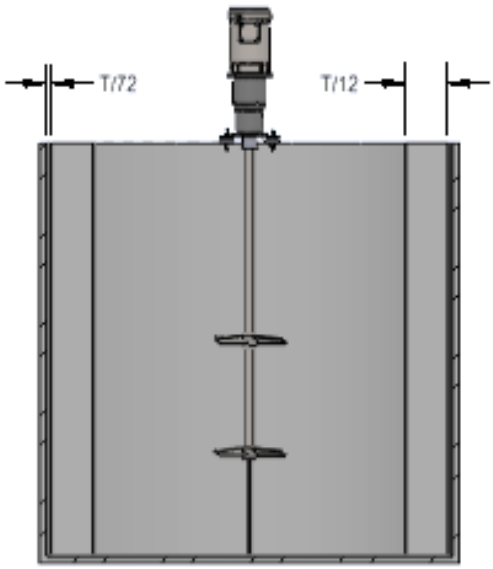
Mounting Guidelines

Center Mounting



CENTER MOUNT - NO BAFFLES

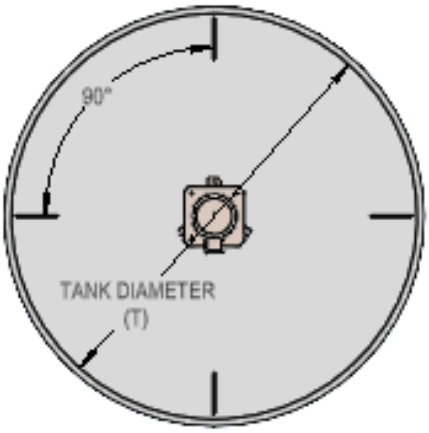
NOT RECOMMENDED



CENTER MOUNT - WITH BAFFLES

BAFFLE DIMENSIONS
WIDTH: 1/12 TANK DIAMETER
NUMBER: 4 @ 90° - PREFERRED OR 3 @ 120°
OFF SIDEWALL: 1/72 TANK DIAMETER

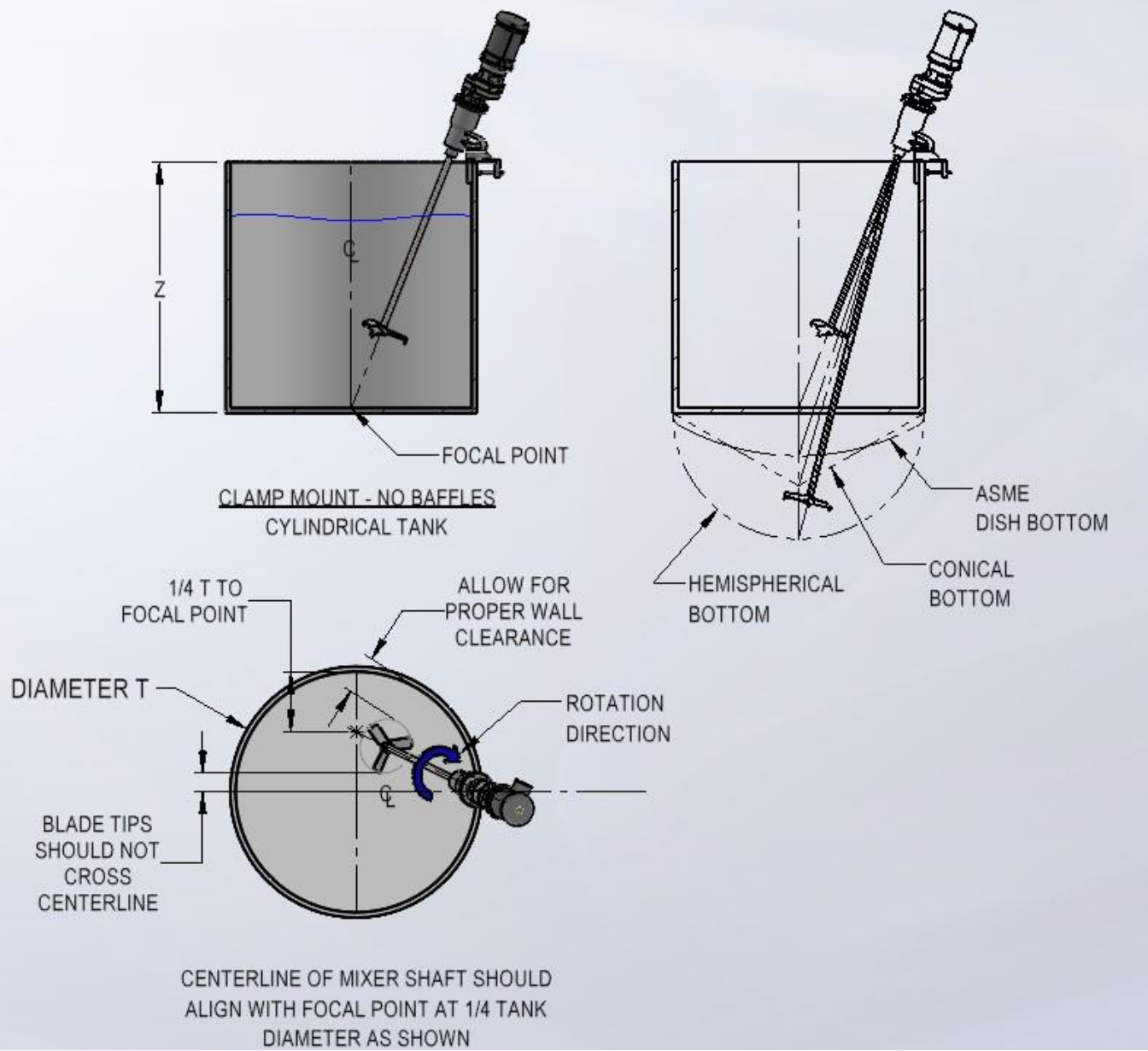
RECOMMENDED



TOP VIEW OF TANK WITH CENTER MOUNT MIXER & 4 BAFFLES

MOUNTING GUIDELINES ARE FOR REFERENCE. PLEASE CONTACT YOUR FUSION APPLICATION ENGINEER OR CONSULT YOUR MOUNTING COORDINATES PROVIDED ON YOUR FUSION ESTIMATE FOR SUGGESTED MOUNTING LOCATIONS.

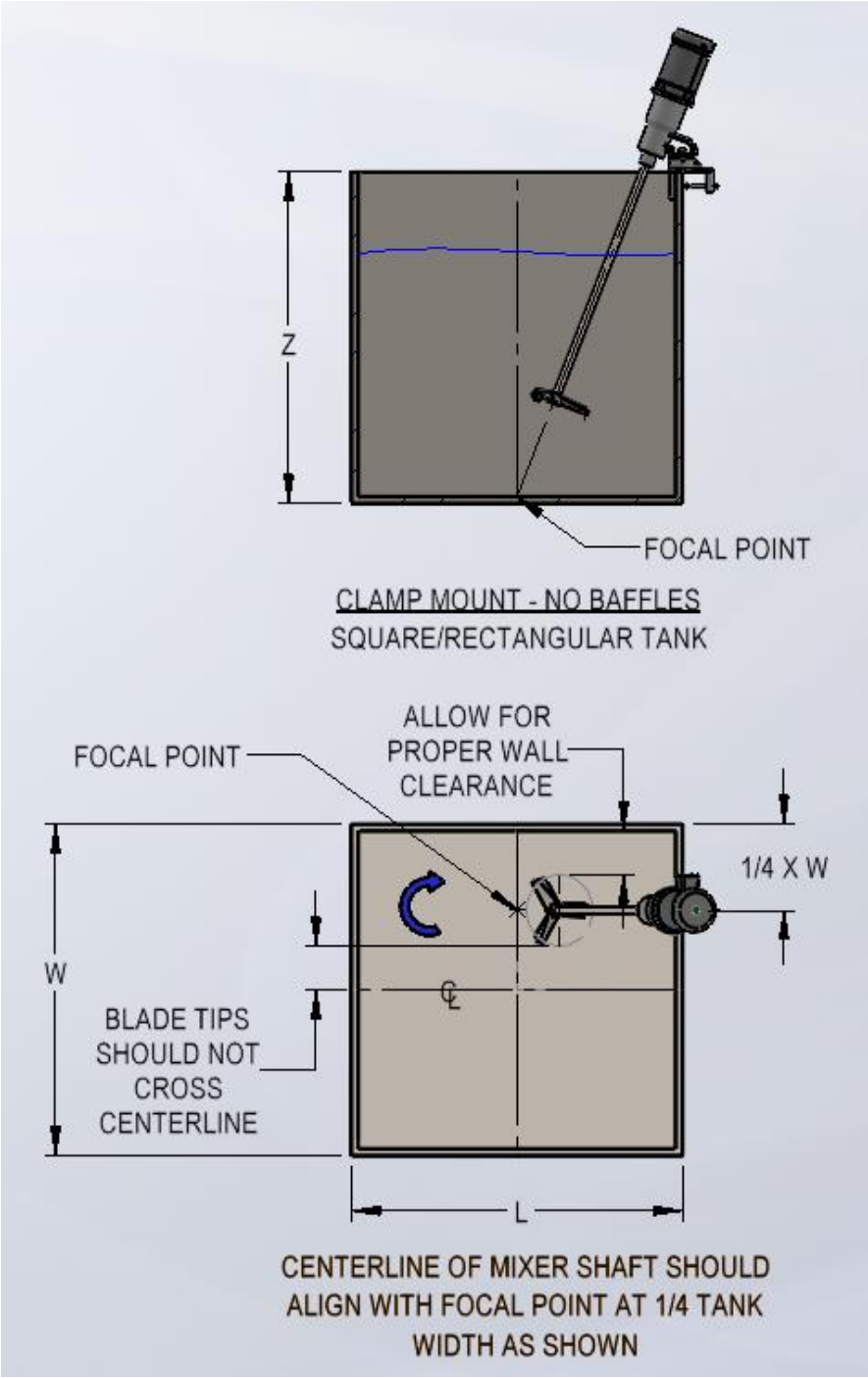
Mounting Guidelines for Fusion Pro Series Mixers Angle Mounting - Clamp Mount Mixers



Make sure that mount location is rigid enough to support the function of the mixer. Max impeller diameter (D) to tank diameter (T) ratio (D/T) should not to exceed 42%. If impeller blade tips cross centerline of the tank, then vortexing will occur.

MOUNTING GUIDELINES ARE FOR REFERENCE. PLEASE CONTACT YOUR FUSION APPLICATION ENGINEER OR CONSULT YOUR MOUNTING COORDINATES PROVIDED ON YOUR FUSION ESTIMATE FOR SUGGESTED MOUNTING LOCATIONS.

Clamp Mount - No Baffles Square/Rectangular Tank



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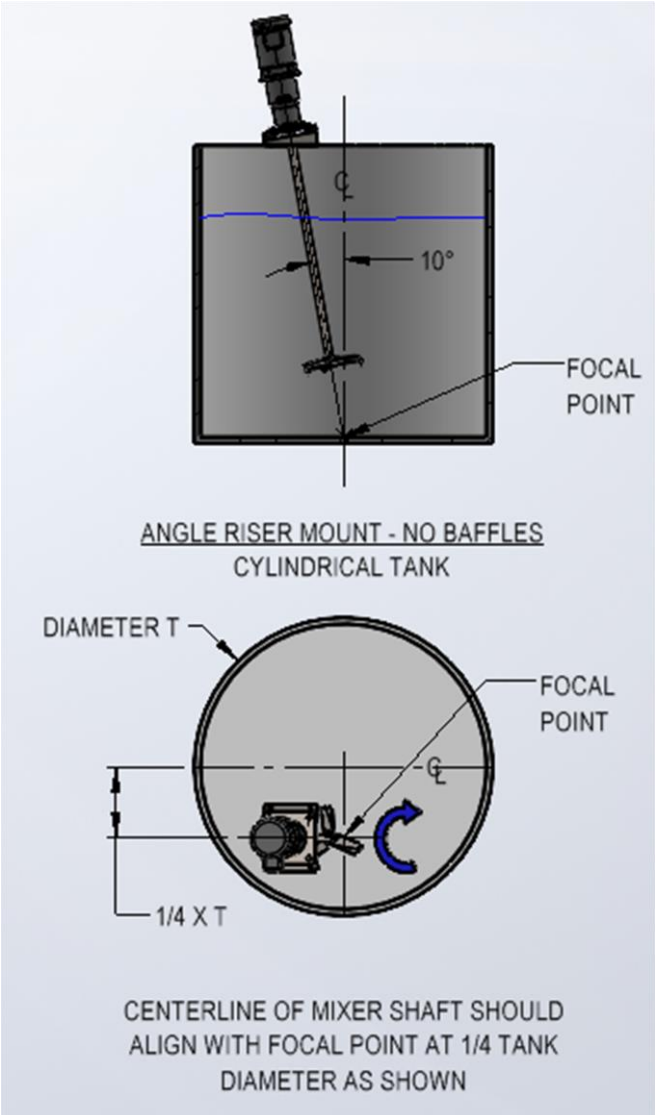
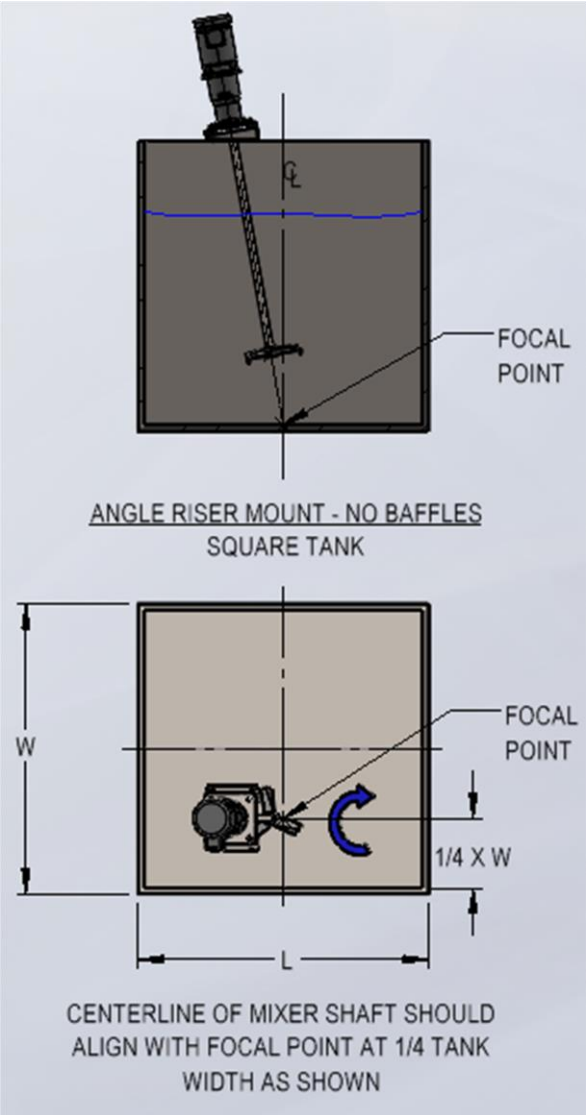
Mounting Guidelines

Angle Riser Mount Mixers





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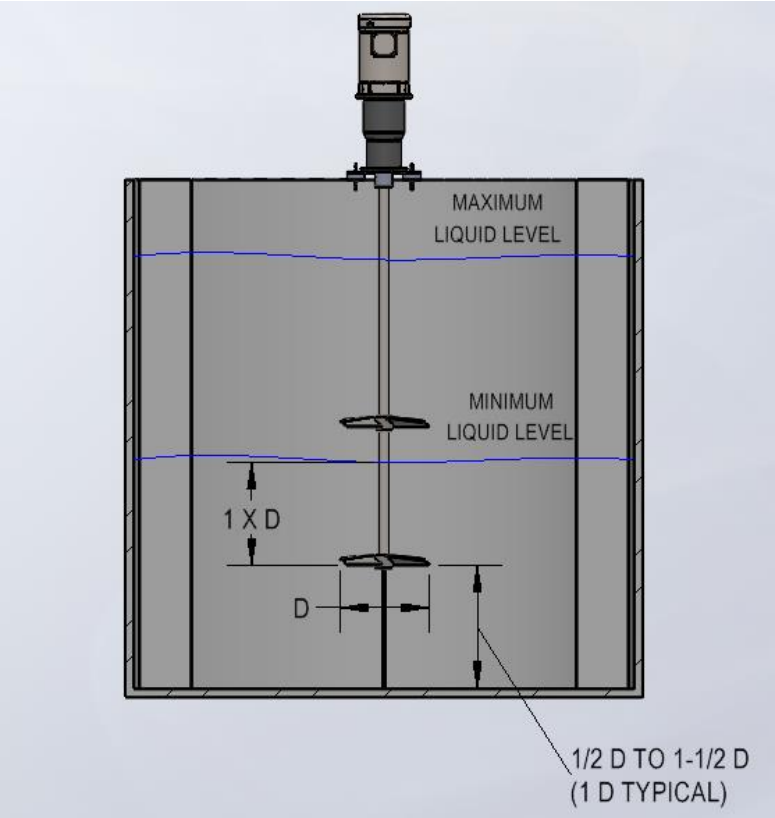
Mounting Guidelines

Impeller Spacing - All Mounting Styles



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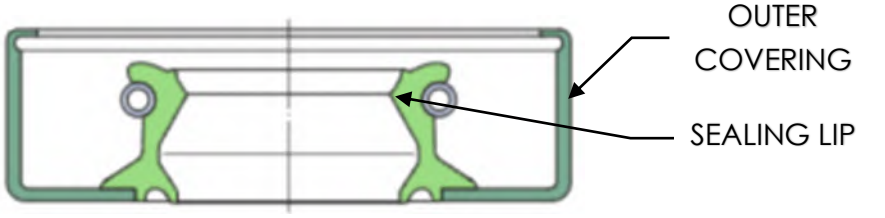
Lip Seal Section

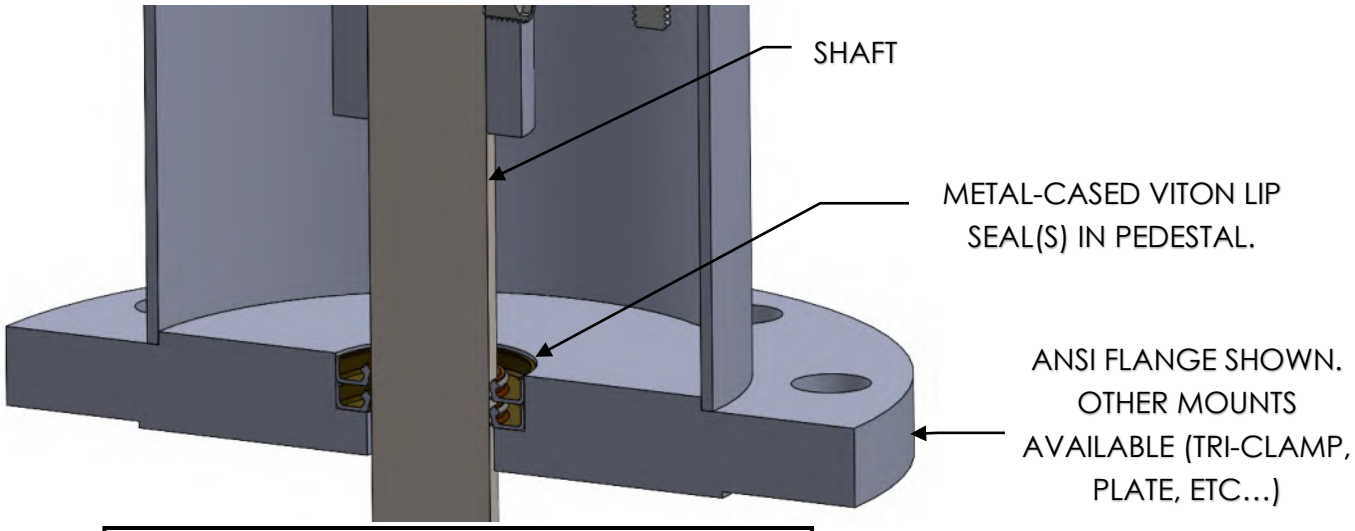
CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

Viton Lip Seal Overview

Radial shaft seals (Lip Seals) are assembled between rotating and stationary components. There are two main parts to the Lip Seal. One is a cylindrical exterior covering that seals statically inside the housing bore with an interference fit. The second is a sealing lip that seals around the rotating shaft.



FUSION MIXERS ARE SHIPPED WITH LIP SEALS ALREADY INSTALLED FOR YOUR CONVENIENCE



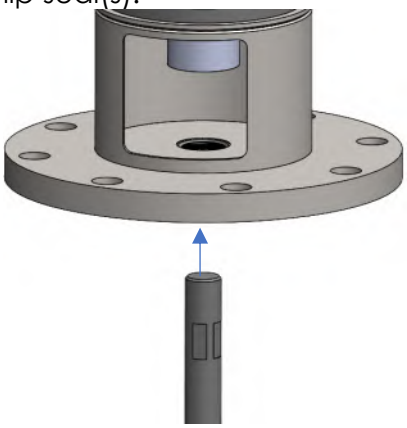
SECTION VIEW OF TYPICAL METAL-CASED VITON LIP

CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

Shaft Installation

The lip seal(s) is typically installed at the factory in the mixer's pedestal base as shown above. If seal is not present, go to the Metal-Cased Viton Lip Seal Replacement section – step C for installation instructions. Make sure the sealing lip(s) is lubricated using process-compatible lubricant.

A) To install the shaft, slide the shaft up through the bottom of the pedestal and the lip seal(s).



CHECK FOR SHARP EDGES OR BURRS ON SHAFT BEFORE INSERTING THROUGH LIP SEAL. DEBURR AS NECESSARY TO PREVENT CUTTING OR TEARING LIP SEAL.

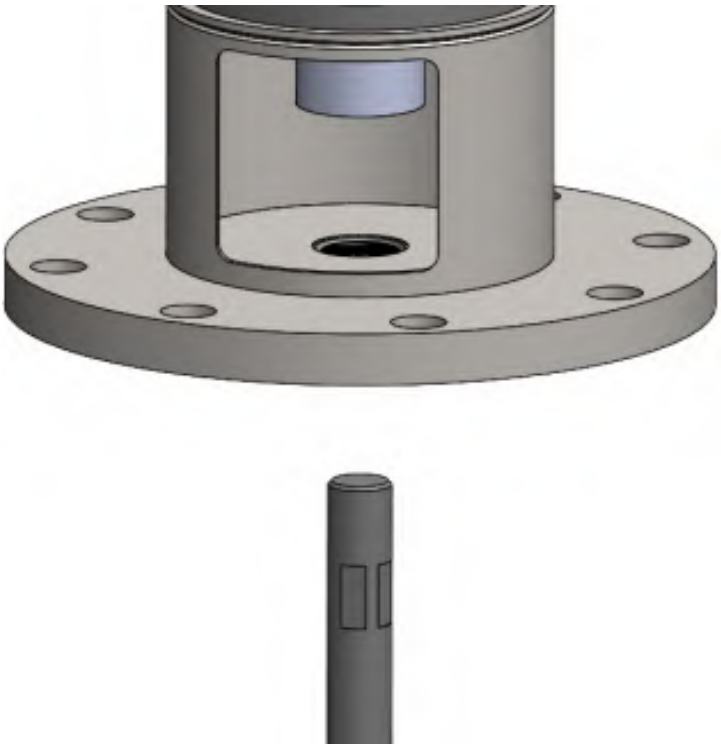
B) Attach the shaft to the mixer drive by following the appropriate manual section for your mixer.

CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

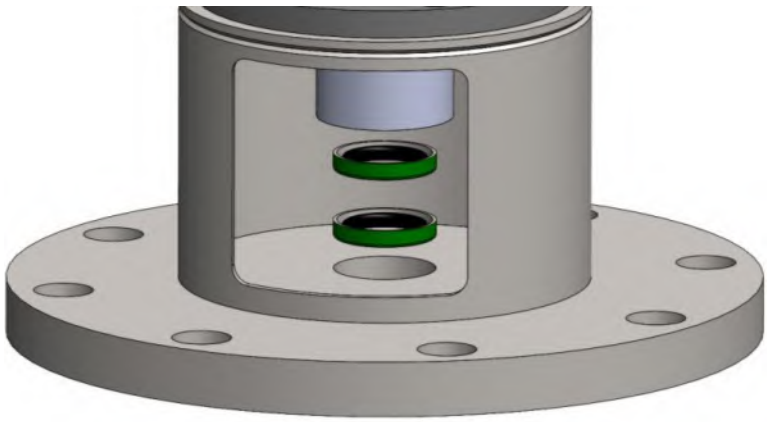
Metal-Cased Viton Lip Seal Replacement

This section covers the replacement of the lip seal(s).

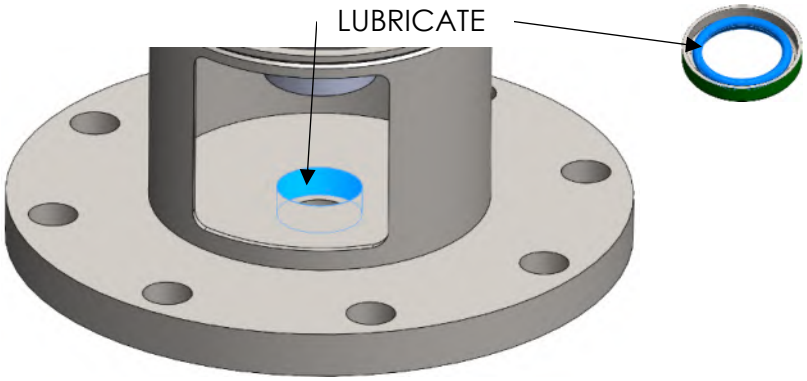
A) Detach the shaft from the mixer drive and remove it by pulling through the lip seal and pedestal bore.



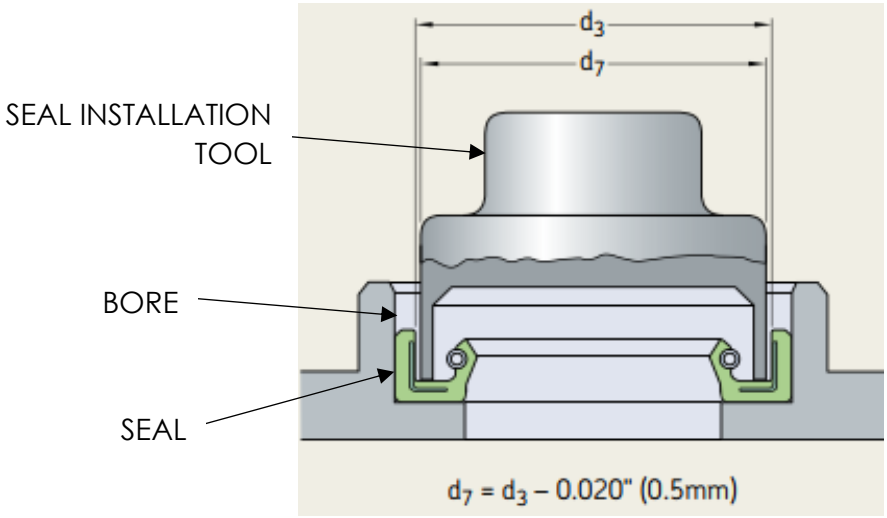
B) Remove the existing lip seal(s) from the pedestal bore by either tapping them out from the bottom of the pedestal or pry them out from the pedestal window.



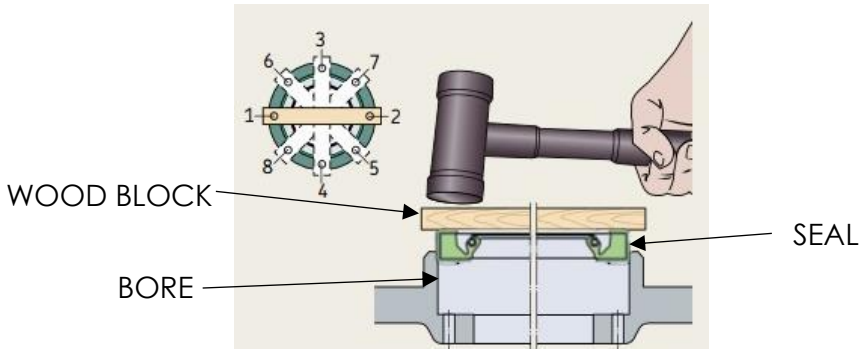
C) Apply a light coat of process-compatible lubricant to the sealing lip of the new lip seal and the pedestal bore.



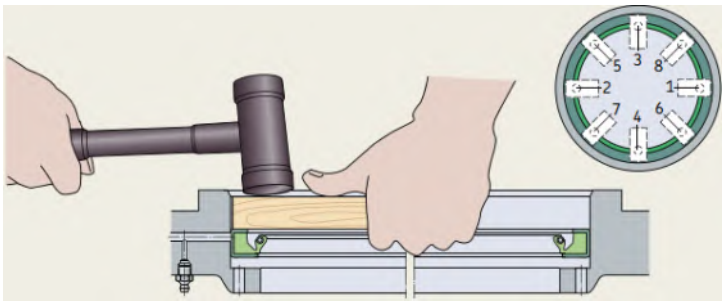
D) Press the seal in by using a tool like the one shown below and a dead blow hammer. Make sure the seal is going into the bore square.



E) If you are unable to get or make a tool like the one in the previous step, use a wooden block that's long enough to span the outside diameter of the seal and a dead blow hammer. Make sure to tap the seal into the bore following the pattern in the image to avoid tilting or skewing the seal in the bore.



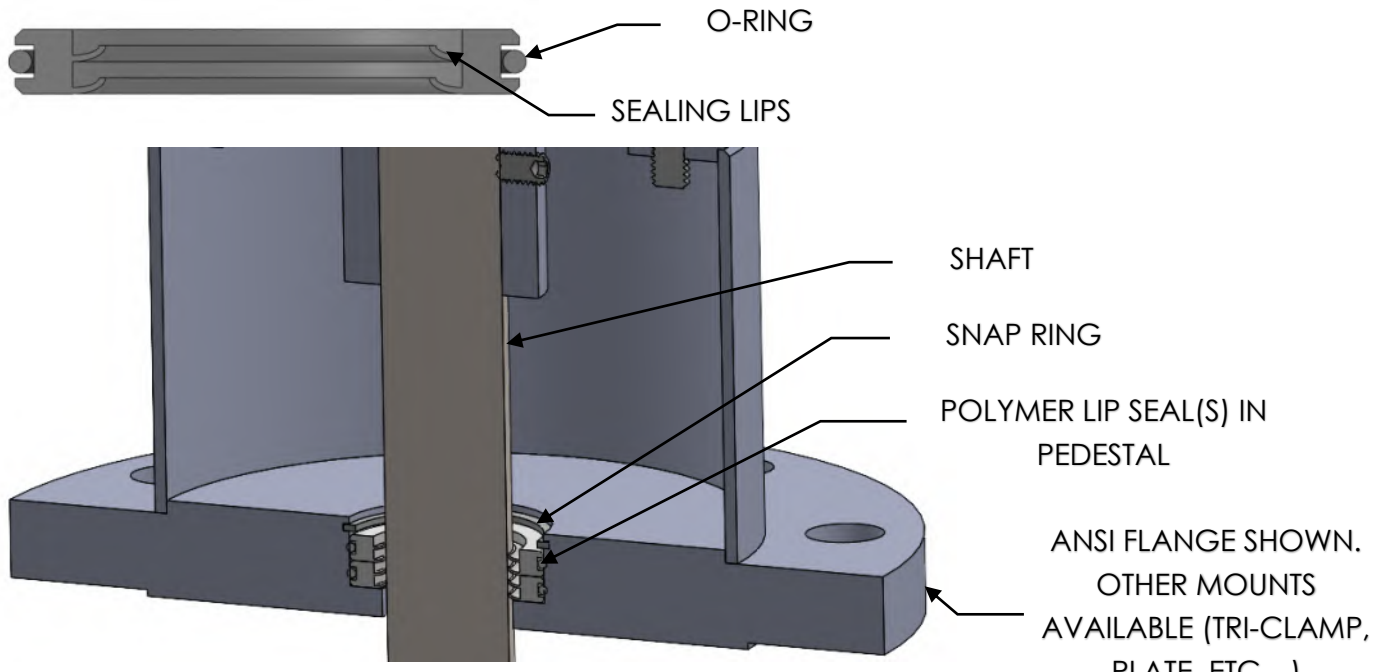
F) Use a shorter piece of wood and this pattern to drive the seal fully into the bore. Make sure to tap the seal into the bore following the pattern in the image.



G) Install the shaft following the instructions on Page 1.

Polymer Lip Seal with Outer O-ring Overview

A Polymer Lip Seal is a type of radial shaft seal which is assembled between rotating and stationary components. There are two main parts to the Polymer Lip Seal. One is an O-ring to create an interference fit between the seal and bore. The second is a sealing lip that seals around the rotating shaft. The Polymer Lip Seal is held in the bore with a retaining or snap ring.



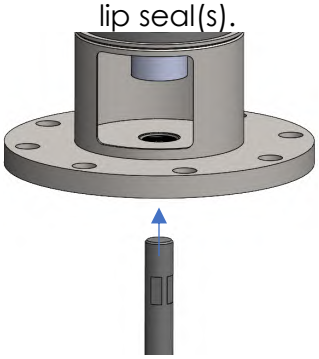
SECTION VIEW OF TYPICAL POLYMER LIP SEAL ASSEMBLY

CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

Shaft Installation

The lip seal(s) is installed in the mixer's pedestal base as shown above – same as page 1. Make sure the sealing lip(s) is lubricated using process compatible lubricant.

A) To install the shaft, slide the shaft up through the bottom of the pedestal and the lip seal(s).



CHECK FOR SHARP EDGES OR BURRS ON SHAFT BEFORE INSERTING THROUGH LIP SEAL. DEBURR AS NECESSARY TO PREVENT CUTTING OR TEARING LIP SEAL.

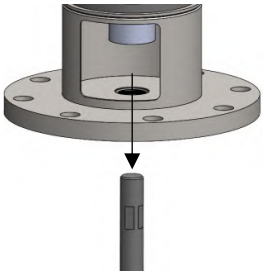
B) Attach the shaft to the mixer drive by following the appropriate manual section for your mixer.

CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

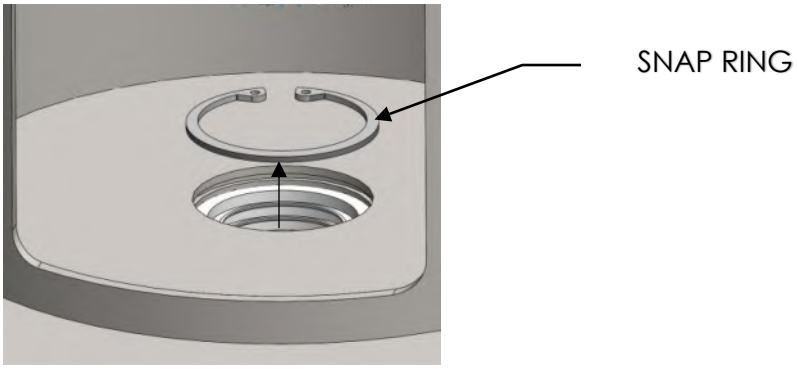
Polymer Lip Seal with Outer O-ring Replacement

This section covers the replacement of the lip seal(s).

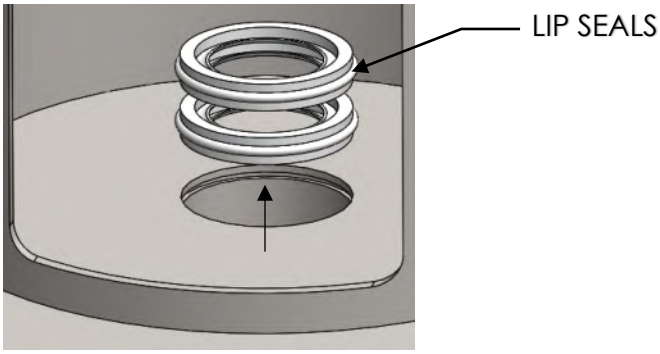
A) Detach the shaft from the mixer drive and remove it by pulling through the lip seal and pedestal bore.



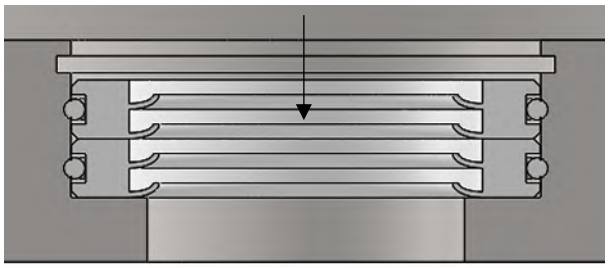
B) Using snap ring pliers, remove the snap ring from the groove in the pedestal. Keep for re-installation.



C) Remove the existing lip seal(s) from the pedestal bore.



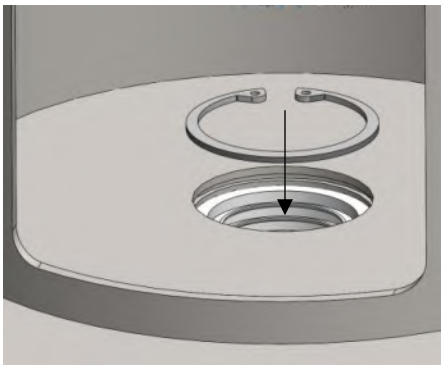
D) Press the new lip seal(s) into the pedestal bore. Note the orientation shown below, the lip should curve up.



TYPICALLY, THE LIP SEALS ARE INSTALLED WITH THE LIP CURVE UP.

NOT ALL LIP SEALS HAVE 2 LIPS.

E) Re-install the snap ring with snap ring pliers, making sure it's fully seated in the snap ring groove.



F) Install the shaft following the instructions on page 4. Attach the shaft to the mixer drive by following the appropriate manual section for your mixer.

Mechanical Seal Installation - BDRA

CAUTION: HEAVY COMPONENTS. HANDLE PROPERLY

Begin Seal Installation

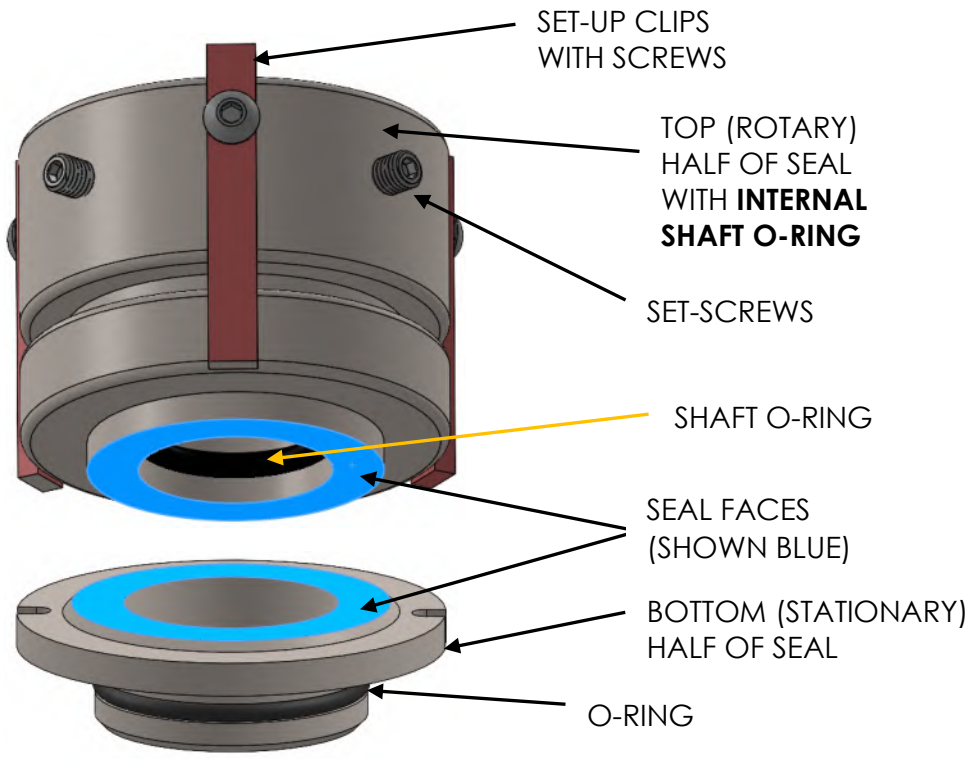
If your mixer is equipped with a BDRA mechanical seal, follow the Seal Manufacturer's Instructions for Seal Installation and Removal. The following steps are generic and assume use of a piloted seal. Here is the basic process:

Basic Seal Installation Process

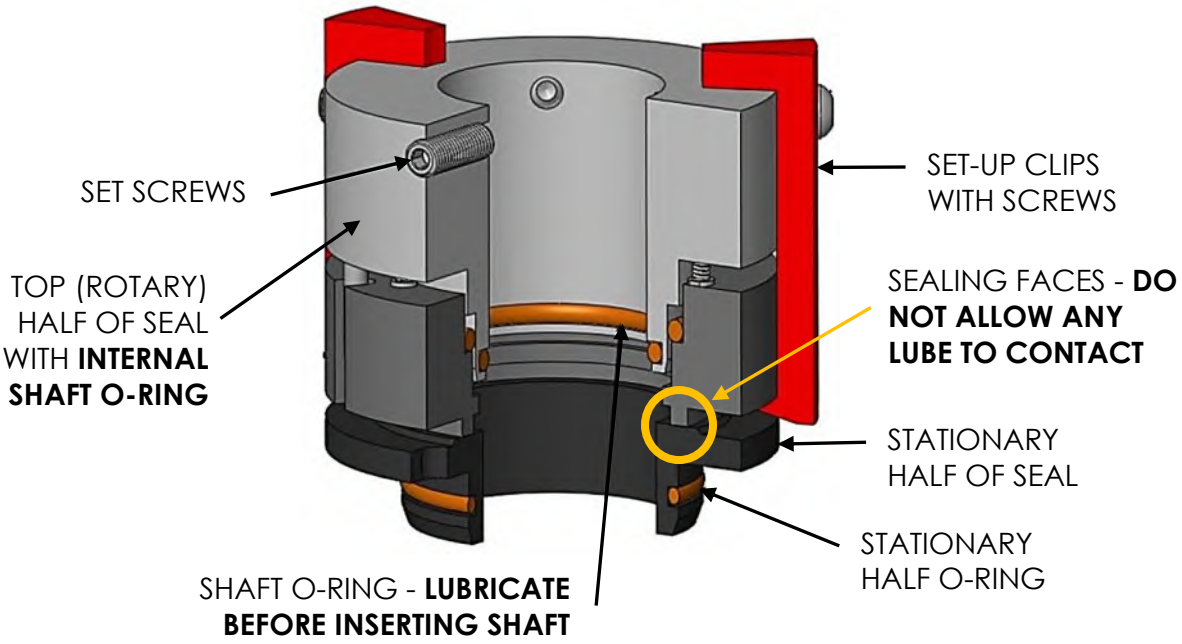
- ☐ Float the Seal
- ☐ Install the Shaft
- ☐ Mount the Seal
- ☐ Tighten Set Screws onto Shaft
- ☐ Remove Set-up Clips

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

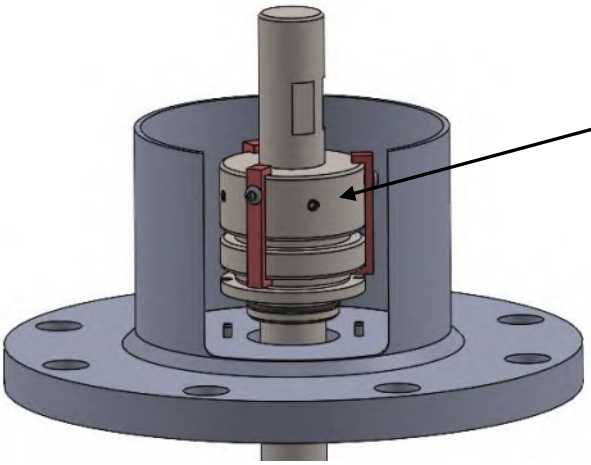
SHOWN BELOW IS THE PROCESS FOR INSTALLING A BDRA SEAL



BDRA SEAL SHOWN SEPARATED (as received)



CUTAWAY OF BDRA SEAL
(O-RINGS SHOWN ORANGE FOR VISIBILITY)



SECURE BOTH HALVES OF SEAL TOGETHER WITH TAPE OR PLASTIC WRAP. **ENSURE THAT THE TAPE OR WRAP DOES NOT COME IN CONTACT WITH THE SEAL FACES.** THEN INSERT SHAFT THROUGH SEAL AS SHOWN. (TOP OF PEDESTAL NOT SHOWN FOR CLARITY)

CHECK FOR SHARP EDGES OR BURRS ON SHAFT BEFORE INSERTING INTO SEAL. DEBURR AS NECESSARY TO PREVENT DAMAGE TO O-RINGS.

Float the Seal

Handle the seal with care to prevent damage to the fragile sealing faces of the seal. Back out the set screws on the rotary half of the seal so they are clear of the bore. Use of a process-compatible lubricant on the O-ring located within the bore of the seal will help the shaft pass through the O-ring. Apply process-compatible lubricant on the O-ring located in the bottom half of the seal. Do not apply or allow any grease to contact the carbon or silicon carbide mating faces of the seal. To Float the Seal, position the seal in the pedestal and orient with the mounting face toward the base of the

pedestal. Insert the shaft through the pedestal then into the mechanical seal bore. Slide the shaft through the bore of the seal.

Seal installation will resume after the shaft is properly installed.

Install drive end of shaft to mixer drive. See appropriate shaft installation section for your mixer model.

Complete Seal Installation

Now that the shaft is properly located and securely affixed, complete the mechanical seal installation. Be sure to follow the manufacturer's instructions. Here is the basic process.

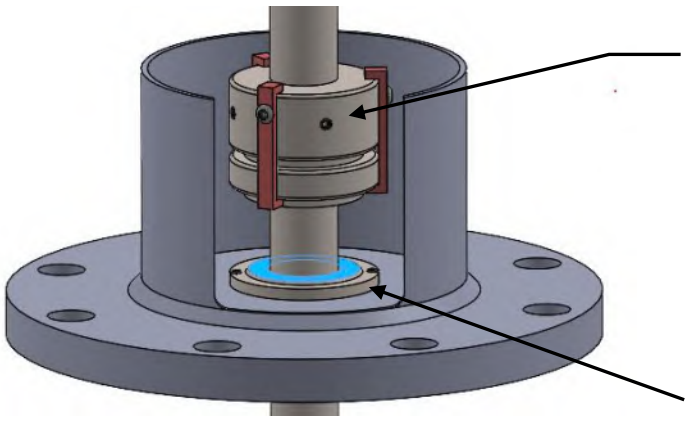
Basic Seal Installation Process

- ✓ Float the Seal *(Previously Completed)*
- ✓ Mount the Shaft *(Previously Completed)*
- ☐ Mount the Seal
- ☐ Tighten Set Screws onto Shaft
- ☐ Remove Set-up Clips

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Mount the Seal

Remove the tape or plastic wrap keeping the two seal halves together. Make sure O-ring in the bottom half of the seal is lubricated to help with installation. Use the roll pins installed in pedestal to mount the bottom half of the seal in the pedestal per Manufacturer's specifications. The piloted design ensures that the seal is already aligned with the mixer shaft. The installation clips that hold the seal together and set the spring tension should remain in place until the end of the installation process.



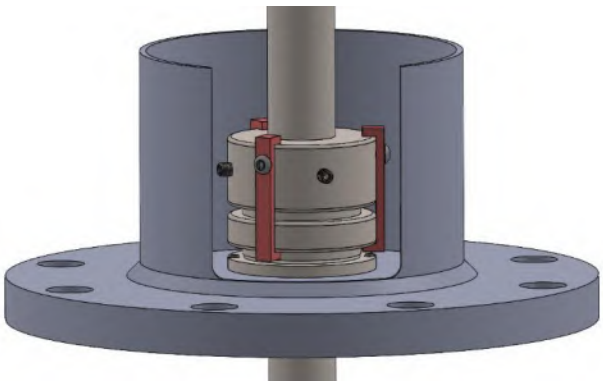
SEPARATE THE BOTTOM (STATIONARY) HALF OF SEAL AND INSERT INTO BORE OF PEDESTAL. MAKE SURE TO ALIGN SLOTS WITH PINS IN PEDESTAL AND PUSH ON FACE AROUND INNER BORE (SHOWN IN BLUE) WITH CLEAN GLOVES ON TO PROTECT SEAL FACE. ENSURE THAT STATIONARY FACE IS FULLY SEATED INTO BORE. WIPE OFF SEAL FACES WITH AN ISOPROPYL WIPE OR CLEAN LINT FREE CLOTH IF NEEDED.

BE SURE NOT TO PUT PRESSURE ON OUTSIDE FACE OF STATIONARY HALF OF SEAL DURING INSTALLATION AS THIS MAY CAUSE THE SEAL TO FRACTURE. MATERIAL IS VERY BRITTLE.

- ✓ Float the Seal *(Previously Completed)*
- ✓ Mount the Shaft *(Previously Completed)*
- ✓ Mount the Seal
- ☐ Tighten Set Screws onto Shaft
- ☐ Remove Set-up Clips

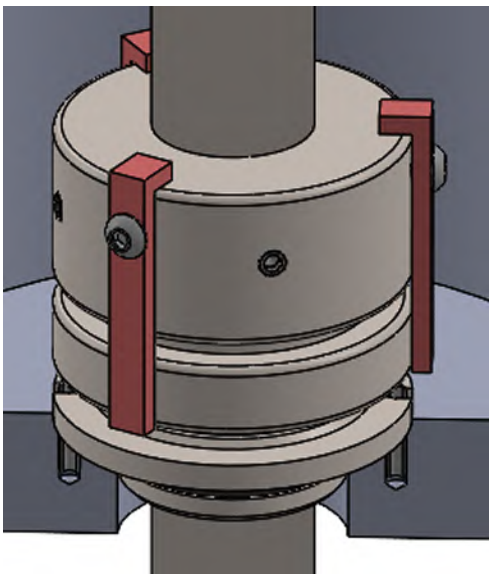
Move Rotary Seal Half to touch Stationary Seal Half

Push rotary seal half on shaft towards stationary half in pedestal until set-up clips touch the stationary half.



Tighten Set Screws onto Shaft

Use an alternating sequence to tighten and then torque the shaft set screws located on the rotating collar of the seal as required by the seal manufacturer. The goal is to keep the shaft centered within the seal bore, rather than pushed completely to one side. Start by loosely snugging the set screws in the prescribed pattern, then tighten the set screws a little more, and a little more, repeating the same pattern multiple times. Finally, torque the set screws to the appropriate value in table.

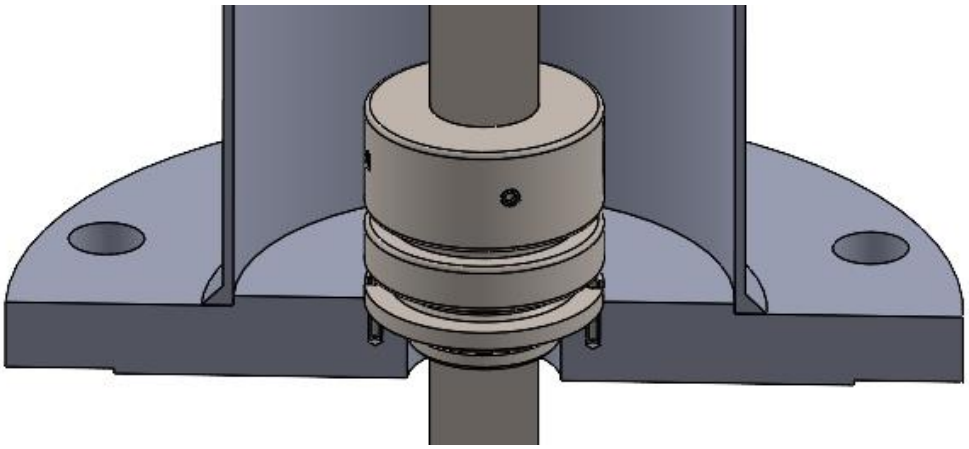


HEX SIZE	SET SCREW THREAD SIZE	18-8 STAINLESS
1/8"	¼"-28	72 in-lb
5/32"	5/16"-24	147 in-lb
3/16"	3/8"-24	**22 FT-LB**

- ✓ Float the Seal *(Previously Completed)*
- ✓ Mount the Shaft *(Previously Completed)*
- ✓ Mount the Seal
- ✓ Tighten Set Screws onto Shaft
- ☐ Remove Set-up Clips

Remove Set-up Clips

A common mistake is failure to **remove the set-up clips** at the end of the seal installation process. **Failure to perform this step will impact performance and cause damage to the seal. Remove set-up clips and be sure to save the seal's set-up clips.** They will be essential for future disassembly, shipment, rebuild, and reassembly of the mechanical seal.



Mechanical Seal Installation - SDRA & SDRG

CAUTION:

- **DISCONNECT AND LOCK OUT POWER SOURCE BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **HEAVY COMPONENTS. HANDLE PROPERLY.**
- **DO NOT ALLOW ROTARY OR STATIONARY SEALING FACES TO CONTACT ANY HARD SURFACES (SEE CROSS SECTION OF SEALING FACES IMAGE ON PAGE 2)**
- **STATIONARY SEALING FACE AND O-RINGS CAN FALL OUT OF GLAND RING. WHEN HANDLING, BE SURE THEY DON'T FALL OUT.**

Begin Seal Installation

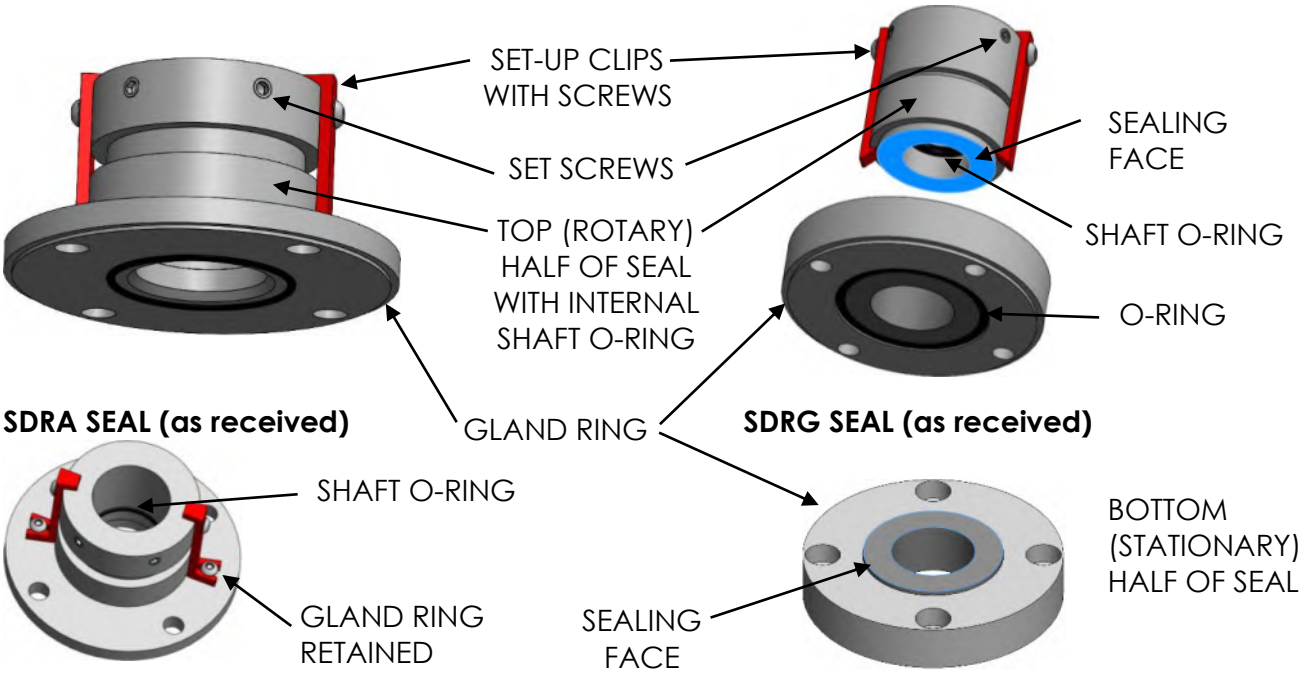
If your mixer is equipped with a SDRA or SDRG mechanical seal, follow the Seal Manufacturer's Instructions for Seal Installation and Removal. The following steps are generic and assume use of a piloted seal. Here is the basic process:

Basic Seal Installation Process

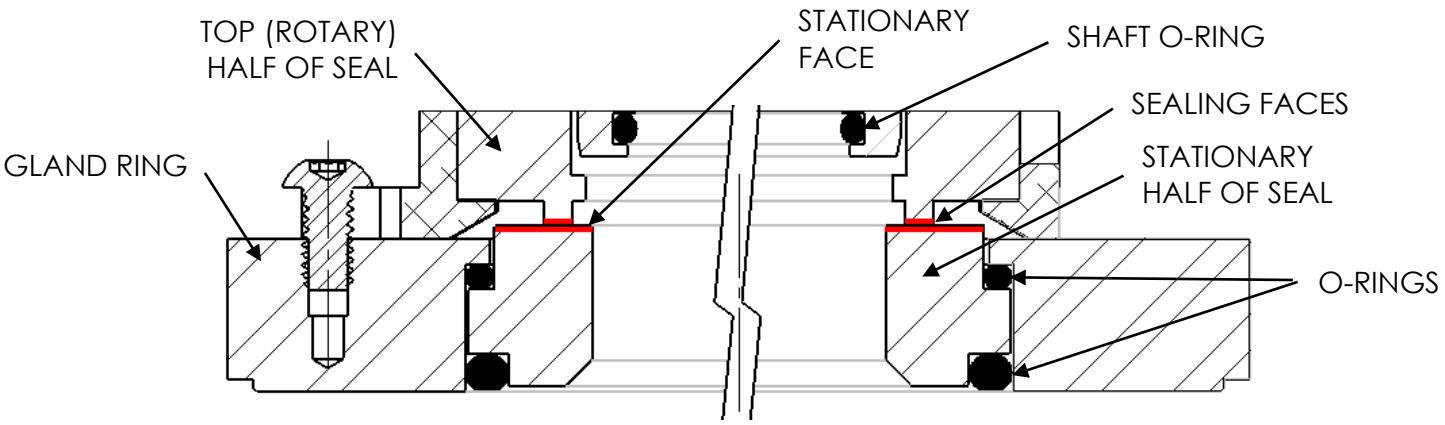
- Float the Seal
- Install the Shaft
- Mount the Seal
- Tighten Set Screws onto Shaft
- Remove Set-up Clips

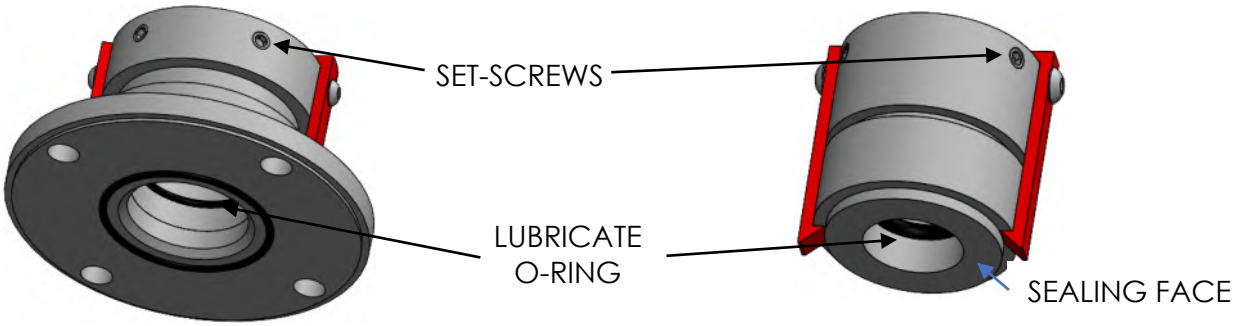
CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

SHOWN BELOW IS THE PROCESS FOR INSTALLING SDRA & SDRG SEALS



CROSS-SECTION OF SEALING FACES





Float the Seal - SDRA

Handle the seal with care to prevent damage to the fragile sealing faces of the seal. Ensure that the stationary face with O-rings does not fall out until the assembly is seated in pedestal.

- Back out the set screws on the rotary half of the seal so they are clear of the bore. Use a process-compatible lubricant on the O-ring located within the bore of the seal as it will help the shaft pass through the O-ring. **Do not apply or allow any grease to contact the mating/sealing faces of the seal**.

Float the Seal - SDRG

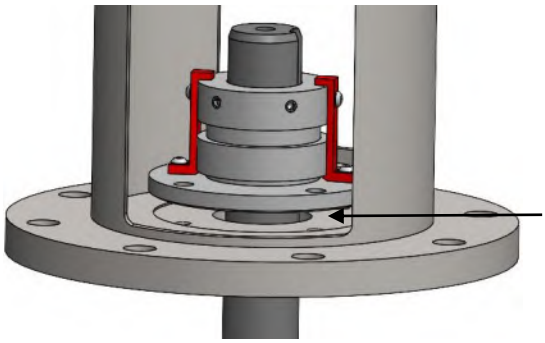
Handle the seal with care to prevent damage to the fragile sealing faces of the seal. Ensure that the stationary face with O-rings does not fall out until the assembly is seated in pedestal.

- Back out the set screws on the rotary half of the seal so they are clear of the bore. Use a process-compatible lubricant on the O-ring located within the bore of the seal as it will help the shaft pass through the O-ring. **Do not apply or allow any grease to contact the mating/sealing faces of the seal**.

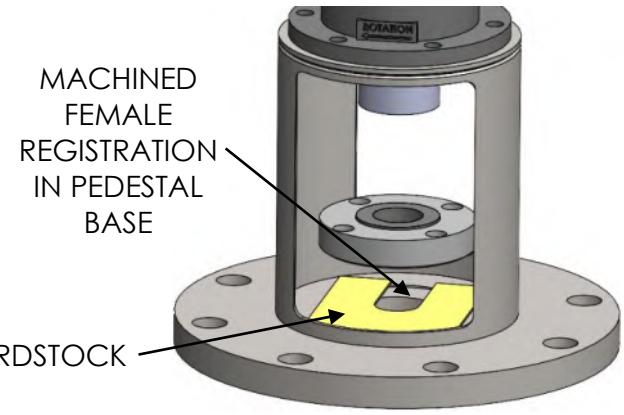
- To Float the Seal, position the seal in the pedestal and orient with the mounting face toward the base of the pedestal. Insert the shaft through the pedestal then into the mechanical seal bore. Slide the shaft through the bore of the seal.

- **FOR SDRG ONLY -** Place a u-shaped piece of cardstock (see last page of this manual section for template) between the stationary half of the seal and the pedestal bore. This prevents the stationary half from sitting in the pedestal female registration.

SDRA SEAL

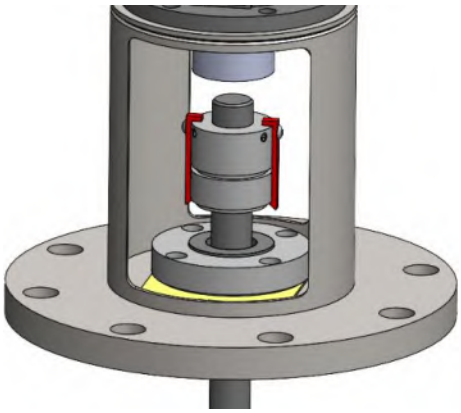


SDRG SEAL



CHECK FOR SHARP EDGES OR BURRS ON SHAFT BEFORE INSERTING INTO SEAL. DEBURR AS NECESSARY TO PREVENT DAMAGE TO O-RINGS.

Insert the shaft through the bottom of the pedestal, the stationary half of the seal, and the rotary half of the seal. Now the rotary half of the seal is "floated" on the shaft.



Seal installation will resume after the shaft is properly installed.

Install drive end of shaft to mixer drive. See appropriate shaft installation section for your mixer model.

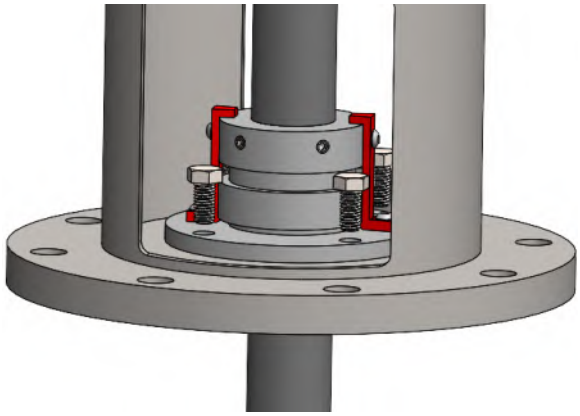
Complete Seal Installation

Now that the shaft is properly located and securely affixed, complete the mechanical seal installation. Be sure to follow the manufacturer's instructions. Here is the basic process.

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

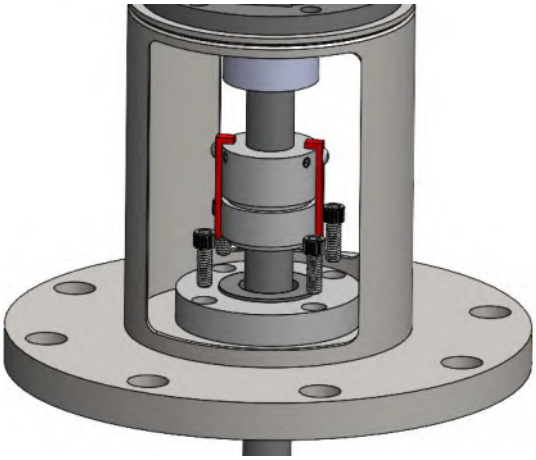
Mount the Seal - SDRA

Slide the seal into the pedestal female registration, aligning the bolt holes in the seal to the holes in the pedestal. Insert and tighten the 4 provided bolts evenly to the appropriate torque value for thread size called out in the table. The installation clips that hold the seal together and set the spring tension should remain in place until the end of the installation process.



Mount the Seal - SDRG

Remove the cardstock and place the stationary half into the pedestal bore, aligning the holes in the seal to the holes in the pedestal. Insert and tighten the 4 provided bolts evenly to the appropriate torque value for thread size called out in the table.

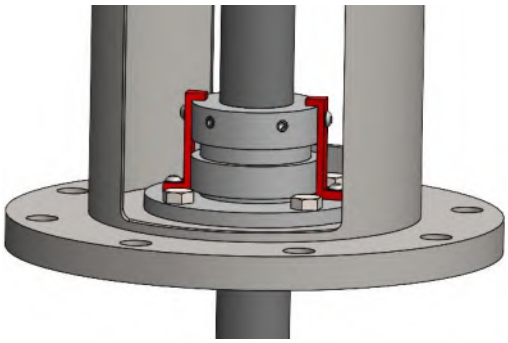


THREAD SIZE	18-8 STAINLESS
5/16"-18	103 in-lb
3/8"-16	**16 ft-lb**
1/2"-13	**36 ft-lb**

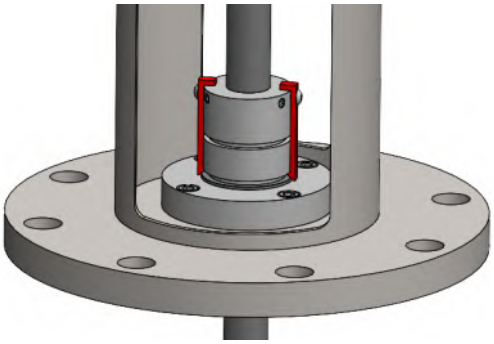
Tighten Set Screws onto Shaft

Use an alternating sequence to tighten and then torque the shaft set screws located on the rotating collar of the seal as required by the seal manufacturer. The goal is to keep the shaft centered within the seal bore, rather than pushed completely to one side. Start by loosely snugging the set screws in the prescribed pattern, then tighten the set screws a little more, and a little more, repeating the same pattern multiple times. Finally, torque the set screws to the appropriate value in table.

HEX SIZE	SET SCREW THREAD SIZE	18-8 STAINLESS
1/8"	1/4"-28	72 in-lb
5/32"	5/16"-24	147 in-lb
3/16"	3/8"-24	**22 ft-lb**



SDRA SEAL



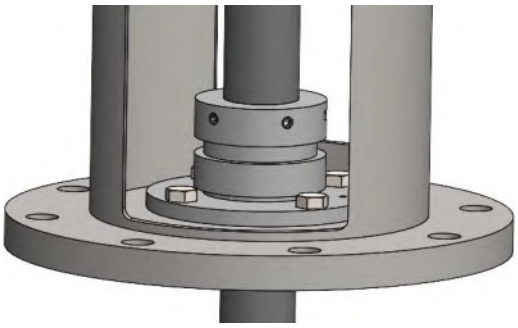
SDRG SEAL

Remove Set-up Clips

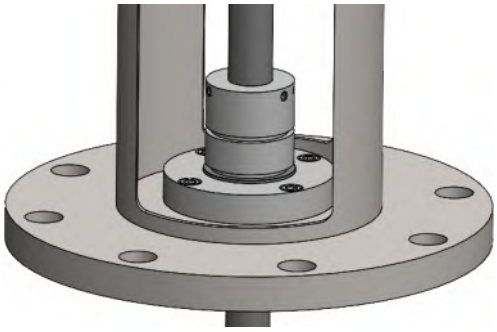
A common mistake is **failure to remove the set-up clips** at the end of the seal installation process.

Failure to remove set-up clips before operating mixer can permanently damage seal and equipment.

Remove the set-up clips and be sure to save the seal's set-up clips. They will be essential for future disassembly, shipment, rebuild, and reassembly of the mechanical seal.

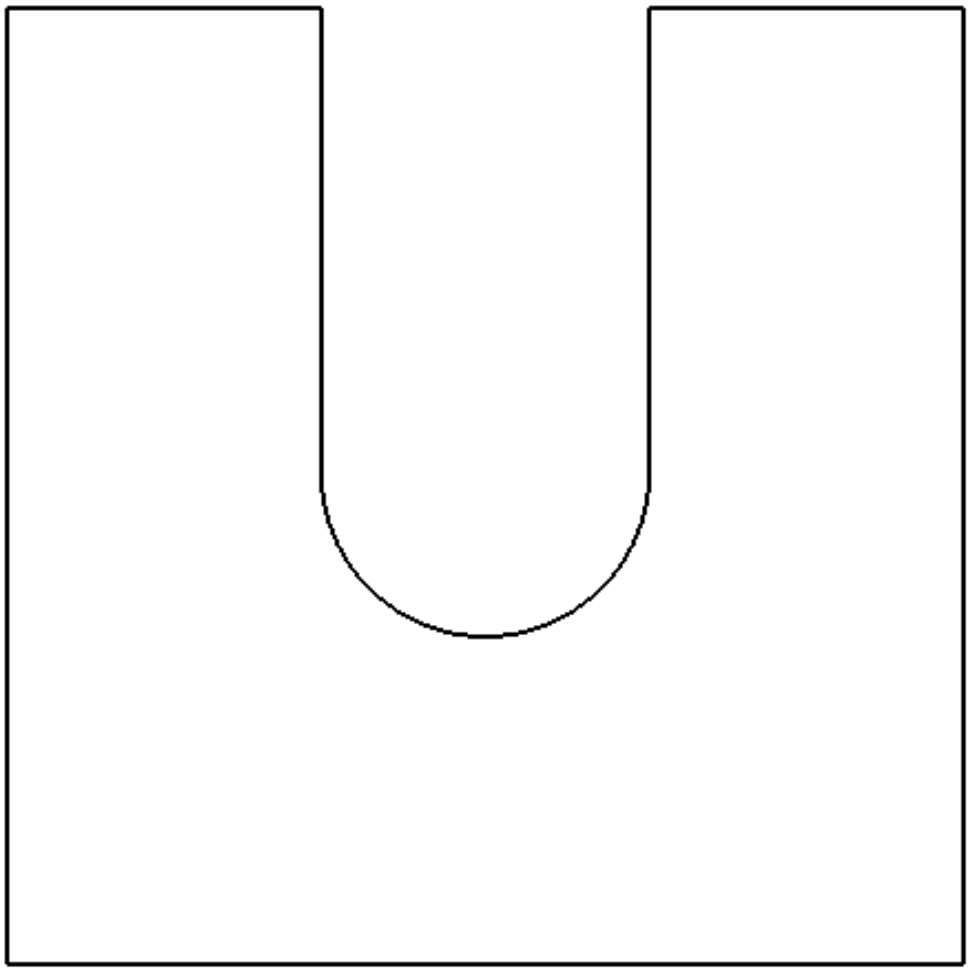


SDRA SEAL



SDRG SEAL

USE THIS TEMPLATE TO CUT OUT THE U-SHAPED CARDSTOCK. DO NOT CUT THIS PIECE OF PAPER. MAY NEED TO TRIM TO FIT INTO PEDESTAL.



Mechanical Seal Installation - DDRA

CAUTION:

- **DISCONNECT AND LOCK OUT POWER SOURCE BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **HEAVY COMPONENTS. HANDLE PROPERLY.**
- **DO NOT ALLOW ROTARY OR STATIONARY SEALING FACES TO CONTACT ANY HARD SURFACES.**
- **STATIONARY SEALING FACE AND O-RINGS CAN FALL OUT OF GLAND RING. WHEN HANDLING, BE SURE THEY DON'T FALL OUT.**

Begin the Seal Installation

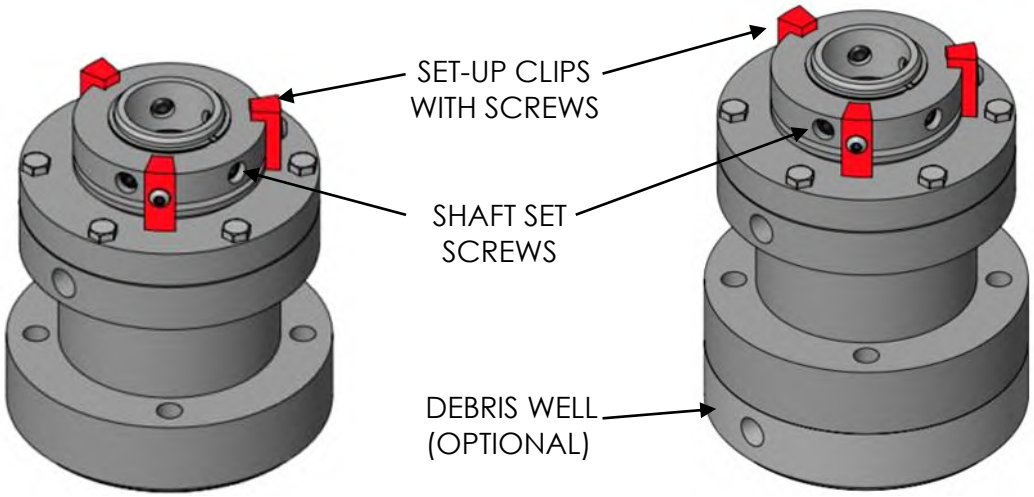
If your mixer is equipped with a DDRA mechanical seal, follow the Seal Manufacturer's Instructions for Seal Installation and Removal. The following steps are generic and assume use of a piloted seal. Here is the basic process:

Basic Seal Installation Process

- Float the Seal
- Install the Shaft
- Mount the Seal
- Tighten Set Screws onto Shaft
- Remove Set-up Clips

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

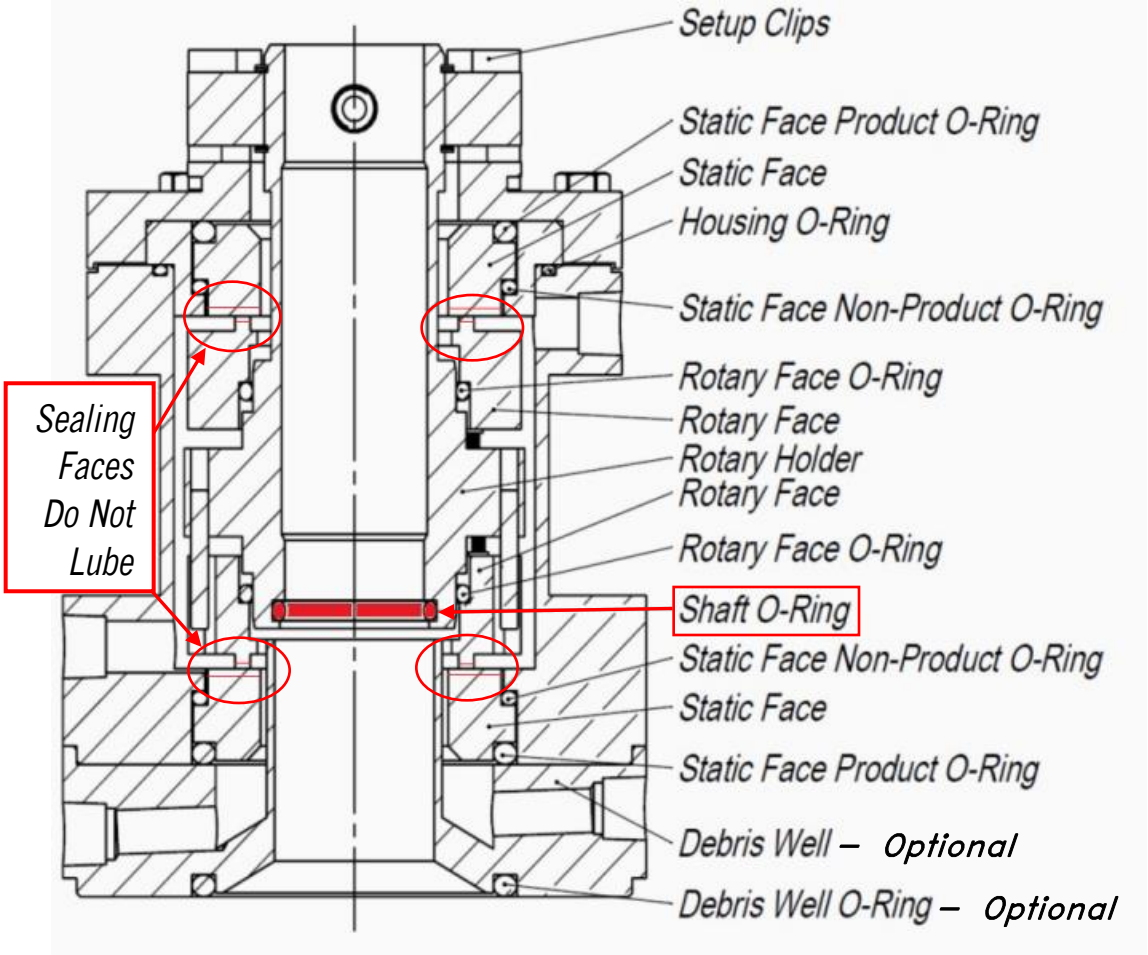
SHOWN BELOW IS THE PROCESS FOR INSTALLING DDRA SEAL



DDRA SEAL (as received)

DDRA SEAL WITH DEBRIS WELL (as received)

CROSS-SECTION OF DDRA SEAL WITH DEBRIS WELL



Float the Seal - DDRA

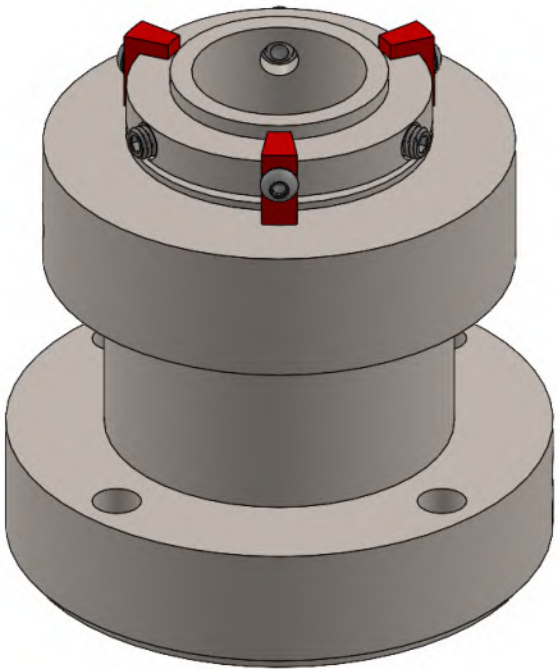
Handle the seal with care to prevent damage to the fragile sealing faces of the seal. The seal excluding the lower stationary (static) face is supplied as a cartridge assembly. The set-up clips set correct spring tension on sealing faces & for optimal seal performance. Ensure that the stationary face with O-rings does not fall out until the assembly is seated in pedestal.

Float the Seal – DDRA with Debris Well

Handle the seal with care to prevent damage to the fragile sealing faces of the seal. The seal is supplied as a cartridge assembly. The set-up clips set correct spring tension on sealing faces & for optimal seal performance. Ensure that the Debris Well O-ring does not fall out until the assembly is seated in pedestal.

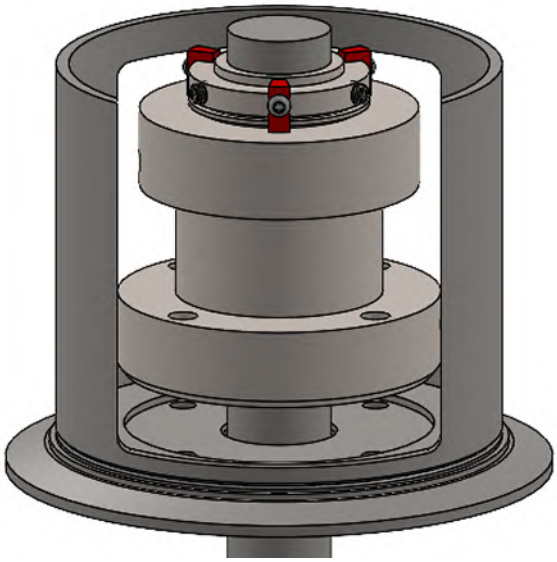
Mechanical Seal Installation - DDRA

- Back out the set screws on the rotary half of the seal so they are clear of the bore. Use a process-compatible lubricant on the Shaft O-ring located within the bore of the seal as it will help the shaft pass through the O-ring. **Do not apply or allow any grease to contact the mating/sealing faces of the seal (see cross section on previous page).**



- To Float the Seal, position the seal in the pedestal and orient with the mounting face toward the base of the pedestal. Insert the shaft through the pedestal then into the mechanical seal bore. Slide the shaft through the bore of the seal. (Top of pedestal removed for clarity)

CHECK FOR SHARP EDGES OR BURRS ON SHAFT BEFORE INSERTING INTO SEAL. DEBURR AS NECESSARY TO PREVENT DAMAGE TO O-RINGS.



Seal installation will resume after the shaft is properly installed.

Install drive end of shaft to mixer drive. See appropriate shaft installation section for your mixer model.

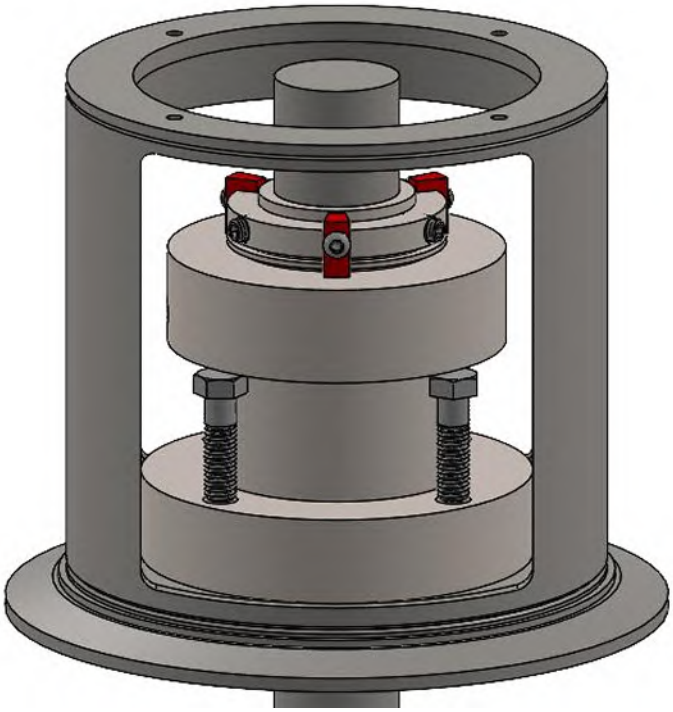
Complete the Seal Installation

Now that the shaft is properly located and securely affixed, complete the mechanical seal installation. Be sure to follow the manufacturer's instructions. Here is the basic process.

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Mount the Seal

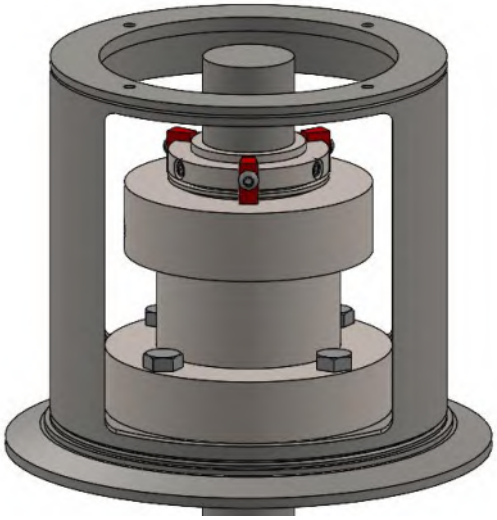
Slide the seal into the pedestal female registration, aligning the bolt holes in the seal to the holes in the pedestal. Insert and tighten the 4 provided bolts evenly to the appropriate torque value for thread size called out in the table. The installation clips that hold the seal together and set the spring tension should remain in place until the end of the installation process.



THREAD SIZE	18-8 STAINLESS
5/16"-18	103 in-lb
3/8"-16	**16 FT-LB**
1/2"-13	**36 FT-LB**

Tighten Set Screws onto Shaft

Use an alternating sequence to tighten and then torque the shaft set screws located on the rotating collar of the seal as required by the seal manufacturer. The goal is to keep the shaft centered within the seal bore, rather than pushed completely to one side. Start by loosely snugging the set screws in the prescribed pattern, then tighten the set screws a little more, and a little more, repeating the same pattern multiple times. Finally, torque the set screws to the appropriate value in table.



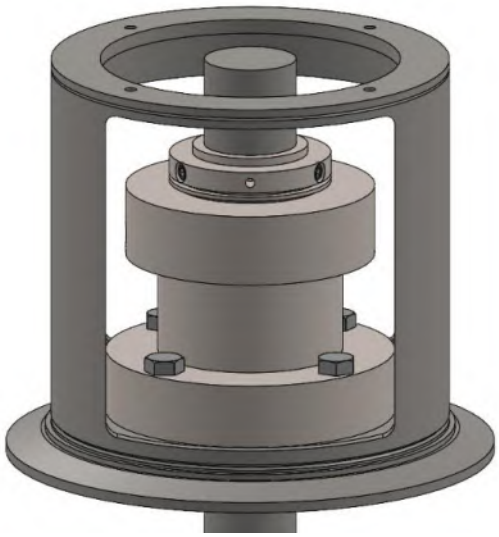
HEX SIZE	SET SCREW THREAD SIZE	18-8 STAINLESS
1/8"	1/4"-28	72 in-lb
5/32"	5/16"-24	147 in-lb
3/16"	3/8"-24	**22 FT-LB**

Remove Set-up Clips

A common mistake is **failure to remove the set-up clips** at the end of the seal installation process.

Failure to remove set-up clips before operating mixer can permanently damage seal and equipment.

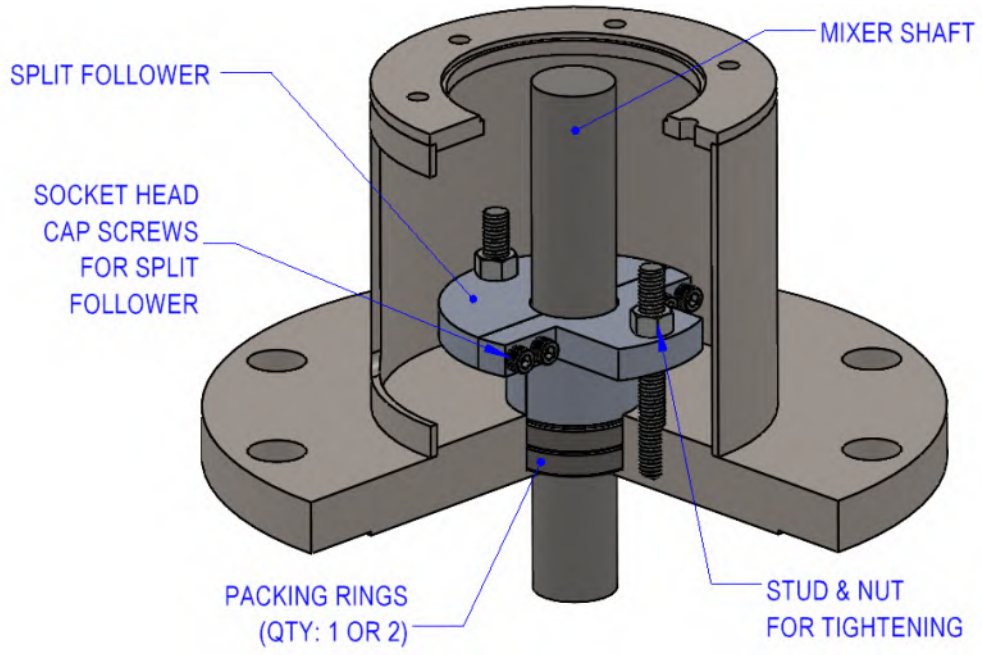
Remove the set-up clips and be sure to save them. They will be essential for future disassembly, shipment, rebuild, and reassembly of the mechanical seal.



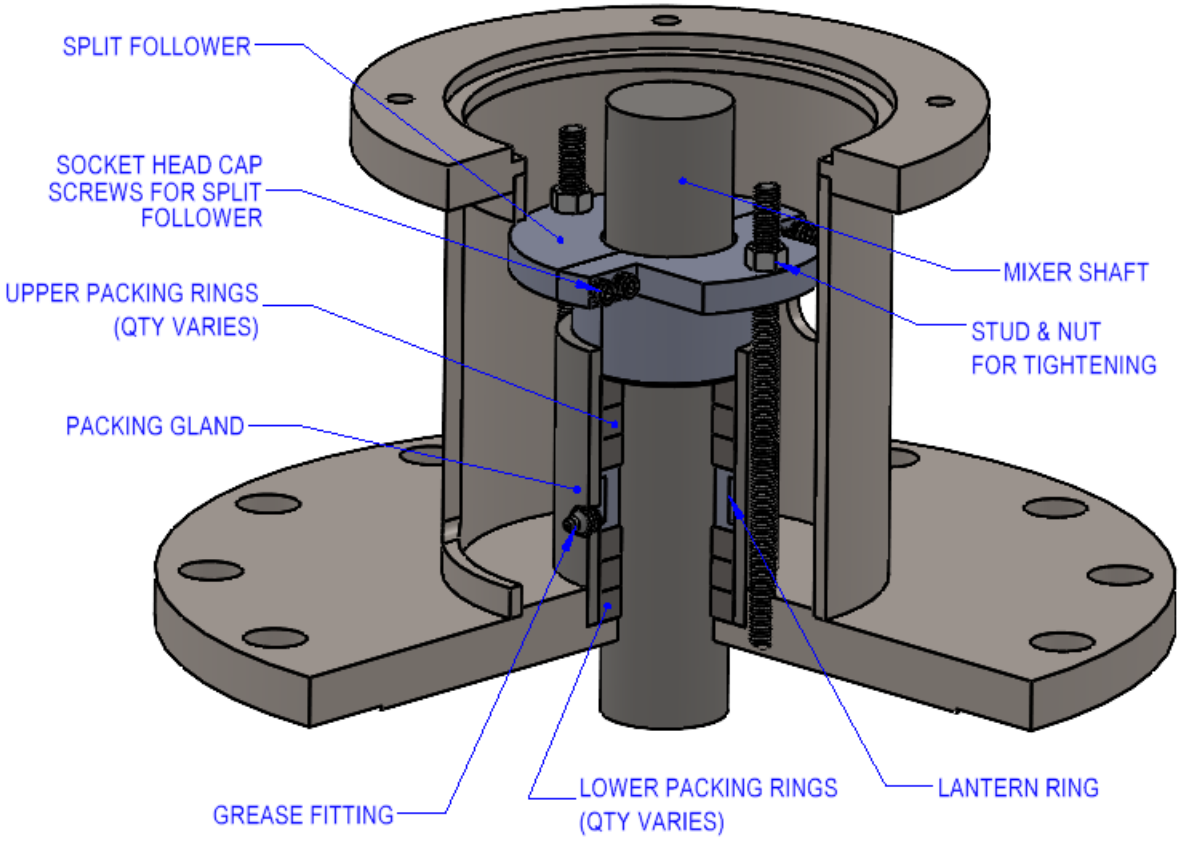
The basic elements of a stuffing box are shown in Figures – 1, 2 & 3. **A stuffing box is a controlled leakage device**. Tolerable leak rates will provide lubrication for most non-abrasive product applications. Your Fusion mixer may contain as few as one or two packing rings (Low Pressure Stuffing Box) or multiple packing rings (typically 5-7) with a lantern ring (High Pressure Stuffing Box). Consult your Fusion Approval Drawing or contact your Fusion Representative for your exact configuration. The stuffing box on your Fusion mixer will be fully assembled at the time of delivery and the gland nuts will need to be adjusted before your tank is filled.

Due to the design of a stuffing box seal, the packing rings involve contact with the rotating shaft. This friction will cause heat and wear. The process of adjusting stuffing box seals is important and tightening of the packing must done gradually to ensure the packing rings deform uniformly and fit close around the shaft. Over-tightening can cause excessive heat buildup, wear on the shaft and may cause an excessive load on the drive motor. Do not over-tighten gland nuts so there is no leakage as this will result in permanent scoring of the shaft. Periodically check leak rate and adjust with least force possible.

Low Pressure Stuffing Box – Figure 1



High Pressure Stuffing Box – Figure 2

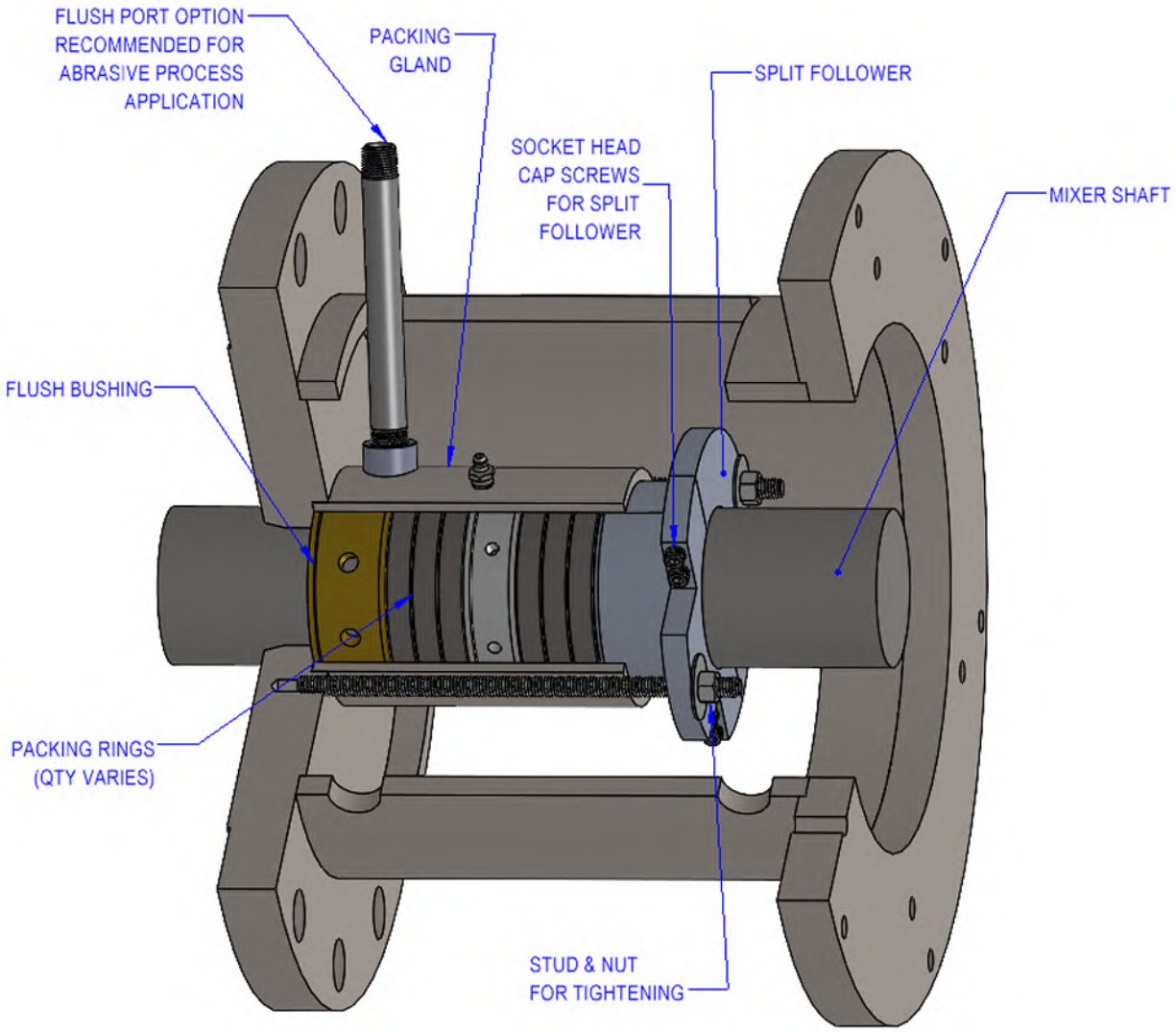


Installation – Top

If your mixer is mounted on the top of your tank (above liquid level), then most leakage will be vapor. Tighten nuts on the split follower down on packing to the point where there is resistance. **DO NOT OVER-TIGHTEN AS THIS WILL CAUSE DAMAGE TO THE SHAFT AND MAY CAUSE EXCESSIVE LOAD ON THE MOTOR.**

The high-pressure stuffing box will need to use process compatible grease for lubrication before starting your mixer. The high-pressure stuffing box will need to be lubricated periodically to insure proper lubrication. In a low-pressure stuffing box, the packing is lubricated during assembly at the factory. Stuffing box packing may need to be replaced to ensure proper lubrication. If tightening the split follower does not reduce the leak rate, the packing will need to be replaced.

High Pressure Stuffing Box / Side Entry with Flush Port – Figure 3



Installation – Side & Bottom

If your mixer is mounted on the side or bottom of your tank (below liquid level), then the leakage will be your product. Figure 2 shows the basic configuration of a high-pressure stuffing box that can & will be used in a side or bottom application. Depending on the tank contents the liquid can provide lubrication or abrasion. For abrasive contents, a secondary lubricating and process compatible liquid may need to be piped into a flush port as shown in Figure 3.

Allow Stuffing box to leak freely at start up – Side & Bottom

Excessive leakage during the first hour of start-up will greatly increase the life of the packing material in your stuffing box. After the first hour take up gradually on the gland by tightening the nuts on the threaded rods until leakage is reduced to a tolerable level. Below is table showing the shaft diameter to tolerable leakage rates:

SHAFT DIA - INCHES	0.75	1	1.25	1.5	1.75	2	2.5	3	3.5	4	4.5	5	6	6.5	7
LEAK RATE - DROPS PER MINUTE ± 1	7	9	11	14	16	18	23	27	32	36	41	45	54	59	63
PACKING SIZE - IN SQUARE	5/16	5/16	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	3/4

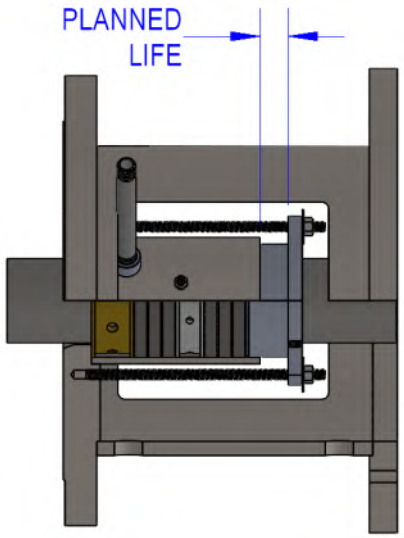
Typical packing materials:

- Graphite-Filled PTFE – Not Food Grade
- Mineral Oil-Lubricated PTFE – FDA Compliant Food Grade

Do not over-tighten gland nuts so there is no leakage as this will result in permanent scoring of the shaft. Periodically check leak rate and adjust with least force possible.

Maintenance

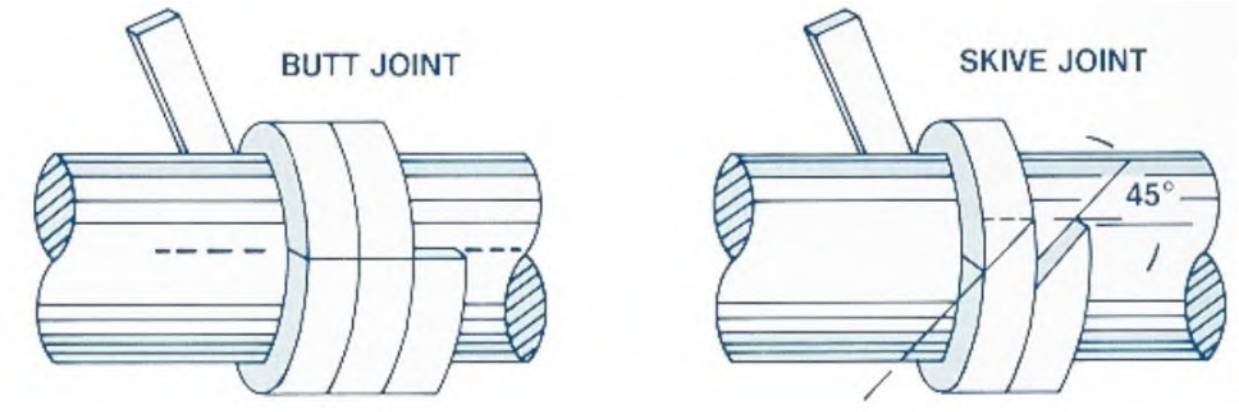
Maintenance on you stuffing box consists of routine lubrication and replacement of the packing material. If leakage cannot be controlled by tightening on the gland nut, it is time to replace the packing rings. Also, life of packing rings is done when there is no space between the split follower and the packing gland (Planned Life – see image below). **DO NOT ADD MORE PACKING RINGS TO TRY TO RESOLVE LEAKAGE – ALL OF THE PACKING RINGS MUST BE REPLACED.**



CAUTION: DISCONNECT POWER SOURCE & LOCK OUT/TAG OUT YOUR MIXER BEFORE SERVICING. PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

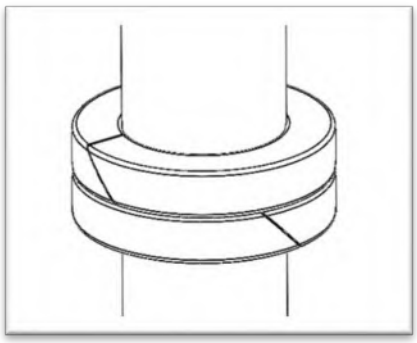
Packing Replacement Procedure

1) Maintenance should only be performed by qualified personnel.
2) Before performing any maintenance, always disconnect power to your mixer. Follow proper Lock Out-Tag Out (LOTO) procedures before proceeding.
3) Secure shaft & apply shaft shut-off (if equipped) before disassembly.
4) Remove gland nuts and washers.
5) Slide split follower toward mixer drive for access to the packing rings. Remove socket head cap screws to separate split follower for better access to packing material inside packing gland.
6) **Remove all old packing from packing gland. Keep track of the location & quantity of rings removed to know how many to replace.** Clean gland and shaft thoroughly.
7) **Examine shaft for wear and scoring. If your stuffing box has a lantern ring make sure there is no damage. Contact your Fusion Representative for a replacement shaft or lantern ring if needed.**
8) Make sure to use the correct packing ring stock (size and material) for your application.
9) If you are using coil packing material, always cut the packing into separate rings. **Never wind a coil of packing into a stuffing box.**
10) Rings can be cut with butt (square) or skive (diagonal) joints, depending on the method used for cutting (see image below). The best way to cut the packing rings is to cut them on a mandrel the same diameter as the mixer shaft.

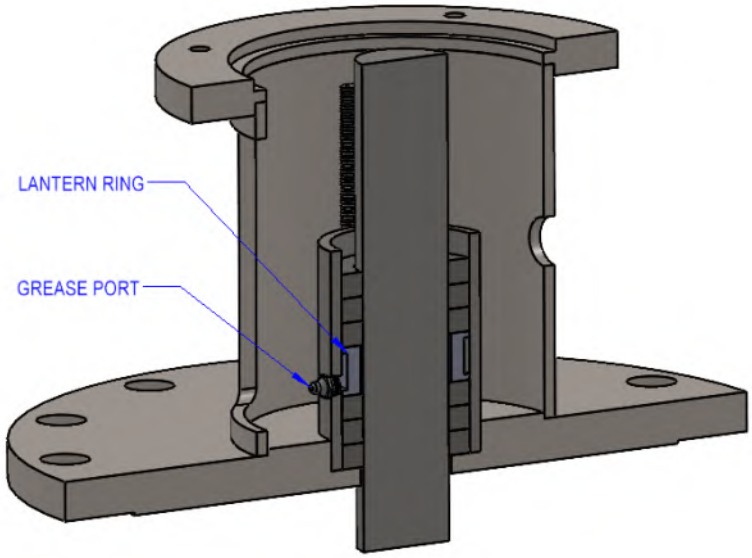


11) Once one ring is cut, make certain it fits the packing space properly. Each additional ring can then be cut in the same manner.

12) Install one ring at a time making sure that it is clean and has not picked up any dirt during handling. Apply required compatible lubrication. Seat rings firmly with a tamping tool if needed. We recommend that joints of successive rings should be staggered and kept 90 degrees apart as shown below.



13) Be sure to install the same amount of packing rings that were removed in the previous step before lantern ring is installed. Make sure the lantern ring is installed slightly above grease port (see image below) so that it will move under the inlet as pressure is applied to the split packing gland.



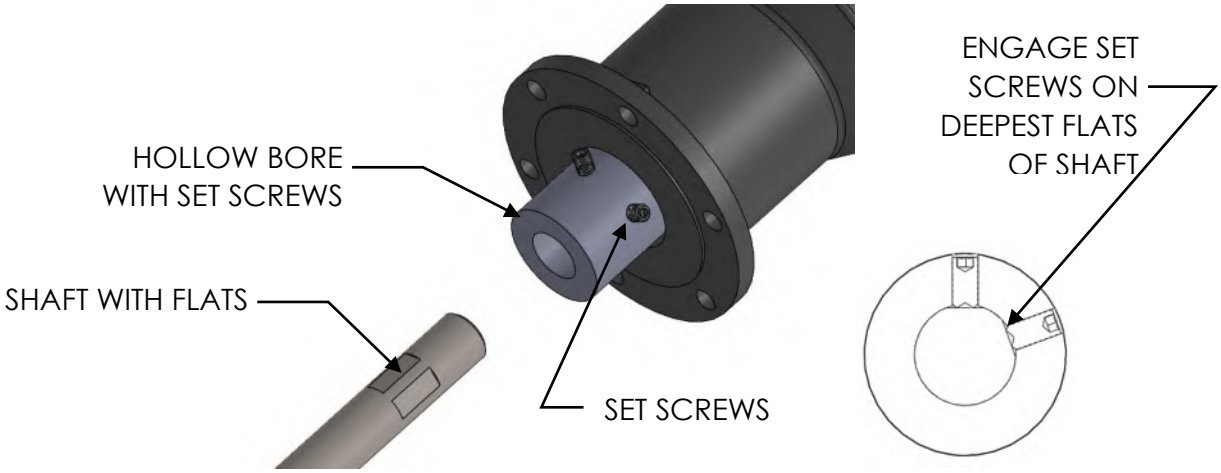
14) Once all the packing rings & lantern ring (if equipped) are installed, replace split follower (if removed) and move follower over threaded studs. Install washers (if present) and nuts on threaded rods, then finger tighten just until resistance is felt.
15) Apply lubrication to packing through grease port until seen coming out the end(s) of the gland.
16) Start your mixer. Once again, allow stuffing box to leak freely as described on page 4 for side & bottom applications. **Gradually tighten nuts on follower until leakage is reduced to an acceptable level (see table on page 4).**

SHAFT INSTALLATION – HOLLOW ARBOR

Shaft Installation - Hollow Arbor with Set Screws

The following section provides instruction on the installation of a shaft with flats into a hollow bore in the bearing housing.

Exploded View of Assembly



CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Check bore and end of shaft for burrs before installing shaft into hollow bore. Remove burrs with fine abrasives such as a medium Scotch-Brite or 120 grit sand paper.

To avoid binding in the future and ease of installation, apply process-compatible grease or anti-seize compound on the drive end portion of the mixer shaft.

Back out set screws so they are clear of the bore. Guide the shaft in the hollow bore of the bearing housing. Align the shaft flats with the hollow bore's set screw locations. Be sure to slide the shaft into the bore slowly and gently. The tolerances are very tight to keep concentricity and limit vibration. **If the shaft is forced, it will gall and the mixer will be damaged. This damage is not covered under warranty.** Light tapping from a plastic mallet may be required for large diameter shafts to slide the shaft into the hollow bore. The shaft will bottom out in the hollow bore.

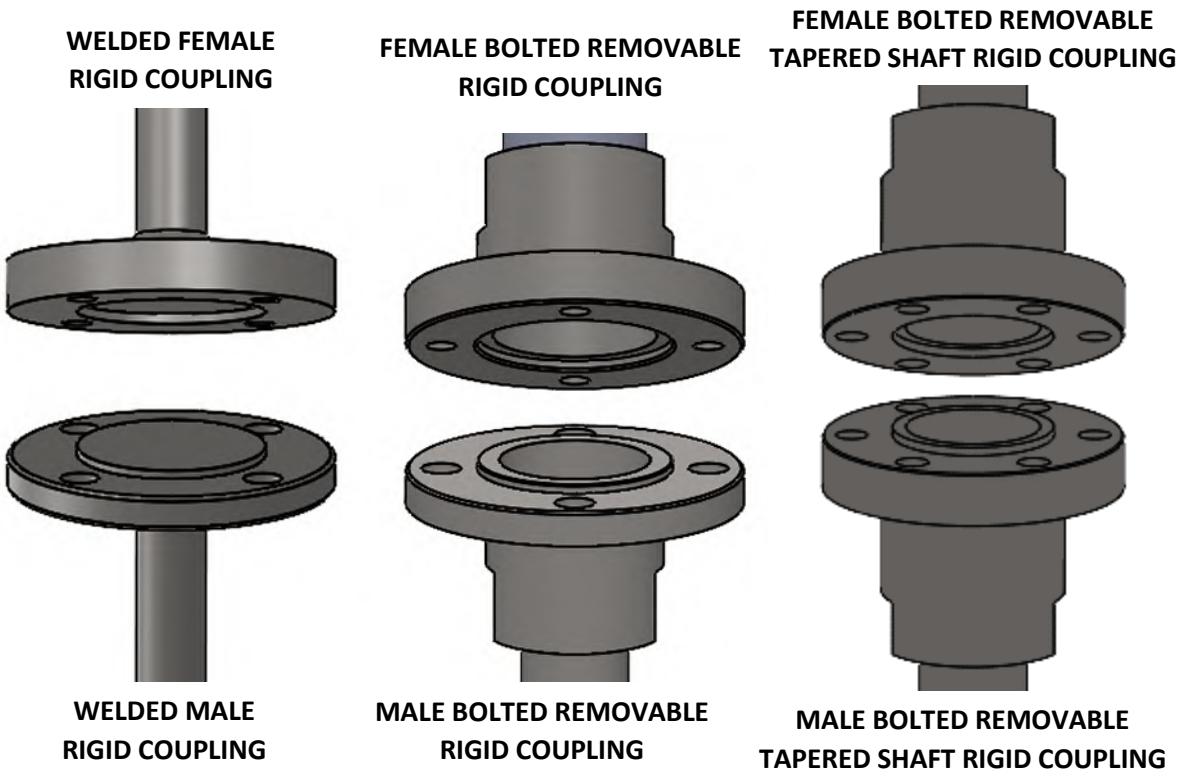
Rotate the shaft within the hollow arbor while snugging the first set screw to locate the deepest part of the flat. **SET SCREWS MUST GO ONTO FLATS TO AVOID GALLING.** Snug the second set screw securely to the shaft. Remove the first set screw and apply service removeable thread-locking compound (Blue 242 Loctite or similar) to the threads. Reinstall first set screw onto shaft flats, tighten and torque as required **(see Torque Chart on page 2 of Installation Section).** Remove the second set screw and apply thread-locking compound to the threads. Reinstall second set screw onto shaft flats, tighten and torque as required. **NOTE: SOME THREAD-LOCKING COMPOUNDS ACT AS A LUBRICANT, REQUIRING TORQUE SETTINGS TO BE ADJUSTED. FOLLOW MANUFACTURER'S INSTRUCTIONS FOR THIS ADJUSTMENT.**

Shaft Rigid Coupling Installation

Overview

Depending on your mixer configuration, there are several types of rigid couplings which can be used. If you have a bolted removable coupling it must be assembled before the coupling halves can be connected. Rigid couplings are typically a match set with one having a male registration and one having a female registration to maintain alignment during assembly. Below are images of typical rigid coupling types.

Bolted Removable and Welded Shaft Rigid Coupling Types



CAUTION: FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE MIXER. CHECK MOUNTING FACES FOR BURRS OR ANY OTHER PROTRUSION THAT MAY CAUSE PROBLEMS WITH ASSEMBLY. REMOVE BURRS AS NEEDED TO COMPLETE ASSEMBLY. MAKE SURE MIXER SHAFT SHOULDER IS TIGHT TO BOTTOM OF BOLTED REMOVABLE RIGID COUPLING. ALSO, MAKE SURE TO USE A THICK WASHER TO AVOID DEFORMING WASHER AS IT IS PULLED TIGHT.

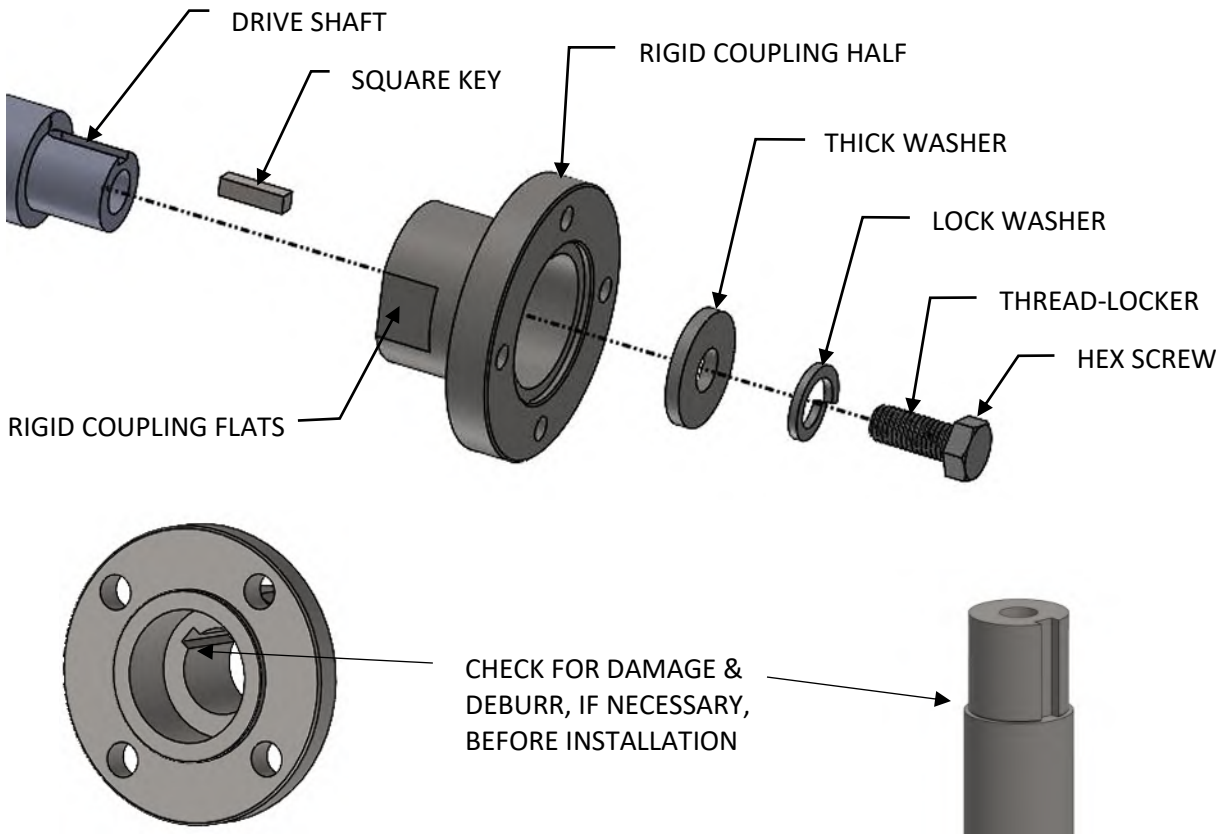
Installation – Bolted Removable Rigid Coupling

The following section is for the installation of a Bolted Removable Rigid Coupling which may be above or below mount.

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.

FOR PRO & PRO XL MODELS THE UPPER HALF OF BOLTED RIGID COUPLING WILL BE RECEIVED ASSEMBLED TO SHAFT OUTPUT OF BEARING HOUSING. PLEASE CONFIRM THAT THE HEX SCREW IS TIGHTENED TO TORQUE CHART ON PAGE 2 IN INSTALLATION SECTION. USE A WRENCH ON THE COUPLING FLATS TO PREVENT FROM ROTATING AND TIGHTEN HEX SCREW TO TORQUE SPECIFICATION.

EXPLODED VIEW OF BOLTED REMOVABLE COUPLING ASSEMBLY

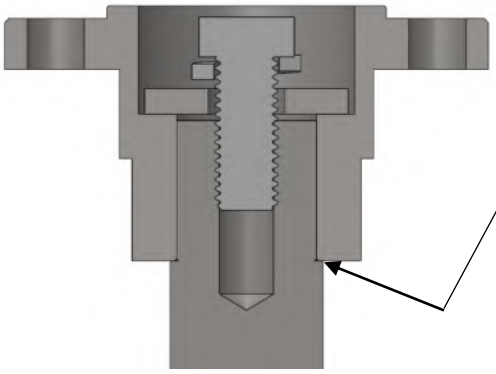


To avoid binding in the future and ease of installation, apply process compatible grease or anti-seize compound on the drive end portion of the drive shaft.

Assemble the rigid coupling half to the drive shaft:

- Insert square key into drive shaft slot.
- Assemble shaft with key into rigid coupling half, then attach shaft to coupling with a hex head screw, lock washer and thick washer. Use service removable thread-locker (Blue 242 Loctite or similar) compound to threads on hex screw. Tighten screw to recommended torque for bolt size according to Torque Chart on page 2 of Installation Section.
- Check that coupling is tight to shoulder on shaft. Use a .001" feeler gauge.

CROSS SECTION OF BOLTED REMOVABLE COUPLING

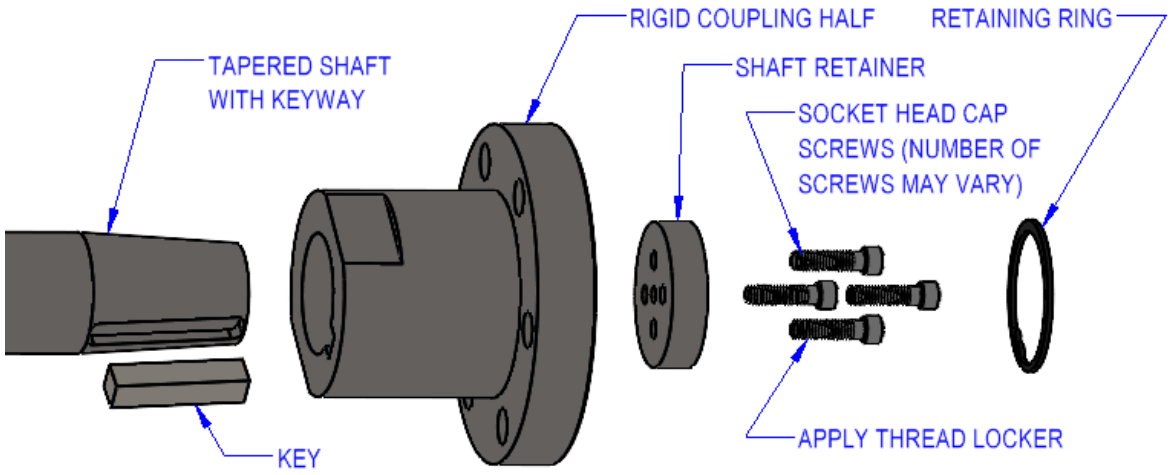


USE A .001" FEELER GAUGE TO ENSURE THE COUPLING IS TIGHT TO THE SHOULDER ON THE SHAFT

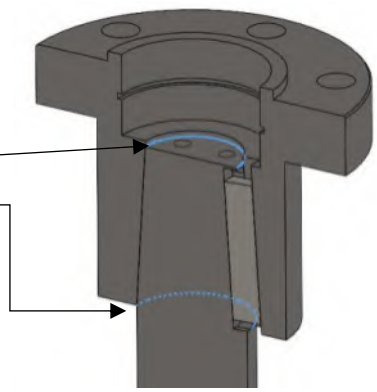
Installation – Bolted Removable Tapered Shaft Rigid Coupling

The following section is for the installation of a Bolted Removable Rigid Tapered Shaft Coupling which may be above or below mount. Below is an image showing components used in the assembly.

EXPLODED VIEW OF TAPERED SHAFT COUPLING ASSEMBLY



USE A .001" FEELER GAGE TO CHECK THESE MATING SURFACES TO ENSURE THAT THE TAPERED SHAFT IS FULLY SEATED IN RIGID COUPLING



Assemble the tapered rigid coupling half to the tapered shaft:

- Insert key into tapered shaft slot.
- Insert shaft with key into rigid coupling half.
- Make sure mixer shaft taper is tight to the rigid coupling. Use .001" feeler gauge to ensure the tapered shaft is seated into rigid coupling.

CLICK ON THE LINK BELOW FOR A VIDEO SHOWING THE INSPECTION PROCESS:

Inspecting and Checking Fit of Tapered Shaft in Coupling

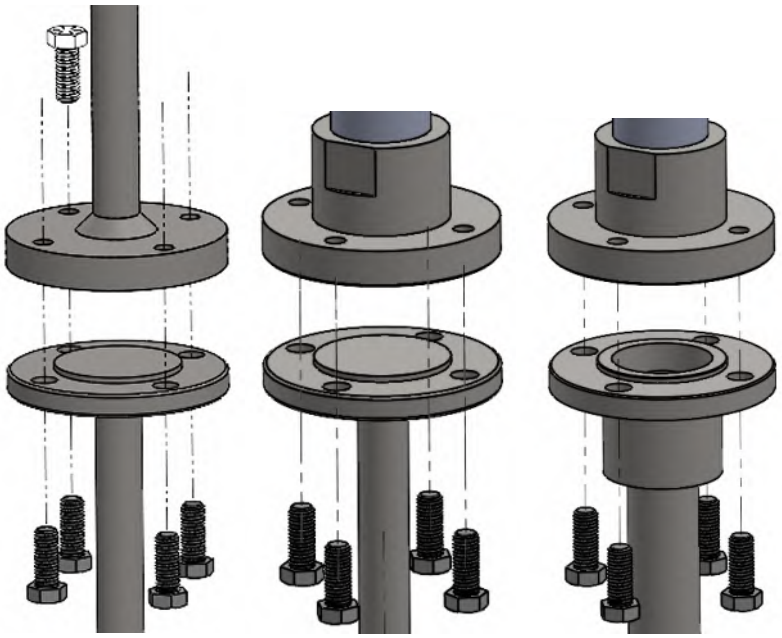
- If the shim slides in at any point during inspection, re-position the coupling and file the key if necessary.
- Attach shaft to coupling with socket head cap screws through shaft retainer into end of tapered shaft. Apply service removable thread-locker (Blue 242 Loctite or similar) compound on cap screw threads. Using a wrench on the coupling flats and a torque wrench on the cap screws, tighten screws to recommended torque for bolt size according to Torque Chart on page 2 of Installation Section.
- Install retaining ring into groove in coupling half.

Installation – Bolting Coupling Halves together

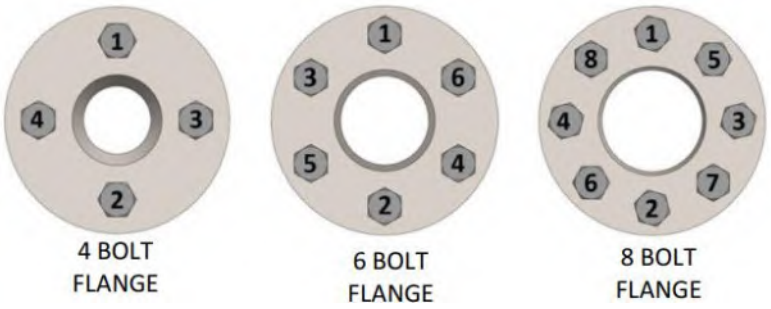
CAUTION: FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE MIXER. CHECK MOUNTING FACES FOR BURRS OR ANY OTHER PROTRUSION THAT MAY CAUSE PROBLEMS WITH ASSEMBLY. REMOVE BURRS AS NEEDED TO COMPLETE ASSEMBLY.

Make sure registration marks on mixer drive and shaft rigid coupling halves align as shown below. If there are multiple mixers on your order the coupling halves will have matching numbers: 1/1; 2/2; 3/3 etc… The registration marks should match your mixers serial number. Use .001" feeler gauge to ensure the coupling halves are fully seated. If not running true, excessive runout, then take apart coupling halves, check to make sure there are no burrs and reassemble.

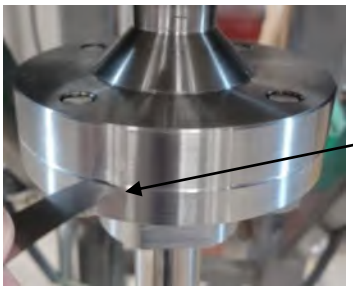
Shaft Rigid Coupling Installation



Assemble shaft and mixer drive rigid coupling halves together typically using hex head screws. Screws may come from top or bottom. Snug all screws, then tighten screws following the crossing pattern image below for the amount screws used in your application.



Tighten screw to recommended torque for bolt size according to Torque Chart on page 2 of Installation Section. Once all screws have been tightened to torque specifications, use a .001" feeler gauge where coupling halves meet to ensure the coupling halves are fully seated.



Use .001" feeler gauge to ensure the coupling halves are fully seated.

For additional Rigid Coupling Installation support go to our YouTube Channel -
FusionFluidEquipment

Installation – Sanitary Threaded Shaft Coupling

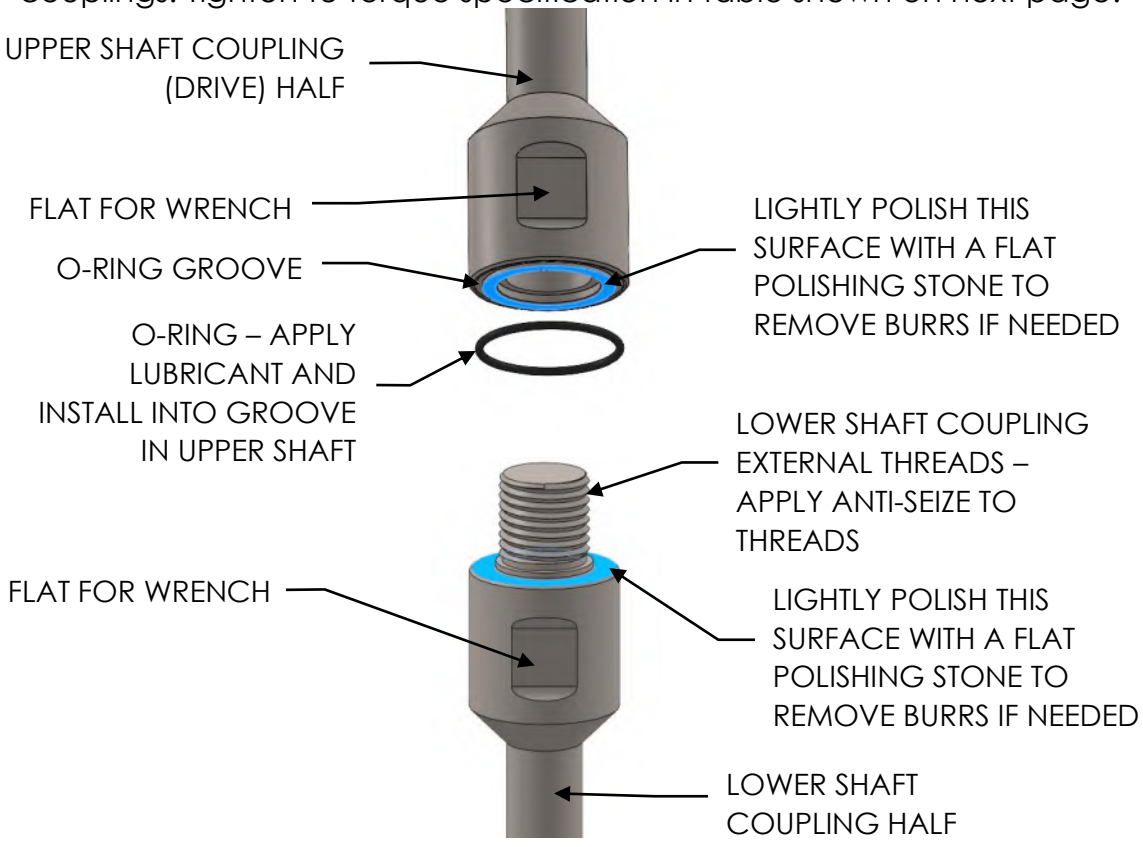
CAUTION: CHECK MOUNTING FACES FOR BURRS OR ANY OTHER PROTRUSION THAT MAY CAUSE PROBLEMS WITH ASSEMBLY. REMOVE BURRS AS NEEDED TO COMPLETE ASSEMBLY.

If the upper (drive) half of the sanitary coupling is not attached to the mixer drive, follow the appropriate instructions to attach to the drive.

- Check for burrs and, if needed, lightly polish mounting surfaces with a flat polishing stone to remove burrs. The faces to be polished are highlighted in blue shown below.
- Apply process compatible lubricant to O-ring before inserting into O-ring groove in upper drive half.
- Apply suitable anti-seize to external threads on lower shaft coupling half before assembling.
- Thread the lower shaft coupling half into the upper shaft coupling half.

THE MOST WRENCH JAWS ARE MADE FROM ALLOY STEEL. THE COUPLING MAY SEE SOME CONTAMINATION OR RUST IF JAWS ARE NOT LINED WITH A MATERIAL SUITABLE FOR THE PROCESS. THE SANITARY SHAFT COUPLINGS ARE USUALLY MADE FROM 316 SS.

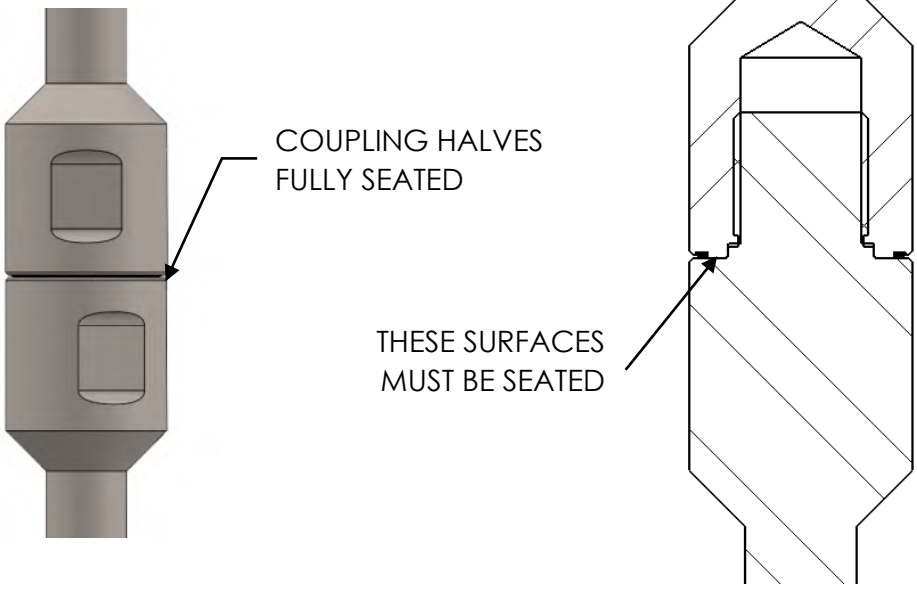
- Once the two couplings are hand tight, tighten the rest of the way using two wrenches, one on each coupling flat. Make sure the wrenches are seated on the flats before tightening to prevent damage to the couplings. Tighten to torque specification in table shown on next page.



Installation – Sanitary Threaded Shaft Coupling

TORQUE SPECIFICATIONS

SHAFT DIA.	THREAD	316 STAINLESS
3/4"	1"-8	**120 FT-LB.**
1"		
1 1/4"	1 1/2" - 6	**320 FT-LB.**
1 1/2"		
1 3/4"	2" - 8	**560 FT-LB.**
2"		



COUPLING HALVES MUST BE FULLY TIGHTENED TO SEAT THE MATING FACES OF THE COUPLING HALVES. IF THE COUPLING IS NOT FULLY SEATED EXCESSIVE RUNOUT AND VIBRATION MAY OCCUR.

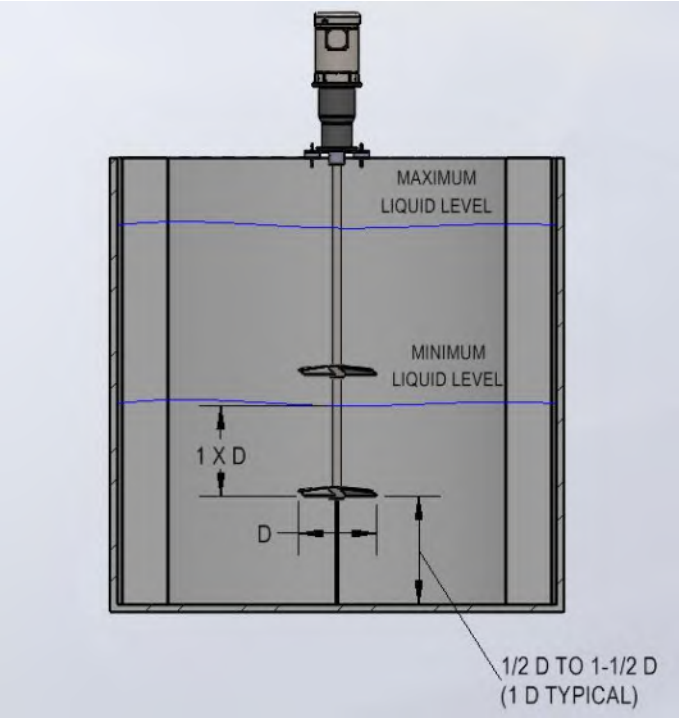
A YouTube Video is also available by following this link -
FusionFluidEquipment

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Impeller Installation - Set Screw

If impellers are not permanently mounted to the mixer shaft, then they will need to be installed on the mixer shaft.

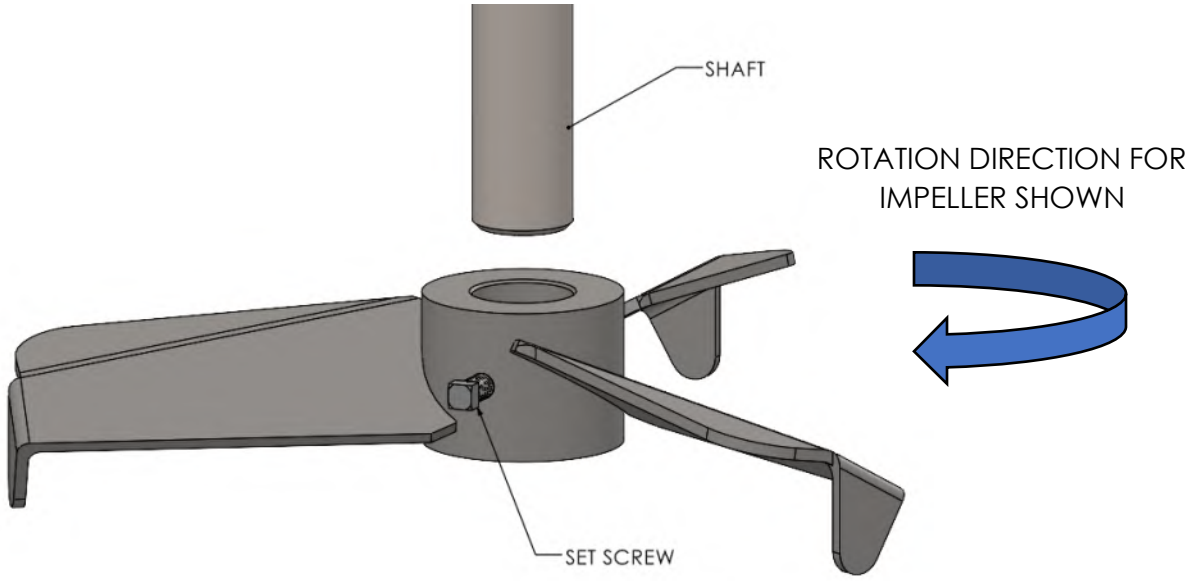
Determine the proper mounting location. In general, the bottom of the shaft should be between 0.5X impeller diameter to 1.5X impeller diameter off the bottom of the tank. For dual impellers, refer back to the quote or Approval Drawing for spacing. As a general rule, in gear drive models, the second impeller should be about 2X impeller diameters from the lower impeller and on direct drive models about 5X impeller diameters from the lower impeller.

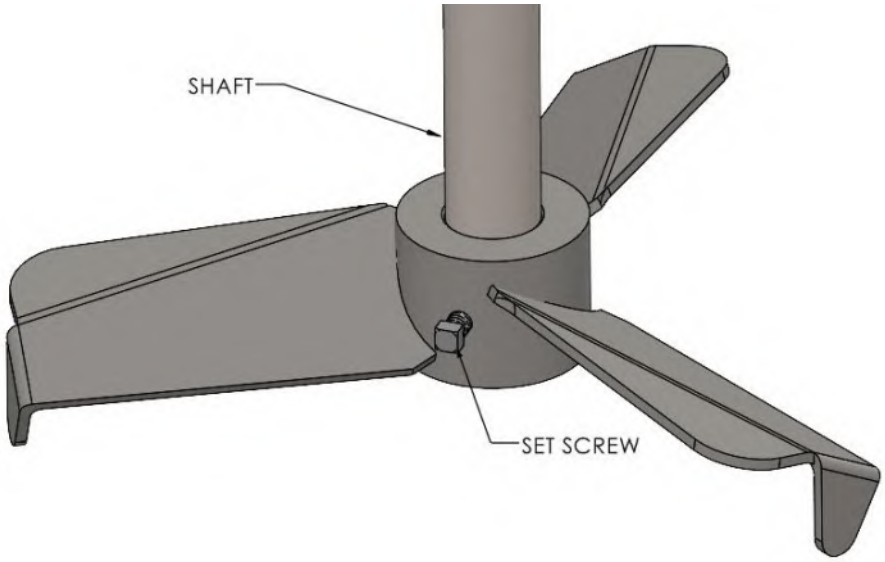


Slide the impeller(s) over the shaft until in their proper location(s). Snug the first set screw to locate the impeller. Snug the second set screw (if equipped) securely to the shaft. *The use of a process compatible service removable thread-locking compound is recommended where acceptable*. Remove the first set screw and apply service removeable thread-locker (Blue 242 Loctite or similar) to the threads. Reinstall first set screw onto shaft, tighten and torque as required. See **Torque Table – Installation Section** for recommended dry torque settings. Remove the second set screw and apply service removeable thread-locker compound to the threads. Reinstall second set screw onto shaft, tighten and torque as required. *NOTE: Some thread-locking compounds act as a lubricant, requiring torque settings to be adjusted. Follow manufacturer's instructions for this adjustment.*

If use of a thread-locking compound is unacceptable, tighten set screws and torque as required. See **Torque Table – Installation Section** for recommended dry torque settings.

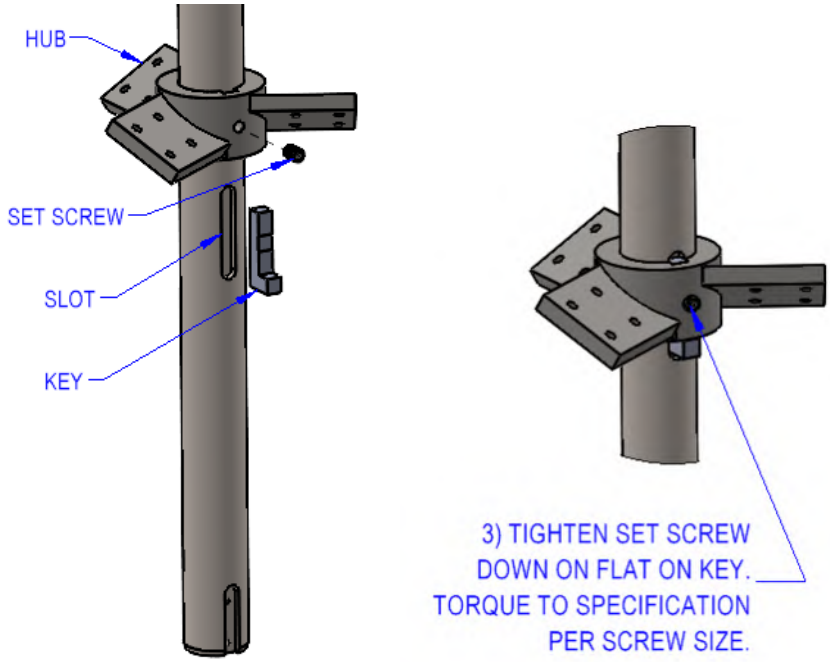
Repeat these steps for additional impeller(s) as required.



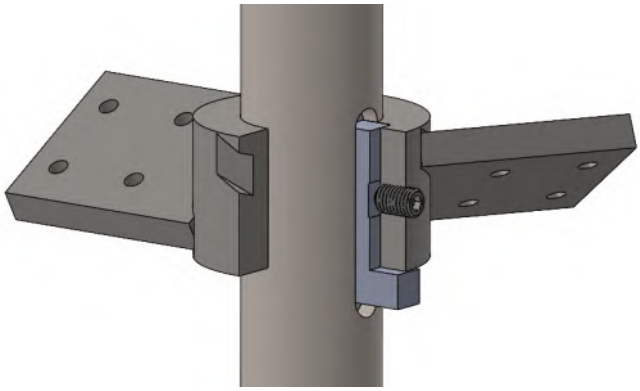


Impeller Installation – Hub & Key

When installing multiple impellers on a shaft, start with the impeller closest to the drive. If your mixer is equipped with a Captured Key, slide impeller hub over the shaft & go past the slot for the key (start with slot closest to drive for multiple impellers) as shown below. Insert key into slot in shaft & slide the hub over key. Align the keyway in hub with the key. Tighten set screw down on flat on key as shown below. Torque screw to specification per screw size see **Torque Table – Installation Section**.

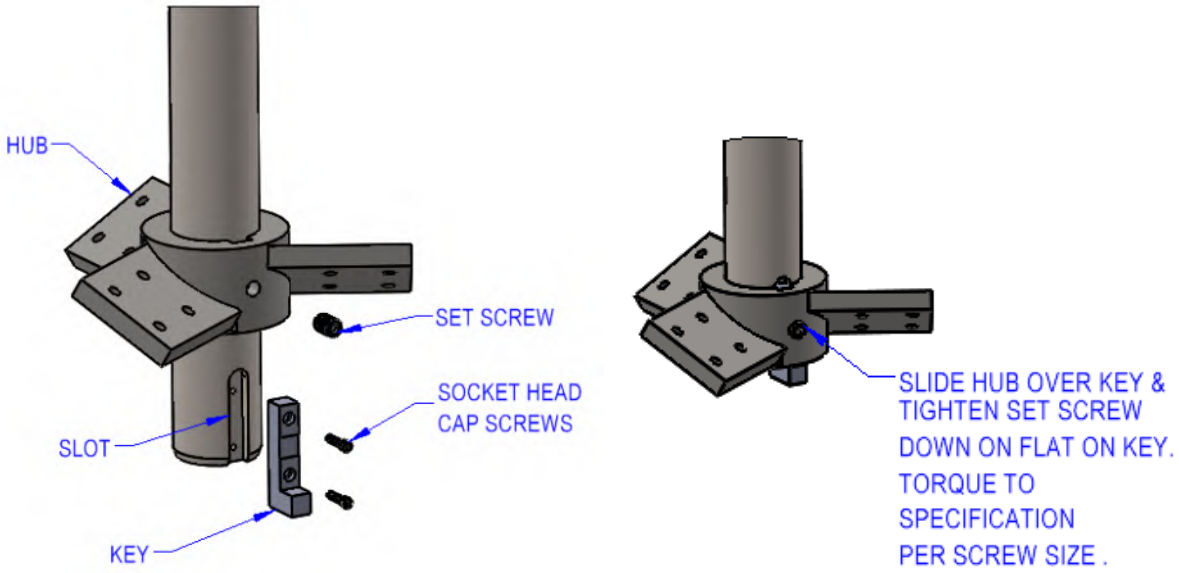


Hub sectioned to show set screw on flat on key in image below

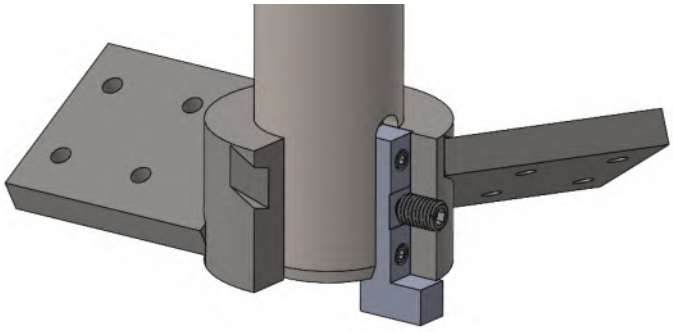


Impeller Installation

If your mixer is equipped with a Bolted Key, slide impeller hub on the shaft & go past the slot for the key as shown below. Insert key into slot in shaft & attach key with 2-socket head cap screws. Align the keyway in hub with the key & slide hub over key. Tighten set screw down on flat on key as shown below. Torque screw to specification per screw size see **Torque Table – Installation Section**.



Hub sectioned to show set screw on flat on key in image below



Electrical Installation

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Electrical Installation

Install, wire and ground in compliance with all applicable regulations. All wiring, including motors, VFD's, panels, and controls, should be performed by qualified electricians in compliance with U.S. National Electrical Code (NEC) or IEC and local code requirements. For non-USA locations consult the applicable national or local codes for your installation.

TAKE PROPER PRECAUTIONS FOR THE HANDLING OF ELECTRICITY.

Follow the motor Manufacturer's Instructions for Installation. Detailed motor data and manuals for all standard motors are available from the motor manufacturer's website. If you cannot locate them, contact your Fusion Representative for help.

Use of extension cords is discouraged. If an extension cord is necessary, be sure to choose one that is rated for the application and is properly grounded. Make sure the cord is the correct wire gage for the length and rated amperage.

Confirm motor rotation direction matches attached mixer rotation indicator. If there is no indicator available, refer to mixer approval drawings for proper direction or contact your Fusion Representative. In some situations, improper rotation direction can cause damage to your mixer.

If any wiring was provided by Fusion, please have your electrical inspector inspect all connections, conductors, etc. to verify that the installation is acceptable. Unless specifically requested, pre-wiring of components may not be UL approved or acceptable to local code. Consult with your local inspector.

CAUTION:

- **ALWAYS SHUT OFF AND LOCK OUT AIR SUPPLY, RELEASE ANY AIR PRESSURE STORED IN HOSE AND DISCONNECT FROM AIR SUPPLY BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **ALWAYS MAKE SURE THERE ARE NO DAMAGED OR LOOSE HOSES OR FITTINGS.**
- **DO NOT EXCEED MAXIMUM AIR PRESSURE.**
- **FOR INSTALLATION IN A HAZARDOUS ENVIRONMENT PLEASE REFER TO SPECIFIC AIR MOTOR MANUAL GUIDELINES. MAKE SURE TO FOLLOW ANY APPLICABLE LOCAL OR INTERNATIONAL CODES.**

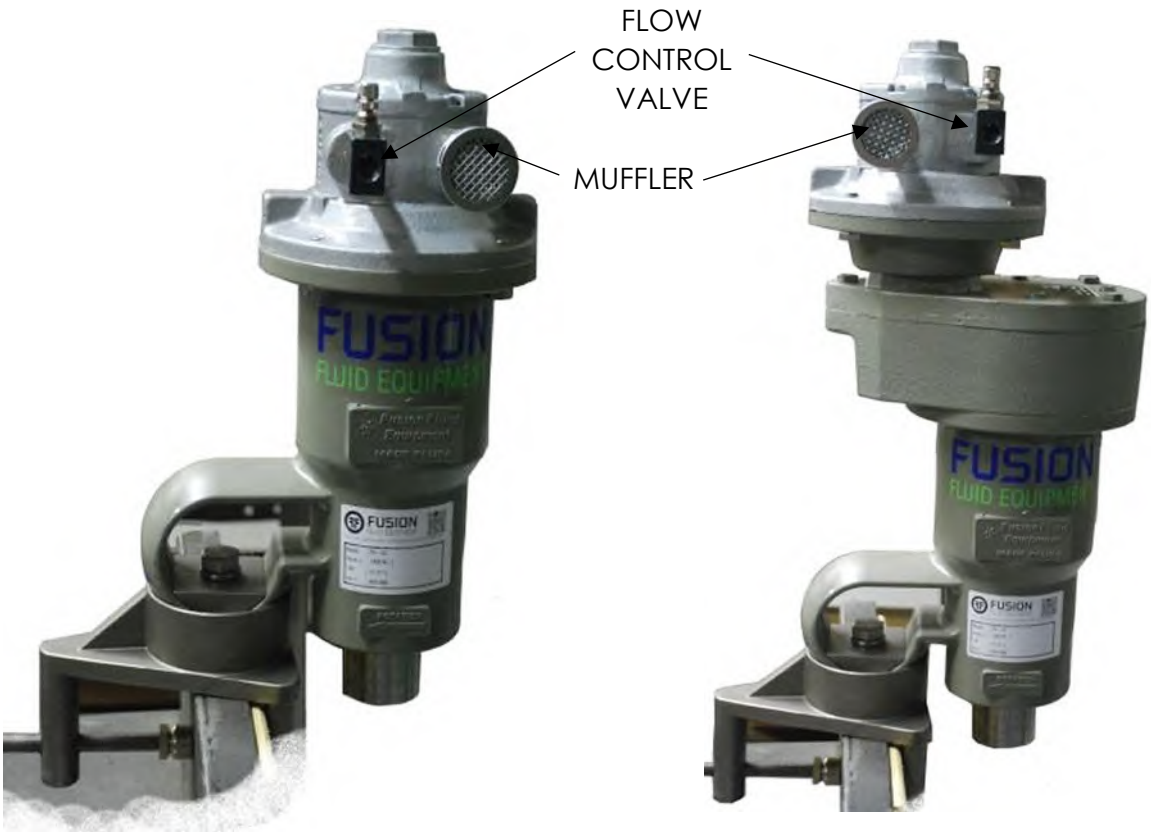
Installation

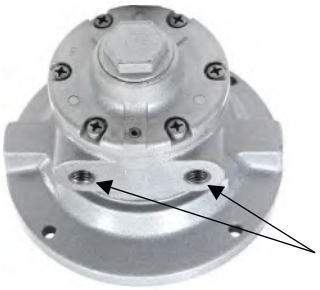
Installation and maintenance of the air motor and support systems should be performed by authorized personnel only. Installation should follow all applicable local and international codes. If an air motor needs to be installed, refer to Drive Coupling Installation manual section.

Confirm motor & mixer shaft rotation

Make sure your mixer shaft rotation matches the rotation arrow label 

on your mixer and the rotation direction called out on the approval drawing. The mixer may have the flow control valve and muffler installed in the inlet/outlet ports in the air motor as shown below. These can be reversed to change the rotation direction.





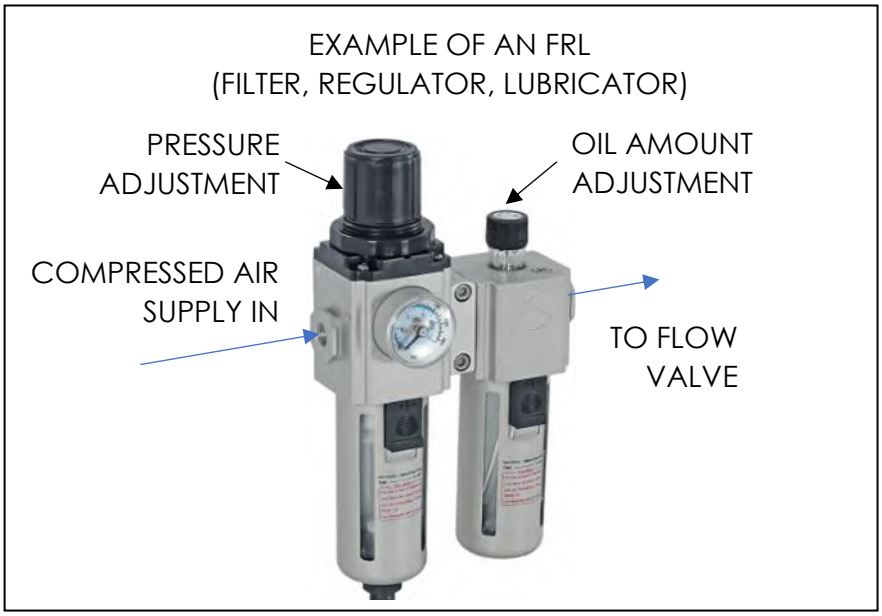
INLET/OUTLET PORTS

Air quality requirements

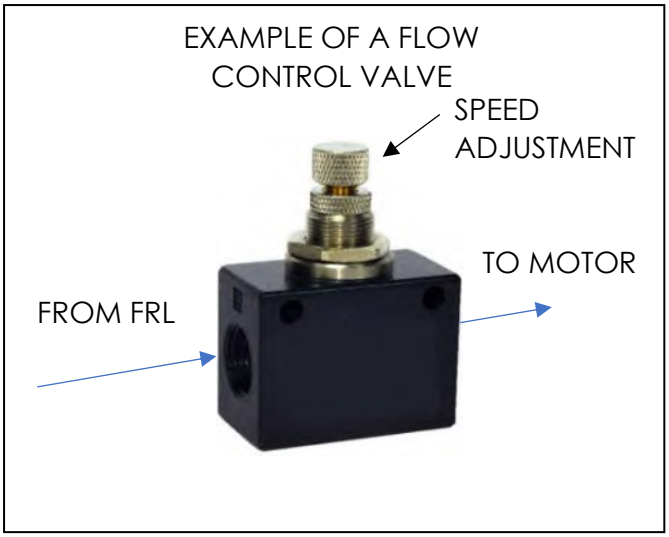
Fusion provides two types of air motors – lubricated and non-lubricated. For lubricated models use a separate air filter, regulator and lubricator (FRL) as described below. For a non-lubricated air motor, a lubricator is recommended as described below.

- Use clean and dry compressed air with a maximum dew point of +10°C (50°F). Make sure that the hose and couplings are clean and free from dust before making any connections.
- Use a separate air filter, regulator and lubricator (FRL). For a non-lubricated air motor, a lubricator is recommended as it will improve performance and increase the life of the motor. Typically, 1-2 drops of oil per minute is recommended.

EXAMPLE OF AN FRL
(FILTER, REGULATOR, LUBRICATOR)



- Installation of a flow control valve is needed to control motor speed and torque.



- The table below shows air requirements for your mixer's horsepower. Confirm air requirements against approval package & motor manufacturer data.

TYPICAL AIR CONSUMPTION	
1 HP	40 CFM @ 80 PSI
2 HP	60 CFM @ 70 PSI
3 HP	90 CFM @ 70 PSI

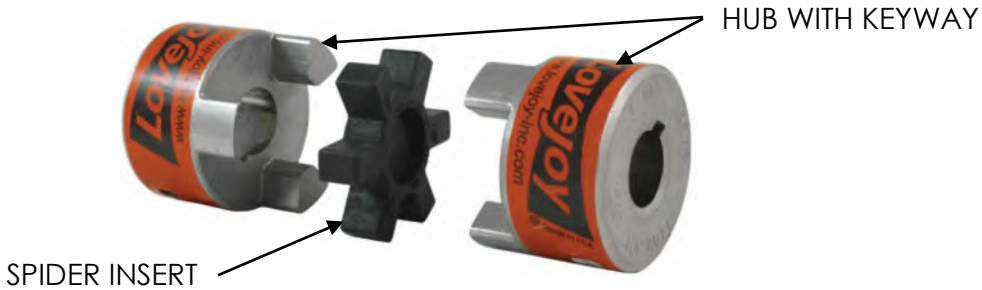
Flexible - Jaw Type Coupling Installation

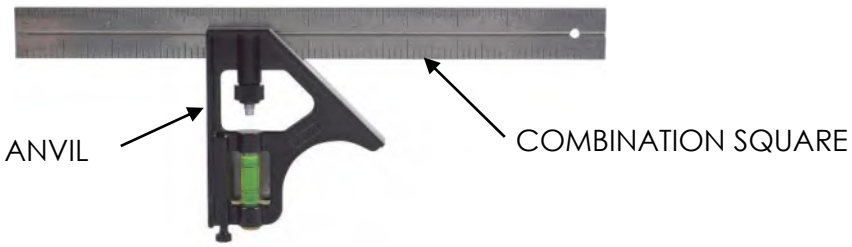
CAUTION:

- **ALWAYS SHUT OFF AND LOCK OUT POWER SUPPLY TO THE MIXER BEFORE ANY MAINTENANCE IS PERFORMED.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.**

This Manual Section Covers Setting Drive Coupling Spacing for a Pro Series using a Flexible – Jaw Type Coupling between Input Drive & Bearing Housing

Correct installation and alignment/spacing practices will ensure longer coupling life, trouble free operation, and a safer operating environment for the coupling. Please thoroughly review all of the following instructions prior to installing this coupling and placing it in operation. Proper safety guidelines and practices should always be followed during every phase of the installation. Below is an image showing the Flexible – Jaw type coupling components. A combination square should be used for the assembly process.



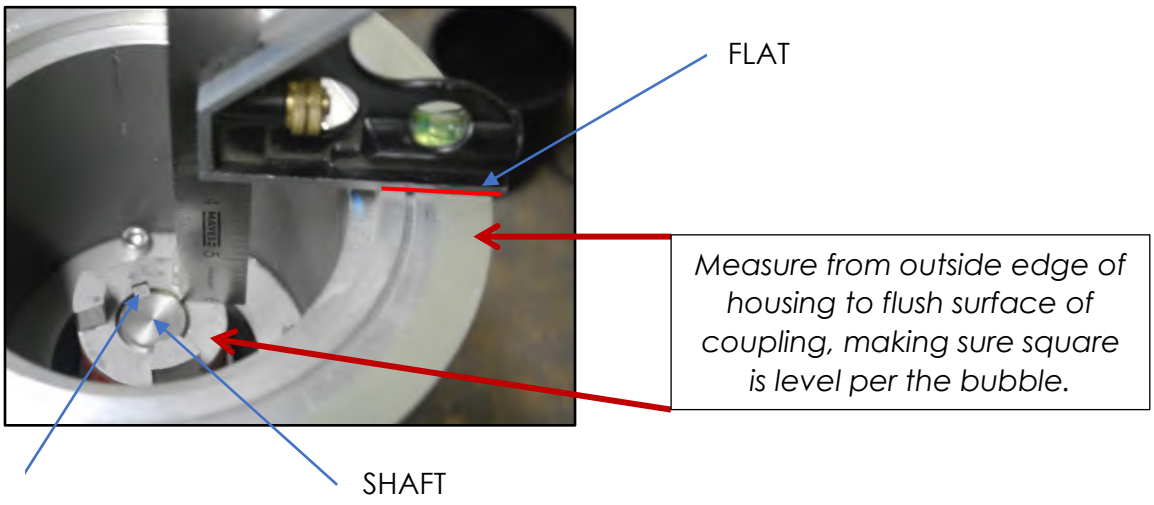


Begin Installation

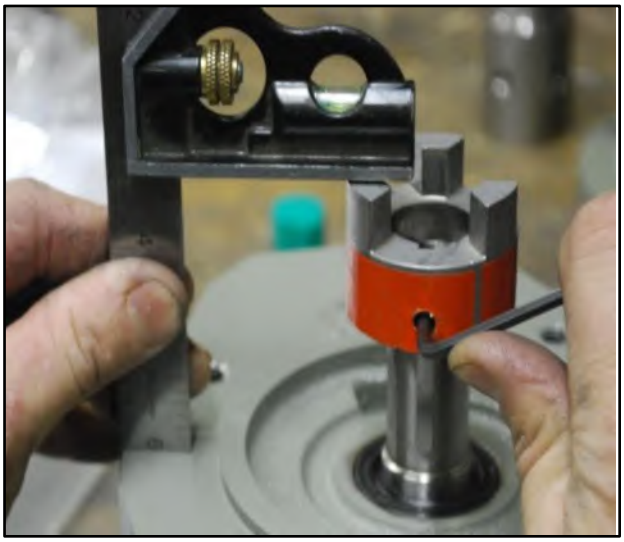
Make sure that all of the components in this assembly are free from any foreign materials, nicks, burrs, dents or gouges. Clean components and remove any nicks, burrs, dents or gouges before attempting installation.

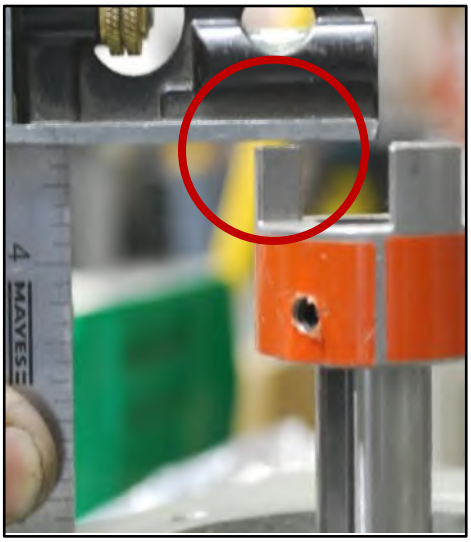
1) The driven coupling (coupling on the bearing housing stub shaft – Pro Series) & key should be installed flush with the driven shaft as shown in the image on the following page.

2) Use a combination square to measure the distance from the OUTSIDE edge of bearing housing to the flush surface where the Lovejoy coupling and stub shaft meet. Make certain the square anvil is flat on the mounting surface & is level per bubble. Tighten square to retain this measurement.



3) Place Lovejoy coupling & key onto the drive output shaft (gearbox or motor). Use the retained measurement on the combination square that was taken from the housing, and transfer measurement to place the Lovejoy coupling onto the drive output shaft. The measurement gets transferred from OUTSIDE edge of gearbox or motor to top of coupling tooth. Leave approximately a 1/16" gap (thickness of a penny) between the coupling and the square's arm. Adjust the integral set screw within the coupling with a hex/allen wrench to position then tighten the coupling to the appropriate value in torque table.

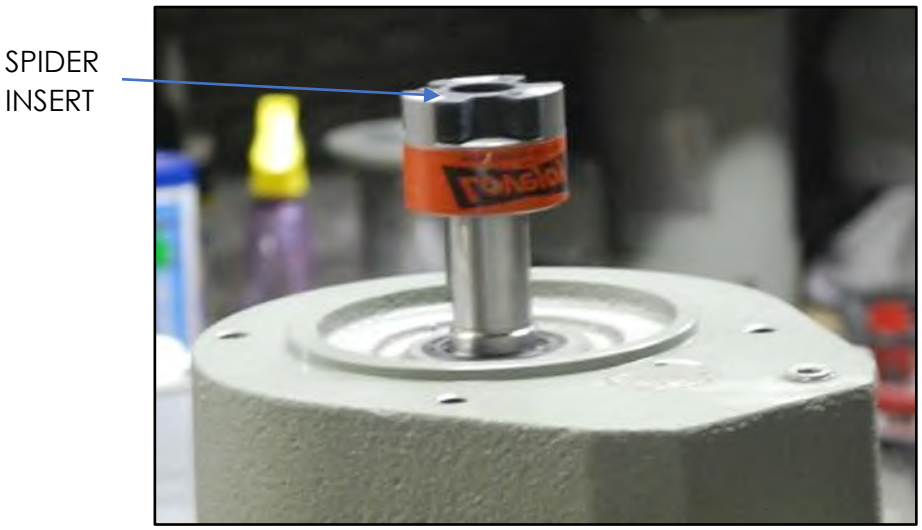




*Note the **1/16**" gap between square's arm and coupling tooth. A penny can be used to set this spacing.*

THREAD SIZE	TORQUE
1/4-20	75 in-lb.
5/16-18	14 ft-lb.

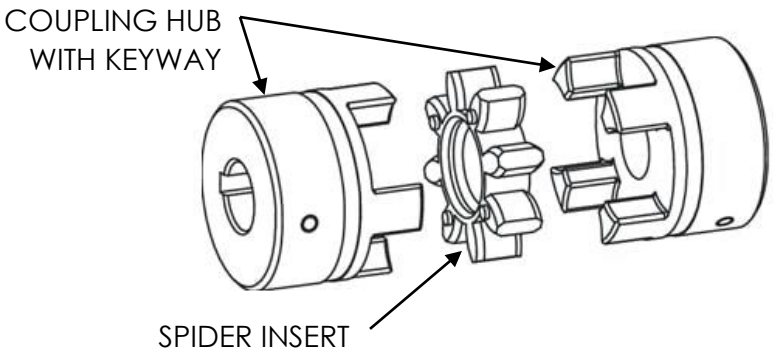
4) Place spider onto the coupling that is attached to the gearbox or motor shaft.



5) Once the drive coupling is in place mount the bearing housing using the appropriate bolts. Use lock washers or service removable thread locker on the bolt threads to prevent the bolts from vibrating loose. Ensure that the couplings are properly engaged without any excess pressure against the spider. Excessive vibration may occur at start up if the hubs are pressed too tightly together causing excess pressure against the spider which will also causes excess axial pressure against the bearings.

This Manual Section Covers Setting Drive Coupling Spacing for a Flow Series using a Flexible – Jaw Type Coupling Installation

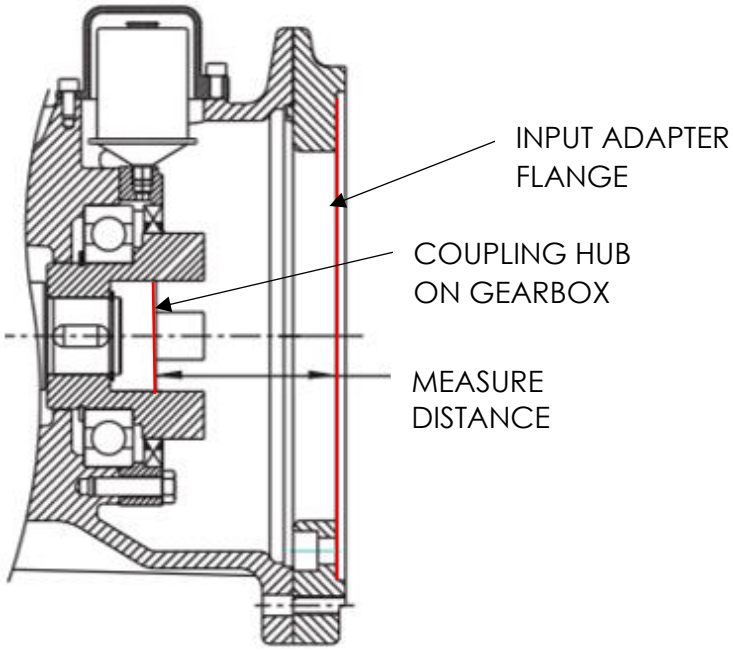
Correct installation and alignment/spacing practices will ensure longer coupling life, trouble free operation, and a safer operating environment for the coupling. Please thoroughly review all of the following instructions prior to installing this coupling and placing it in operation. Proper safety guidelines and practices should always be followed during every phase of the installation. Below is an image showing the Flexible – Jaw type coupling components. A combination square should be used for the assembly process.



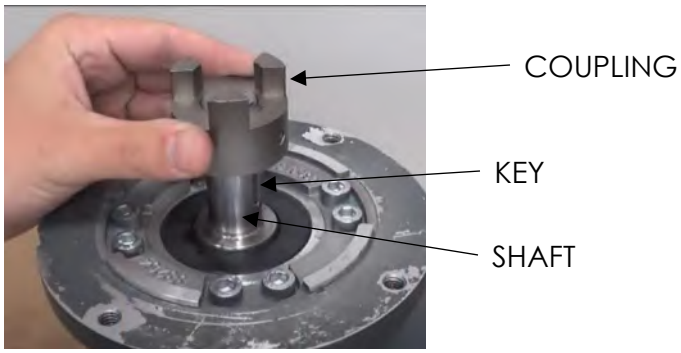
Begin Installation

Make sure that all of the components in this assembly are free from any foreign materials, nicks, burrs, dents or gouges. Clean components and remove any nicks, burrs, dents or gouges before attempting installation.

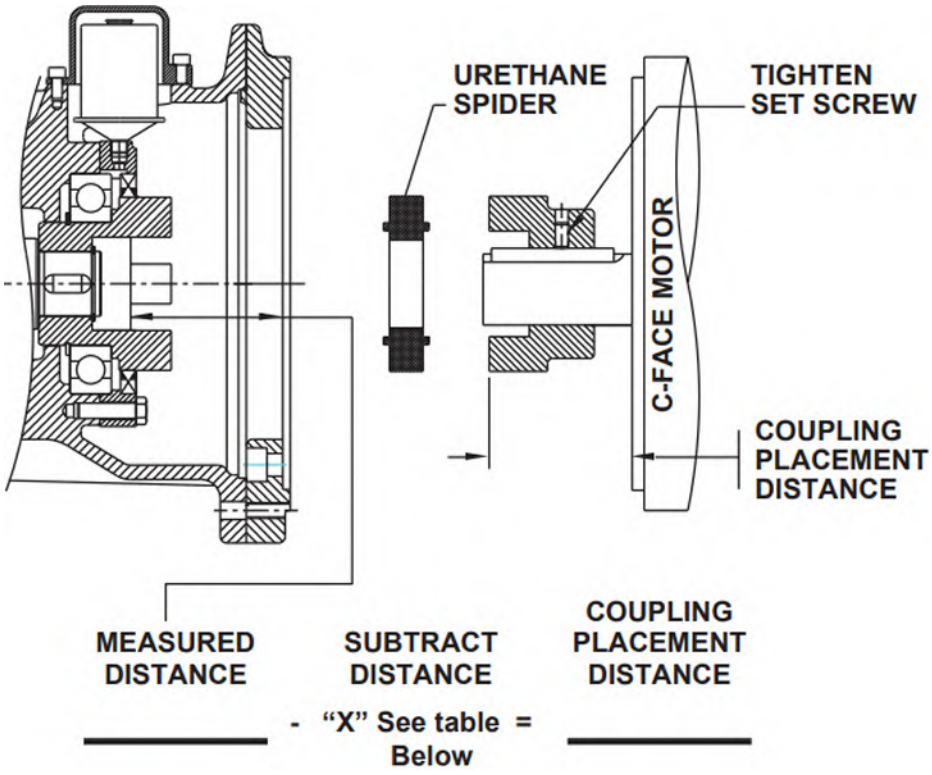
1) The coupling on the gearbox is already in place. Using a combination square, measure the distance from the gearbox input adapter flange to the lower surface of the coupling, as shown. Ensure the combination square's anvil is sitting flat on the gearbox input adapter flange.



2) Place the other coupling onto the motor's shaft with the key in the keyway.

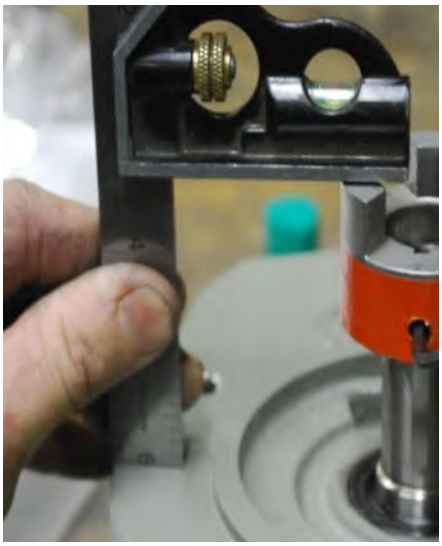


3) Based on the coupling size, use the table to select the appropriate subtract distance "X". Subtract this value from the measured distance from step 1 to get the coupling placement distance.



Coupling Size	Subtract Distance "X"	
R14	0.06"	1.5 mm
R19 & R24	0.08"	2.0 mm
R28	0.10"	2.5 mm
R38 & R42	0.12"	3.0 mm
R48	0.14"	3.5 mm
R55	0.16"	4.0 mm
R65	0.18"	4.5 mm
R75	0.20"	5.0 mm
R90	0.22"	5.5 mm

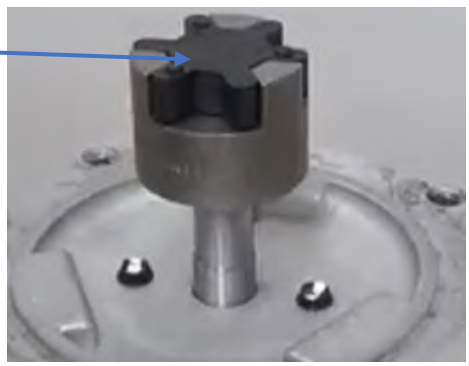
4) Set the combination square to the calculated value coupling placement distance from step 3. Set the coupling distance from the motor mounting face to the top of the coupling. Tighten the set screw(s) to keep the coupling at this location.



5) Tighten the set screw(s) to the appropriate value from the table below. Place the spider insert into the motor's coupling.

Coupling Size	Set Screw Size	Torque
R14	M4	13 in-lb.
R19 & R24	M5	18 in-lb.
R28	M8	89 in-lb.
R38 & R42	M8	89 in-lb.
R48	M8	89 in-lb.
R55; R65 & R75	M10	13 ft-lb.
R90	M12	30 ft-lb.

SPIDER INSERT



6) Mount the motor onto the gearbox with the appropriate bolts. Ensure that the couplings engage securely. Use lock washers or service removable thread locker to prohibit bolts from vibrating loose. Tighten to the appropriate value in the table below.

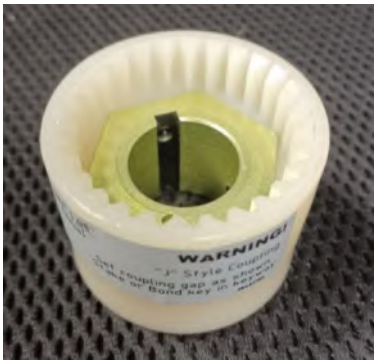
BOLT SIZE	18-8 SS	Gr5/Gr8
3/8"-16	16 ft-lb.	25 ft-lb.
1/2"-13	36 ft-lb.	61 ft-lb.
9/16"-12	48 ft-lb.	88 ft-lb.
5/8"-11	81 ft-lb.	121 ft-lb.
3/4"-10	114 ft-lb.	215 ft-lb.
7/8"-9	178 ft-lb.	251 ft-lb.
1"-8	269 ft-lb.	375 ft-lb.

Nylon Coupling Installation

This manual section covers "J" Style Nylon Coupling NEMA C-face installation.

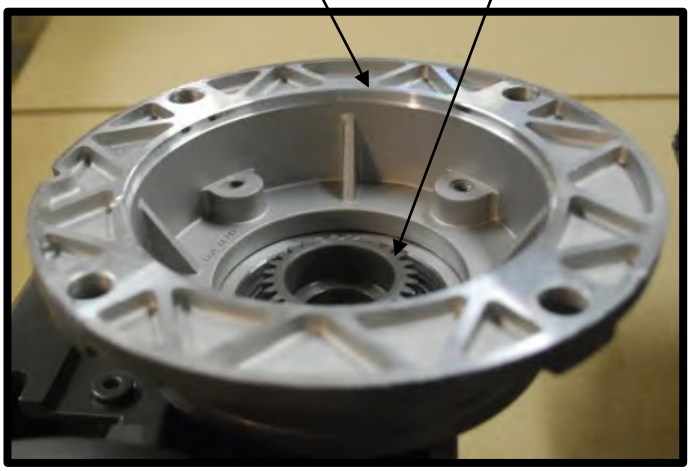
Below are images of "J" Style Couplings which are used to couple the motor drive shaft to the gearbox spline shaft.

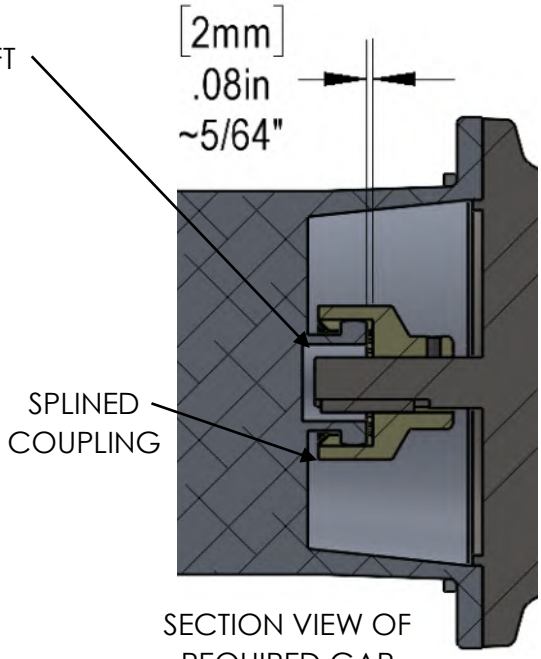
"J" Style Coupling 5/8" Bore



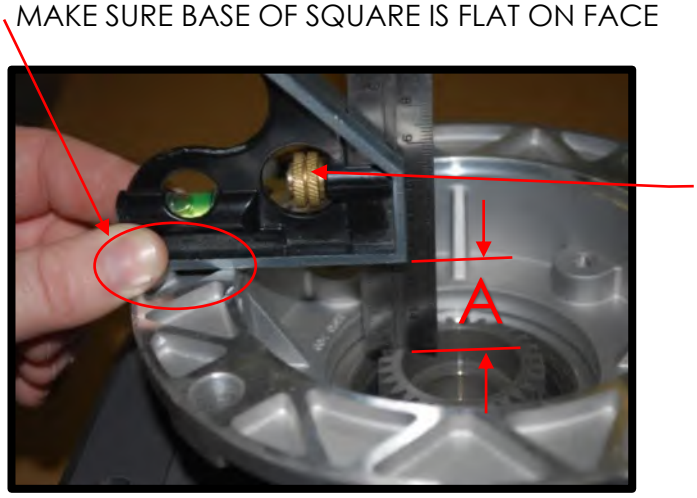
"J" Style Coupling 7/8" Bore

1) Using a combination square, measure the distance from the face of the input adapter mounting flange to the face of the splined shaft and record that measurement as A in the equation on the following page.

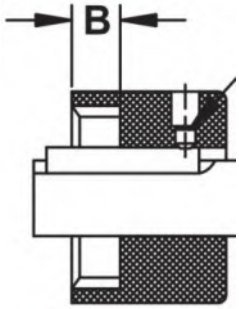


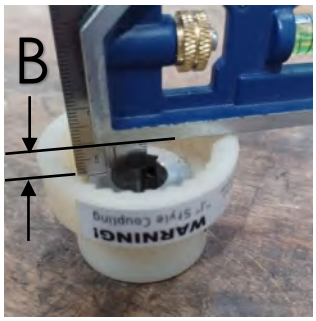


SECTION VIEW OF REQUIRED GAP WHEN ASSEMBLED

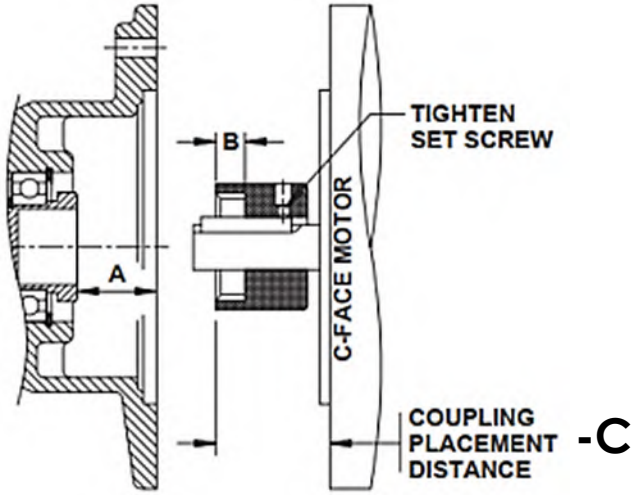


2) Measure the depth of coupling engagement zone of female splined coupling and record the measurement as B in the equation on the following page.



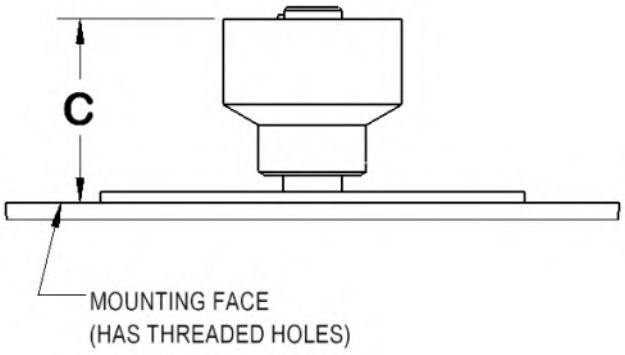


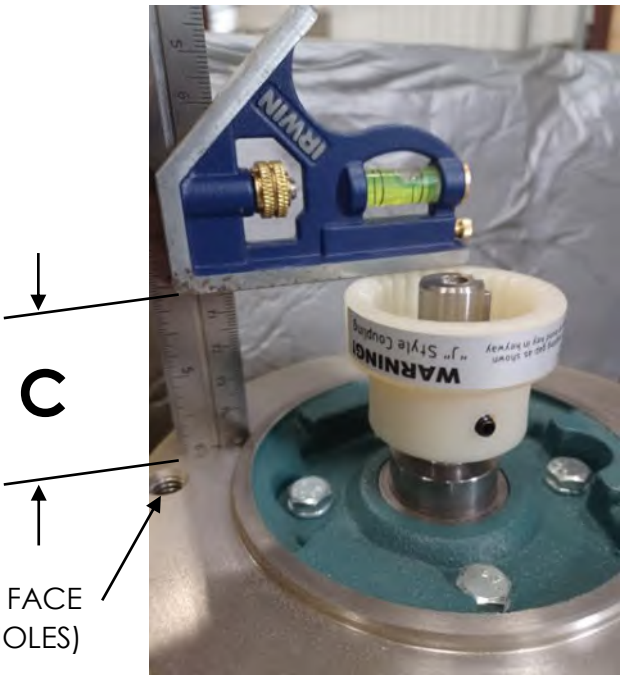
3) Add "A" + "B" and subtract 0.08" (2mm) ~5/64" from the distance. This needs to be done so that the coupling will not be axially preloaded after installation!



MEASURED DISTANCES				SUBTRACT DISTANCE		COUPLING PLACEMENT DISTANCE - C
A	**+**	**B**	**-**	**.08" (2mm)**	**=**	
____	**+**	____	**-**	**~5/64"**	**=**	_____
			(minus)			

4) Use measurement "C" to locate the coupling from the face of the motor onto the shaft.





5) Once in place, tighten the set screws to lock the coupling in place. Tighten to a torque specification of 1.4 Nm (12.4 in-lbs.) It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.

6) Mount the motor onto the input adapter with appropriate bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.

- One of the most common problems is a "noisy gearbox." This could be due to an improper gap causing the motor & gearbox shafts to be "axially loaded." We recommend disassembling and reassembling to ensure correct gap between spline adapter and coupling.

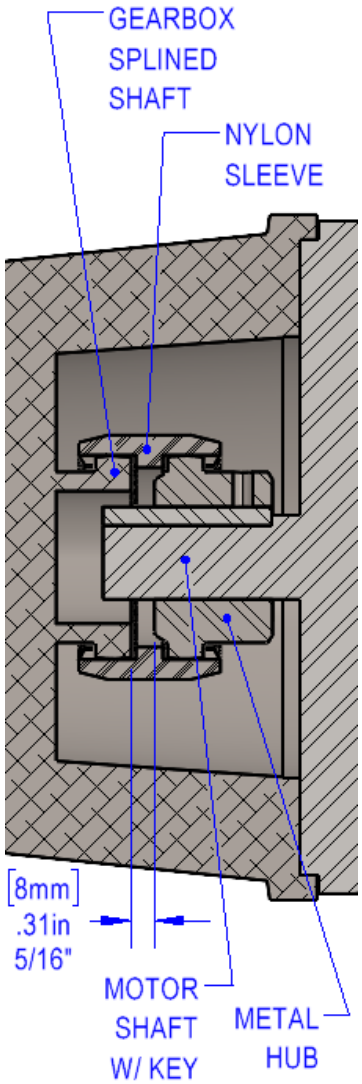
This manual section covers "M" Style Nylon Coupling NEMA C-face installation.

Below are images of the "M" Style Coupling components which are used to couple the motor drive shaft with key to the gearbox spline shaft.

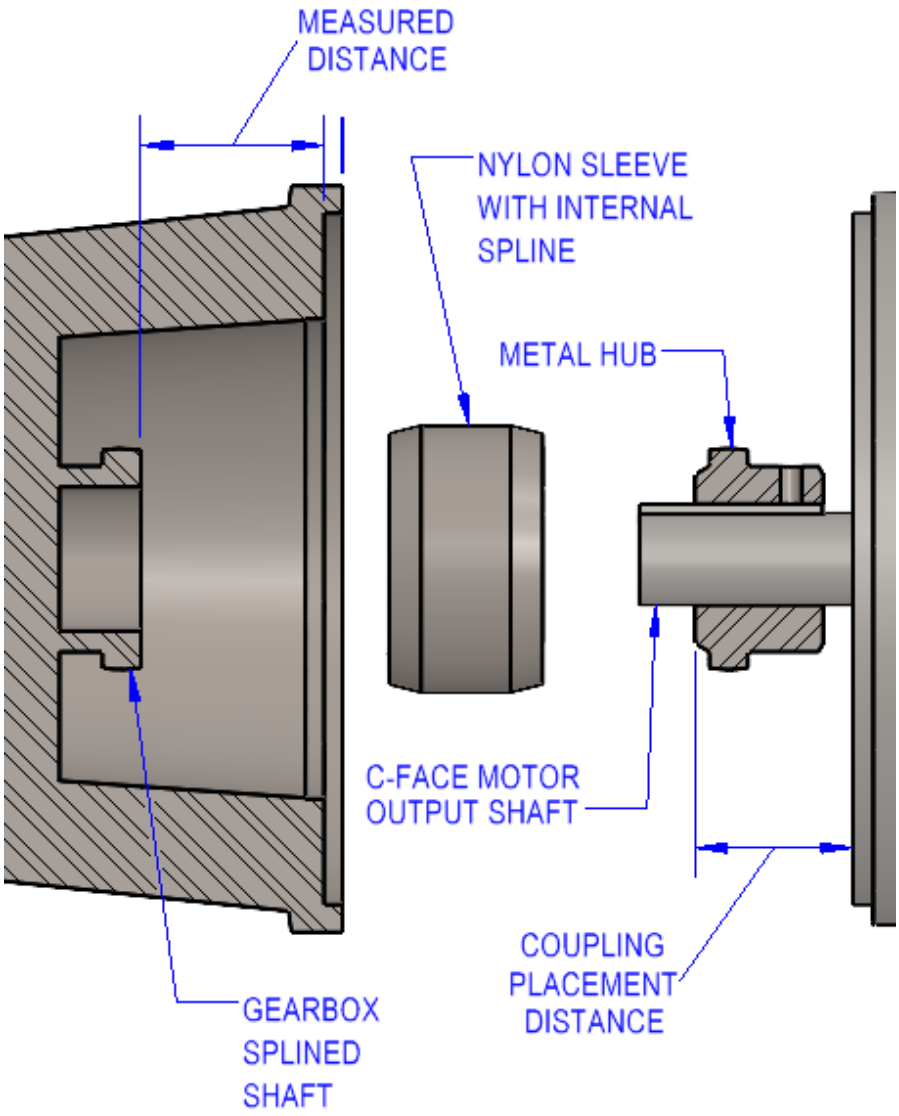
Metal Hub

Nylon Sleeve with Spline

SECTION VIEW OF REQUIRED GAP (.31") WHEN ASSEMBLED



1) Using a combination square, measure the distance from the face of the input adapter mounting flange to the face of the splined shaft and record that measurement in the equation below.

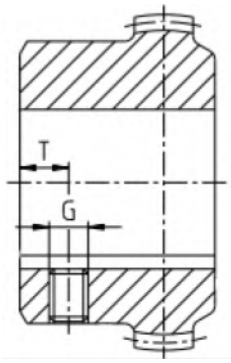


2) Subtract 0.31" (8mm) 5/16" from the measured distance to get the coupling placement distance. This needs to be done so that the coupling assembly will not be axially preloaded after installation!

MEASURED DISTANCE		**SUBTRACT DISTANCE**		**COUPLING PLACEMENT DISTANCE**
		0.31" (8mm) 5/16"	**=**	
_____	**-** (minus)			_____

3) Use that measurement to locate the Metal Hub from the face of the motor onto the shaft.

4) Once in place, tighten the set screws to lock the Metal Hub in place. Tighten to the torque specification for the coupling size/screw size per the table below. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.



Size	14	19	24	28	32	38	42	48	65	80	100	125
Dimension G	M5			M8					M10		M12	M16
Dimension T	6			10					15 / 20 [1]	20	30	40
Tightening torque T_A [Nm]	2			10					17		40	80

1) Length of hub 55 mm T = 15 mm, length of hub 70 mm T = 20 mm

5) Place Nylon Sleeve on either the Metal Hub mounted to the motor or the splined shaft on the gearbox depending on orientation of your assembly. Gravity will be holding the sleeve in place until the motor is attached to the gearbox. Mount the motor onto the input adapter with appropriate bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.

Pro Series Bearing Housing Maintenance

WARNING: TURN OFF POWER TO THE MIXER BEFORE ANY MAINTENANCE IS PERFORMED

Fusion Pro Series Mixers are designed to require a minimal amount of regular maintenance. Basic preventative maintenance and proper care will help ensure reliability and a long service life. The amount of maintenance will depend largely on your specific service and environmental conditions.

CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

As you gain more experience with how the mixer behaves in your specific application, you may adjust the frequency of this inspection as desired.

Bearing Housing Maintenance

The bearing housing provided with your Fusion Pro Series Mixer is designed to provide a long service life and should require no maintenance.

Your operators will likely be the first to identify bearing housing issues. Fusion recommends training and encouraging operators to report changes in sound and/or abnormal vibrations.

Where available, Fusion recommends adding the motor, gearbox, and bearing housing to your predictive maintenance plan which may include infrared, thermal, and vibration inspection. Fusion recommends frequent inspection until a baseline is achieved. As you gain more experience with how the mixer behaves in your specific application, you may adjust the frequency of this inspection as desired.

Should repair be required, contact your Fusion Representative for parts. See Appendix A for a breakdown of your bearing housing.

Setting Gearbox and Motor Coupling Spacing

Please refer to the manual section for either a Flexible-Jaw Type Coupling (FM-1034) or a Nylon Spline Type Coupling (FM-1026). Correct installation and alignment/spacing practices will ensure longer coupling life, trouble free operation, and a safer operating environment for the coupling. Please thoroughly review all of the instructions prior to installing this coupling and placing it in operation. Proper safety guidelines and practices should always be followed during every phase of the installation.

If replacing the motor & your motor has this style coupling, be sure to remove for use on the new motor.

Spare Parts

Fusion strives to choose standard components with widespread availability, yet certain components are custom-built. Fusion Pro Series mixers are robust in design and have been tested for a long service life. If a replacement part or assembly is needed contact your Fusion Representative with serial number, if possible, for pricing and availability.

Maintenance – Pro Series Gearbox Lubrication

Lubrication

Fusion Pro Series Mixers are designed to require a minimal amount of regular maintenance. These are typical lubrication points:

- Bearing Housing Bearings – Sealed Bearings - Synthetic Lube – "Lubed for Life" – No regular lubrication required
- Motor – Lubricate per Manufacturer Instructions
- Gearbox - Lubricate per Manufacturer Instructions

Below are some of the Gearbox options with oil type and volume listed:

PICTURE	CASE MATERIAL	OIL TYPE / VOLUME
	Aluminum	Klubersynth UH1-6-220 Food Grade Synthetic ISO Viscosity 220/ .613 Quarts
	Stainless Steel	Mobile SHC Cibus Food Grade Synthetic ISO Viscosity 150/ .438 Quarts
	Stainless Steel	PAG460 H1 Food Grade Synthetic ISO Viscosity 460/ .3 Quarts

Warranty

All equipment or parts covered by this manual are guaranteed free from defective material and workmanship for a period of twelve (12) months from date of shipment, under normal use and service. This warranty does not cover failure of normal wear parts unless the failure of such part has resulted from defective material and workmanship. Fusion Fluid Equipment LLC will repair or replace, at its option, any equipment which has been found to be defective and is within the warranty period, provided that the equipment is shipped, with previous factory authorization, freight prepaid, to Fusion's plant in Whitehall, Michigan, USA. All return shipments are made FOB Fusion's factory. Fusion Fluid Equipment LLC is not responsible for removal, installation, or any other incidental expenses incurred in shipping the equipment to or from Fusion Fluid Equipment LLC. In the case of components purchased by Fusion Fluid Equipment LLC, and incorporated in the equipment, the component manufacturer's guarantee shall apply. NOTE: Any modifications or corrective work done to the equipment which were not specifically authorized in writing by Fusion Fluid Equipment LLC shall void this limited warranty, and Fusion Fluid Equipment LLC shall accept no liability for any of the corrective work or expenditures which were conducted without its prior, written authorization. Fusion Fluid Equipment LLC shall not be held liable for any further cost, expense, or labor to replace equipment or replaceable parts, or indirect or consequential damages.

With the exceptions of the limited warranty set out above, there are no other understandings, agreements, representatives, or warranties implied (including any regarding the merchant-ability or fitness for a particular purpose), not specified herein, respecting this agreement or equipment, hereunder. This contract states the entire obligation of Fusion Fluid Equipment LLC in connection with this transaction.

Contact

For questions, concerns, or comments, we strongly recommend contacting the sales representative that supplied your equipment. Otherwise, you may email us or visit our website. We typically respond same day.

Website: www.fusionfluid.com

Email: info@fusionfluid.com

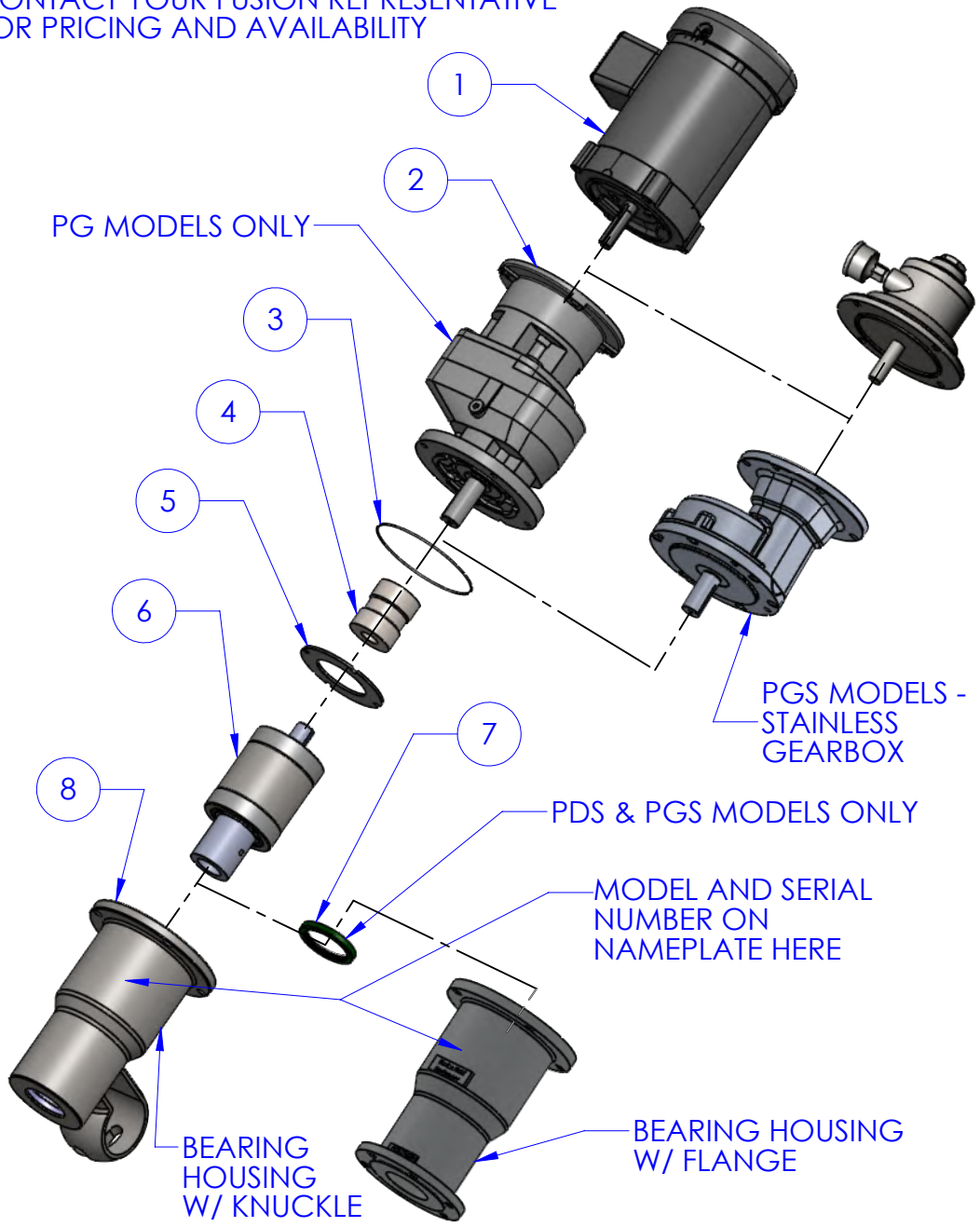
Phone: **877.812.7573**

Thank you for choosing Fusion. We look forward to a long-standing relationship with you, by providing high-quality, custom equipment!

Appendix A - Supporting Drawings

- Typical Arrangement – Fusion Pro Drive Components General Assembly
- Typical Bearing Housing Arrangement – Fusion Pro Series Bearing Housing Breakdown

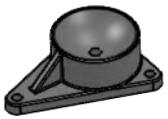
CONTACT YOUR FUSION REPRESENTATIVE
FOR PRICING AND AVAILABILITY



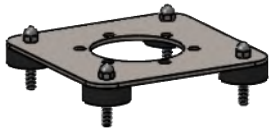
ITEM NO.	DESCRIPTION	QTY.
1	MOTOR: PER ORDER	1
2	GEARBOX: SIZE, RATIO & MATERIAL PER ORDER	1
3	VITON O-RING	1
4	FLEX COUPLING: SIZE & STYLE PER ORDER	1
5	BEARING CAP	1
6	BEARING CARTRIDGE: PER ORDER	1
7	LIP SEAL-STAINLESS MIXERS ONLY: FKM	1
8	BEARING HOUSING - KNUCKLE/FLANGE - STAINLESS/ALUMINUM	1

MOUNTING OPTIONS

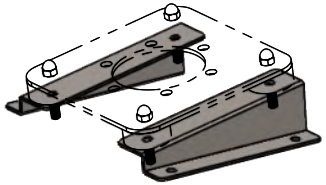
CLAMP MOUNT



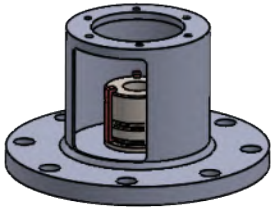
CUP PLATE



FIXED PLATE W/ ISOLATION MOUNTS



ANGLE RISERS FOR FIXED PLATE MOUNT



PEDESTAL MOUNT W/ SEAL AND FLANGE

NOTE: YOUR MIXER MAY NOT CONTAIN A GEARBOX, O-RINGS OR LIP SEALS. MATERIALS OF CONSTRUCTION MAY ALSO VARY. EVERY MIXER IS CUSTOM BUILT TO CUSTOMER REQUIREMENTS. PLEASE HAVE YOUR SERIAL NUMBER READY WHEN ORDERING PARTS.

	NAME	DATE
DRAWN	PM	06/07/22
CHECKED	DP	08/11/22

PROPRIETARY AND CONFIDENTIAL

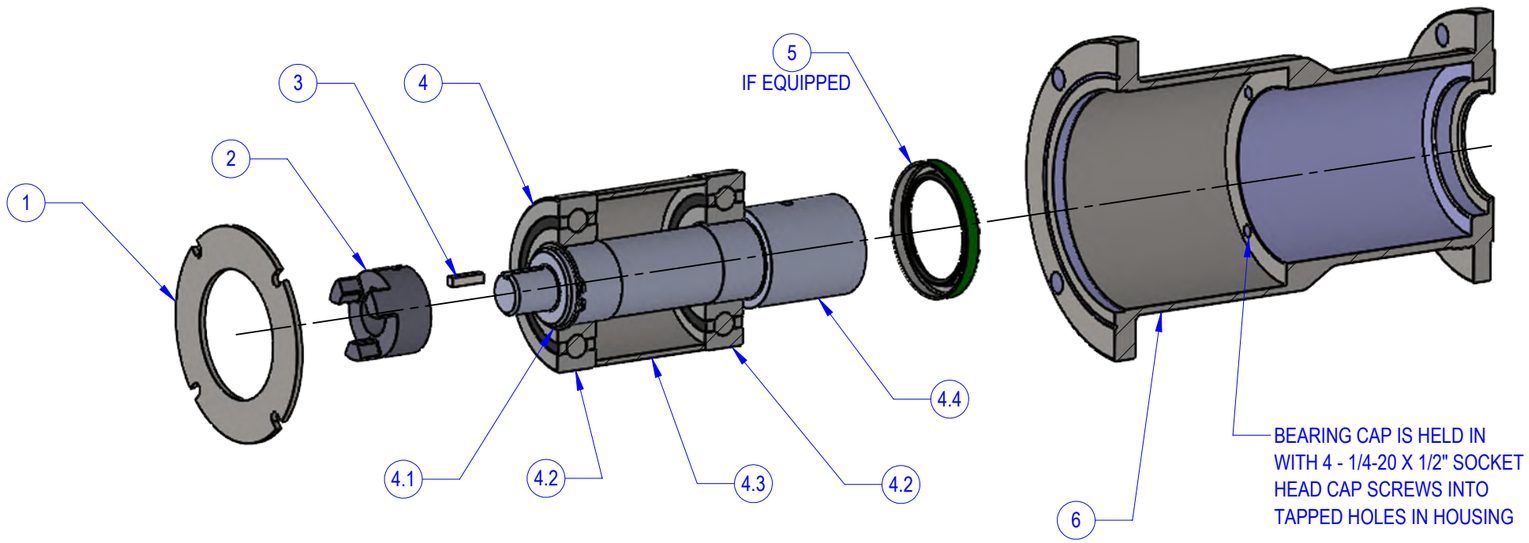
UNLESS OTHERWISE SPECIFIED:
BREAK ALL SHARP EDGES.
DIMENSIONS ARE IN INCHES.
TOLERANCES:
FRACTIONAL ± 1/16"
ANGULAR: ± 2 DEG
ONE PLACE DECIMAL ± .060"
TWO PLACE DECIMAL ± .010"
THREE PLACE DECIMAL ± .005"
DO NOT SCALE DRAWING

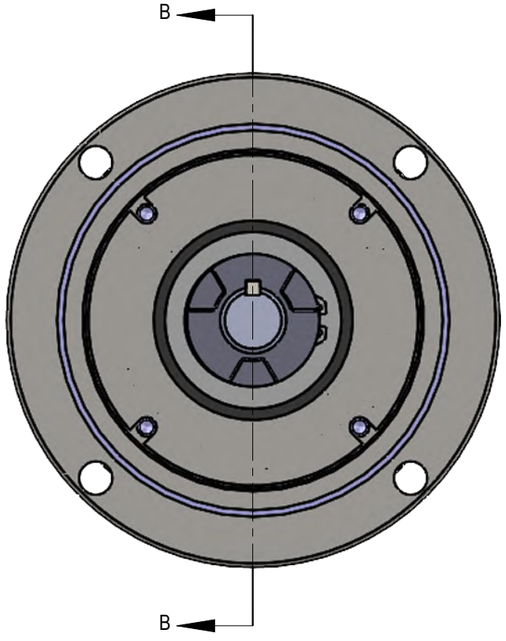
FUSION FLUID EQUIPMENT

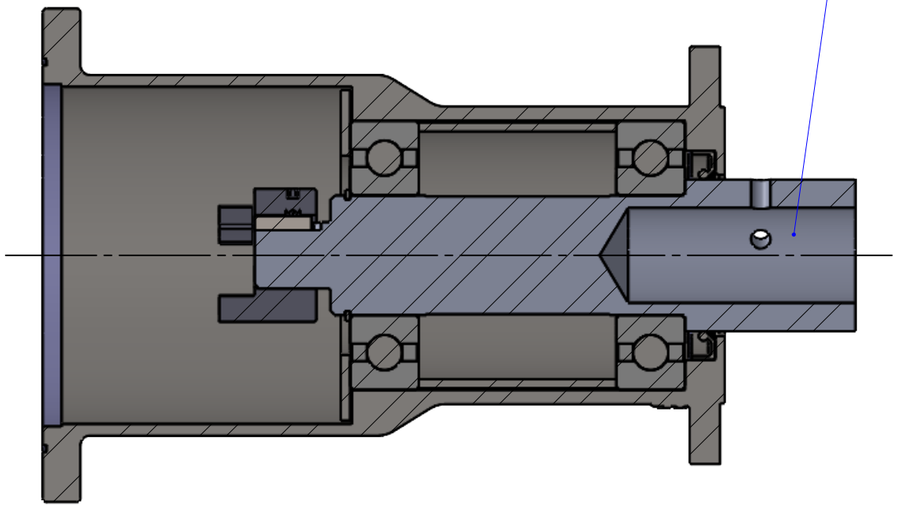
TITLE: FUSION PRO DRIVE COMPONENTS

SIZE	DWG. NO.	REV
A	GEN-ASSY-PRO	A

SCALE: 1:16 | WEIGHT: | SHEET 1 OF 1







SECTION B-B
SCALE 1 : 2

BEARING HOUSING DISASSEMBLY

1. REMOVE BEARING CAP (1) BY REMOVING 4-SCREWS HOLDING CAP IN BEARING HOUSING.
2. PRESS TO REMOVE BEARING CARTRIDGE ASSY (4) & COUPLING (2) FROM BEARING HOUSING (6).
3. REMOVE COUPLING (2) & KEY (3).
4. REMOVE INNER SNAP RING (4.1).
5. PRESS TO REMOVE UPPER BEARING (4.2), SPACER (4.3), AND LOWER BEARING (4.2) FROM THE STUB SHAFT (4.4).
6. FOR OPTIONAL LIPSEAL (PDS OR PGS ONLY) - PRESS TO REMOVE LIPSEAL (5) FROM BEARING HOUSING IF REPLACEMENT IS REQUIRED.

BEARING HOUSING REASSEMBLY

7. REVERSE OF PROCESS ABOVE.
8. IF EQUIPPED, INSERT THE SEAL (5) WITH THE SEAL FACE POINTING TOWARD THE BOTTOM OF THE BEARING HOUSING. PRESS TO SEAT THE SEAL INTO HOUSING.
9. ASSEMBLE COUPLING (2) & KEY (3) TO STUB SHAFT (4.4) BEFORE PRESSING BEARING CARTRIDGE ASSY (4) INTO BEARING HOUSING (6).
10. LUBRICATE THE INTERIOR RACE OF HOUSING WITH ANTI-SEIZE BEFORE PRESSING IN BEARING CARTRIDGE.
11. WHEN BEARING CARTRIDGE ASSY (4) IS TO BE REINSERTED, STUB SHAFT (4.4) WILL HAVE TO BE CAREFULLY INSERTED THROUGH LIPSEAL (5). NOTE ORIENTATION OF LIPS.
12. WHEN ASSEMBLING BEARING CAP (1) WITH 4-SCREWS INTO BEARING HOUSING USE SERVICE REMOVEABLE THREAD LOCKER (BLUE LOCTITE 242 OR SIMILAR).

	NAME	DATE
DRAWN	PM	06/24/22
CHECKED	DP	08/11/22

UNLESS OTHERWISE SPECIFIED:
BREAK ALL SHARP EDGES.
DIMENSIONS ARE IN INCHES.
TOLERANCES:
FRACTIONAL ± 1/16"
ANGULAR: ± 2 DEG
ONE PLACE DECIMAL ± .060"
TWO PLACE DECIMAL ± .010"
THREE PLACE DECIMAL ± .005"
DO NOT SCALE DRAWING

TITLE: TYPICAL BEARING HOUSING ARRANGEMENT PRO SERIES

SIZE	DWG. NO.	REV
B	PRO-BRG-HSG-BRKDN	A

SCALE: 1:8 | WEIGHT: | SHEET 1 OF 1

Appendix B - Component Manual Excerpts

Component Manuals are supplied for convenience and are subject to change without notice.

- Motor Manuals
  - Air Motors
    - Atlas Copco
    - Gast
  - Electric Motors
    - Baldor
    - Marathon
    - Fusion Fluid Equipment Sterling Electric
- Gearbox Manuals
  - Hub City
  - Nord
  - Sterling Electric
- Accessories
  - AD - Proximity Sensor – PNM-AP-4H
  - Invertek - VFD User Guide
  - MFD - Filter Regulator Lubricator & Flow Control Valve

Atlas Copco Air Motors

877.812.7573 info@fusionfluid.com

LZL05-RL-P-NEMA

Printed Matter No.9834 4247 00
Publication Date 2019-11-29

Air Motors

Valid from Serial No. A1820001

Safety Information

LZL05-RL-P-NEMA 8411101101

Lubrication free

Ex II 2GD h T4 IIC T110 °C X

⚠ WARNING

To reduce risk of injury, everyone using, installing, repairing, maintaining, changing accessories on, or working near this tool MUST read and understand these instructions before performing any such task.

DO NOT DISCARD - GIVE TO USER

Atlas Copco

Table of Contents

Technical Data

Technical data

Ordering No	8411101101
Model	LZL05-RL-P-NEMA
Air consumption at 3000 RPM	l/s
Air consumption at 3000 RPM	cfm
Air consumption at free speed	l/s
Air consumption at free speed	cfm
Air consumption at max output	37 l/s
Air consumption at max output	78 cfm
External parts material	Stainless steel
Free speed	9000 r/min
Inlet hose	13 mm
Inlet hose	0.5 in
Max allowed speed	r/min
Max ambient temperature	40 ºC
Max output	1.3 kW
Max output	1.7 hp
Max radial load at max output	N
Min starting torque	4.8 Nm
Min starting torque	3.5 ft lb
Mounting arrangement	
Outlet hose	20 mm
Outlet hose	1 in
Power at 3000 RPM	kW
Power at 3000 RPM	hp
Ratio	
Rotation direction	Reversible
Shaft loading code	
Speed at max output	4300 r/min
Stall torque	5.8 Nm
Stall torque	4.3 ft lb
Torque at max output	2.9 Nm
Torque at max output	2.1 ft lb
Vane type	Lubrication free
Weight	6.1 kg
Weight	13.4 lb

IP Rating

The IP Rating of the air motors refer to the mechanical casing according to the IEC 60529 standard. The IP rating does not cover corrosion resistance or any liquids other than clean freshwater.

Declarations

EU DECLARATION OF INCORPORATION AND EU DECLARATION OF CONFORMITY

We **Atlas Copco Industrial Technique AB**, S-105 23 STOCKHOLM SWEDEN, declare under our sole responsibility that this product (with name, type and serial number, see front page) fulfils the following essential requirements of Machinery Directive 2006/42/EC, and must not be put into service until the final machinery, into which it is to be incorporated, has been declared in conformity with that Directive. It is in conformity with the following Directive(s):
2006/42/EC (Annex I, clauses 1.1, 1.2 (excluding 1.2.4.3), 1.3, 1.4, 1.5, 1.6, 1.7), 2014/34/EU

Harmonized standards applied:
DIN EN 1127-1:2011 DIN EN ISO 12100:2010 EN ISO 80079-36:2016 EN ISO 80079-37:2016

The relevant technical documentation was compiled and was communicated in accordance with Machinery Directive 2006/42/EC part B of Annex VII and ATEX Directive 2014/34/EU Article 13 (1) b) ii in the Notified Body SP (EU Identification No 04 02) in Sweden. Authorities can request the technical file 9836 4610 00 for ATEX Directive 2014/34/EU in paper form from:
Product Compliance Manager, Atlas Copco Industrial Technique AB, S-105 23 Stockholm Sweden

Stockholm, 25 October 2019

Carl von Schantz, Managing Director

Signature of issuer

Disclaimer

- ATEX:

  In order for the ATEX code Ex II 2GD h T4 IIC T110 ºC X to be valid, the motor must not be operated at a speed above 5000 rpm.

- Non lubricated operation:

  The motor shall not be operated at a speed above 3000 rpm.

Information regarding Article 33 in REACH

The European Regulation (EU) No. 1907/2006 on Registration, Evaluation, Authorization and restriction of Chemicals (REACH) defines among other things requirements related to communication in the supply chain. The information requirement applies also to products containing so called Substances of Very High Concern (the “Candidate List”). On 27 June 2018 lead metal (CAS nr 7439-92-1) was added to the Candidate List.

In accordance with the above this is to inform you that certain mechanical components in the product may contain lead metal. This is in compliance with current substance restriction legislation and based on legit exemptions in the RoHS Directive (2011/65/EU). Lead metal will not leak or mutate from the product during normal use and the concentration of lead metal in the complete product is well below the applicable threshold limit. Please consider local requirements on the disposal of lead at product end of life.

Regional Requirements

⚠ WARNING

This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Safety

DO NOT DISCARD - GIVE TO USER

⚠ WARNING Read all safety warnings, instructions, illustrations and specifications provided with this product.

Failure to follow all instructions listed below may result in electric shock, fire, property damage and/or serious injury.

Save all warnings and instructions for future reference.

⚠ WARNING All locally legislated safety rules regarding installation, operation and maintenance shall be respected at all times.

Statement of Use

- For professional use only.
- This product and its accessories must not be modified in any way.
- Do not use this product if it has been damaged.
- If the product data or hazard warning signs on the product cease to be legible or become detached, replace without delay.
- The product must only be installed, operated and serviced by qualified personnel in an industrial environment.

Intended Use

This motor is designed to be incorporated into a fixed or moving machine. It is either for right hand rotation only, left hand rotation only, or reversible rotation and should be mounted by the flange or threaded nose only, as appropriate. No other use permitted.

The risk of motors being the source of ignition of a potentially explosive atmosphere is extremely small. The user is responsible for assessing the risks associated with the whole machine into which the motor is to be incorporated.

Product Specific Instructions

Warning

⚠ WARNING Polymer hazard

The vanes in this product contain PTFE (a synthetic fluoropolymer). Due to wear, there might be PTFE particles inside the product. Heated PTFE can produce fumes which may cause polymer fume fever with flu-like symptoms, especially when smoking contaminated tobacco.

Health and Safety recommendations for PTFE must be followed when handling vanes and other components:

- ► Do not smoke when servicing this product
- ► PTFE-particles must not come in contact with open fire, glow or heat
- ► Motor components must be washed with cleaning fluid and not blown clear with an air line
- ► Wash your hands before starting any other activity

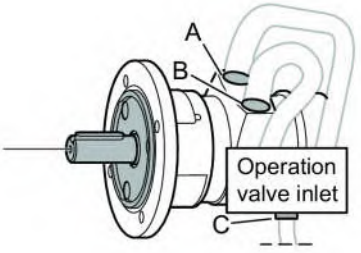
Rotation

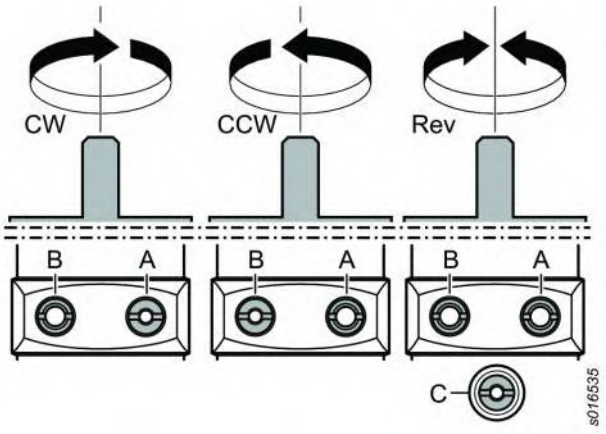
⚠ WARNING Never run the motor without the restriction plates in place!

The restriction plates must be assembled on the engine in order for ATEX to be valid. If the restriction plates are removed, the motor will become overheated when in use.

Restrictors

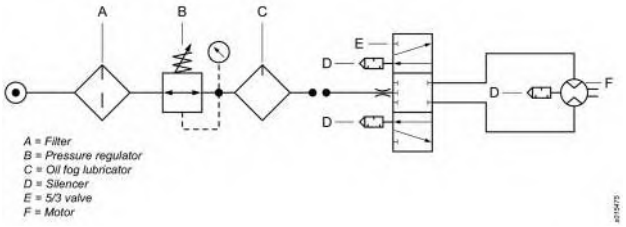
To achieve clockwise (CW) or counter clockwise (CCW) rotation, mount selected restrictor plates at the inlet/ outlet ports A and B. For reversible rotation (Rev) mount restrictor plates at the inlet port C and at the outlet ports A and B.





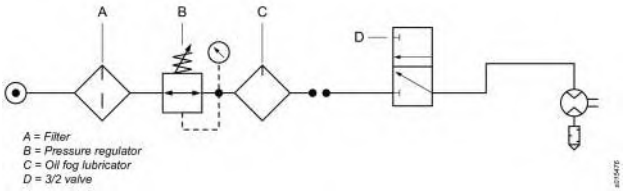
Installation diagram

Reversible motor

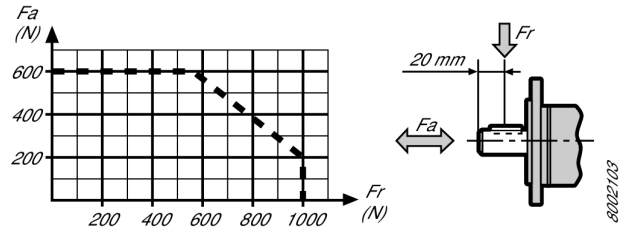


Installation diagram

Non-Reversible motor



Shaft load diagram



Hot Spots

The following hotspots on the air motor can reach high temperatures during operation:

- motor housing
- seal ring at the output shaft

The highest temperatures occur when the air motor is running at full pressure without load. With increasing torque, the air motor reduces the rotational speed and the temperature.

Warning

Make sure you are familiar with the operating instructions before you use this motor.

This motor, its attachments and accessories must only be used for the purpose for which they were designed.

For product liability and safety reasons any modification to the motor or its accessories, which may have an influence on the product liability, must be agreed upon by the technical authority of the manufacturer.

To prevent personal injury and long term risks:

- If the motor is ATEX-certified, filter/silencers must be installed at the motor outlet ports.

  Silencers are recommended also for other applications to reduce noise exposure.
- Disconnect the motor from the air line before any adjustment operation.
- **Mind your hands, hair and clothing – always keep well away from rotating parts.**

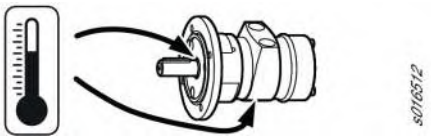
Overhaul

The air motor must be deactivated and inspected whenever there is the slightest indication of a fault. The service interval will vary, depending on motor speed and air quality. The first vane inspection should be carried out after 500 hours' running time. Inspect wear and tear of the vanes via the outlet port. If the vane's tapered part appear to be worn, we recommend service of the motor.

Maintenance

Maintenance and repairs of this ATEX product must be carried out exclusively by authorised personnel, after which a no-load test and temperature measurements of hotspots (as seen in the figure) must be carried out and recorded in a report.

After a 5 min no-load test the surface temperature must not exceed the sum of 45°C + surrounding temperature, where the surrounding temperature can vary up to max 40°C.



General safety instructions

To reduce risk of injury, everyone using, installing, repairing, maintaining, changing accessories on, or working near this tool must read and understand these instructions before performing any such task.

Our goal is to produce tools that help you work safely and efficiently. The most important safety device for this or any tool is YOU. Your care and good judgment are the best protection against injury. All possible hazards cannot be covered here, but we have tried to highlight some of the important ones.

- Only qualified and trained operators should install, adjust or use this power tool.
- This tool and its accessories must not be modified in any way.
- Do not use this tool if it has been damaged.
- If the rated speed, operating pressure or hazard warning signs on the tool cease to be legible or become detached, replace without delay.

For additional safety information consult:

- Other documents and information packed with this tool.
- Your employer, union and / or trade association.
- Further occupational health and safety information can be obtained from the following web sites:
  - http://www.osha.gov (USA)
  - https://osha.europa.eu/ (Europe)

Air supply and connection hazards

- Air under pressure can cause severe injury.
- Always shut off air supply, drain hose of air pressure and disconnect tool from air supply when not in use, before changing accessories or when making repairs.
- Never direct air at yourself or anyone else.
- Whipping hoses can cause severe injury. Always check for damaged or loose hoses and fittings.
- Do not exceed maximum air pressure of 6.3 bar / 90 psig, or as stated on tool nameplate.

Entanglement hazards

- Keep away from rotating drive. Choking, scalping and / or lacerations can occur if loose clothing, gloves, jewellery, neck ware and hair are not kept away from tool and accessories.

Projectile hazards

- Always wear impact-resistant eye and face protection when involved with or near the operation, repair or maintenance of the tool or changing accessories on the tool.
- Be sure all others in the area are wearing impact-resistant eye and face protection. Even small projectiles can injure eyes and cause blindness.
- Ensure the workpiece is securely fixed.

Operating hazards

- Clamp the tool securely.
- Ensure the tool is at a complete stop before removing work.
- Always fit start, stop and emergency stop controls to the machine into which the motor/torque motor is incorporated.

Noise hazards

- High sound levels can cause permanent hearing loss and other problems such as tinnitus. Use hearing protection as recommended by your employer or occupational health and safety regulations.
- To prevent unnecessary increases in noise levels operate and maintain the tool, and select, maintain and replace the accessories and consumables, in accordance with this instruction manual.

Workplace hazards

- Slip/Trip/Fall is a major cause of serious injury or death. Be aware of excess hose left on the walking or work surface.
- Avoid inhaling dust or fumes or handling debris from the work process which can cause ill health (for example, cancer, birth defects, asthma and/or dermatitis). Use dust extraction and wear respiratory protective equipment when working with materials which produce airborne particles.
- Some dust created by power sanding, sawing, grinding, drilling and other construction activities contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Some examples of these chemicals are:
  - Lead from lead based paints
  - Crystalline silica bricks and cement and other masonry products
  - Arsenic and chromium from chemically-treated rubber

  Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: work in a well ventilated area, and work with approved safety equipment, such as dust masks that are specially designed to filter out microscopic particles.
- Proceed with care in unfamiliar surroundings. Be aware of potential hazards created by your work activity. This tool is not insulated from coming into contact with electric power sources.

DO NOT DISCARD – GIVE TO USER

Signs and stickers

The product is fitted with signs and stickers containing important information about personal safety and product maintenance. The signs and stickers shall always be easy to read. New signs and stickers can be ordered by using the spare parts list.

s011050

ATEX Certification Information

ATEX Code Definition

The ATEX code is:

Ex II 2GD h T4 IIC T110 °C X
°C ≤ Ta ≤ 40 °C

Description	Value	Definition
Equipment group	**II**	Surface Industry

Description	Value	Definition
Equipment category **Group II**	**2**	High level of protection • zone 1 (gas) • zone 2 (gas) • zone 21 (dust) • zone 22 (dust)
Atmosphere	**G**	Atmosphere containing Gas, Vapors or Mist
	D	Atmosphere containing Dust
Safety design	**h**	Mechanical product
Gas group	**IIC**	Hydrogene/ Acetylene
	IIB	Ethylene
Max surface temperature in **Gas** atmosphere		**T1** = 450°C **T2** = 300°C **T3** = 200°C **T4** = 135°C **T5** = 100°C **T6** = 85°C
Max surface temperature in **Dust** atmosphere		Example temperatures: T85°C T110°C T120°C T125°C T240°C
Special restriction, for example ambient temperature range.	**X**	

Temperatures

- The maximum surrounding temperature for which the certification is valid is 40°C.
- 40°C is also the maximum allowed temperature of the compressed air when it enters the product.
- If the product is installed in an equipment, the entire equipment has to correspond to the guidelines 2014/34/EU.
- Make sure that the compressed air fulfil our quality demands (quality classes 2.4.3. and 3.4.4 respectively 3.5.4 acc. to ISO/DIS 8573-1:2010).
- Do not exceed maximum pressure of 6.3 bar, or as stated on the product nameplate. Exceeding the operating pressure can increase the surface temperature due to higher rotating speed and the product can become an ignition source.

Ex Classification

If the product is part of an assembly where the components have different Ex classification, the component with the lowest level of safety defines the Ex classification of the complete assembly.

Explosion Prevention Guidelines

Cleanliness

- Make sure the product is kept clean from dust and dirt to prevent increased bearing and surface temperature.
- If using a silencer: Make sure a silencer with a filtering effect at the air outlet is installed to prevent any friction-heated particles entering into the surrounding atmosphere.

Usage

- Make sure the product is earthed to the equipotential bonding system of the workshop, for example through accessories such as hoses and air-pressure connections.
- It is the responsibility of the user to make sure that the product and all possible accessories, such as wrenches and air connections, conform to the national safety regulations for equipment used in potentially explosive areas.

Useful Information

Website

Information concerning our Products, Accessories, Spare Parts and Published Matters can be found on the Atlas Copco website.

Please visit: www.atlascopco.com.

ServAid

ServAid is a portal that is continuously updated and contains Technical Information, such as:

- Regulatory and Safety Information
- Technical Data
- Installation, Operation and Service Instructions
- Spare Parts Lists
- Accessories
- Dimensional Drawings

Please visit: https://servaid.atlascopco.com.

For further Technical Information, please contact your local Atlas Copco representative.

Caractéristiques techniques

Caractéristiques techniques

Référence	8411101101
Modèle	LZL05-RL-P-NEMA

LZL05-RL-P-NEMA

Printed Matter No. 9839 1086 01
Publication Date 2019-11-06

Air Motors

Valid from Serial No. A8400001
Valid to Serial No. A1779999

Product Instructions

LZL05-RL-P-NEMA 8411101101

Lubrication free

Ex II 2GD c T4 IIC T110 °C X

⚠ WARNING

Read all safety warnings and instructions

Failure to follow the safety warnings and instructions may result in electric shock, fire and/or serious injury.

Save all warnings and instructions for future reference

Atlas Copco

Table of Contents

Product information

General information

⚠ WARNING Risk of Property Damage or Severe Injury

Ensure that you read, understand and follow all instructions before operating the tool. Failure to follow all the instructions may result in electric shock, fire, property damage and/or severe bodily injury.

- ► Read all Safety Information delivered together with the different parts of the system.
- ► Read all Product Instructions for installation, operation and maintenance of the different parts of the system.
- ► Read all locally legislated safety regulations regarding the system and parts thereof.
- ► Save all Safety Information and instructions for future reference.

Safety signal words

The safety signal words Danger, Warning, Caution, and Notice have the following meanings:

DANGER	DANGER indicates a hazardous situation which, if not avoided, **will** result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.
CAUTION	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE is used to address practices not related to personal injury.

Warranty

- Product warranty will expire 12 months after the product is first taken into use, but will in any case expire at the latest 13 months after delivery.
- Normal wear and tear on parts is not included within the warranty.
  - Normal wear and tear is that which requires a part change or other adjustment/overhaul during standard tools maintenance typical for that period (expressed in time, operation hours or otherwise).
- The product warranty relies on the correct use, maintenance, and repair of the tool and its component parts.
- Damage to parts that occurs as a result of inadequate maintenance or performed by parties other than Atlas Copco or their Certified Service Partners during the warranty period is not covered by the warranty.
- To avoid damage or destruction of tool parts, service the tool according to the recommended maintenance schedules and follow the correct instructions.
- Warranty repairs are only performed in Atlas Copco workshops or by Certified Service Partners.

Atlas Copco offers extended warranty and state of the art preventive maintenance through its ToolCover contracts. For further information contact your local Service representative.

For electrical motors:

- Warranty will only apply when the electric motor has not been opened.

ServAid

ServAid is a portal that contains technical information for all hardware and software products such as:

- Safety Information including declarations, standards and directives

- Technical data

- Installation, Operation and Service Instructions
- Spare parts lists
- Accessories

ServAid is continuously updated and is available at:
https://servaid.atlascopco.com

For further information contact your local Atlas Copco representative.

Website

Log in to Atlas Copco: www.atlascopco.com.

You can find information concerning our products, accessories, spare parts and published matters on our website.

Safety Data Sheets MSDS/SDS

The safety data sheets describes chemical products sold by Atlas Copco.

For more information, consult the website:
www.atlascopco.com
Choose **Products** - **Safety Data Sheets**, and follow the instructions on the page.

Warning

⚠ **WARNING Polymer hazard**

The vanes in this product contain PTFE (a synthetic fluoropolymer). Due to wear, there might be PTFE particles inside the product. Heated PTFE can produce fumes which may cause polymer fume fever with flu-like symptoms, especially when smoking contaminated tobacco.

Health and Safety recommendations for PTFE must be followed when handling vanes and other components:

- ► Do not smoke when servicing this product
- ► PTFE-particles must not come in contact with open fire, glow or heat
- ► Motor components must be washed with cleaning fluid and not blown clear with an air line
- ► Wash your hands before starting any other activity

Country of origin

Please refer to the information on the product label.

Dimensional drawings

For information about the dimensions of a product, see the Dimensional drawings archive:

http://webbox.atlascopco.com/webbox/dimdrw

Overview

Technical data

Ordering No	8411101101
Model	LZL05-RL-P-NEMA
Air consumption at 3000 RPM	l/s
Air consumption at 3000 RPM	cfm
Air consumption at free speed	l/s

Air consumption at free speed	cfm
Air consumption at max output	37 l/s
Air consumption at max output	78 cfm
External parts material	Stainless steel
Free speed	9000 r/min
Inlet hose	13 mm
Inlet hose	0.5 in
Max allowed speed	r/min
Max ambient temperature	40 ºC
Max output	1.3 kW
Max output	1.7 hp
Max radial load at max output	N
Min starting torque	4.8 Nm
Min starting torque	3.5 ft lb
Mounting arrangement	
Outlet hose	20 mm
Outlet hose	1 in
Power at 3000 RPM	kW
Power at 3000 RPM	hp
Ratio	
Rotation direction	Reversible
Shaft loading code	
Speed at max output	4300 r/min
Stall torque	5.8 Nm
Stall torque	4.3 ft lb
Torque at max output	2.9 Nm
Torque at max output	2.1 ft lb
Vane type	Lubrication free
Weight	6.1 kg
Weight	13.4 lb

Service overview

Service recommendations

Preventive maintenance is recommended at regular intervals. See the detailed information on preventive maintenance. If the product is not working properly, take it out of service and inspect it.

If no detailed information about preventive maintenance is included, follow these general guidelines:

- Clean appropriate parts accurately
- Replace any defective or worn parts

Overhaul

The air motor must be deactivated and inspected whenever there is the slightest indication of a fault. The service interval will vary, depending on motor speed and air quality. The first vane inspection should be carried out after 500 hours' running time. Inspect wear and tear of the vanes via the outlet port. If the vane's tapered part appear to be worn, we recommend service of the motor.

ATEX certification information

Temperatures

- The maximum surrounding temperature for which the certification is valid is 40°C.
- 40°C is also the maximum allowed temperature of the compressed air when it enters the product.
- If the product is installed in an equipment, the entire equipment has to correspond to the guidelines 2014/34/EU.
- Make sure that the compressed air fulfil our quality demands (quality classes 2.4.3. and 3.4.4 respectively 3.5.4 acc. to ISO/DIS 8573-1).
- Do not exceed maximum pressure of 6.3 bar, or as stated on the product nameplate. Exceeding the operating pressure can increase the surface temperature due to higher rotating speed and the product can become an ignition source.

Disclaimer

- ATEX:

  In order for the ATEX code Ex II 2GD c T4 IIC T110 °C X to be valid, the motor must not be operated at a speed above 5000 rpm.
- Non lubricated operation:

  The motor shall not be operated at a speed above 3000 rpm.

Ex Classification

If the product is part of an assembly where the components have different Ex classification, the component with the lowest level of safety defines the Ex classification of the complete assembly.

ATEX code definition

The ATEX code is:	
	Ex II 2GD c T4 IIC T110 °C X

Description	Value	Definition
Equipment group	**II**	Surface Industry
Equipment category **Group II**	**2**	High level of protection ■ zone 1 (gas) ■ zone 2 (gas) ■ zone 21 (dust) ■ zone 22 (dust)
Atmosphere	**G**	Atmosphere containing Gas, Vapors or Mist
	D	Atmosphere containing Dust
Safety design	**c**	Constructional safety
Gas group	**IIC**	Hydrogene/ Acetylene
	IIB	Ethylene

Description	Value	Definition
Max surface temperature in **Gas** atmosphere		**T1** = 450°C **T2** = 300°C **T3** = 200°C **T4** = 135°C **T5** = 100°C **T6** = 85°C
Max surface temperature in **Dust** atmosphere		Example temperatures: T85°C T110°C T120°C T125°C T240°C

Explosion prevention guidelines

Cleanliness

- Make sure the product is kept clean from dust and dirt to prevent increased bearing and surface temperature.
- If using a silencer: Make sure a silencer with a filtering effect at the air outlet is installed to prevent any friction-heated particles entering into the surrounding atmosphere.

Usage

- Make sure the product is earthed to the equipotential bonding system of the workshop, for example through accessories such as hoses and air-pressure connections.
- It is the responsibility of the user to make sure that the product and all possible accessories, such as wrenches and air connections, conform to the national safety regulations for equipment used in potentially explosive areas.

Installation

Installation requirements

Air quality

- For optimum performance and maximum product life we recommend the use of compressed air with a maximum dew point of +10°C (50°F). We also recommend to install an Atlas Copco refrigeration type air dryer.
- Use a separate air filter which removes solid particles larger than 30 microns and more than 90% of liquid water. Install the filter as close as possible to the product and prior to any other air preparation units to avoid pressure drop.

For impulse/impact tools make sure to use lubricators adjusted for these tools. Regular lubricators will add too much oil and therefore decrease the tool performance due to too much oil in the motor.

Make sure that the hose and couplings are clean and free from dust before connecting to the tool.

Both lubricated and lubrication free products will benefit from a small quantity of oil supplied from a lubricator.

Air lubrication

Brand	Air lubrication
Mobil	Mobil SHC Cibus 32

Compressed air connection

⚠ WARNING Compressed air can cause serious injury

- ► Always shut off the air supply, drain hose of air pressure and disconnect the tool from air supply; when not in use, before making any adjustments to the product - for example changing accessories, or when making repairs.

⚠ WARNING Whipping hoses can cause serious injury

- ► Always make sure that there are no damaged or loose hoses or fittings.

⚠ WARNING Compressed Air

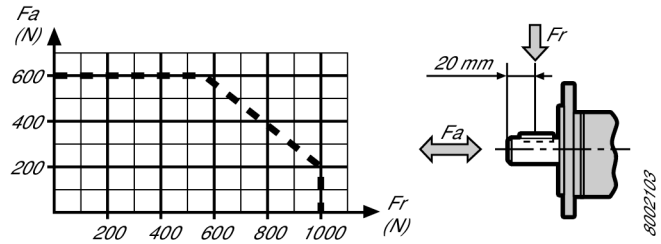
High air pressure can cause severe damage and bodily injury.

- ► Do not exceed maximum air pressure.
- ► Make sure that there are no damaged or loose hoses or fittings.

For correct air pressure and hose size, see section **Technical data**.

Make sure that the hose and couplings are clean and free from dust before connecting to the tool.

Shaft load diagram



Shaft load

- Make sure that the maximum shaft load is not exceeded, in order to prevent an excessive increase of the bearing temperature.

Installation instructions

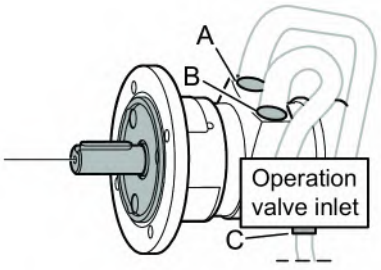
Rotation

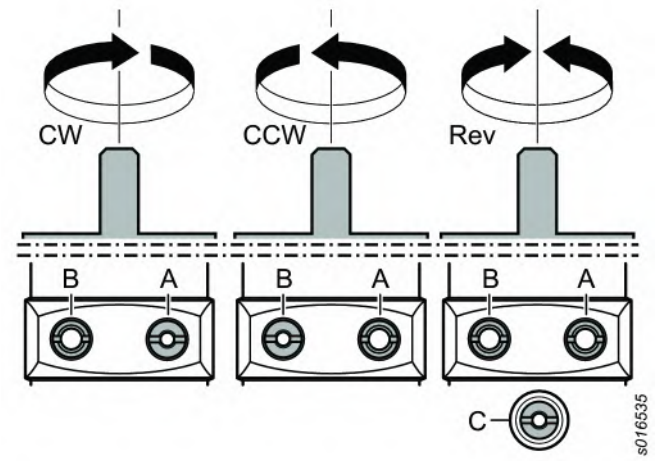
⚠ **WARNING Never run the motor without the restriction plates in place!**

The restriction plates must be assembled on the engine in order for ATEX to be valid. If the restriction plates are removed, the motor will become overheated when in use.

Restrictors

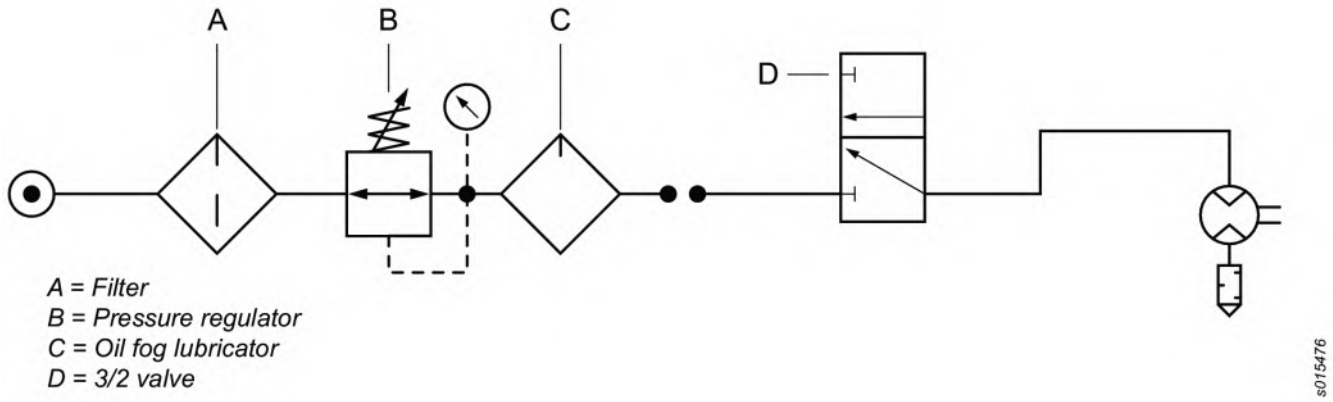
To achieve clockwise (CW) or counter clockwise (CCW) rotation, mount selected restrictor plates at the inlet/ outlet ports A and B. For reversible rotation (Rev) mount restrictor plates at the inlet port C and at the outlet ports A and B.





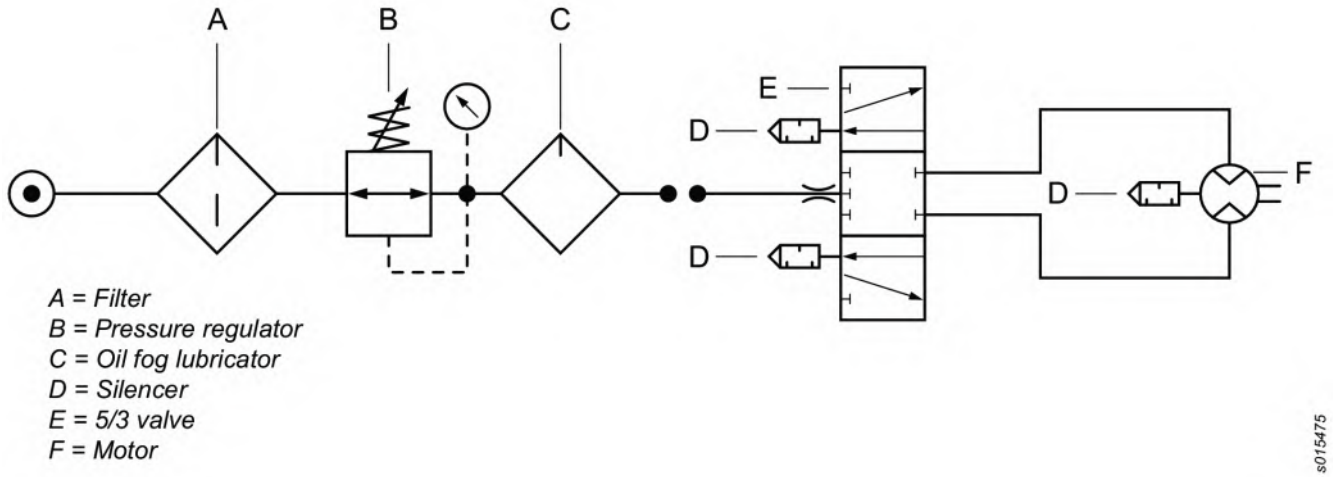
Installation diagram

Non-Reversible motor



Installation diagram

Reversible motor



Operation

Ergonomic guidelines

Consider your workstation as you read through this list of general ergonomic guidelines and see if you can identify areas for improvement in posture, component placement, or work environment.

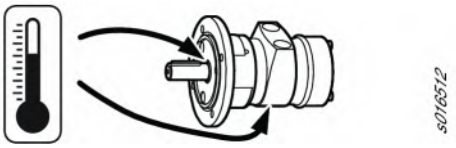
- Take frequent breaks and change work positions frequently.
- Adapt the work area to your needs and the work task.
  - Adjust for convenient reach range by determining where parts or tools should be located to avoid static load.
  - Use workstation equipment such as tables and chairs appropriate for the work task.
- Avoid work positions above shoulder level or with static holding during assembly operations.
  - When working above shoulder level, reduce the load on the static muscles by reducing the weight of the load. You can also reduce the load on the static muscles by holding the load close to the body.
  - Make sure to take frequent breaks.
  - Avoid extreme arm or wrist postures, particularly for operations requiring a degree of force.
- Adjust for convenient field of vision by minimizing movement of the eyes and head during the work task.
- Use the appropriate lighting for the work task.
- Use ear protection equipment in noisy environments.
- Use dust extraction system or mouth protection mask in dusty environments.

Operating instructions

Hot Spots

The following hotspots on the air motor can reach high temperatures during operation:

- motor housing
- seal ring at the output shaft



The highest temperatures occur when the air motor is running at full pressure without load. With increasing torque, the air motor reduces the rotational speed and the temperature.

Service

Maintenance instructions

Service recommendations

Preventive maintenance is recommended at regular intervals. See the detailed information on preventive maintenance. If the product is not working properly, take it out of service and inspect it.

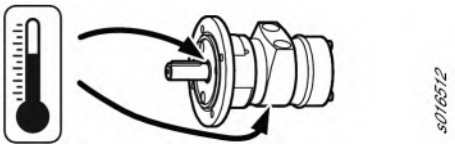
If no detailed information about preventive maintenance is included, follow these general guidelines:

- Clean appropriate parts accurately
- Replace any defective or worn parts

Maintenance

Maintenance and repairs of this ATEX product must be carried out exclusively by authorised personnel, after which a no-load test and temperature measurements of hotspots (as seen in the figure) must be carried out and recorded in a report.

After a 5 min no-load test the surface temperature must not exceed the sum of 45°C + surrounding temperature, where the surrounding temperature can vary up to max 40°C.



Lubrication instructions

Rust protection and cleaning

Water in the compressed air can cause rust. To prevent rust we strongly recommend to install an air dryer.

Water and particles can cause sticking of vanes and valves. This can be prevented by installing an air filter close to the product to avoid pressure drop.

Before longer standstills always protect your tool by adding a few drops of oil into the air inlet. Run the tool for 5–10 seconds and absorb any access oil at the air outlet in a cloth.

Grease guide

Brand	Grease
Shell	AeroShell Grease 22

LZL models 03-05 M

Brand	Grease
Shell	Shell Gadus S2 V100 2
Shell	Shell Gadus S2 V220 2

LZL seal rings

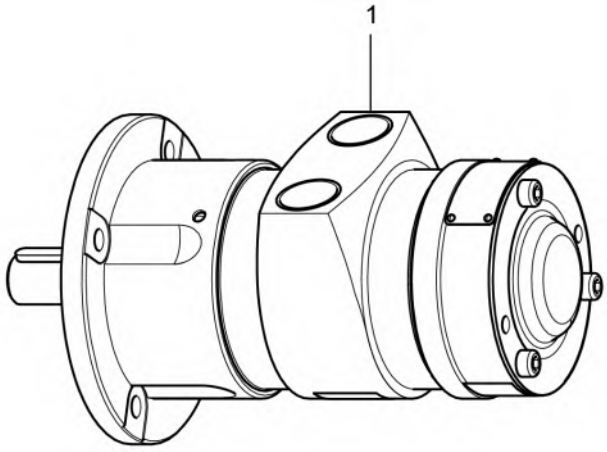
Lubrication

Planetary gears, ball- and needle bearings and seal ring should be lubricated with grease in conjunction with the regular overhaul of the motor.

Always use lubricants of good quality. The oils and greases mentioned in the chart are examples of lubricants which are recommended.

Recycling

Recycling information



	Part:	Recycle as:
1	LZL complete	Stainless steel*

*The rotor blades (vanes) in the product contains PTFE, the normal health and safety recommendations concerning PTFE must be observed.

Recycling instruction

When a product has served its purpose it has to be recycled properly. Dismantle the product and recycle the components in accordance with local legislation.

Batteries shall be taken care of by your national battery recovery organization.

Original instructions

Atlas Copco Industrial Technique AB
SE-10523 STOCKHOLM
Sweden
Telephone: +46 8 743 95 00
Telefax: +46 8 644 90 45
www.atlascopco.com

Gast Air Motors

877.812.7573 info@fusionfluid.com

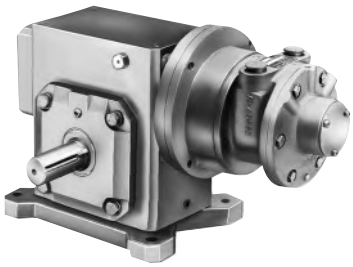
Part No. 45-200 D170 (Rev. T)

AM SERIES AIR MOTORS

Operation and Maintenance Manual

Model 2AM Shown

Model 4AM Shown



Model 6AM Shown

Model 16AM Shown

Thank you for purchasing this Gast product. It is manufactured to the highest standards using quality materials. **This manual includes general safety instructions for operation under normal conditions and for operation in hazardous conditions.** Please follow all recommended maintenance, operational and safety instructions and you will receive years of trouble-free service.

⚠ WARNING

PLEASE READ THIS MANUAL COMPLETELY BEFORE INSTALLING AND USING THIS PRODUCT. SAVE THIS MANUAL FOR FUTURE REFERENCE AND KEEP IN THE VICINITY OF THE PRODUCT.

General Information:
Operating Pressure Limits

Lubricated Models	Pressure	LL and NLP Models	Pressure
1AM	100 psi / 7 bar	1AM	80 psi / 5.5 bar
1UP	80 psi / 5.6 bar	1UP	65 psi / 4.9 bar
2AM	100 psi / 7 bar	2AM	80 psi / 5.5 bar
4AM	100 psi / 7 bar	4AM	80 psi / 5.5 bar
6AM	100 psi / 7 bar	6AM	80 psi / 5.5 bar
8AM	100 psi / 7 bar	8AM	80 psi / 5.5 bar
16AM	100 psi / 7 bar	16AM	80 psi / 5.5 bar

Product Use Criteria:

- Non-hazardous conditions: Operate at ambient temperatures up to 250ºF (121ºC).
- Hazardous conditions: Operate at ambient temperatures up to 104ºF (40ºC).
- Protect unit from dirt and moisture.
- Use ONLY compressed air to drive motor.
- Air lines connected to motor should be the same size or the next size larger than the inlet port for efficient output and speed control.
- Protect all surrounding items from exhaust air.
- Bearings are grease packed.
- Use Gast #AD220 or a detergent SAE#10 automotive engine oil for lubricating.
- Motors are to be used in commercial installations only.
- **⟨Ex⟩ This symbol appears on labels of air motors that are designed for use in hazardous atmospheres. These air motors comply with the applicable standards and specifications and meet the requirements of the guidelines of the Directive 2014/34/EU. They are intended to be used in zones 1 and 2 where explosive atmospheres are likely to occur.**
- Air supply, directional control valve and pressure regulator should be selected based upon the air consumption of the motor.

GAST

A UNIT OF IDEX CORPORATION

www.gastmfg.com

ISO 9001 CERTIFIED

Your safety and the safety of others is extremely important.

We have provided many important safety messages in this manual and on your product. Always read and obey safety messages.

This is the safety alert symbol. This symbol alerts you to hazards that can kill or hurt you and others. The safety alert symbol and the words "DANGER" and "WARNING" will preceed all safety messages. These words mean:

⚠ DANGER

You will be killed or seriously injured if you don't follow instructions.

⚠ WARNING

You can be killed or seriously injured if you don't follow instructions.

All safety messages will identify the hazard, tell you how to reduce the chance of injury, and tell you what can happen if the safety instructions are not followed.

CODE SYMBOLS

	Hazard. Possible consequences: death or severe injuries
	Hazardous Situation. Possible consequences: slight or mild injuries
STOP	**Dangerous Situation.** Possible consequences: damage to the drive or the environment
Ex	**Important instructions on protection against explosion**

Improper environment, installation and operation can result in severe personal injury and/or damage to property.

Qualified personnel must perform all work to assemble, install, operate, maintain and repair air motor.

Qualified personnel must follow:

- These instructions and the warning and information labels on the motor.
- All other drive configuration documents, startup instructions and circuit diagrams.
- The system specific legal regulations and requirements.
- The current applicable national and regional specifications regarding explosion protection, safety and accident prevention.

Complete the following checklist prior to starting installation in a hazardous area. All actions must be completed in accordance with Directive 2014/34/EU.

Checklist for installation in hazardous areas:

_____ Read air motor label to check that motor has been designed for use in a hazardous application:
- Hazardous zone
- Hazardous category
- Equipment group
- Temperature class
- Maximum surface temperatures

Example:
Model designation: 1UP-NRV-10
Year manufactured: 2003
Ex II 2GD
Ex h IIC T4 Gb
Ex IIIC T135°C Db
Benton Harbor, MI USA
Telephone: 269.926.6171

*** Legend:**
II: Equipment group II
2: Equipment category 2
G: Gas atmospheres
D: Dust atmospheres
b: EPL b.
Max. surface temp. 275ºF/135ºC
Ambient range (Ta) +1Cº to +40ºC (34ºF/104ºF)

_____ Check the site environment for potentially explosive oils, acids, gases, vapors or radiation

_____ Check the ambient temperature of the site and the ability to maintain proper ambient temperature.
Ambient range:
Non-hazardous conditions: 34ºF/1ºC to 250ºF/121ºC
Hazardous conditions: 34ºF/1ºC to 104ºF/40ºC

_____ Check the site to make sure that the air motor will be adequately ventilated and that there is no external heat input (e.g. couplings). The cooling air may not exceed 104ºF/40ºC.

_____ Check that products to be driven by the air motor meet ATEX approval.

_____ Check that the air motor is not damaged.

INSTALLATION

Correct installation is your responsibility. Make sure you have the proper installation conditions.

⚠ WARNING

Injury Hazard

Install proper guards around output shaft as needed.

Air stream from product may contain solid or liquid materials that can result in eye or skin damage.

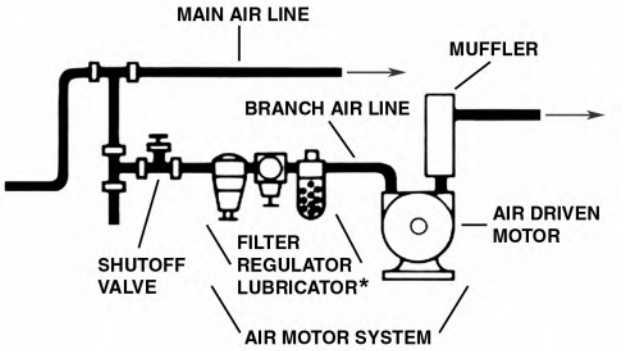
Wear eye protection when installing this product.

Failure to follow these instructions can result in serious injury or property damage.

Mounting

This product can be installed in any orientation. Mount the motor to a solid metal base plate that is mounted to a stable, rigid operating surface. Use shock mounts to reduce noise and vibration. Install a pressure regulator or simple shut-off valve to control motor.

Connection



Check the direction of the motor airflow. A single rotation motor will operate properly only in one direction. Single rotation motors require a sound absorber to be connected to the air port. Remove the plastic shipping plugs from the ports. Save plugs for future use during shutdown.

Install a 5-micron filter in the air line before the connection to the motor. Next install an air pressure regulator to control motor speed and torque.

For lubricated operation: Air motors with an "LL" or "NLP" designation in the model number can operate with or without lubrication. For optimal service and life, lubrication is recommended.

An automatic air line lubricator should be installed in the air line as close as possible and no more than 18 inches (1/2 meter) from the air motor. Install the lubricator level with or above the air motor so that the oil mist will blow directly into or fall down into the motor.

Fill the oil reservoir to the proper level with Gast #AD220 or SAE 10W high detergent or non-detergent motor oil. For food processing applications, use an FDA-approved, food-grade lubricant. Adjust lubricator to feed 1 drop of oil for every 50 CFM of air while the unit is running, or 1 drop of oil per continuous minute of run time. Do Not overfeed oil or exhaust air may become contaminated.

Clean the compressed air connection with low pressure air to remove any dirt from the line before connecting to the ports.

Use the proper sized fasteners. For the most efficient output and control of speed, use air lines that are the same size as the motor inlet port if the connection is less than 7 feet (2 meters). For longer connections, use the next pipe size larger than the motor intake port. Connect lines to motor in the proper direction.

A reversible motor will work equally well in both directions. Connect a 4-way valve with piping to both air ports of motor to make reversing possible. Connect the sound absorber on the exhaust air port or valve connection.

Do not add any thrust to the end or side of the shaft when making connections.

Do not use a hammer on the shaft or connections.

Lubricating the drive shaft will make assembly easier. Use a puller for removal of pulleys, couplings and pinions on the motor shaft. Check that the tension on the belt pulley matches the manufacturer's specifications. Do not exceed the maximum radial and axial forces on the shaft. If the motor shaft is connected to the part to be driven without a coupling, check that the radial offset and axial force effect will not cause problems.

Use only belts with < 109 electrical leakage resistance to prevent static electrical problems. Ground the motor.

Accessories

A muffler is shipped with the air motor (except 16AM) but is not installed. Consult your Gast Distributor/Representative for additional filter recommendations. Install a moisture trap and 5 micron filter in the air line ahead of motor.

Air consumption data at various speeds and pressures are available from your Gast Distributor/Representative or the factory.

OPERATION

⚠ WARNING



Injury Hazard

Air stream from product may contain solid or liquid material that can result in eye or skin damage.

Do Not use cumbustible gases to drive this motor.

Wear hearing protection. Sound level from motor may exceed 85 db(A).

Failure to follow these instructions can result in eye injury or other serious injury.

Check all connections before starting motor. It is your responsibility to operate this product at recommended speeds, loads and room ambient temperatures. Do not run the motor at high speeds with no load. This will result in excessive internal heat that may cause motor damage.

The starting torque is less than the running torque. The starting torque will vary depending upon the position of the vanes when stopped in relation to the air intake port.

Use a pressure regulator and/or simple shut-off valve to regulate the motor's speed and torque. This will provide the required power and will conserve air. Open the air supply valve to the motor. Set the pressure or flow rate to the required speed or torque. Adjust the lubricator to feed one drop of oil for every 50-75 CFM (1.5-2 M^3 per minute) of air moving through motor. Check the oil level daily. The gear reducer does not need lubrication.

Operate the motor for approximately 2 hours at the maximum desired load. Measure the surface temperature of the motor on the casting opposite the pipe ports. The maximum surface temperature listed on the motor is for normal environmental and installation conditions. For most air motors, the maximum surface temperature should not exceed 275ºF/135ºC. Do not continue to operate the motor if the measured surface temperature exceeds temperature listed on the motor. If your measured temperature does exceed listed value, consult with your Gast Distributor/Representative for a recommendation.

MAINTENANCE

⚠ ⚠ WARNING

Injury Hazard

Disconnect air supply and vent all air lines.

Wear eye protection when flushing this product.

Air stream from product may contain solid or liquid material that can result in eye or skin damage.

Flush this product in a well ventilated area.

Do Not use kerosene or other combustible solvents to flush this product.

Failure to follow these instructions can result in eye injury or other serious injury.

It is your responsibility to regularly inspect and make necessary repairs to this product in order to maintain proper operation.

For Lubricated Operation

Use Gast #AD220 or a detergent SAE #10 automotive engine oil for lubricating. Lubricating is necessary to prevent rust on all moving parts. Excessive moisture in air line may cause rust or ice to form in the muffler when air expands as it passes through the motor. Install a moisture separator in the air line and an after cooler between compressor and air receiver to help prevent moisture problems.

Manual Lubrication

Shut the air motor down and oil after every 8 hours of operation. Add 10-20 drops of oil to the air motor intake port.

Automatic Lubrication

Adjust inline oiler to feed 1 drop of oil per minute for high speed or continuous duty usage. Do not overfeed oil or exhaust air may become contaminated. Check intake and exhaust filters after first 500 hours of operation. Clean filters and determine how frequently filters should be checked during future operation. This one procedure will help assure the motor's performance and service life.

Flushing

Flushing this product to remove excessive dirt, foreign particles, moisture or oil that occurs in the operating environment will help to maintain proper vane performance. Flush the motor if it is operating slowly or inefficiently.

Use only Gast #AH255B Flushing Solvent. DO NOT use kerosene or ANY other combustible solvents to flush this product.

1. Disconnect air line and muffler.
2. Add flushing solvent directly into motor. If using liquid solvent, pour several tablespoons directly into the intake port. If using Gast #AH255B, spray solvent for 5-10 seconds into intake port.
3. Rotate the shaft by hand in both directions for a few minutes.
4. You must wear eye protection for this step. Cover exhaust with a cloth and reconnect the air line.
5. Restart the motor at a low pressure of approximately 10 psi/ 0.7 bar until there is no trace of solvent in the exhaust air.
6. Listen for changes in the sound of the motor. If motor sounds smooth, you are finished. If motor does not sound like it is running smoothly, installing a service kit will be required (See "Service Kit Installation").

Check that all external accessories such as relief valves or gauges are attached and are not damaged before operating product.

Cleaning the sound absorber.

1. Remove the sound absorber (for non-lubricated operation, inspect muffler every 90 days. To avoid excessive clogging of muffler element, change frequently).
2. Clean the felt filter.
3. **You must wear eye protection for this step.** For lubricated operation, add 3-4 drops of oil.
4. Check the air compressor.
5. Listen for changes in the sound of the motor. If motor sounds smooth, you are finished. If motor does not sound like it running smoothly, installing a service kit will be required (See "Service Kit Installation").

Shutdown.

It is your responsibility to follow proper shutdown procedures to prevent product damage.

1. Turn off air intake supply.
2. Disconnect air supply and vent all air lines.
3. Disconnect air lines.
4. Remove air motor from connecting machinery.
5. Remove the muffler.
6. ⚠ ⚠ **Wear eye protection. Keep away from air stream.** Use clean, dry air to remove condensation from the inlet port of the motor.
7. For lubricated operation, add a small amount of oil into the intake port. Rotate shaft by hand several times to distribute oil.
8. Plug or cap each port.
9. Coat output shaft with oil or grease.
10. Store motor in a dry environment.

Disposal (Please note current regulations) Parts of the air motor or air powered gear motor, shafts, cast iron or aluminum castings, gear wheels as well as rolling contact bearings may be recycled as scrap metal.

Estimated Ball Bearing Life of Air Motors

Air Model Model	Shaft Speed in RP	Ball Bearing Life Hours L_{10}
1AM	10,000	28,000
1UP	6,000	14,000
2AM	3,000	30,000
4AM	3,000	14,000
6AM	3,000	6,500
8AM	2,000	8,000
16AM	2,000	15,000

Based on running pressure of 60 PSI and coupling connection to motor load. The direction, magnitude and location of applied loads to the motor shaft will change expected bearing life. Driving the motor with wet dirty compressed air can reduce expected bearing life. The above are life estimates not warrantied minimum values.

SPUR AND WORM REDUCERS - OPERATING AND MAINTENANCE INSTRUCTIONS

General Information:

The product nameplate specifies all information required when ordering parts or requests for information. The type of lubricant required for unit is also specified on the nameplate.

Product Use Criteria

- All worm gear reducers require that the air motor be mounted so that the inlet and exhaust ports are at a 90º angle to the centerline of the reducer output shaft.
- Gear reducers are NOT self-locking. If a brake is required for safety, as in the case of air pressure failure, etc., contact your Gast Distributor/Representative.
- Some worm gear reducers may be shipped with a plug in the top pipe plug. The plug must be removed and the breather plug installed for proper operation.
- Check the oil level in spur gear reducers which have been stored or not operated for a period of time.
- Gear motors require proper lubrication. Insufficient oil level can cause loss of performance, damage or failure of the gear reducer.

Spur Gear Reducer Specifications

Model	GR11	GR20	GR25
Speed Range (Reducer Output Shaft)	33.3 to 400 RPM	30 to 300 RPM	20 to 200 RPM
Gear Reduction	15:1	10:1	15:1
Maximum Allowable End Thrust With Zero Overhung Load. (Reducer Output Shaft)	100 lbs/45,4 kg	200 lbs/90,8 kg @300 RPM to 800 lbs/363,2 kg at 30 RPM	250 lbs/113,5 kg @200 RPM to 800 lbs/363,2 kg at 20 RPM
Maximum Allowable Overhung Load With Zero End Thrust. (Reducer Output Shaft)	100 lbs/45,4 kg @ 333 RPM to 200 lbs/90,8 kg at 33.3 RPM	200 lbs/90,8 kg @ 300 RPM to 600 lbs/272,4 kg at 30 RPM	200 lbs/90,8 kg @ 200 RPM to 600 lbs/272,4 kg at 20 RPM
Lubrication	Use a 300 ssu at 100°F/38°C turbine quality lubricant – Gast #AG292A, Gulf Harmony 53, Shell Tellus 33, Socony DTE heavy medium or Humble Nuto 53. **For horizontal operation,** remove both plugs and add oil to top hole until other hole overflows. **For vertical operation,** fill to overflow point of upper most hole.		

Worm Gear Reducer Series A-F
Gear Reducer Specifications

All output shafts are in the standard location.

Model	Air Motor	Ratio
AG803	4AM	20:1
AG805	4AM	40:1
AG807	4AM	60:1
AG809	6AM	10:1
AG811	6AM	20:1
AG816	8AM	20:1

Service, Parts, or Repair

For service, parts or repair of the worm gear reducer, contact the manufacturer listed on the nameplate.

Change output shaft direction of worm gear reducers

1. Remove drain plug and drain oil from unit.
2. Remove end cover and seal cage cap screws. While supporting output shaft, remove end cover and shims from unit. Keep shims with cover.
3. Remove output shaft and seal cage together from extension side. Keep shims with seal cage.
4. Insert seal cage, shims and sub-assembly into housing from the side opposite from which they were removed.
5. Insert seal cage cap screws and tighten with light pressure.
6. Assemble end cover with shims. Insert end cover cap screws and tighten with light pressure.
7. Turn high speed shaft in both directions to check that gear train is running freely.
8. Cross-tighten seal cage and end cover cap screws.

Part No. 45-200 D170PL (Rev. S)

TROUBLESHOOTING GUIDE

Problem					Reason and Remedy for Problem
Low Torque	Low Speed	Won't Run	Runs Hot	Runs Well Then Slows Down	
●	●	●			Dirt or foreign material present. Inspect and flush.
●	●	●			Internal rust. Inspect and flush.
●	●				Low air pressure. Increase pressure.
	●				Air line too small. Install larger line(s).
	●			●	Restricted exhaust. Inspect and repair.
●	●	●		●	Motor is jammed. Have motor serviced.
	●			●	Air source inadequate. Inspect and repair.
	●			●	Air source too far from motor. Reconfigure setup.

WARRANTY

Gast finished products, when properly installed and operated under normal conditions of use, are warranted by Gast to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase from Gast or an authorized Gast Representative or Distributor. In order to obtain performance under this warranty, the buyer must promptly (in no event later than thirty (30) days after discovery of the defect) give written notice of the defect to Gast Manufacturing Incorporated, PO Box 97, Benton Harbor Michigan USA 49023-0097 or an authorized Service Center (unless specifically agreed upon in writing signed by both parties or specified in writing as part of a Gast OEM Quotation). Buyer is responsible for freight charges both to and from Gast in all cases.

This warranty does not apply to electric motors, electrical controls, and gasoline engines not supplied by Gast. Gast's warranties also do not extend to any goods or parts which have been subjected to misuse, lack of maintenance, neglect, damage by accident or transit damage.

THIS EXPRESS WARRANTY EXCLUDES ALL OTHER WARRANTIES OR REPRESENTATIONS EXPRESSED OR IMPLIED BY ANY LITERATURE, DATA, OR PERSON. GAST'S MAXIMUM LIABILITY UNDER THIS EXCLUSIVE REMEDY SHALL NEVER EXCEED THE COST OF THE SUBJECT PRODUCT AND GAST RESERVES THE RIGHT, AT ITS SOLE DISCRETION, TO REFUND THE PURCHASE PRICE IN LIEU OF REPAIR OR REPLACEMENT.

GAST WILL NOT BE RESPONSIBLE OR LIABLE FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, however arising, including but not limited to those for use of any products, loss of time, inconvenience, lost profit, labor charges, or other incidental or consequential damages with respect to persons, business, or property, whether as a result of breach of warranty, negligence or otherwise. Notwithstanding any other provision of this warranty, BUYER'S REMEDY AGAINST GAST FOR GOODS SUPPLIED OR FOR NON-DELIVERED GOODS OR FAILURE TO FURNISH GOODS, WHETHER OR NOT BASED ON NEGLIGENCE, STRICT LIABILITY OR BREACH OF EXPRESS OR IMPLIED WARRANTY IS LIMITED SOLELY, AT GAST'S OPTION, TO REPLACEMENT OF OR CURE OF SUCH NONCONFORMING OR NON-DELIVERED GOODS OR RETURN OF THE PURCHASE PRICE FOR SUCH GOODS AND IN NO EVENT SHALL EXCEED THE PRICE OR CHARGE FOR SUCH GOODS. GAST EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE WITH RESPECT TO THE GOODS SOLD. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTIONS SET FORTH IN THIS WARRANTY, notwithstanding any knowledge of Gast regarding the use or uses intended to be made of goods, proposed changes or additions to goods, or any assistance or suggestions that may have been made by Gast personnel.

Unauthorized extensions of warranties by the customer shall remain the customer's responsibility.

CUSTOMER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF GAST PRODUCTS FOR CUSTOMER'S USE OR RESALE, OR FOR INCORPORATING THEM INTO OBJECTS OR APPLICATIONS WHICH CUSTOMER DESIGNS, ASSEMBLES, CONSTRUCTS OR MANUFACTURES.

This warranty can be modified only by authorized Gast personnel by signing a specific, written description of any modifications.

MAINTENANCE RECORD

Date	Procedure Performed

For repair parts ordering information and exploded product view, visit our website or call us at the number listed below.

We have Gast Authorized Repair Facilities throughout the world. For the most up-to-date listing, contact one of our sales offices below:

Gast Manufacturing
2300 M-139 Highway
Benton Harbor, MI 49023
Ph: 269-926-6171
Fax: 269-927-0808

Gast Group Limited
Room 3502-3505
No. 1027 Chang Ning Road,
Zhaofeng Plaza
Shanghai, China 200050
Phone +86-21-52415599
Fax +86-21-52418339

Gast Group Ltd.
Unit 11, The I O Centre
Nash Road
Redditch, B98 7AS
United Kingdom
Phone +44 (0)1527-504040
Fax +44 (0)1527-525262

GAST

A UNIT OF IDEX CORPORATION

www.gastmfg.com

ISO 9001 CERTIFIED

Baldor-Reliance Electric Motors

877.812.7573 info@fusionfluid.com

Baldor-Reliance AC & DC Motor Installation & Maintenance

Note! The manufacturer of these products, Baldor Electric Company, became ABB Motors and Mechanical Inc. on March 1, 2018. Nameplates, Declaration of Conformity and other collateral material may contain the company name of Baldor Electric Company and the brand names of Baldor-Dodge and Baldor-Reliance until such time as all materials have been updated to reflect our new corporate identity.

Safety Notice: Be sure to read and understand all of the Safety Notice statements in MN408, MN605 or Product Specific manual for your motor. A copy is available at: http://www.baldor.com/support/product_manuals.asp

WEEE EU Directive 2012/19/EU
Products that are marked with the crossed-out wheeled bin symbol as shown here; shall be handled by applying following information:

The crossed-out wheeled bin symbol on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For users in the European Union, please contact your dealer or supplier for more information on how to discard electrical and electronic equipment (EEE).

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

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

INSTALLATION OUTSIDE THE USA:
Refer to MN408, MN605 and MN1383 for Compliance with European Directives. Copies are available at:
http://www.baldor.com/support/product_manuals.asp

MOTOR ENCLOSURE
ODP, Open drip proof motors are intended for use in clean, dry locations with adequate supply of cooling air. These motors should not be used in the presence of flammable or combustible materials. Open motors can emit flame and/or molten metal in the event of insulation failure.

Standard Totally Enclosed motors provide additional protection from moisture and dust compared to Open motors. Severe Duty and Washdown Duty motors provide additional protection compared to Standard Totally Enclosed motors.

Explosion protected motors, as indicated by a Nationally Recognized Testing Laboratory Certification mark and marking with Class, Division and Temperature Code are intended for installation in hazardous locations as described in Article 500 of the NEC. Refer to MN408 for more details.

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

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

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

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

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

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

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

WIRING
Connect the motor as shown in the connection diagrams. If this motor is installed as part of a motor control drive system, connect and protect the motor according to the control manufacturers diagrams. Refer to MN408 or MN605 for additional details on lead marking. The wiring, fusing and grounding must comply with the National Electrical Code or IEC and local codes. When the motor is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If not, stop the motor immediately and determine the cause. Possible causes are: low voltage at the motor, motor connections are not correct or the load is too heavy. Check the motor current after a few minutes of operation and compare the measured current with the nameplate rating.

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

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

NOISE
For specific sound power or pressure level information, contact your local sales office.

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

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

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

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

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

DRAIN PLUGS
Condensation drains are typically provided in each endplate. For optimal drainage, drains should be located in the lowest portion of the motor. For Washdown motors with multiple drain plugs, drain holes at the lowest portion of the motor should be open or have a T-drain installed. Drain holes not at the lowest portion of the motor should be plugged.

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

IP (Ingress Protection)
IP designations include two numerals, the first characteristic numeral is for ingress solid bodies and from dust. The second for ingress protection from liquid - water. The IP rating assigned to a motor is based on horizontal mounting unless the motor is specifically designed for vertical positioning. Mounting the horizontal rated motor in a non-horizontal position may require additional protection, contact the local ABB District Office to review the mounting requirements and ingress protection. Open motors (IPX2 and IPX3) must be located, oriented, or additionally protected in the application to prevent falling water from entering the motor.

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

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

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

Maintenance Procedures

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

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

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

Relubrication Intervals
(For motors with regrease capability)
New motors that have been stored for a year or more should be relubricated. Lubrication is also recommended at Table 1 intervals.

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

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

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

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

SPECIAL APPLICATIONS
For special temperature applications, contact your local sales office.

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

Table 1 Relubrication Interval

NEMA (IEC) Frame Size	Rated 60 Hz (50 Hz) Speed - RPM			
	3600 (3000)	1800 (1500)	1200 (1000)	900 (750)
Up to 210 incl. (132)	5500Hrs.	12000Hrs.	18000Hrs.	22000Hrs.
Over 210 to 280 incl. (180)	3600Hrs.	9500Hrs.	15000Hrs.	18000Hrs.
Over 280 to 360 incl. (225)	2200Hrs.	7400Hrs.	12000Hrs.	15000Hrs.
Over 360 to 5800 incl. (400)	2200Hrs.	3500Hrs.	7400Hrs.	10500Hrs.

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

** For motors operating at speeds greater than 3600 RPM, contact your local sales office for relubrication recommendations.

Table 2 Service Conditions

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

* Special high temperature grease is recommended (Dow Corning DC44).

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

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

Table 3 Lubrication Interval Multiplier

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

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

Table 4 Amount of Grease to Add

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

Typical IEC vs NEMA Lead Marking

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

Single Phase Reversible

Dual Voltage Reversible

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

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

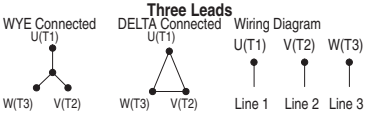
Refer to the connection diagram provided on the motor.

Three Phase
For single winding 3 phase motors, lead markings can be directly translated between IEC and NEMA designations. For these motors, the lead markings are:

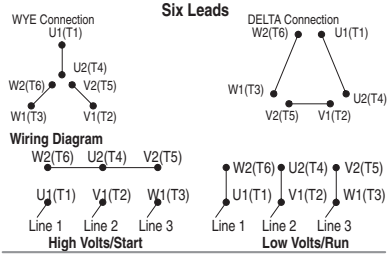
U1=T1 U2=T4 U3=T7 U4=T10
V1=T2 V2=T5 V3=T8 V4=T11
W1=T3 W2=T6 W3=T9 W4=T12

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

Three Leads



Six Leads



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Marathon Electric Motors

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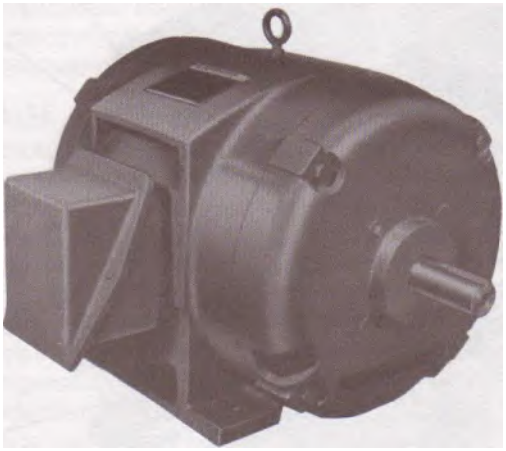
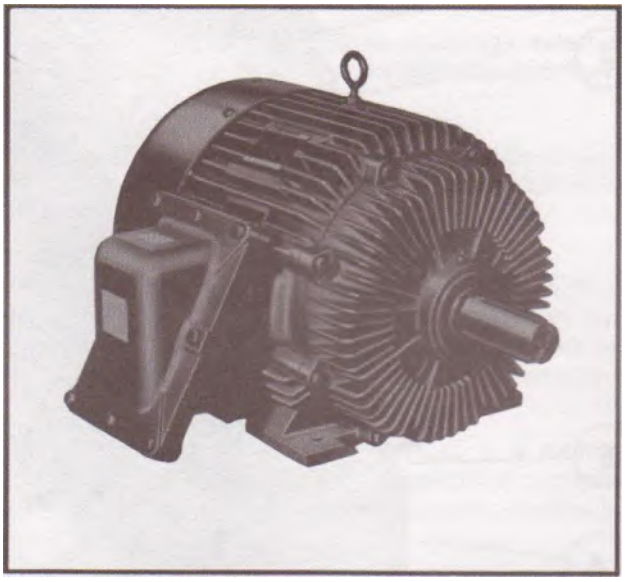
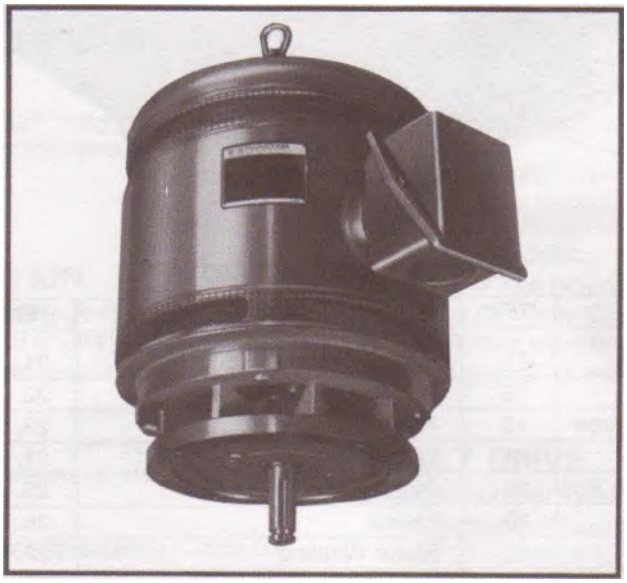
marathon™ Motors

Standard Induction Motors

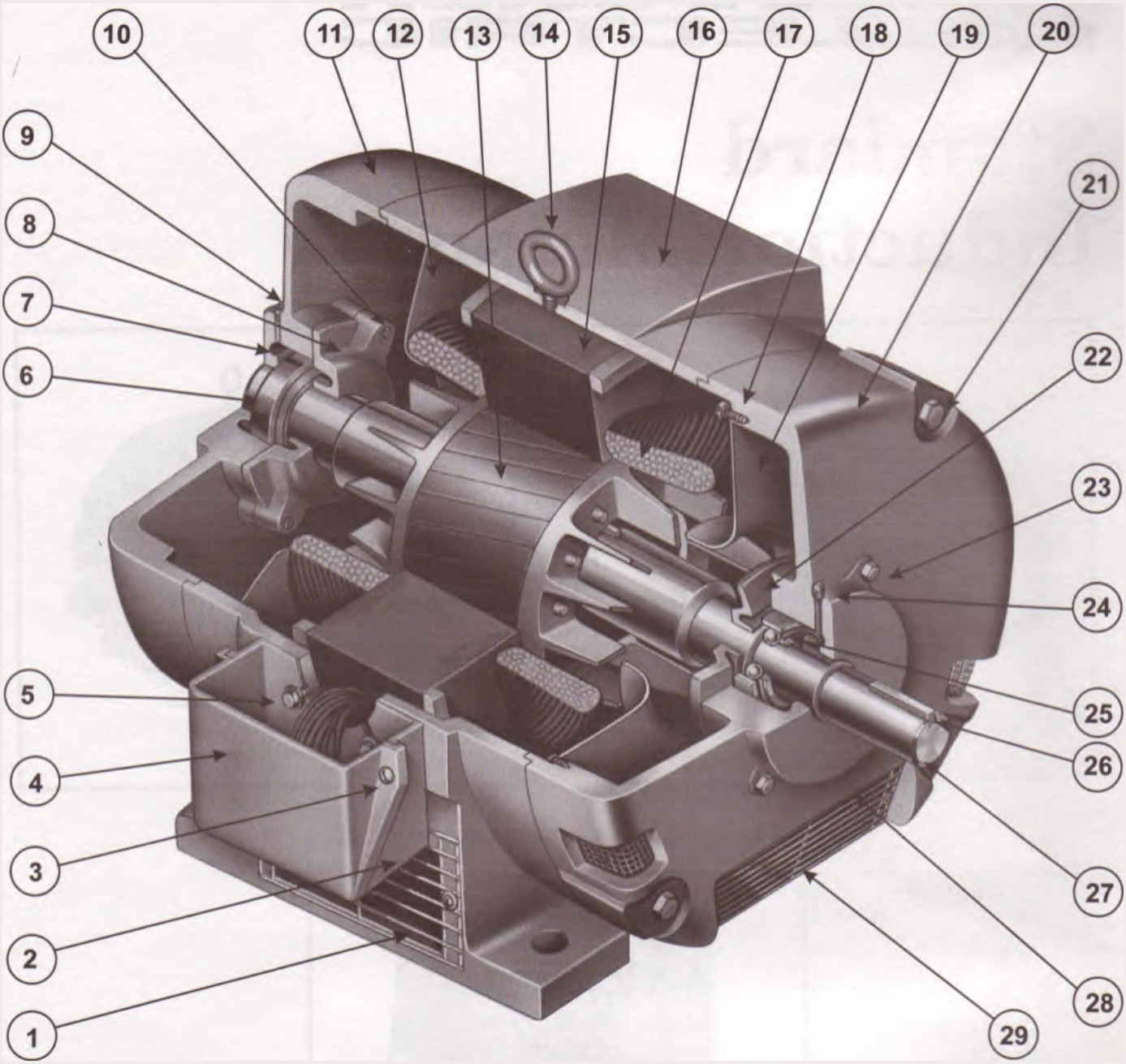






Installation, Operation, & Maintenance Instructions

TYPICAL CUTAWAY VIEW
OF A DRIPPROOF, HORIZONTAL
INTEGRAL HORSEPOWER MOTOR & PARTS DESCRIPTION
364 THRU 445 FRAME SIZE



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	**Frame Vent Screen	11.	Bracket O.P. E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap **Bolt**
4.	Conduit Box Top	14.	Lifting Eye Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extension Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffle Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	**Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End

O.P.E. = Opposite Pulley End

* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.

** = Bracket and frame screens are optional.

WARNING

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment.

GENERAL INFORMATION

Motors are all fully factory tested and inspected before shipping. Damage during shipment and storage can occur. Motors not correctly matched to the power supply and/or the load will not operate properly. These instructions are intended as a guide to identify and eliminate these problems before they are overlooked or cause further damage.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

STORAGE

A. Keep motors clean
   1. Store indoors
   2. Keep covered to eliminate airborne dust and dirt.
   3. Cover openings for ventilation, conduit connections, etc. to prevent entry of rodents, snakes, birds, and insects, etc.

B. Keep motors dry
   1. Store in a dry area indoors
   2. Temperature swings should be minimal to prevent condensation.
   3. Space heaters are recommended to prevent condensation.
   4. Treat unpainted flanges, shafts, and fittings with a rust inhibitor.
   5. Check insulation resistance before putting motor into service. (Consult manufacturer for guidelines).

C. Keep Bearings Lubricated
   1. Once per month, rotate shaft several turns to distribute grease in bearings.
   2. If unit has been stored more than one year, add grease before start-up. (Refer to lubrication procedure).

INSTALLATION

UNCRATING AND INSPECTION

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor.

Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see operation). Clean and dry the windings as required.

Never start a motor which has been wet without having it thoroughly dried.

SAFETY

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local codes.

Eyebolts or lifting lugs are intended for lifting the motor only. These lifting provisions should never be used when lifting or handling the motor with other equipment (i.e. pumps, gear boxes, fans or other driven equipment) as a single unit. Be sure the eyebolt is fully threaded and tight in its mounting hole.

Eyebolt lifting capacity ratings is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases. See NEMA MG 2.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, and shaft extensions should be permanently guarded.

LOCATION

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected.

The ambient temperature of the air surrounding the motor should not exceed 40c C (104°F) unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

The motor should never be placed in a room with a hazardous process, or where flammable gases or combustible material may be present, unless it is specifically designed for this type of service.

1. Dripproof (open) motors are intended for use indoors where atmosphere is relatively clean, dry and non-corrosive.
2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
3. Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult UL, NEC, and local codes for guidance.

Refer to manufacturer for application assistance.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within .010" for 56 to 210 frame; .015" from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance.

V-BELT DRIVE

1. Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.
2. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.

3. When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
4. Adjust belt tension to belt manufacturer's recommendations. Excessive tension will decrease bearing life.
5. For more information see Marathon Electric Publication SB528.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical.

Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

ELECTRICAL CONNECTIONS

CAUTION

Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

1. All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
2. To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact Marathon Electric for assistance.
3. Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

THERMAL PROTECTOR INFORMATION

The nameplate will indicate one of the following:

1. Motor is thermally protected
2. Motor is not thermally protected
3. Motor is provided with overheat protective device

For examples, refer to paragraphs below:

1. Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded.
   The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
2. Motors without thermal protection have nothing stamped on nameplate about thermal protection.
3. Motors that are provided with overheat protective device that does not open the motor circuit directly will indicate "WITH OVERHEAT PROTECTIVE DEVICE".
   A. Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of the 3-wire pilot circuit for the magnetic starter which controls the motor. See Figure 1.
   B. The circuit controlled by the above "Overheat Protective Device" must be limited to a maximum of 600 volts and 360 volt-amps.

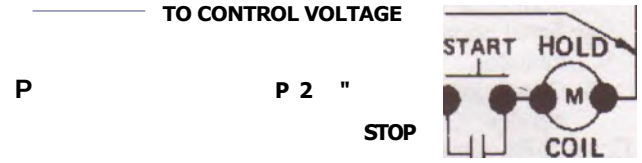
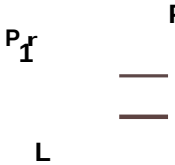


FIGURE 1

NORMALLY CLOSED PROTECTORS



Normally Open (N/O) Motor Thermostats may be used in conjunction with controls installed by Original Equipment Manufacturers.

NORMALLY OPEN PROTECTORS

FIGURE 1A

CHANGING ROTATION

1. Keep hands and clothing away from rotating parts.
2. Before the motor is coupled to the load, determine proper rotation.
3. Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
4. Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor.

REDUCED VOLTAGE STARTING

Motors used on reduced voltage starting, should be carefully selected based upon power supply limitations and driven load requirements. The motors starting torque will be reduced when using reduced voltage starting. The elapsed time on the start step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds. Refer to Marathon Electric for application assistance.

OPERATION

WARNING

Disconnect and lock out before working on motor or driven equipment.

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, measure the insulation resistance of the stator winding.

$$\text{Minimum Insulation Resistance In Megohms} = 1 + \frac{\text{Rated Voltage}}{1000}$$

   Do not attempt to run the motor if the insulation resistance is below this value.

2. If insulation resistance is low, dry out the moisture in one of the following ways:
   a. Bake in oven at temperature not more than 90°C (1 94°F).
   b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
   c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following caution). Check for proper rotation. Check for correct voltage (within + 10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines. Shut down the motor if the above parameters are not met or if any other noise or vibration disturbances are present. Consult NEMA guidelines or the equipment manufacturer if any questions exist before operating equipment.

CAUTION

For motors nameplated as "belted duty only", do not run motor without belts properly installed.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes treated at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the collector rings should be cleaned to remove this treatment. Use a cleaning fluid that is made for degreasing electrical equipment. All of the brushes must be released and lowered to the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brush holders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 1 0% above or below the value stamped on the nameplate. On three phase systems the voltage should be balanced within 1%. A small voltage unbalance will cause a significant current unbalance.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

All explosion proof and some totally enclosed motors are equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up. The drain system is designed for normal floor (feet down) mounting. For other mounting positions, modification of the drain system may be required, consult Marathon Electric.

SERVICE

WARNING

Disconnect power before working on motor or driven equipment. Motors with automatic thermal protectors will automatically restart when the protector cools. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

CAUTION

Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Motors are pregreased with polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL AND AMOUNTS

(For motors with regreasing provisions)

Service Condition	NEMA FRAME SIZE					
	140-180		210-360		400-510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE

1. For motors nameplated as "belted duty only" divide the above intervals by 3.

2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions)

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.

2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.

4. Discharge all capacitors before servicing motor.

5. Always keep hands and clothing away from moving parts.

6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.

7. Electrical repairs should be performed by trained and qualified personnel only.

8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.

9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3 The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the manufacturer.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also see that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	See that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay. stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running under load	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
	Unbalanced voltage	Correct unbalanced power supply.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small.	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.

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Fusion Fluid Equipment Sterling Electric Motors

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STERLING
ELECTRIC, INC.

SINGLE PHASE MOTORS

INSTALLATION AND MAINTENANCE MANUAL

March 21, 2006

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INSTRUCTION MANUAL
CAPACITOR START SINGLE PHASE MOTORS

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THE EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS CAUTION RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Read ALL instructions prior to operating motor

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which buyer shall apply the product. The application by buyer shall not be subject to any implied warranty of fitness for a particular purpose. Information contained in this manual is considered correct at the time of publication and is subject to change without notice.

SAFETY ALERT

WARNING: Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.

CAUTION: The system of connected rotating parts must be free from critical speed, torsional or other type vibration, no matter how induced. The responsibility for this system analysis lies with the purchaser.

CAUTION: Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.

RECEIVING

(1) Check nameplate data.
(2) Check whether any damage has occurred during transportation. If there is evidence of rough handling or potential damage in shipment, file a claim immediately with the carrier. Notify your Sterling Electric sales representative.
(3) Turn motor shaft by hand to check that it turns freely.

LOCATION

(1) Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations. Specially designed washdown duty motors can be used in sanitary environments were exposure to high pressure wash down procedures are present.

WARNING: Installation instructions regarding the use of washdown duty motors and the location and installation of condensation drain plugs as supplied with the motor must be followed or the warranty will be void. Consult factory for further information.

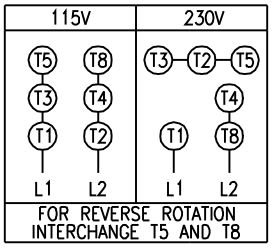
MOUNTING

(1) Mount motor securely on a firm, flat base. All ball bearing motors, horizontal or vertical, normal thrust, grease lubricated, may be mounted in any position.
(2) Align motor accurately, using a flexible coupling if possible. For drive recommendations, consult with drive or equipment manufacturer, or Sterling Electric.
(3) V-Belt Sheave Pitch Diameters should not be less than the NEMA recommended values. Refer to NEMA MG1-14.41.
(4) Tighten belts only enough to prevent belt slippage. Belt speed should not exceed 5000 feet per minute.

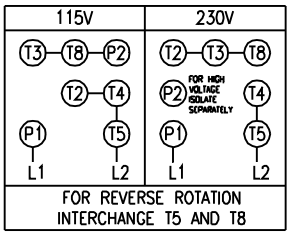
POWER SUPPLY AND CONNECTIONS

(1) Nameplate voltage and frequency should agree with power supply. Motor will operate satisfactorily on line voltage within 10% of nameplate value; or frequency within 5%; combined variation not to exceed 10%. 230 volt motors can be used on 208 volt network systems, but with slightly modified performance characteristics.
(2) Dual voltage motors can be connected for the desired voltage by following the connection diagram on the nameplate.
(3) Wiring of motor and motor control, overload protection and grounding should be in accordance with the National Electric Code and/or local building codes. Consult wiring diagrams below. Motors with 6 leads do not contain auto-reset thermal protection. Motors with 7 leads contain auto-reset thermal protection.

6 LEAD 1 PHASE



7 LEAD 1 PHASE



START UP

(1) Dry the motor windings if motor has been stored in a damp location. In drying, DO NOT exceed 194 degrees F (90 degrees C).
(2) Disconnect load and start motor. Check direction of rotation. Consult connection diagram on motor nameplate to change direction of rotation on bi-directional motors.
(3) Connect motor to load. The motor should start up quickly and run smoothly. If not, shut power off at once. Recheck the assembly including all connections before restarting. Operate under load for at least one hour. Observe whether any unusual noise or heating has developed and check operating current against nameplate data.
(4) If excessive vibration is noted, check for loose mounting bolts, too flexible motor support structure, or transmitted vibration from adjacent machinery. Recheck the coupling alignment between the motor and the driven equipment.

NOTE: Sterling Electric single phase capacitor start motors utilize a mechanical centrifugal switching mechanism to engage and disengage the start winding. This switching mechanism may be heard engaging when the motor is shut off and the shaft is spinning down. This is considered normal operation.

MAINTENANCE

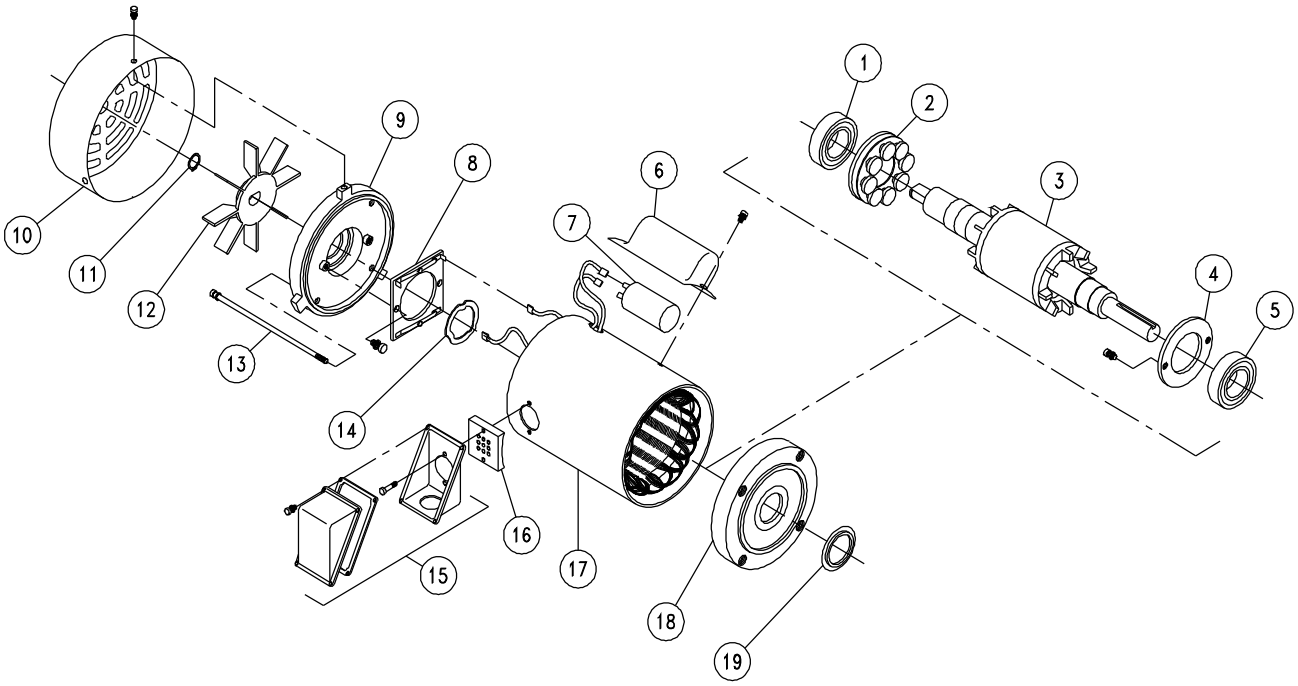
(1) INSPECTION: Inspect motor at regular intervals. Keep motor clean and ventilating openings clear of any obstructions.

(2) LUBRICATION: Pre-lubricated double sealed bearings and shielded bearings are lubricated for life and do not need to be re-lubricated. The bearings may be changed if necessary. Bearing sizes are noted on the nameplate. See table for standard bearing sizes for 56C and 140T motors.

Frame Size	Standard Duty		Washdown Duty	
	DE	ODE	DE	ODE
56C / 140TC	6205ZZ	6204ZZ	6205LL	6204LL

RENEWAL PARTS

(1) Use only genuine Sterling replacement parts.
(2) When ordering, include model number, serial number, item number and description (from parts list), and quantity required.



Parts List

Item No.	Description	Qty	Item No.	Description	Qty
1	ODE Ball Bearing	1	11	External Snap Ring*	1
2	Centrifugal Mechanism	1	12	Outside Fan*	1
3	Shaft / Rotor Assembly	1	13	Thru-Bolt	1
4	Bearing Cap	1	14	Wave Washer	1
5	DE Ball Bearing	1	15	Terminal Box Assembly	1
6	Capacitor Cover	1	16	Lead Seal	1
7	Start Capacitor	1	17	Frame / Stator Assembly	1
8	Stationary Switch	1	18	DE Bracket	1
9	ODE Bracket	1	19	Slinger	1
10	Fan Cover*	1			

* TEFC Models Only

IMPORTANT INFORMATION

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> *The manufacturer makes no warranty or representations, expressed or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the good sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental or other damages.*

Resellers/Buyers agree to also include this entire document including the warnings above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This instruction manual should be read together with all other printed information such as catalogs, supplied by Sterling Electric.

TROUBLESHOOTING

TROUBLE SHOOTER'S GUIDE BASED ON SYMPTOMS

SYMPTOMS	CAUSE	RESULT	REMEDY
1. Motor does not start.	a. Incorrectly connected.	a. Burnout	a. Connect correctly per diagram on motor.
	b. Incorrect power supply.	b. Burnout	b. Use only with correct rated power supply.
	c. Fuse out, loose or open connection.	c. Burnout	c. Correct open circuit condition.
	d. Open control circuit.	d. None	d. Correct open circuit condition.
	e. Rotating parts of motor may be jammed mechanically.	e. Burnout	e. Check and correct: 1. Bent shaft 2. Broken housing 3. Damaged bearing 4. Jammed or broken fan 5. Foreign material in motor
	f. Driven machine may be jammed.	f. Burnout	f. Correct jammed condition.
	g. No power supply.	g. None	g. Check voltage at motor and work back to power supply.
	h. Faulty Capacitor	h. Burnout	h. Replace capacitor
2. Motor starts, but does not come up to speed.	a. Same as 1-a, b, c above.		
	b. Overload	b. Burnout	b. Reduce load to bring current to rated limit. Use proper fuses and overload protection.
3. Motor noisy electrically	a. Same as 1-a, b, c above.		

SYMPTOMS	CAUSE	RESULT	REMEDY
4. Motor runs hot. Exceeds rating.	a. Same as 1-a, b, c above.		
	b. Overload	b. Burnout	b. Reduce load.
	c. Impaired ventilation.	c. Burnout	c. Remove obstruction.
	d. Frequent start or stop.	d. Burnout	d. 1. Reduce number of starts or reversals. 2. Secure proper motor for this duty.
	e. Imbalance in voltage or frequency of power supply.	e. Burnout	e. Check and correct power supply.
5. Motor noisy mechanically	a. Misalignment of coupling or sprocket.	a. Bearing failure, broken shaft, burnout due to rotor drag.	a. Correct misalignment.
	b. Mechanical unbalance of rotating parts.	b. Same as 5-a	b. Find unbalanced part, then rebalance.
	c. Lack of or improper lubricant.	c. Bearing failure	c. Use correct lubricant, and replace parts as necessary.
	d. Foreign material in lubricant.	d. Same as 5-c	d. Clean out or replace bearing.
	e. Overload	e. Same as 5-c	e. Remove overload condition. Replace damaged parts.
	f. Shock load.	f. Same as 5-c	f. Correct causes and replace damaged parts.
	g. Mounting acts as amplifier of normal noise.	g. Annoying	g. Isolate motor from base.
	h. Rotor dragging due to worn bearings, shaft or bracket	h. Burnout	h. Replace bearings, shaft or bracket as needed.
6. Bearing failure	a. Same as 5-a, b, c, d, e above.	a. Burnout, damaged shaft or housing	a. Replace bearings and follow 5-a, b, c, d, e above.
	b. Entry of water or foreign material into bearing housing.	b. Same as 6-a above	b. Replace bearings and shield against entry of foreign material (water, dust, etc.) Use proper motor.

TYPICAL BURNOUT PATTERNS

SYMPTOM	CAUSED BY	APPEARANCE
1. Shorted coil	a. Moisture, chemicals, foreign material in motor, damage winding.	a. Black or burned coil with remainder of winding good.
	b. Faulty stationary switch	b. Black or burned coil with remainder of winding good. Burned contacts on stationary switch
2. 100% Burnout	a. Overload.	a. Burned equally all around winding.
	b. Stalled.	b. Burned equally all around winding.
	c. Impaired ventilation.	c. Burned equally all around winding.
	d. Frequent reversal or starting.	d. Burned equally all around winding.
	e. Incorrect power.	e. Burned equally all around winding.
3. Other	a. Improper connection.	a. Irregular burned groups or spot burns.
	b. Ground	b. Badly damaged burn spot.

WARRANTY (LIMITED)

The warranty will cover all of the parts in the motor for 24 months from the date of shipment.

The warranty is only for parts and labor. In no event shall our liability exceed the original price of the unit, nor does it cover cost of on site repair, installation, or freight.

Contact the service department for a complete explanation as to the full warranty policies and conditions of sale.

All dimensions designs and specifications are subject to change without notice.

The information in this user's manual is subject to change without notice.

STERLING
ELECTRIC, INC.

3 Phase AC Induction Motors

INSTALLATION AND OPERATION MANUAL

January 22, 2018

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INSTALLATION AND OPERATION OF STERLING 3-PHASE AC INDUCTION MOTORS

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THE EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS CAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

SELECTION INFORMATION

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which buyer shall apply the product. The application by buyer shall not be subject to any implied warranty of fitness for a particular purpose. Information contained in this manual is considered correct at the time of publication and is subject to change without notice.

Read ALL instructions prior to operating unit. Improper maintenance or operation may cause injury to personnel or reducer failure.

SAFETY ALERT

WARNING: For safety, purchaser or user should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The user is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

WARNING: Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.

WARNING: Lifting devices supplied with motors (Frame 180T and larger) are for lifting and placing the motor **only**. Do not use lifting devices to lift **any** other objects or additional weight such as gear reducers, pumps, skids, etc. Using lifting devices to lift other objects or additional weight may cause lifting devices to fail and resulting in death, serious personal injury or property damage.

CAUTION: Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.

WARNING: For motors to be used in hazardous locations, check National Electric Code, NEMA, and UL (Underwriters Laboratory) standards to make sure that explosion-proof motors are not required. Note that UL labeling (certification) is required in some hazardous locations.

CAUTION: Rolled Steel motors and Stainless Steel motors are designed to run at elevated temperatures. Avoid physical contact. Use gloves and/ or other protective clothing or gear when working in the proximity of these motors while they are in operation.

IMPORTANT INFORMATION

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> *The manufacturer makes no warranty or representations, expressed or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the good sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental or other damages.*

Resellers/Buyers agree to also include this entire document including the warnings above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This instruction manual should be read together with all other printed information such as catalogs, supplied by Sterling Electric.

RECEIVING

1. Check nameplate data.

2. Check whether any damage has occurred during transportation. If there is evidence of rough handling or potential damage in shipment, file a claim immediately with the carrier. Notify your Sterling Electric sales representative.

3. Turn motor shaft by hand to check that it turns freely.

NOTE: Large motors may have a shaft locking device to aid in the protection of the bearings during shipment. This locking device needs to be removed before the motor is put into service.

INSTALLATION

Location and Mounting Position

A. The location for installing motors should be accessible and allow routine inspection, cleaning, and maintenance.

B. ODP (Open Drip Proof) motors are designed for installation in a well-ventilated area where the atmosphere is reasonably free of dirt and moisture.

C. TEFC (Totally Enclosed Fan Cooled) or TENV (Totally Enclosed Non Ventilated) motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations. For locations were motors will be exposed to washdown or severe weather, washdown duty motors are recommended.

WARNING: For locations considered hazardous or flammable, check National Electric Code, NEMA, and UL standards to make sure that explosion-proof motors are not required. Note the UL labeling (certification) is required in some hazardous locations.

D. All general purpose and washdown duty cast iron motors and general purpose rolled steel motors are configured for horizontal foot mounting (F-1 or F-2) as standard. For all other mounting positions including vertical, ceiling, or wall mount, consult factory.

E. All stainless steel and rolled steel washdown duty motors can be mounted in any position as long as the condensation drain plugs are removed in the proper location and the supplied T-drains are installed. Failure to do so will void the warranty. Please refer to the condensation drain instructions supplied with the motor.

Environment

A. Temperature
   1. For standard motors, ambient operating temperature is normally within the range of –15 to 40°C (5 to 104°F).

   2. In case of excessive ambient temperature, or excessive heat, protective measures, such as forced cooling or heat insulating should be applied or the load should be reduced.

   3. If the ambient temperature is too low, space heaters may need to be added to the motor.

B. Ventilation
   1. All motors will require the free circulation air whether the enclosure is ODP, TEFC, or TENV. If the motor is installed in poorly ventilated area, steps may have to be taken to guard the motor against over-heating which may include de-rating the motor or reducing the load.

   2. For ODP motors with internal fans and TEFC motors with external fans, a clearance of at least (8) inches from ventilation ports is required around motor to assure proper airflow.

C. Humidity
   1. If the motor is installed outdoors or in very damp or wet environments, steps may have to be taken to guard the motor against excessive moisture or a washdown duty motor should be used.

D. Dust
   1. ODP Enclosure
      A large accumulation of dust on windings and cooling ducts will result in over-heated windings leading to insulation breakdown. In severe cases, dust accumulated on the rotor, not evenly distributed, can cause vibration. If dust particles get into the bearings, the lubricant should be changed as soon as possible to prevent damage.

   2. TEFC Enclosure
      A large accumulation of dust on the fame, fins, and other surfaces will greatly reduce heat dissipation. If the dust accumulated on cooling fans or transmission device is not evenly distributed poor balance and vibration can occur.

3. TENV Enclosure
   A large accumulation of dust on the frame and other surfaces will greatly reduce heat dissipation.

E. Gases and Steam
   1. If corrosive, flammable, or other chemical gases, or steam exist in the environment, motors of explosion-proof type or corrosion protective motors should be chosen; particular attention should be placed on motor selection, when flammable gases, dust, or steam, which are all liable to fire hazard, exist.

WARNING: For hazardous locations, check National Electric Code, NEMA, and UL standards to make sure the explosion-proof motors selected are satisfactory. Note UL labeling (certification) is required in some hazardous locations.

Foundation

A. The ground footing or foundation on which motors are installed must be hard and stable and not susceptible to vibration from surrounding equipment. If not, vibration may become excessive, especially when coupled to machines such as crushers and reciprocating compressors. Vibration of a large amplitude while the motor is running can bring about the following failures:
   1. The service life of bearings may be reduced.

   2. Parts may come loose or become displaced.

   3. Cooling fans or other parts on rotor may fail due to material fatigue.

   4. The insulation on the windings could be damaged.

B. Severe vibration from the environment may induce vibration on motors causing some damage. Depression on roller bearings can occur during idle periods (when the motors are not running).

Power Supply

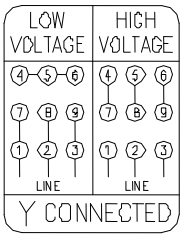
A. Nameplate voltage and frequency must agree with power supply. Motor will operate satisfactorily on line voltage within 10% of nameplate value or frequency within 5%. The combined variation is not to exceed 10%. 230 volt motors can be used on 208 volt network systems, but with slightly modified performance characteristics.

B. Dual voltage motors can be connected for the desired voltage by following the connection diagram on the nameplate. For motors capable of alternate starting methods such as part winding start and wye start-delta run, the proper connections are located on a connection diagram inside the conduit box cover or consult factory.

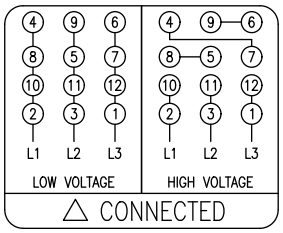
C. Wiring of motor and motor control, overload protection and grounding should be in accordance with the National Electric Code and/or local building codes.

D. The following are the connection diagrams for STANDARD 3-phase general purpose 9-lead and 12-lead dual voltage motors. For all other connections such as two speed motors, 1-phase motors, alternate starting methods, etc., consult factory.

9 LEADS



12 LEADS



Thermal Protection

The motor nameplate will indicate whether the motor is thermally protected. These are Normally Closed (NC) "Klixons" that open when a predetermined temperature is reached breaking continuity. Thermal protection leads are labeled **P1** and **P2** and are to be connected in series with the motor magnetic starter holding coil or magnetic starter assembly. For inverter duty motors used with VFD (Variable Frequency Drive) controllers, connect to interlock circuitry so that the contact will open to stop the controller in the event that the motor overheats.

Altitude

If the motor location is more than 3300 feet above sea level, the operating temperature of the motor will be 5 to 10°C higher. The motor may require de-rating to allow for this additional heating. Consult factory.

Alignment Procedures

Since poor alignment will bring about vibration and early bearing failure it is essential to be accurate when doing alignment of the motor to the driven equipment. The following steps should be taken to obtain proper alignment to the driven equipment.

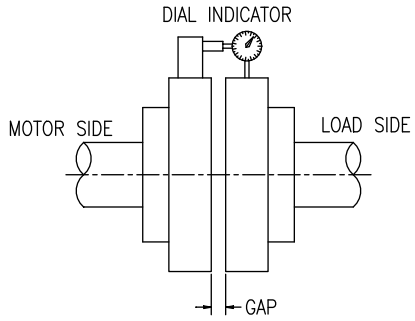
1. Use a level instrument to adjust the level mounting plate or surface to which the flange of the motor will mount.

2. Check the (up and down) endplay of the shaft of driven machine.

3. Mount the motor on the mounting plate and/or driven equipment. Install mounting bolts but do not tighten. Mounting hardware should be grade 5 or higher.

4. Check angular alignment by using a feeler gauge between coupling hubs at four points, 90 degrees apart. Position the motor to obtain best possible alignment and correct coupling hub separation. Consult factory, equipment supplier, or coupling manufacturer for proper values.

5. Check the offset alignment between the two shafts. Use a dial indicator mounting on one hub (motor side, for example), with the dial indicator button contacting the alignment surface of the opposite hub. Rotate the opposite shaft slowly by hand and take a reading on at least four equally spaced points. Move motor until the indicator movement does not exceed 0.002 in. Transfer indicator to opposite hub and recheck. Recheck angular alignment as described above.



ALIGNMENT METHOD OF COUPLING

6. After each corrective adjustment is made, connect the couplings and tighten the motor and mounting plate bolts. Recheck the alignment and correct if necessary.

Belts

A. V-Belt Sheave Pitch Diameters should not be less than the NEMA recommended values. Refer to NEMA MG1-14.41.

B. Tighten belts only enough to prevent belt slippage. Belt speed should not exceed 5000 feet per minute.

START UP

1. If the motor has become damp or has been in storage for a prolonged period of time, measure the insulation resistance of the stator winding. For motors rated 600V and below the minimum resistance should not be less than 1 megaohm.
   If the insulation resistance measures less than the desired value, in may be necessary to dry the windings, especially if the motor has been stored in a damp location. In drying, DO NOT exceed 90°C (194°F).

2. Disconnect load and start motor. Check direction of rotation. Interchange any two line leads to reverse rotation on 3-phase motors.

3. Connect the motor to load referring to procedures above for mounting and alignment. The motor should start up quickly and run smoothly. If not, shut power off at once. Recheck the assembly including all connections before restarting.

4. Operate under load for at least one hour. Observe whether any unusual noise or heating has developed and check operating current against nameplate data.

5. If excessive vibration is noted, check for loose mounting bolts, too flexible of a motor support structure, or transmitted vibration from adjacent machinery. Recheck the coupling alignment between the motor and the driven equipment.

MAINTENANCE

A. Inspection

Inspect motor at regular intervals.

Keep motor clean and ventilating openings clear of any obstructions. Double check the mounting bolts and couplings to ensure that they are tight and properly adjusted.

Check belt tension and adjust of necessary.

B. Lubrication

Motors in storage longer than 2 years should have the bearings inspected and/or replaced before putting the motor into service.

Motors with pre-lubricated double sealed bearings (bearing suffix LL, VV, or UU) or double shielded bearings (bearing suffix ZZ) do not need to be re-lubricated and are considered lubricated for life. However, it is recommend changing bearings at times shown, but if not changeable, you can re-lubricate by removing seal plate, cleaning and refilling the bearing and bracket cavity with the recommended grease.

Motors with re-greasable bearings have sufficient lubrication from the factory for storage up to 2 years. However, bearings should be re-lubricated when the motor is initially put into service and at the intervals shown below thereafter, or whenever the motor has been inoperable for more than 2 months.

FREQUENCY OF RELUBRICATION

MOTOR RPM	FRAME VS. HP	TYPE OF SERVICE STANDARD 8 HR/DAY	HEAVY DUTY 24 HR/DAY
3600	143T - 286TS 1.5 - 30	*	*
	324TS - 445TS 40 - 150	6 MONTHS	2 MONTHS
1800	143T - 256T 1 - 20	*	*
	284T - 326T 25 - 50	4 YEARS	18 MONTHS
	364T-445T 60 - 150	9 MONTHS	3 MONTHS
1200	143T - 256T .75 - 10	*	*
	284T - 326T 15 - 30	4 YEARS	18 MONTHS
	364T - 445T 40 - 125	1 YEAR	4 MONTHS

***** Motors of this size normally do not have bearings that can be re-lubricated. These bearings should be replaced at least every 5 years for 8 hr/day service, or every 2 years for 24 hr/day service.

C. Instructions for lubricating
Motors with re-greasable type bearings are to be lubricated using the following steps. See the figure below for reference.

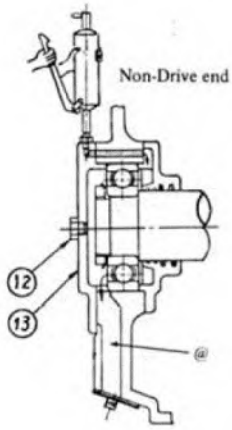


Figure 8
@ Storage for discharged grease

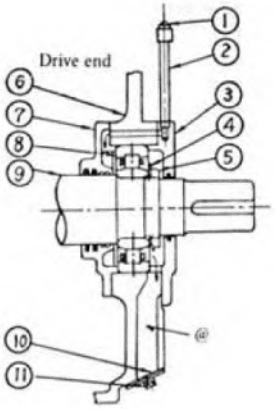


Figure9
@ Storage for discharged grease

Item Number	Description	Item Number	Description
1	Grease Fitting	8	Roller Bearing
2	Grease Fitting Extension Pipe	9	Motor Shaft
3	Outer Bearing Cap	10	Grease Relief Cover Plate
4	Bearing Lock Washer	11	Cover Plate Thumb Screw
5	Bearing Lock Nut	12	Bolt
6	Motor End Bracket	13	Outer Bearing Cap
7	Inner Bearing Cap		

1. Remove plastic cap covering grease fitting on both end brackets.

2. Remove pipe plug or cover plate opposite grease fitting for grease relief.

3. Be sure fittings are clean and free from dirt.

4. Using a low-pressure grease gun, pump in the recommended grease until new grease appears at the grease relief hole.

5. After relubricating, allow motor to run for 10 minutes to purge any excess grease before replacing any pipe plugs or cover plates in the end brackets.

6. Remove discharged grease from relief area, clean area thoroughly, and replace pipe plugs or cover plate.

D. Recommended Greases
Unless special grease is specified on the motor nameplate, standard Sterling Electric motors use lithium based NLGI grade #3 bearing grease. Use the following compatible grease: Shell Alvania R3, BP Energrease LS3, Castrol Spheerol MP3, Esso Beacon 3, Gulf Gulfcrown Grease No.3, Texaco Multifak Premium 3, Mobil Mobilux EP3, Kluber Centoplex 3.

E. Lubrication Amounts
The following replenishment amounts are for motors with provisions for re-greasable bearings. Typically smaller motors (250 and below) do not have this feature.

NEMA Frame Size	Volume (fl-oz)
280T	1.13
320T	1.13
360T	1.87
400T	1.87
440T	1.87

CAUTION: The amount of grease in the bearings is critical. Too little grease or too much grease will cause excessive wear, noise, and elevated running temperatures leading to premature bearing failure and possible permanent motor damage. Refer to motor nameplate or table above for amount and type of grease, or consult factory.

REPLACEMENT PARTS

A. Sterling Electric motors use commercially available bearings and seals (where appropriate) that can usually be sourced locally. For all other items or items that are not readily available, consult factory.

B. When ordering replacement parts, include the unit model number, serial number, item number and description (from parts list), and the quantity required.

WARRANTY

Generally, Sterling Electric will correct by repair or replacement any defect in material and workmanship when properly used for a period of one year after installation, or 18 months after shipment, whichever one comes first. Sterling Electric is not responsible for apparatus returned without proper authorization and identification, improper handling or storage, misapplication of the motor or the driven equipment or device. Sterling Electric, as a motor manufacturer, sells quality motors that are warranted to perform at a given load condition with performance characteristics in accordance with NEMA Standards. Sterling Electric is not responsible for the application, installation, or proper maintenance of the motor. Proper application, and whether a given motor is suited for a given application, is the responsibility of the purchaser and/or user of the motor. Refer to the complete Conditions of Sale and Warranty available from any Sterling Electric authorized distributor or factory representative.

TROUBLE SHOOTER'S GUIDE BASED ON SYMPTOMS

SYMPTOMS	CAUSE	RESULT	REMEDY
1. Motor does not start.	a. Incorrectly connected.	a. Burnout	a. Connect correctly per diagram on motor.
	b. Incorrect power supply.	b. Burnout	b. Use only with correct rated power supply.
	c. Fuse out, loose or open connection.	c. Burnout	c. Correct open circuit condition.
	d. Open control circuit.	d. None	d. Correct open circuit condition.
	e. Rotating parts of motor may be jammed mechanically.	e. Burnout	e. Check and correct: 1. Bent shaft 2. Broken housing 3. Damaged bearing 4. Jammed or broken fan 5. Foreign material in motor
	f. Driven machine may be jammed.	f. Burnout	f. Correct jammed condition.
	g. No power supply.	g. None	g. Check voltage at motor and work back to power supply.
2. Motor starts, but does not come up to speed.	a. Same as 1-a, b, c above.		
	b. Overload	b. Burnout	b. Reduce load to bring current to rated limit. Use proper fuses and overload protection.
3. Motor noisy electrically	a. Same as 1-a, b, c above.		
SYMPTOMS	CAUSE	RESULT	REMEDY
4. Motor runs hot. Exceeds rating.	a. Same as 1-a, b, c above.		
	b. Overload	b. Burnout	b. Reduce load.
	c. Impaired ventilation.	c. Burnout	c. Remove obstruction.
	d. Frequent start or stop.	d. Burnout	d. 1. Reduce number of starts or reversals. 2. Secure proper motor for this duty.
	e. Imbalance in voltage or frequency of power supply.	e. Burnout	e. Check and correct power supply.
5. Motor noisy mechanically	a. Misalignment of coupling or sprocket.	a. Bearing failure, broken shaft, burnout due to rotor drag.	a. Correct misalignment.
	b. Mechanical unbalance of rotating parts.	b. Same as 5-a	b. Find unbalanced part, then rebalance.
	c. Lack of or improper lubricant.	c. Bearing failure	c. Use correct lubricant, and replace parts as necessary.
	d. Foreign material in lubricant.	d. Same as 5-c	d. Clean out or replace bearing.
	e. Overload	e. Same as 5-c	e. Remove overload condition. Replace damaged parts.
	f. Shock load.	f. Same as 5-c	f. Correct causes and replace damaged parts.
	g. Mounting acts as amplifier of normal noise.	g. Annoying	g. Isolate motor from base.
	h. Rotor dragging due to worn bearings, shaft or bracket	h. Burnout	h. Replace bearings, shaft or bracket as needed.
6. Bearing failure	a. Same as 5-a, b, c, d, e above.	a. Burnout, damaged shaft or housing	a. Replace bearings and follow 5-a, b, c, d, e above.
	b. Entry of water or foreign material into bearing housing.	b. Same as 6-a above	b. Replace bearings and shield against entry of foreign material (water, dust, etc.) Use proper motor.

TYPICAL BURNOUT PATTERNS

SYMPTOM	CAUSED BY	APPEARANCE
1. Shorted coil	a. Moisture, chemicals, foreign material in motor, damage winding.	a. Black or burned coil with remainder of winding good.
2. 100% Burnout	a. Overload.	a. Burned equally all around winding.
	b. Stalled.	b. Burned equally all around winding.
	c. Impaired ventilation.	c. Burned equally all around winding.
	d. Frequent reversal or starting.	d. Burned equally all around winding.
	e. Incorrect power.	e. Burned equally all around winding.
3. Single phase condition.	a. Open circuit in one line. The most common causes are loose connection, one fuse out, loose contact in switch or contactor.	a. If 1800 RPM motor-four equally burned groups at 90° intervals. b. If 1200 RPM motor-six equally burned groups at 60° intervals. c. If 3600 RPM motor-two equally burned groups at 180° apart. NOTE: If WYE connected each burned group will consist of two adjacent phase groups. If DELTA connected each burned group will consist of one phase group.
4. Other	a. Improper connection.	a. Irregular burned groups or spot burns.
	b. Ground	b. Badly damaged burn spot.

PARTS LIST ** TOTALLY ENCLOSED FAN COOLED (T.E.F.C.)

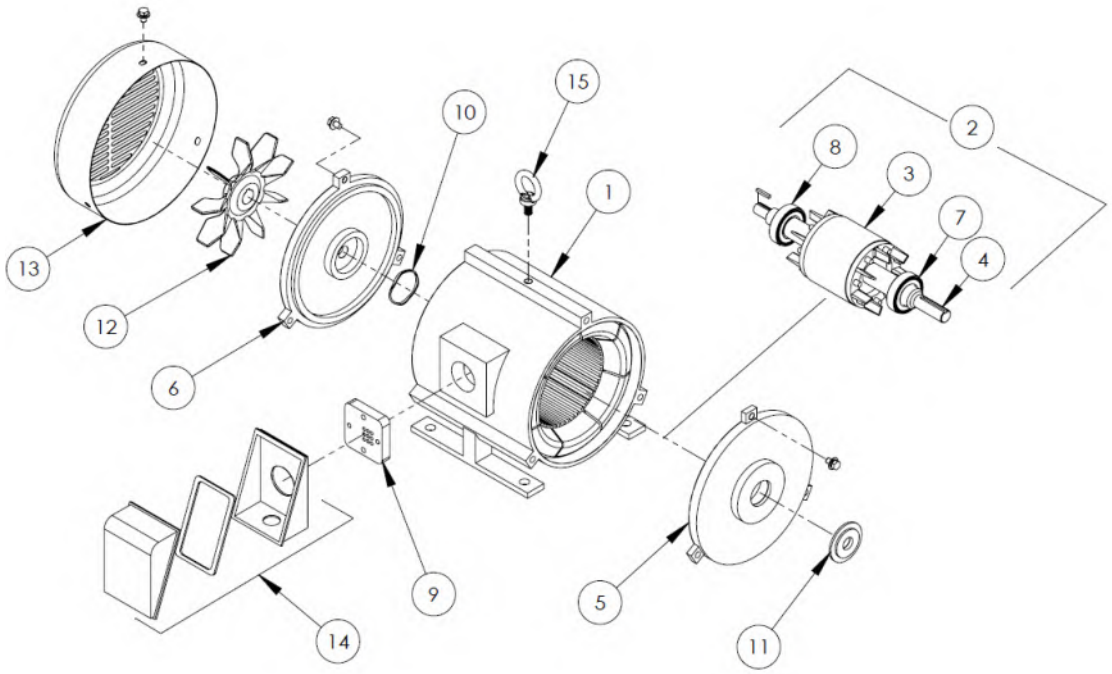
ITEM	DESCRIPTION
1	Wound Stator w/Frame
2	Rotor Assembly
3	Rotor Core
4	Shaft
5	Bracket, Drive End
6	Bracket, Opp. Drive End
7	Bearing, Drive End
8	Bearing, Opp. Drive End

ITEM	DESCRIPTION
9	Lead Seal
10	Wave Washer 56 - 320T Bearing Shim 360T - 440T
11	Slinger
12	Outside Fan
13	Fan Cover
14	Conduit Box Assembly
15	Lifting Eye

BEARINGS

FRAME	T-SERIES 7	T-SERIES 8	E-SERIES 7	E-SERIES 8	N,R-SERIES 7	N,R-SERIES 8	S,X,D-SERIES 7	S,X,D-SERIES 8
56					6205ZZ*	6204ZZ	6205LL	6204LL
140T 180T	6205LL 6206LL	6205LL 6206LL	6205ZZ 6207ZZ	6205ZZ 6206ZZ			6205LL 6306LL	6204LL 6206LL**
210T 250T	6208LL 6309LL	6208LL 6309LL	6308ZZ 6310ZZ	6208ZZ 6208ZZ			6308LL 6309LL	6306LL 6309LL
280T 280TS	6311CLL 6311C3LL	6311CLL 6311C3LL	6310ZZ 6310C3	6210ZZ 6210C3			6311LL 6311C3LL	6311LL 6311C3LL
320T 320TS	6312C3 6312C3	6312C3 6312C3	6312ZZ 6312C3	6212ZZ 6212C3				
360T 360TS	6314 6314C3	6314 6314C3	NU215 6312C3	6312 6312C3				
400T 400TS	6316 6316C3	6316 6316C3	NU218 6313C3	6313 6313C3				
440T 440TS	NU316 6316C3	6316 6316C3	NU220 6313C3	6315 6313C3				

* N-Series footed models with non-C-face output end have 6204ZZ bearings on both ends.
** 2P (3600RPM) 180T X-Series stainless steel motors and D-Series rolled steel motors have 6305LL bearing at position 8.



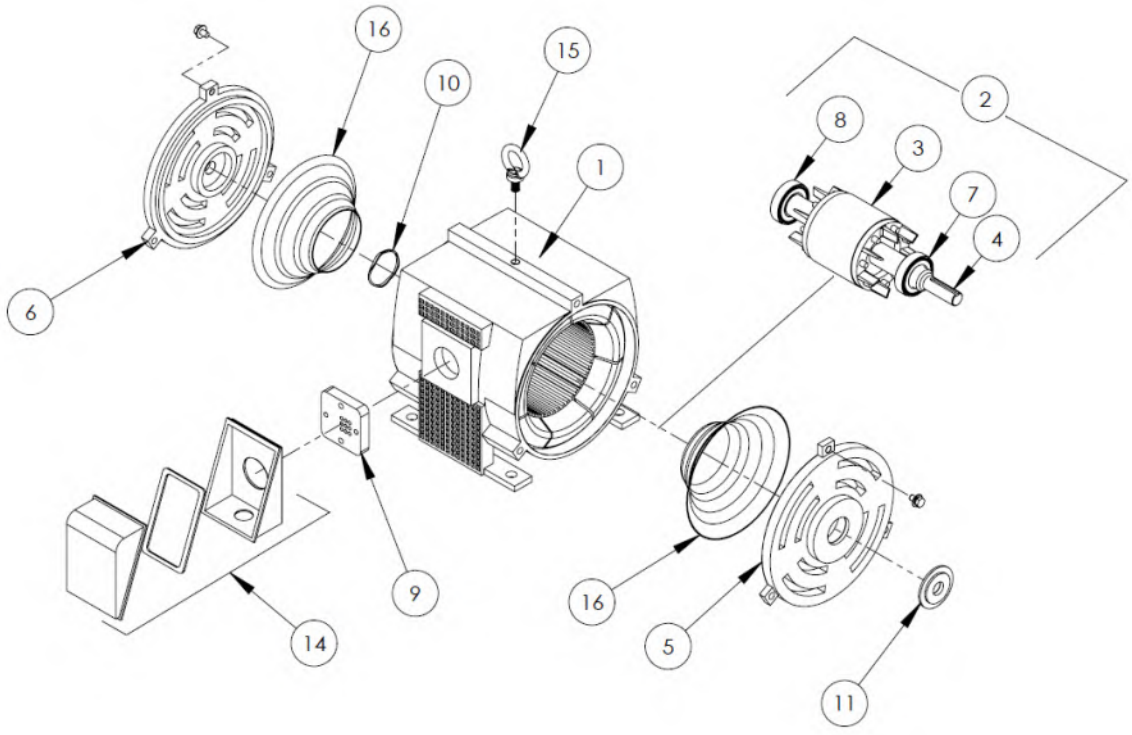
PARTS LIST ** OPEN DRIP PROOF (O.D.P)

ITEM	DESCRIPTION
1	Wound Stator w/Frame
2	Rotor Assembly
3	Rotor Core
4	Shaft
5	Bracket, Drive End
6	Bracket, Opp. Drive End
7	Bearing, Drive End
8	Bearing, Opp. Drive End

ITEM	DESCRIPTION
9	Lead Seal
10	Wave Washer 56 - 320T Bearing Shim 360T - 440T
11	Slinger
14	Conduit Box Assembly
15	Lifting Eye
16	Air Deflector

BEARINGS

FRAME	E-SERIES 7	E-SERIES 8	J-SERIES 7	J-SERIES 8	C,P-SERIES 7	C,P-SERIES 8		
56					6204ZZ	6203ZZ		
140T 180T			6205ZZ 6306ZZ	6205ZZ 6206ZZ				
210T 250T	6308ZZ 6309ZZ	6208ZZ 6208ZZ	6308ZZ 6309ZZ	6208ZZ 6208ZZ				
280T 280TS	6312ZZ 6311C3	6211ZZ 6311C3	6312ZZ 6311C3	6211ZZ 6311C3				
320T 320TS	6313 6312C3	6312 6312C3	6313 6312C3	6312 6312C3				
360T 360TS	6314 6313C3	6314 6313C3	6314 6313C3	6314 6313C3				
400T 400TS	6317 6313C3	6317 6313C3	6317 6313C3	6317 6313C3				
440T 440TS	NU318 6313C3	6318 6313C3	NU318 6313C3	6318 6313C3				



Hub City Helical Ratio Multipliers

877.812.7573 info@fusionfluid.com

Warnings & Cautions, Lubrication & Installation Instructions

Parallel Shaft Reducers & Helical Ratio Multipliers

PARALLEL SHAFT REDUCERS AND HELICAL RATIO MULTIPLIERS LUBRICATION

⚠ CAUTION

ALL PARALLEL SHAFT REDUCERS (EXCEPT HELICAL RATIO MULTIPLIERS) ARE SHIPPED DRY AND OIL MUST BE ADDED PRIOR TO OPERATION.

HELICAL RATIO MULTIPLIERS ARE FACTORY FILLED WITH THE PROPER AMOUNT OF PAG 460 H1 SYNTHETIC OIL FOR UNIVERSAL MOUNTING EXCEPT FOR VERTICAL SHAFTS. NO LUBRICATION CHANGE IS NECESSARY. FOR VERTICAL SHAFT APPLICATIONS CONSULT FACTORY. *NOTE: PAG SYNTHETIC LUBRICANTS ARE NOT COMPATIBLE WITH ANY OTHER LUBRICANTS, AND MUST NEVER BE MIXED. TOPPING OFF WITH THE WRONG LUBRICANT COULD CAUSE UNIT FAILURE.*

All HUB CITY™ parallel shaft reducers are splash lubricated. Figures P1, P2, and P3 indicate oil levels for three basic mounting positions. Shaded area indicates the recommended oil level when input speeds are **greater than 800 RPM**. Dashed lines indicates the recommended oil level when input speeds are less **than 800 RPM**. Always determine mounting position before installing lubricant.
NOTE: When parallel shaft reducer is mounted so that shafts are in a vertical position (Figure P3), see "VARIATIONS FROM NORMAL CONDITIONS – Parallel Shaft Reducers".

BEFORE OPERATING Parallel shaft reducer — Remove uppermost plug and fill reducer with a recommended lubricant (see APPROXIMATE OIL CAPACITY CHART in these instructions and GEAR LUBRICANT page of these instructions) Clean threads on removed plugs and plug holes with degreaser; coat with thread sealant and install securely into reducer case. If fill, level and drain plugs are not located conveniently for your mounting position, additional plugs may be installed. Consult factory for recommendations.

⚠ WARNING

VARIATIONS FROM NORMAL CONDITIONS — Parallel Shaft Reducers: When operating high speed shaft (Figures P1, P2 and P3) at speeds above 1800 RPM or below 400 RPM, special adjustment in oil level may be required. Consult factory for recommendations.

If either shaft is in a vertical position or inclined more than 15°, zerk fittings may be required to lubricate upper bearings. It may also be necessary to make some oil level or plug modifications. Consult factory for recommendations.

⚠ CAUTION

CHANGING LUBRICANT — Parallel Shaft Reducers: After the first 100 hours of operation, drain out initial oil, flush out the parallel shaft gear case with an approved nonflammable, non-toxic solvent, such as Lubriplate® Syn Flush, Lubriplate Pure Flush, Whitmore's® Flushing Oil (#06802030) or Medallion™ Flushing Oil Kosher (#06812010), and refill. Thereafter, oil should be changed at least every 5,000 operating hours (10,000 for synthetic oil lubricant) or every 12 months (24 months for synthetic oil lubricant), which ever occurs first.

⚠ WARNING

IMPORTANT – HELICAL RATIO MULTIPLIERS: Unit should not be operated when internal temperature exceeds 225°F or below 40°F unless a special duty lubricant is used. Reduced seal, bearing and gear life due to lubrication failure could result.

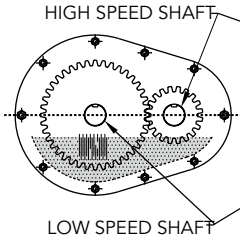


FIGURE P1

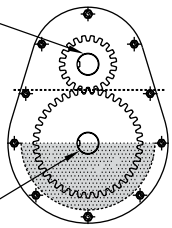


FIGURE P2

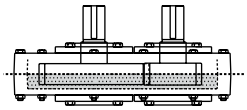


FIGURE P3

APPROXIMATE OIL CAPACITIES
Parallel Shaft Reducers & Helical Ratio Multipliers

MODEL	QUANTITY
22	0.50 pints
230	0.75 pints
240	1.50 pints
280	1.75 pints
85L	1.40 pints
200	1.50 pints
95L	2.50 pints
95H	3.50 pints
290	12.0 pints
83L & 83S	1.80 pints

MODEL	QUANTITY
1	2.10 pints
2	2.90 pints
3	3.60 pints
4	4.30 pints
5	4.90 pints
6	20.0 pints
8	42.0 pints
ARM1X	(Prelubed) 0.75
RM3	(Prelubed) 1
SSRM1	(Prelubed) 0.6

PARALLEL SHAFT REDUCERS INSTALLATION

The basic design of HUB CITY™ parallel shaft reducers allows operation in virtually any position. However, if your reducer has a fill/breather plug and/or pipe plugs, the ideal position would be: Fill/breather plug at the top of the reducer, drain plug at the bottom of the reducer and a level plug located where oil level is desired according to shaft position and input speed.

Because mounting positions can vary greatly along with the location and availability of plugs in certain model reducers, it may be necessary to install additional plugs as needed or level gages in level plugs.

Power may be applied (drive shaft) to either the high speed or the low speed shafts providing that the high speed shaft does not rotate more than 1750 RPM. Shafts may rotate in either direction.

Because of varying requirements, mounting hardware is not supplied with these units. Good quality cap screws with lock washers should be used. Base and fasteners for motor and reducer must be rigid enough to maintain alignment between reducer and motor and between reducer and couplings.

⚠ CAUTION

SHAFT MOUNTED PARALLEL SHAFT REDUCERS — The driven shaft must extend through the full width of the reducer and shaft should be independently supported with pillow block bearings, located as close to the reducer as possible.

A torque arm must be installed on shaft mounted reducers to prevent unit from rotating. Figure P4 shows the suggested installation. A rigid torque arm will cause bearings to "load up", causing excessive wear. To prevent this, provide a slight amount of "float" at the pivot point. Install torque arm so that it is approximately 90° to a line drawn through the low speed sleeve centerline and torque arm pivot point. Brackets must be fashioned by using a minimum of three attaching points on case.

No flexible coupling is required to connect low speed shaft on shaft mounted models but a clutch or torque limiting device is advisable somewhere in the drive train.

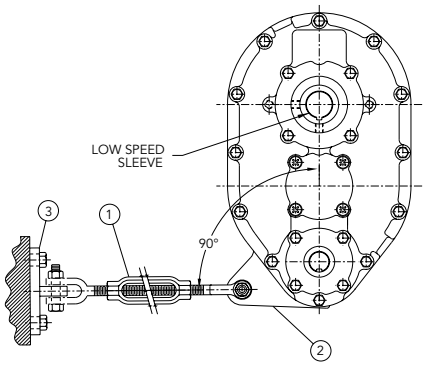


FIGURE P4

HELICAL RATIO MULTIPLIERS INSTALLATION

OPERATING POSITIONS – Normal speed reducer mounting positions are shown in Figures HRM1-HRM5. Because of varying requirements, mounting hardware is not supplied with these units, however foot mounting kits are available. Grade 5 or stronger cap screws should always be used. Base and fasteners for motor and reducers must be rigid enough to maintain alignment between reducer and motor, and between reducer and couplings. Input rotation of the speed reducer can be either clockwise or counterclockwise.

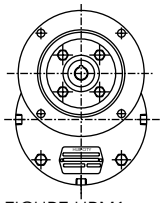


FIGURE HRM1 - FOOT MOUNTING AVAILABLE

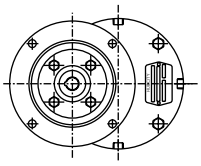


FIGURE HRM2 - FOOT MOUNTING AVAILABLE

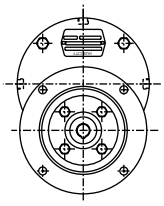


FIGURE HRM3

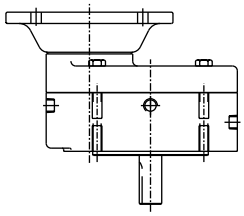


FIGURE HRM4 - VERTICAL SHAFT
Mounting requires factory modification

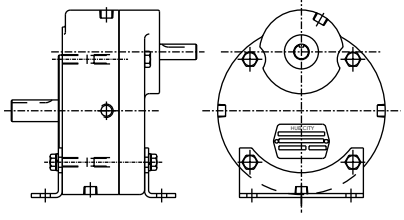


FIGURE HRM5 - SHAFT VERSION
(Optional mounting feet shown)

Nord Helical Gear Unit

877.812.7573 info@fusionfluid.com

Intelligent Drivesystems, Worldwide Services

INSTALLATION & OPERATING INSTRUCTIONS

NORD.COM/DOCS
DOCUMENT COLLECTION

NORD Model SK371.1

NORD DRIVESYSTEMS

Order and product data

Product Name	Nordbloc® Helical Gearbox
NORD Model Type	SK371.1
Mounting Position	M4
Lubricant	Food-compatible oil ISO VG 220
Lubricant Qty	0.613 Qts

Contents

Manuals

U10020-Safety Notes
U10020 Version: 3521

U10040-Storage & Commissioning
U10040 Version: 3521

U10060-Unit Installation
U10060 Version: 3521

U10250-Solid Shaft Connections
U10250 Version: 3521

U10500-Reducer Mounting Footed & Flange Mount Gear Units
U10500 Version: 3521

U10750-Helical & Bevel Reducer lubrication
U10750 Version: 3521

U11000-Helical & Bevel Reducer Lubrication Types
U11000 Version: 3521

U13000-Nordbloc.1 Flanged Oil Fill Quantities
U13000 Version: 3521

U14700-Nordbloc.1 Oil Plug & Vent Locations
U14700 Version: 3521

U19000-Troubleshooting
U19000 Version: 3521

U45100-NEMA IEC Input Adapters and Their Couplings
U45100 Version: 3521

U45250-NEMA or IEC Input Adapter Lubrication Options
U45250 Version: 3521

Spare Part Lists

1. Safety & information symbols

All work including transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must be performed **only by qualified specialists or personnel**. It is recommended that repairs to NORD Products are carried out by the NORD Service Department. Instructions related to operational safety will be emphasized as shown.

Symbol	Meaning
⚠	**Danger, Caution or Warning -** Severe risk or danger of personal injury or death by working around dangerously high electrical voltage or moving machinery. Proper safety precautions must be taken.
NOTICE	**Notice -** Care must be taken to avoid the possibility of damaging the drive unit, driven machine, or the environment.
ℹ	**Important Note -** Useful note or tip to help assure trouble-free operation.
♻	**Material Disposal Note -** Important note concerning suggested material disposal.

2. Safety warnings

⚠ DANGER

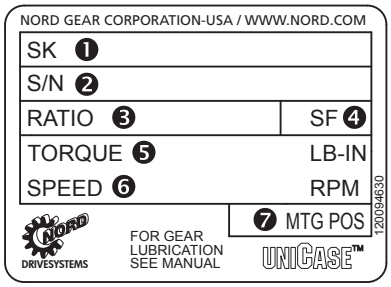
- All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians. All applicable national, regional, and local work regulations and safety requirements must also be complied with. **NORD assumes no liability for personal injury, accidental death, or equipment damage and malfunctions resulting from failure to comply with installation or operating instructions, safety notes, or any work regulations and laws!**
- Gear unit installation and maintenance work may only be performed when no power is available to the prime mover or motor. Electric motors, electrical brakes, and variable frequency drives, contain potentially dangerous high-voltage. Prior to installation or maintenance, shut down the power at the circuit breaker or power switch. **While working on the drive, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!**
- Surfaces of motors and gear units may become hot during operation or shortly after start-up. In some instances additional protection against accidental contact may be necessary. **Use caution to avoid burns or serious injury!**

3. Observe published performance range & nameplate data

NOTICE

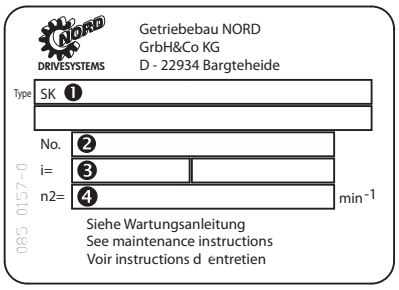
Observe the data on all reducer nameplates and verify published ratings for the NORD item/s in question. Do not operate any NORD equipment outside the published performance range. Failure to comply may result in damage to the drive unit, driven machine, or the environment.

U.S. Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Service Factor
❺ Torque Rating
❻ Output Speed RPM
❼ Mounting Position

European Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Speed

4. Transportation and handling

Make sure that all eyebolts and lifting lugs are tight and lift only at designed points. Protect the mounting surface from possible damage during transportation.

⚠ WARNING

Do not attach other machinery or loads to the NORD assembly, the supplied lifting bolts are not designed for this purpose and may result in drive damage or personal injury.

If the gearmotor or assembly is equipped with two suspension eye bolts, then both locations should be used for transportation and placement of the unit; in this case the tension force of the slings must not exceed a 45° angle.

In some instances it may be appropriate to use additional lifting straps or slings in order to assure safe transportation of the assembly. Always use sufficiently rated handling equipment and ensure that adequate safety measures are taken to protect personnel from injury during transportation. Once the NORD assembly is properly installed, remove the transportation fixtures.

5. DISPOSAL

MATERIAL DISPOSAL

Properly dispose of all used gear units and internal parts in accordance with all local regulations. In particular, all lubricants must be properly collected and disposed.

For confirmation of specific materials used in a specific reducer or gearmotor assembly, please consult NORD with the appropriate unit identification or serial number.

Components	Material
Gear wheels, shafts, rolling bearings, parallel keys, snap rings, spacers, shims, etc.	Steel
Gear housing and housing components	Cast iron or Aluminum (depending on type and size)
Worm gears	Bronze alloy
Radial seals, sealing caps, and rubber components	Elastomers with some steel
Coupling components	Plastic or Elastomer with Steel
Housing gaskets and flat oil seals	Asbestos-free sealing or gasket material (various types used)
Gear Oil	Mineral, SHC-Synthetic or PG-Synthetic (can vary)

1. Storage

IMPORTANT NOTE

For storage periods longer than 9 months, or for storage in less than desirable conditions, please consult NORD for recommendations.

Storage for up to 9 months is possible, so long as the following conditions are observed:

- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Protect all exposed or unpainted shaft and flange surfaces with an anti-corrosion agent or grease.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Whenever possible, rotate the shafts periodically, by hand if necessary, to help prevent brinelling (bearing damage) and to help keep the shaft seals pliable.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.

2. Commissioning

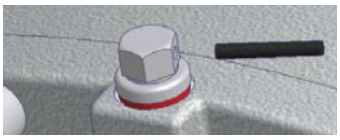
Prior to gear unit start-up, complete the following:

- Please check your gear unit for a vent and if applicable to your product, remove the sealing plug to activate.

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal gearbox components and leakage.

Sealed vent



Activated vent

- Check the lubricant and be sure the gear unit is filled with the proper oil type, to the proper level, as determined by the mounting position.

IMPORTANT NOTE

Some smaller gear units are supplied as maintenance free/ lubricated for life gear units. Oil level may not be checked on some of these units.

- Check the condition of all shaft seals and all assembled flange gasket areas. If any change is detected in the shape, color, hardness or permeability, or if any leaks are detected, the corresponding shaft seals and/or gaskets must be replaced.
- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

3. Long-Term Storage

By taking special precautions, problems such as seal leakage and reducer failure due to the lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect gear reducers during periods of extended storage:

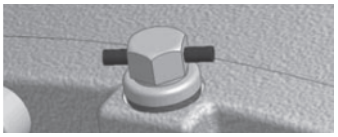
- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Fill the reducer full with oil that is compatible with the product normally used or recommended during service.
- Apply grease to all unpainted or unprotected shafts, bores, keyways, flange surfaces, tapped holes, and to the exterior of all oil seals.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Once every few months rotate the input shaft approximately 10-20 revolutions to redistribute the weight of gears and shafts and to prevent brinnelling of the bearings and drying of the seal track.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.)

4. Commissioning After Long-Term Storage

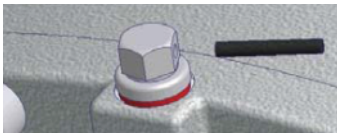
• Please check your gear unit for a vent and if applicable to your product, remove the sealing plug to activate.

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal gearbox components and leakage.



Sealed vent



Activated vent

- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Drain the reducer and refill it with the proper type and amount of lubricant.
- Observe start-up and initial operation to make sure there are no seal or gasket leaks, or unusual sounds, vibration or heat rise during operation.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

1. Installation site

Drives must be properly installed if they are to produce the rated torque. Improper installation may lead to oil leaks, reduced life, or even catastrophic failure. NORD gear drives and motors are intended to be installed at a suitable mounting site under the following conditions:

- Unimpeded airflow to and around the units.
- Accessibility to oil drain, level and breather plugs.
- On brakemotors, allow adequate space for removing the fan guard and replacing and adjusting the brake.
- Mounting surfaces must be flat, torsionally rigid, and dampened against vibration.
- Unless special measures are taken, the immediate vicinity around the gear drive or motor should not be exposed to any aggressive or corrosive substances, contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity, etc.

2. Mounting position

Reducer mounting position charts illustrate the standard mounting positions for horizontal and vertical mounting. All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, **according to the customer-specified mounting position**. For mounting orientations other than shown consult NORD Gear.

NOTICE

Improper oil levels may lead to premature component wear and diminished service life. The gear reducer may not receive proper lubrication if the unit is not mounted in the position for which it is designed. Observe the mounting position designated on the reducer nameplate, or specified in the order acknowledgement. Consult NORD prior to changing mounting position in the field. While it is often possible to simply relocate the oil fill-level and vent locations, and adjust the oil fill amount, in some cases, different mounting positions may lend themselves to different internal construction features.

3. Reducer mounting

- The support foundation must be straight, level and flat. Whether the gear unit is foot-mounted or flange-mounted, NORD recommends that the straightness and flatness of the customer-supplied support foundation follow **Table 1**.
- The gear unit must be properly aligned with the driven shaft of the machine in order to prevent additional stress or load forces from being imposed upon the gear unit.
- To facilitate oil drainage it may be desirable to elevate the gear box foundation above the surrounding support structure.
- All bolting surfaces must be clean and free from contamination and corrosion.

Table 1: Recommended Straightness and Flatness of Customer-Supplied Support Foundation

Above (in)	To & Including (in)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0.00	0.39	+/- 0.002 in
0.39	1.18	+/- 0.004 in
1.18	3.9	+/- 0.008 in
3.9	11.8	+/- 0.016 in
11.8	39	+/- 0.024 in
39	118	+/- 0.031 in

Above (mm)	To & Including (mm)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0	10	+/- 0.05 mm
10	30	+/- 0.1 mm
30	100	+/- 0.2 mm
100	300	+/- 0.4 mm
300	1000	+/- 0.6 mm
1000	3000	+/- 0.8 mm

Straightness: Based upon the length of the corresponding line.

Flatness: Based upon the longer lateral surface or the diameter of the circular surface.

IMPORTANT NOTE

The responsibility for the design and construction of the support foundation is with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads. ***Motors and drive components mounted on prefabricated base plates can become misaligned during shipment. Always check alignment after installation.***

4. Steel foundation

An engineered structural steel foundation should be designed to provide adequate rigidity and prevent loads from distorting the housing or causing misalignment of internal gears and shafts. When foot-mounting the gear reducer, a base plate or sole plate with suitable thickness (generally equal or greater than the thickness of the drive feet) should be securely bolted to steel supports and extend under the entire gear drive assembly. When flange-mounting the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear unit or gear motor.

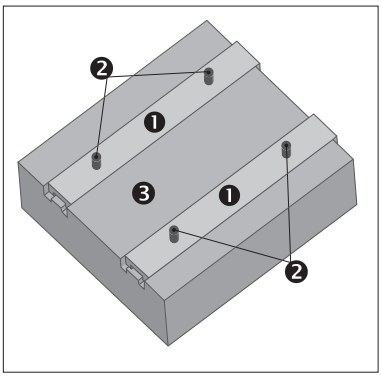
NOTICE

Do not weld on the gear unit or use the gear unit as an earth or ground connection for any welding procedure as this may cause permanent damage to the bearings and gears.

5. Concrete foundation

If a concrete foundation is used, allow the concrete to set firmly before bolting down the gear drive. Grout structural steel mounting pads and bolts of sufficient size into the concrete, to adequately distribute the load stress onto the concrete foundation.

Figure 1: Concrete Foundation



❶ Grouted Structural Steel Mounting Pads
❷ Mounting Bolts
❸ Concrete Foundation

6. Bolt connections for footed & flange mounted units

NORD footed reducers and flange-mount reducers (with B5 flange) have clearance designed into the mounting holes to allow for some minor adjustments in alignment. Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement. Tightening torque for gear reducer mounting bolts, and recommended fastener grades, are provided in Table 2.

Table 2A: Tightening Torque for Inch Reducer Mounting Bolts

Thread Size	Grade SAE 5 / ASTM A449		Grade SAE 8	
(in)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
1/4-20	7.1	9.6	10.0	13.6
5/16-18	16	21	22	30
3/8-16	28	37	39	53
1/2-13	69	93	98	132
5/8-11	138	188	195	264
3/4-10	247	334	348	472
7/8-9	396	537	558	757
1-8	592	802	833	1,130
1 1/8-7	-	-	1,233	1,672
1 1/4-7	-	-	1,717	2,327
1 3/8-6	-	-	2,267	3,073
1 1/2-6	-	-	2,983	4,045
1 3/4-5	-	-	4,458	6,045

- Calculated tightening torques are based a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using inch-fasteners, NORD recommends a minimum Grade SAE 5 (ASTM A-449) for sizes up to 1-8 UNC, and Grade SAE 8 for all larger sizes.

Table 2B: Tightening Torque for Metric Reducer Mounting Bolts

Above	ISO Grade 8.8		ISO Grade 10.9		ISO Grade 12.9	
(mm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
M4	2.4	3.2	3.5	4.7	4.1	5.5
M5	4.7	6.4	6.9	9.3	8.1	11
M6	8	11	12	16	14	19
M8	20	27	29	39	34	46
M10	39	53	58	78	67	91
M12	68	92	100	135	110	155
M14	107	145	159	215	180	250
M16	170	230	247	335	290	390
M18	240	325	343	465	400	540
M20	339	460	487	660	570	770
M22	465	630	664	900	770	1,050
M24	583	790	848	1,150	960	1,300
M27	848	1,150	1,217	1,650	1,440	1,950
M30	1,180	1,600	1,660	2,250	1,950	2,650
M36	2,050	2,780	2,884	3,910	3,470	4,710
M42	3,297	4,470	4,639	6,290	5,560	7,540
M48	4,940	6,700	7,010	9,500	8,260	11,200

- Calculated tightening torques are based on a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using metric-fasteners, NORD recommends a minimum ISO Grade 8.8 bolt.

7. Mounting the prime mover

When the motor is not flange mounted or integrally mounted to the gearbox, it is important to properly secure and align the gear drive with respect to the driven machine before attempting to align the prime mover or motor.

A. After the main gear drive is properly aligned and bolted in place, align the prime mover with respect to the reducer input shaft.

B. Use shims under the feet of the prime mover as needed, and secure in place with the proper mounting bolts. Dowel pins may be field-installed to help prevent misalignment and ensure proper realignment if removed for service.

IMPORTANT NOTE

When using a high speed coupling connection between the prime mover and the reducer, check alignment per the coupling manufacturers recommendations. If the coupling is misaligned, the reducer alignment or shimming is incorrect. Re-align the gear reducer and re-check the high-speed coupling alignment before re-aligning the motor.

1. Solid shaft diameter tolerance

Reducer input and output shaft extensions have a diameter tolerance as specified in **Table 1**.

Table 1: Solid Shaft Diameter Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)
0.375	1.750	+0.0000 / -0.0005
1.750	7.500	+0.0000 / -0.0010

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
10	18	+0.012 / +0.001	k6
18	30	+0.015 / +0.002	k6
30	50	+0.018 / +0.002	k6
50	80	+0.030 / +0.011	m6
80	120	+0.035 / +0.013	m6
120	180	+0.040 / +0.015	m6
180	190	+0.046 / +0.017	m6

2. Fitting drive elements onto the reducer solid shaft

Solid input and output shaft extensions are provided with a drill and tap feature as indicated in Table 2. When installing drive elements such as coupling hubs, pulleys, sprockets, or gears, NORD recommends using the threaded hole in the end of the shaft, along with a suitable assembly device fitted into the threaded hole.

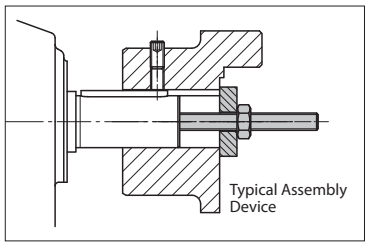


Table 2: Solid Shaft End - Threaded Holes

Above ø (in)	To & Including ø (in)	Tap Size & Depth (in)
0.375	0.500	10-24 x 0.43 in
0.500	0.875	1/4-20 x 0.59 in
0.875	0.938	5/16-18 x 0.71 in
0.938	1.100	3/8-16 x 0.87 in
1.100	1.300	1/2-13 x 1.10 in
1.300	1.875	5/8-11 x 1.42 in
1.875	3.500	3/4-10 x 1.73 in
3.500	7.500	1-8 x 2.63 in
5.125	8.875	1 1/4 - 7 x 3.15*
6.000	8.875	1 3/8 - 6 x 3.46**

Above ø (mm)	To & Including ø (mm)	Tap Size & Depth (mm)
10	13	M4 x 10 mm
13	16	M5 x 12.5 mm
16	21	M6 x 16 mm
21	24	M8 x 19 mm
24	30	M10 x 22 mm
30	38	M12 x 28 mm
38	50	M16 x 36 mm
50	85	M20 x 42 mm
85	130	M24 x 50 mm
130	225	M30 x 60 mm*
130	225	M36 x 74 mm**

* Only used on the SK9096.1 Helical-Bevel Gear Unit.

** Only used on the SK10382.1 & SK11382.1 CLINCHER™ gear units.

NOTICE

DO NOT DRIVE or **HAMMER** the coupling hub, pulley, sprocket, or gear into place. An endwise blow to the reducer shaft can generate damaging axial forces and cause damage to the reducer housing, bearings or internal components.

⚠ WARNING

To avoid serious injury the user must provide suitable safety guards for all rotating shafts and shaft components such as couplings, chain drives, belt drives, etc. All guarding must adhere to local regulations and safety standards.

3. Installing interference-fit hubs to the reducer shaft

Prior to installing any interference-fit hubs to the reducer shaft, consult with the manufacturer to determine proper assembly and fit. Interference-fits usually require heating the coupling, sprocket or gear hub, per the manufacturer's recommendations. Coupling hub installation typically follows ANSI/AGMA 9002-A86. Always make sure the reducer shaft seals are protected from the heat source. Apply uniform heat to the drive element hub to prevent distortion. NORD does not recommend heating the drive element hub beyond 212°F to 275°F (100°C to 135° C).

⚠ WARNING

When using heat to mount a drive element hub, do not use open flame in a combustible atmosphere or near flammable materials. Use suitable protection to avoid burns or serious injury.

IMPORTANT NOTE

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close to the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tighten the belts or chains.

4. Coupling installation

The performance and life of any coupling depends upon how well it is installed. Coupling hubs are typically mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. To help obtain critical shaft alignment coupling hubs may be installed to the machine shafts prior to final shimming or tightening of the foundation bolts. Proper coupling alignment allows for thermal and mechanical shaft movement during operation and ensures that only torque (no radial load) is transmitted between the mating shafts.

Coupling gap and angular alignment

The shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement. When setting the coupling gap, insert a spacer or shim stock equal to the required spacing or gap between the coupling hub faces. Measure the clearance using feeler gauges at 90-degree intervals, to verify the angular alignment.

Parallel (or offset) alignment

Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel or offset misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90° intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel or offset misalignment.

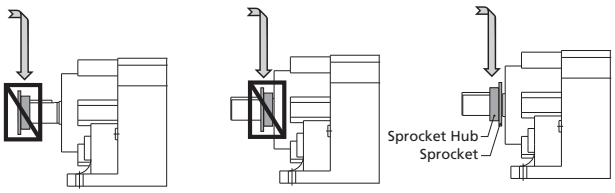
Check alignment

After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and re-check critical alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

5. Installing sheaves (pulleys), sprockets and gears

To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, gears, etc.) so that the applied load center is as close to the gear housing as possible, as shown in **Figure 2**.

Figure 2: Sprocket or Gear Mounting



Preferred Mounting of Sprocket or Gear

Align the driver sheave or sprocket with the driven sheave or sprocket by placing a straight-edge length-wise across the face of the sheaves or sprockets. Alignment of bushed sheaves and sprockets should be checked only after bushings have been tightened. Check horizontal shaft alignment by placing one leg of a square or a level vertically against the face of the sheave or sprocket.

Always check component alignment and tension any belts or chains per the manufacturer's recommendation. The ideal belt or chain tension allows proper wrap of the driver and driven wheels, while maintaining the lowest possible tension of the belts or chain, so that no slipping occurs under load conditions. Check belt or chain tension frequently over the first 24 to 48 hours of operation.

IMPORTANT NOTE

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tension the belts or chains.

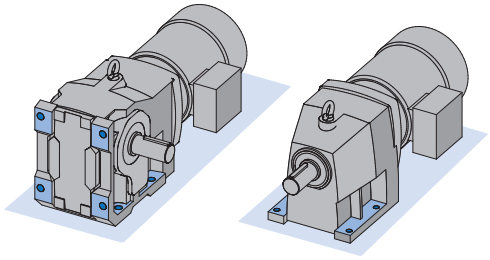
6. Outboard pinion gear alignment

Align outboard pinion gears and adjust the gear tooth clearance according to the manufacturer's recommendations, checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the gear unit moved slightly to obtain proper gear tooth contact. After the unit is moved to correct tooth contact, the prime mover may need to be realigned.

REDUCER MOUNTING
FOOTED & FLANGE MOUNT GEAR UNITS

1. Foot-mounted reducers

When installing the foot-mounted gear unit, observe the flatness specifications and bolt tightening torque guidelines provided in U10060 and make sure the mating mounting surface and reducer feet are clean and free of debris. Use of shims under the feet of the gear unit may be required in order to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will cause mis-alignment and may reduce the life of the gear unit or cause component failure. Dowel pins may be field-installed to help prevent misalignment and ensure proper realignment if removed for service.



IMPORTANT NOTE

Gear units may be subjected to radial loads or side pull, caused by external chain drives or belt drives. In these instances it is recommended that the mounting base be designed with a slide-plate adjustment to accommodate extra slack in the chain or the belt after the feet are loosened. When using an external chain or belt drive, make sure the reducer is sized so that the shaft and bearings have adequate capacity.

2. Flange-mounted reducers (with B5 flange)

When using the B5 flange to mount the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear reducer or gearmotor. When the mating hole is designed with the proper fit, the flange pilot tenon provides a means of accurately positioning the reducer while the hold-down bolts are properly secured; once the reducer is secured, the tenon helps prevent movement of the reducer and it helps locate the center of the reducer output shaft. The flange centering shoulder tolerance for standard units is listed in table 1. For units with NSD Tuph please see table 2 on the following page.

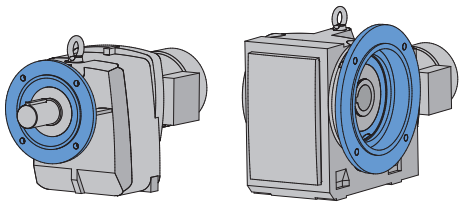


Table 1 : Flange Centering Shoulder Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)	ISO 286-2 Fit Class
1.969	3.150	+0.0005 / -0.0003	j6
3.150	4.724	+0.0005 / -0.0004	j6
4.724	7.087	+0.0006 / -0.0004	j6
7.087	9.055	+0.0006 / -0.0005	j6
9.055	9.843	+0.0000 / -0.0011	h6
9.843	12.402	+0.0000 / -0.0013	h6
12.402	15.748	+0.0000 / -0.0014	h6
15.748	19.685	+0.0000 / -0.0016	h6
19.685	21.654	+0.0000 / -0.0017	h6

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
50	80	+0.012 / -0.007	j6
80	120	+0.013 / -0.009	j6
120	180	+0.014 / -0.011	j6
180	230	+0.016 / -0.013	j6
230	250	+0.000 / -0.029	h6
250	315	+0.000 / -0.032	h6
315	400	+0.000 / -0.036	h6
400	500	+0.000 / -0.040	h6
500	550	+0.000 / -0.044	h6

When installing the flange mounted gear unit, observe the flatness specifications and bolt tightening torque guidelines provided in U10060. Make sure the mating mounting surface and reducer flange are clean and free of debris. Use a straight edge or parallel bar to check for high spots on the mating mounting surface and remove any raised material around the mounting holes.

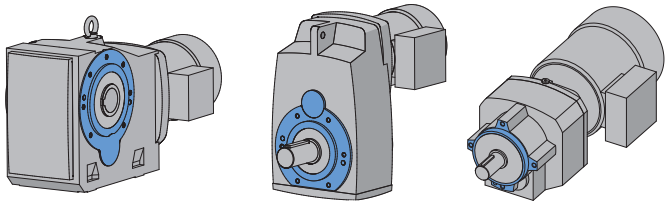
Set the gear unit into place and tighten the bolts until they are snug. Before final bolt-tightening check for any material gaps between the mating surfaces and if shimming is required, use “U” shaped shims at least 2 times the width of the bolt. Avoid over shimming a very irregular surface as this will make it very difficult to achieve proper alignment.

IMPORTANT NOTE

For heavy shock applications, it is advisable to field-install dowel pins through the mounting flange connection (in addition to the mounting bolts). This will help control flange movement or flange rotation and relieve the mounting bolts from this additional stress.

3. Flange-mounted reducers (with B14 flange)

When using the B14 flange to mount the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear reducer or gearmotor. When properly installed, the output flange of the reducer housing is designed to enable the permissible torques and radial forces to be reliably transmitted by the bolt connections. The flange centering shoulder tolerance for standard units is listed in table 1 on the previous page. For units with NSD Tuph please see table 2 below.



IMPORTANT NOTE

When using the B14 flange-face for mounting, if dowel pin holes are provided in addition to the threaded holes, then it is advisable to also use the proper dowel pins, to help control flange movement or flange rotation and relieve the mounting bolts from this additional stress This is especially important for heavy shock applications.

Table 2 : Flange Centering Shoulder Tolerance on NSD Tuph Units

Above ø (in)	To & Including ø (in)	Tolerance (in)
1.969	3.150	+0.0020 / +0.0013
3.150	4.724	+0.0021 / +0.0012
4.724	7.087	+0.0021 / +0.0011
7.087	9.055	+0.0022 / +0.0011

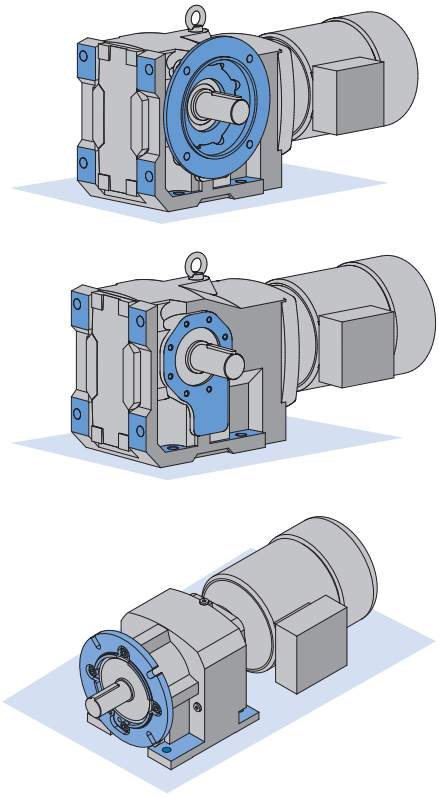
Above ø (mm)	To & Including ø (mm)	Tolerance (mm)
50	80	+0.052 / +0.033
80	120	+0.053 / +0.031
120	180	+0.054 / +0.029
180	230	+0.056 / +0.027

4. Foot & flange reducer housings

Some gear reducer housings are available with a foot and an output flange. Units with a foot and a B5 Flange are designated with the suffix XF after the primary model number and units with a B14 face-flange are designated with the suffix XZ after the primary model number. When a gear unit is provided with both a foot and a flange, the foot is consider the primary mounting surface. The flange is generally considered to be the secondary mounting option and it is intended that this surface be used for auxiliary add on elements that place minimal load stress on the reducer housing.

NOTICE

To prevent overstress on the main gear unit housing, never tighten the reducer mounting feet and the mounting flange against one-another. Auxiliary add-on elements that are mounted to the reducer flange, must not transmit excessive force, torque or vibration to the main gear housing.



HELICAL & BEVEL REDUCER LUBRICATION

1. Importance of proper lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Most NORD reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position.

2. Standard oil type

The following tables indicate the standard oil fill type used. Please see user manual U11000 for more specific information and for optional helical and bevel gear lubricants:

Serviceable Gear Units	
Helical In-line	Standard Oil Fill: ISO VG 220, Mineral Oil
Clincher Parallel-Shaft	
Right-Angle Bevel	
NORDBLOC® Series In-line	
NORDBLOC®.1 Series In-line	
Standard Series In-line	

IMPORTANT NOTE

For shipping purposes, the following large Clincher™ gear units are supplied without oil:
- Clincher™ Sizes SK11282, SK11382, SK11382.1 and SK12382

Maintenance-free / Lubricated For Life Gear Units	
Clincher™ sizes SK0182NB, SK0282NB & SK1382NB	Standard Oil Fill: ISO VG220 SHC/PAO Synthetic Oil
NORDBLOC® Sizes SK172, SK272, SK371F, SK372, SK373, SK320	

IMPORTANT NOTE

Maintenance-free units are supplied as sealed units with no vent-plug. Consult NORD prior to ordering if interested in ordering any of the above sizes as serviceable gear units.

IMPORTANT NOTE

Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Some units have special lubricants designed to operate in certain environments or intended to extend the service life or service temperature range of the lubricant. If in doubt about which lubricant is needed for a certain application, please contact NORD Gear.

3. Lubrication replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years. Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to establish a condition-based oil service interval.

4. Oil viscosity

Viscosity, or the oil's resistance to shear under load, is often considered the single most important property of any gear oil.

- Often one will consider making a viscosity correction to the oil to improve the performance when operating the gear unit at low temperature or high temperature.
- In cases of extreme load conditions, gear pairs and antifriction bearings may be more susceptible to sliding or scuffing wear. In these operating conditions, it may also be beneficial to consider an increased lubrication viscosity and/or a lubrication with improved antiwear additive packages.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

5. Maximum oil sump temperature limit

To prevent reducer overheating, the reducer's maximum oil sump temperature limit must not be exceeded for prolonged periods of operation (up to 3 hours continuous operation depending upon reducer size).

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Mineral	80-85°C (176-185°F)	95°C (203°F)
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

6. The importance of routine oil analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends will help establish proper lubrication maintenance and change-out intervals. To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NOTICE

NORD suggests replacing the gear oil if oil analysis indicates any of the following. Failure to replace the oil may cause internal damage to gearbox and diminished performance:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- The total acid number (TAN) tests indicate a significant level of oxidative break-down of the oil, and a critical reduction in performance; If the TAN number measured changes by more than 5% over the new oil, then an oil change would be recommended.

7. Mounting position and oil fill quantity

All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. ***For additional information, please see the seperate mounting position diagrams and the corresponding oil fill quantity tables for the specified gear unit.***

The gearbox nametag will indicate the mounting position that was provided. ***For mounting orientations other than shown in the mounting position charts, please consult NORD Gear.***

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

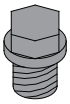
8. Oil plug locations

All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

9. Drain and fill-level plugs

All reducer drain plugs are metric socket head cap screws. For easier identification, it is NORD's standard practice to provide a hex-head screw for the fill-level plug. For ease of draining the used oil from the gear reducer, use the socket head screw located at the lowest part of the gearbox.

Drain Plug



Fill Level Plug

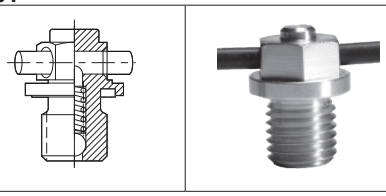
10. Vent plug locations

Reducer venting allows for air pressure differences that occur during operation, between the inner space of the reducer and the atmosphere, while ensuring leak-free operation. The AUTOVENT™ is standard for all vented gear units, unless otherwise noted.

AUTOVENT™ - The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

Figure 1 AUTOVENT™ Types

Type 1

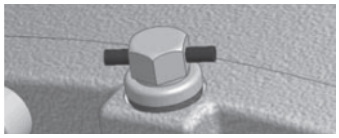


Type 2 with transportation plug

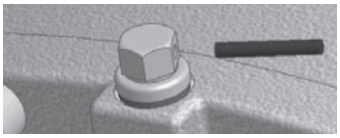
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal components and cause leakage.



Sealed vent



Activated vent

Filtered Vent - NORD may offer an optional filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

HELICAL & BEVEL REDUCER LUBRICATION TYPES

Lubrication Tables – Helical and Bevel Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	♦❶
	PAO-EP	-35 to 60°C (-31 to 140°F)	Mobil SHC Gear 220	♦❷
	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO-EP	-35 to 80°C (-31 to 176°F)	Mobil SHC Gear 460	-
	FG-PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC Cibus 460	-
VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC Cibus 220	S
VG150	PAO-EP	-35 to 25°C (-31 to 77°F)	Mobil SHC Gear 150	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	♦❶
	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	♦❷
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	♦

♦ Stocked Lubricants

❶ Standard product on serviceable gear units

❷ Standard product on maintenance free gear units

IMPORTANT NOTE

- The "Ambient Temperature" is intended to be an operation guideline based upon the typical properties of all the lubricant. The viscosity and other properties of the lubricant change based upon load, speed, ambient conditions, and reducer operating temperatures. The user should consult with their lubrication supplier & NORD gear before considering changes in oil type or viscosity.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Mineral Oil: 85 °C (185 °F).
  Synthetic Oil: 105 °C (225 °F).
- In the following instances, please consult NORD for specific recommendations:
  - √ Gear units will operate in high ambient temperature conditions exceeding 40 °C (104 °F).
  - √ Gear units will operate in cold ambient temperature conditions approaching 0 °C (32 °F) or lower.
  - √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.
  - √ Fluid grease is required for lubricating the gear unit.
- Observe the general lubrication guidelines outlined in user manual U10750.

Oil Formulation Codes

MIN-EP - Mineral Oil with EP Additive
PAO-EP - Synthetic Polyalphaolefin Oil with EP Additive
PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG - Food-Grade Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

Lubrication Notes

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil or polyalphaolefin (PAO) synthetic oil.

HELICAL & BEVEL REDUCER LUBRICATION TYPES

Oil Cross-reference Chart

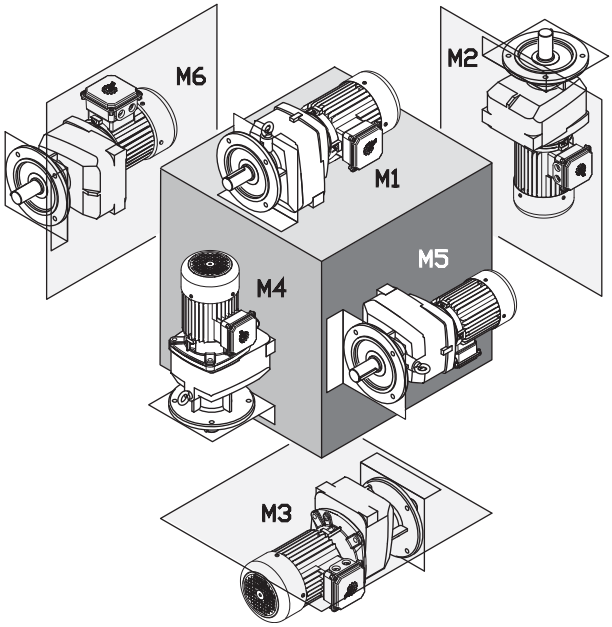
ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG150	MIN-EP	0 to 25°C (32 to 77°F)	Mobilgear 600XP150	Omala S2 G 150	Alpha SP150	Renolin EP150	Klüberoil GEM 1-150N
	PAO-EP	-30 to 25 °C (-22 to 77 °F)	Mobil SHC Gear 150	Omala S4 GX 150	Alphasyn EP150	Gearmaster SYN150/NA	Klübersynth EG 4-150
	PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG	0 to 25°C (32 to 77°F)	Mobil DTE FM 150	N/A	N/A	N/A	N/A
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	Omala S2 G 220	Alpha SP220	Renolin EP220	Klüberoil GEM 1-220N
	PAO-EP	-30 to 60 °C (-22 to 140 °F)	Mobil SHC Gear 220	Omala S4 GX 220	Alphasyn EP220	Gearmaster SYN220/NA	Klübersynth EG 4-220
	PAO	-30 to 60°C (-22 to 140°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM 220	N/A	N/A	Fuchs FM220	N/A
	FG-PAO	-25 to 60°C (-13 to 140°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	MIN-EP	0 to 40°C (32 to 104°F)	Mobilgear 600XP460	Omala S2 G 460	Alpha SP460	Renolin EP460	Klüberoil GEM 1-460N
	PAO-EP	-20 to 80°C (-4 to 176°F)	Mobil SHC Gear 460	Omala S4 GX 460	Alphasyn EP460	Gearmaster SYN460/NA	Klübersynth EG 4-460
	PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM460	N/A	N/A	Fuchs FM460	N/A
	FG-PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

NORDBLOC®.1 FLANGED OIL FILL QUANTITIES

NORDBLOC®.1 Fill Quantities (Flanged)

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The correct oil level should be located at the lower edge of the oil level hole.

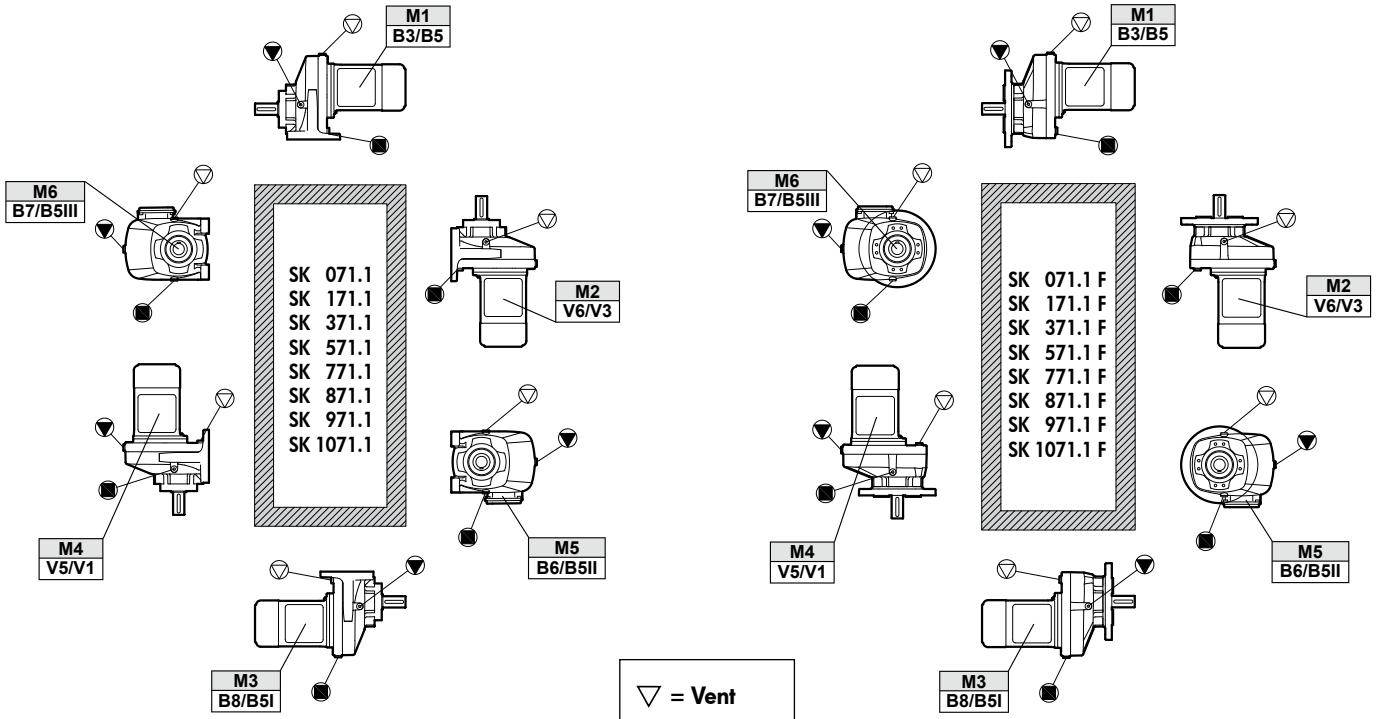
For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

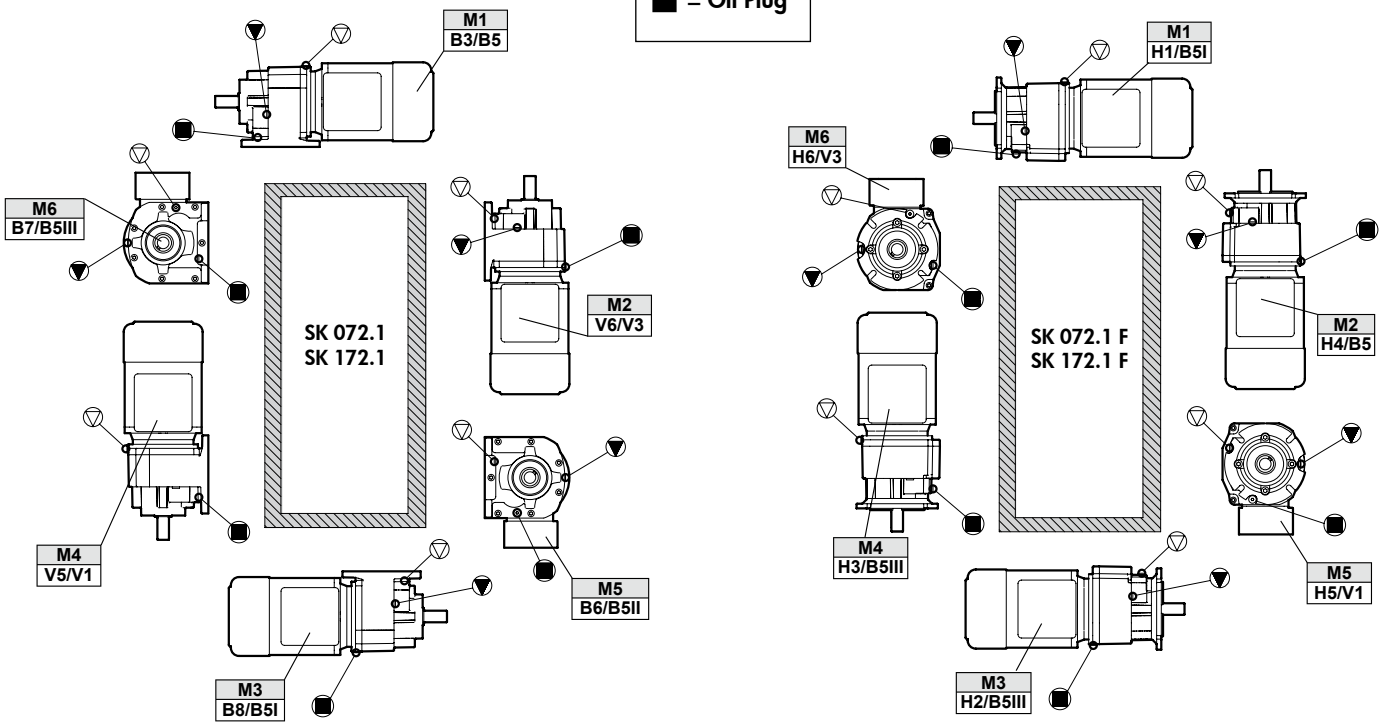
Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 071.1 F	0.19	0.18	0.42	0.40	0.40	0.38	0.42	0.40	0.32	0.30	0.32	0.30
SK 072.1 F	0.17	0.16	0.34	0.32	0.22	0.21	0.24	0.23	0.19	0.18	0.21	0.20
SK 171.1 F	0.23	0.22	0.42	0.40	0.38	0.36	0.42	0.40	0.35	0.33	0.35	0.33
SK 172.1 F	0.29	0.27	0.62	0.59	0.44	0.42	0.48	0.45	0.34	0.32	0.41	0.39
SK 371.1 F	0.37	0.35	0.61	0.58	0.58	0.55	0.61	0.58	0.52	0.49	0.52	0.49
SK 372.1 F	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 373.1 F	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 571.1 F	0.51	0.48	0.91	0.86	0.85	0.80	0.97	0.92	0.72	0.68	0.72	0.68
SK 572.1 F	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 573.1 F	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 672.1 F	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 673.1 F	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 771.1 F	0.95	0.90	1.60	1.50	1.30	1.20	1.80	1.70	1.20	1.16	1.20	1.16
SK 772.1 F	1.40	1.30	4.00	3.80	2.50	2.40	3.50	3.30	1.80	1.70	2.50	2.40
SK 772.1 VL F	2.10	2.00	4.00	3.80	2.50	2.40	3.50	3.30	1.80	1.70	2.50	2.40
SK 773.1 F	2.10	2.00	3.70	3.50	3.40	3.20	3.10	2.90	2.40	2.30	3.20	3.00
SK 773.1 VL F	2.10	2.00	3.70	3.50	3.40	3.20	3.10	2.90	2.40	2.30	3.20	3.00
SK 871.1 F	1.59	1.5	3.38	3.2	3.38	3.2	2.75	2.6	2.43	2.3	2.43	2.3
SK 872.1 F	3.40	3.20	7.90	7.50	5.40	5.10	7.10	6.70	2.70	2.60	4.50	4.30
SK 872.1 VL F	5.30	5.00	7.90	7.50	5.40	5.10	7.10	6.70	2.70	2.60	4.50	4.30
SK 873.1 F	4.30	4.10	8.00	7.60	7.30	6.90	7.00	6.60	5.30	5.00	7.00	6.60
SK 873.1 VL F	4.30	4.10	8.00	7.60	7.30	6.90	7.00	6.60	5.30	5.00	7.00	6.60
SK 971.1 F	2.01	1.9	4.12	3.9	4.12	3.9	3.59	3.4	3.28	3.1	3.28	3.1
SK 972.1 F	4.80	4.50	13.00	12.50	8.50	8.00	13.00	12.50	4.80	4.50	8.10	7.70
SK 972.1 VL F	9.00	8.50	13.00	12.50	8.50	8.00	13.00	12.50	4.80	4.50	8.10	7.70
SK 973.1 F	7.80	7.40	13.00	12.20	12.00	11.10	12.00	11.60	8.50	8.00	12.00	10.90
SK 973.1 VL F	7.80	7.40	13.00	12.20	12.00	11.10	12.00	11.60	8.50	8.00	12.00	10.90
SK 1071.1 F	3.49	3.3	7.82	7.4	7.82	7,4	7.08	6.7	5.6	5.3	5.6	5.3

NORDBLOC®.1
OIL PLUG & VENT LOCATIONS

Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The correct oil level should be located at the lower edge of the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***





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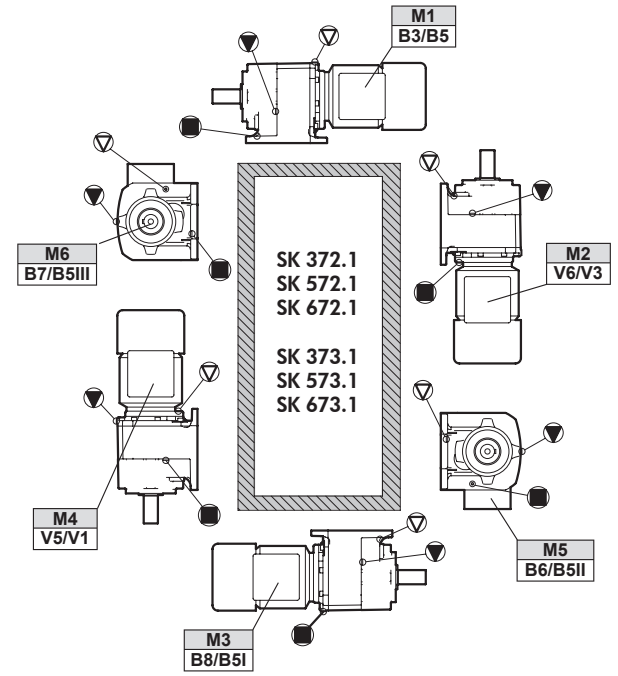
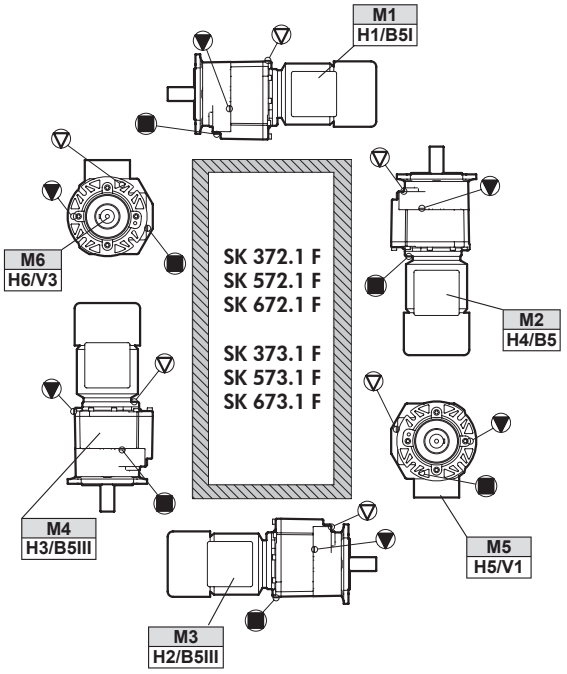
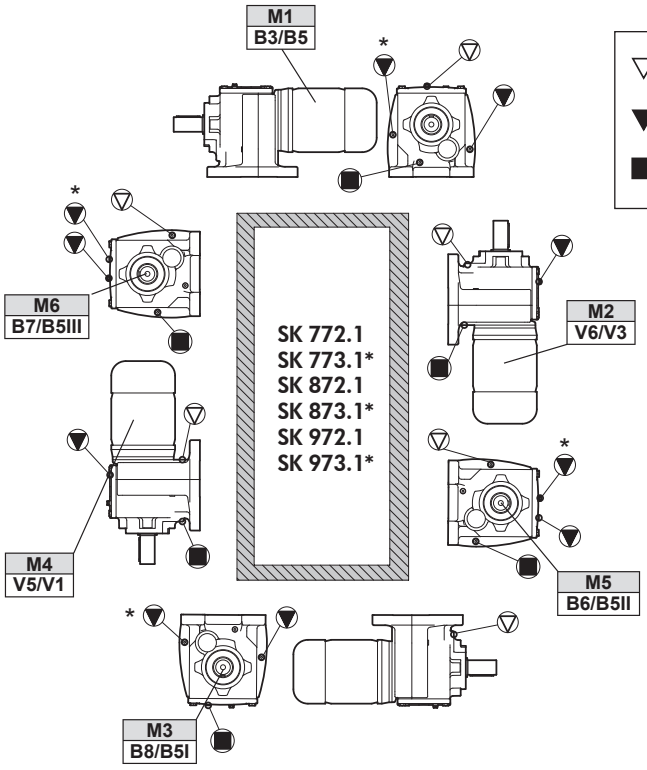
NORDBLOC®.1
OIL PLUG & VENT LOCATIONS

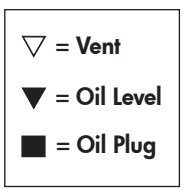
Oil plug connections

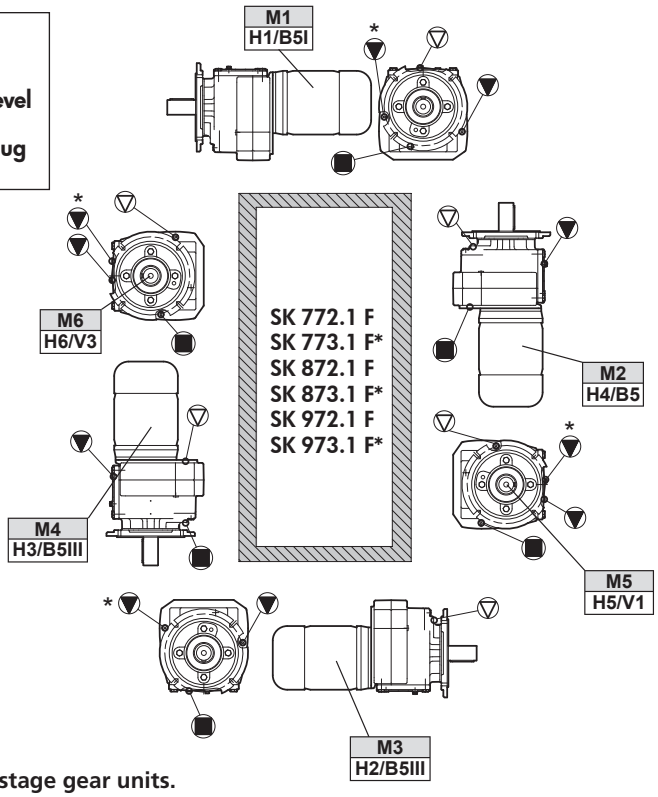
Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The correct oil level should be located at the lower edge of the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***











*** Oil fill level for three stage gear units.**

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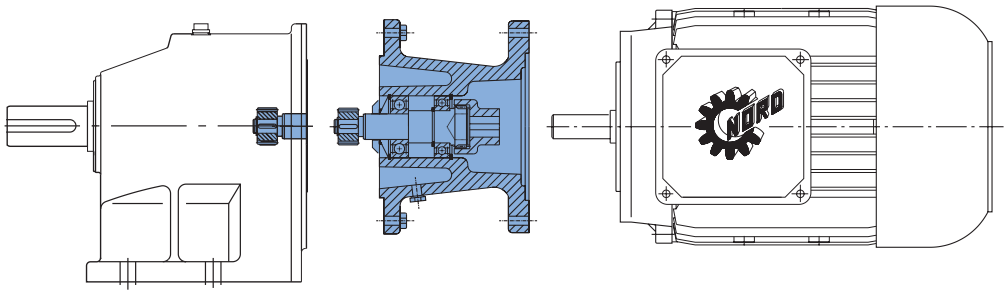
Troubleshooting

This section identifies some of the most common issues involved with NORD Gear speed reducers , and provides recommendations to assist you in defining and answering your questions as you work with our products. You may also contact our Engineering/Application departments if your questions are not answered in the table below.

Problem With the Reducer		Possible Causes	Suggested Remedy
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce the load.
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels.
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting and structure.
		Loose hold down bolts	Tighten bolts
	Failure of bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient lubricant	Level of lubricant in reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output shaft does not turn	Internal parts are broken or missing	Overloading of reducer can cause damage	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected	Properly allign reducer and coupling. Tighten coupling.
Oil Leakage	Worn seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
	Unit runs hot or leaks	Overfilled reducer	Check lubricant level and adjust to recommended level.
		Vent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
	Incorrect fill level	Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position on the name tag & verify with mounting chart in manual.

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS



⚠ WARNING

While working on the gear drive system, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!

NEMA/ IEC Motor Adapters

Motor adapters allow for easy installation and removal of industry standard motors. Motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer.

NORD Gear supplies a coupling that is to be mounted on the motor shaft. It is important that the coupling is properly positioned.

- For NEMA Input Adapters, follow the Motor Installation Instructions on pages 3-5.
- For IEC Input Adapters, the supplied coupling will mount directly against the motor shaft shoulder. No locating measurements need to be taken.

IMPORTANT NOTE

Some of the larger IEC inputs will have a coupling spacer included to help locate the coupling. Slide the spacer against the motor shaft shoulder, slide the coupling against the spacer and tighten set screw(s).

IMPORTANT NOTE

For the larger motor adapters (IEC160 / N250TC and larger), an Automatic Lubricator may be supplied. This will need to be activated at the time of startup. For operation andactivation instructions, refer to user manual U45200. Motor adapter option AI and AN do not utilize an Automatic Lubricator and are lubricated for life.

NEMA/IEC Motor Weight Limits

When mounting a motor to a NORD NEMA C-face motor adapter it is important to consider the motor's weight. Following is a table that includes the maximum motor weight the NEMA adapter can support. If the motor exceeds the listed weight is must be externally supported. When a C-face mounted motor is externally supported care must be taken to ensure that the support system does not impose additional pre-loads on the NEMA motor adapter.

NEMA Motor Weight Limit

Motor FRAME	56C	140TC	180TC	210TC	250TC	280TC
Max Weight [lb]	66	110	176	221	441	551
Motor FRAME	**320TC**	**360TC**	**400TC**			
Max Weight [lb]	772	1544[4)]	1544			

IEC Motor Weight Limit

Motor FRAME	63	71	80	90	100	112	132
Max Weight [kg]	25	30	50[1)]	50	80[2)]	80	100
Motor FRAME	**160**	**180**	**200**	**225**	**250**	**280**	**315**
Max Weight [kg]	250[3)]	250	350	500	1000	1000	1500

1) ≤ 40 kg SK 920072.1, SK 92072.1, SK 071.1, SK 0182.1
2) ≤ 60 kg SK 1382.1, SK 92372.1, SK 12063, SK 372.1, SK 371.1
3) ≤ 200 kg SK 42, SK 4282, SK 9042.1, SK 42125
4) ≤ 1103 lb SK 62, SK 72, SK 73, SK 83, SK 93, SK 9072.1, SK 6282, SK 7282, SK 7382, SK 8382, SK 9392

Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending upon the size of the input, NORD provides either a gear or a jawtype coupling.

NORD supplies three different types of couplings depending on the size of input: "J" style, "M" style and "Jaw" style coupling. Following are instructions on how to properly mount each type of coupling onto the motor.

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS

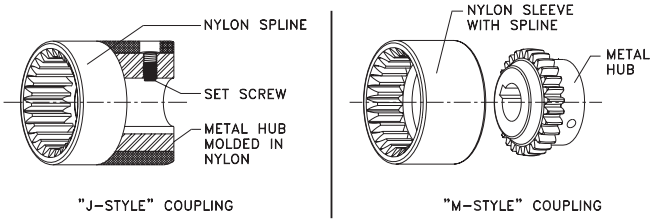
Couplings for the NEMA and IEC Adapters

Depending on the size of the input adapter to the gearbox, NORD Gear supplies two styles of couplings - BoWex® (gear tooth) and Rotex® (jaw) couplings.

BoWex® Couplings

NORD motor adapter input shafts have a machined spline on the end. NORD incorporates two styles of BoWex® couplings, the "J" and "M" styles. The "J" style is a one-piece coupling with a metal hub and nylon spline. The "M" style is a two-piece coupling – the metal hub and a nylon sleeve. Nylon and steel components allow them to operate in high ambient temperatures without lubrication or maintenance.

- Nylon sleeves resist dirt, moisture, most chemicals and petroleum products
- No lubrication required
- Operating Conditions: -22°F - 212°F (-30°C - 100°C)
- Higher temperature coupling sleeve available up to 250°F (120°C)
- Special bore available



BoWex® Couplings Mechanical Ratings "J" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
BoWex® J14	44.3 lb-in 5 N-m	88.5 lb-in 10 N-m	N56C IEC63, IEC71	5/8" 11mm, 14mm
BoWex® J24	106 lb-in 12 N-m	212 lb-in 24 N-m	N56C, N140TC IEC80, IEC90	5/8", 7/8" 19mm, 24mm
BoWex® J28	398 lb-in 45 N-m	1,195 lb-in 135 N-m	N180TC IEC100, IEC112	1-1/8" 28mm

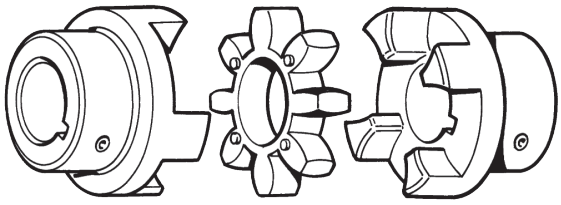
BoWex® Couplings Mechanical Ratings "M" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
BoWex® M38	708 lb-in 80 N-m	2,124 lb-in 240 N-m	N180TC, N210TC IEC132	1-1/8", 1-3/8" 38 mm
BoWex® M42	885 lb-in 100 N-m	2,655 lb-in 300 N-m	N250TC IEC160	1-5/8" 42 mm
BoWex® M48	1,239 lb-in 140 N-m	3,717 lb-in 420 N-m	N280TC IEC180	1-7/8" 48 mm

Rotex® Couplings

The cast iron jaw type couplings have an integral urethane "spider" that provides smooth transmission of the motor torque. A set screw on the coupling prohibits axial movement along the motor shaft.

- Excellent shock and vibration dampening
- Excellent resistance to oils and most chemicals
- No metal-to-metal contact
- Operating Conditions: -22°F - 195°F (-30°C - 90°C)
- Higher temperature material (Hytrel) spider available up to 230°F (110°C)
- Low temperature materials available upon request
- Special bores available



Rotex® Couplings Mechanical Ratings "R" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
Rotex® R42	3,983 lb-in 450 N-m	7,966 lb-in 900 N-m	AN250TC	1-5/8"
Rotex® R48	4,647 lb-in 525 N-m	9,294 lb-in 1,050 N-m	AN280TC AI160, AI180	1-7/8" 42, 42 mm
Rotex® R55	6,063 lb-in 685 N-m	12,126 lb-in 1,370 N-m	AN320TC AI200	2-1/8" 55 mm
Rotex® R65	8,319 lb-in 940 N-m	12,125 lb-in 1,880 N-m	N320TC, AN360TC[1)] IEC200, AI200, IEC225	2-1/8", 2-3/8" 55, 55, 60mm
Rotex® R75	16,992 lb-in 1,920 N-m	33,954 lb-in 3,840 N-m	AN360TC[2)], AN400TC AI250, AI280	2-3/8", 2-7/8" 70, 80 mm
Rotex® R90	31,860 lb-in 3,600 N-m	63,720 lb-in 7,200 N-m	N360TC IEC250, IEC280, IEC315, AI315	2-3/8" 70, 80, 85, 85 mm

1) AN360TC with R350 flange
2) AN360TC with R450 flange

Couplings for Servo Adapters

NORD Gear supplies Rotex® (jaw) couplings for SERVO adapter connections.

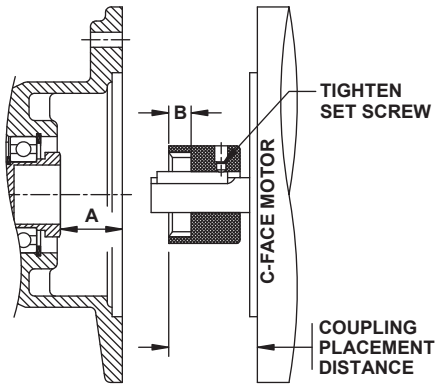
Rotex® Couplings Mechanical Ratings (Servo Adapter)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Reducer Input Flange	Bore Size
Rotex® R19 GS	150 lb-in 17 Nm	301 lb-in 34 Nm	-SEP100, -SEK100	160S	19 mm
Rotex® R24 GS	531 lb-in 60 Nm	1062 lb-in 120 Nm	-SEP130, -SEK130	160S, 250S	24 mm
Rotex® R28 GS	1416 lb-in 160 Nm	2832 lb-in 320 Nm	-SEP165, -SEK165, -SEP215, -SEK215	160S, 250S 250S	32 mm 38 mm
Rotex® R48 GS	4647 lb-in 525 Nm	9293 lb-in 1050 Nm	-SEP215, -SEK215 -SEP300, -SEK300 -SEP300, -SEK300	300S 300S 350	38 mm 48 mm

SEP adapter couplings are for keyed motor shafts.
SEK adapter couplings are clamping style for shafts without key.
Alternate bores upon request.

"J" Style Coupling NEMA C-face Motor Installation

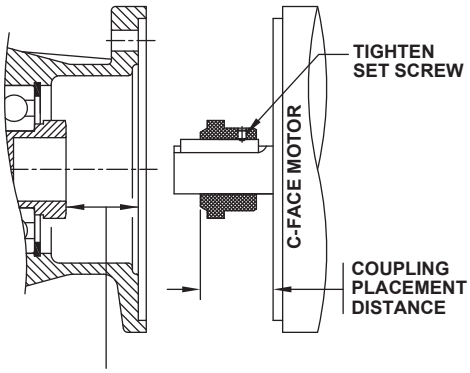
1. Measure the distance from the face of the input adapter to the face of the splined shaft and record that measurement as A in the equation below.
2. Measure depth of coupling engagement zone and record the measurement as "B" in the equation below.
3. Add "A" + "B" and subtract 0.08" (~2mm) from the distance. This needs to be done so that the coupling will not be preloaded after installation!
4. Use that measurement to locate the coupling from the face of the motor onto the shaft.
5. Once in place, tighten the set screw to lock the coupling in place. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.
6. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



MEASURED DISTANCES A + B		SUBTRACT DISTANCE	COUPLING PLACEMENT DISTANCE
____ +	____	- 0.080" (2mm) =	____

"M" Style Coupling NEMA C-face Motor Installation

1 Measure the distance from the face of the input adapter to the face of the splined shaft & record that measurement.
2. Subtract 0.31" (~8mm) from the distance. This needs to be done so that the coupling will not be preloaded after installation!
3. Use that measurement to locate the coupling from the face of the motor onto the shaft.
4. Once in place, tighten the set screw to lock the coupling in place. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.
5. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



MEASURED DISTANCE	SUBTRACT DISTANCE	COUPLING PLACEMENT DISTANCE
____	- 0.310" (8mm) =	____

"Jaw" Style Coupling NEMA C-face Installation for Type N Adapters and Servo Adapters

1. Measure the distance from the face of the input adapter to the face of the coupling as shown and record that measurement.

2. Subtract the "X" dimension from the measured distance. This needs to be done so that the coupling will not be preloaded after installation!

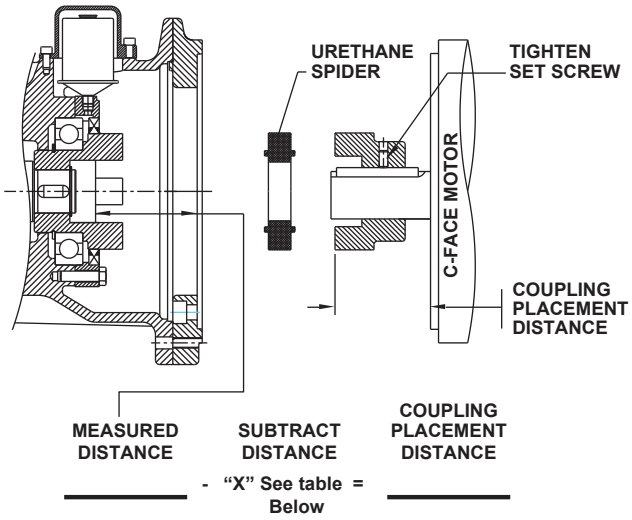
3. Use that measurement to locate the coupling from the face of the motor onto the shaft.

4. The metal portion of the coupling should be heated up prior to assembly, generally 250°F to 300°F (120°C to 150°C).

IMPORTANT NOTE
DO NOT HEAT THE URETHANE SPIDER.

5. Once in place, tighten the setscrew to lock coupling in place. Let the coupling cool down before placing the spider into the jaws. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.

6. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



Coupling Size	"X" (Subtract this value from measured distance)
R14	0.06" (1.5 mm)
R19 & R24	0.08" (2.0 mm)
R28	0.10" (2.5 mm)
R38 & 42	0.12" (3.0 mm)
R48	0.14" (3.5 mm)
R55	0.16" (4.0 mm)
R65	0.18" (4.5 mm)
R75	0.20" (5.0 mm)
R90	0.22" (5.5 mm)

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS

"Jaw" Style Coupling NEMA C-face Installation for Type AN Adapters

1. Remove the motor shaft's key and replace with the key supplied with the adapter. Reference Motor Parallel Keys table below.

IMPORTANT NOTE

NORD SUPPLIES A SPECIAL MOTOR SHAFT KEY
DO NOT USE THE KEY SUPPLIED WITH THE MOTOR!

2. For the attachment of the coupling half, heat up the coupling half to approx. 212°F (100°C). Position the coupling half as follows:
   - Push AI160, AI180 and AI225 on to the spacer bushing.
   - Push AI200, AI250, AI280 and AI315 on to the motor shaft collar.
   - AN250TC–AN400TC until dimension A has been reached (reference Position of the Coupling Half on the NEMA Motor Shaft table below)

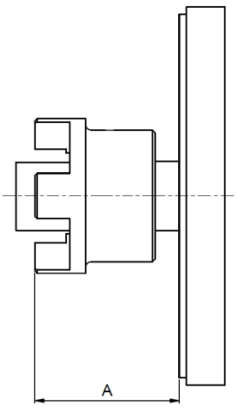
IMPORTANT NOTE

DO NOT HEAT THE URETHANE SPIDER.

2. Once in place, apply Loctite to the setscrew and tighten the setscrew to lock coupling in place. Let the coupling cool down before placing the spider into the jaws. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.

3. Attach the motor to the adapter. For the AN360TC and AN400TC adapters, attach the adapter flange to the motor first, then attach to the adapter.

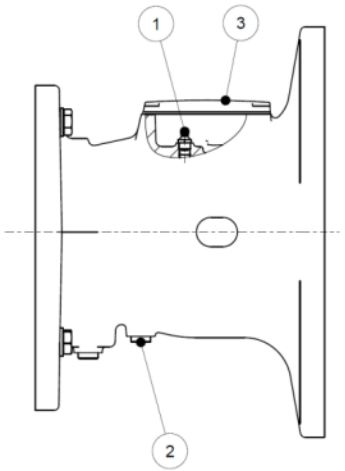
Motor Parallel Keys			
IEC/NEMA Type	**Coupling**	**Shaft ø**	**Motor Shaft's Key**
AI 160	R42	42 mm	12x8x45 mm
AI 180	R48	48 mm	14x9x45 mm
AN 250	R42	1.625 in	3/8x3/8x1 1/2 in
AN 280	R48	1.875 in	1/2x1/2x1 1/2 in
AI 200	R55	55 mm	16x10x50 mm
AN 320	R55	2.125 in	1/2x1/2x1 1/2 in
AI 225	R65	60 mm	18x11x70 mm
AN 360 R350	R65	2.375 in	5/8x5/8x2 1/4 in
AI 250	R75	65 mm	18x11x70 mm
AI 280	R75	75 mm	20x12x70 mm
AN 360 R450	R75	2.375 in	5/8x5/8x3 1/8 in
AN 400	R75	2.875 in	3/4x3/4x3 1/4 in



Coupling Half on the NEMA Motor Shaft		
NEMA type	**Coupling size**	**A [in]**
N250TC R350	R42	3.26
N250TC 300S	R42	3.38
N280TC R350	R48	3.44
N280TC 300S	R48	4.03
N320TC	R55	3.58
N360TC/350	R65	4.98
N360TC/450	R75	5.92
N400TC	R75	6.47

Re-greasing Option for AI...BRG1 and AN...BRG1

For the IEC/NEMA adapters AI and AN with option BRG1, grease the outer roller bearing with approx. 20–25 g of grease at the grease nipple. The grease nipple is located under a bolt-on inspection cover. Before re-greasing, unscrew the grease drain screw so that the excess grease can drain off. Remove the excess grease on the motor adapter.



1 Conical grease nipple
2 Grease drain screw
3 Inspection cover

Automatic Lubricator

Some NORD gear units with NEMA (or IEC) adapters ranging in size from N250TC-N400TC (or IEC160-IEC315) are supplied with a factory-installed, field-activated, PERMA® Classic Automatic Lubrication Cartridge. The automatic lubricator is used to dispense lubricant to the outer most roller bearing of the input NEMA (or IEC) input assembly. The lubrication cartridge must be activated prior to commissioning the gear unit. (Figures 1 & 2)

Some newer versions of the NEMA (or IEC) adapters also include a grease purge. The grease purge area is sealed for transportation; however, it is recommended that the G1/4 sealing screw be removed and that the grease collection container provided by NORD be installed just prior to activating the automatic lubricant dispenser. (Figure 3)

Principle of Operation

First the activation screw is threaded into the lubrication canister. Then the ring-eyelet on top of the activation screw is tightened until its breaking point. This causes a zinc-molybdenum gas generator to drop into a citric acid liquid electrolyte, which is contained within an elastic bladder. An electrochemical reaction slowly releases small amounts of hydrogen gas and gradually pressurizes the bladder, pushing the piston towards the lubrication chamber.

Grease is continuously injected into the lubrication point until the bearing cavity is full. Any back pressure from the bearing will cause the system to neutralize. The bladder inside the canister will continue to slowly build pressure so that once the equipment resumes normal operation; the lubricator will also resume its normal function.

The lubricator contains approximately 120 cm^3 or 120 ml (4.8 oz) of grease. For reference, a single stroke of a typical grease gun delivers approximately 1.0-1.2 cm^3 (0.03–0.04 oz) of grease. This means the canister contains approximately 100 strokes of grease. See Figure 1 for a detailed view of the PERMA® Lubricator.

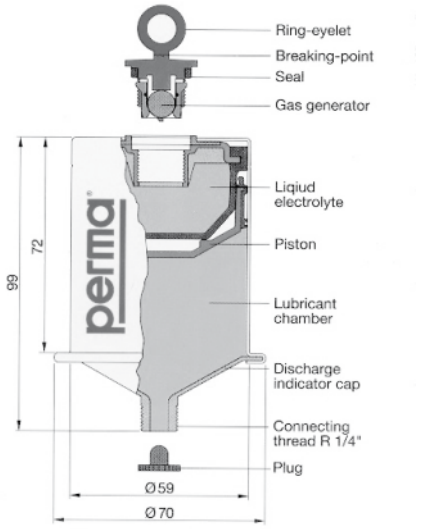


Figure 1 - PERMA® Automatic Lubrication Canister

NOTICE

- To prevent premature bearing failure, the lubrication dispenser must be activated prior to commissioning the gear reducer.
- The lubricator must only be used once and should never be opened or taken apart or permanent damage will result.
- Never unscrew the PERMA® canister from the lubrication point after activation or during the discharge period. This would cause a permanent pressure loss in the lubricator and would justify replacing the lubricator.

⚠ WARNING

- Avoid swallowing the gas generator, the liquid electrolyte, and the lubricant.
- Avoid contact of, the liquid electrolyte, and the lubricant with the eyes, skin or clothing.
- Observe all applicable MSDS sheets.
- Follow applicable local laws and regulations concerning waste disposal.

PERMA® Automatic Lubricator Options Supplied by NORD

NORD Part Number	28301000	28301010
Lubrication Option	Synthetic (standard)	Food Grade (optional)
PERMA® Classic Temperature Range ♦	0 to 40 °C (32 to 104 °F)	0 to 40 °C (32 to 104 °F)
Lubrication Volume	120 cm^3 or 120 ml (4.8 oz)	120 cm^3 or 120 ml (4.8 oz)
Grease Lubrication Mfg. / Type	Klüber / Petamo GHY 133	Lubriplate / FGL1
Lubrication Temperature Range ♦	-30 to 120 °C (-22 to 248 °F)	-18 to 120 °C (0 to 248 °F)

♦ The temperature range values shown do not apply to other components and/or lubricants within the gear reducer.

Lubricator Service Interval

The Automatic lubricator should be inspected approximately every 6 months. At the end of the lubrication period the piston becomes clearly visible through the clear nylon discharge indicator cap located at the bottom of the PERMA® canister (Figure 1); this helps indicate that the lubricant has been fully discharged at which time the lubricator should be replaced. When operating the gear unit 8 hours/day or less a replacement interval of 12 months or 1 year is possible. Ambient temperature will influence the discharge rate and may extend or shorten the replacement interval.

Ambient Considerations

The grease discharge rate is affected by the ambient temperature. PERMA® indicates that the lubricator contents will dispense for a 12 month period when the average temperature is 20 °C (68 °F). Grease dispensing rates depend primarily on average ambient conditions and not extreme highs and lows. Lower ambient temperatures will lead to slower dispensing rates and higher ambient temperatures will lead to faster dispensing rates.

Average Ambient Temperature	Discharge Period Months ♦
0 °C (32 °F)	>18
10 °C (50 °F)	18
20 °C (68 °F)	12
30 °C (86 °F)	6
40 °C (104 °F)	3

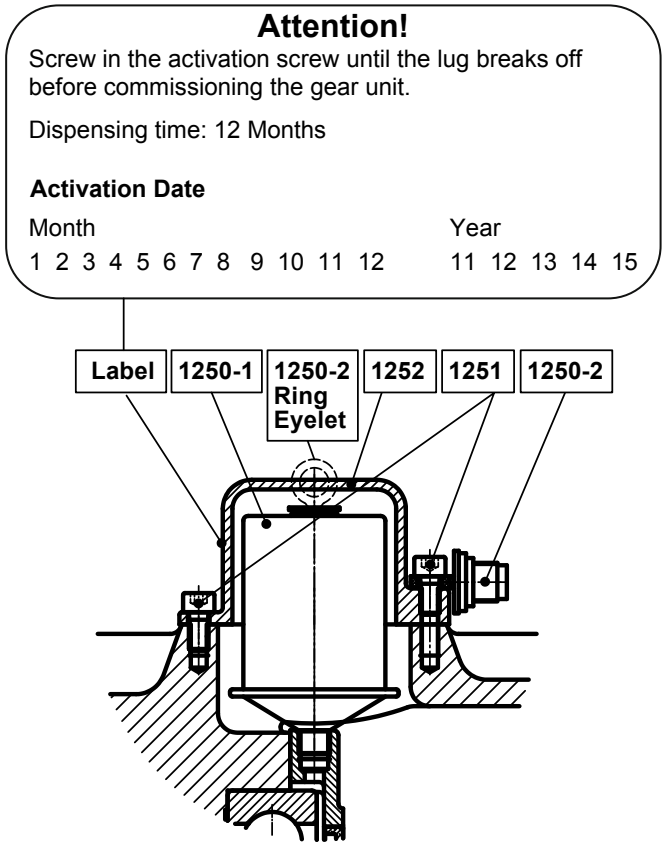
♦ Values are approximate.

Discharge can also be influenced by type of lubricant, vibration, and by the mating connecting parts in the lubrication system.

Activating the Automatic Lubricator

1. Loosen and remove the M8x16 assembly socket head cap screws (1251).
2. Carefully remove the protective cover (1252) installed over the automatic lubricator (1250-1).
3. Screw the activation screw (1250-2) into the automatic lubricator (1250-1) and twist the ring-eyelet until it reaches its breaking point.
4. Re-fit the cartridge cover (1252) and re-install and tighten the assembly screws (1251).
5. Mark the activation date on the adhesive label that is provided.

Figure 2 - Activating the Automatic Lubricator



1250-1 Automatic Lubricator
1250-2 Activation Screw
1251 Socket Head Cap Screws
1252 Protective Cover

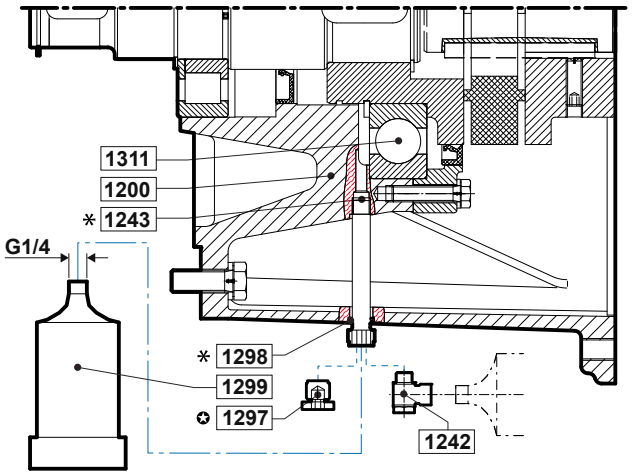
Grease Purge and Grease Drain Cup

Some versions of the NEMA (or IEC) adapters also include a grease purge and a grease drain cup (1299) for collecting old grease. The grease purge area is sealed for transportation.

It is recommended that the G1/4 sealing screw (1297) be removed and that the grease drain cup be installed after the automatic lubricant dispenser is activated.

The swivel fitting (1242) that NORD supplies allows the grease cup to be positioned at a 90° angle from its typical mounting. The swivel fitting allows the grease cup to be rotated so that it remains clear of any gear unit mounting obstructions.

Figure 3 – Grease Purge and Grease Cup Assembly



1200 NEMA or IEC Input Cylinder
1242 Swivel Fitting (P/N) 22006359)
1243 Extension*
1297 Screw Plug ✪
1298 Seal Ring*
1299 Grease Drain Cup (P/N 28301210)
1311 Bearing

* Supplied on certain input assembly sizes as needed.

✪ Remove the screw plug to install either the grease drain cup or the swivel fitting with the grease drain cup.

Grease Cup Servicing

NORD suggests that with every second replacement of the automatic lubricator, the grease collection cup (NORD Part No. 28301210) should be emptied or replaced with a new one. Follow the steps below to service the grease cup.

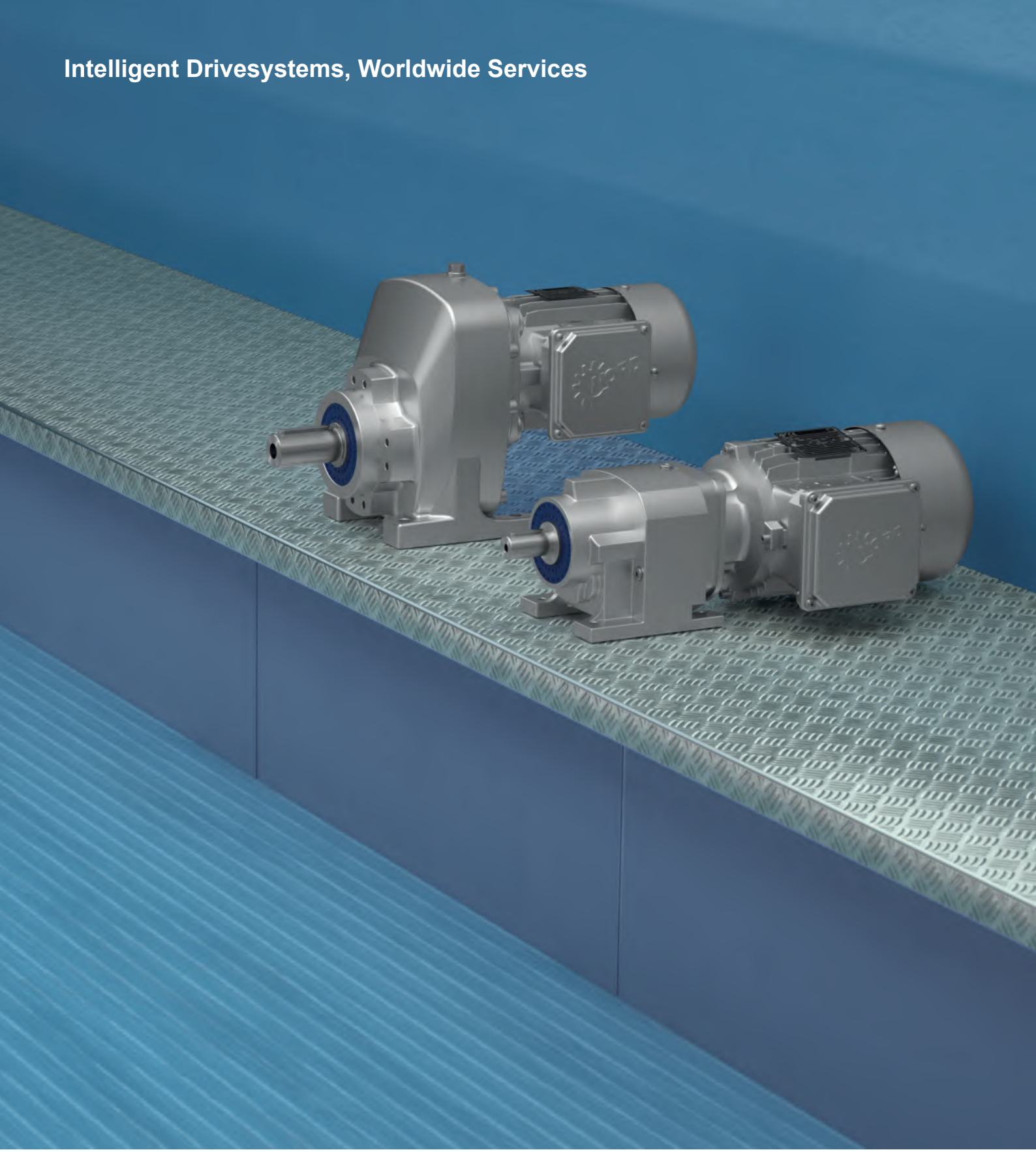
1. Unscrew the grease drain cup (1299) from either the outlet port of the NEMA or IEC input cylinder or from the extension (1243) that is secured to the NEMA or IEC input cylinder.
2. To empty the grease drain cup (1299) insert a stiff rod through the hole in the grey cap-end of the drain cup and push the internal plunger towards the thread-end of the drain cup. Please note that the dark gray end cap is bonded into place and cannot be removed.
3. Collect and properly dispose of the grease being pushed out of the drain cup. Due to the design of the container a residual amount of grease may remain in the container.
4. After emptying and cleaning the grease cup it can be fitted back onto the grease outlet port of the NEMA or IEC adaptor.
5. In the event the grease cup becomes damaged it should be replaced with a new container. Consider replacing the grease cup (P/N 28301210) with every second replacement of the automatic lubricator.

Replacing the Automatic Lubricator

A new automatic lubricator can be ordered from NORD by specifying the appropriate Part Number from the table at the bottom of Page 1 of this manual. Reference Figure 2 and follow the steps below to replace the automatic lubricator.

1. Loosen and remove the M8x16 socket head cap screws (1251) holding the protective cover (1252) in place.
2. Unscrew the automatic lubricator (1250-1) from the bearing cover area of the NEMA or IEC input cylinder.
3. Install the new automatic lubricator and activate per the instructions on page 2.
4. Re-install the protective cover (1252) and the assembly screws (1251).
5. Note the activation date of the newly installed automatic lubricator

Intelligent Drivesystems, Worldwide Services



DE EN FR

PL1011

Ersatzteilkatalog NORDBLOC
Spare parts catalogue NORDBLOC
Catalogue de pièces de rechange NORDBLOC

NORD®
DRIVESYSTEMS

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Allgemeine Ersatzteile
General parts list
Vues éclatées et nomenclature

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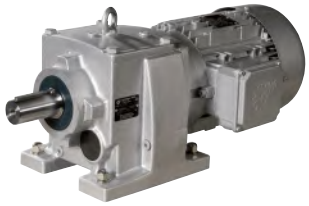
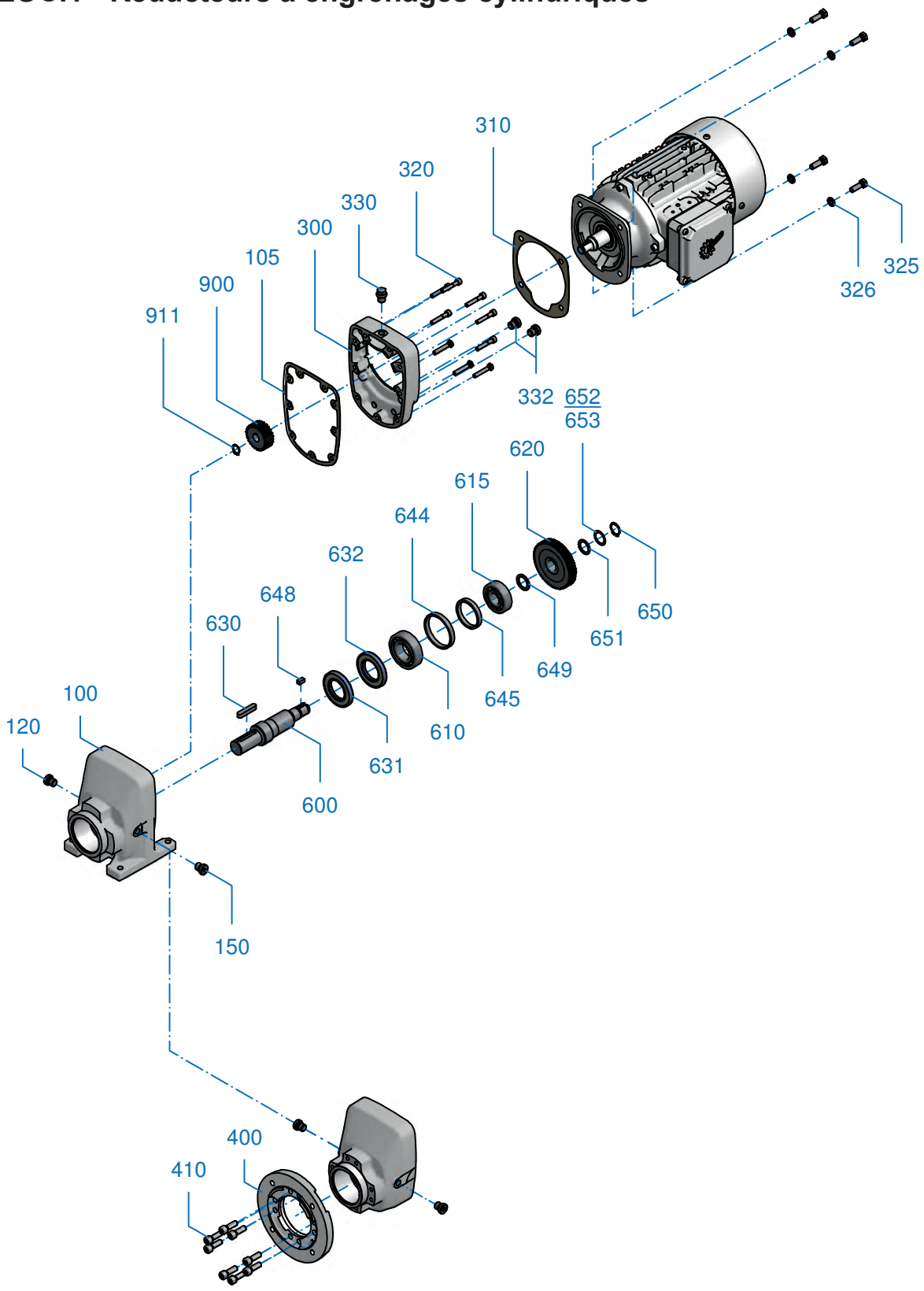
NORDBLOC.1 - Helical Gear Units
NORDBLOC.1 - Réducteurs à engrenages cylindriques



NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 553 9000 E3 #1

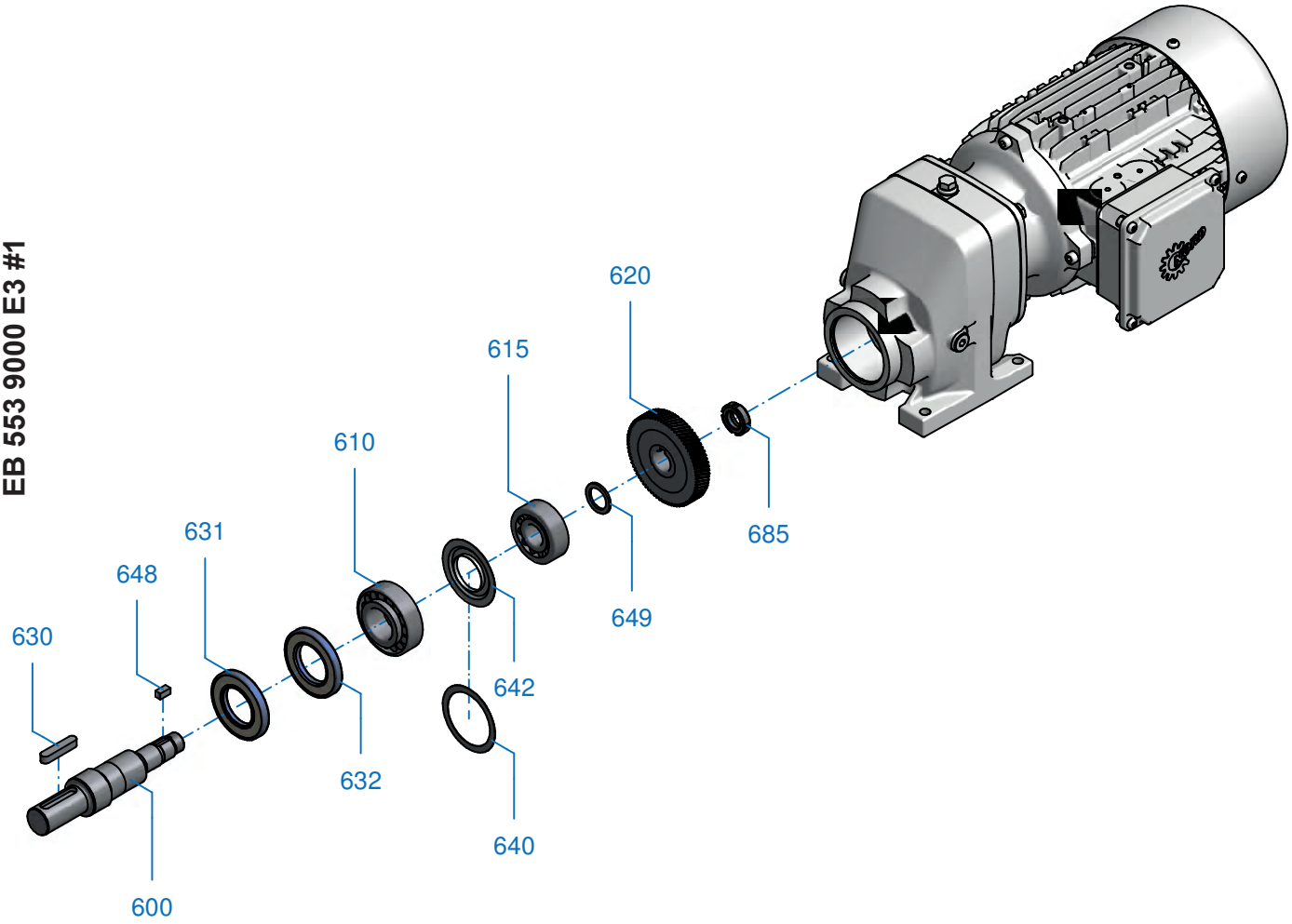


SK 071.1 - SK 771.1

DE		GB		FR	
100	Gehäuse	100	Housing	100	Boîtier
105	Dichtung	105	Seal	105	Bague d‘étanchéité
120	Schraube	120	Screw	120	Vis
150	Schraube	150	Screw	150	Vis
300	Getriebedeckel	300	Gear unit cover	300	Couvercle du réducteur
310	Dichtung	310	Seal	310	Bague d‘étanchéité
320	Schraube	320	Screw	320	Vis
325	Schraube	325	Screw	325	Vis
326	Federring	326	Lock washer	326	Rondelle élastique
330	Schraube	330	Screw	330	Vis
332	Schraube	332	Screw	332	Vis
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d‘étanchéité de l‘arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d‘étanchéité de l‘arbre
644	Buchse	644	Socket	644	Douille
645	Buchse	645	Socket	645	Douille
648	Passfeder	648	Key	648	Clavette
649	Buchse	649	Socket	649	Douille
650	Sicherungsring	650	Circlip	650	Circlip
651	Stützscheibe	651	Supporting disc	651	Rondelle support
652	Passscheibe	652	Shim	652	Rondelles d‘ajustage
653	Passscheibe	653	Shim	653	Rondelles d‘ajustage
900	Antriebsritzel	900	Driving pinion	900	Pignon d‘entrée
911	Sicherungsring	911	Circlip	911	Circlip

NORDBLOC.1 - Stirnradgetriebe mit verstärkter Lagerung VL
NORDBLOC.1 - Helical Gear Unit with reinforced bearing VL
NORDBLOC.1 - Reducteurs à engrenages cylindriques avec roulements renforcés VL

EB 553 9000 E3 #1



Restliche Getriebeteile siehe Ersatzteilkatalog NORDBLOC Stirnradgetriebe

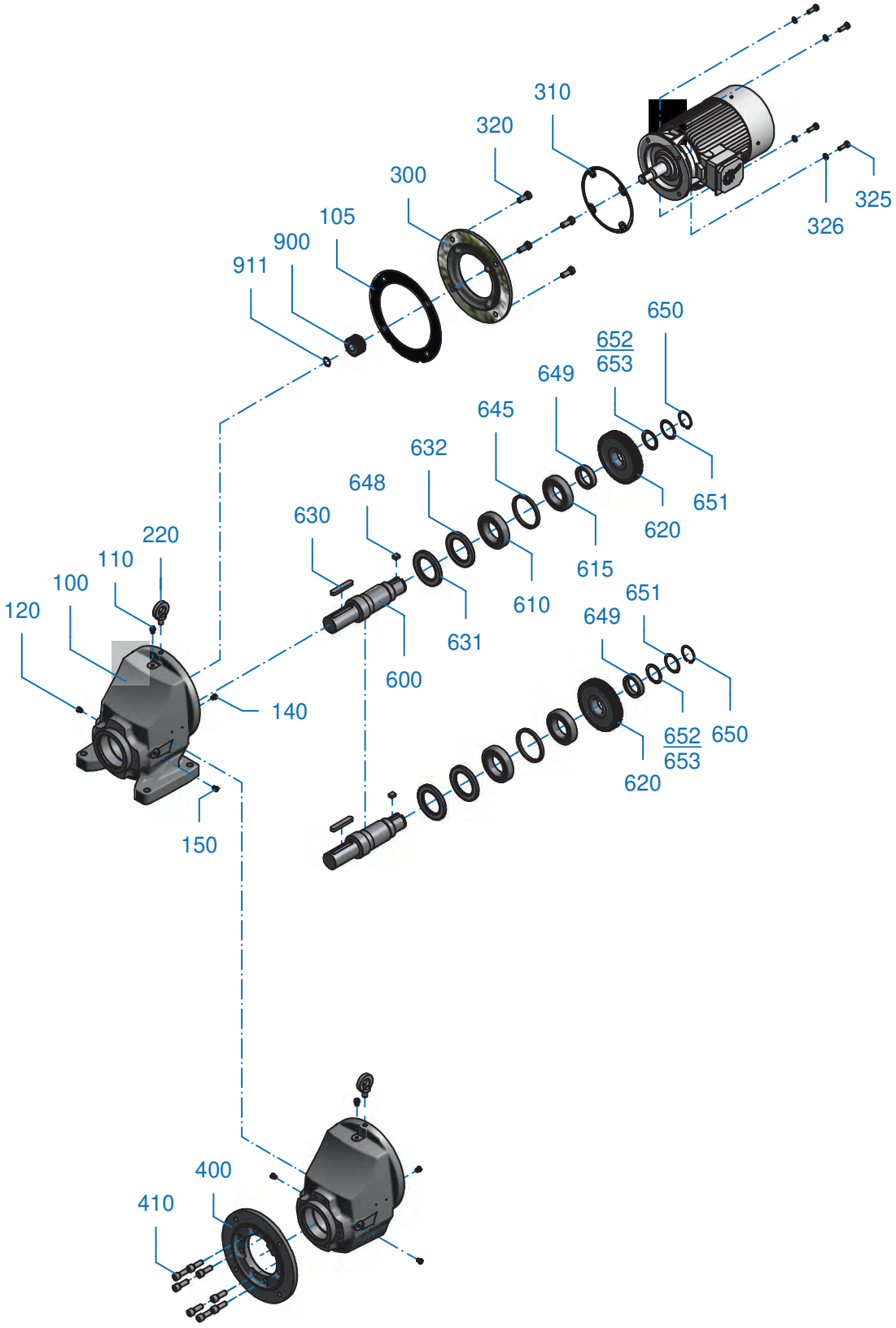
Remaining gear parts see catalogue NORDBLOC Helical Inline Gear Unit

SK 071.1 - SK 771.1

DE		GB		FR	
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d‘étanchéité de l‘arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d‘étanchéité de l‘arbre
640	Passscheibe	640	Shim	640	Rondelles d‘ajustage
642	Nilosring	642	Nilos-ring	642	Bague Nilos
648	Passfeder	648	Key	648	Clavette
649	Buchse	649	Socket	649	Douille
685	Nutmutter	685	Locknut	685	Écrou à encoches

NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 556 9000 E1 #1



SK 871.1 - SK 1071.1

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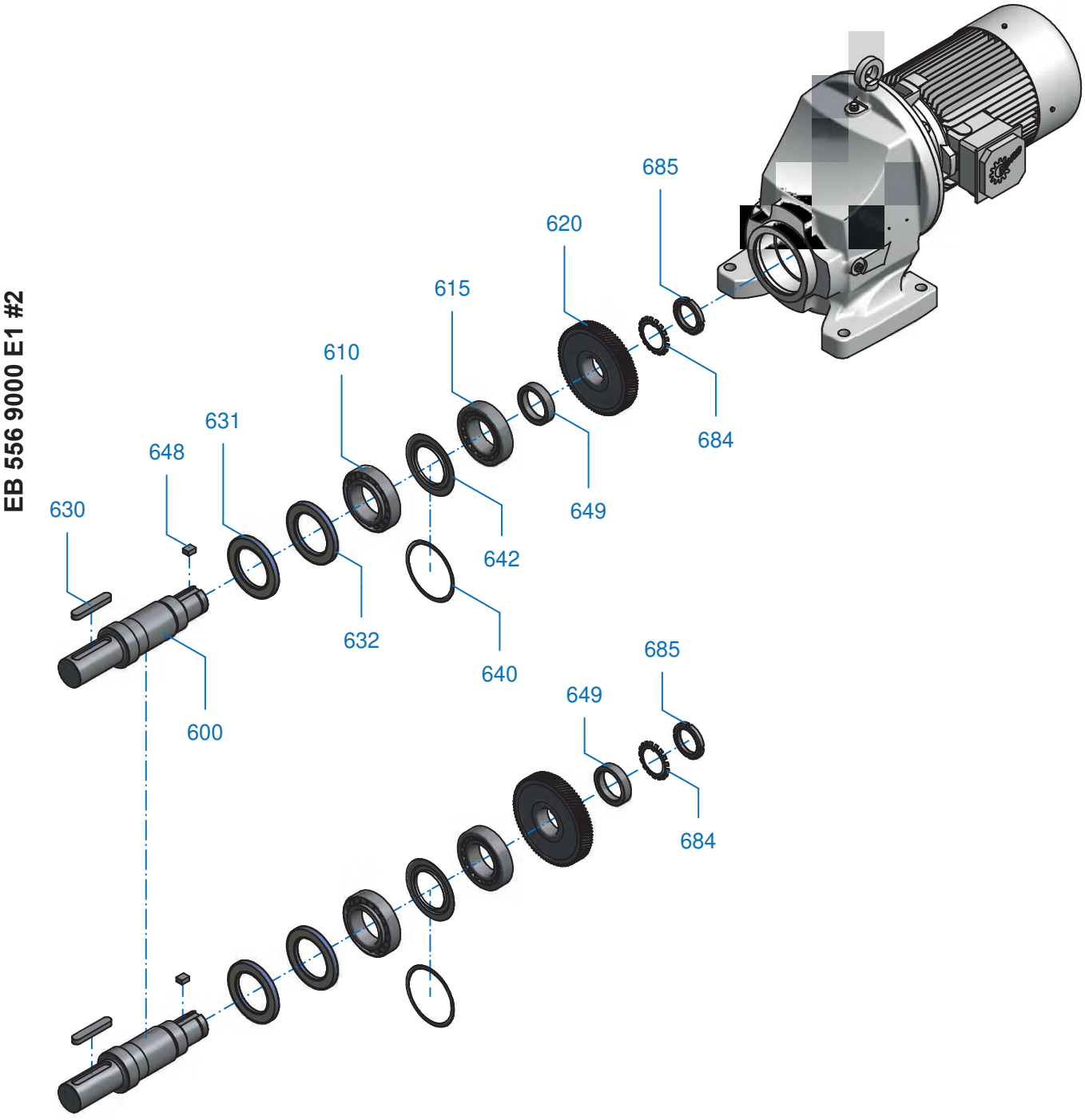
105	Dichtung	105	Seal	105	Bague d'étanchéité
110	Schraube	120	Screw	120	Vis
120	Schraube	120	Screw	120	Vis
140	Schraube	120	Screw	120	Vis
150	Schraube	150	Screw	150	Vis
220	Schraube	120	Screw	120	Vis
300	Getriebedeckel	300	Gear unit cover	300	Couvercle du réducteur
310	Dichtung	310	Seal	310	Bague d'étanchéité
320	Schraube	320	Screw	320	Vis
325	Schraube	325	Screw	325	Vis
326	Federring	326	Lock washer	326	Rondelle élastique
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d'étanchéité de l'arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d'étanchéité de l'arbre
645	Buchse	645	Socket	645	Douille
648	Passfeder	648	Key	648	Clavette
649	Buchse	649	Socket	649	Douille
650	Sicherungsring	650	Circlip	650	Circlip
651	Stützscheibe	651	Supporting disc	651	Rondelle support
652	Passscheibe	652	Shim	652	Rondelles d'ajustage
653	Passscheibe	653	Shim	653	Rondelles d'ajustage
900	Antriebsritzel	900	Driving pinion	900	Pignon d'entrée
911	Sicherungsring	911	Circlip	911	Circlip

NORDBLOC.1 - Stirnradgetriebe mit verstärkter Lagerung VL
NORDBLOC.1 - Helical Gear Unit with reinforced bearing VL
NORDBLOC.1 - Reducteurs à engrenages cylindriques avec roulements renforcés VL

EB 556 9000 E1 #2



SK 871.1 - SK 1071.1

DE		GB		FR	
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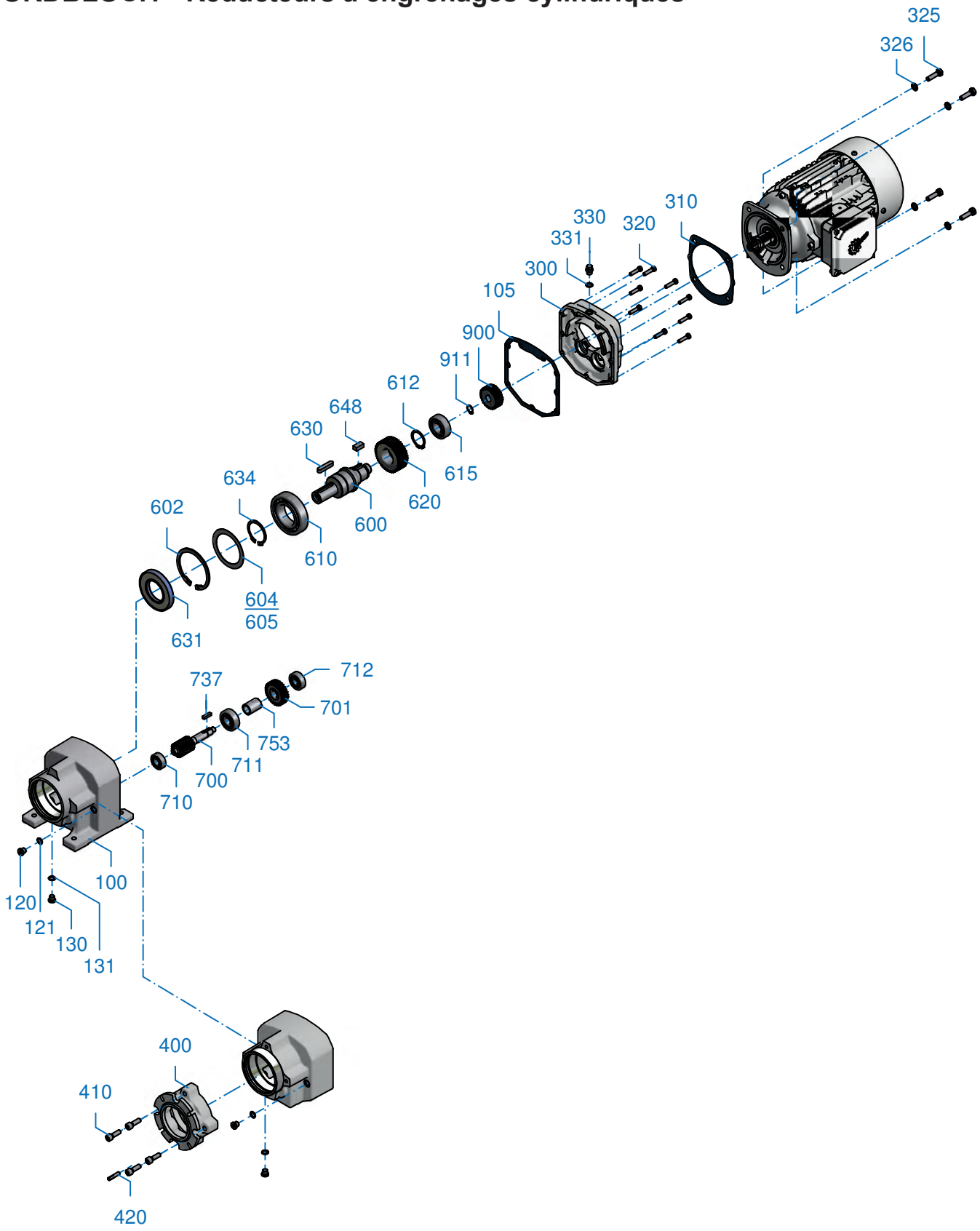
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d‘étanchéité de l‘arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d‘étanchéité de l‘arbre
640	Passscheibe	640	Shim	640	Rondelles d‘ajustage
642	Nilosring	642	Nilos-ring	642	Bague Nilos
648	Passfeder	648	Key	648	Clavette
649	Buchse	649	Socket	649	Douille
684	Sicherungsblech	684	Securing plate	684	Tôle de sécurité
685	Nutmutter	685	Locknut	685	Écrou à encoches

NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 573 9000 E1 #1



SK 072.1 - SK 672.1

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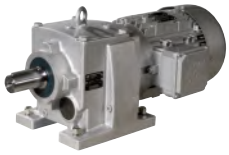
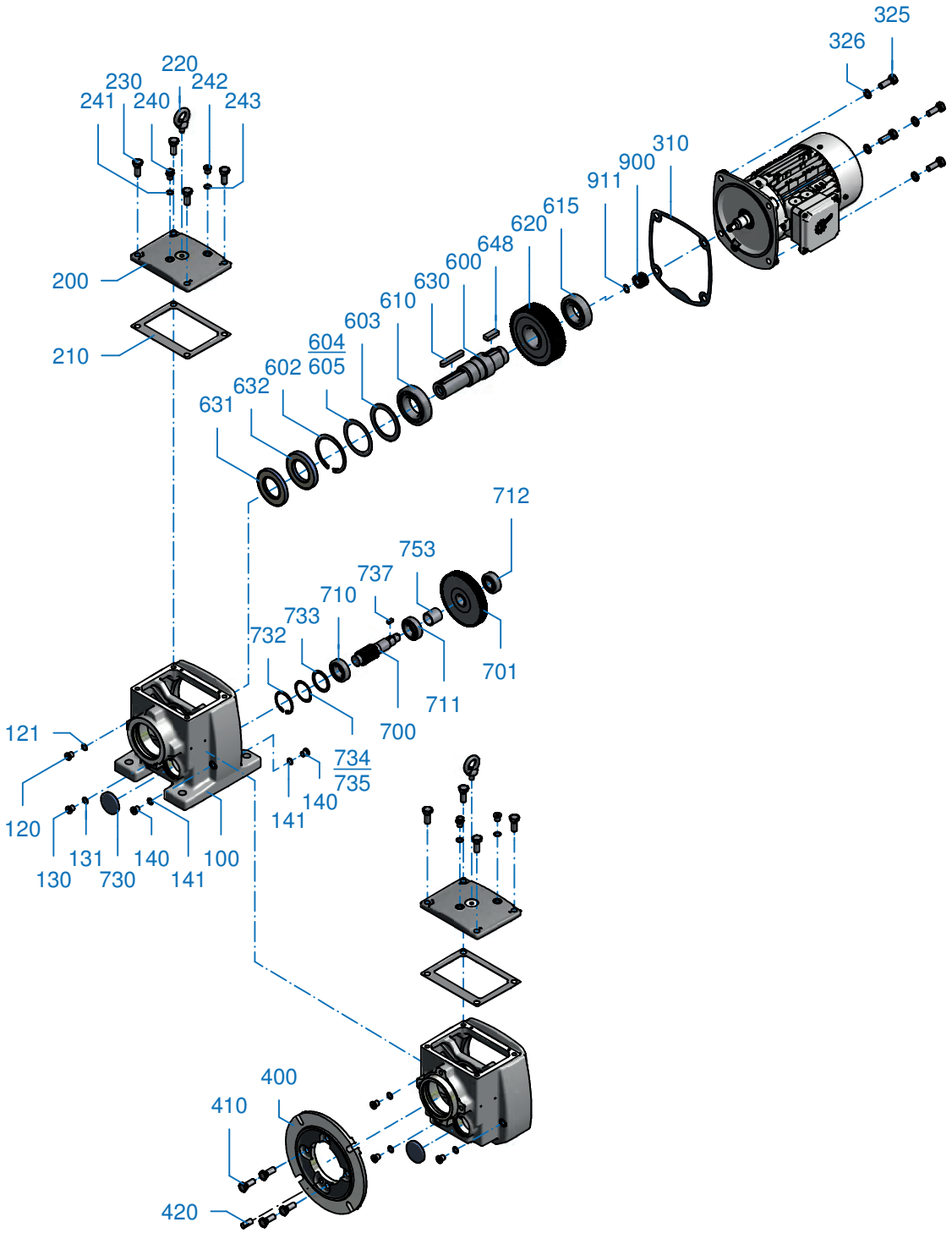
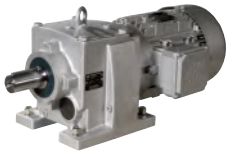
120	**Schraube**	120	Screw	120	Vis
121	**Dichtung**	121	Seal	121	Bague d'étanchéité
130	**Schraube**	130	Screw	130	Vis
131	**Dichtung**	131	Seal	131	Bague d'étanchéité
300	**Getriebedeckel**	300	Gear unit cover	300	Couvercle du réducteur
310	**Dichtung**	310	Seal	310	Bague d'étanchéité
320	**Schraube**	320	Screw	320	Vis
325	**Schraube**	325	Screw	325	Vis
326	**Federring**	326	Lock washer	326	Rondelle élastique
330	**Schraube**	330	Screw	330	Vis
331	**Dichtung**	331	Seal	331	Bague d'étanchéité
400	**Flansch**	400	Flange	400	Bride
410	**Schraube**	410	Screw	410	Vis
420	**Stift**	420	Pin	420	Goupille
600	**Abtriebswelle**	600	Output shaft	600	Arbre de sortie
602	**Sicherungsring**	602	Circlip	602	Circlip
604	**Passscheibe**	604	Shim	604	Rondelles d'ajustage
605	**Passscheibe**	605	Shim	605	Rondelles d'ajustage
610	**Wälzlager**	610	Roller bearing	610	Palier
612	**Sicherungsring**	612	Circlip	612	Circlip
615	**Wälzlager**	615	Roller bearing	615	Palier
620	**Abtriebsrad**	620	Output gear	620	Roue de sortie
630	**Passfeder**	630	Key	630	Clavette
631	**Wellendichtring**	631	Radial shaft seal	631	Bague d'étanchéité de l'arbre
634	**Sicherungsring**	634	Circlip	634	Circlip
648	**Passfeder**	648	Key	648	Clavette
700	**Ritzelwelle**	700	Pinion shaft	700	Arbre de pignon
701	**Antreibsrad**	701	Drive gear	701	Roue d'entrée
710	**Wälzlager**	710	Roller bearing	710	Palier
711	**Wälzlager**	711	Roller bearing	711	Palier
712	**Wälzlager**	712	Roller bearing	712	Palier
737	**Passfeder**	737	Key	737	Clavette
753	**Buchse**	753	Socket	753	Douille
900	**Antriebsritzel**	900	Driving pinion	900	Pignon d'entrée
911	**Sicherungsring**	911	Circlip	911	Circlip



NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 577 9000 E3 #1



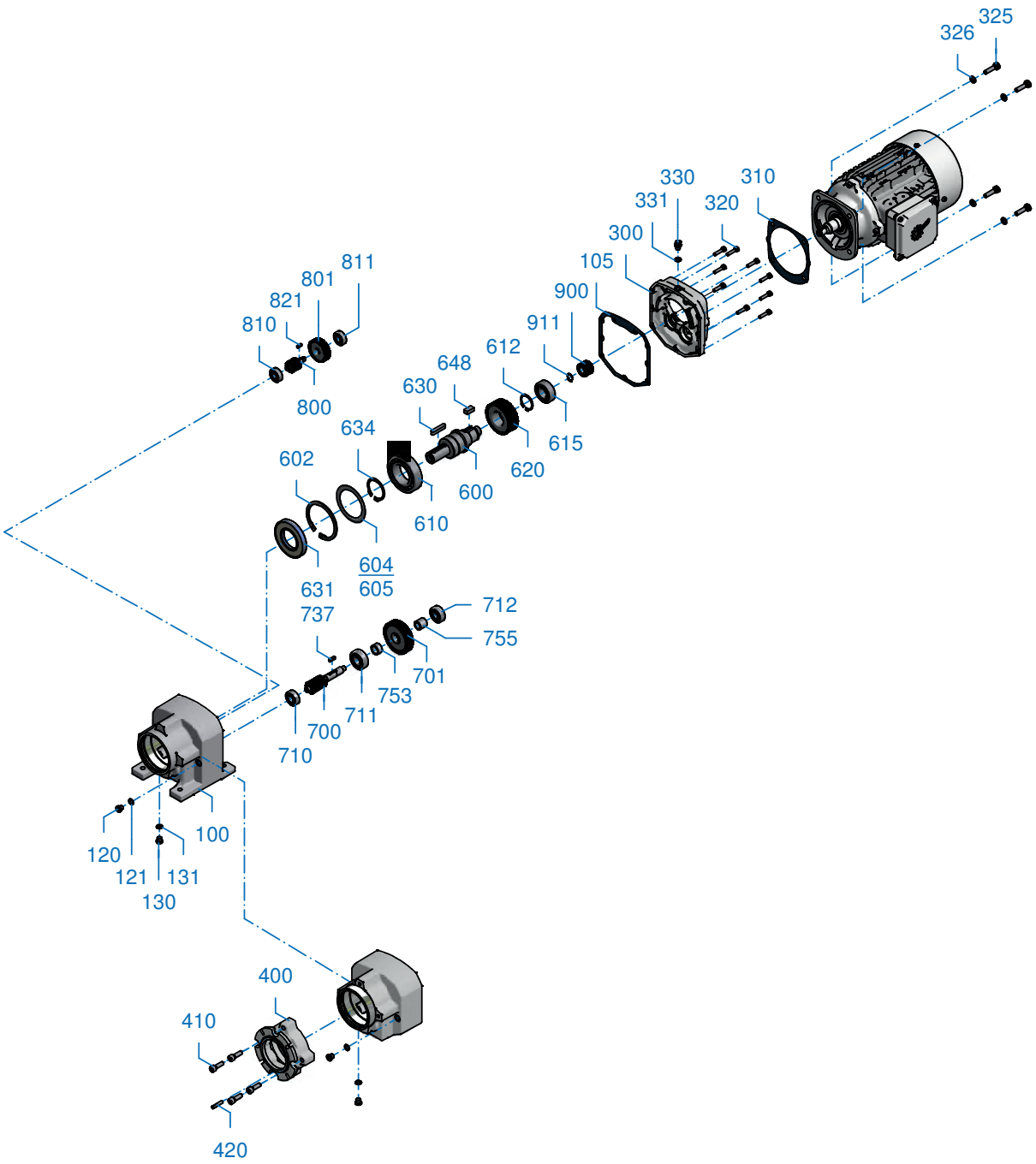


SK 772.1 - SK 972.1

DE		GB		FR	
100	Gehäuse	100	Housing	100	Boîtier
120	Schraube	120	Screw	120	Vis
121	Dichtung	121	Seal	121	Bague d'étanchéité
130	Schraube	130	Screw	130	Vis
131	Dichtung	131	Seal	131	Bague d'étanchéité
140	Schraube	140	Screw	140	Vis
141	Dichtung	141	Seal	141	Bague d'étanchéité
200	Gehäusedeckel	200	Housing cover	200	Couvercle du carter
210	Dichtung	210	Seal	210	Bague d'étanchéité
220	Schraube	220	Screw	220	Vis
230	Schraube	230	Screw	230	Vis
240	Schraube	240	Screw	240	Vis
241	Dichtung	241	Seal	241	Bague d'étanchéité
242	Schraube	242	Screw	242	Vis
243	Dichtung	243	Seal	243	Bague d'étanchéité
310	Dichtung	310	Seal	310	Bague d'étanchéité
325	Schraube	325	Screw	325	Vis
326	Federring	326	Lock washer	326	Rondelle élastique
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
420	Stift	420	Pin	420	Goupille
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
602	Sicherungsring	602	Circlip	602	Circlip
603	Stützscheibe	603	Supporting disc	603	Rondelle d'appui
604	Passscheibe	604	Shim	604	Rondelles d'ajustage
605	Passscheibe	605	Shim	605	Rondelles d'ajustage
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d'étanchéité de l'arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d'étanchéité de l'arbre
648	Passfeder	648	Key	648	Clavette
700	Ritzelwelle	700	Pinion shaft	700	Arbre de pignon
701	Antriebsrad	701	Drive gear	701	Roue d'entrée
710	Wälzlager	710	Roller bearing	710	Palier
711	Wälzlager	711	Roller bearing	711	Palier
712	Wälzlager	712	Roller bearing	712	Palier
730	Verschlusskappe	730	Sealing cap	730	Bouchon
732	Sicherungsring	732	Circlip	732	Circlip
733	Stützscheibe	733	Supporting disc	733	Rondelle support
734	Passscheibe	734	Shim	734	Rondelles d'ajustage
735	Passscheibe	735	Shim	735	Rondelles d'ajustage
737	Passfeder	737	Key	737	Clavette
753	Buchse	753	Socket	753	Douille
900	Antriebsritzel	900	Driving pinion	900	Pignon d'entrée
911	Sicherungsring	911	Circlip	911	Circlip

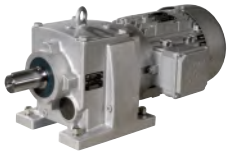
NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 573 9050 E1 #1



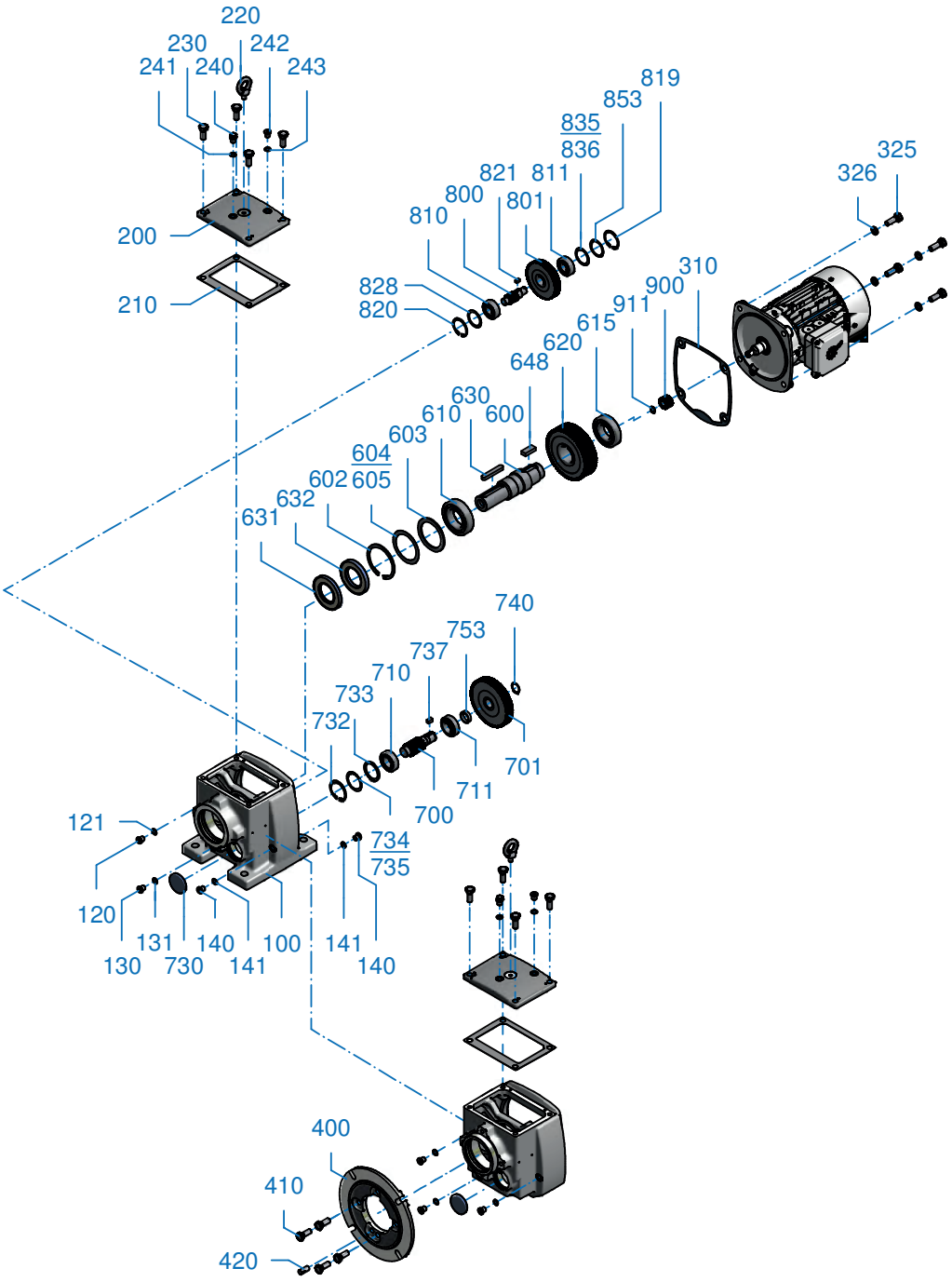
SK 373.1 - SK 673.1

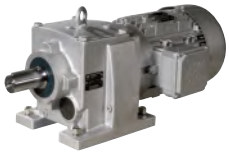
DE		GB		FR	
100	**Gehäuse**	100	Housing	100	Boîtier
105	**Dichtung**	105	Seal	105	Bague d'étanchéité
120	**Schraube**	120	Screw	120	Vis
121	**Dichtung**	121	Seal	121	Bague d'étanchéité
130	**Schraube**	130	Screw	130	Vis
131	**Dichtung**	131	Seal	131	Bague d'étanchéité
300	**Getriebedeckel**	300	Gear unit cover	300	Couvercle du réducteur
310	**Dichtung**	310	Seal	310	Bague d'étanchéité
320	**Schraube**	320	Screw	320	Vis
325	**Schraube**	325	Screw	325	Vis
326	**Federring**	326	Lock washer	326	Rondelle élastique
330	**Schraube**	330	Screw	330	Vis
331	**Dichtung**	331	Seal	331	Bague d'étanchéité
400	**Flansch**	400	Flange	400	Bride
410	**Schraube**	410	Screw	410	Vis
420	**Stift**	420	Pin	420	Goupille
600	**Abtriebswelle**	600	Output shaft	600	Arbre de sortie
602	**Sicherungsring**	602	Circlip	602	Circlip
604	**Passscheibe**	604	Shim	604	Rondelles d'ajustage
605	**Passscheibe**	605	Shim	605	Rondelles d'ajustage
610	**Wälzlager**	610	Roller bearing	610	Palier
612	**Sicherungsring**	612	Circlip	612	Circlip
615	**Wälzlager**	615	Roller bearing	615	Palier
620	**Abtriebsrad**	620	Output gear	620	Roue de sortie
630	**Passfeder**	630	Key	630	Clavette
631	**Wellendichtring**	631	Radial shaft seal	631	Bague d'étanchéité de l'arbre
634	**Sicherungsring**	634	Circlip	634	Circlip
648	**Passfeder**	648	Key	648	Clavette
700	**Ritzelwelle**	700	Pinion shaft	700	Arbre de pignon
701	**Antriebsrad**	701	Drive gear	701	Roue d'entrée
710	**Wälzlager**	710	Roller bearing	710	Palier
711	**Wälzlager**	711	Roller bearing	711	Palier
712	**Wälzlager**	712	Roller bearing	712	Palier
737	**Passfeder**	737	Key	737	Clavette
753	**Buchse**	753	Socket	753	Douille
755	**Buchse**	755	Socket	755	Douille
800	**Ritzelwelle**	800	Pinion shaft	800	Arbre de pignon
801	**Antriebsrad**	801	Drive gear	801	Roue d'entrée
810	**Wälzlager**	810	Roller bearing	810	Palier
811	**Wälzlager**	811	Roller bearing	811	Palier
821	**Passfeder**	821	Key	821	Clavette
900	**Antriebsritzel**	900	Driving pinion	900	Pignon d'entrée
911	**Sicherungsring**	911	Circlip	911	Circlip



NORDBLOC.1 - Stirnradgetriebe
NORDBLOC.1 - Helical Gear Unit
NORDBLOC.1 - Reducteurs à engrenages cylindriques

EB 577 9050 E4 #1





SK 773.1 - SK 973.1

DE		GB		FR	
100	Gehäuse	1100	Housing	100	Boîtier
120	Schraube	120	Screw	120	Vis
121	Dichtung	121	Seal	121	Bague d‘étanchéité
130	Schraube	130	Screw	130	Vis
131	Dichtung	131	Seal	131	Bague d‘étanchéité
140	Schraube	140	Screw	140	Vis
141	Dichtung	141	Seal	141	Bague d‘étanchéité
200	Gehäusedeckel	200	Housing cover	200	Couvercle du carter
210	Dichtung	210	Seal	210	Bague d‘étanchéité
220	Schraube	220	Screw	220	Vis
230	Schraube	230	Screw	230	Vis
240	Schraube	240	Screw	240	Vis
241	Dichtung	241	Seal	241	Bague d‘étanchéité
242	Schraube	242	Screw	242	Vis
243	Dichtung	243	Seal	243	Bague d‘étanchéité
310	Dichtung	310	Seal	310	Bague d‘étanchéité
325	Schraube	325	Screw	325	Vis
326	Federring	326	Lock washer	326	Rondelle élastique
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
420	Stift	420	Pin	420	Goupille
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
602	Sicherungsring	602	Circlip	602	Circlip
603	Stützscheibe	603	Supporting disc	603	Rondelle d’appui
604	Passscheibe	604	Shim	604	Rondelles d‘ajustage
605	Passscheibe	605	Shim	605	Rondelles d‘ajustage
610	Wälzlager	610	Roller bearing	610	Palier
615	Wälzlager	615	Roller bearing	615	Palier
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Key	630	Clavette
631	Wellendichtring	631	Radial shaft seal	631	Bague d‘étanchéité de l‘arbre
632	Wellendichtring	632	Radial shaft seal	632	Bague d‘étanchéité de l‘arbre
648	Passfeder	648	Key	648	Clavette
700	Ritzelwelle	700	Pinion shaft	700	Arbre de pignon
701	Antriebsrad	701	Drive gear	701	Roue d‘entrée
710	Wälzlager	710	Roller bearing	710	Palier
711	Wälzlager	711	Roller bearing	711	Palier
730	Verschlusskappe	730	Sealing cap	730	Bouchon
732	Sicherungsring	732	Circlip	732	Circlip
733	Stützscheibe	733	Supporting disc	733	Rondelle d’appui
734	Passscheibe	734	Shim	734	Rondelles d‘ajustage
735	Passscheibe	735	Shim	735	Rondelles d‘ajustage
737	Passfeder	737	Key	737	Clavette
740	Sicherungsring	740	Circlip	740	Circlip
753	Buchse	753	Socket	753	Douille
800	Ritzelwelle	800	Pinion shaft	800	Arbre de pignon
801	Antriebsrad	801	Drive gear	801	Roue d‘entrée
810	Wälzlager	810	Roller bearing	810	Palier
811	Wälzlager	811	Roller bearing	811	Palier
819	Sicherungsring	819	Circlip	819	Circlip
820	Sicherungsring	820	Circlip	820	Circlip
821	Passfeder	821	Key	821	Clavette
828	Stützscheibe	828	Supporting disc	828	Rondelle support
835	Passscheibe	835	Shim	835	Rondelles d‘ajustage
836	Passscheibe	836	Shim	836	Rondelles d‘ajustage
853	Stützscheibe	853	Supporting disc	853	Rondelle d’appui
900	Antriebsritzel	900	Driving pinion	900	Pignon d‘entrée
911	Sicherungsring	911	Circlip	911	Circlip

Bestellangaben
Order details
Informations de commande

Kontaktdaten / Contact details / Contacts:

Firma / Company / Entreprise:

Straße / Street / Rue

Stadt / Town / Ville:

PLZ / Postcode/
Code postal:

Telefon / Telephone / Téléphone:

Fax:

E-mail:

Getriebebau NORD

Getriebebau-Nord-Straße 1
D-22941 Bargteheide
Telefon +49(0) 4532/289-0
Telefax +49(0)4532/289-2253
E-Mail info@nord.com
www.nord.com

DE

Diese NORD Ersatzteilliste beinhaltet eine standardisierte Darstellung der NORD Getriebe. Um Ihnen das Finden und Nachbestellen von Ersatzteilen zu erleichtern, finden Sie am Ende der Ersatzteilliste ein Bestellformular mit wichtigen Hinweisen zur Bestimmung der richtigen Teile.

Für Rückfragen stehen wir Ihnen gerne zur Verfügung. Ihren lokalen Ansprechpartner finden Sie unter http://locator.nord.com.

EN

This NORD spare parts list contains a standardised depiction of NORD gear units. In order to enable you to find and re-order replacement parts more easily, you can find an order form and important information regarding the identification of the correct components at the end of this spare parts list.

We will be glad to help you if you have any queries: You can find your local contact partner under http://locator.nord.com.

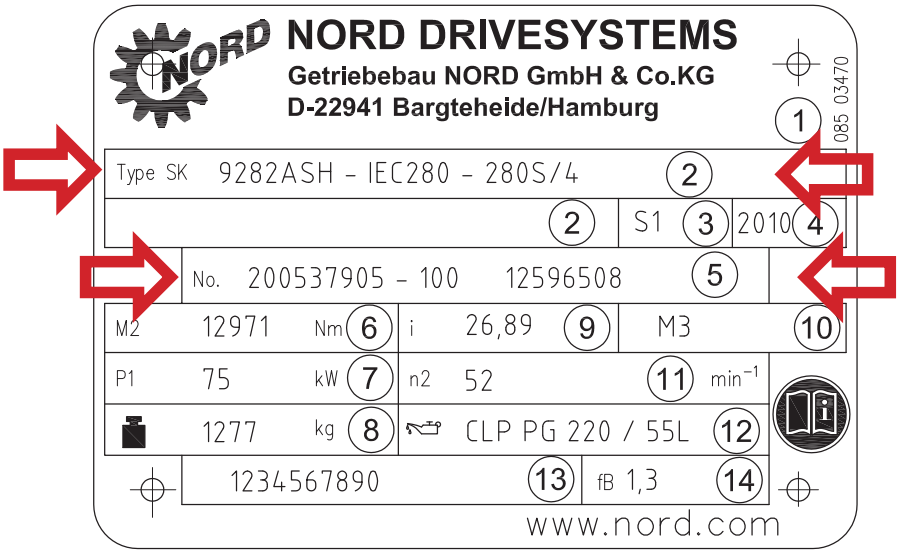
FR

Cette liste de pièces de rechange NORD contient une représentation standard des réducteurs NORD. Pour faciliter la recherche et la commande de pièces de rechange, un formulaire de commande se trouve à la fin de la liste des pièces de rechange et vous donne toutes les informations essentielles pour déterminer les pièces dont vous avez besoin.

En cas de questions, n'hésitez pas à nous contacter. Pour connaître votre interlocuteur local, veuillez consulter le site http://locator.nord.com.

Bestellangaben
Order details
Informations de commande

Erläuterung des Typenschildes
Explanation of the rating plate
Explication de la plaque signalétique



DE

1 Matrix – Barcode
2 NORD - Getriebetyp
3 Betriebsart
4 Herstellungsjahr
5 Fabrikationsnummer
6 Nenndrehmoment der Getriebeabtriebswelle
7 Antriebsleistung
8 Gewicht entsprechend Auftragsausführung
9 Gesamte Getriebeübersetzung
10 Einbaulage
11 Nenndrehzahl der Getriebeabtriebswelle
12 Schmierstoffart, -viskosität und –menge
13 Kundenmaterialnummer
14 Betriebsfaktor

EN

1 Matrix – Barcode
2 NORD gear unit type
3 Operating mode
4 Year of manufacture
5 Serial number
6 Rated torque of gear unit output shaft
7 Drive power
8 Weight according to ordered version
9 Overall gear unit ratio
10 Installation orientation
11 Rated speed of gear unit output shaft
12 Lubricant type, viscosity and quantity
13 Customer's part number
14 Operating factor

FR

1 Code matriciel, à barres
2 Type de réducteur NORD
3 Mode de fonctionnement
4 Année de fabrication
5 Numéro de série
6 Couple nominal de l'arbre de sortie du réducteur
7 Puissance d'entraînement
8 Poids selon l'exécution du contrat
9 Rapport de réduction total
10 Position de montage
11 Vitesse de rotation nominale de l'arbre de sortie du réducteur
12 Type de lubrifiant, viscosité et quantité
13 Numéro d'article client
14 Facteur de service

Ersatzteil-Bestellung / Replacement parts order / Commande de pièces de rechange:

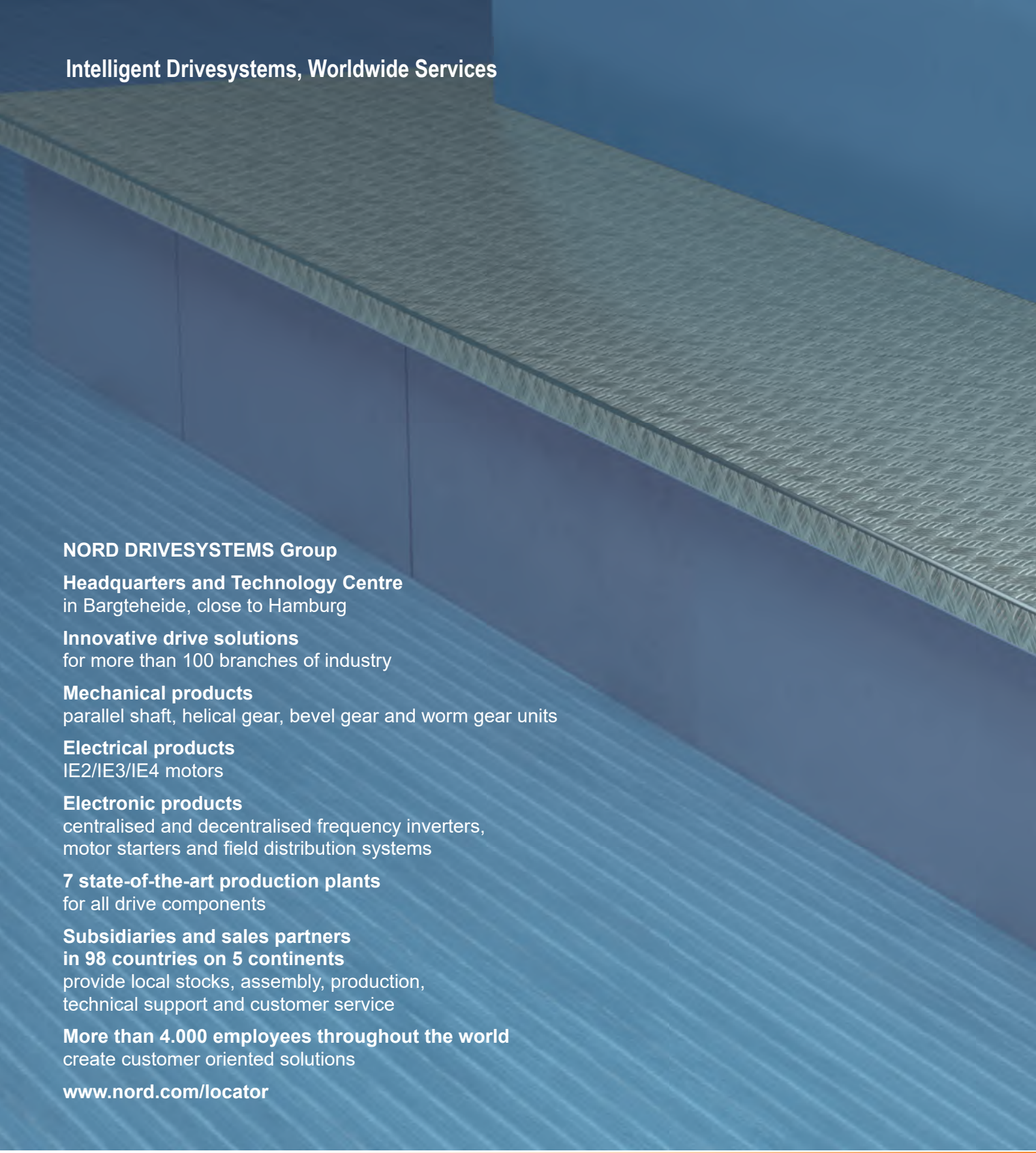
Bezeichnung / Designation / Désignation:

Pos.-Nr. / Item No. / N° pos :

Stückzahl / Pieces / Quantité:

Getriebetyp / Gear unit type / Type de réducteur:

Fabrikationsnummer / Serial No. / Numéro de série:



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info@nord.com, www.nord.com

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Mat.Nr. 6002399 / 1019

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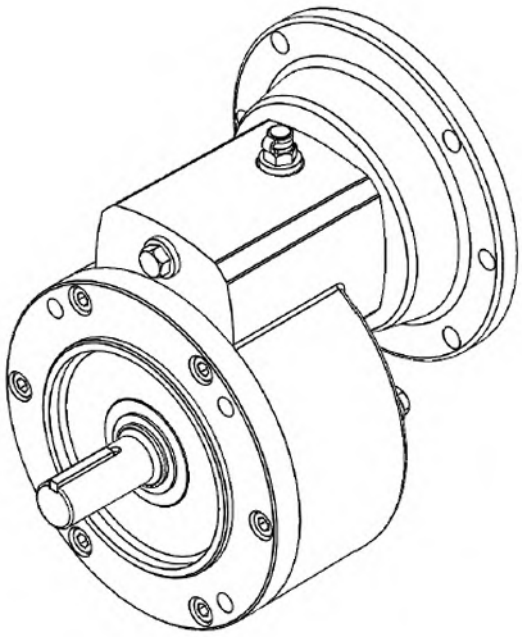
STERLING
ELECTRIC, INC.

2000HG®

NEW STYLE HELICAL GEAR RATIO MULTIPLIER



INSTALLATION AND MAINTENANCE MANUAL

May 4, 2017

Indianapolis, Indiana (800) 866-7973

e-mail: sales@sterlingelectric.com
www.sterlingelectric.com

STERLING
ELECTRIC, INC.

7997 Allison Avenue, Indianapolis, IN 46268
Website: *www.sterlingelectric.com*

(800) 866-7973 FAX (317) 872-0907
email:*sales@sterlingelectric.com*

2000HG NEW STYLE HELICAL GEAR RATIO MULTIPLIER INSTRUCTION MANUAL

SELECTION INFORMATION

Read ALL instructions prior to operating unit. Improper maintenance or operation may cause injury to personnel or reducer failure.

Written authorization from Sterling Electric is required to operate or use this unit in man lift or people moving devices.

Check to make certain application does not exceed the allowable load capacities published in the current catalog.

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which buyer shall apply the product. The application by buyer shall not be subject to any implied warranty of fitness for a particular purpose. Information contained in this manual is considered correct at the time of publication and is subject to change without notice.

SAFETY ALERT

WARNING: For safety, purchaser or user should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The user is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

WARNING: Hot oil or gear units can cause severe burns. Use extreme care when removing lubrication plugs and vents.

WARNING: Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.

WARNING: Any brakes that are used in conjunction with this unit must be sized or positioned in such a way as to not subject the unit to loads beyond the catalog rating.

CAUTION: Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.

CAUTION: If the unit cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants. Units located in confined spaces may require forced air-cooling.

IMPORTANT INFORMATION

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> *The manufacturer makes no warranty or representations, expressed or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the good sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental or other damages.*

Resellers/Buyers agree to also include this entire document including the warnings above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This instruction manual should be read together with all other printed information such as catalogs, supplied by Sterling Electric.

GENERAL OPERATION

1. Run the motor, which drives the unit, and check the direction of unit output rotation. Consult motor nameplates for instructions to reverse the direction of rotation.

2. Attaching the load: On direct-coupled installations, check shaft and coupling alignment between unit and loading mechanism. On chain/sprocket and belt/pulley installation, locate the sprocket or pulley as close to the oil seal as possible to minimize overhung load. Check to verify that the overhung load does not exceed specifications published in the catalog.

3. High momentum loads: If coasting to a stop is undesirable, a braking mechanism should be provided to the unit output or the driven mechanism.

CAUTION: The system of connected rotating parts must be free from critical speed, torsional or other type vibration, no matter how induced. The responsibility for this system analysis lies with the purchaser of the speed reducer.

INSTALLATION

1. Mount the unit using grade 5 or higher fasteners.

2. For shipment, solid plugs are installed in the unit along with a vent plug with transportation lock which is pre-installed assuming standard horizontal mounting (M1). The vent plug will need to removed and relocated if the unit is to be mounted in any positon other than the standard horizontal positon as shown in the chart under **LUBRICATION**. After the unit is mounted, completely remove the transportation lock from the vent plug as directed under **VENT PLUG LOCATION**. Failure to vent the unit can cause premature seal wear or loss of seal and oil. These conditions are not covered by warranty. Check for correct oil level. Contact the factory for level and vent recommendations on non-standard mounting positions.

CAUTION: Do not operate the unit without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, reducer or other equipment may result.

CAUTION: A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted either through a shaft-mounted arrangement, and any shaft mounted power transmitting device. *(e.g. sprockets, pulleys, couplings)*

CAUTION: For safe operation and to maintain the unit warranty, when changing a factory installed fastener for any reason, it becomes the responsibility of the person making the change to properly account for fastener grade, thread engagement, load, tightening torque and the means of torque retention.`

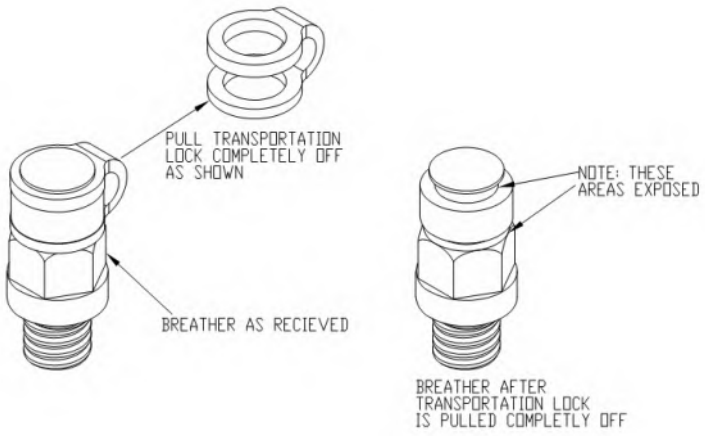
LUBRICATION

CAUTION: On **ALL** quill style input units with a motor mounted vertical shaft up or quill under on the input will require a double input seal arrangement to prevent leakage or C-face coupled style units should be used. Consult factory.

All standard helical ratio multipliers ordered from the factory are shipped with standard compounded lubricant and is good for ambient temperature ranges of 30° F to 104° F. All washdown and stainless steel helical ratio multipliers ordered from the factory are shipped with synthetic NSF H1 Food Grade lubricant and are good for ambient temperature ranges of -10° F to 105° F. Double reduction units have separate oil sumps and must be filled and checked independently. Use of synthetics can cause problems if they are not compatible with the seals or conventional lubes they replace. **Prior to startup, verify that the oil is at the level shown on the drawing below.** If the ambient temperature will be outside the range for the lubricant installed at the factory, drain and refill the reducer with the proper viscosity lubricant prior to use.

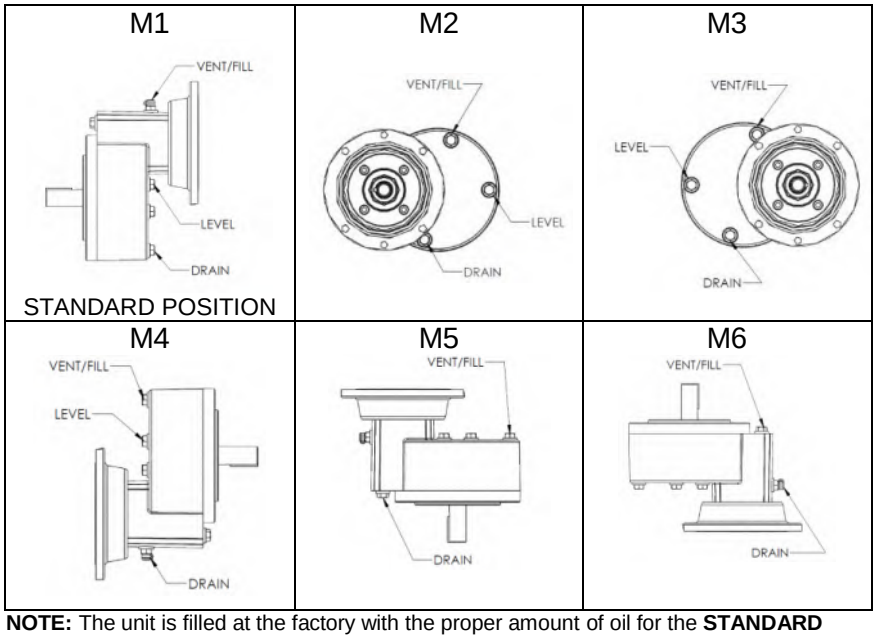
VENT PLUG LOCATION

Washdown and stainless steel units are supplied with a Heinrichs Breather with a rubber transportation lock. The transportation lock must be completely removed before operation. Failure to do so may cause the unit to leak. See below.



Before putting the unit into operation, it may be necessary to relocate the vent plug for positions other than standard (M1). Substitute the vent plug for the solid plug at the position desired. Install the solid plug in the location the vent plug was removed from. Refer to the following chart for the recommended vent plug locations based on mounting position.

VENT/ LEVEL/ DRAIN LOCATIONS



NOTE: The unit is filled at the factory with the proper amount of oil for the **STANDARD** mounting position. The level plug is for reference only so the unit can be checked for proper oil level prior to installation and start-up. All other mounting positions will require the oil level to be measured out prior to filling the unit based on the value in the table labeled **OIL CAPACITIES** below.

CAUTION: On **ALL** quill style input units, cast iron and stainless with the input mounted vertical shaft up or input under will require a double input seal arrangement to prevent leakage or C-face coupled style units should be used. Consult factory

OIL & WEIGHT SPECIFICATIONS

RECOMMENDED LUBRICATION OIL (ISO 150)		
Mineral Oil	PAO† Synthetic	PAO† Synthetic H1 Food Grade
Mobilgear 600XP-150	Mobil SHC 150	Mobil Cibus 150

OIL CAPACITIES (FLUID OUNCE)	
56C/140TC	180TC/210TC
14	16

†The use of PAG synthetics is not recommended.

Change Intervals: Standard compounded lubricants should be changed every six months or 2500 operating hours, whichever comes first. Synthetic lubricants should be changed every two years or 6000 hours, whichever comes first.

CAUTION: Oil should be changed more often if the unit is used in a severe environment. *(i.e. dusty, humid)*

CAUTION: In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction.

MAINTENANCE

Your Sterling Electric unit has been tested and adjusted at the factory. Dismantling or replacement of components must be done by Sterling Electric to maintain the warranty.

Frequently check the oil level of the unit. If oil level is low, (refer to the vent and level position chart) add proper lubrication through the filler plug until it comes out the oil level plug.

Inspect vent plug often to insure it is clean and operating.

CAUTION: Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

CLASS OF SERVICE

All capacity ratings are based on American Gear Manufacturers Association (AGMA) Standards. Load conditions must be within cataloged ratings published in the current Sterling Electric Catalog (available upon request).

LONG-TERM STORAGE (6 MONTHS UP)

Units must be stored indoors, in a dry, warm temperature.

Completely fill the unit with oil.

Rotate the input shaft so that the output shaft rotates at least one revolution per month.

Completely cover the input and output shaft with grease.

At the time of start up, drain the storage oil, install the breather, and fill to the proper oil level with correct lubricant for the operating condition.

WARRANTY (LIMITED)

The warranty will cover all of the parts in the gearmotor or reducer unit for 12 months from the date of shipment.

The warranty is only for parts and labor. In no event shall our liability exceed the original price of the unit, nor does it cover cost of on site repair, installation, or freight.

Contact the service department for a complete explanation as to the full warranty policies and conditions of sale.

All dimensions designs and specifications are subject to change without notice

SEAL AND BEARING SIZES

Input Bearing

Motor Input	Bearing Part Number and Size				
	Series	OD (mm)	ID (mm)	Width (mm)	Sterling P/N
56C/140TC	6206	62	30	16	400-0008-9
180TC/210TC	6206	62	30	16	400-0008-9

ODE Output Bearing

Motor Output	Bearing Part Number and Size				
	Series	OD (mm)	ID (mm)	Width (mm)	Sterling P/N
56C/140TC	6305	62	25	17	400-0495-5
180TC/210TC	6305	62	25	17	400-0495-5

DE Output Bearings

Motor Input	Bearing Part Number and Size				
	Series	OD (mm)	ID (mm)	Width (mm)	Sterling P/N
56C/140TC	6206	62	30	16	400-0008-9
180TC/210TC	6207	72	35	17	400-0009-7

Input Seal

Motor Input	Bearing Part Number and Size			
	Shaft (mm)	Bore (mm)	Width (mm)	Sterling P/N
56C/140TC (Item #4)	35	50	8	404-0292-8
56C/140TC (Item #15)*	35	62	7	404-0350-0
180TC/210TC (Item #21)	50	60	8	404-0377-3
180TC/210TC (Item #24)*	50	62	7	404-0452-8

*Only present on units with double input seal option.

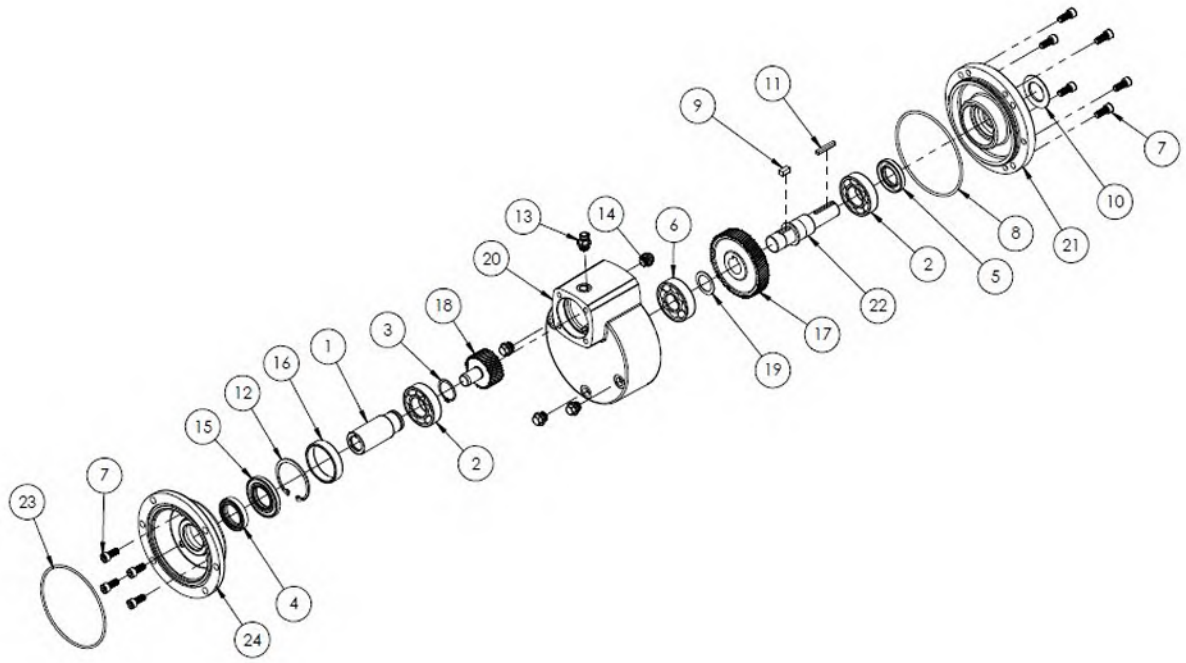
Output Seal

Motor Output	Bearing Part Number and Size			
	Shaft (mm)	Bore (mm)	Width (mm)	Sterling P/N
56C/140TC	30	50	7	404-0291-9
180TC/210TC	35	55	8	404-0294-6

56C/140TC PARTS

Item No.	Description	Qty	Item No.	Description	Qty
1	INPUT QUILL SHAFT	1	13	HEINRICHS BREATHER	1
2	BALL BEARING	2	14	SEAL PLUG	4
3	EXTERNAL SNAP RING	1	15	METRIC SEAL	1
4	METRIC SEAL	1	16	SPACER RING/ SPLASH GUARD	1
5	METRIC SEAL	1	17	SOLID OUTPUT GEAR	1
6	BALL BEARING	1	18	PINION	1
7	SOCKET HEAD CAP SCREW	10	19	SPACER	1
8	O-RING	1	20	SS2RBQ ONE PIECE HOUSING	1
9	METRIC KEY	1	21	C-FACE OUTPUT CAP	1
10	SLINGER	1	22	OUTPUT SHAFT	1
11	KEY	1	23*	O-RING	1
12	INTERNAL SNAP RING	1	24	INPUT FLANGE	1

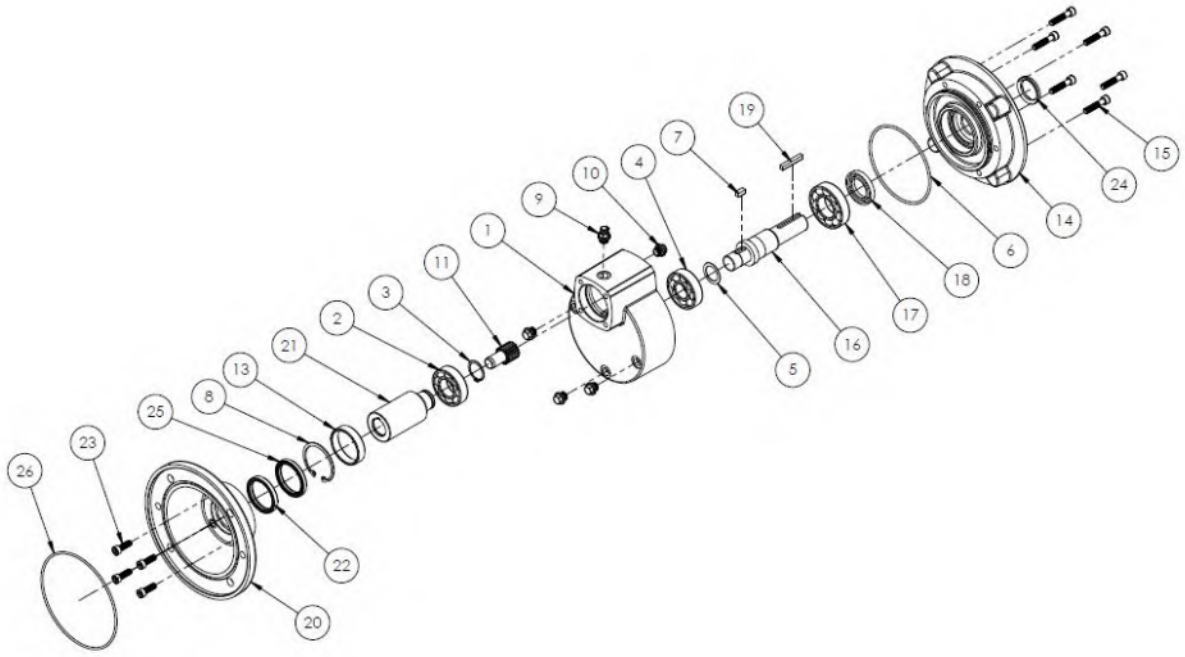
*Applies to Stainless Steel units only.



180TC/210TC PARTS

Item No.	Description	Qty	Item No.	Description	Qty
1	ONE PIECE HOUSING	1	14	C-FACE OUTPUT CAP	1
2	BALL BEARING	1	15	SOCKET HEAD CAP SCREW	6
3	EXTERNAL SNAP RING	1	16	OUTPUT SHAFT	1
4	BALL BEARING	1	17	BALL BEARING	1
5	SPACER	1	18	METRIC SEAL	1
6	O-RING	1	19	KEY	1
7	METRIC KEY	1	20	INPUT FLANGE	1
8	INTERNAL SNAP RING	1	21	INPUT QUILL SHAFT	1
9	HEINRICHS BREATHER	1	22	METRIC SEAL	1
10	SEAL PLUG	4	23	SOCKET HEAD CAP SCREW	4
11	PINION	1	24	V-SEAL	1
12	OUTPUT GEAR	1	25	METRIC SEAL	1
13	SPACER RING/ SPLASH GUARD	1	26*	O-RING	1

*Applies to Stainless Steel units only.



Indianapolis, Indiana (800) 866-7973

e-mail: sales@sterlingelectric.com
www.sterlingelectric.com

Automation Direct Proximity Sensor

877.812.7573 info@fusionfluid.com

PNM Series Inductive Proximity Sensors

M12 (12mm) Bronze-plated Brass - DC

- Low cost/high performance
- 32 models available
- Short and regular body styles
- IP65 / IP66 / IP67 / IP68 / IP69K rated
- Axial cable / M12 quick-disconnect; purchase cable separately
- Lifetime warranty

PNM Series Inductive Prox Selection Chart (Regular Body)								
Part Number		**Sensing Range**	**Mounting**	**Output State**	**Logic**	**Connection**	**Wiring**	**Dimensions**
M12 Models (regular body)								
PNM-AP-4H		7mm (0.28 in)	Non-flush	NO	PNP	M12 (12 mm) connector	Diagram 2	Figure 4

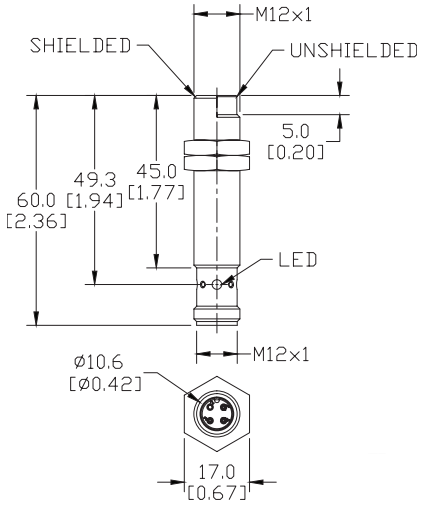
PN Series Specifications	M12 Models (PNM)	M18 Models (PNK)	M30 Models (PNT)
Mounting Type	Flush or Non-flush		
Nominal Sensing Distance	Flush: 4mm (0.16 in) Non-flush: 7mm (0.28 in)	Flush: 8mm (0.31 in) Non-flush:12mm (0.47 in)	Flush: 15mm (0.6 in) Non-flush: 22mm (0.79 in)
Operating Distance	Flush: 0 to 3.24 mm Non-flush: 0 to 5.67 mm	Flush: 0 to 6.48 mm Non-flush: 0 to 9.72 mm	Flush: 0 to 12.15 mm Non-flush: 0 to 17.82 mm
Material Correction Factors	See the Material influence table		
Output Type	NPN or PNP, NO or NC		
Operating Voltage	10 to 30 VDC		
No-load Supply Current	<10 mA		
Operating (Load) Current	100mA		
Off-state (Leakage) Current	For 3-wire (< 50µ)		
Voltage Drop	<2.5 V		
Switching Frequency	700Hz	Flush 400Hz; Non-flush 300Hz	100Hz
Differential Travel (% of Nominal Distance)	3 . . . 15		
Repeat Accuracy	< 10%		
Ripple	NA		
Time Delay Before Availability (tv)	NA		
Reverse Polarity Protection	Yes		
Short-circuit Protection	Yes, pulsed		
Operating Temperature	-40° to 85°C (-40° to 185°F)		
Protection Degree (DIN 40050)	IP65, IP66, IP67, IP68, IP69K		
Indication/Switch Status	Yellow (output energized), 1 LED prewired/4 LEDs for quick disconnect		
Housing Material	Housing: brass, bronze-plated; PEI; Lock nuts: brass		
Sensing Face Material	Polybutylene Terephthalate (PBT)		
Shock/Vibration	See Proximity Sensor Terminology		
Tightening Torque	Connector type: 7Nm (1.57 lb-ft) Cable type: 12Nm (2.70 lb-ft)	25 Nm (5.62 lb-ft)	50Nm (11.21 lb-ft)
Weight	NA		
Connectors	M12 connector/2m axial cable. 2 lock nuts included		
Agency Approvals	M12 Connector versions cULus file E328811, CE, RoHS; Cable versions UL file E328811, CE, RoHS		

PN Series Inductive Proximity Sensors

Dimensions

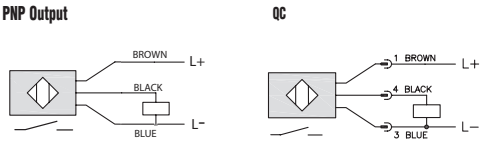
mm [inches]

Figure 4

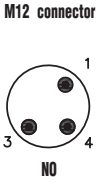


Wiring diagrams

Diagram 2



Connector



Invertek Drives VFD

877.812.7573 info@fusionfluid.com

Invertek Drives.com

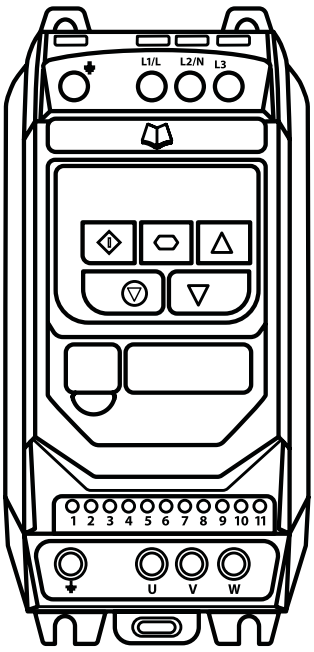
User Manual

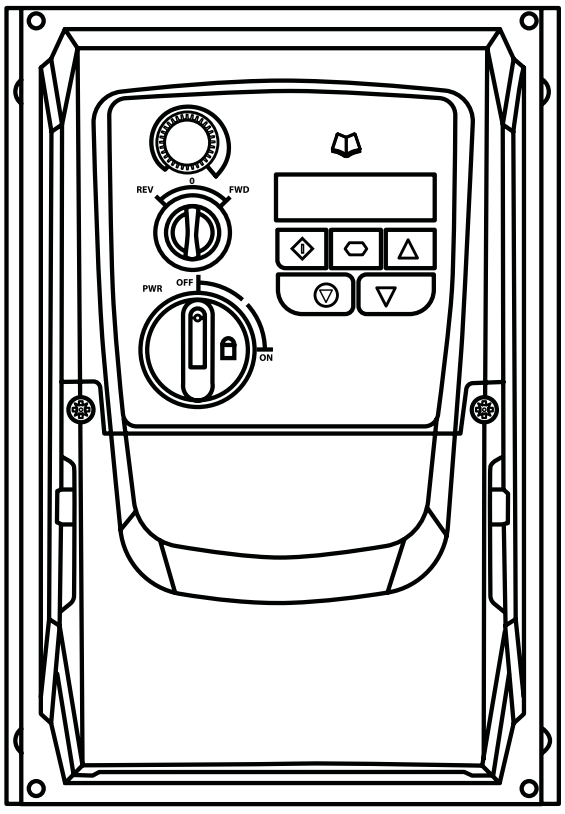
OPTIDRIVE™ E3

Single Phase Output

IP20 & IP66 (NEMA 4X)

0.37 – 1.1kW (0.5 – 1.5HP)
110 – 230V





Declaration of Conformity

Invertek Drives Ltd hereby states that the Optidrive ODE-3 product range conforms to the relevant safety provisions of the following council directives:

2014/30/EU (EMC) and 2014/35/EU (LVD)

Designed and manufacture is in accordance with the following harmonised European standards:

EN 61800-5-1: 2007	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
EN 61800-3: 2004 /A1 2012	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
EN 55011: 2007	Limits and Methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment (EMC)
EN60529: 1992	Specifications for degrees of protection provided by enclosures

Electromagnetic Compatibility

All Optidrives are designed with high standards of EMC in mind. All versions suitable for operation on Single Phase 230 volt and Three Phase 400 volt supplies and intended for use within the European Union are fitted with an internal EMC filter. This EMC filter is designed to reduce the conducted emissions back into the mains supply via the power cables for compliance with the above harmonised European standards.

It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the EMC legislation of the country of use, and the relevant category. Within the European Union, equipment into which this product is incorporated must comply with the EMC Directive 2004/108/EC. This User Guide provides guidance to ensure that the applicable standards may be achieved.

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2 Year Warranty

All Invertek Optidrive units carry a 2 year warranty against manufacturing defects from the date of manufacture. The manufacturer accepts no liability for any damage caused during or resulting from transport, receipt of delivery, installation or commissioning. The manufacturer also accepts no liability for damage or consequences resulting from inappropriate, negligent or incorrect installation, incorrect adjustment of the operating parameters of the drive, incorrect matching of the drive to the motor, incorrect installation, unacceptable dust, moisture, corrosive substances, excessive vibration or ambient temperatures outside of the design specification.

The local distributor may offer different terms and conditions at their discretion, and in all cases concerning warranty, the local distributor should be contacted first.

This user guide is the "original instructions" document. All non-English versions are translations of the "original instructions".

The contents of this User Guide are believed to be correct at the time of printing. In the interest of a commitment to a policy of continuous improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Guide without notice.

This User Guide is for use with version 3.04 Firmware

User Guide Revision 2.00

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

	When installing the drive on any power supply where the phase-ground voltage may exceed the phase-phase voltage (typically IT supply networks or Marine vessels) it is essential that the internal EMC filter ground and surge protection varistor ground (where fitted) are disconnected. If in doubt, refer to your Sales Partner for further information.
	This manual is intended as a guide for proper installation. Invertek Drives Ltd cannot assume responsibility for the compliance or the non-compliance to any code, national, local or otherwise, for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.
	This Optidrive contains high voltage capacitors that take time to discharge after removal of the main supply. Before working on the drive, ensure isolation of the main supply from line inputs. Wait ten (10) minutes for the capacitors to discharge to safe voltage levels. Failure to observe this precaution could result in severe bodily injury or loss of life.
	Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

1. Quick Start Up

1.1. Important Safety Information

Please read the IMPORTANT SAFETY INFORMATION below, and all Warning and Caution information elsewhere.

Danger: Indicates a risk of electric shock, which, if not avoided, could result in damage to the equipment and possible injury or death.

This variable speed drive product (Optidrive) is intended for professional incorporation into complete equipment or systems as part of a fixed installation. If installed incorrectly it may present a safety hazard. The Optidrive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control mechanical plant that may cause injury. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction. Only qualified electricians are allowed to install and maintain this product.

System design, installation, commissioning and maintenance must be carried out only by personnel who have the necessary training and experience. They must carefully read this safety information and the instructions in this Guide and follow all information regarding transport, storage, installation and use of the Optidrive, including the specified environmental limitations.

Do not perform any flash test or voltage withstand test on the Optidrive. Any electrical measurements required should be carried out with the Optidrive disconnected.

Electric shock hazard! Disconnect and ISOLATE the Optidrive before attempting any work on it. High voltages are present at the terminals and within the drive for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.

Where supply to the drive is through a plug and socket connector, do not disconnect until 10 minutes have elapsed after turning off the supply.

Ensure correct earth connections and cable selection as per defined by local legislation or codes. The drive may have a leakage current of greater than 3.5mA; furthermore the earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or MCB.

Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes.

Do not carry out any work on the drive control cables whilst power is applied to the drive or to the external control circuits.

Danger: Indicates a potentially hazardous situation other than electrical, which if not avoided, could result in damage to property.

Within the European Union, all machinery in which this product is used must comply with Directive 2006/42/EC, Safety of Machinery. In particular, the machine manufacturer is responsible for providing a main switch and ensuring the electrical equipment complies with EN60204-1.

Whilst every effort is made to ensure the contents of this user guide are applicable to the wides range of applications and installations, it is the responsibility of the installer to ensure compliance with any local codes or regulations relevant to the installation location.

The level of integrity offered by the Optidrive control input functions – for example stop/start, maximum speed, etc. is not sufficient for use in safety-critical applications without independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment and further protection provided where needed.

The driven motor can start at power up if the enable input signal is present.

The STOP function does not remove potentially lethal high voltages. ISOLATE the drive and wait 10 minutes before starting any work on it. Never carry out any work on the Drive, Motor or Motor cable whilst the input power is still applied.

The Optidrive can be programmed to operate the driven motor at speeds above or below the speed achieved when connecting the motor directly to the mains supply. Obtain confirmation from the manufacturers of the motor and the driven machine about suitability for operation over the intended speed range prior to machine start up.

Do not activate the automatic fault reset function on any systems whereby this may cause a potentially dangerous situation.

IP20 drives must be installed in a pollution degree 2 environment mounted in a cabinet with IP54 or better.

Optidrives are intended for indoor use only.

When mounting the drive, ensure that sufficient cooling is provided. Do not carry out drilling operations with the drive in place, dust and swarf from drilling may lead to damage.

The entry of conductive or flammable foreign bodies should be prevented. Flammable material should not be placed close to the drive.

Relative humidity must be less than 95% (non-condensing).

Ensure that the supply voltage, frequency and no. of phases (1 or 3 phase) correspond to the rating of the Optidrive as delivered.

Never connect the mains power supply to the Output terminals U, V, W.

Do not install any type of automatic switchgear between the drive and the motor.

Wherever control cabling is close to power cabling, maintain a minimum separation of 100 mm and arrange crossings at 90 degrees. Ensure that all terminals are tightened to the appropriate torque setting.

Do not attempt to carry out any repair of the Optidrive. In the case of suspected fault or malfunction, contact your local Invertek Drives Sales Partner for further assistance.

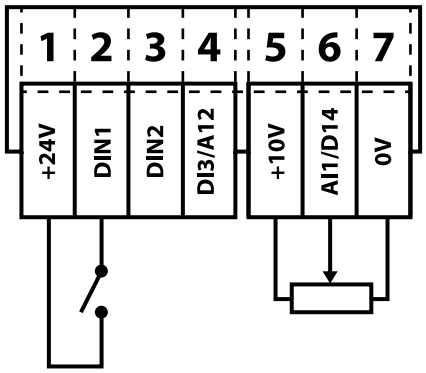
1.2. Quick Start Process

Step	Action	See section	Page
1	Identify the Enclosure Type, Model Type and ratings of your drive from the model code on the label. In particular - Check the voltage rating suits the incoming supply - Check the output current capacity meets or exceeds the full load current for the intended motor	2.1. Identifying the Drive by Model Number	7
2	Unpack and check the drive. Notify the supplier and shipper immediately of any damage.		
3	Ensure correct ambient and environmental conditions for the drive are met by the proposed mounting location.	9.1. Environmental	34
4	Install the drive in a suitable cabinet (IP20 Units) ensuring suitable cooling air is available. Mount the drive to the wall or machine (IP66).	3.1. General 3.3. Mechanical Dimensions and Mounting – IP20 Open Units 3.4. Guidelines for Enclosure Mounting – IP20 Units 3.5. Mechanical Dimensions – IP66 (NEMA 4X) Enclosed Units 3.6. Guidelines for mounting (IP66 Units)	8 8 9 10 11
5	Select the correct power and motor cables according to local wiring regulations or code, noting the maximum permissible sizes	9.2. Rating Tables	34
6	If the supply type is IT or corner grounded, disconnect the EMC filter before connecting the supply.	9.4. EMC Filter Disconnect	35
7	Check the supply cable and motor cable for faults or short circuits.		
8	Route the cables		
9	Check that the intended motor is suitable for use, noting any precautions recommended by the supplier or manufacturer.		
10	Check the motor cable length does not exceed the maximum allowed for the drive unit - 100m (328ft) shielded cable maximum - 150m (293ft) unshielded cable maximum - 200m (656ft) shielded cable maximum with optional external output filter - 300m (984ft) unshielded cable maximum with optional external output filter		
11	Ensure wiring protection is providing, by installing a suitable circuit breaker or fuses in the incoming supply line	4.3.2. Fuse / Circuit Breaker Selection 9.2. Rating Tables	14 34
12	Connect the power cables, especially ensuring the protective earth connection is made	4.1. Connection Diagram 4.2. Protective Earth (PE) Connection 4.3. Incoming Power Connection 4.4. Motor Connection	13 14 14 15
13	Connect the control cables as required for the application	4.6. Control Terminal Wiring 7. Analog and Digital Input Macro Configurations 7.8. Example Connection Diagrams	15 28 32
14	Thoroughly check the installation and wiring		
15	Ensure that all aspects of the installation comply with local codes and regulations relevant to the installation location		
16	Commission the drive parameters	5.1. Managing the Keypad 6. Parameters	19 21

1.3. Quick Start Overview

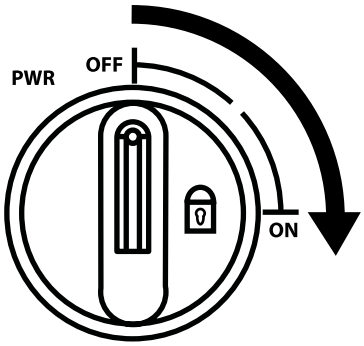
Quick Start – IP20 & IP66 Non Switched

- Connect a Start / Stop switch between control terminals 1 & 2
  - o Close the Switch to Start
  - o Open to Stop
- Connect a potentiometer (5k – 10kΩ) between terminals 5, 6 and 7 as shown
  - o Adjust the potentiometer to vary the speed from P-02 (0Hz default) to P-01 (50 / 60 Hz default)



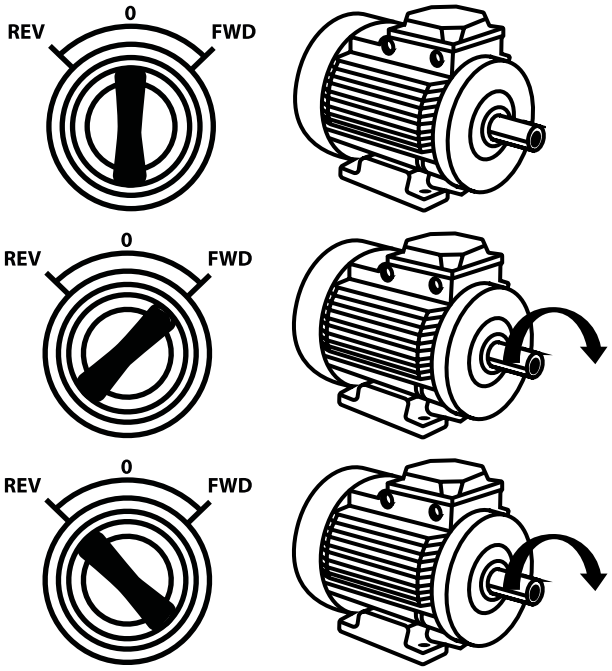
Quick Start – IP66 Switched

Switch the mains power on to the unit using the built in isolator switch on the front panel.

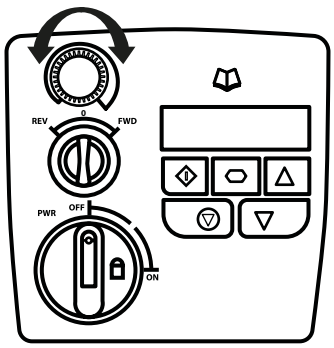


The OFF/REV/FWD will enable the output and control the direction of rotation of the motor.

NOTE: With single phase motors, forward rotation only is possible.



The potentiometer will control the motor shaft rotational speed.

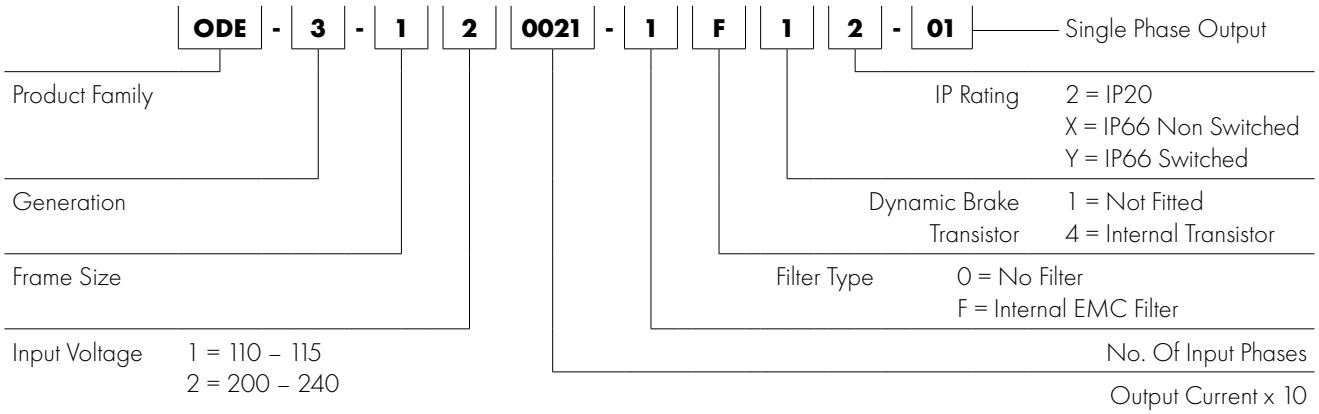


2. General Information and Ratings

This chapter contains information about the Optidrive E3 including how to identify the drive.

2.1. Identifying the Drive by Model Number

Each drive can be identified by its model number, as shown in the table below. The model number is on the shipping label and the drive nameplate. The model number includes the drive and any options.



2.2. Drive Model Numbers

110 – 115V + / - 10% - 1Phase Input – 1 Phase 110V Output					
Model Number		kW	HP	Output Current (A)	Frame Size
With Filter	Without Filter				
N/A	ODE-3-110070-101#-01		0.5	7.0	1
N/A	ODE-3-210105-104#-01		0.75	10.5	2
200 – 240V + / - 10% - 1Phase Input – 1 Phase Output					
Model Number		kW	HP	Output Current (A)	Frame Size
With Filter	Without Filter				
ODE-3-120043-1F1#-01	ODE-3-120043-101#-01	0.37	0.5	4.3	1
ODE-3-120070-1F1#-01	ODE-3-120070-101#-01	0.75	1	7.0	1
ODE-3-220105-1F4#-01	ODE-3-220105-104#-01	1.1	1.5	10.5	2

NOTE

For IP20 units, replace '#' with '2'
For IP66 Non Switched Units, replace '#' with 'X'
For IP66 Switched Units, replace '#' with 'Y'

3. Mechanical Installation

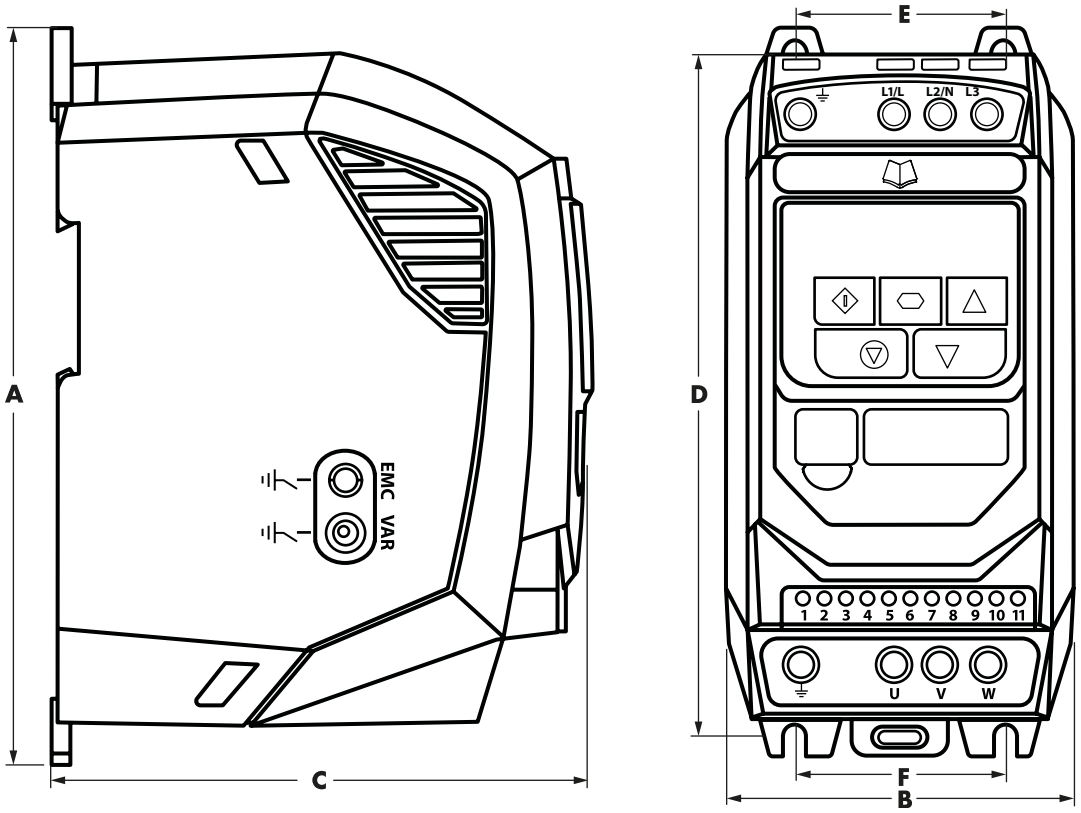
3.1. General

- The Optidrive should be mounted in a vertical position only, on a flat, flame resistant, vibration free mounting using the integral mounting holes or DIN Rail clip (Frame Sizes 1 and 2 only).
- IP20 Optidrives must be installed in a pollution degree 1 or 2 environment only.
- Do not mount flammable material close to the Optidrive.
- Ensure that the minimum cooling air gaps, as detailed in section 3.5. Mechanical Dimensions – IP66 (NEMA 4X) Enclosed Units and 3.7. Gland Plate and Lock Off are left clear.
- Ensure that the ambient temperature range does not exceed the permissible limits for the Optidrive given in section 9.1. Environmental.
- Provide suitable clean, moisture and contaminant free cooling air sufficient to fulfil the cooling requirements of the Optidrive.

3.2. UL Compliant Installation

Refer to section 9.3. Additional Information for UL Compliance on page 34 for Additional Information for UL Compliance.

3.3. Mechanical Dimensions and Mounting – IP20 Open Units



Drive Size	A		B		C		D		E		F		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	Kg	lb
1	173	6.81	83	3.27	123	4.84	162	6.38	50	1.97	50	1.97	1.0	2.2
2	221	8.70	110	4.33	150	5.91	209	8.23	63	2.48	63	2.48	1.7	3.8

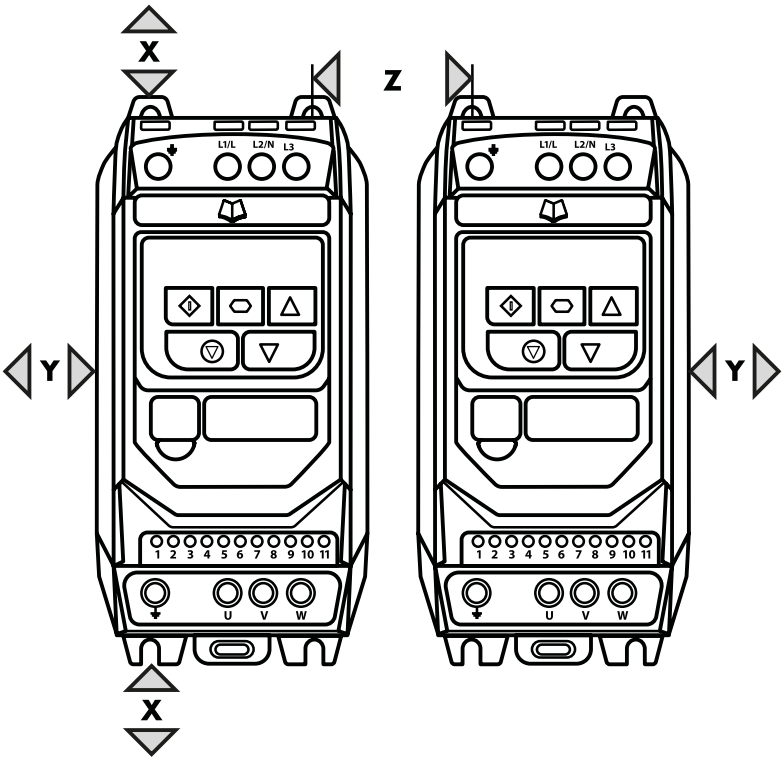
Mounting Bolts	
Frame Size	
1 – 2	4 x M5 (#8)

Tightening Torques		
Frame Size	Control Terminals	Power Terminals
1 – 2	0.5 Nm (4.5 lb-in)	1 Nm (9 lb-in)

3.4. Guidelines for Enclosure Mounting – IP20 Units

- IP20 drives are suitable for use in pollution degree 1 environments, according to IEC-664-1. For pollution degree 2 or higher environments, drives should be mounted in a suitable control cabinet with sufficient ingress protection to maintain a pollution degree 1 environment around the drive.
- Enclosures should be made from a thermally conductive material.
- Ensure the minimum air gap clearances around the drive as shown below are observed when mounting the drive.
- Where ventilated enclosures are used, there should be venting above the drive and below the drive to ensure good air circulation. Air should be drawn in below the drive and expelled above the drive.
- In any environments where the conditions require it, the enclosure must be designed to protect the Optidrive against ingress of airborne dust, corrosive gases or liquids, conductive contaminants (such as condensation, carbon dust, and metallic particles) and sprays or splashing water from all directions.
- High moisture, salt or chemical content environments should use a suitably sealed (non-vented) enclosure.

The enclosure design and layout should ensure that the adequate ventilation paths and clearances are left to allow air to circulate through the drive heatsink. Invertek Drives recommend the following minimum sizes for drives mounted in non-ventilated metallic enclosures:



Drive Size	X Above & Below		Y Either Side		Z Between		Recommended airflow
	mm	in	mm	in	mm	in	CFM (ft3/min)
1	50	1.97	50	1.97	33	1.30	11
2	75	2.95	50	1.97	46	1.81	22

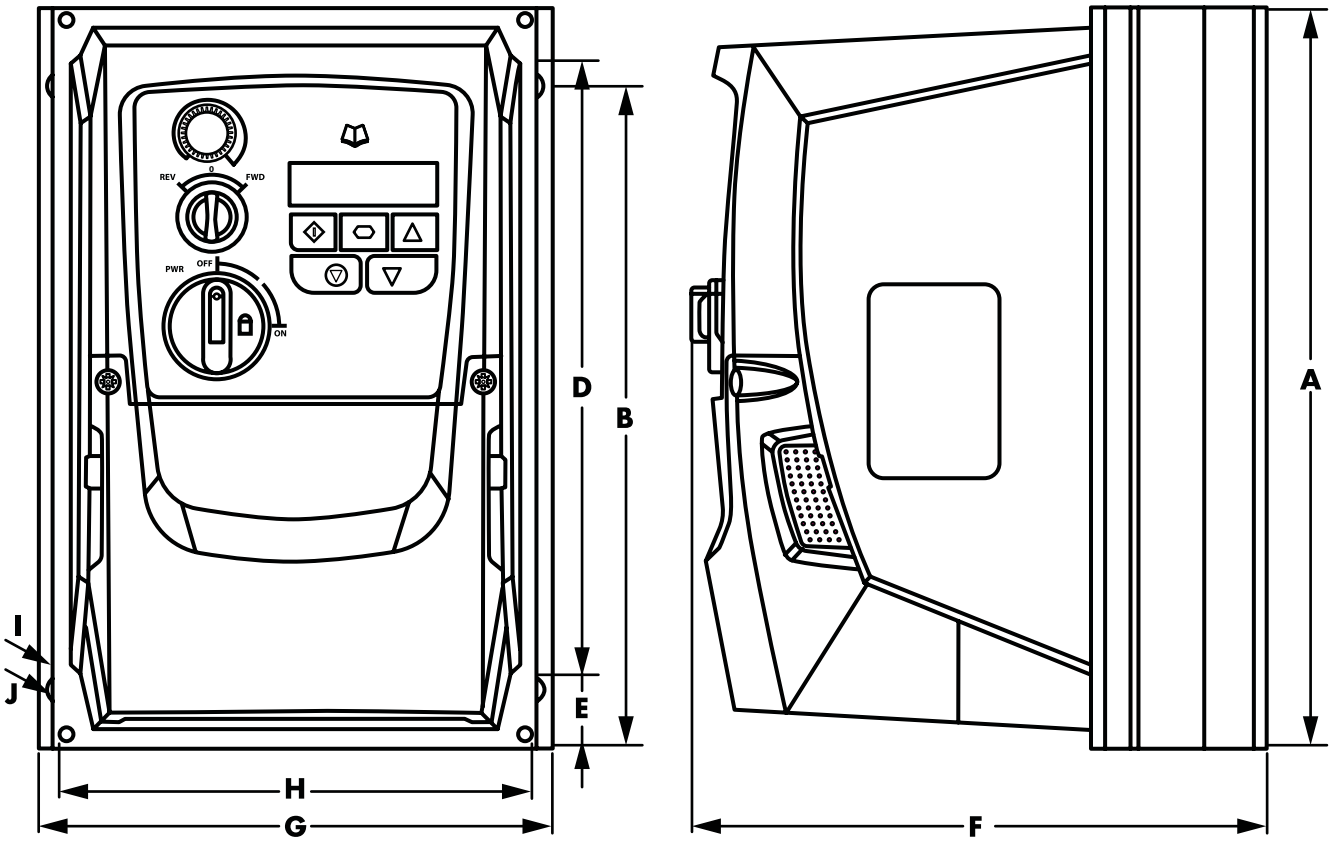
NOTE

Dimension Z assumes that the drives are mounted side-by-side with no clearance.

Typical drive heat losses are 3% of operating load conditions.

Above are guidelines only and the operating ambient temperature of the drive MUST be maintained at all times.

3.5. Mechanical Dimensions – IP66 (NEMA 4X) Enclosed Units



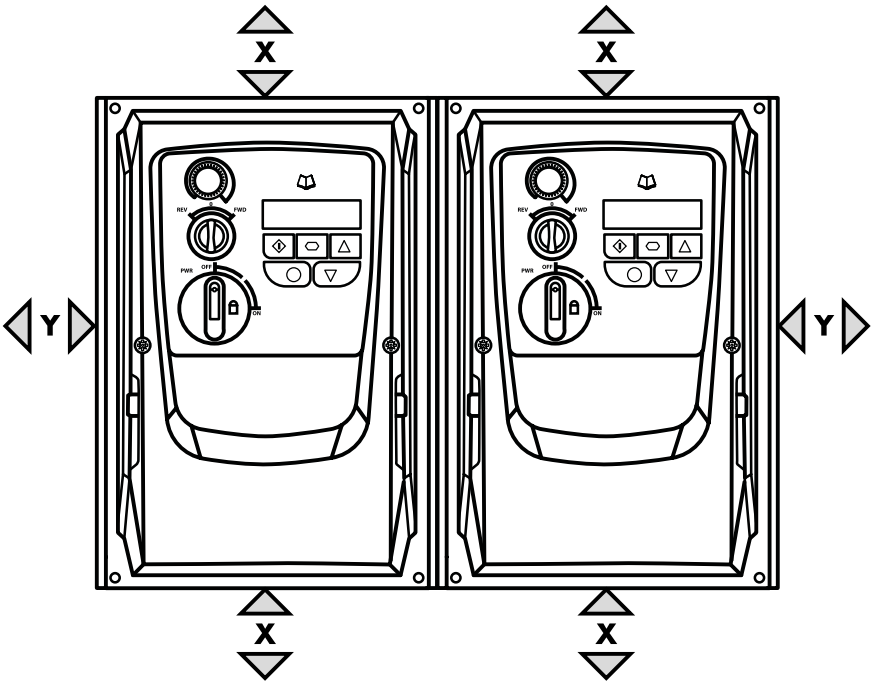
Drive Size	A		B		D		E		F		G		H		I		J		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
1	232.0	9.13	207.0	8.15	189.0	7.44	25.0	0.98	179.0	7.05	161.0	6.34	148.5	5.85	4.0	0.16	8.0	0.31	3.1	6.8
2	257.0	10.12	220.0	8.67	200.0	7.87	28.5	1.12	187.0	7.36	188.0	7.40	176.0	6.93	4.2	0.17	8.5	0.33	4.1	9.0

Mounting Bolts	
Frame Size	
All Frame Sizes	4 x M4 (#8)

Tightening Torques		
Frame Size	**Control Terminals**	**Power Terminals**
All Frame Sizes	0.5 Nm (4.5 lb-in)	1 Nm (9 lb-in)

3.6. Guidelines for mounting (IP66 Units)

- Before mounting the drive, ensure that the chosen location meets the environmental condition requirements for the drive shown in section 9.1. Environmental.
- The drive must be mounted vertically, on a suitable flat surface.
- The minimum mounting clearances as shown in the table below must be observed.
- The mounting site and chosen mountings should be sufficient to support the weight of the drives.
- Using the drive as a template, or the dimensions shown above, mark the locations required for drilling.
- Suitable cable glands to maintain the ingress protection of the drive are required. Gland holes for power and motor cables are pre-moulded into the drive enclosure, recommended gland sizes are shown above. Gland holes for control cables may be cut as required.



Drive Size	X Above & Below		Y Either Side	
	mm	in	mm	in
1	200	7.87	10	0.39
2	200	7.87	10	0.39

Drive Size	Cable Gland Sizes		
	Power Cable	Motor Cable	Control Cables
1	M20 (PG13.5)	M20 (PG13.5)	M20 (PG13.5)
2	M25 (PG21)	M25 (PG21)	M20 (PG13.5)

NOTE

Typical drive heat losses are approximately 3% of operating load conditions.

Above are guidelines only and the operating ambient temperature of the drive MUST be maintained at all times.

3.7. Gland Plate and Lock Off

The use of a suitable gland system is required to maintain the appropriate IP / NEMA rating. The gland plate has pre moulded cable entry holes for power and motor connections suitable for use with glands as shown in the following table. Where additional holes are required, these can be drilled to suitable size. Please take care when drilling to avoid leaving any particles within the product.

Cable Gland recommended Hole Sizes & types:

	Power & Motor Cables			Control & Signal Cables		
Drive Size	Power Cable	Motor Cable	Control Cables	Power Cable	Motor Cable	Control Cables
Size 1	22mm	PG13.5	M20	22mm	PG13.5	M20
Size 2 & 3	27mm	PG21	M25	22mm	PG13.5	M20

Flexible Conduit Hole Sizes:

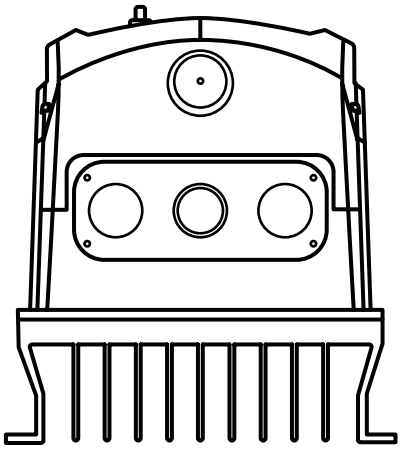
Drive Size	Drill Size	Trade Size	Metric
Size 1	28mm	¾ in	21
Size 2 & 3	35mm	1 in	27

- UL rated ingress protection ("Type") is only met when cables are installed using a UL recognized bushing or fitting for a flexible-conduit system which meets the required level of protection ("Type").
- For conduit installations the conduit entry holes require standard opening to the required sizes specified per the NEC.
- Not intended for installation using rigid conduit system.

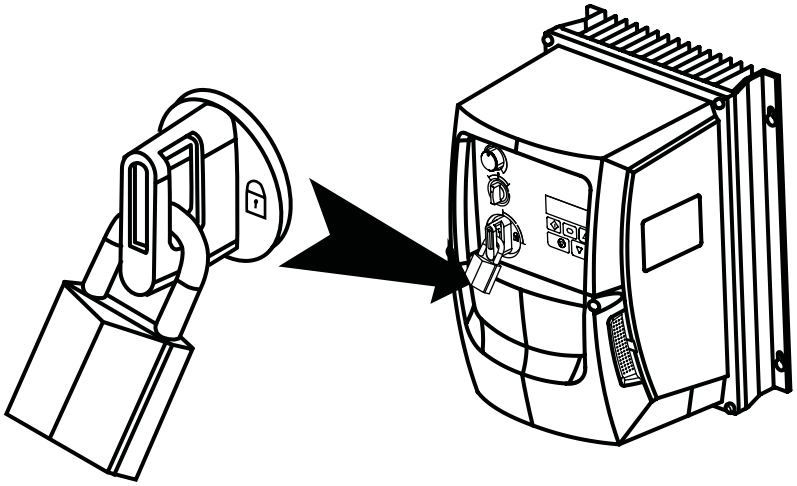
Power Isolator Lock Off

On the switched models the main power isolator switch can be locked in the 'Off' position using a 20mm standard shackle padlock (not supplied).

IP66 / NEMA 4X Gland Plate



IP66 / NEMA 4X Unit Lock Off

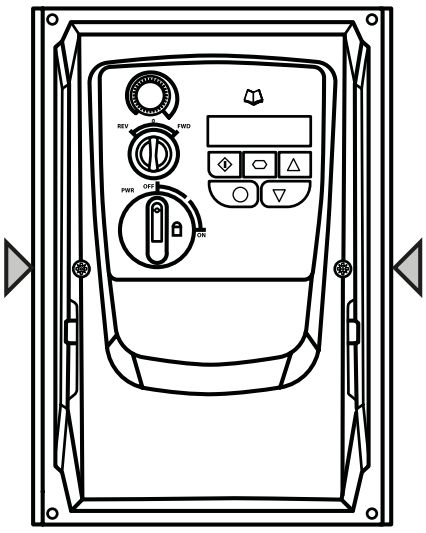


3.8. Removing the Terminal Cover

To access the connection terminals, the drive front cover needs to be removed as shown.

IP66 / NEMA 4X Units

Removing the 2 screws on the front of the product allows access to the connection terminals, as shown below.



3.9. Routine Maintenance

The drive should be included within the scheduled maintenance program so that the installation maintains a suitable operating environment, this should include:

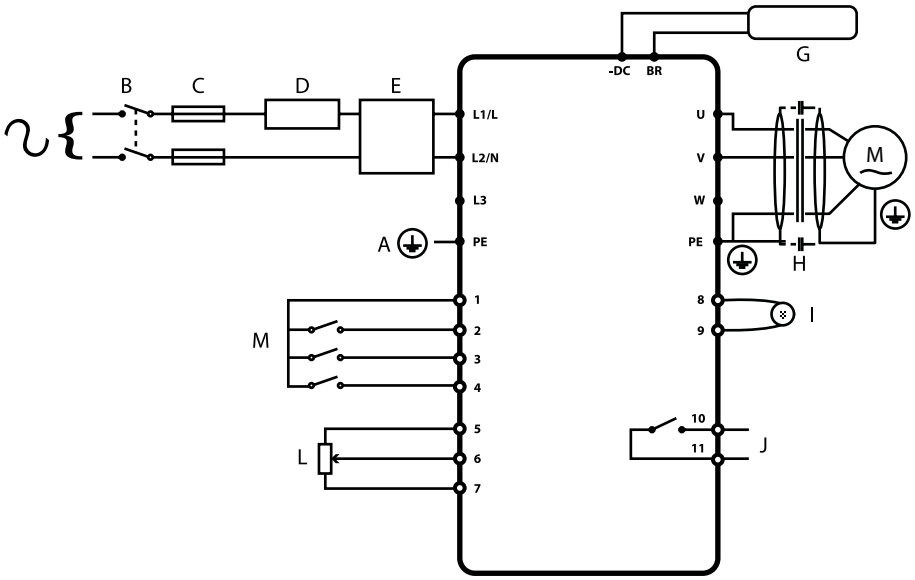
- Ambient temperature is at or below that set out in section 9.1. Environmental.
- Heat sink fans freely rotating and dust free.
- The Enclosure in which the drive is installed should be free from dust and condensation; furthermore ventilation fans and air filters should be checked for correct air flow.

Checks should also be made on all electrical connections, ensuring screw terminals are correctly torqued; and that power cables have no signs of heat damage.

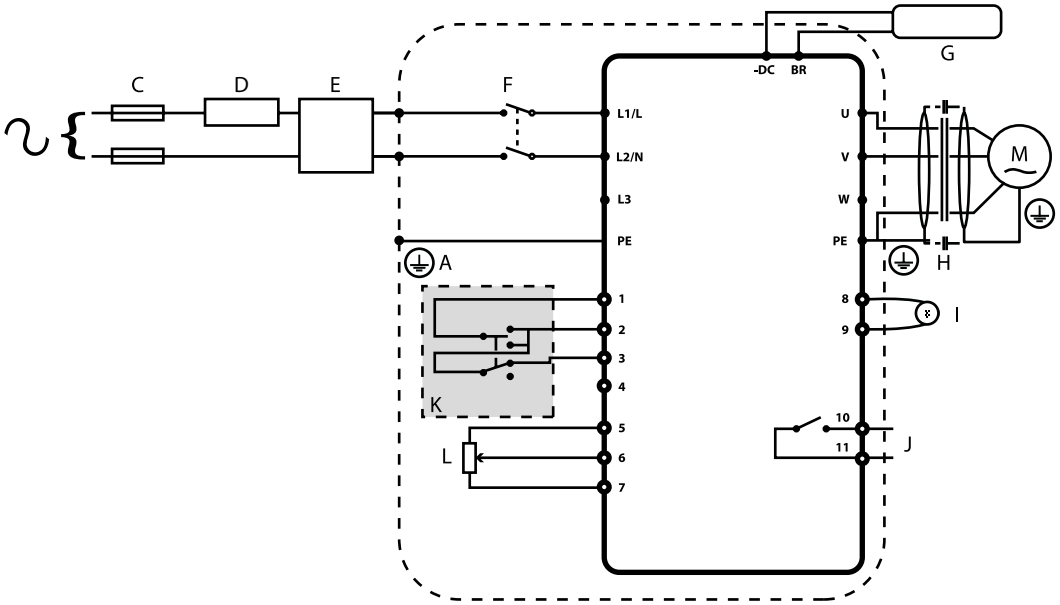
4. Power & Control Wiring

4.1. Connection Diagram

4.1.1. IP20 & IP66 (NEMA 4X) Non-Switched Units



4.1.2. IP66 (NEMA 4X) Switched Units



	Key	Sec.	Page
A	Protective Earth (PE) Connection	4.2	14
B	Incoming Power Connection	4.3	14
C	Fuse / Circuit Breaker Selection	4.3.2	14
D	Optional Input Choke	4.3.3	15
E	Optional External EMC Filter	4.10	17
F	Internal Disconnect / Isolator	4.3	14
G	Optional Brake Resistor	4.11	18
H	Motor Connection		
I	Analog Output	4.8.1	16
J	Relay Output	4.8.2	17
K	Using the REV/0/FWD Selector Switch (Switched Version Only)	4.7	16
L	Analog Inputs	4.8.3	17
M	Digital Inputs	4.8.4	17

4.2. Protective Earth (PE) Connection

Grounding Guidelines

The ground terminal of each Optidrive should be individually connected DIRECTLY to the site ground bus bar (through the filter if installed). Optidrive ground connections should not loop from one drive to another, or to, or from any other equipment. Ground loop impedance must confirm to local industrial safety regulations. To meet UL regulations, UL approved ring crimp terminals should be used for all ground wiring connections.

The drive Safety Ground must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be checked periodically.

Protective Earth Conductor

The Cross sectional area of the PE Conductor must be at least equal to that of the incoming supply conductor.

Safety Ground

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Ground Fault Monitoring

As with all inverters, a leakage current to earth can exist. The Optidrive is designed to produce the minimum possible leakage current whilst complying with worldwide standards. The level of current is affected by motor cable length and type, the effective switching frequency, the earth connections used and the type of RFI filter installed. If an ELCB (Earth Leakage Circuit Breaker) is to be used, the following conditions apply:

- A Type B Device must be used.
- The device must be suitable for protecting equipment with a DC component in the leakage current.
- Individual ELCBs should be used for each Optidrive.

Shield Termination (Cable Screen)

The safety ground terminal provides a grounding point for the motor cable shield. The motor cable shield connected to this terminal (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

4.3. Incoming Power Connection

4.3.1. Cable Selection

- The mains power cables should be connected to L1/L, L2/N.
- For compliance with CE and C Tick EMC requirements, refer to section 4.10. EMC Compliant Installation on page 17.
- A fixed installation is required according to IEC61800-5-1 with a suitable disconnecting device installed between the Optidrive and the AC Power Source. The disconnecting device must conform to the local safety code / regulations (e.g. within Europe, EN60204-1, Safety of machinery).
- The cables should be dimensioned according to any local codes or regulations. Maximum dimensions are given in section 9.2. Rating Tables.

4.3.2. Fuse / Circuit Breaker Selection

- Suitable fuses to provide wiring protection of the input power cable should be installed in the incoming supply line, according to the data in section 9.2. Rating Tables. The fuses must comply with any local codes or regulations in place. In general, type gG (IEC 60269) or UL type J fuses are suitable; however in some cases type aR fuses may be required. The operating time of the fuses must be below 0.5 seconds.
- Where allowed by local regulations, suitably dimensioned type B MCB circuit breakers of equivalent rating may be utilised in place of fuses, providing that the clearing capacity is sufficient for the installation.
- The maximum permissible short circuit current at the Optidrive Power terminals as defined in IEC60439-1 is 100kA.

4.3.3. Optional Input Choke

- An optional Input Choke is recommended to be installed in the supply line for drives where any of the following conditions occur:
  - o The incoming supply impedance is low or the fault level / short circuit current is high.
  - o The supply is prone to dips or brown outs.
  - o The power supply to the drive is via a busbar and brush gear system (typically overhead Cranes).
- In all other installations, an input choke is recommended to ensure protection of the drive against power supply faults. Part numbers are shown in the table.

Supply	Frame Size	AC Input Inductor
110 & 230 Volt 1 Phase	1	OPT-2-L1016-20
	2	OPT-2-L1025-20

4.4. Motor Connection

- The drive inherently produces fast switching of the output voltage (PWM) to the motor compared to the mains supply. For motors which have been wound for operation with a variable speed drive then there is no preventative measures required, however if the quality of insulation is unknown then the motor manufacturer should be consulted and preventative measures may be required.
- The motor should be connected to the Optidrive U, and V terminals using a suitable 2 or 3 core cable. Where a 2 core cable is utilised, with the shield operating as an earth conductor, the shield must have a cross sectional area at least equal to the phase conductors when they are made from the same material. Where a 3 core cable is utilised, the earth conductor must be of at least equal cross sectional area and manufactured from the same material as the phase conductors.
- The motor earth must be connected to one of the Optidrive earth terminals.

4.5. Suitable Motor Types

Optidrive E3 Single Phase Output is intended for use with the following motor types:

- PSC (Permanent Split Capacitor)
- Shaded Pole

The motor should be suitable for operation with a PWM inverter. If in doubt, consult the motor manufacturer for guidance - additional filtering may be required to prevent damage to the motor.

4.6. Control Terminal Wiring

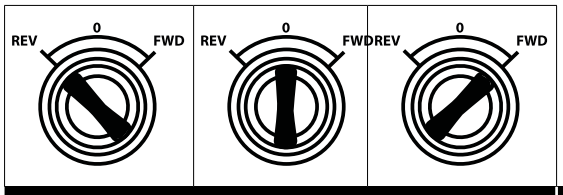
- All analog signal cables should be suitably shielded. Twisted pair cables are recommended.
- Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.
- Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be routed in the same cable.
- Maximum control terminal tightening torque is 0.5Nm.
- Control Cable entry conductor size: 0.05 – 2.5mm2 / 30 – 12 AWG.

4.7. Using the REV/0/FWD Selector Switch (Switched Version Only)

By adjusting the parameter settings the Optidrive can be configured for multiple applications.

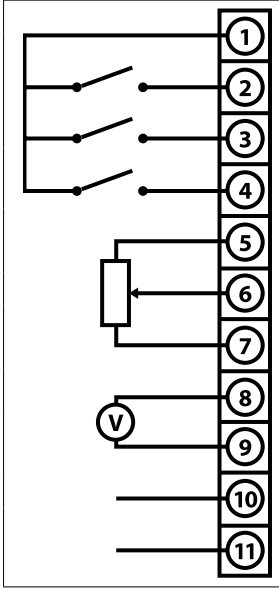
This could typically be for Hand/Off/Auto applications (also known as Local/Remote) for HVAC and pumping industries.

NOTE Forward / Reverse operation of single phase motors is not possible.



Switch Position			Parameters to Set		Notes
			P-12	P-15	
Run (Pot)	STOP	Run (Pot)	0	0	Factory Default Configuration Run Forward only with speed controlled from the Local POT
Run (Preset Speed 1)	STOP	Run (Pot)	0	1	Run forward with speed controlled form the local POT or preset speed
Run (Analog Input 2)	STOP	Run (Pot)	0	4	Run Forward with speed controlled from the Local POT or 2nd analog input
Enable	STOP	Enable	3, 4	0	Control from Modbus RTU
Run (Preset Speed 1)	STOP	Enable (Modbus RTU)	3, 4	5	Local / Remote function with Modbus RTU speed reference or preset speed
Run (Preset Speed 1)	STOP	Run in PI Control	5, 6	0	Selectable PI control or preset speed
Run (Pot)	STOP	Run in PI Control	5, 6	0	Selectable PI control or Pot speed control
Enable	STOP	Enable	7, 8	0	Control from CAN interface
Run (Preset Speed 1)	STOP	Enable (Modbus RTU)	7, 8	5	Local / Remote function with CAN speed reference or preset speed

4.8. Control Terminal Connections

Default Connections	Control Terminal	Signal	Description	
	1	+24Vdc User Output	+24Vdc user output, 100mA. Do not connect an external voltage source to this terminal.	
	2	Digital Input 1	Positive logic "Logic 1" input voltage range: 8V ... 30V DC "Logic 0" input voltage range: 0V ... 4V DC	
	3	Digital Input 2		
	4	Digital Input 3 / Analog Input 2	Digital: 8 to 30V Analog: 0 to 10V, 0 to 20mA or 4 to 20mA	
	5	+10V User Output	+10V, 10mA, 1kΩ minimum	
	6	Analog Input 1 / Digital Input 4	Analog: 0 to 10V, 0 to 20mA or 4 to 20mA Digital: 8 to 30V	
	7	0V	0 Volt Common, internally connected to terminal 9	
	8	Analog Output / Digital Output	Analog: 0 to 10V, Digital: 0 to 24V	20mA maximum
	9	0V	0 Volt Common, internally connected to terminal 7	
	10	Relay Common		
	11	Relay NO Contact	Contact 250Vac, 6A / 30Vdc, 5A	

4.8.1. Analog Output

The analog output function may be configured using parameter P-25, which is described in section 6.2. Extended Parameters on page 22.

The output has two operating modes, dependent on the parameter selection:

- Analog Mode
  - o The output is a 0 – 10 volt DC signal, 20mA max load current.
- Digital Mode
  - o The output is 24 volt DC, 20mA max load current.

4.8.2. Relay Output

The relay output function may be configured using parameter P-18, which is described in section 6.2. Extended Parameters on page 22.

4.8.3. Analog Inputs

Two analog inputs are available, which may also be used as Digital Inputs if required. The signal formats are selected by parameters as follows:

- Analog Input 1 Format Selection Parameter P-16.
- Analog Input 2 Format Selection Parameter P-47.

These parameters are described more fully in section 6.2. Extended Parameters on page 22.

The function of the analog input, e.g. for speed reference or PID feedback for example is defined by parameters P-15. The function of these parameters and available options is described in section 7. Analog and Digital Input Macro Configurations on page 28.

4.8.4. Digital Inputs

Up to four digital inputs are available. The function of the inputs is defined by parameters P-12 and P-15, which are explained in section 7. Analog and Digital Input Macro Configurations on page 28.

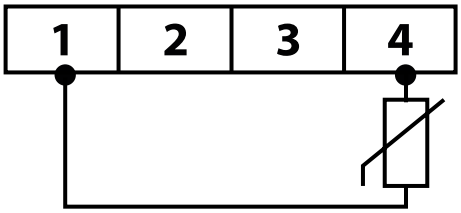
4.9. Motor Thermal Overload Protection

4.9.1. Internal Thermal Overload Protection

The drive has an in-built motor thermal overload function; this is in the form of an "I.t-trP" trip after delivering >100% of the value set in P-08 for a sustained period of time (e.g. 150% for 60 seconds).

4.9.2. Motor Thermistor Connection

Where a motor thermistor is to be used, it should be connected as follows:

Control Terminal Strip	Additional Information
	Compatible Thermistor: PTC Type, 2.5kΩ trip level. ▪ Use a setting of P-15 that has Input 3 function as External Trip, e.g. P-15 = 3. Refer to section 7. Analog and Digital Input Macro Configurations on page 28 for further details. ▪ Set P-47 = "PtC-tH"

4.10. EMC Compliant Installation

Category	Supply Cable Type	Motor Cable Type	Control Cables	Maximum Permissible Motor Cable Length
C1[6]	Shielded[1]	Shielded[1,5]	Shielded[4]	1M / 5M[7]
C2	Shielded[2]	Shielded[1, 5]		5M / 25M[7]
C3	Unshielded[3]	Shielded[2]		25M / 100M[7]

[1] A screened (shielded) cable suitable for fixed installation with the relevant mains voltage in use. Braided or twisted type screened cable where the screen covers at least 85% of the cable surface area, designed with low impedance to HF signals. Installation of a standard cable within a suitable steel or copper tube is also acceptable.

[2] A cable suitable for fixed installation with relevant mains voltage with a concentric protection wire. Installation of a standard cable within a suitable steel or copper tube is also acceptable.

[3] A cable suitable for fixed installation with relevant mains voltage. A shielded type cable is not necessary.

[4] A shielded cable with low impedance shield. Twisted pair cable is recommended for analog signals.

[5] The cable screen should be terminated at the motor end using an EMC type gland allowing connection to the motor body through the largest possible surface area. Where drives are mounted in a steel control panel enclosure, the cable screen may be terminated directly to the control panel using a suitable EMC clamp or gland, as close to the drive as possible. For IP66 drives, connect the motor cable screen to the internal ground clamp.

[6] Compliance with category C1 conducted emissions only is achieved. For compliance with category C1 radiated emissions, additional measures may be required, contact your Sales Partner for further assistance.

[7] Permissible cable length with additional external EMC filter.

4.11. Optional Brake Resistor

Optidrive E3 Frame Size 2 and above units have a built in Brake Transistor. This allows an external resistor to be connected to the drive to provide improved braking torque in applications that require this.

The brake resistor should be connected to the "+" and "BR" terminals as shown.

The voltage level at these terminals may exceed 400VDC.

Stored charge may be present after disconnecting the mains power.

Allow a minimum of 10 minutes discharge after power off before attempting any connection to these terminals.

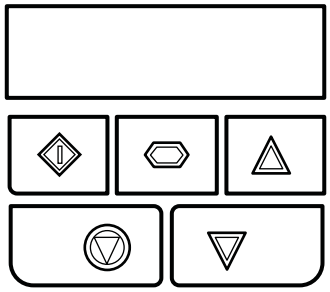
Suitable resistors and guidance on selection can be obtained from your Invertek Sales Partner.

5. Operation

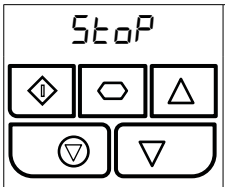
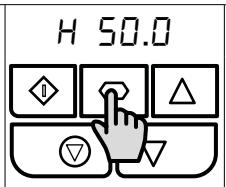
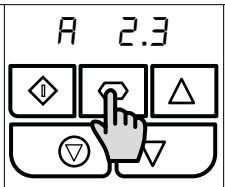
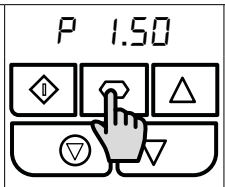
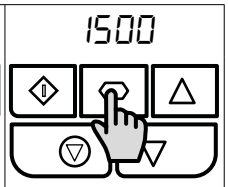
5.1. Managing the Keypad

The drive is configured and its operation monitored via the keypad and display.

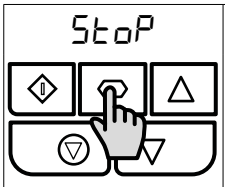
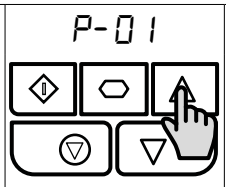
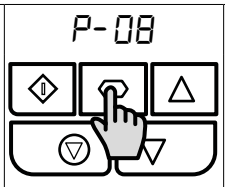
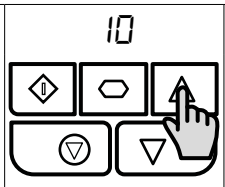
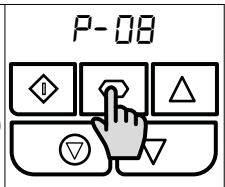
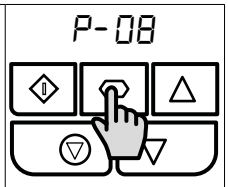
	NAVIGATE	Used to display real-time information, to access and exit parameter edit mode and to store parameter changes.
	UP	Used to increase speed in real-time mode or to increase parameter values in parameter edit mode.
	DOWN	Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode.
	RESET / STOP	Used to reset a tripped drive. When in Keypad mode is used to Stop a running drive.
	START	When in keypad mode, used to Start a stopped drive or to reverse the direction of rotation if bi-directional keypad mode is enabled.



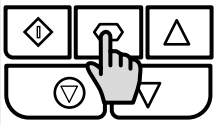
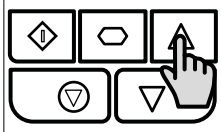
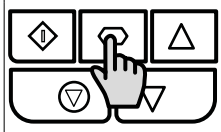
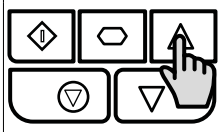
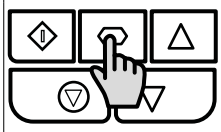
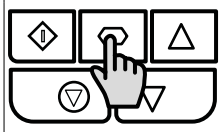
5.2. Operating Displays

				
Drive Stopped / Disabled	Drive is enabled / running, display shows the output frequency (Hz)	Press the Navigate key for < 1 second. The display will show the motor current (Amps)	Press the Navigate key for < 1 second. The display will show the motor power (kW)	If P-10 > 0, pressing the Navigate key for < 1 second will display the motor speed (RPM)

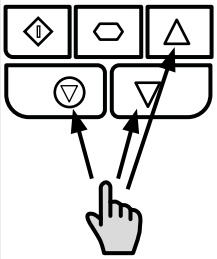
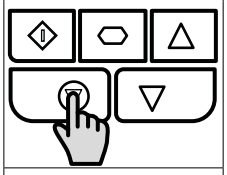
5.3. Changing Parameters

					
Press and hold the Navigate key > 2 seconds	Use the up and down keys to select the required parameter	Press the Navigate key for < 1 second	Adjust the value using the Up and Down keys	Press for < 1 second to return to the parameter menu	Press for > 2 seconds to return to the operating display

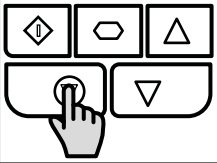
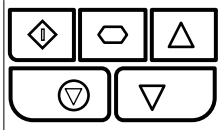
5.4. Read Only Parameter Access

StoP	P-00	P00-01	P00-08	330	StoP
					
Press and hold the Navigate key > 2 seconds	Use the up and down keys to select P-00	Press the Navigate key for < 1 second	Use the up and down keys to select the required Read Only parameter	Press the Navigate key for < 1 second to display the value	Press and hold the Navigate key > 2 seconds to return to the operating display

5.5. Resetting Parameters

P-dEF	StoP
	
To reset parameter values to their factory default settings, press and hold Up, Down and Stop buttons for > 2 seconds. The display will show "P-dEF"	Press the Stop key. The display will show "StoP"

5.6. Resetting a Fault

0-1	StoP
	
Press the Stop key. The display will show "StoP"	

6. Parameters

6.1. Standard Parameters

Par.	Description	Minimum	Maximum	Default	Units
P-01	**Maximum Frequency / Speed Limit**	**P-02**	**500.0**	**50.0 (60.0)**	**Hz / RPM**
	Maximum output frequency or motor speed limit – Hz or RPM. If P-10 >0, the value entered / displayed is in RPM.				
P-02	**Minimum Frequency / Speed Limit**	**0.0**	**P-01**	**35.0**	**Hz / RPM**
	Minimum speed limit – Hz or RPM. If P-10 >0, the value entered / displayed is in RPM.				
P-03	**Acceleration Ramp Time**	**0.00**	**600.0**	**5.0**	**s**
	Acceleration ramp time from zero Hz / RPM to base frequency (P-09) in seconds.				
P-04	**Deceleration Ramp Time**	**0.00**	**600.0**	**5.0**	**s**
	Deceleration ramp time from base frequency (P-09) to standstill in seconds. When set to 0.00, the value of P-24 is used.				
P-05	**Stopping Mode / Mains Loss Response**	**0**	**3**	**0**	**-**
	Selects the stopping mode of the drive, and the behaviour in response to a loss of mains power supply during operation.				

Setting	On Disable	On Mains Loss
0	Ramp to Stop (P-04)	Ride Through (Recover energy from load to maintain operation)
1	Coast	Coast
2	Ramp to Stop (P-04)	Fast Ramp to Stop (P-24), Coast if P-24 = 0

P-06	**Reserved**	**-**	**-**	**-**	**-**
P-07	**Motor Rated Voltage**	**0**	**150 / 250**	**115 / 230**	**V**
	This parameter should be set to the rated (nameplate) voltage of the motor (Volts).				
P-08	**Motor Rated Current**	**Drive Rating Dependent**			**A**
	This parameter should be set to the rated (nameplate) current of the motor.				
P-09	**Motor Rated Frequency**	**25**	**120**	**50 (60)**	**Hz**
	This parameter should be set to the rated (nameplate) frequency of the motor.				
P-10	**Motor Rated Speed**	**0**	**7200**	**0**	**RPM**
	This parameter can optionally be set to the rated (nameplate) RPM of the motor. When set to the default value of zero, all speed related parameters are displayed in Hz and the slip compensation (where motor speed is maintained at a constant value regardless of applied load) for the motor is disabled. Entering the value from the motor nameplate allows the Optidrive to display motor speed in RPM. All speed related parameters, such as Minimum and Maximum Speed, Preset Speeds etc. will also be displayed in RPM. **NOTE** If P-09 value is changed, P-10 value is reset to 0.				
P-11	**Start Boost Voltage**	**0.0**	**100.0**	**3.0**	**%**
	This parameter sets the initial voltage applied to the motor following a start command. The inverter applied the voltage set in this parameter at the frequency set in P-32 initially, and then ramps to the motor rated voltage set in P-09 over the time period set in P-33. Excessive voltage boost levels may result in increased motor current and temperature, and can result in the drive tripping during starting. An explanation of the motor starting, and procedure for optimising the boost voltage is described in section 6.4. Single Phase Motor - Boost Starting cycle.				
P-12	**Primary Command Source**	**0**	**9**	**0**	**-**
	0: Terminal Control. The drive responds directly to signals applied to the control terminals. **1: Uni-directional Keypad Control.** The drive can be controlled in the forward direction only using the internal keypad, or an external remote Keypad. **2: Bi-directional Keypad Control.** The drive can be controlled in the forward and reverse directions u using the internal keypad, or an external remote Keypad. Pressing the keypad START button toggles between forward and reverse. **3: Modbus Network Control.** Control via Modbus RTU (RS485) using the internal Accel / Decel ramps. **4: Modbus Network Control.** Control via Modbus RTU (RS485) interface with Accel / Decel ramps updated via Modbus. **5: PI Control.** User PI control with external feedback signal. **6: PI Analog Summation Control.** PI control with external feedback signal and summation with analog input 1. **7: CAN Control.** Control via CAN (RS485) using the internal Accel / Decel ramps. **8: CAN Control.** Control via CAN (RS485) interface with Accel / Decel ramps updated via CAN. **9: Slave Mode.** Control via a connected Invertek drive in Master Mode. Slave drive address must be > 1. **NOTE** When P-12 = 1, 2, 3, 4, 7, 8 or 9, an enable signal must still be provided at the control terminals, digital input 1.				

Par.	Description	Minimum	Maximum	Default	Units
P-13	**Reserved**	-	-	-	-
P-14	**Extended Menu Access code**	0	65535	0	-
	Enables access to Extended and Advanced Parameter Groups. This parameter must be set to the value programmed in P-37 (default: 101) to view and adjust Extended Parameters and value of P-37 + 100 to view and adjust Advanced Parameters. The code may be changed by the user in P-37 if desired.				

6.2. Extended Parameters

Par.	Description	Minimum	Maximum	Default	Units
P-15	**Digital Input Function Select**	0	17	0	-
	Defines the function of the digital inputs depending on the control mode setting in P-12. See section 7. Analog and Digital Input Macro Configurations for more information.				
P-16	**Analog Input 1 Signal Format**	**See Below**		U0-10	-
	U 0-10 = Uni-polar 0 to 10 Volt Signal. The drive will remain at minimum speed (P-02) if the analog reference after scaling and offset are applied is =<0.0%. 100% signal means the output frequency / speed will be the value set in P-01. A 0-20 = 0 to 20mA Signal. t 4-20 = 4 to 20mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA. r 4-20 = 4 to 20mA Signal, the Optidrive will run at Preset Speed 1 (P-20 if the signal level falls below 3mA. t 20-4 = 20 to 4mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA. r 20-4 = 20 to 4mA Signal, the Optidrive will run at Preset Speed 1 (P-20 if the signal level falls below 3mA. U 10-0 = 10 to 0 Volt Signal (Uni-polar). The drive will operate at Maximum Frequency / Speed if the analog reference after scaling and offset are applied is =<0.0%.				
P-17	**Maximum Effective Switching Frequency**	4	32	8	kHz
	Sets maximum effective switching frequency of the drive. If "rEd" is displayed when the parameter is viewed, the switching frequency has been reduced to the level in P00-32 due to excessive drive heatsink temperature.				
P-18	**Output Relay Function Select**	0	9	1	-
	Selects the function assigned to the relay output. The relay has two output terminals, Logic 1 indicates the relay is active, and therefore terminals 10 and 11 will be connected. **0: Drive Enabled (Running).** Logic 1 when the motor is enabled. **1: Drive Healthy.** Logic 1 when power is applied to the drive and no fault exists. **2: At Target Frequency (Speed).** Logic 1 when the output frequency matches the setpoint frequency. **3: Drive Tripped.** Logic 1 when the drive is in a fault condition. **4: Output Frequency >= Limit.** Logic 1 when the output frequency exceeds the adjustable limit set in P-19. **5: Output Current >= Limit.** Logic 1 when the motor current exceeds the adjustable limit set in P-19. **6: Output Frequency < Limit.** Logic 1 when the output frequency is below the adjustable limit set in P-19. **7: Output Current < Limit.** Logic 1 when the motor current is below the adjustable limit set in P-19. **8: Analog Input 2 > Limit.** Logic 1 when the signal applied to analog input 2 exceeds the adjustable limit set in P-19. **9: Drive Ready to Run.** Logic 1 when the drive is ready to run, no trip present.				
P-19	**Relay Threshold Level**	0.0	200.0	100.0	%
	Adjustable threshold level used in conjunction with settings 4 to 8 of P-18.				
P-20	**Preset Frequency / Speed 1**	0.00	P-01	5.0	Hz / RPM
P-21	**Preset Frequency / Speed 2**	0.00	P-01	25.0	Hz / RPM
P-22	**Preset Frequency / Speed 3**	0.00	P-01	40.0	Hz / RPM
P-23	**Preset Frequency / Speed 4**	0.00	P-01	P-09	Hz / RPM
	Preset Speeds / Frequencies selected by digital inputs depending on the setting of P-15. If P-10 = 0, the values are entered as Hz. If P-10 > 0, the values are entered as RPM. **NOTE** Changing the value of P-09 will reset all values to factory default settings.				
P-24	**2nd Ramp Time (Fast Stop)**	0.00	600.0	0.00	s
	This parameter allows a 2nd ramp time to be programmed into the drive. This ramp time is automatically selected in the case of a mains power loss if P-05 = 2 or 3. When set to 0.00, the drive will coast to stop. When using a setting of P-15 that provides a "Fast Stop" function, this ramp time is also used.				

Par.	Description	Minimum	Maximum	Default	Units
P-25	**Analog Output Function Select**	**0**	**10**	**8**	**-**
	Digital Output Mode. Logic 1 = +24V DC **0: Drive Enabled (Running).** Logic 1 when the Optidrive is enabled (Running). **1: Drive Healthy.** Logic 1 When no Fault condition exists on the drive. **2: At Target Frequency (Speed).** Logic 1 when the output frequency matches the setpoint frequency. **3: Drive Tripped.** Logic 1 when the drive is in a fault condition. **4: Output Frequency >= Limit.** Logic 1 when the output frequency exceeds the adjustable limit set in P-19. **5: Output Current >= Limit.** Logic 1 when the motor current exceeds the adjustable limit set in P-19. **6: Output Frequency < Limit.** Logic 1 when the output frequency is below the adjustable limit set in P-19. **7: Output Current < Limit.** Logic 1 when the motor current is below the adjustable limit set in P-19. **Analog Output Mode** **8: Output Frequency (Motor Speed).** 0 to P-01, resolution 0.1Hz. **9: Output (Motor) Current.** 0 to 200% of P-08, resolution 0.1A. **10: Output Power.** 0 – 200% of drive rated power. **11: Load Current.** 0 – 200% of P-08, resolution 0.1A.				
P-26	**Skip frequency hysteresis band**	**0.0**	**P-01**	**0.0**	**Hz / RPM**
P-27	**Skip Frequency Centre Point**	**0.0**	**P-01**	**0.0**	**Hz / RPM**
	The Skip Frequency function is used to avoid the Optidrive operating at a certain output frequency, for example at a frequency which causes mechanical resonance in a particular machine. Parameter P-27 defines the centre point of the skip frequency band, and is used in conjunction with P-26. The Optidrive output frequency will ramp through the defined band at the rates set in P-03 and P-04 respectively, and will not hold any output frequency within the defined band. If the frequency reference applied to the drive is within the band, the Optidrive output frequency will remain at the upper or lower limit of the band.				
P-28	**V/F Characteristic Adjustment Voltage**	**0**	**P-07**	**0**	**V**
P-29	**V/F Characteristic Adjustment Voltage**	**0.0**	**P-09**	**0.0**	**Hz**
	This parameter in conjunction with P-28 sets a frequency point at which the voltage set in P-29 is applied to the motor. Care must be taken to avoid overheating and damaging the motor when using this feature.				
P-30	**Start Mode, Automatic Restart, Fire Mode Operation**				
	Index 1: Start Mode & Automatic Restart	**N/A**	**N/A**	**Edge-r**	**-**
	Selects whether the drive should start automatically if the enable input is present and latched during power on. Also configures the Automatic Restart function. *EdGE-r*: Following Power on or reset, the drive will not start if Digital Input 1 remains closed. The Input must be closed after a power on or reset to start the drive. *AUto-0*: Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed. *AUto-1* To *AUto-5*: Following a trip, the drive will make up to 5 attempts to restart at 20 second intervals. The numbers of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip with a fault, and will require the user to manually reset the fault. The drive must be powered down to reset the counter.				
	Index 2: Fire Mode Input Logic	**0**	**1**	**0**	**-**
	Defines the operating logic when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17. **0: Normally Closed (NC) Input.** Fire Mode active if input is open. **1: Normally Open (NO) Input.** Fire Mode active if input is closed.				
	Index 3: Fire Mode Input Type	**0**	**1**	**0**	**-**
	Defines the input type when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17. **0: Maintained Input.** The drive will remain in Fire Mode, only as long the fire mode input signal remains (Normally Open or Normally Closed operation is supported depending on Index 2 setting). **1: Momentary Input.** Fire Mode is activated by a momentary signal on the input. Normally Open or Normally Closed operation is supported depending on Index 2 setting. The drive will remain in Fire Mode until disabled or powered off.				

Par.	Description	Minimum	Maximum	Default	Units
P-31	**Keypad Start Mode Select**	**0**	**7**	**1**	**-**
	This parameter is active only when operating in Keypad Control Mode (P-12 = 1 or 2) or Modbus Mode (P-12 = 3 or 4). When settings 0, 1, 4 or 5 are used, the Keypad Start and Stop keys are active, and control terminals 1 and 2 must be linked together. Settings 2, 3, 6 and 7 allow the drive to be started from the control terminals directly, and the keypad Start and Stop keys are ignored. **0: Minimum Speed, Keypad Start** **1: Previous Speed, Keypad Start** **2: Minimum Speed, Terminal Enable** **3: Previous Speed, Terminal Enable** **4: Current Speed, Keypad Start** **5: Preset Speed 4, Keypad Start** **6: Current Speed, Terminal Start** **7: Preset Speed 4, Terminal Start**				
P-32	**Starting Boost Frequency**	**0.0**	**P-09**	**P-09**	**Hz**
	Sets the frequency used during the starting boost phase of operation refer to section 6.4 for further information.				
P-33	**Boost Period Duration**	**0.0**	**150**	**5.0**	**s**
	Time for which the start-up boost period is applied. During this period, the output frequency is set to P-32 and the voltage increases linearly from P-11 to P-07. Setting P-33 to zero disables boost. See section 6.4 for additional information.				
P-34	**Brake Chopper Enable (Not Size 1)**	**0**	**4**	**0**	**-**
	0: Disabled **1: Enabled With Software Protection.** Enables the internal brake chopper with software protection for a 200W, 100R resistor. **2: Enabled Without Software Protection.** Enables the internal brake chopper without software protection. An external thermal protection device should be fitted. **3: Enabled With Software Protection.** As setting 1, however the Brake Chopper is only enabled during a change of the frequency setpoint, and is disabled during constant speed operation. **4: Enabled Without Software Protection.** As setting 2, however the Brake Chopper is only enabled during a change of the frequency setpoint, and is disabled during constant speed operation.				
P-35	**Analog Input 1 Scaling / Slave Speed Scaling**	**0.0**	**2000.0**	**100.0**	**%**
	Analog Input 1 Scaling. The analog input signal level is multiplied by this factor, e.g. if P-16 is set for a 0 – 10V signal, and the scaling factor is set to 200.0%, a 5 volt input will result in the drive running at maximum frequency / speed (P-01). **Slave Speed Scaling.** When operating in Slave Mode (P-12 = 9), the operating speed of the drive will be the Master speed multiplied by this factor, limited by the minimum and maximum speeds.				
P-36	**Serial Communications Configuration**	**See Below**			
	Index 1: Address	**0**	**63**	**1**	**-**
	Index 2: Baud Rate	**9.6**	**9.6**	**115.2**	**kbps**
	Index 3: Communication loss protection	**0**	**3000**	**t 3000**	**ms**
	This parameter has three sub settings used to configure the Modbus RTU Serial Communications. The Sub Parameters are:				
	1st Index: Drive Address: Range: 0 – 63, default: 1.				
	2nd Index: Baud Rate & Network type: Selects the baud rate and network type for the internal RS485 communication port. For Modbus RTU: Baud rates 9.6, 19.2, 38.4, 57.6, 115.2 kbps are available. For CAN: Baud rates 125, 250, 500 & 1000 kbps are available.				
	3rd Index: Watchdog Timeout: Defines the time for which the drive will operate without receiving a valid command telegram to Register 1 (Drive Control Word) after the drive has been enabled. Setting 0 disables the Watchdog timer. Setting a value of 30, 100, 1000, or 3000 defines the time limit in milliseconds for operation. A '**t**' suffix selects trip on loss of communication. An '**r**' suffix means that the drive will coast stop (output immediately disabled) but will not trip.				
P-37	**Access Code Definition**	**0**	**9999**	**101**	**-**
	Defines the access code which must be entered in P-14 to access parameters above P-14.				
P-38	**Parameter Access Lock**	**0**	**1**	**0**	**-**
	0: Unlocked. All parameters can be accessed and changed. **1: Locked.** Parameter values can be displayed, but cannot be changed except P-38.				
P-39	**Analog Input 1 Offset**	**-500.0**	**500.0**	**0.0**	**%**
	Sets an offset, as a percentage of the full scale range of the input, which is applied to the analog input signal. This parameter operates in conjunction with P-35, and the resultant value can be displayed in P00-01. The resultant value is defined as a percentage, according to the following: P00-01 = (Applied Signal Level(%) - P-39) x P-35).				

Par.	Description	Minimum	Maximum	Default	Units
P-40	**Index 1: Display Scaling Factor**	**0.000**	**16.000**	**0.000**	**-**
	Index 2: Display Scaling Source	**0**	**3**	**0**	**-**
	Allows the user to program the Optidrive to display an alternative output unit scaled from either output frequency (Hz), Motor Speed (RPM) or the signal level of PI feedback when operating in PI Mode.				
	Index 1: Used to set the scaling multiplier. The chosen source value is multiplied by this factor.				
	Index 2: Defines the scaling source as follows: **0: Motor Speed.** Scaling is applied to the output frequency if P-10 = 0, or motor RPM if P-10 > 0. **1: Motor Current.** Scaling is applied to the motor current value (Amps). **2: Analog Input 2 Signal Level.** Scaling is applied to analog input 2 signal level, internally represented as 0 – 100.0%. **3: PI Feedback.** Scaling is applied to the PI feedback selected by P-46, internally represented as 0 – 100.0%.				
P-41	**PI Controller Proportional Gain**	**0.0**	**30.0**	**1.0**	**-**
	PI Controller Proportional Gain. Higher values provide a greater change in the drive output frequency in response to small changes in the feedback signal. Too high a value can cause instability.				
P-42	**PI Controller Integral Time**	**0.0**	**30.0**	**1.0**	**s**
	PI Controller Integral Time. Larger values provide a more damped response for systems where the overall process responds slowly.				
P-43	**PI Controller Operating Mode**	**0**	**1**	**0**	**-**
	0: Direct Operation. Use this mode if when the feedback signal drops, the motor speed should increase. **1: Inverse Operation.** Use this mode if when the feedback signal drops, the motor speed should decrease. **2: Direct Operation, Maximum Start.** As option 1, but with output preset to maximum after Wake from Standby. **3: Inverse Operation, Maximum Start.** As option 2, but with output preset to maximum after Wake from Standby.				
P-44	**PI Reference (Setpoint) Source Select**	**0**	**1**	**0**	**-**
	Selects the source for the PID Reference / Setpoint. **0: Digital Preset Setpoint.** P-45 is used. **1: Analog Input 1 Setpoint.** Analog input 1 signal level, readable in P00-01 is used for the setpoint.				
P-45	**PI Digital Setpoint**	**0.0**	**100.0**	**0.0**	**%**
	When P-44 = 0, this parameter sets the preset digital reference (setpoint) used for the PI Controller as a % of the feedback signal.				
P-46	**PI Feedback Source Select**	**0**	**5**	**0**	**-**
	Selects the source of the feedback signal to be used by the PI controller. **0: Analog Input 2** (Terminal 4) Signal level readable in P00-02. **1: Analog Input 1** (Terminal 6) Signal level readable in P00-01. **2: Motor Current** Scaled as % of P-08. **3: DC Bus Voltage** Scaled 0 – 1000 Volts = 0 – 100%. **4: Analog 1 – Analog 2** The value of Analog Input 2 is subtracted from Analog 1 to give a differential signal. The value is limited to 0. **5: Largest (Analog 1, Analog 2)** The larger of the two analog input values is always used for PI feedback.				
P-47	**Analog Input 2 Signal Format**	**-**	**-**	**-**	**U0-10**
	U 0-10 = 0 to 10 Volt Signal. A 0-20 = 0 to 20mA Signal. t 4-20 = 4 to 20mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA. r 4-20 = 4 to 20mA Signal, the Optidrive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA. t 20-4 = 20 to 4mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA. r 20-4 = 20 to 4mA Signal, the Optidrive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA. Ptc-th = Use for motor thermistor measurement, valid with any setting of P-15 that has Input 3 as E-Trip. Trip level: 1.5kΩ, reset 1kΩ.				
P-48	**Standby Mode Timer**	**0.0**	**25.0**	**0.0**	**s**
	When standby mode is enabled by setting P-48 > 0.0, the drive will enter standby following a period of operating at minimum speed (P-02) for the time set in P-48. When in Standby Mode, the drive display shows StndbY, and the output to the motor is disabled.				
P-49	**PI Control Wake Up Error Level**	**0.0**	**100.0**	**5.0**	**%**
	When the drive is operating in PI Control Mode (P-12 = 5 or 6), and Standby Mode is enabled (P-48 > 0.0), P-49 can be used to define the PI Error Level (E.g. difference between the setpoint and feedback) required before the drive restarts after entering Standby Mode. This allows the drive to ignore small feedback errors and remain in Standby mode until the feedback drops sufficiently.				

Par.	Description	Minimum	Maximum	Default	Units
P-50	**User Output Relay Hysteresis**	**0.0**	**100.0**	**0.0**	**%**
	Sets the hysteresis level for P-19 to prevent the output relay chattering when close to the threshold.				
P-60	**Thermal Overload Retention**	**0**	**1**	**0**	**-**
	0 : Disabled **1: Enabled.** When enabled, the drive calculated motor overload protection information is retained after the mains power is removed from the drive.				

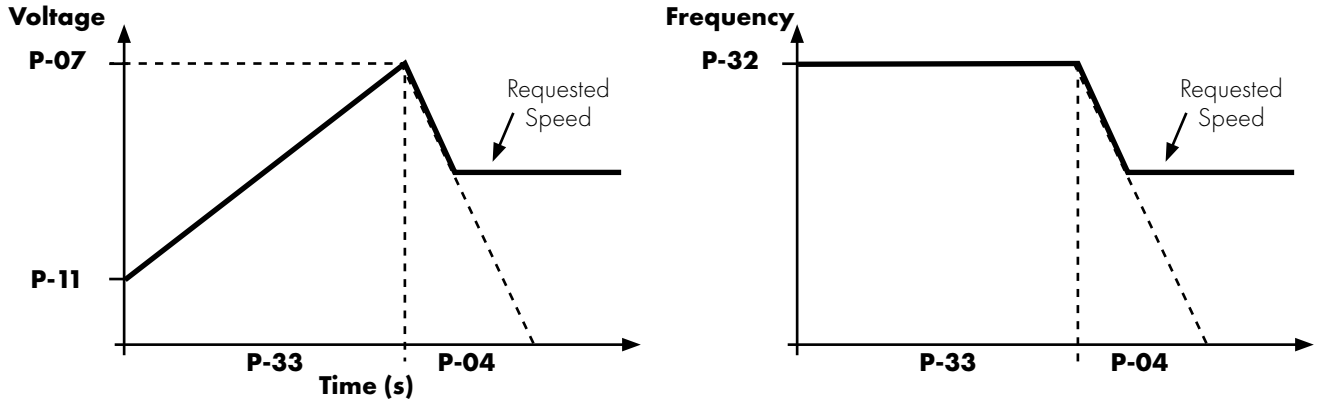
6.3. P-00 Read Only Status Parameters

Par.	Description	Explanation
P00-01	1st Analog input value (%)	100% = max input voltage
P00-02	2nd Analog input value (%)	100% = max input voltage
P00-03	Speed reference input (Hz / RPM)	Displayed in Hz if P-10 = 0, otherwise RPM
P00-04	Digital input status	Drive digital input status
P00-05	User PI output (%)	Displays value of the User PI output
P00-06	DC bus ripple (V)	Measured DC bus ripple
P00-07	Applied motor voltage (V)	Value of RMS voltage applied to motor
P00-08	DC bus voltage (V)	Internal DC bus voltage
P00-09	Heatsink temperature (°C)	Temperature of heatsink in °C
P00-10	Run time since date of manuf. (Hours)	Not affected by resetting factory default parameters
P00-11	Run time since last trip (1) (Hours)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred. Reset also on next enable after a drive power down
P00-12	Run time since last trip (2) (Hours)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred (under-volts not considered a trip) – not reset by power down / power up cycling unless a trip occurred prior to power down
P00-13	Trip Log	Displays most recent 4 trips with time stamp
P00-14	Run time since last disable (Hours)	Run-time clock stopped on drive disable, value reset on next enable
P00-15	DC bus voltage log (V)	8 most recent values prior to trip, 256ms sample time
P00-16	Heatsink temperature log (°C)	8 most recent values prior to trip, 30s sample time
P00-17	Motor current log (A)	8 most recent values prior to trip, 256ms sample time
P00-18	DC bus ripple log (V)	8 most recent values prior to trip, 22ms sample time
P00-19	Internal drive temperature log (°C)	8 most recent values prior to trip, 30 s sample time
P00-20	Internal drive temperature (°C)	Actual internal ambient temperature in °C
P00-21	CAN process data input	Incoming process data (RX PDO1) for CAN: PI1, PI2, PI3, PI4
P00-22	CAN process data output	Outgoing process data (TX PDO1) for CAN: PO1, PO2, PO3, PO4
P00-23	Accumulated time with heatsink > 85°C (Hours)	Total accumulated hours and minutes of operation above heatsink temp of 85°C
P00-24	Accumulated time with drive internal temp > 80°C (Hours)	Total accumulated hours and minutes of operation with drive internal ambient above 80°C
P00-25	Estimated rotor speed (Hz)	In vector control modes, estimated rotor speed in Hz
P00-26	kWh meter / MWh meter	Total number of kWh / MWh consumed by the drive
P00-27	Total run time of drive fans (Hours)	Time displayed in hh:mm:ss. First value displays time in hrs, press up to display mm:ss
P00-28	Software version and checksum	Version number and checksum. "1" on LH side indicates I/O processor, "2" indicates power stage
P00-29	Drive type identifier	Drive rating, drive type and software version codes
P00-30	Drive serial number	Unique drive serial number
P00-31	Motor current Id / Iq	Displays the magnetising current (Id) and torque current (Iq). Press UP to show Iq
P00-32	Actual PWM switching frequency (kHz)	Actual switching frequency used by drive
P00-33	Critical fault counter – O-I	These parameters log the number of times specific faults or errors occur, and are useful for diagnostic purposes
P00-34	Critical fault counter – O-Volts	
P00-35	Critical fault counter – U-Volts	
P00-36	Critical fault counter – O-temp (h/sink)	
P00-37	Critical fault counter – b O-I (chopper)	
P00-38	Critical fault counter – O-hEAt (control)	
P00-39	Modbus comms error counter	
P00-40	CANbus comms error counter	
P00-41	I/O processor comms errors	
P00-42	Power stage uC comms errors	

Par.	Description	Explanation
P00-43	Drive power up time (life time) (Hours)	Total lifetime of drive with power applied
P00-44	Phase U current offset & ref	Internal value
P00-45	Phase V current offset & ref	Internal value
P00-46	Phase W current offset & ref	Internal value
P00-47	Index 1: Fire mode total active time Index 2: Fire Mode Activation Count	Total activation time of Fire Mode Displays the number of times Fire Mode has been activated
P00-48	Scope channel 1 & 2	Displays signals for first scope channels 1 & 2
P00-49	Scope channel 3 & 4	Displays signals for first scope channels 3 & 4
P00-50	Bootloader and motor control	Internal value

6.4. Single Phase Motor - Boost Starting cycle

In order to provide a reliable method for starting the motor, a special technique is used. The motor is started immediately at rated frequency, whilst the voltage is ramped from an initial Boost Voltage (set in P-11) to the Motor Rated Voltage (set in P-07) over a Boost Period Duration (set in P-33). Following the starting boost period, the drive then begins to control the output frequency and speed of the motor. The graphs below show how this operation works.



In order to achieve reliable starting and optimise the starting method, the following procedure can be used.

1. The motor must be correctly connected to the drive and safe to operate before using this procedure.

2. Ensure the motor rated voltage (P-07) and current (P-08) have been correctly programmed in the drive parameters.

3. Select Extended Parameter Access by setting P-14 = 101.

4. Set the Boost Period Duration P-33 to the maximum allowed value of 150 seconds.

5. Start the drive, and display the motor current (press the Navigate button until the display shows "A x.x" where x is the motor current).

6. Check the current value compared to the motor rated current around 3 – 5 seconds after starting the drive.

a. If the current displayed is less than 80% of the motor rated current:

- o Stop the drive
- o Increase P-11
- o Repeat from step 5.

b. If the current displayed is greater than 90% of the motor rated current:

- o Stop the drive
- o Reduce P-11
- o Repeat from step 5.

7. The correct boost voltage setting should deliver 80 – 90% of the motor rated current approximately 3 – 5 seconds after enabling the drive.

8. Now the Boost Period Duration may be reduced to match the actual time required for the motor to start. The simplest method is to initially reduce in large steps and monitor the motor behaviour on starting the drive. The ideal boost period will be a few seconds longer than is required to bring the motor to full speed.

By following this procedure, the motor starting parameter can be optimised to start the motor reliably without excessive starting current.

7. Analog and Digital Input Macro Configurations

7.1. Overview

Optidrive E3 uses a Macro approach to simplify the configuration of the Analog and Digital Inputs. There are two key parameters which determine the input functions and drive behaviour:

P-12 Selects the main drive control source and determines how the output frequency of the drive is primarily controlled.

P-15 Assigns the Macro function to the analog and digital inputs.

Additional parameters can then be used to further adapt the settings, e.g.

P-16 Used to select the format of the analog signal to be connected to analog input 1, e.g. 0 – 10 Volt, 4 – 20mA.

P-20 – P-23 Preset speed parameters, which may be selected by the digital inputs

P-30 Determines whether the drive should automatically start following a power on if the Enable Input is present.

P-31 When Keypad Mode is selected, determines at what output frequency / speed the drive should start following the enable command, and also whether the keypad start key must be pressed or if the Enable input alone should start the drive.

P-47 Used to select the format of the analog signal to be connected to analog input 2, e.g. 0 – 10 Volt, 4 – 20mA.

The diagrams below provide an overview of the functions of each terminal macro function, and a simplified connection diagram for each.

7.2. Macro Functions Guide Key

The table below should be used as a key for pages 32 to 34.

STOP / RUN	Latched input, Close to Run, Open to Stop.
START ⤒	Normally Open, Rising Edge Start Function.
AI1 REF	Analog Input 1 is the selected speed reference.
P-xx REF	Speed setpoint from the selected preset speed.
PR-REF	Preset speeds P-20 – P-23 are used for the speed reference, selected according to other digital input status.
^-FAST STOP (P-24)-^	When both inputs are active simultaneously, the drive stops using Fast Stop Ramp Time P-24.
E-TRIP ⤓	External Trip input, which must be Normally Closed. When the input opens, the drive trips showing E-tr iP or Ptc-th depending on P-47 setting.
(NO)	Normally Open Contact, Momentarily Close to Start.
(NC)	Normally Closed Contact, momentary Open to Stop.
Fire Mode	Activates Fire Mode, see section 7.7. Fire Mode.
ENABLE	Hardware Enable Input. In Keypad Mode, P-31 determines whether the drive immediately starts, or the keypad start key must be pressed. In other modes, this input must be present before the start signal via the fieldbus interface.
INC SPD ⤒	Normally Open, Close the input to Increase the motor speed.
DEC SPD ⤒	Normally Open, Close input to Decrease motor speed.
KPD REF	Keypad Speed Reference selected.
FB REF	Selected speed reference from Fieldbus (Modbus RTU / CAN / Master depending on P-12 setting).

7.3. Macro Functions – Terminal Mode (P-12 = 0)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	RUN	No Function		AI1 REF	P-20 REF	Analog Input AI1		1
1	STOP	RUN	AI1 REF	PR-REF	P-20	P-21	Analog Input AI1		2
2	STOP	RUN	**DI2**	**DI3**	**PR**		P-20 - P-23	P-01	3
			0	0	P-20				
			1	0	P-21				
			0	1	P-22				
			1	1	P-23				
3	STOP	RUN	AI1	P-20 REF	E-TRIP ↴	OK	Analog Input AI1		4
4	STOP	RUN	AI1	AI2	Analog Input AI2		Analog Input AI1		5
5	STOP	RUN	OK	FAST STOP (P-24) ↥	AI1	P-20 REF	Analog Input AI1		6
6	STOP	RUN	No Function		E-TRIP ↴	OK	Analog Input AI1		7
7	STOP	RUN	OK	FAST STOP (P-24) ↥	E-TRIP ↴	OK	Analog Input AI1		8
8	STOP	RUN	No Function		**DI3**	**DI4**	**PR**		9
					0	0	P-20		
					1	0	P-21		
					0	1	P-22		
					1	1	P-23		
9	STOP	RUN	OK	FAST STOP (P-24) ↥	**DI3**	**DI4**	**PR**		10
					0	0	P-20		
					1	0	P-21		
					0	1	P-22		
					1	1	P-23		
10	(NO)	START ↥	STOP ↴	(NC)	AI1 REF	P-20 REF	Analog Input AI1		11
11	(NO)	START ↥	STOP ↴	(NC)	(NO)	FAST STOP (P-24) ↥	Analog Input AI1		12
12	STOP	RUN	FAST STOP (P-24)	OK	AI1 REF	P-20 REF	Analog Input AI1		13
13	(NO)	START ↥	STOP ↴	(NC)	(NO)	FAST STOP (P-24) ↥	KPD REF	P-20 REF	12
14	STOP	RUN	DI2		E-TRIP ↴	OK	**DI2**	**DI4**	**PR**
							0	0	P-20
							1	0	P-21
							0	1	P-22
							1	1	P-23
15	STOP	RUN	P-23 REF	AI1 REF	Fire Mode		Analog Input AI1		2
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		DI4 = No Function	DI4 = No Function	3
17	STOP	RUN	DI2		Fire Mode		**DI2**	**DI4**	**PR**
							0	0	P-20
							1	0	P-21
							0	1	P-22
							1	1	P-23
18	STOP	RUN	AI1 REF	P-20 REF	Fire Mode		Analog Input AI1		2

7.4. Macro Functions - Keypad Mode (P-12 = 1 or 2)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	-	INC SPD ↑	-	DEC SPD ↑	No Function		15
1	STOP	ENABLE	PI Speed Reference						5
2	STOP	ENABLE	-	INC SPD ↑	-	DEC SPD ↑	KPD REF	P-20 REF	15
3	STOP	ENABLE	-	INC SPD ↑	E-TRIP ↓	OK	-	DEC SPD	
4	STOP	ENABLE	-	INC SPD ↑	KPD REF	AI1 REF	Analog Input AI1		6
5	STOP	ENABLE	No Function		KPD REF	AI1 REF	Analog Input AI1		1
6	STOP	ENABLE	No Function		E-TRIP ↓	OK	KPD REF	P-20 REF	4
7	STOP	ENABLE	OK	FAST STOP (P-24)	E-TRIP	OK	KPD REF	P-20 REF	4
8	STOP	ENABLE	OK	FAST STOP (P-24)	KPD REF	AI1 REF	Analog Input AI1		2
14	STOP	ENABLE	No Function		E-TRIP ↓	OK	No Function		4
15	STOP	ENABLE	PR REF	KPD REF	Fire Mode		P-23	P-21	3
16	STOP	ENABLE	P-23 REF	KPD REF	Fire Mode		No Function		3
17	STOP	ENABLE	KPD REF	P-23 REF	Fire Mode		No Function		3
18	STOP	ENABLE	AI1 REF	KPD REF	Fire Mode		Analog Input AI1		2
NOTE	**8, 9, 10, 11, 12, 13 = 0** When P-12 = 1 or 2, Refer to P-31 for starting control								

7.5. Macro Functions - Fieldbus Control Mode (P-12 = 3, 4, 7, 8 or 9)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	FB REF (Fieldbus Speed Reference, Modbus RTU / CAN / Master-Slave defined by P-12)						1
1	STOP	ENABLE	PI Speed Reference						5
3	STOP	ENABLE	FB REF	P-20 REF	E-TRIP ↓	OK	Analog Input AI1		4
5	STOP	ENABLE	FB REF	PR REF	P-20	P-21	Analog Input AI1		2
6	STOP	ENABLE	FB REF	AI1 REF	E-TRIP ↓	OK	Analog Input AI1		4
7	STOP	ENABLE	FB REF	KPD REF	E-TRIP ↓	OK	Analog Input AI1		4
14	STOP	ENABLE	No Function		E-TRIP ↓	OK	Analog Input AI1		4
15	STOP	ENABLE	PR REF	FB REF	Fire Mode		P-23	P-21	3
16	STOP	ENABLE	P-23 REF	FB REF	Fire Mode		Analog Input AI1		2
17	STOP	ENABLE	FB REF	P-23 REF	Fire Mode		Analog Input AI1		2
18	STOP	ENABLE	AI1 REF	FB REF	Fire Mode		Analog Input AI1		2
NOTE	**2, 4, 8, 9, 10, 11, 12, 13 = 0** When P-12 = 3 or 4, and P-15 = 5, 6, or 7, when DI 2 is on, DI1 will start and stop the drive. When P-12 = 3 or 4 and P-31 = 2, 3, 6 or 7, The drive will start / stop based on DI1 only and communication loss is disabled.								

7.6. Macro Functions - User PI Control Mode (P-12 = 5 or 6)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	RUN	PI REF	P-20 REF	AI2		AI1		5
1	STOP	RUN	PI REF	AI1 REF	Analog Input AI2 (PI Feedback)		AI1		5
3, 7	STOP	RUN	PI REF	P-20	E-TRIP	OK	AI1 (PI FB)		4
4	(NO)	START ⮥	(NC)	STOP	AI2 (PI FB)		Analog Input AI1		
5	(NO)	START ⮥	(NC)	STOP	PI REF	P-20 REF	AI1 (PI FB)		11
6	(NO)	START ⮥	(NC)	STOP	E-TRIP	OK	AI1 (PI FB)		
14	STOP	RUN	No Function		E-TRIP	OK	AI1 (PI FB)		1
15	STOP	RUN	P-23 REF	PI REF	Fire Mode		AI1 (PI FB)		2
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		AI1 (PI FB)		2
17	STOP	RUN	P-21 REF	P-23 REF	Fire Mode		AI1 (PI FB)		2
18	STOP	RUN	AI1 REF	PI REF	Fire Mode		Analog Input AI1		2
NOTE	**2, 8, 9, 10, 11, 12, 13 = 0**								

7.7. Fire Mode

The Fire Mode function is designed to ensure continuous operation of the drive in emergency conditions until the drive is no longer capable of sustaining operation. The Fire Mode input may be a normally open (Close to Activate Fire Mode) or Normally Closed (Open to Activate Fire Mode) according to the setting of P-30 Index 2. In addition, the input may be momentary or maintained type, selected by P-30 Index 3.

This input may be linked to a fire control system to allow maintained operation in emergency conditions, e.g. to clear smoke or maintain air quality within that building.

The fire mode function is enabled when P-15 = 15, 16 or 17, with Digital Input 3 assigned to activate fire mode.

Fire Mode disables the following protection features in the drive:

O-t (Heat-sink Over-Temperature), U-t (Drive Under Temperature), Th-FLt (Faulty Thermistor on Heat-sink), E-trip (External Trip), 4-20 F (4-20mA fault), Ph-Ib (Phase Imbalance), P-Loss (Input Phase Loss Trip), SC-trp (Communications Loss Trip), I.t-trp (Accumulated overload Trip).

The following faults will result in a drive trip, auto reset and restart:

O-Volt (Over Voltage on DC Bus), U-Volt (Under Voltage on DC Bus), h O-I (Fast Over-current Trip), O-I (Instantaneous over current on drive output), Out-F (Drive output fault, Output stage trip).

7.8. Example Connection Diagrams

Diagram 1

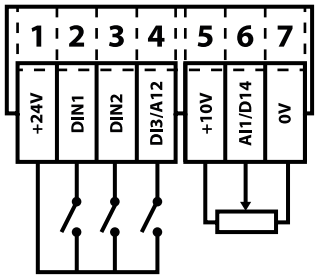
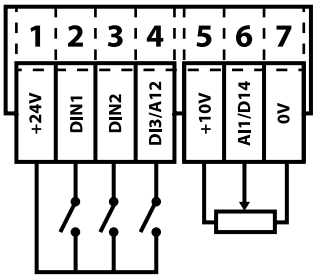


Diagram 2



P-16 =
0 – 10V
4 – 20mA

Diagram 3

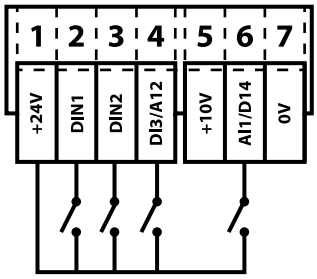
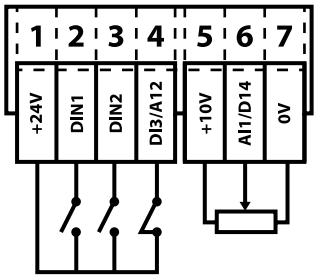
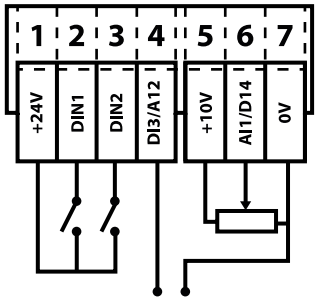


Diagram 4



(NC)
Open
Trip

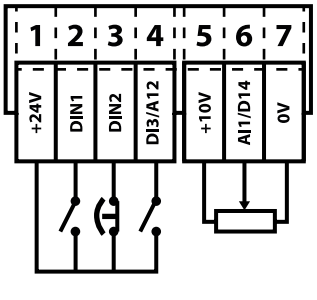
Diagram 5



P-47=
0-10V
4-20mA

P-16=
0-10V
4-20mA

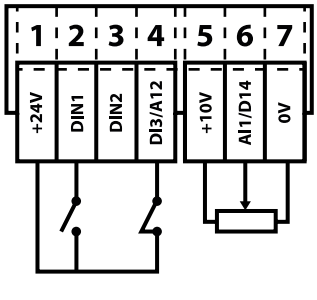
Diagram 6



(NO)
Close
Fast
Stop

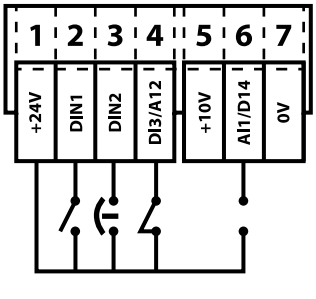
P-16=
0-10V
4-20mA

Diagram 7



(NC)
Open
Trip

Diagram 8



(NO)
Close
Fast
Stop

(NC)
Open
Trip

Diagram 9

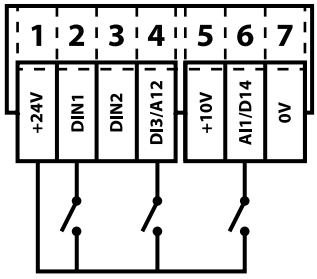
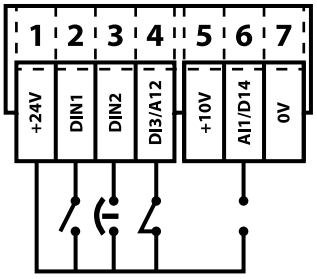


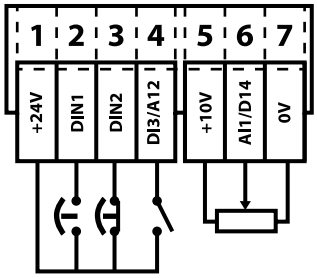
Diagram 10



(NO)
Close
Fast
Stop

(NC)
Open
Trip

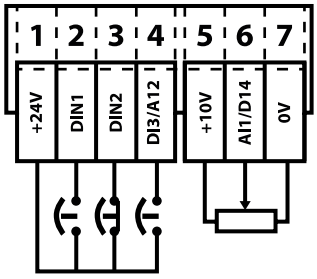
Diagram 11



(NO)
Close
Start

(NC)
Open
Stop

Diagram 12

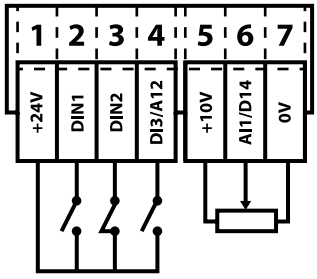


(NO)
Close
Start

(NC)
Open
Stop

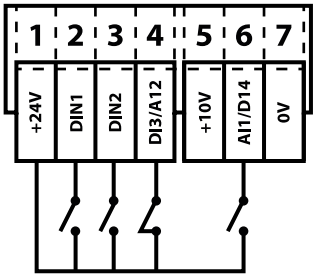
(NO)
Close
Fast
Stop

Diagram 13



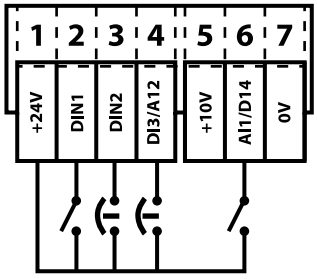
(NC)
Open Trip

Diagram 14



(NC)
Open Trip

Diagram 15



(NO)
Speed ↑

(NO)
Speed ↓

8. Modbus RTU Communications

8.1. Introduction

The Optidrive E3 can be connected to a Modbus RTU network via the RJ45 connector on the front of the drive.

8.2. Modbus RTU Specification

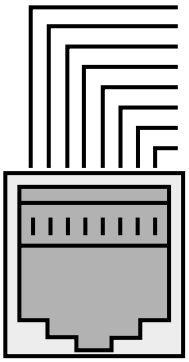
Protocol	Modbus RTU
Error check	CRC
Baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps (default)
Data format	1 start bit, 8 data bits, 1 stop bits, no parity
Physical signal	RS 485 (2-wire)
User interface	RJ45
Supported Function Codes	03 Read Multiple Holding Registers 06 Write Single Holding Register 16 Write Multiple Holding Registers (Supported for registers 1 – 4 only)

8.3. RJ45 Connector Configuration

For full MODBUS RTU register map information please refer to your Invertek Drives Sales Partner. Local contacts can be found by visiting our website:

www.invertekdrives.com

When using MODBUS control the Analog and Digital Inputs can be configured as shown in section 7.5. Macro Functions - Fieldbus Control Mode (P-12 = 3, 4, 7, 8 or 9).



1	CAN -
2	CAN +
3	0 Volts
4	-RS485 (PC)
5	+RS485 (PC)
6	+24 Volt
7	-RS485 (Modbus RTU)
8	+RS485 (Modbus RTU)

Warning: This is not an Ethernet connection. Do not connect directly to an Ethernet port.

8.4. Modbus Register Map

Register Number	Par.	Type	Supported Function Codes			Function		Range	Explanation
			03	06	16	Low Byte	High Byte		
1	-	R/W	✔	✔	✔	Drive Control Command		0..3	16 Bit Word. Bit 0: Low = Stop, High = Run Enable Bit 1: Low = Decel Ramp 1 (P-04), High = Decel Ramp 2 (P-24) Bit 2: Low = No Function, High = Fault Reset Bit 3: Low – No Function, High = Coast Stop Request
2	-	R/W	✔	✔	✔	Modbus Speed reference setpoint		0..5000	Setpoint frequency x10, e.g. 100 = 10.0Hz
4	-	R/W	✔	✔	✔	Acceleration and Deceleration Time		0..60000	Ramp time in seconds x 100, e.g. 250 = 2.5 seconds
6	-	R	✔			Error code	Drive status		Low Byte = Drive Error Code, see section 10.1. Fault Code Messages High Byte = Drive Status as follows: 0: Drive Stopped 1: Drive Running 2: Drive Tripped
7		R	✔			Output Motor Frequency		0..20000	Output frequency in Hz x10, e.g. 100 = 10.0Hz
8		R	✔			Output Motor Current		0..480	Output Motor Current in Amps x10, e.g. 10 = 1.0 Amps
11	-	R	✔			Digital input status		0..15	Indicates the status of the 4 digital inputs Lowest Bit = 1 Input 1
20	P00-01	R	✔			Analog Input 1 value		0..1000	Analog input % of full scale x10, e.g. 1000 = 100%
21	P00-02	R	✔			Analog Input 2 value		0..1000	Analog input % of full scale x10, e.g. 1000 = 100%
22	P00-03	R	✔			Speed Reference Value		0..1000	Displays the setpoint frequency x10, e.g. 100 = 10.0Hz
23	P00-08	R	✔			DC bus voltage		0..1000	DC Bus Voltage in Volts
24	P00-09	R	✔			Drive temperature		0..100	Drive heatsink temperature in °C

All user configurable parameters are accessible as Holding Registers, and can be Read from or Written to using the appropriate Modbus command. The Register number for each parameter P-04 to P-60 is defined as 128 + Parameter number, e.g. for parameter P-15, the register number is 128 + 15 = 143. Internal scaling is used on some parameters, for further details please contact your Invertek Drives Sales Partner.

9. Technical Data

9.1. Environmental

Operational ambient temperature range	Open Drives	:	-10 ... 50°C (frost and condensation free)
	Enclosed Drives	:	-10 ... 40°C (frost and condensation free)
Storage ambient temperature range		:	-40 ... 60°C
Maximum altitude		:	2000m. Derate above 1000m: 1% / 100m
Maximum humidity		:	95%, non-condensing

NOTE For UL compliance: the average ambient temperature over a 24 hour period for 200-240V, 2.2kW and 3HP, IP20 drives is 45°C.

9.2. Rating Tables

Frame Size	kW	HP	Input Current	Fuse / MCB (Type B)		Maximum Cable Size		Output Current	Recommended Brake Resistance
				Non UL	UL	mm	AWG	A	Ω
110 - 115 (+ / - 10%) V 1 Phase Input, 1 Phase Output									
1	0.37	0.5	8.5	16	15	8	8	7.0	-
2	0.75	1	12.5	16	15	8	8	10.5	100
200 - 240 (+ / - 10%) V 3 Phase Input, 3 Phase Output									
1	0.37	0.5	6.0	10	10	8	8	4.3	-
1	0.75	1	9.3	16	15	8	8	7.0	-
1	1.1	1.5	14.0	20	20	8	8	10.5	100

NOTE Cable sizes shown are the maximum possible that may be connected to the drive. Cables should be selected according to local wiring codes or regulations at the point of installation.

9.3. Additional Information for UL Compliance

Optidrive E3 is designed to meet the UL requirements. For an up to date list of UL compliant products, please refer to UL listing NMMS.E226333. In order to ensure full compliance, the following must be fully observed.

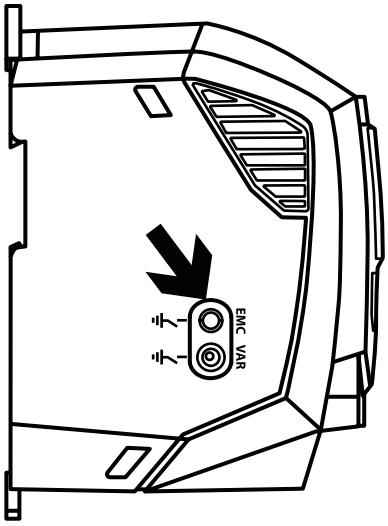
Input Power Supply Requirements				
Supply Voltage	110 – 115 RMS Volts for 115 Volt rated units, + /- 10% variation allowed. 115 Volt RMS Maximum.			
	200 – 240 RMS Volts for 230 Volt rated units, + /- 10% variation allowed. 240 Volt RMS Maximum.			
Frequency	50 – 60Hz + / - 5% Variation			
Short Circuit Capacity	Voltage Rating	Min kW (HP)	Max kW (HP)	Maximum supply short-circuit current
	115V	0.37 (0.5)	0.75 (1)	100kA rms (AC)
	230V	0.37 (0.5)	1.1 (1.5)	100kA rms (AC)
	All the drives in the above table are suitable for use on a circuit capable of delivering not more than the above specified maximum short-circuit Amperes symmetrical with the specified maximum supply voltage when protected by Class J fuses.			
Mechanical Installation Requirements				
All Optidrive E3 units are intended for indoor installation within controlled environments which meet the condition limits shown in section 9.1. Environmental.				
The drive can be operated within an ambient temperature range as stated in section 9.1. Environmental.				
For IP20 units, installation is required in a pollution degree 1 environment.				
For IP66 (NEMA 4X) units, installation in a pollution degree 2 environment is permissible.				
Electrical Installation Requirements				
Incoming power supply connection must be according to section 4.3. Incoming Power Connection.				
Suitable Power and motor cables should be selected according to the data shown in section 9.2. Rating Tables and the National Electrical Code or other applicable local codes.				
Motor Cable	75°C Copper must be used.			
Power cable connections and tightening torques are shown in sections 3.3. Mechanical Dimensions and Mounting – IP20 Open Units and 3.5. Mechanical Dimensions – IP66 (NEMA 4X) Enclosed Units.				
Integral Solid Sate short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the national electrical code and any additional local codes. Ratings are shown in section 9.2. Rating Tables				
Transient surge suppression must be installed on the line side of this equipment and shall be rated 480Volt (phase to ground), 480 Volt (phase to phase), suitable for over voltage category iii and shall provide protection for a rated impulse withstand voltage peak of 4kV.				
UL Listed ring terminals / lugs must be used for all bus bar and grounding connections.				

General Requirements

Optidrive E3 provides motor overload protection in accordance with the National Electrical Code (US).

- Where a motor thermistor is not fitted, or not utilised, Thermal Overload Memory Retention must be enabled by setting P-50 = 1.
- Where a motor thermistor is fitted and connected to the drive, connection must be carried out according to the information shown in section 4.9.2. Motor Thermistor Connection.

9.4. EMC Filter Disconnect



Drives with an EMC filter have an inherently higher leakage current to Ground (Earth).
For applications where tripping occurs the EMC filter can be disconnected (on IP20 units only) by completely removing the EMC screw on the side of the product.

Remove the screw as indicated right.

The Optidrive product range has input supply voltage surge suppression components fitted to protect the drive from line voltage transients, typically originating from lightning strikes or switching of high power equipment on the same supply.

When carrying out a HiPot (Flash) test on an installation in which the drive is built, the voltage surge suppression components may cause the test to fail. To accommodate this type of system HiPot test, the voltage surge suppression components can be disconnected by removing the VAR screw After completing the HiPot test, the screw should be replaced and the HiPot test repeated. The test should then fail, indicating that the voltage surge suppression components are once again in circuit.

10. Troubleshooting

10.1. Fault Code Messages

Fault Code	No.	Description	Suggested Remedy
no-FLt	00	No Fault	Not required.
OI-b	01	Brake channel over current	Check external brake resistor condition and connection wiring.
OL-br	02	Brake resistor overload	The drive has tripped to prevent damage to the brake resistor.
O-I	03	Output Over Current	Instantaneous Over current on the drive output. Excess load or shock load on the motor. **NOTE** Following a trip, the drive cannot be immediately reset. A delay time is inbuilt, which allows the power components of the drive time to recover to avoid damage.
I_t-trP	04	Motor Thermal Overload (I2t)	The drive has tripped after delivering >100% of value in P-08 for a period of time to prevent damage to the motor.
PS-trP	05	Power stage trip	Check for short circuits on the motor and connection cable
O-uoLt	06	Over voltage on DC bus	Check the supply voltage is within the allowed tolerance for the drive. If the fault occurs on deceleration or stopping, increase the deceleration time in P-04 or install a suitable brake resistor and activate the dynamic braking function with P-34.
U-uoLt	07	Under voltage on DC bus	The incoming supply voltage is too low. This trip occurs routinely when power is removed from the drive. If it occurs during running, check the incoming power supply voltage and all components in the power feed line to the drive.
O-t	08	Heatsink over temperature	The drive is too hot. Check the ambient temperature around the drive is within the drive specification. Ensure sufficient cooling air is free to circulate around the drive.
U-t	09	Under temperature	Trip occurs when ambient temperature is less than -10°C. Temperature must be raised over -10°C in order to start the drive.
P-dEF	10	Factory Default parameters loaded	
E-trIP	11	External trip	E-trip requested on digital input 3. Normally closed contact has opened for some reason. If motor thermistor is connected check if the motor is too hot.
SC-Obs	12	Optibus comms loss	Check communication link between drive and external devices. Make sure each drive in the network has its unique address.
FLt-dc	13	DC bus ripple too high	Check incoming supply phases are all present and balanced.
P-LOSS	14	Input phase loss trip	Check incoming power supply phases are present and balanced.
h O-I	15	Output Over Current	Check for short circuits on the motor and connection cable. Note: Following a trip, the drive cannot be immediately reset. A delay time is inbuilt, which allows the power components of the drive time to recover to avoid damage.
th-FLt	16	Faulty thermistor on heatsink	
dAtA-F	17	Internal memory fault (IO)	Press the stop key. If the fault persists, consult you supplier.
4-20 F	18	4-20mA Signal Lost	Check the analog input connection(s).
dAtA-E	19	Internal memory fault (DSP)	Press the stop key. If the fault persists, consult you supplier.
F-PtC	21	Motor PTC thermistor trip	Connected motor thermistor over temperature, check wiring connections and motor.
FAn-F	22	Cooling Fan Fault (IP66 only)	Check / replace the cooling fan.
O-hEAt	23	Drive internal temperature too high	Drive ambient temperature too high, check adequate cooling air is provided.
SC-F01	50	Modbus comms loss fault	Check the incoming Modbus RTU connection cable. Check that at least one register is being polled cyclically within the timeout limit set in P-36 Index 3.
SC-F02	51	CAN comms loss trip	Check the incoming CAN connection cable. Check that cyclic communications take place within the timeout limit set in P-36 Index 3.

82-E31PH-IN_V2.00

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www.invertekdrives.com

BIMBA MFD Pneumatic

877.812.7573 info@fusionfluid.com

Product Features

Technical Data

MGFC Series filters-regulator-lubricator combination units will be discontinued in 2021. Please contact your local salesperson for additional information.

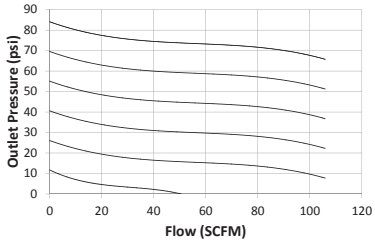
Engineering Specifications

Model	MGFC200-06-S	MGFC200-08-S	MGFC300-08	MGFC300-10	MGFC400-15
Fluid	Air				
Port Size	1/8 NPT	1/4 NPT	1/4 NPT	3/8 NPT	1/2 NPT
Type	Relieving Regulator with Push to Lock Adjustment Knob and Fine Oil Mist Lubricator				
Pressure Range	22 to 130 PSI (0.15 to 0.9 MPa)				
Proof Pressure	215 PSI (1.5 MPa)				
Temperature Range	23 °F to 158 °F (-5 °C to 70 °C)				
Drain Bowl Capacity	0.34 FL OZ (10CC)		1.35 FL OZ (40CC)		2.7 FL OZ (80CC)
Oil Bowl Capacity	0.85 FL OZ (25CC)		2.5 FL OZ (75CC)		5.4 FL OZ (160CC)
Bowl Material	Polycarbonate Bowl		Polycarbonate Bowl with Metal Bowl Guard		
Material	Aluminum Alloy Body				
Mounting	Modular Connecting Kit (page 65) included				
Recommended Lubricant	Non-Detergent SAE10, ISO VG32, or equivalent				
Drain	Semi-Auto Drain		Auto Drain		
Includes	T Style Modular Connecting Kit / Panel Nut				

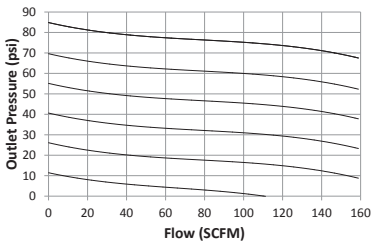
See page 71 for service parts.

Performance Data MGFC

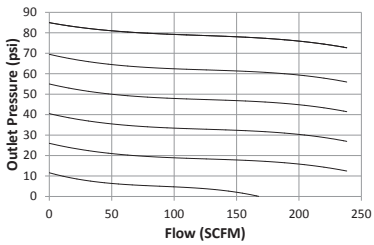
Flow Characteristics MGFC200



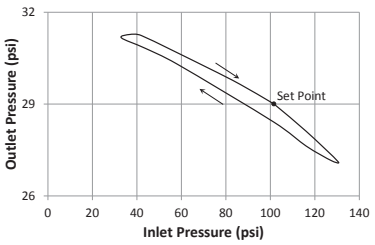
Flow Characteristics MGFC300



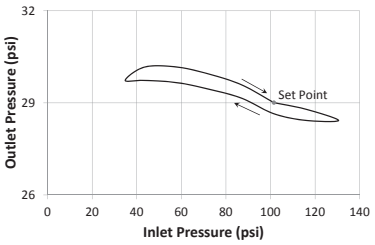
Flow Characteristics MGFC400



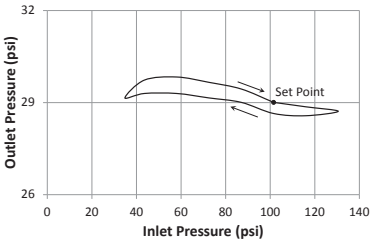
Regulation Characteristics MGFC200



Regulation Characteristics MGFC300

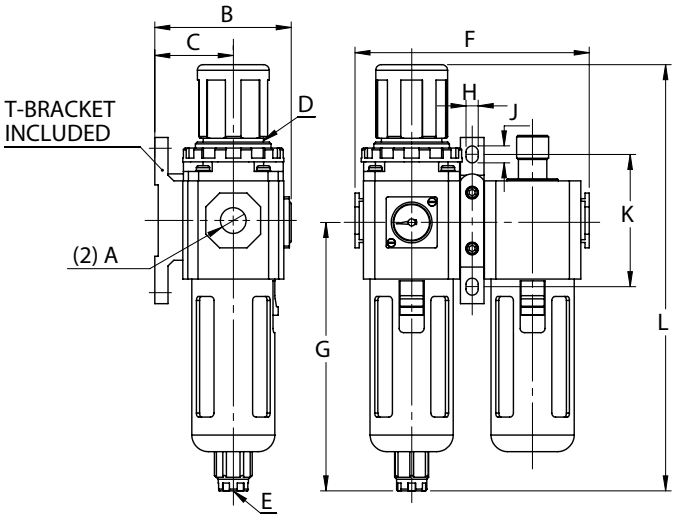


Regulation Characteristics MGFC400



Product Information

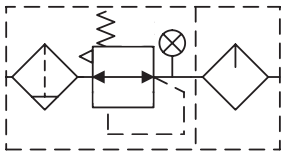
Dimensions (mm)



Model	A	B	C	D	E
MGFC200-06-S	1/8 NPT	62	30	M30X1.5	-
MGFC200-08-S	1/4 NPT	62	30	M30X1.5	-
MGFC300-08	1/4 NPT	72	41.5	M40X1.5	G 1/8
MGFC300-10	3/8 NPT	72	41.5	M40X1.5	G 1/8
MGFC400-15	1/2 NPT	89	50	M55X2.0	G 1/4

Model	F	G	H	J	K	L
MGFC200-06-S	97	93	5.5	8.5	50	161
MGFC200-08-S	97	93	5.5	8.5	50	161
MGFC300-08	124	143	6.5	9	70	225.5
MGFC300-10	124	143	6.5	9	70	225.5
MGFC400-15	164	165.5	8.5	12	80	270.5

How to Order



MGFC 200 - 08 - S - W

Product Line	Model	Port Size		Drain		Filtering	
MGFC Series	200 Series	06	1/8 NPT (200 Series)	Blank	Auto Drain[1]	Blank	40µm
	300 Series	08	1/4 NPT (200, 300 Series)	S	Semi-Auto Drain[2]	W	5µm
	400 Series	10	3/8 NPT (300 Series)				
		15	1/2 NPT (400 Series)				

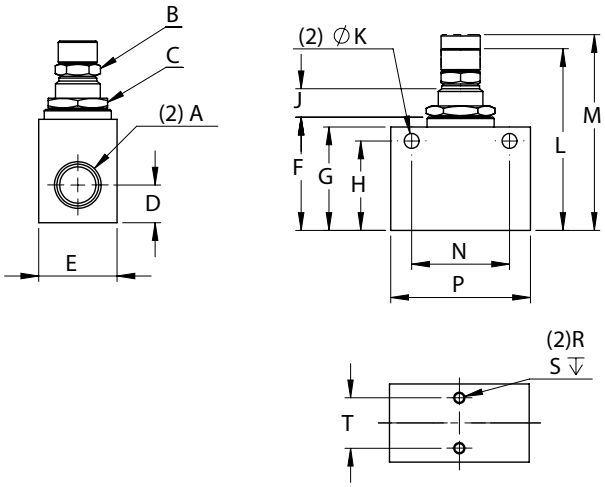
[1] Not available on 200 series
[2] Not available on 300 & 400 series

Technical Data

Engineering Specifications

Model		MASC100-06	MASC200-08	MASC300-10	MASC300-15
Fluid		Air (Clean/Dry)			
Port Size		1/8 NPT	1/4 NPT	3/8 NPT	1/2 NPT
Pressure Range		7 to 138 PSI (0.05 to 0.95 MPa)			
Proof Pressure		215 PSI (1.5 MPa)			
Temperature Range		-4 °F to 158 °F (-20 °C to 70 °C)			
Max. Flow (SCFM)	Controlled	7.1	15.9	44.1	58.3
	Free	14.1	28.3	53.0	88.3
Material		Aluminum Alloy Body			

Dimensions (mm)



Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
MASC100-06	1/8 NPT	M6X0.5	M12X0.75	10	18	26	23	18	8.6	4.3	47	52.5	22	32	-	-	-
MASC200-08	1/4 NPT	M6X0.5	M12X0.75	13.5	18	30	27	23	8.6	4.3	51	56.5	26	36	-	-	-
MASC300-10	3/8 NPT	M8X0.75	M16X1.0	17.5	28	40.5	37	32	10	5.3	65	74	35	50	M4X0.7	6	18
MASC300-15	1/2 NPT	M8X0.75	M16X1.0	17.5	28	40.5	37	32	10	5.3	65	74	35	50	M4X0.7	6	18

How to Order

MASC 200 08

Product Line
M4F Series

Model	
1	100 Series
2	200 Series
3	300 Series

Port Size	
06	1/8 NPT (100 Series)
08	1/4 NPT (200 Series)
10	3/8 NPT (300 Series)
15	1/2 NPT (300 Series)