

Flow Series Mixers

Installation, Operations, and Maintenance Manual for Open Tank Application

- For additional O & M support go to our YouTube Channel - [FusionFluidEquipment](#)

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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.

**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.

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.

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/or mixer support structure are suitable for the weight and dynamic loads from the mixer. Small deflections in the mount will cause large deflections in the mixer shaft. Loading information can be found on your approval drawing or by contacting your Fusion distributor. 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 Fusion mixer.



USE CARE. MULTIPLE HAZARDS EXIST

Installation Process Overview

- Define Correct Mixer Placement
- Mount the Mixer Drive
 - Clamp – Pro Series Only
 - Cup – Pro Series Only
 - Plate
 - Circular Plate – Flow Series Only
 - Plate & Angle Risers
- Shaft Installation
- Impeller Installation
- Electrical Installation

Mount the Mixer Drive

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.**

RETAIN THIS DOCUMENT FOR HARDWARE TIGHTENING TORQUE REFERENCE

Recommended Tightening Torques

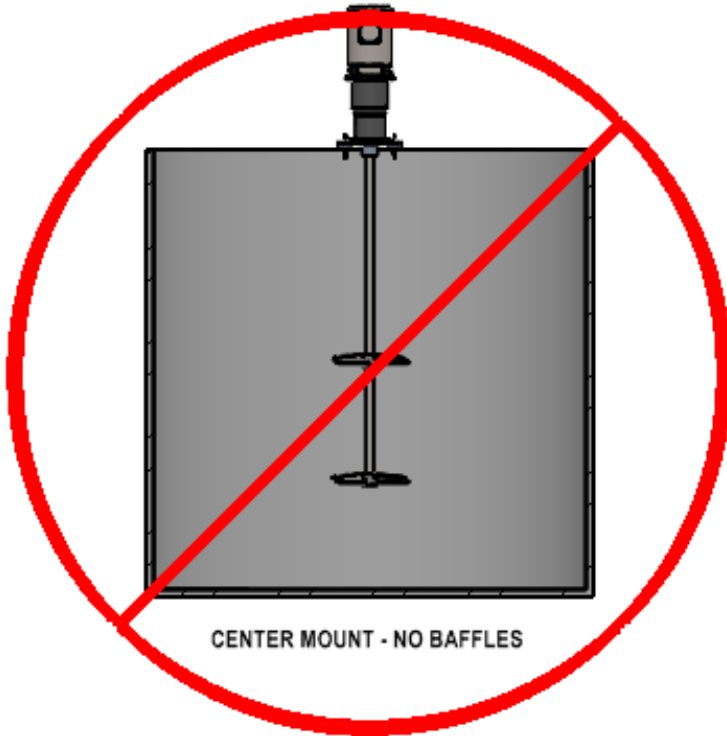
Tighten all of the hardware to the torque specifications in the table below. These average torque values should be used as a guide and not as absolute values:

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	<i>in-lbs</i>	60	<i>in-lbs</i>	75	<i>in-lbs</i>
5/16"-18	103	<i>in-lbs</i>	108	<i>in-lbs</i>	165	<i>in-lbs</i>
3/8"-16	189	<i>in-lbs</i>	198	<i>in-lbs</i>	300	<i>in-lbs</i>
7/16"-14	308	<i>in-lbs</i>	322	<i>in-lbs</i>	480	<i>in-lbs</i>
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.

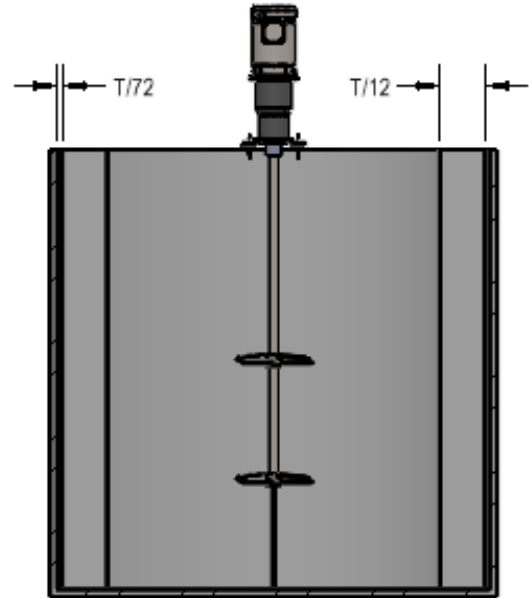
- 1) **ALL BOLTS SHOULD BE TIGHTENED TO TORQUE SPECIFICATIONS AFTER 12 HOURS OF SERVICE AND AT EACH SCHEDULED SHUT DOWN.**
- 2) **SOME INSTALLATION INSTRUCTIONS (e.g., FIXING ELEMENT or SHRINK DISC) MAY REQUIRE DIFFERENT TIGHTENING TORQUE SPECIFICATIONS OTHER THAN SHOWN IN THE TABLE ABOVE. PLEASE FOLLOW THE APPROPRIATE SPECIFICATION PER INSTRUCTIONS.**
- 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.

Center Mounting



CENTER MOUNT - NO BAFFLES

NOT RECOMMENDED



CENTER MOUNT - WITH BAFFLES

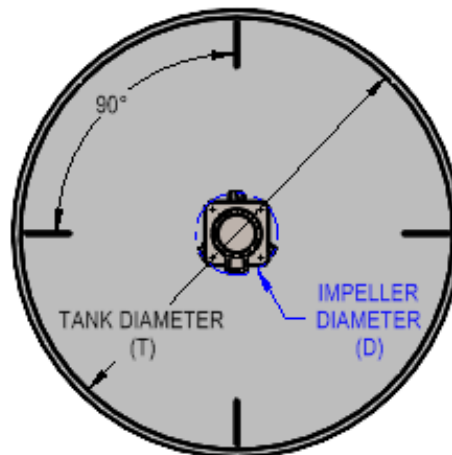
BAFFLE DIMENSIONS

WIDTH: 1/12 TANK DIAMETER

NUMBER: 4 @ 90° - PREFERRED OR 3 @ 120°

OFF SIDEWALL: 1/72 TANK DIAMETER

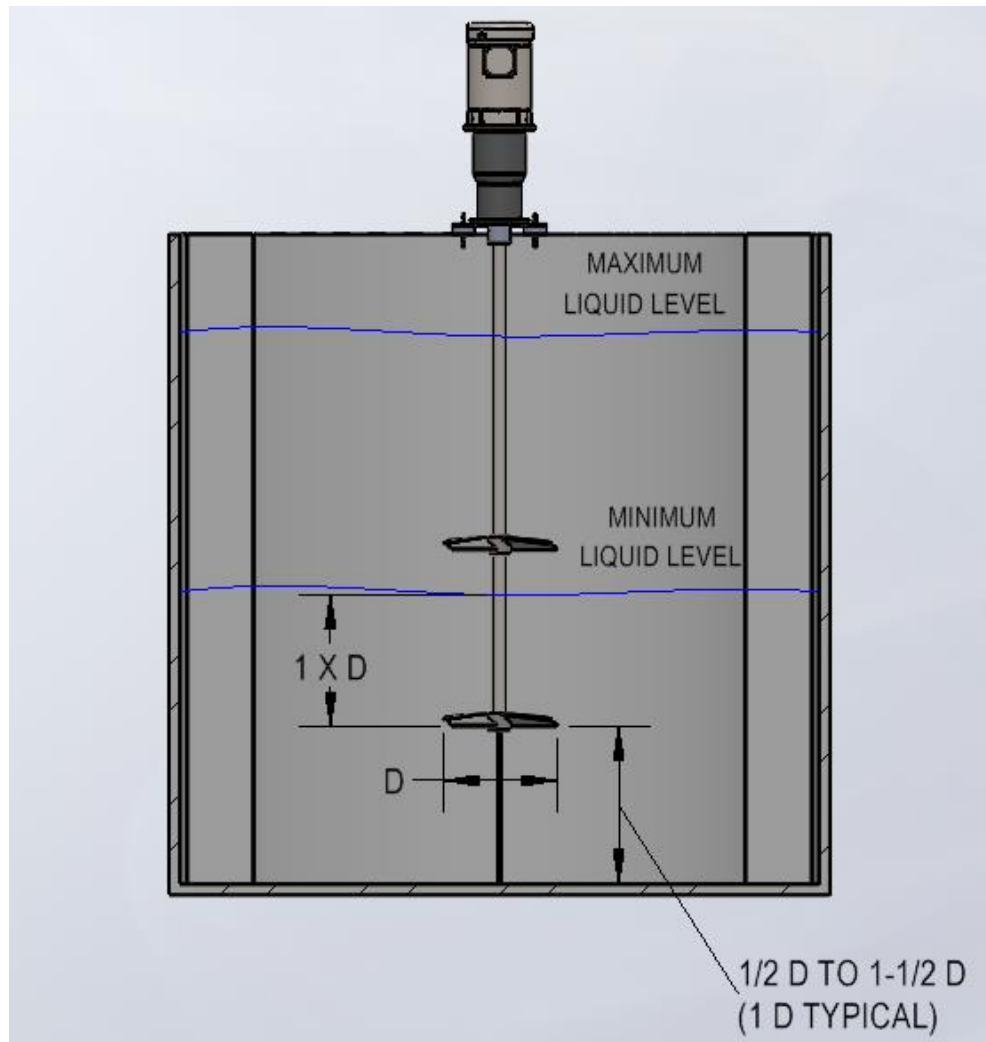
RECOMMENDED



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.

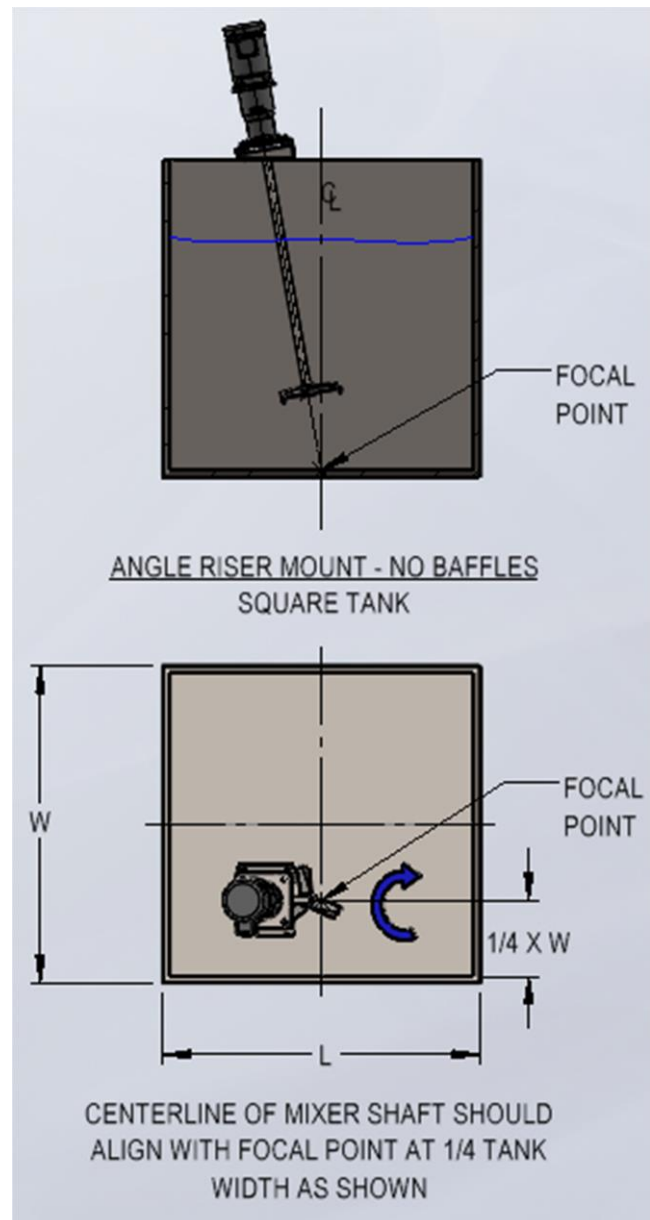
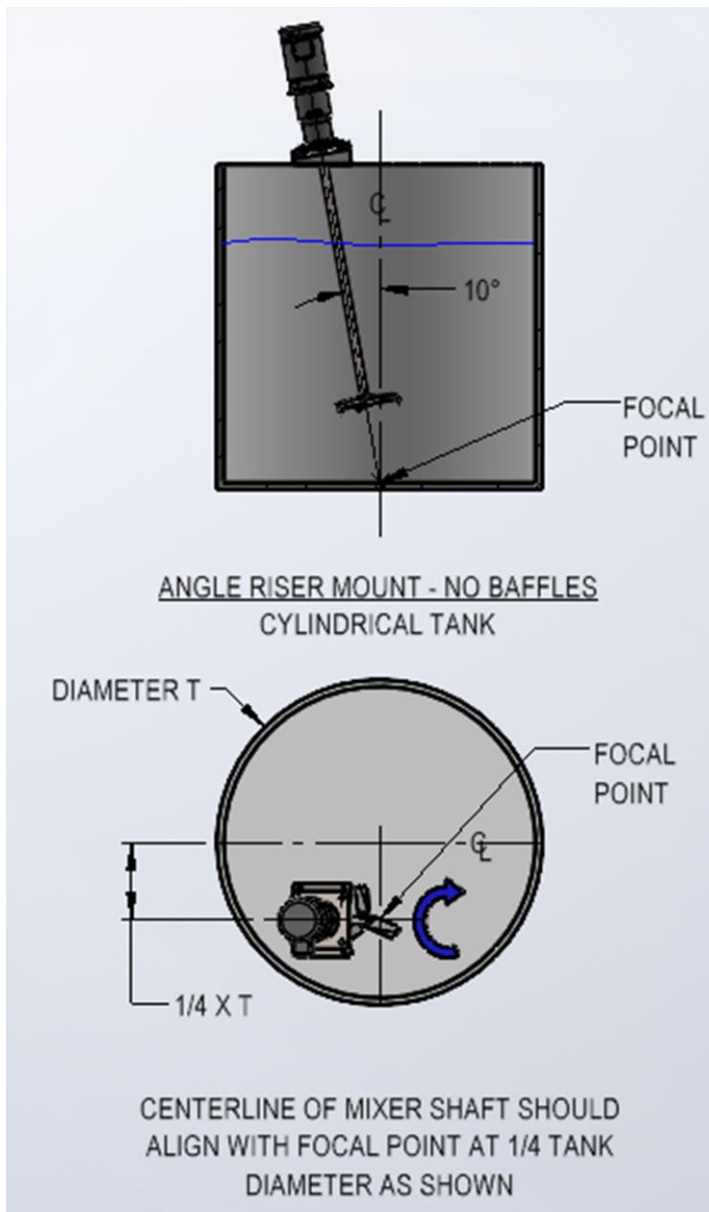
Typical Impeller Spacing - All Mounting Styles



**Make sure that mount location is rigid enough to support the function of the mixer.
Small deflections in the mount will cause large deflections in the shaft.**

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.

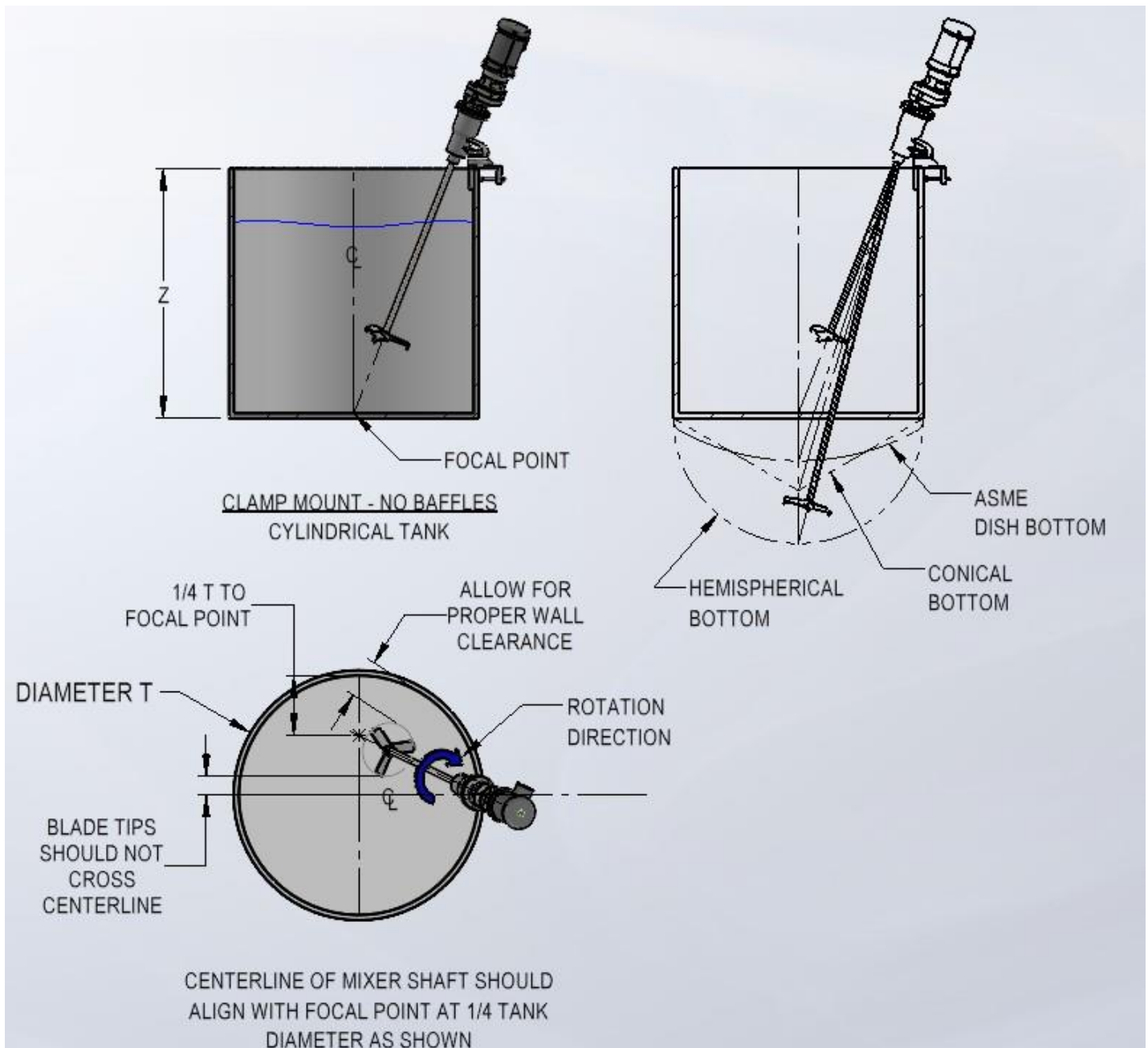
Angle Riser Mount Mixers



Make sure that mount location is rigid enough to support the function of the mixer. Small deflections in the mount will cause large deflections in the shaft. 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.

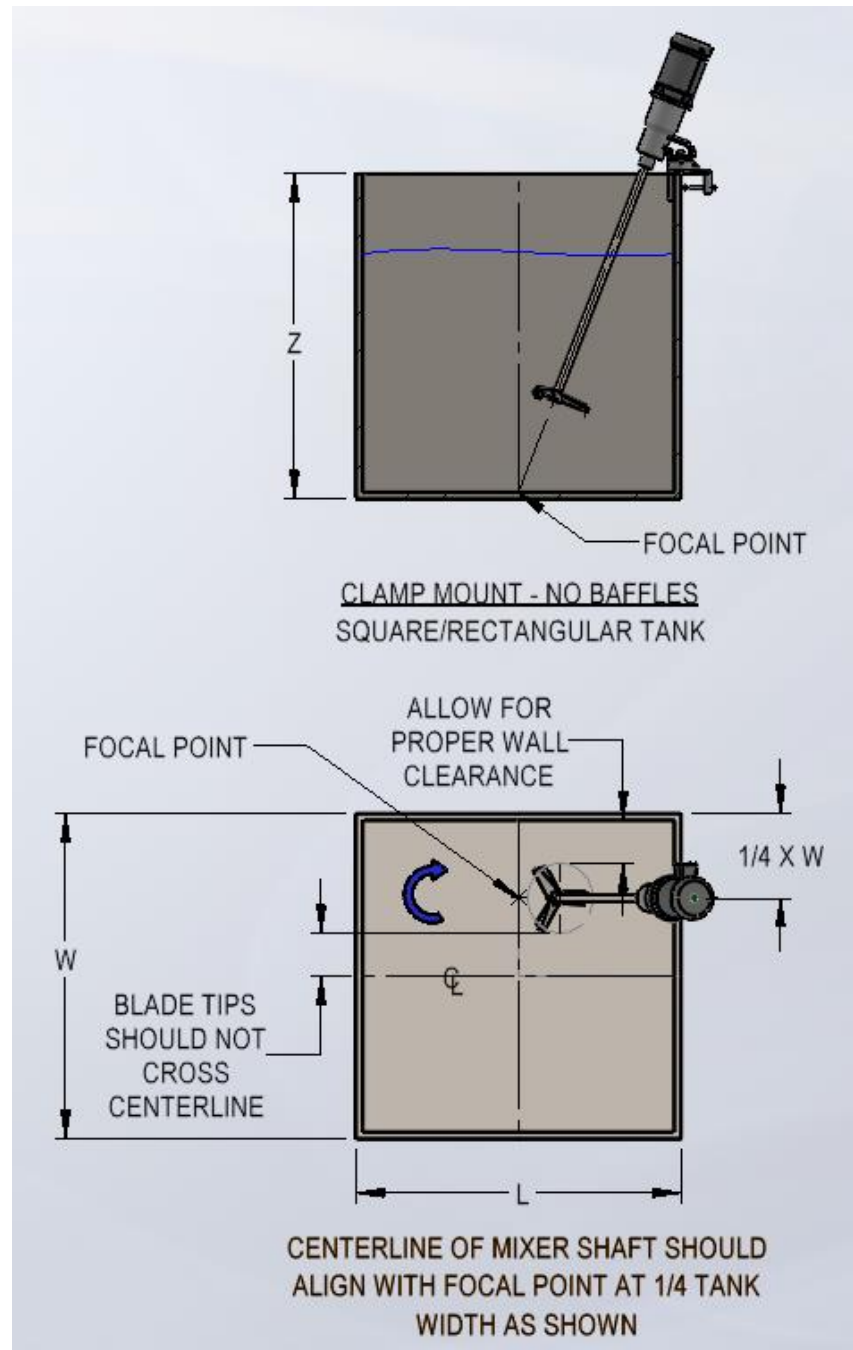
Mounting Guidelines for Fusion Pro Series Mixers Angle Mounting - Clamp Mount Mixers



Make sure that mount location is rigid enough to support the function of the mixer. Small deflections in the mount will cause large deflections in the shaft. 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

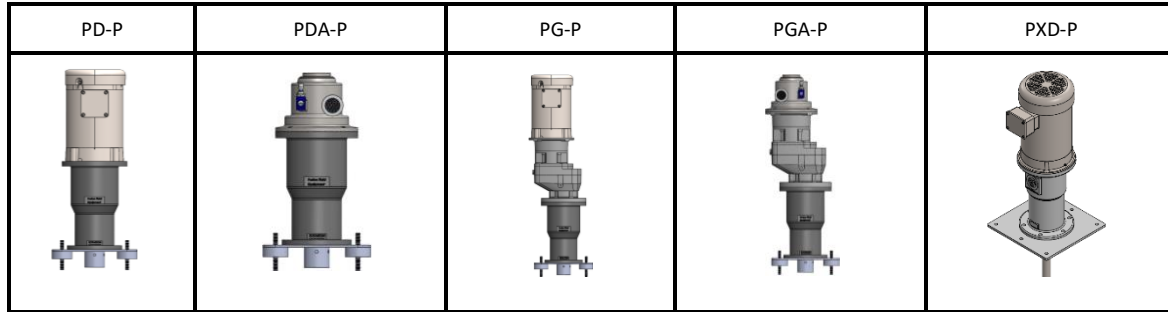


Make sure that mount location is rigid enough to support the function of the mixer. Small deflections in the mount will cause large deflections in the shaft. Max impeller diameter (D) to tank diameter (T) ratio (D/T) should not to exceed 42%. If impeller blade tips cross centerline of the tank, then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

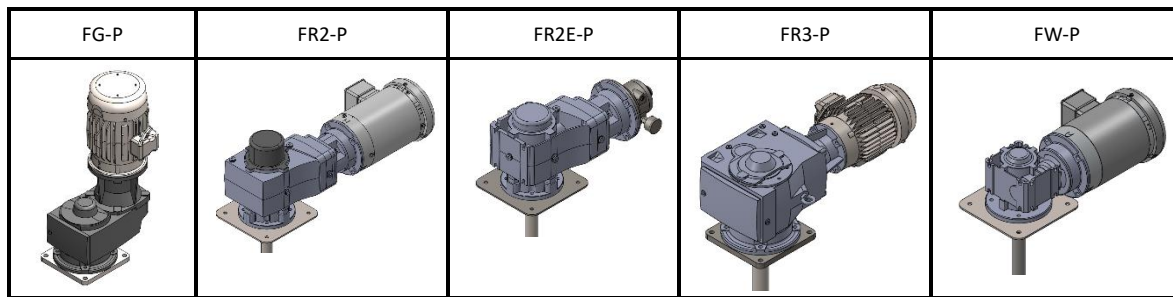
MOUNTING GUIDELINES ARE FOR REFERENCE. PLEASE CONTACT YOUR FUSION APPLICATION ENGINEER OR CONSULT YOUR MOUNTING COORDINATES PROVIDED ON YOUR FUSION ESTIMATE FOR SUGGESTED MOUNTING LOCATIONS.

Shown below are images of some of the typical Fusion Pro & Flow Series models. The appearance of your actual model may vary depending on material selection or another custom configuration.

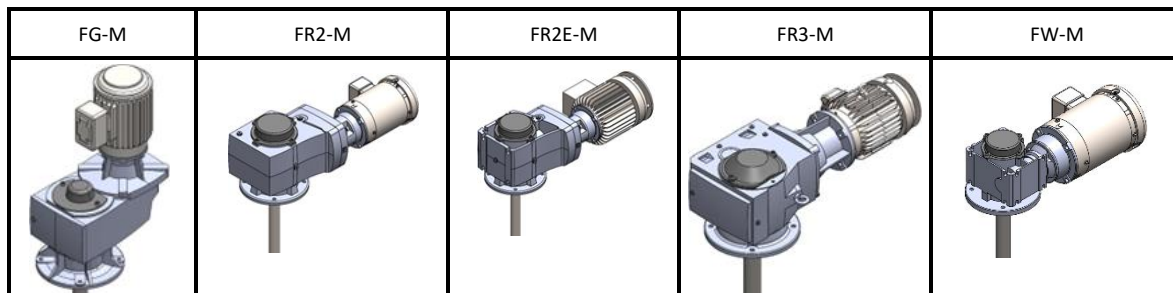
The plate mount instructions apply to the following typical Pro Series models (Pro XL models will not have Isolation Pads):



The plate mount instructions apply to the following typical Flow Series Plate Mount models:



The plate mount instructions apply to the following typical Flow Series Circular Plate Mount models:



CAUTION:



ALWAYS SHUT OFF, LOCK OUT AND DISCONNECT FROM POWER SUPPLY BEFORE SERVICING MIXER.

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

Plate With Isolation Pad Mount Instructions

Make sure the Plate Mount location is rigid enough to support your mixer during operation. The foundation under the mount must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components.

We recommend that the shaft is left out during this step to avoid damage to the side wall of tank, shaft or impellers during installation.

- Make sure (4) Isolation Pads in Plate Mount line up with holes in tank or bridge mounting location.
- **Keep in mind to allow for clearance between impellers and side wall of tank once shaft and impellers are installed (see FM-1013 Mounting Guidelines section).**
- Place mixer drive assembly with Plate Mount & Isolation pads in desired location and secure with lock nuts or use service removeable thread-locker on standard thick hex nuts (nuts not included). Tighten nuts to torque specification (**see Torque Chart – FM-1004 Installation Section**).
- Once mounted, install the shaft and impeller(s) per appropriate manual section for your application.

* Note: Pro Series mixer drive may vibrate due to flexibility in isolation pads.

For the Pro Series there are two possible isolation pad mounts as shown below

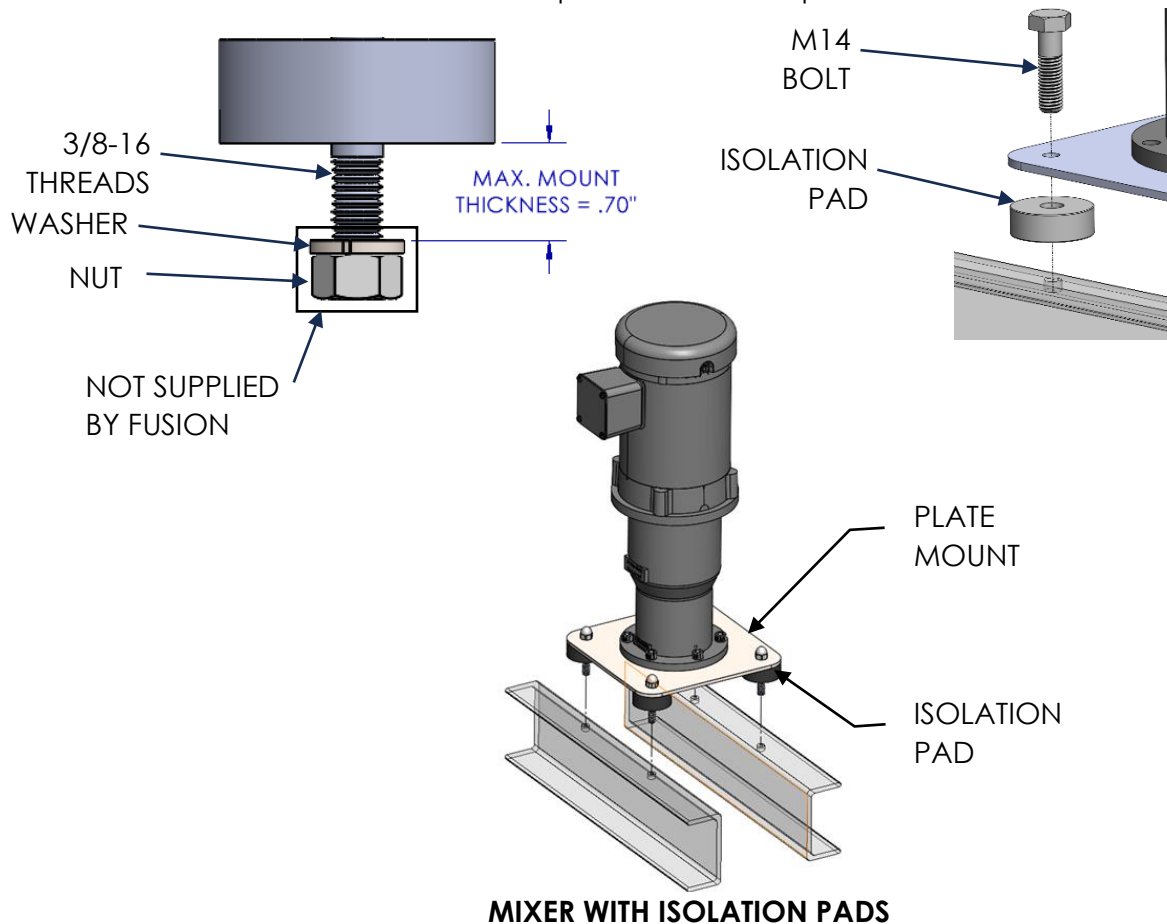


Plate Without Isolation Pad Mount Instructions

Make sure the Plate Mount location is rigid enough to support your mixer during operation. The foundation under the mount must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components. For the Circular Plate Mount application, we recommend the straightness and flatness of the support foundation follow Table 1. The dimension shown in the Table is based off the diameter of the Circular Plate Mount. Fusion Circular Plate Mount models will have a number such as: FR2-3M. The number "3" after the dash will designate the gearbox case size and the "M" designates the Circular Plate Mount.

Circular Plate Mount Application Only:

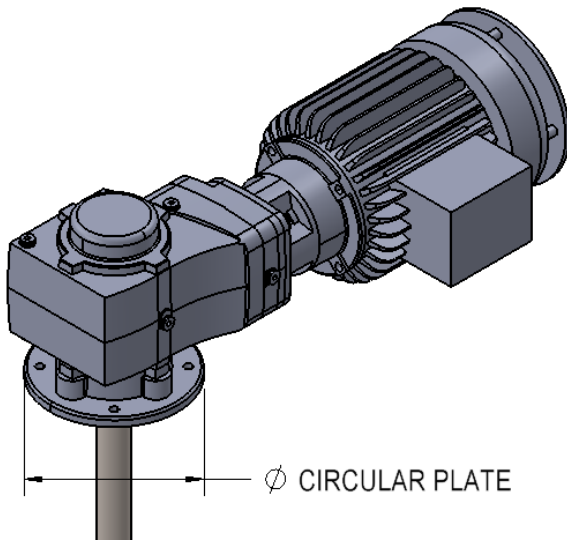


TABLE 1: Recommended Straightness and Flatness of Customer-Supplied Support Foundation

Ø CIRCULAR PLATE ABOVE (in)	Ø CIRCULAR PLATE TO & INCLUDING (in)	GENERAL TOLERANCE ON STRAIGHTNESS & FLATNESS
3.9	11.8	±.016 in
11.8	39	±.024 in
39	118	±.031 in

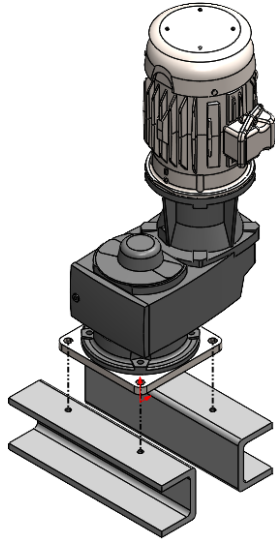
Straightness: Based upon the length of the corresponding line.

Flatness: Based upon the diameter of the circular surface.

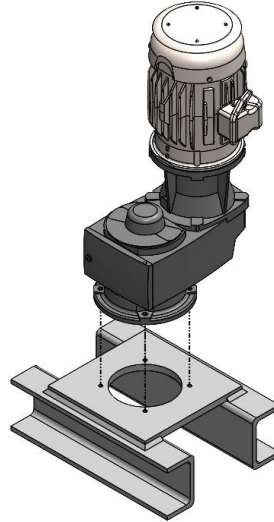
We recommend that the shaft is left out during this step to avoid damage to the side wall of tank, shaft or impellers during installation.

- Make sure holes in Plate Mount line up with holes in tank or bridge mounting location.
- **Keep in mind to allow for clearance between impellers and side wall of tank once shaft and impellers are installed (see FM-1013 Mounting Guidelines section).**

- Place mixer drive assembly with Plate Mount or Circular Plate Mount in desired location and secure with appropriate thread-locking hardware. **Circular Plate Mount must be fully supported by mounting location.** Tighten mixer mounting hardware to torque specification (**see Torque Chart – FM-1004 Installation Section**).



**TYPICAL FLOW SERIES
PLATE MOUNT**



**TYPICAL FLOW SERIES
CIRCULAR PLATE MOUNT**

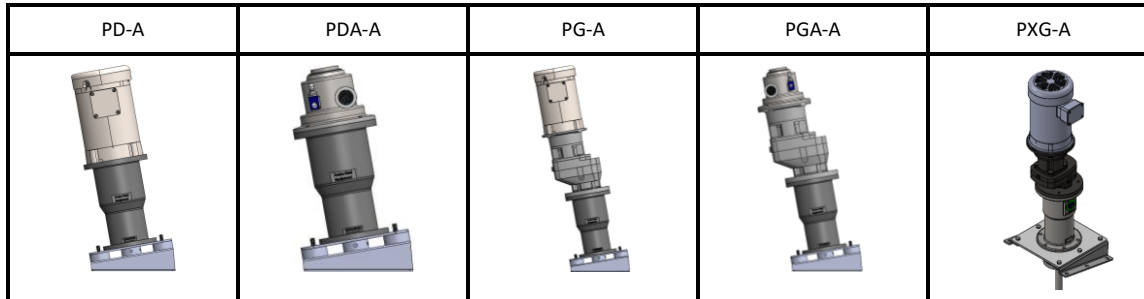
(NO HARDWARE PROVIDED WITH FLOW SERIES)

**MIXER'S CIRCULAR MOUNT
NEEDS TO BE FULLY SUPPORTED
BY THE MOUNTING LOCATION AS
SHOWN TO THE LEFT.**

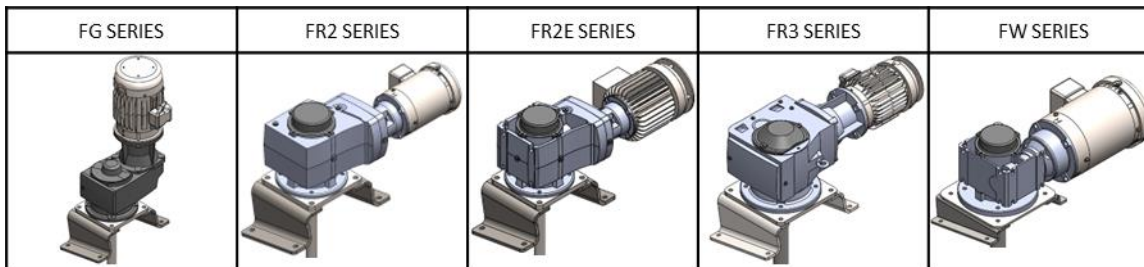


Shown below are images of some of the typical Fusion Pro & Flow Series models. The appearance of your actual model may vary depending on material selection or another custom configuration.

The plate with angle riser mount instructions apply to the following typical Pro Series models (Pro XL models will not have Isolation Pads):



The plate with angle riser mount instructions apply to the following typical Flow Series models:



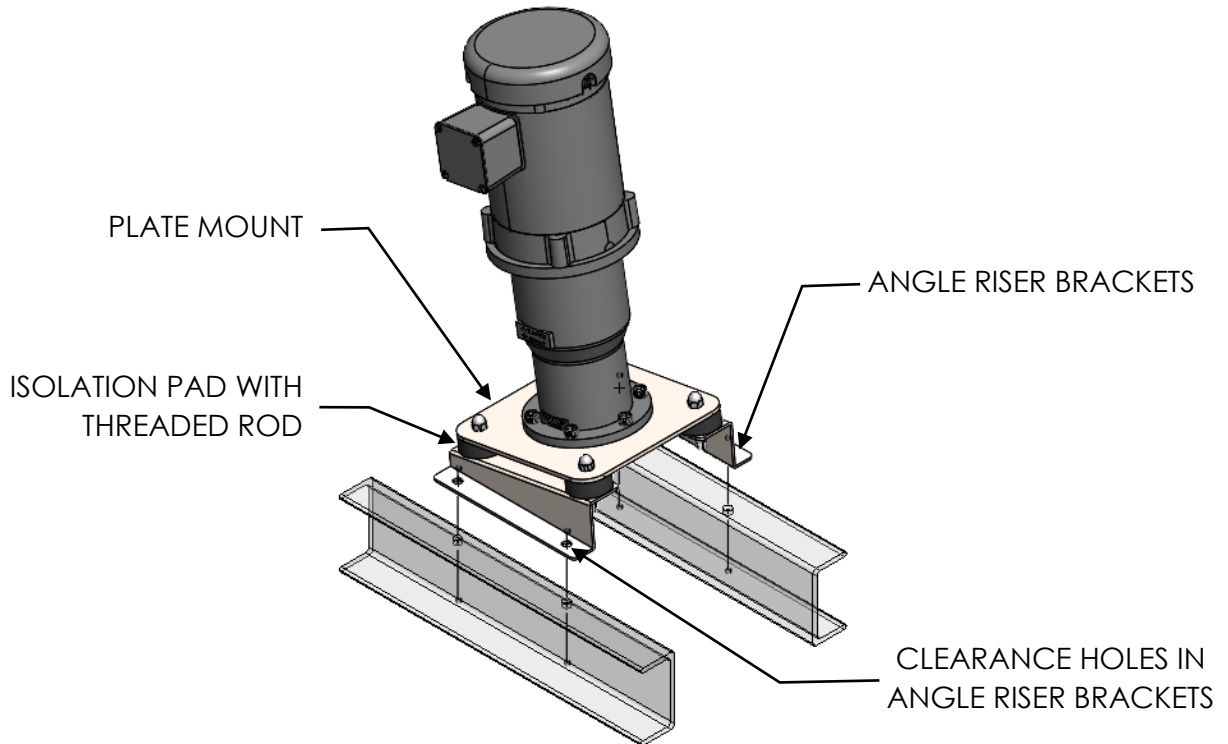
CAUTION: PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA

Angle Risers Mount Instructions

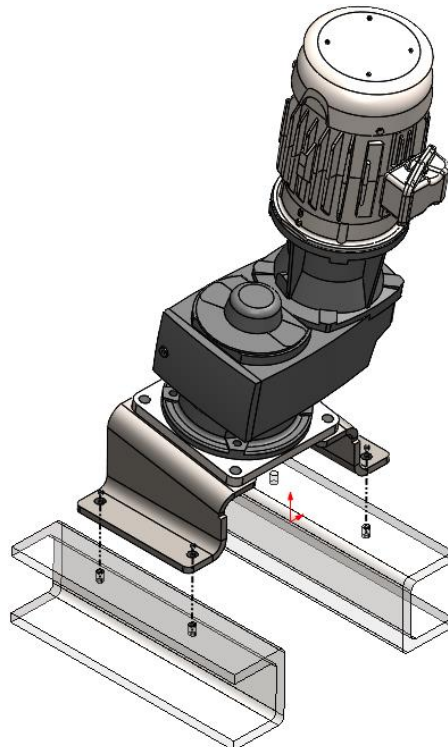
Make sure the Angle Risers Mount location will support your mixer during operation. We recommend that the shaft is left out during this step to avoid damage to the side wall of tank, shaft or impellers during installation.

- Make sure holes in Angle Risers line up with holes in mounting location.
- **Keep in mind to allow for clearance between impellers and side wall of tank once shaft and impellers are installed (see FM-1013 Mounting Guidelines section).**
- Place mixer drive assembly with Angle Risers in desired location. Secure with appropriate thread-locking hardware or use a service removeable thread locker. Note: there are clearance holes for mounting hardware in Angle Riser Brackets. Tighten hardware to torque specification **(see Torque Chart – FM-1004 Installation Section)**.
- Once mounted, install the shaft and impeller(s) per appropriate manual section for your application.

* Note: Pro Series mixer drive may vibrate due to flexibility in isolation pads.



PRO SERIES ANGLE RISER MOUNT



FLOW SERIES ANGLE RISER MOUNT

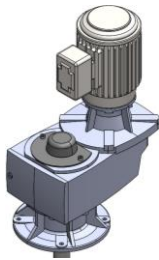
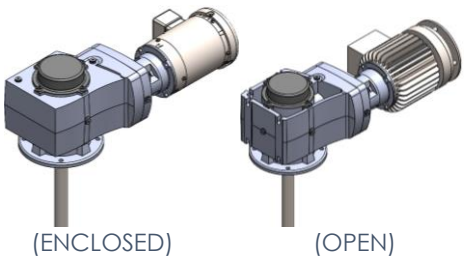

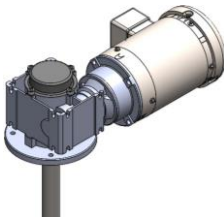
(NO MOUNTING HARDWARE PROVIDED WITH FLOW SERIES)



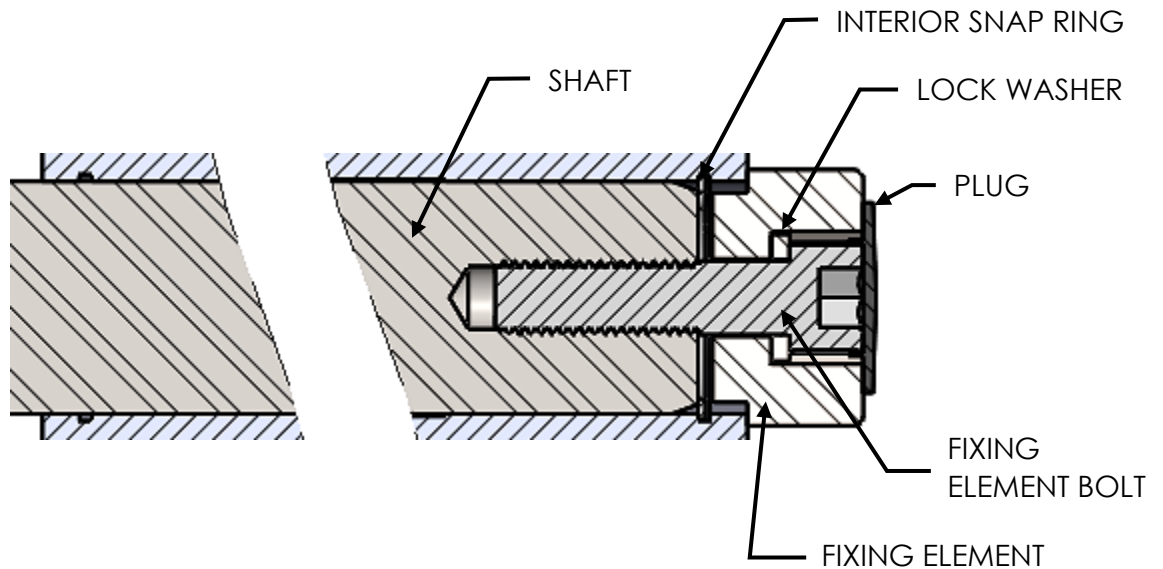
CAUTION:

- **ALWAYS SHUT OFF AND LOCK OUT POWER SUPPLY AND DISCONNECT FROM POWER SUPPLY BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.**

The following Fusion mixer models may use a fixing element to secure the shaft to the Nord gearbox:

FG SERIES	FR2E SERIES	FR3 SERIES	FW SERIES
	 <p>(ENCLOSED) (OPEN)</p>		

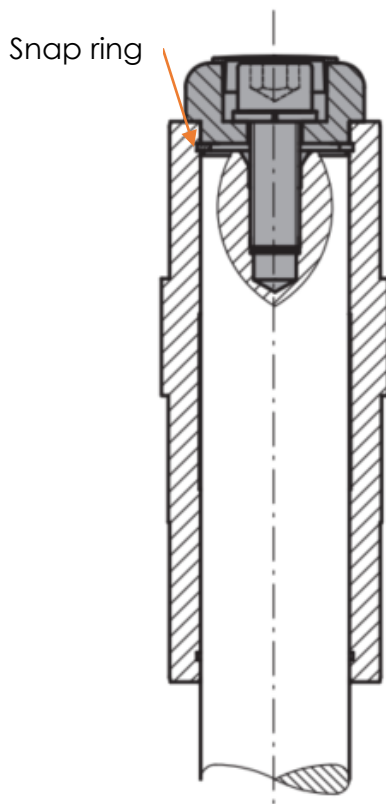
Typical fixing kit components



*Snap Ring is used on Side Entry mixers & when the mixer has a non-stepped shaft.

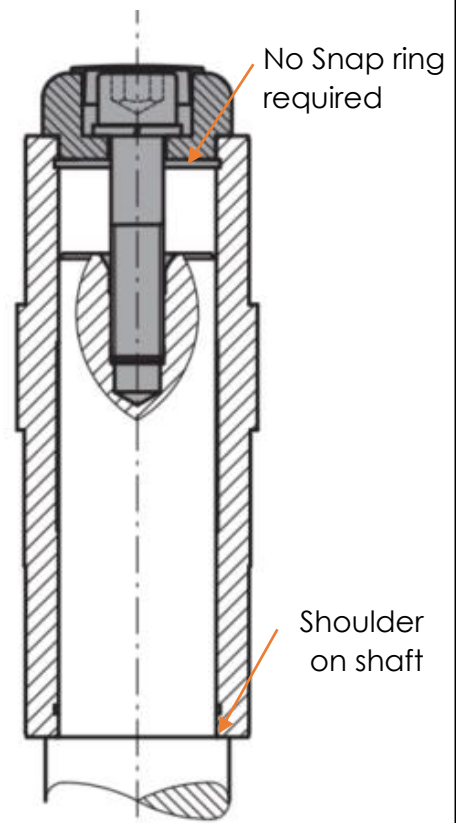
Assembly Type 1 – Fixing Element with Snap Ring

The mixer shaft is located against a fixed snap ring located inside the bore of the gearbox.



Assembly Type 2 – Fixing Element with Stepped (Shouldered) Shaft

The mixer shaft is shouldered and is pulled tight against the hollow bore.



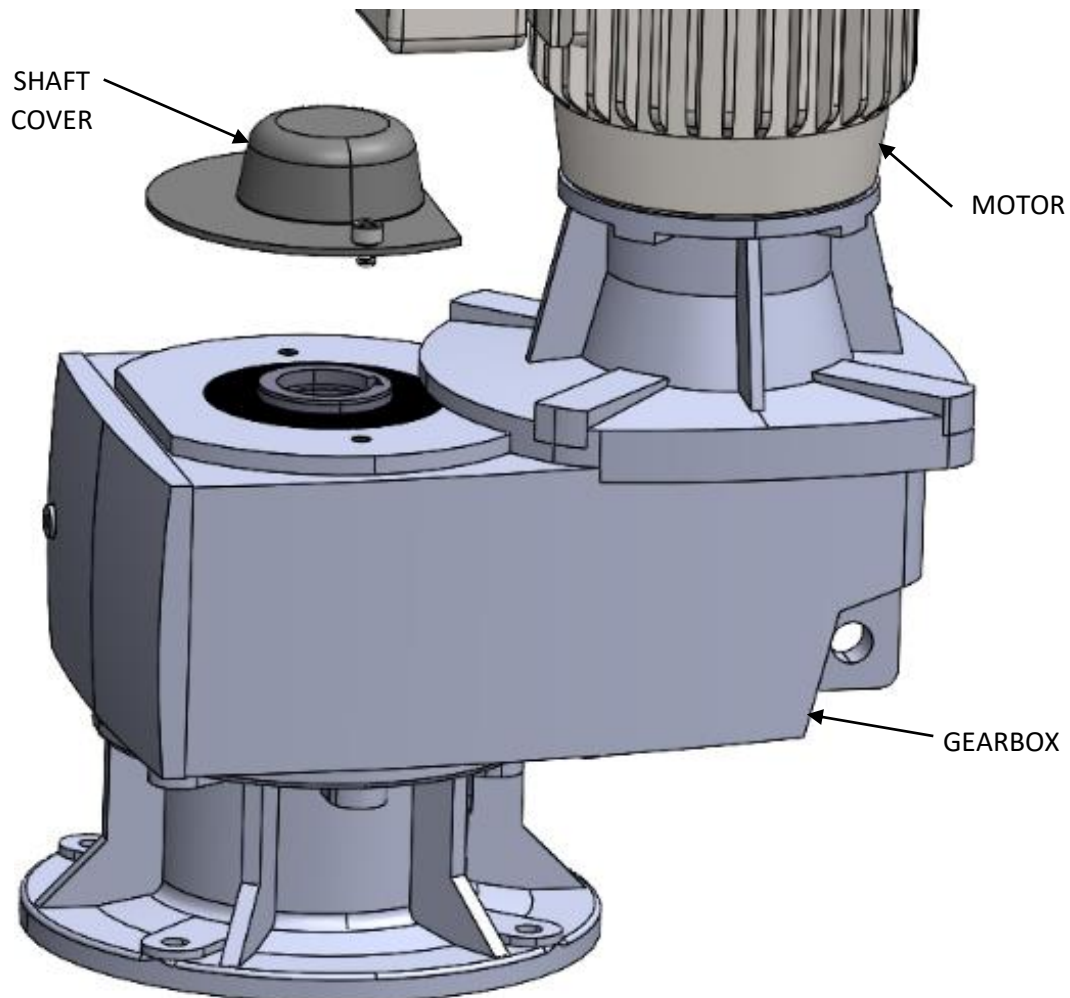
Type 1 Assembly typical shaft sizes: $\varnothing 3/4''$; $\varnothing 1''$; $\varnothing 1-1/4''$ and for Side Entry.

Type 2 Assembly typical shaft sizes: larger than $\varnothing 1-1/4''$. Not used on Side Entry application.

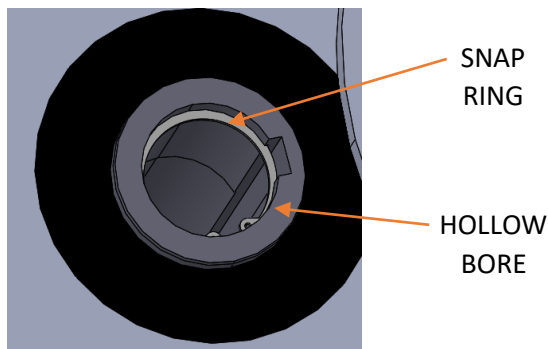
Note: Some of the assembly steps are identical for the fixing element with snap ring and the fixing element with stepped shaft. The steps will note this as you follow the assembly methods below.

Type 1 - Shaft Installation – Fixing Element with Snap Ring	Type 2 - Shaft Installation – Fixing Element with Stepped (Shouldered) Shaft
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- **This assembly step is the same for both Type 1 & 2.** Remove the gearbox's shaft cover by removing the bolts that hold it down. Keep the shaft cover and bolts.

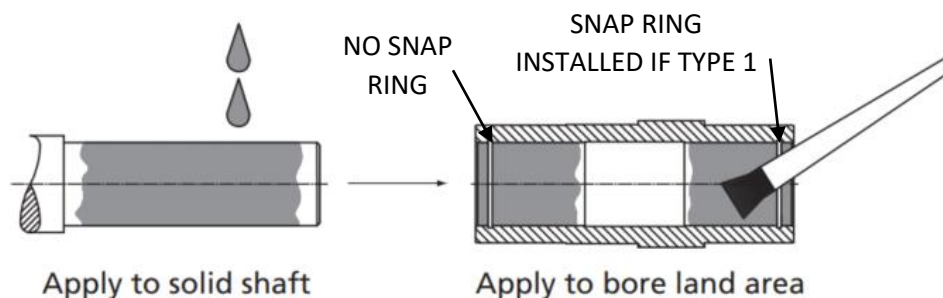


Type 1 - Shaft Installation – Fixing Element with Snap Ring	Type 2 - Shaft Installation – Fixing Element with Stepped (Shouldered) Shaft
<ul style="list-style-type: none"> • Type 1 assembly only. Ensure the snap ring is fully seated in the top groove in the gearbox's hollow bore. Some gearboxes have multiple grooves in hollow bore. 	<ul style="list-style-type: none"> • Type 2 assembly only. Remove the snap ring if installed.



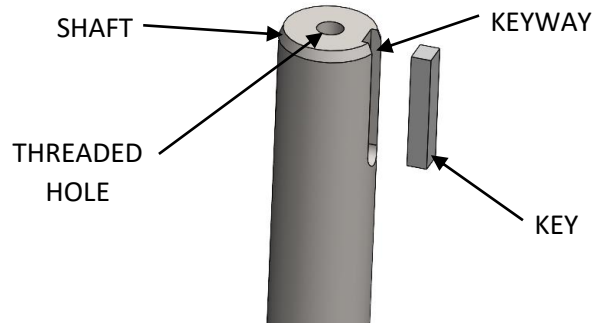
- **Type 1 & 2.** Clean and remove any dirt, grease, or rust-preventative coatings from both the gearbox hollow bore and the mixer shaft. Make sure the edges of both the gearbox hollow bore and mixer shaft are free from any nicks or burrs. If nicks or burrs are present, remove them using an abrasive material such as an emery cloth. Before installing the mixer shaft into the gearbox, apply an anti-seize compound or anti-corrosive lubricant to the mating shafts as shown in Figure 1. Assembly and subsequent disassembly will be aided by the anti-seize agent.

Figure 1 – Application of anti-seize to the mating shafts



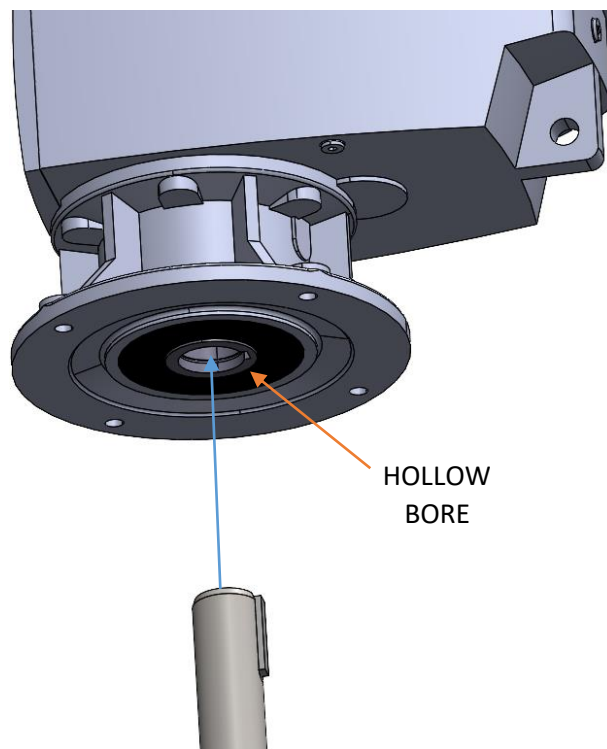
Type 1 - Shaft Installation – Fixing Element with Snap Ring	Type 2 - Shaft Installation – Fixing Element with Stepped (Shouldered) Shaft
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- **Type 1 & 2.** Insert the key into the keyway on the shaft before assembly in hollow bore.



- **Type 1 & 2.** Insert the shaft and key into the gearbox's hollow bore. Ensure that the key in the shaft is aligned with the keyway in the gearbox's hollow bore.

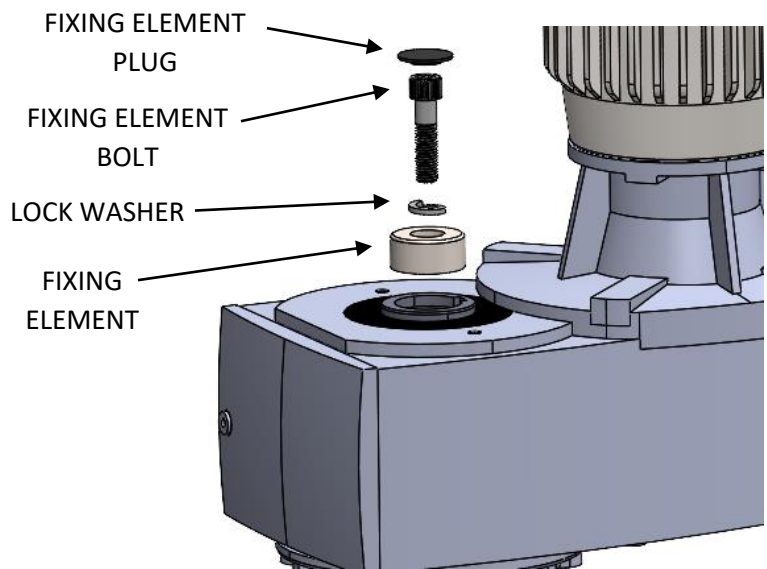
Type 1 only. The shaft needs to be in contact with the snap ring when fully inserted.	Type 2 only. The shaft shoulder should make contact with the bottom of the gearbox hollow
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Type 1 - Shaft Installation – Fixing Element with Snap Ring	Type 2 - Shaft Installation – Fixing Element with Stepped (Shouldered) Shaft
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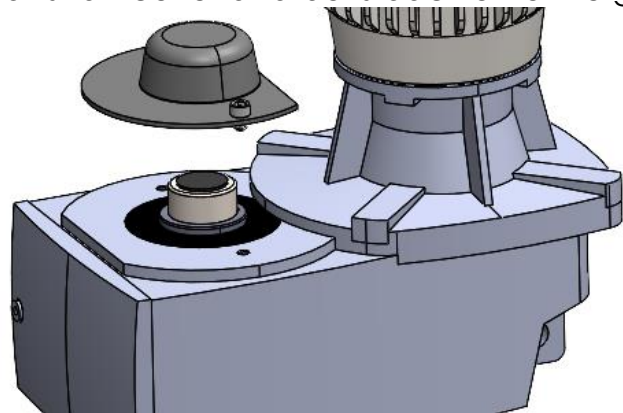
- Type 1 & 2.** Attach the shaft to the gearbox using the fixing element and fixing element bolt (both provided). Apply service removable thread-locking compound to the fixing element bolt before assembling to threaded end of shaft. Tighten the fixing element bolt to the appropriate torque value in the table.

TYPE 1 ONLY. DO NOT OVER TIGHTEN SCREW AS IT COULD CAUSE THE SNAP RING TO PULL OUT!



TYPE 1 & TYPE 2			
BOLT SIZE	18-8 & 304 STAINLESS	316 STAINLESS	GRADES 5 & 8
10-32	15 in-lb.	16 in-lb.	17 in-lb.
1/4-20	29 in-lb.	30 in-lb.	38 in-lb.
5/16-18	52 in-lb.	54 in-lb.	84 in-lb.
3/8-16	96 in-lb.	102 in-lb.	13 ft-lb.
7/16-14	13 ft-lb.	14 ft-lb.	20 ft-lb.
1/2-13	18 ft-lb.	19 ft-lb.	31 ft-lb.
5/8-11	41 ft-lb.	42 ft-lb.	61 ft-lb.
3/4-10	57 ft-lb.	59 ft-lb.	108 ft-lb.
7/8-9	89 ft-lb.	93 ft-lb.	126 ft-lb.
1-8	135 ft-lb.	141 ft-lb.	188 ft-lb.

- Type 1 & 2.** Install shaft cover and bolts back onto the gearbox.


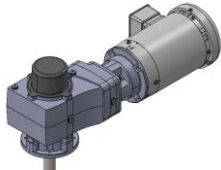
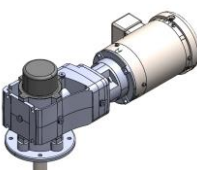
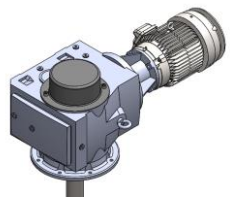


For additional Shaft Installation with Fixing Element support go to our YouTube Channel - [FusionFluidEquipment](https://www.youtube.com/channel/UCFusionFluidEquipment)


CAUTION:

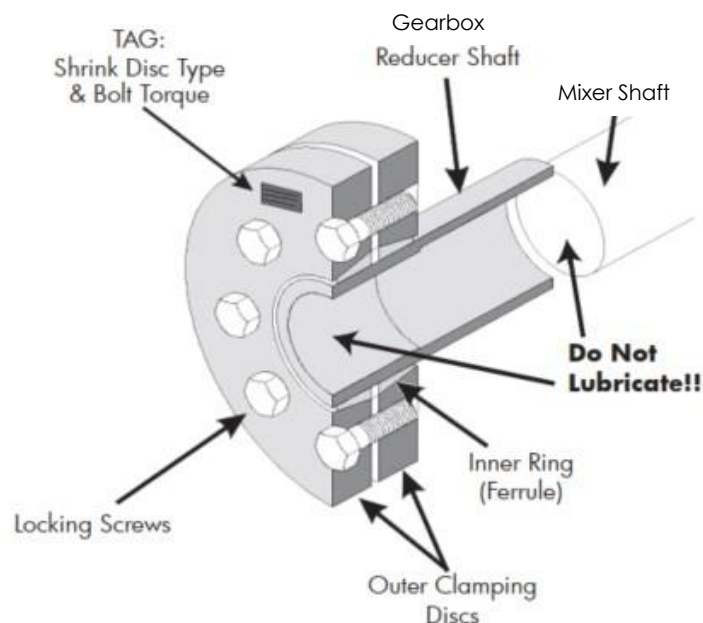
- **ALWAYS SHUT OFF AND LOCK OUT POWER SOURCE AND DISCONNECT FROM POWER SOURCE BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.**
- **HEAVY COMPONENTS – HANDLE PROPERLY.**

The following Fusion mixer models may use a shrink disc to secure the shaft to the Nord gearbox:

FG SERIES	FR2E SERIES	FR3 SERIES
	 (ENCLOSED)  (OPEN)	

Shrink Disc Assembly Concept

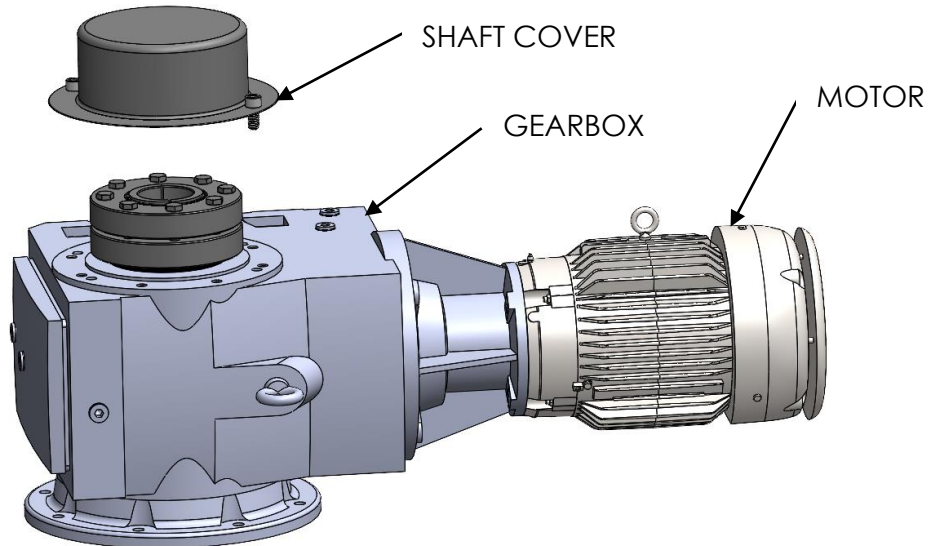
The shrink disc uses outer clamping discs and a double tapered inner ring to provide radial contact pressure on the mixer shaft. As the locking screws are properly tightened, the inner ring applies pressure on the mixer shaft creating a high-capacity interference fit (see image below).



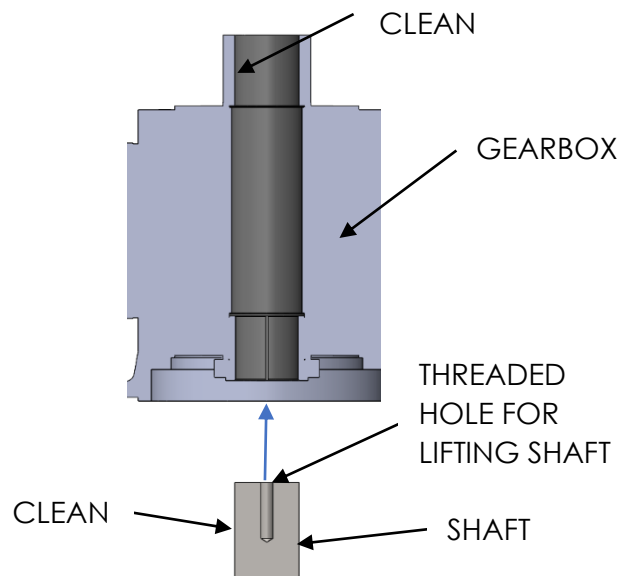
Shaft Installation with Shrink Disc

- 1) Remove the gearbox's shaft cover by removing the bolts that hold it down. Keep the shaft cover and bolts.

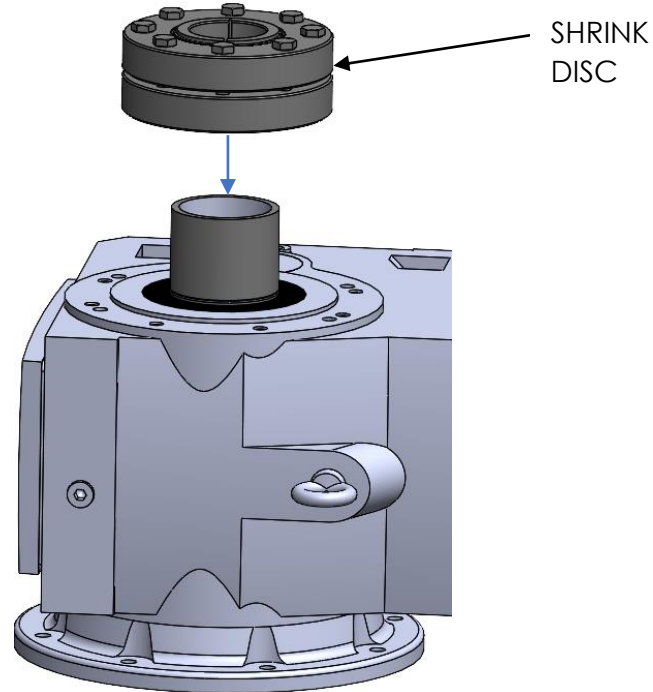
CAUTION:
 TIGHTENING
 SHRINK DISC
 WITHOUT A SHAFT
 IN THE BORE, WILL
 CAUSE DAMAGE
 TO THE GEARBOX.



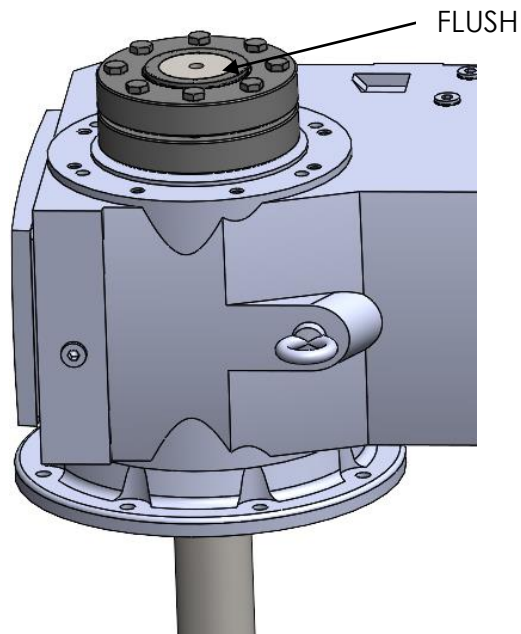
- 2) Make sure shaft and gearbox hollow bore are free from any rust, corrosion, lubricants, nicks, burrs or foreign matter. If nicks or burrs are present, remove them using an abrasive material such as an emery cloth or Scotch-Brite pad. Clean shaft and hollow bore ID with acetone or a similar solvent.



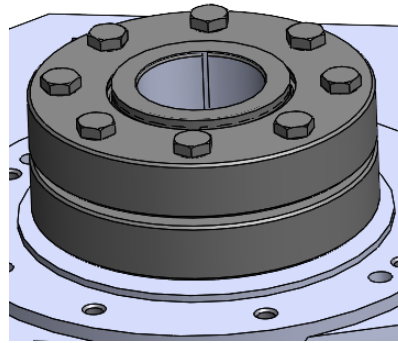
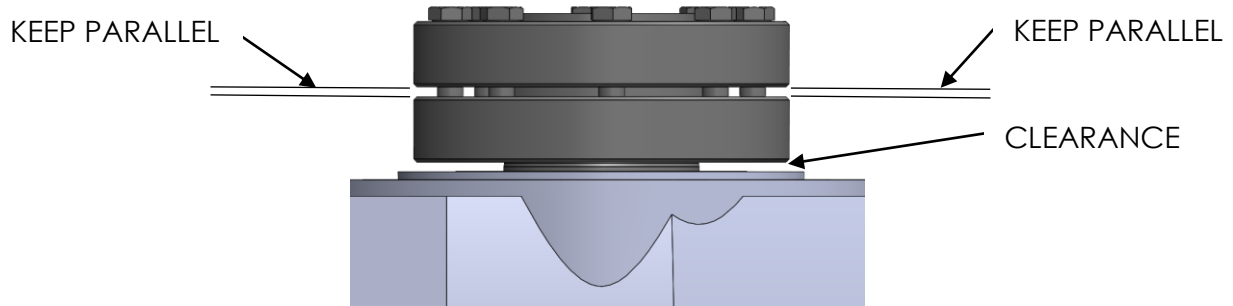
- 3) Verify all the bolts on the shrink disc are loose and slide the shrink disc onto the hollow bore OD.



- 4) Insert the shaft into the gearbox hollow bore. Position the shaft so it's flush with the gearbox hollow bore or as indicated on the approval (or as manufactured) drawing. The shaft will typically have a threaded hole in the end which can be used for lifting shaft in position and holding until the shrink disc is installed. The mixer shaft can be "BLOCKED UP" in position if an eyebolt cannot be used.

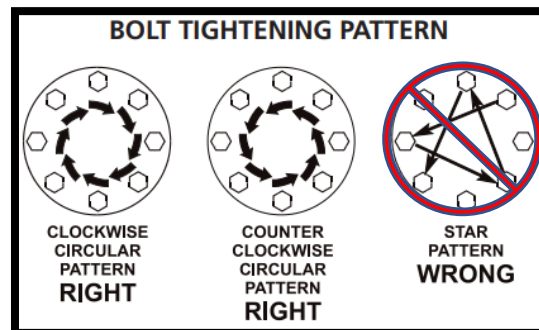


- 5) Verify there is clearance between the gearbox and the shrink disc. Hand tighten 3 or 4 equally spaced bolts. **MAKE SURE THE OUTER COLLARS OF THE SHRINK DISC ARE DRAWN TOGETHER IN A PARALLEL FASHION.** Then hand tighten the remaining bolts. **DO NOT TIGHTEN THE SHRINK DISC WITHOUT A SHAFT IN THE BORE OF THE GEARBOX, AS THIS WILL CAUSE DAMAGE TO THE GEARBOX.**



CAUTION: TIGHTENING SHRINK DISC WITHOUT A SHAFT IN THE BORE, WILL CAUSE DAMAGE TO THE GEARBOX.

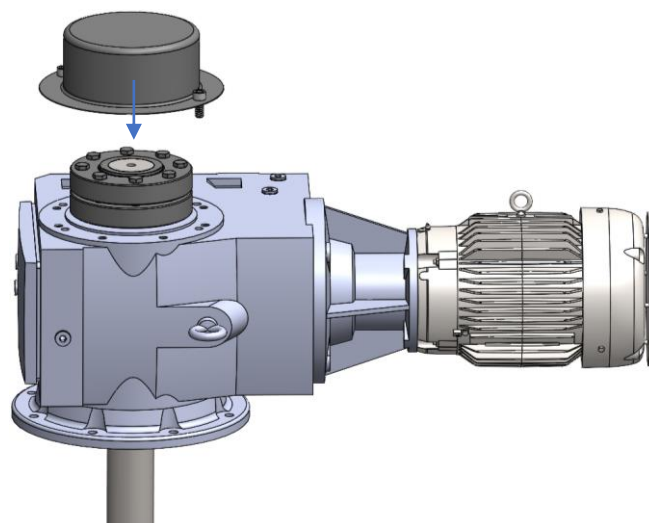
- 6) Tighten the bolts in a circular pattern using 1/4 (90°) turns, even if some bolts initially require very low tightening torque to achieve 1/4 turns. **ENSURE THE SHRINK DISC IS TIGHTENING EVENLY AND PARALLEL.** Tighten the bolts to the appropriate “tightening torque” value in the table on next page.



ENSURE THE SHRINK DISC IS TIGHTENING EVENLY AND PARALLEL

Screw Size	Wrench Size	Tightening Torque	4% Over Torque
M5	8	62 in-lb.	64 in-lb.
M6	10	106 in-lb.	110 in-lb.
M8	13	22 ft-lb.	23 ft-lb.
M10	17	44 ft-lb.	46 ft-lb.
M12	19	74 ft-lb.	77 ft-lb.
M16	24	184 ft-lb.	191 ft-lb.
M20	30	361 ft-lb.	375 ft-lb.
M24	36	620 ft-lb.	645 ft-lb.
M30	46	1254 ft-lb.	1304 ft-lb.

- 7) When the torque on the bolt is at the “tightening torque” value with less than 1/4 turn on the bolt, proceed to step 8.
- 8) Set the torque wrench to the appropriate value in the table, but use the “4% over torque” value in the table. Do one or two complete rotations using the same circular pattern technique.
- 9) Reset the torque wrench to the appropriate “tightening torque” value in the table. Confirm all of the bolts are tightened to the torque value using the circular pattern.
- 10) If an eyebolt or blocking was used to support shaft during shrink disc installation, this can now be removed.
- 11) Install the shaft cover and bolts back onto the gearbox.



For additional Shaft Installation with Shrink Disc support go to our YouTube Channel - [FusionFluidEquipment](https://www.youtube.com/channel/UCFusionFluidEquipment)

Removal of Shrink Disc



DANGER:

MAKE SURE MIXER SHAFT IS SUPPORTED BEFORE THE LOOSENING ANY OF THE SHRINK DISC BOLTS. FAILURE TO DO SO COULD RESULT IN PERSONNEL INJURY, DEATH, DAMAGE TO MIXER SHAFT OR MIXING TANK.

- 1) Make sure the mixer shaft is supported in operating position before removing shrink disc. An eyebolt can be use in the threaded hole in the end of the shaft to hold the shaft in place while the shrink disc is removed. The mixer shaft can be “BLOCKED UP” in place if an eyebolt cannot be used.
- 2) Loosen the shrink disc locking screws in a circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and reducer shaft will return to their original fits.



DANGER:

DO NOT COMPLETELY REMOVE THE LOCKING SCREWS BEFORE THE OUTER CLAMPING DISKS OF THE SHRINK DISC ARE DISENGAGED FROM THE INNER RING. A SUDDEN RELEASE OF THE OUTER COLLARS WILL CREATE HIGH SEPARATING FORCES AND COULD RESULT IN INJURY OR EVEN DEATH.

- 3) Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a soft faced hammer or prying lightly between the outer collars.
- 4) Remove the mixer shaft from the gearbox.

Re-installation of Shrink Disc

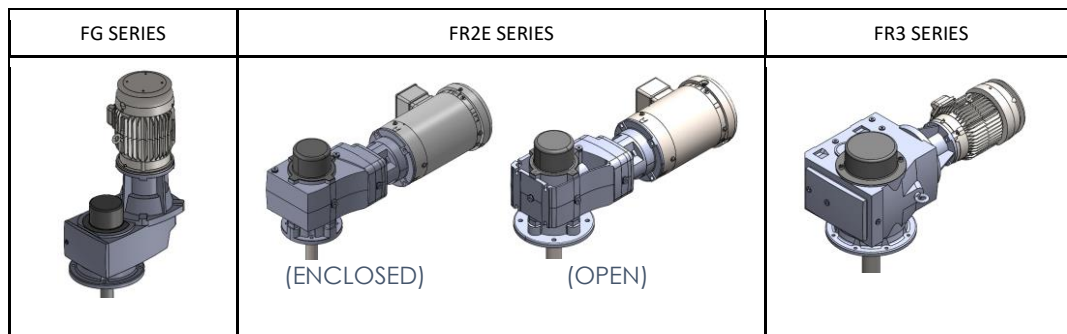
It may be possible to re-use the shrink disc. However, the shrink disc should not be re-used if it becomes damaged during removal, or if excessively rusty or corroded.

- 1) Shrink discs must always be disassembled and thoroughly cleaned before re-using.
- 2) After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multi-purpose grease.
- 3) The gearbox hollow bore should be thoroughly cleaned and check for damage before reinstalling mixer shaft.
- 4) Begin shrink disc assembly installation starting on page 2.


CAUTION:

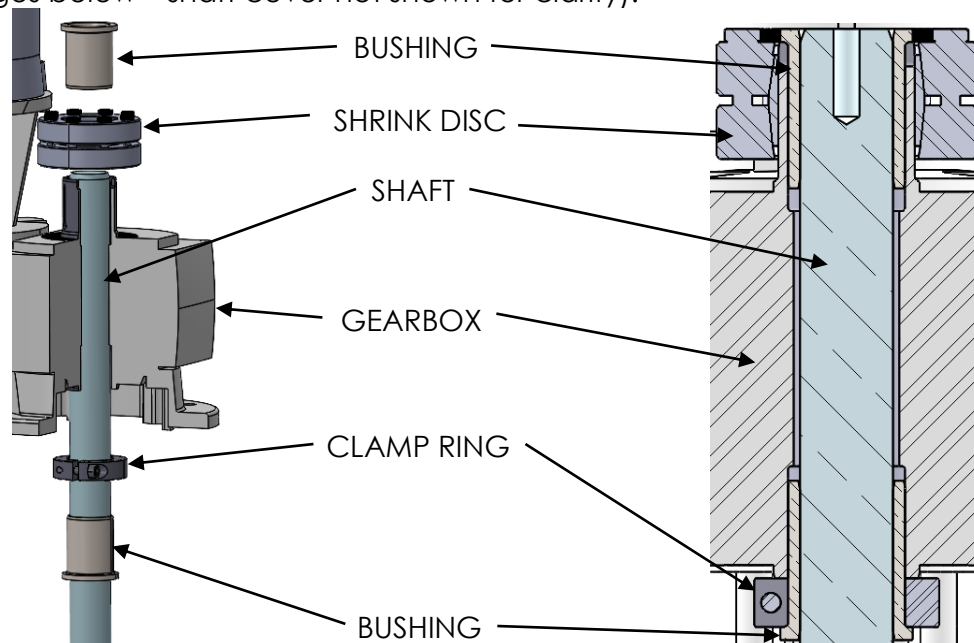
- **ALWAYS SHUT OFF AND LOCK OUT POWER SOURCE AND DISCONNECT FROM POWER SOURCE BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.**
- **HEAVY COMPONENTS – HANDLE PROPERLY.**

The following Fusion mixer models may use a Gripmaxx™ bushing system to secure the shaft to the Nord gearbox:



Gripmaxx™ Shrink Disc Assembly Concept

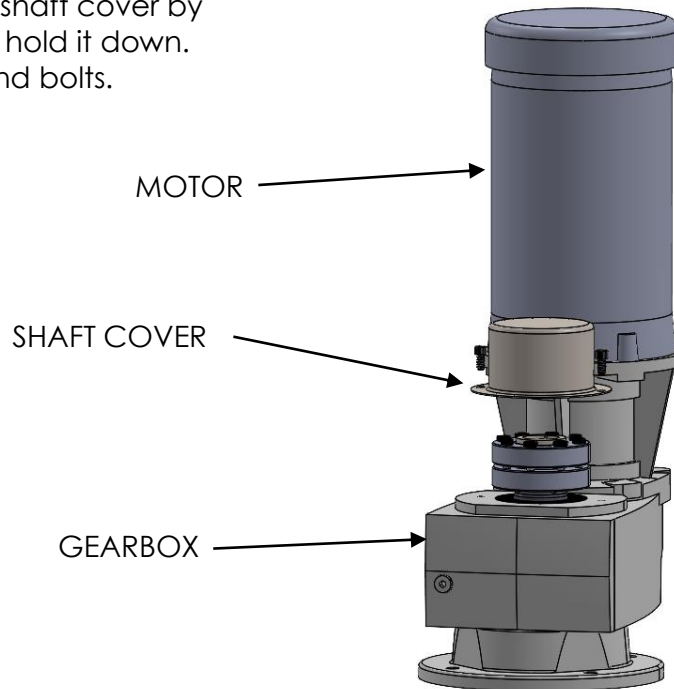
The Gripmaxx™ bushing system uses a shrink disc and keyless bushings for mounting a mixer shaft to the gearbox hollow bore. The shrink disc uses outer clamping discs and a double tapered inner ring to provide high compressive pressure on the mixer shaft. As the locking screws are properly tightened, the inner ring applies pressure on the mixer shaft through the hollow bore and split-bushing creating a high-capacity interference fit (see images below – shaft cover not shown for clarity).



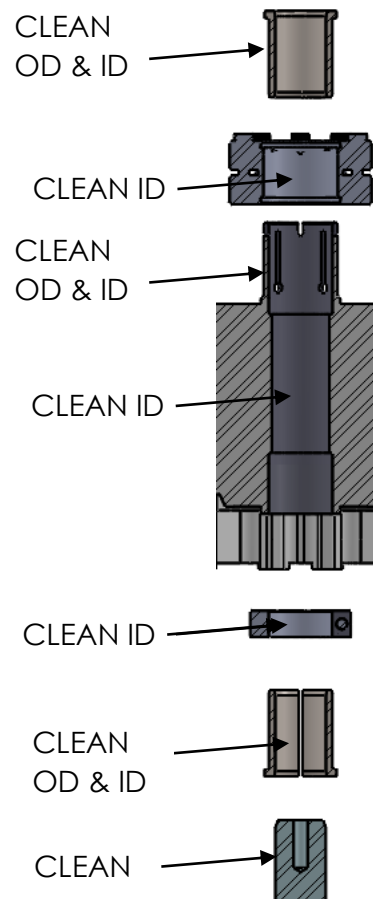
Shaft Installation with Gripmaxx™

- 1) Remove the gearbox's shaft cover by removing the bolts that hold it down. Keep the shaft cover and bolts.

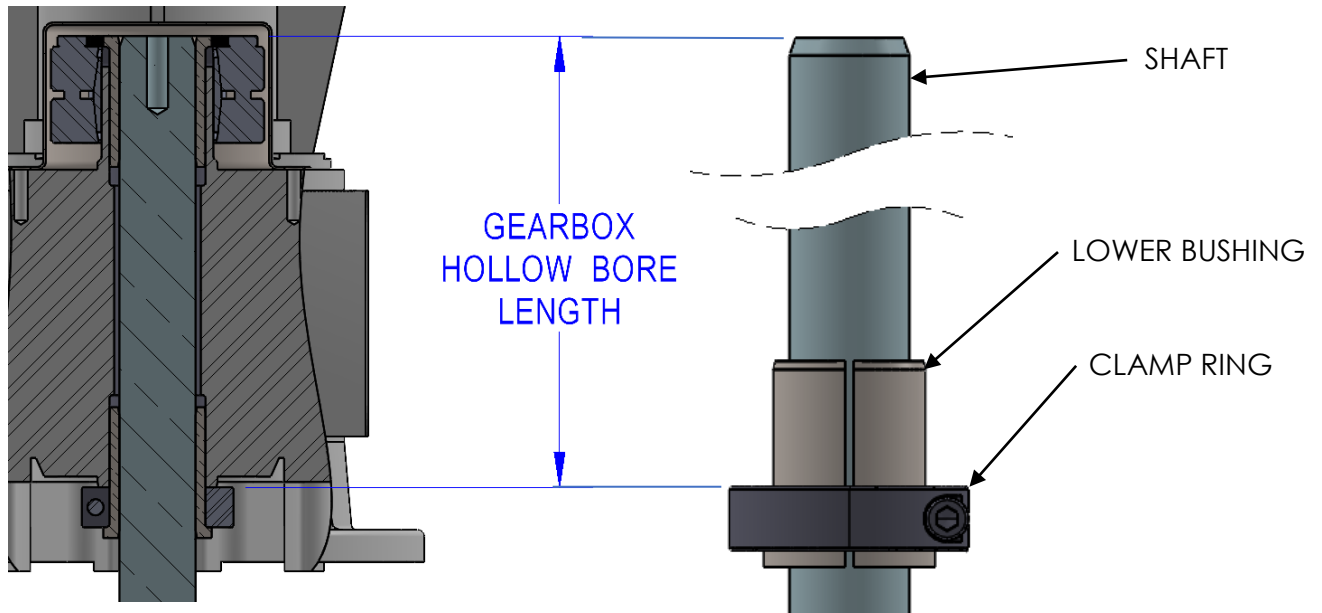
CAUTION:
TIGHTENING
SHRINK DISC
WITHOUT A SHAFT
IN THE BORE, WILL
CAUSE DAMAGE
TO THE GEARBOX.



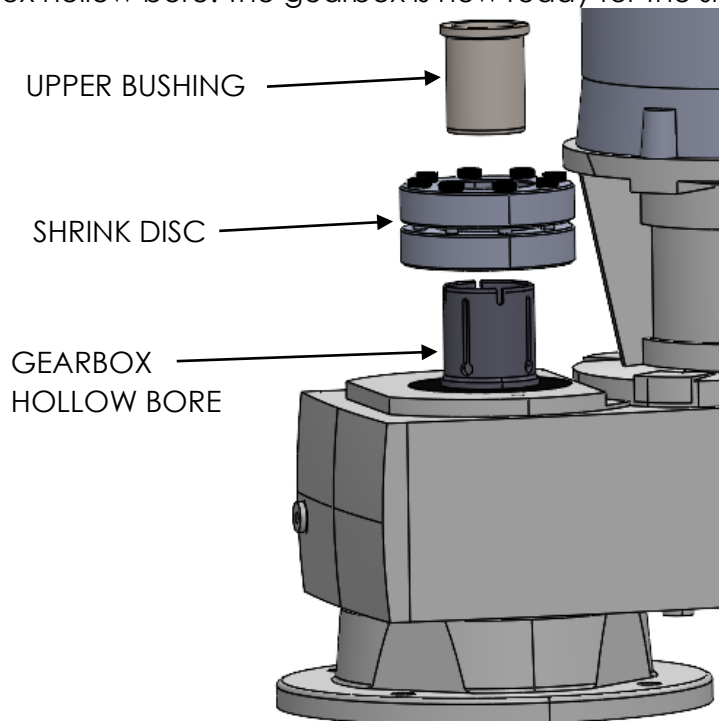
- 2) Make sure the mixer shaft and gearbox hollow bore are free from any rust, corrosion, lubricants, nicks, burrs or foreign matter. If nicks or burrs are present, remove them using an abrasive material such as an emery cloth or Scotch-Brite pad. Clean shaft, hollow bore ID, bushings, clamp ring and shrink disc with acetone or a similar solvent. The shrink disc & upper bushing are typically shipped installed into the gearbox hollow bore. They will need to be removed to be cleaned and to clean the upper portion of the hollow bore.



- 3) Position the clamp ring and lower bushing over the machine shaft as shown below. Make sure the bushing and clamp are in its desired location. The end of the shaft should be flush with the top of the upper bushing as shown on page 1. Once the position is verified, secure the support bushing with the clamp ring and tighten the clamp ring screw.

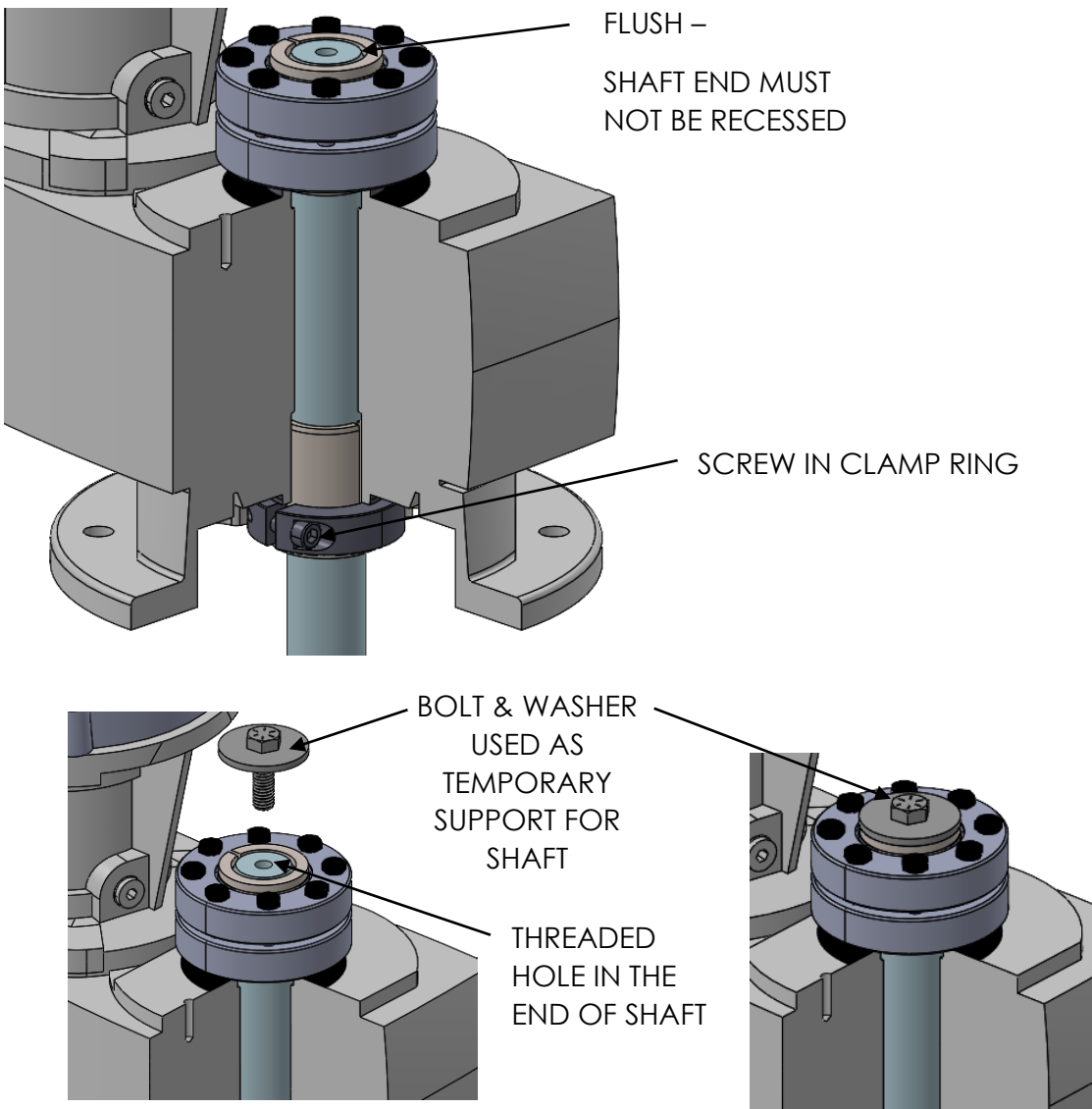


- 4) Without taking the shrink disc apart, verify all the bolts on the shrink disc are loose and slide the shrink disc onto the hollow bore OD. Slide the upper bushing into the gearbox hollow bore. The gearbox is now ready for the shaft installation.

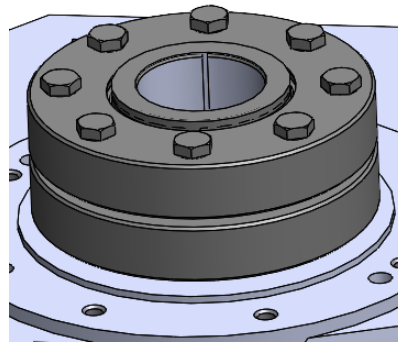
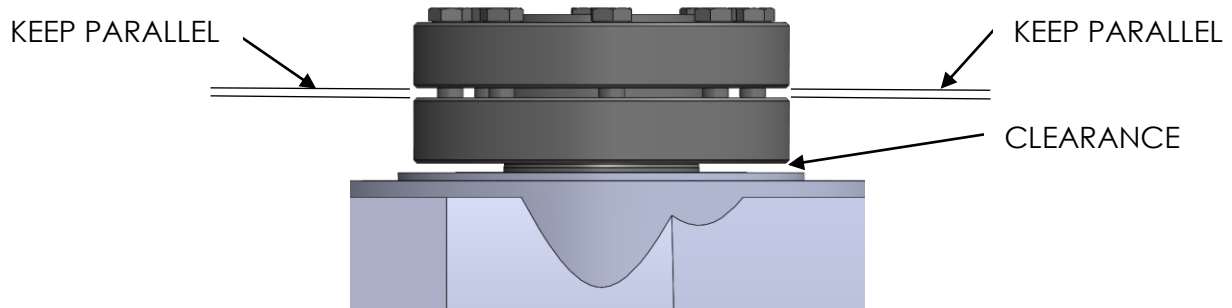


CAUTION:
 TIGHTENING
 SHRINK DISC
 WITHOUT A SHAFT
 IN THE BORE, WILL
 CAUSE DAMAGE
 TO THE GEARBOX.

- 5) Insert the shaft into the gearbox hollow bore. Position the shaft so it's flush with the top of the bushing in gearbox hollow bore or as indicated on the approval (or as manufactured) drawing. The screw in clamp ring on the lower bushing may have to be loosened in order for the shaft to be flush. The shaft will typically have a threaded hole in the end. An eyebolt can be used in the threaded hole for lifting shaft in position and holding until the shrink disc is installed. If an eyebolt cannot be used, a bolt through a large washer can be used as a temporary fixing element to support the shaft during assembly. The mixer shaft can also be "BLOCKED UP" in position if an eyebolt cannot be used.



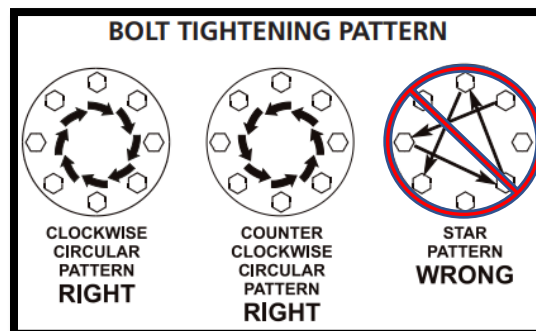
- 6) Confirm the position of the shrink disc and the upper bushing. Make sure the bushing is seated completely seated in the hollow bore. **DO NOT TIGHTEN THE SHRINK DISK UNTIL THE SHAFT AND BUSHING ARE IN CORRECT POSITION, OR THE GEARBOX HOLLOW BORE WILL BE DAMAGED.** Hand tighten 3 or 4 equally spaced bolts. **MAKE SURE THE OUTER COLLARS OF THE SHRINK DISK ARE DRAWN TOGETHER IN A PARALLEL FASHION.** Then hand tighten the remaining bolts.



CAUTION: TIGHTENING SHRINK DISK WITHOUT A SHAFT IN THE BORE, WILL CAUSE DAMAGE TO THE GEARBOX.

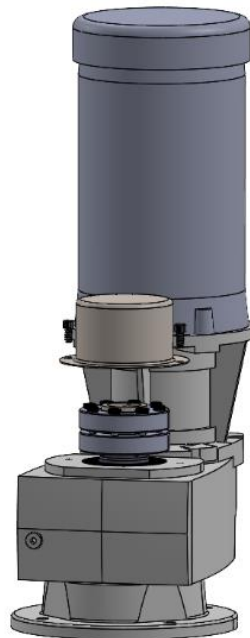
- 7) Tighten the bolts in a circular pattern using 1/4 (90°) turns, even if some bolts initially require very low tightening torque to achieve 1/4 turns. **ENSURE THE SHRINK DISK IS TIGHTENING EVENLY AND PARALLEL.** Tighten to the appropriate “tightening torque” value in the table on next page.

Screw Size	Wrench Size	Tightening Torque	4% Over Torque
M5	8	62 in-lb.	64 in-lb.
M6	10	106 in-lb.	110 in-lb.
M8	13	22 ft-lb.	23 ft-lb.
M10	17	44 ft-lb.	46 ft-lb.
M12	19	74 ft-lb.	77 ft-lb.
M16	24	184 ft-lb.	191 ft-lb.
M20	30	361 ft-lb.	375 ft-lb.
M24	36	620 ft-lb.	645 ft-lb.
M30	46	1254 ft-lb.	1304 ft-lb.



ENSURE THE SHRINK DISK IS TIGHTENING EVENLY AND PARALLEL

- 8) When the torque on the bolt is at the “tightening torque” value with less than 1/4 turn on the bolt, proceed to step 9.
- 9) Set the torque wrench to the appropriate value in the table, but use the “4% over torque” value in the table. Do one or two complete rotations using the same circular pattern technique.
- 10) Reset the torque wrench to the appropriate “tightening torque” value in the table. Ensure all of the bolts are properly tightened using the circular pattern.
- 11) If an eyebolt or blocking was used to support shaft during shrink disc installation, this can now be removed.
- 12) Install the shaft cover and bolts back onto the gearbox.



**DANGER:**

- **ALWAYS SHUT OFF AND LOCK OUT POWER SUPPLY AND DISCONNECT FROM POWER SUPPLY BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA**
- **MAKE SURE MIXER SHAFT IS SUPPORTED BEFORE THE LOOSENING ANY OF THE SHRINK DISC BOLTS. FAILURE TO DO SO COULD RESULT IN PERSONNEL INJURY, DEATH, DAMAGE TO MIXER SHAFT OR MIXING TANK.**

Removal of Shrink Disc

- 1) Make sure the mixer shaft is supported in operating position before removing shrink disc. An eyebolt can be use in the threaded hole in the end of the shaft to hold the shaft in place while the shrink disc is removed. The mixer shaft can be “BLOCKED UP” in place if an eyebolt cannot be used.
- 2) Loosen the shrink disc locking screws in a circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and gearbox shaft will return to their original fits.

**DANGER:**

DO NOT COMPLETELY REMOVE THE LOCKING SCREWS BEFORE THE OUTER CLAMPING DISKS OF THE SHRINK DISC ARE DISENGAGED FROM THE INNER RING. A SUDDEN RELEASE OF THE OUTER COLLARS WILL CREATE HIGH SEPARATING FORCES AND COULD RESULT IN INJURY OR EVEN DEATH.

- 3) Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a **soft faced** hammer or prying lightly between the outer collars.
- 4) Remove the mixer shaft from the gearbox.

Re-installation of Shrink Disc

It may be possible to re-use the bushings and shrink disc. However, the bushings and shrink disc should not be re-used if they become damaged during removal, or if excessively rusty or corroded.

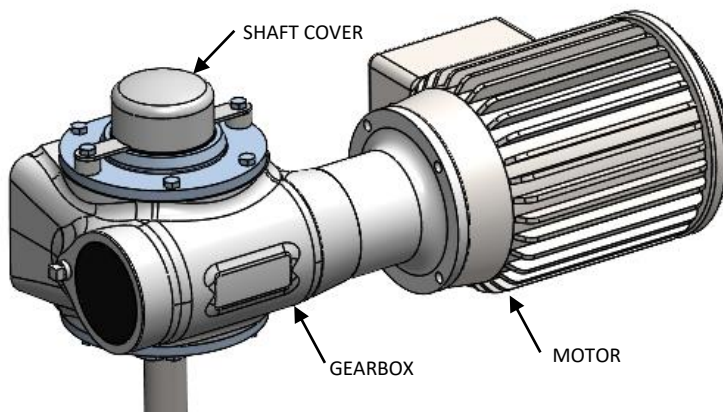
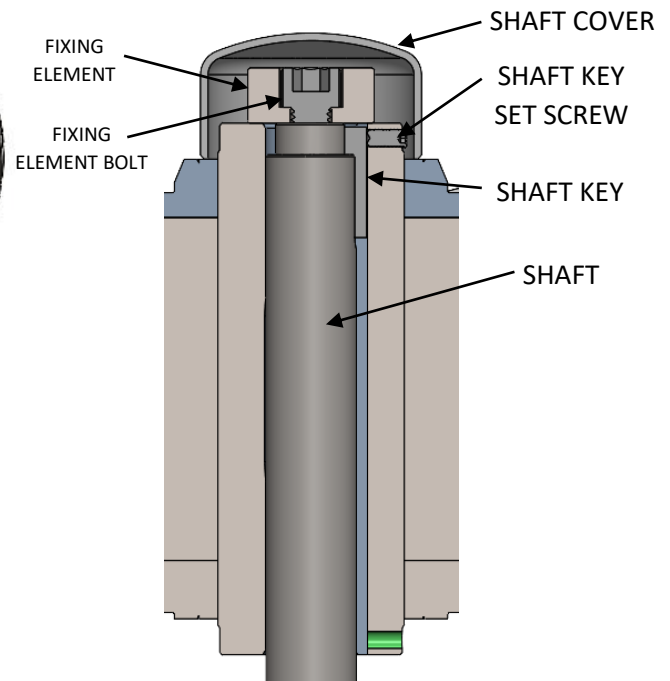
- 1) Shrink discs must always be disassembled and thoroughly cleaned before re-using.
- 2) After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multi-purpose grease.
- 3) The bushings should be thoroughly cleaned before re-installation.
- 4) The gearbox hollow bore should be thoroughly cleaned and check for damage before reinstalling mixer shaft.
- 5) Begin shrink disc assembly installation starting on page 2.


CAUTION:

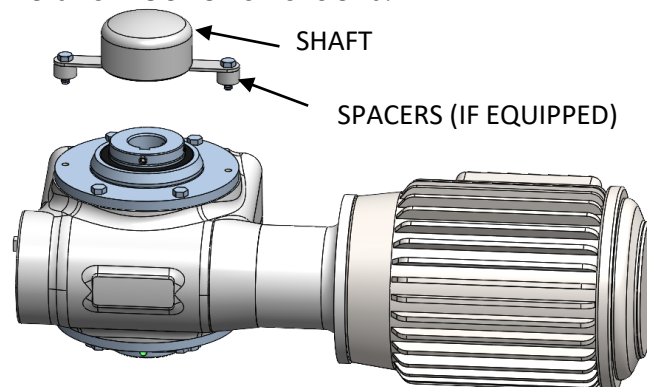
- **ALWAYS SHUT OFF AND LOCK OUT POWER SUPPLY AND DISCONNECT FROM POWER SUPPLY BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA**

Shaft Installation – Cone Drive Fixing Element

The following section provides instruction on the installation of a shaft with keyway and fixing element in a hollow bore of a Cone Drive gearbox.

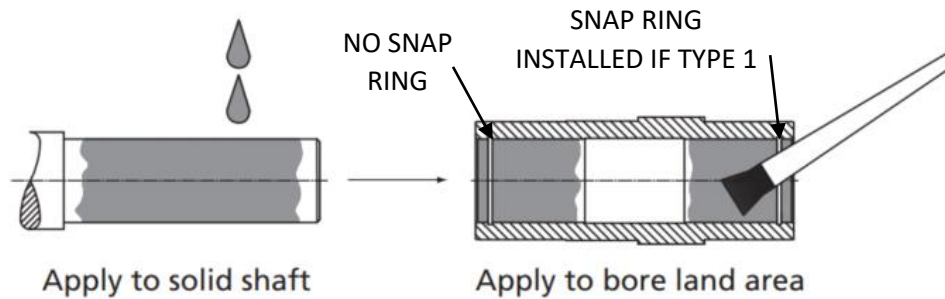
 FINAL ASSEMBLY WITH SHAFT
AND SHAFT COVER INSTALLED

 SECTION VIEW OF
FINAL ASSEMBLY


- 1) Remove the gearbox's shaft cover by removing the bolts that hold it down. Keep the shaft cover and bolts.

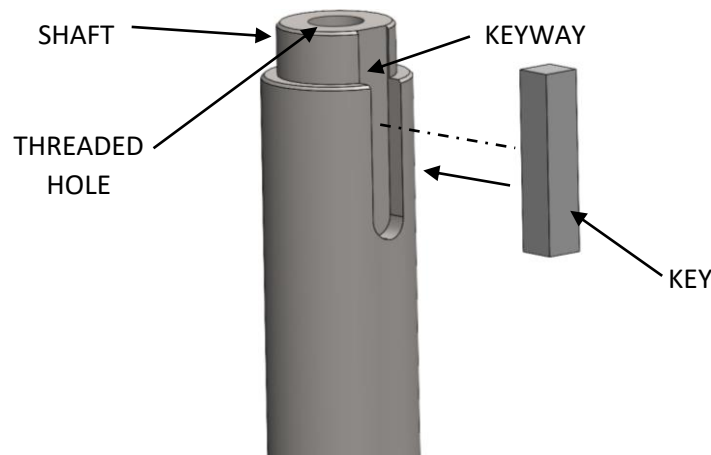


- 2) Clean and remove any dirt, grease, or rust-preventative coatings from both the gearbox hollow bore and the mixer shaft. Make sure the edges of both the gearbox hollow bore and mixer shaft are free from any nicks or burrs. If nicks or burrs are present remove them using an abrasive material such as an emery cloth. Before installing the mixer shaft into the gearbox, apply an anti-seize compound or anti-corrosive lubricant to the mating shafts as shown in Figure 1. Assembly and subsequent disassembly will be aided by the anti-seize agent.

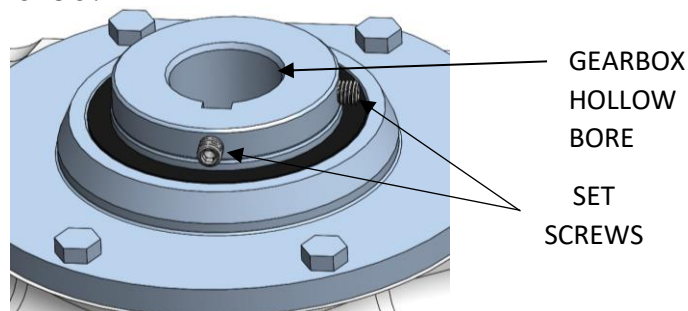
Figure 1 – Application of anti-seize to the mating shafts



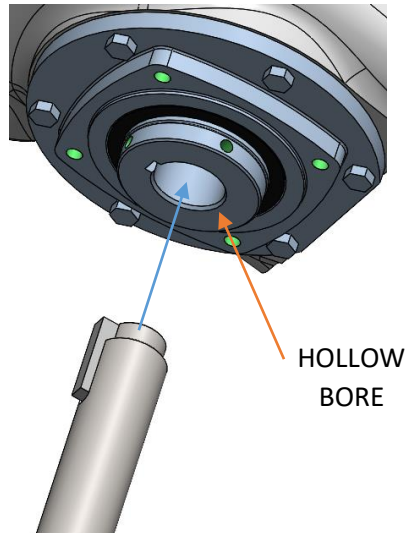
- 3) Insert the key into the keyway on the shaft before assembly in hollow bore.



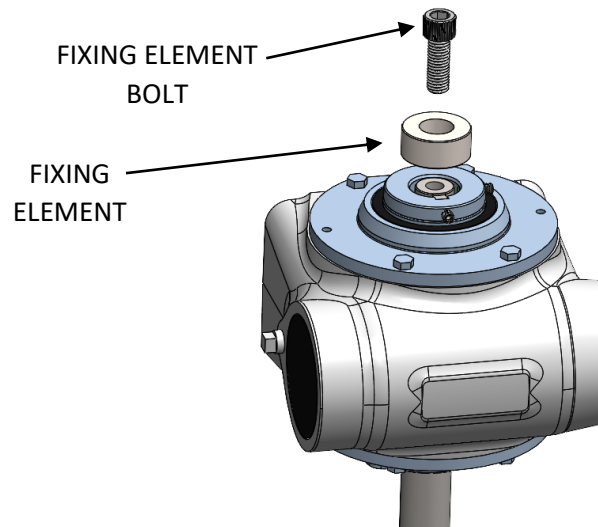
- 4) Ensure the set screws are backed up and clear of the bore to allow for the shaft and key to be installed.



- 5) Insert the shaft and key into the gearbox's hollow bore. Ensure that the key in the shaft is aligned with the keyway in the gearbox's hollow bore.

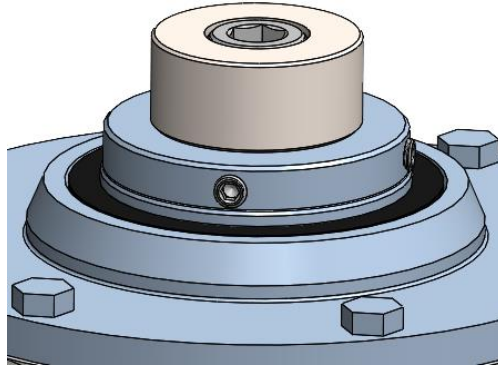


- 6) Attach the shaft to the gearbox using the fixing element and fixing element bolt (both provided). Apply service removable thread-locking compound to the fixing element bolt threads before assembling to tapped end of shaft. Tighten the fixing element bolt to the appropriate value in the table.

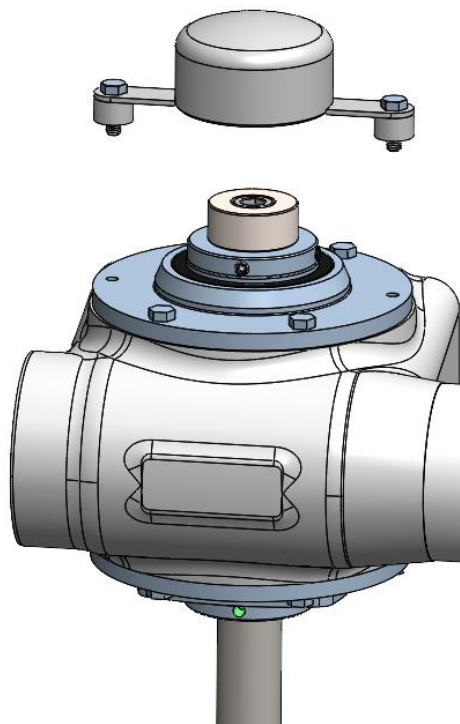


BOLT SIZE	18-8 & 304 STAINLESS	316 STAINLESS
5/16-24	71 in-lb.	74 in-lb.
3/8-16	96 in-lb.	102 in-lb.
7/16-14	13 ft-lb.	14 ft-lb.
5/8-11	41 ft-lb.	42 ft-lb.

- 7) Removed set screws & apply service removable thread-locking compound to the set screw threads, reinstall & then tighten the screws to 71 in-lbs.



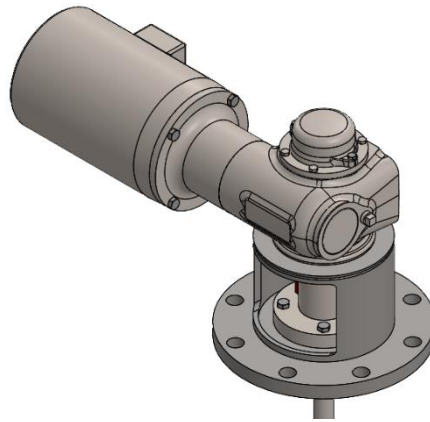
- 8) Install shaft cover and bolts (and spacers if provided) back onto the gearbox.




CAUTION:

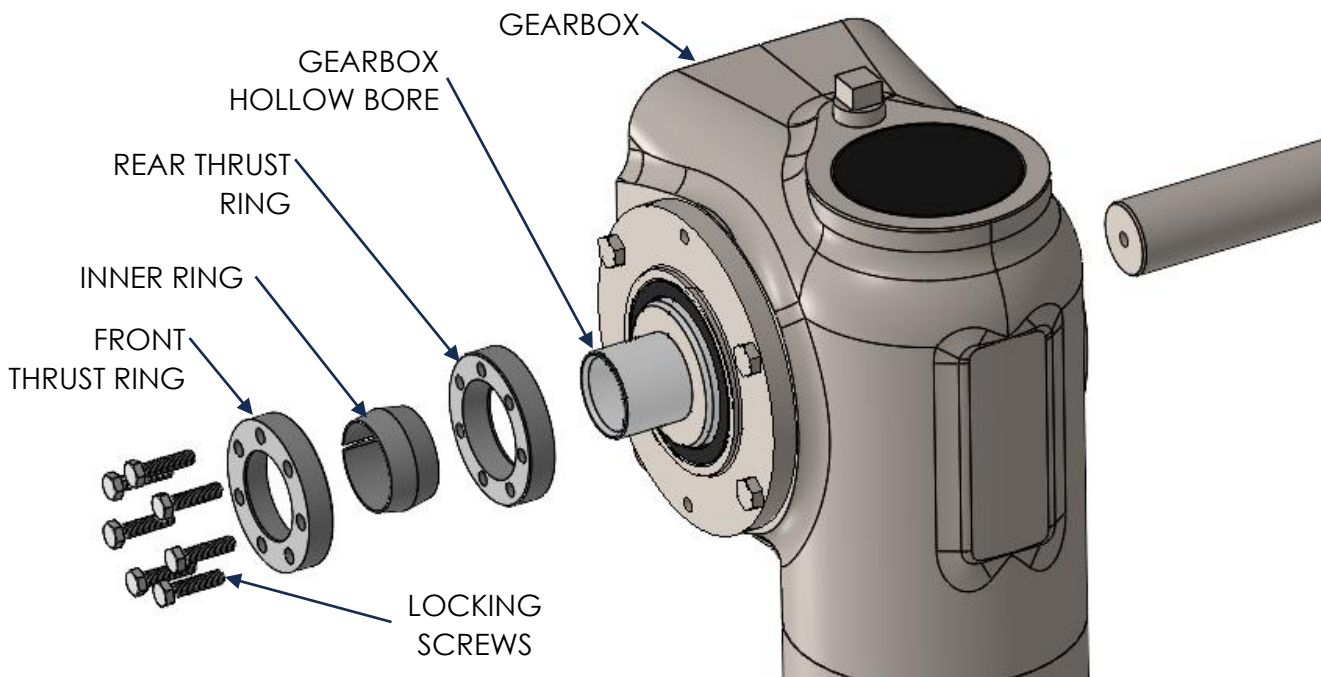
- **ALWAYS SHUT OFF AND LOCK OUT POWER SOURCE AND DISCONNECT FROM POWER SOURCE BEFORE SERVICING MIXER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.**
- **PINCH POINTS & SHARP EDGES MAY BE LOCATED IN THIS AREA.**
- **HEAVY COMPONENTS – HANDLE PROPERLY.**

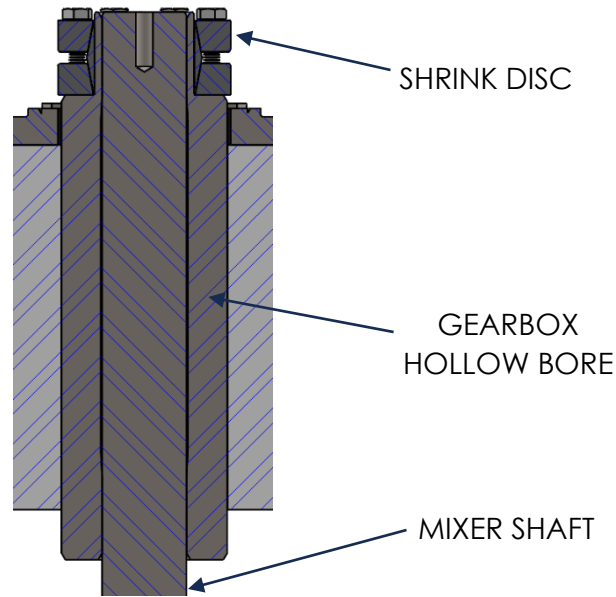
Typically, a Fusion FCWS model (shown below) may use a shrink disc to secure the shaft to the Cone Drive gearbox:



Shrink Disc Assembly Concept

The shrink disc uses Front and Rear Thrust Rings, and a double tapered inner ring to provide radial contact pressure on the mixer shaft. As the locking screws are properly tightened, the inner ring applies pressure on the mixer shaft creating a high-capacity interference fit (see image below).

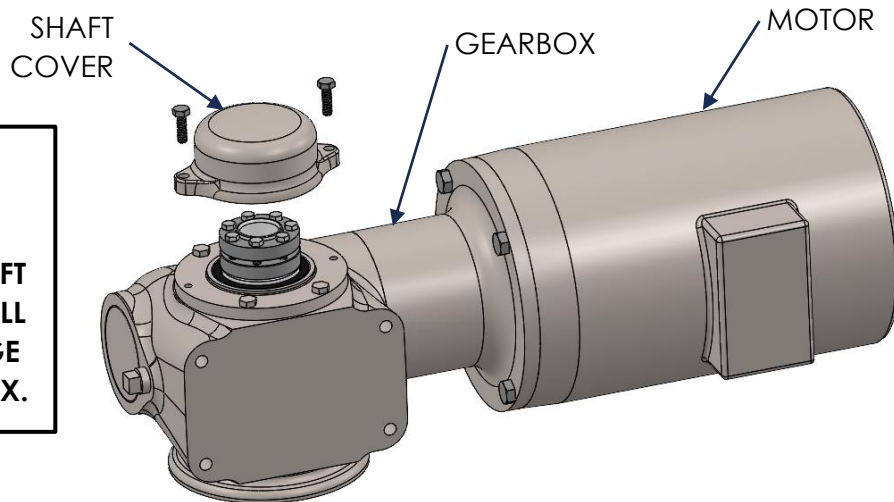




SECTION VIEW OF SHAFT ASSEMBLED TO GEARBOX

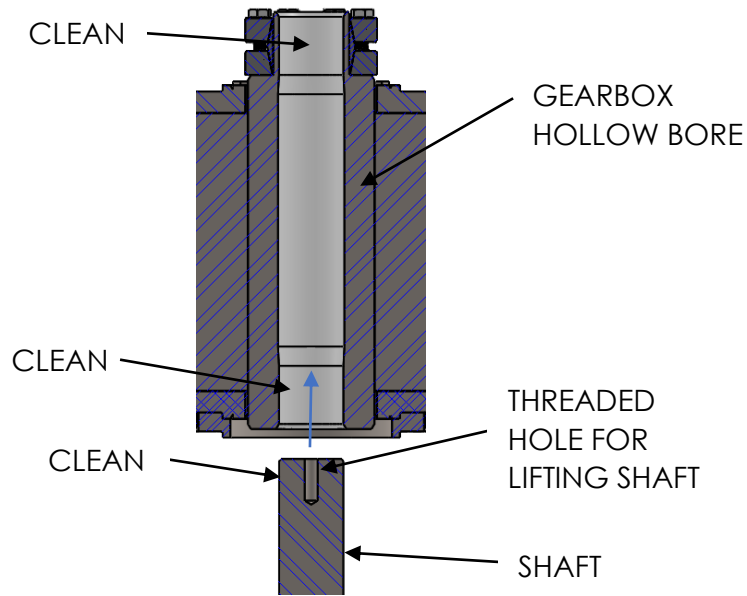
Shaft Installation with Shrink Disc

- 1) Remove the gearbox's shaft cover by removing the bolts that hold it down. Keep the shaft cover and bolts.

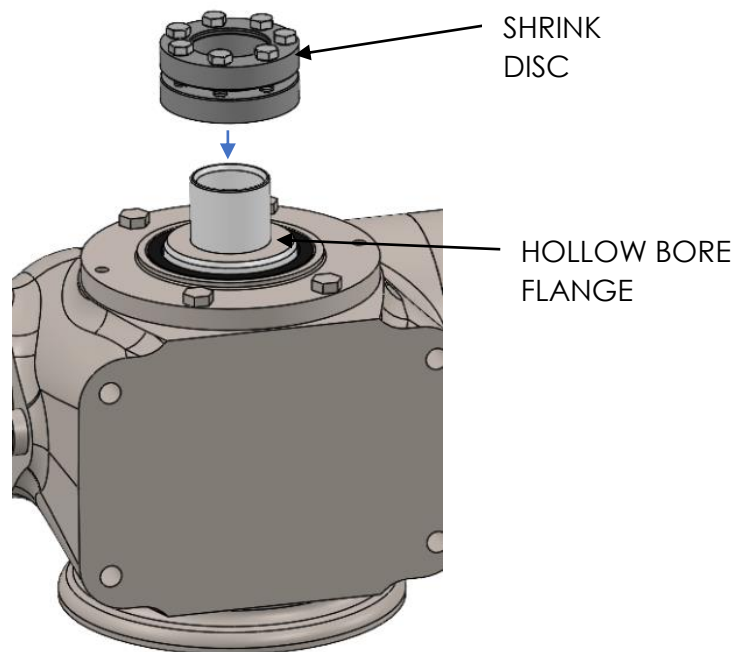


CAUTION:
 TIGHTENING
 SHRINK DISC
 WITHOUT A SHAFT
 IN THE BORE, WILL
 CAUSE DAMAGE
 TO THE GEARBOX.

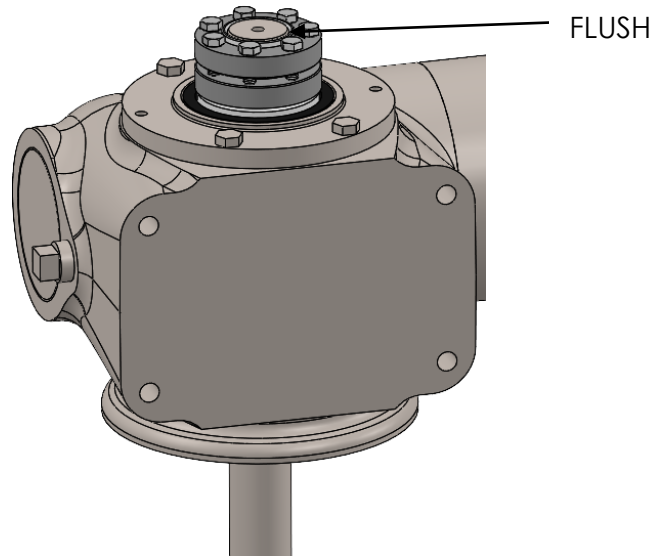
- 2) Make sure shaft and gearbox hollow bore are free from any rust, corrosion, nicks, burrs or foreign matter. If nicks or burrs are present, remove them using an abrasive material such as an emery cloth or Scotch-Brite pad. Clean shaft and hollow bore ID with acetone or a similar solvent. A light oil on the shaft to aid in assembly is permissible, but not recommended. **If any oil is applied to shaft, "MAKE SURE TO NOT USE" Molykote or an oil containing MoS₂.**



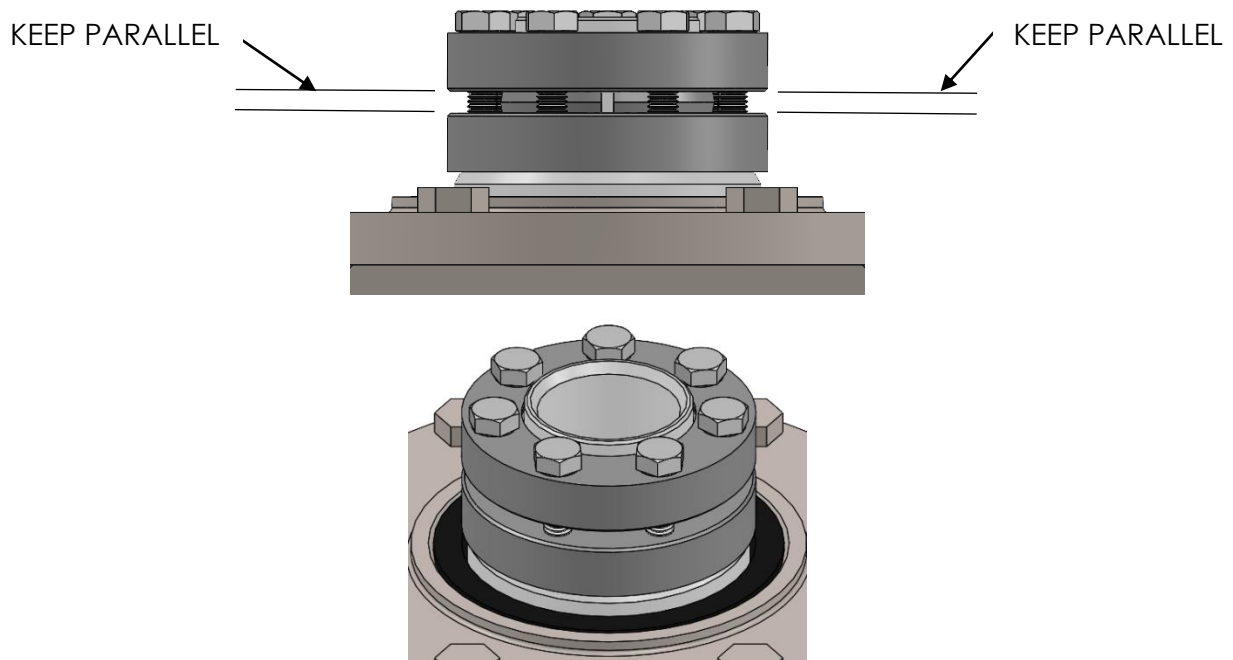
- 3) Typically, a Fusion mixer with a shrink disc will be shipped with the shrink disc on the gearbox hollow bore. The bolts will be loose on the shrink disc, so it can be easily removed. If the shrink disc is not on the gearbox, verify all the bolts on the shrink disc are loose and slide the shrink disc onto the hollow bore OD. Slide the shrink disc down the hollow bore until it rests on the hollow bore flange.



- 4) Insert the shaft into the gearbox hollow bore. Position the shaft so it's flush with the gearbox hollow bore or as indicated on the approval (or as manufactured) drawing. The shaft will typically have a threaded hole in the end which can be used for lifting shaft in position and holding until the shrink disc is installed. The mixer shaft can be "BLOCKED UP" in position if an eyebolt cannot be used.

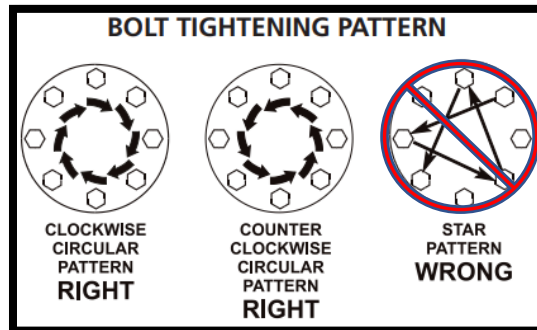


- 5) Once mixer shaft is supported in place, hand tighten 3 or 4 equally spaced bolts. **MAKE SURE THE OUTER COLLARS OF THE SHRINK DISC ARE DRAWN TOGETHER IN A PARALLEL FASHION.** Then hand tighten the remaining bolts. **DO NOT TIGHTEN THE SHRINK DISC WITHOUT A SHAFT IN THE BORE OF THE GEARBOX, AS THIS WILL CAUSE DAMAGE TO THE GEARBOX.**



CAUTION: TIGHTENING SHRINK DISC WITHOUT A SHAFT IN THE BORE, WILL CAUSE DAMAGE TO THE GEARBOX HOLLOW BORE.

- 6) Tighten the bolts in a circular pattern using 1/4 (90°) turns, even if some bolts initially require very low tightening torque to achieve 1/4 turns. **ENSURE THE SHRINK DISC IS TIGHTENING EVENLY AND PARALLEL.** Tighten the bolts to the appropriate “tightening torque” value in the table below.

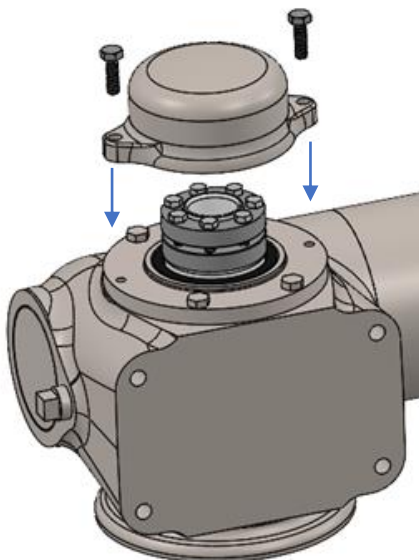


ENSURE THE SHRINK DISC IS TIGHTENING EVENLY AND PARALLEL

Screw Size	Wrench Size	Tightening Torque	4% Over Torque
M5	8	62 in-lb.	64 in-lb.
M6	10	106 in-lb.	110 in-lb.
M8	13	22 ft-lb.	23 ft-lb.
M10	17	44 ft-lb.	46 ft-lb.
M12	19	74 ft-lb.	77 ft-lb.
M16	24	184 ft-lb.	191 ft-lb.
M20	30	361 ft-lb.	375 ft-lb.
M24	36	620 ft-lb.	645 ft-lb.
M30	46	1254 ft-lb.	1304 ft-lb.

- 7) When the torque on the bolt is at the “Tightening Torque” value with less than 1/4 turn on the bolt, proceed to step 8.
- 8) Set the torque wrench to the appropriate value in the table, but use the “4% Over Torque” value in the table. Do one or two complete rotations using the same circular pattern technique.
- 9) Reset the torque wrench to the appropriate “Tightening Torque” value in the table. Confirm all of the bolts are tightened to the torque value using the circular pattern.
- 10) If an eyebolt or blocking was used to support shaft during shrink disc installation, this can now be removed.
- 11) Install the shaft cover and bolts back onto the gearbox.

NOTE: Check the “Tightening Torque” for the bolts on your shrink disc after running your mixer continuously for 12 hours or at the next scheduled Preventative Maintenance to make sure they are tightened to specification.



Removal of Shrink Disc



DANGER:

MAKE SURE MIXER SHAFT IS SUPPORTED BEFORE THE LOOSENING ANY OF THE SHRINK DISC BOLTS. FAILURE TO DO SO COULD RESULT IN PERSONNEL INJURY, DEATH, DAMAGE TO MIXER SHAFT OR MIXING TANK.

- 1) Make sure the mixer shaft is supported in operating position before removing shrink disc. An eyebolt can be used in the threaded hole in the end of the shaft to hold the shaft in place while the shrink disc is removed. The mixer shaft can be “BLOCKED UP” in place if an eyebolt cannot be used.



DANGER:

DO NOT COMPLETELY REMOVE THE LOCKING SCREWS BEFORE THE OUTER CLAMPING DISKS OF THE SHRINK DISC ARE DISENGAGED FROM THE INNER RING. A SUDDEN RELEASE OF THE OUTER COLLARS WILL CREATE HIGH SEPARATING FORCES AND COULD RESULT IN INJURY OR EVEN DEATH.

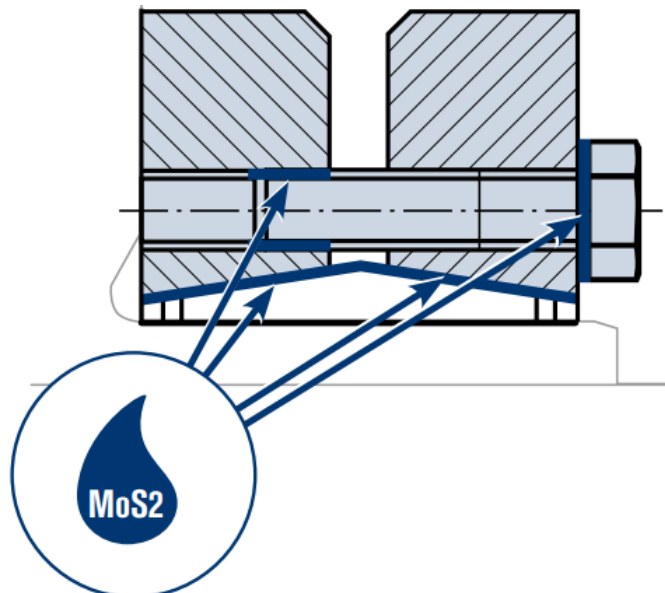
- 2) Loosen the shrink disc locking screws in a circular pattern by using 1/4 (90°) turns, until the screws are loose, but threads still engaged.
- 3) The outer collars of the shrink disc may not be loose from the tapered inner ring. This may require tapping the bolts with a soft faced hammer or prying lightly between the outer collars until the shrink disc hub can be moved.
- 4) Remove the mixer shaft from the gearbox.

Re-installation of Shrink Disc

It may be possible to re-use the shrink disc. However, the shrink disc should not be re-used if it becomes damaged during removal, or if excessively rusty or corroded.

- 1) Shrink discs must always be disassembled and thoroughly cleaned before re-using.

- 2) After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (**MoS₂** product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multi-purpose grease.

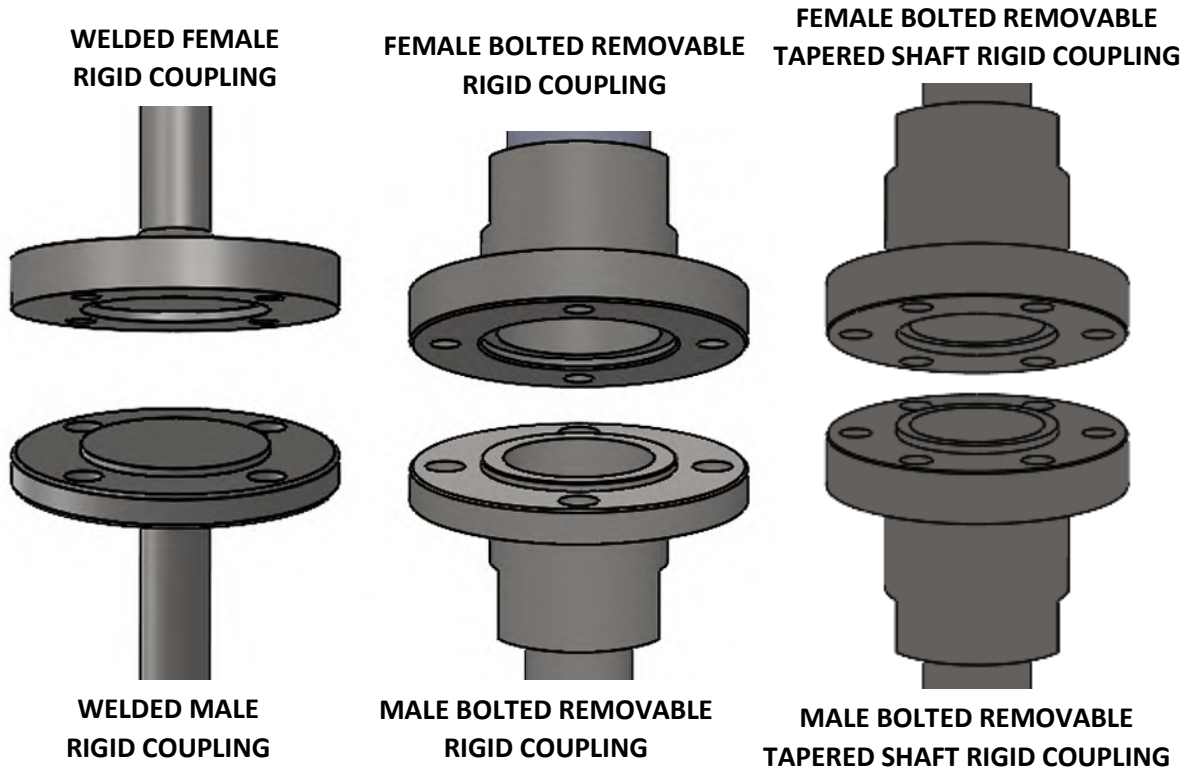


- 3) The gearbox hollow bore should be thoroughly cleaned and check for damage before reinstalling mixer shaft.
- 4) Begin shrink disc assembly installation starting on page 2.

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

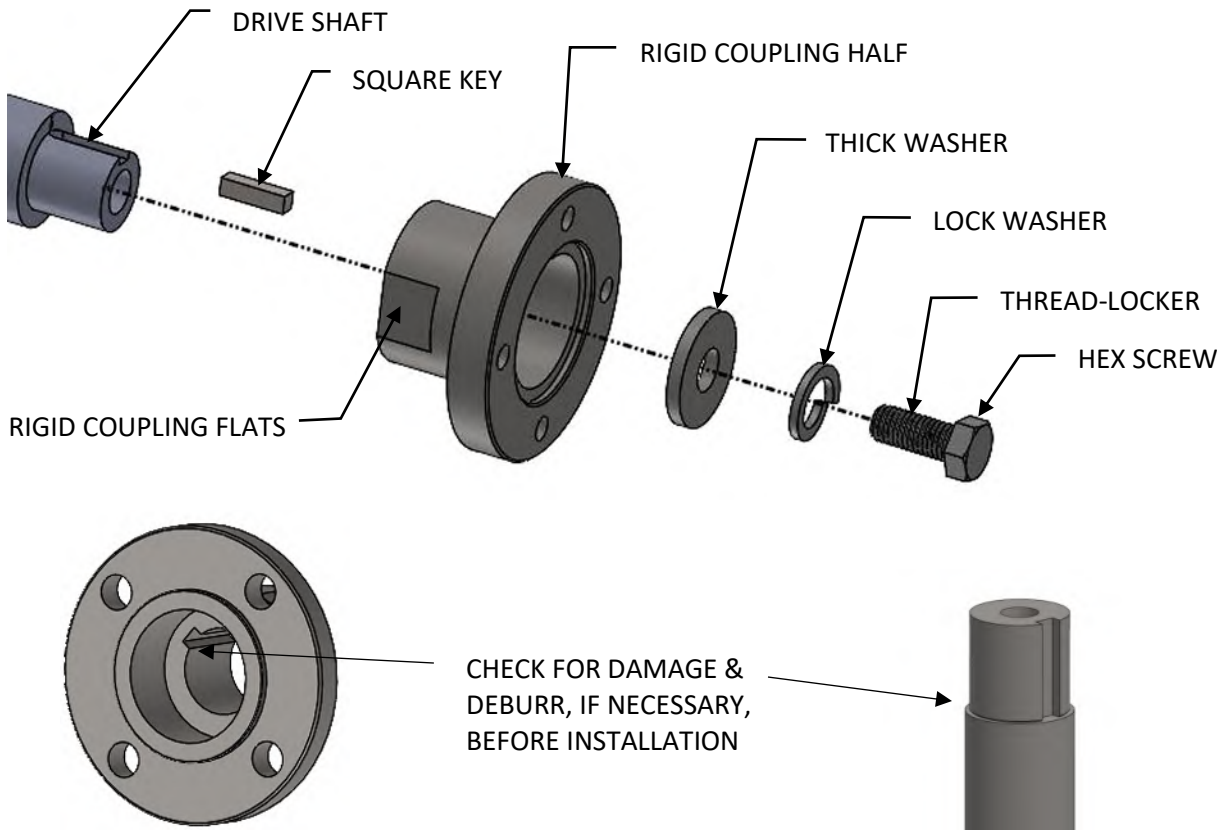
The following section is for the installation of a Bolted Removable Rigid Coupling which may be above or below mount.



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

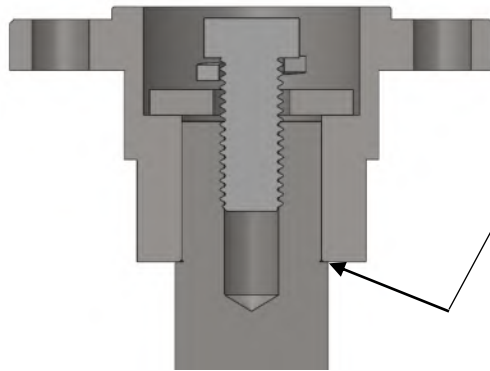


To avoid binding in the future and ease of installation, apply process compatible grease or anti-seize compound on the drive end portion of the drive shaft.

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

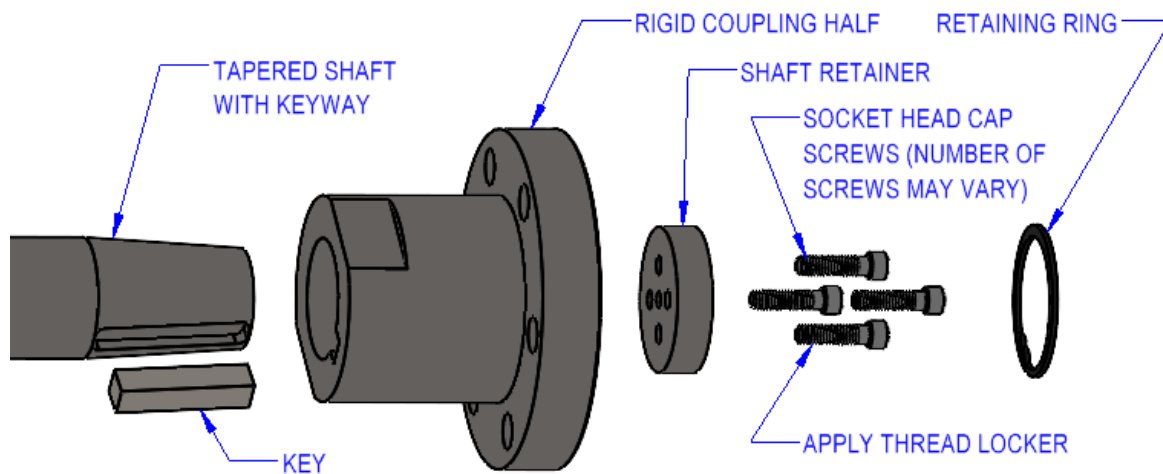


USE A .001" FEELER GAUGE TO ENSURE THE COUPLING IS TIGHT TO THE SHOULDER ON THE SHAFT

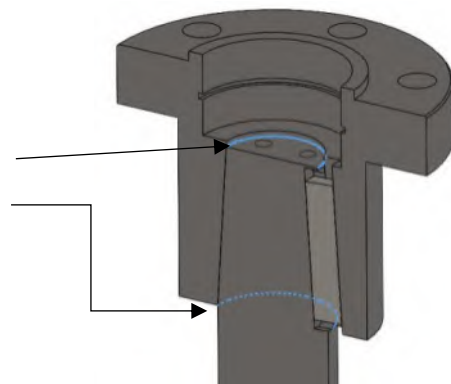
Installation – Bolted Removable Tapered Shaft Rigid Coupling

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

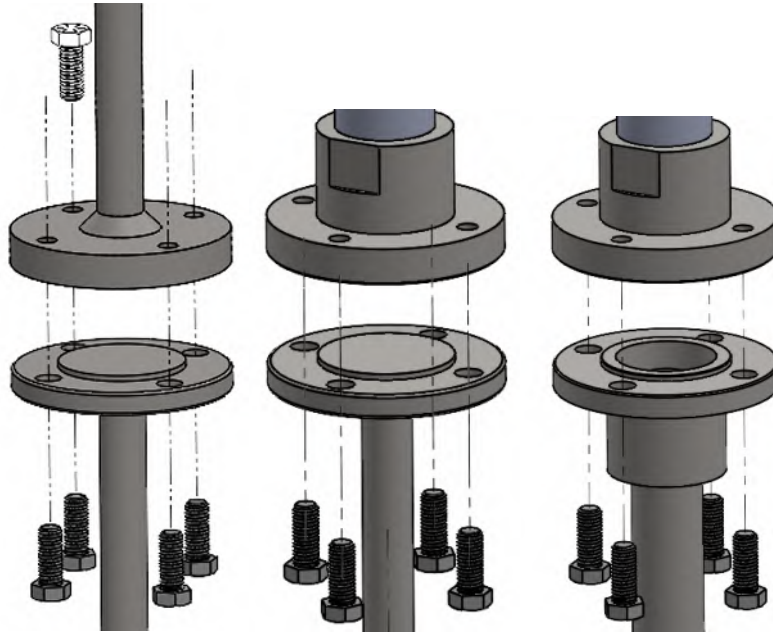


CAUTION: FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE MIXER. CHECK MOUNTING FACES FOR BURRS OR ANY OTHER PROTRUSION THAT MAY CAUSE PROBLEMS WITH ASSEMBLY. REMOVE BURRS AS NEEDED TO COMPLETE ASSEMBLY.

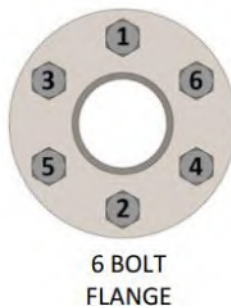
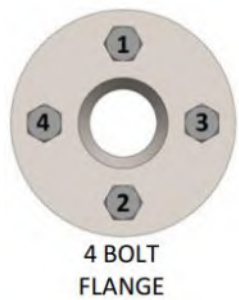
Make sure registration marks on mixer drive and shaft rigid coupling halves align as shown below. If there are multiple mixers on your order the coupling halves will have matching numbers: 1/1; 2/2; 3/3 etc... The registration marks should match your mixers serial number. Use .001" feeler gauge to ensure 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.



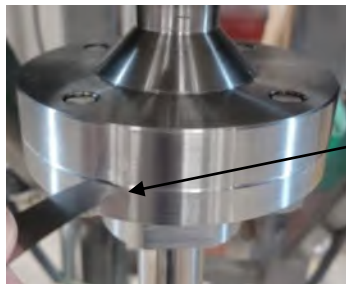
ALIGN REGISTRATION
MARKS ON COUPLING
HALVES. MAY BE 1/1; 2/2;
3/3 etc....



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](https://www.youtube.com/channel/UCFusionFluidEquipment)

This manual section will cover the Installation of the Threaded Sanitary Shaft Coupling & the Bolted Sanitary Shaft Coupling.

Note: Your mixer configuration and mounting orientation will help determine the assembly sequence for when to assemble the shaft of the sanitary coupling to the mixer drive, follow the appropriate instructions to attach to the drive.

Threaded Sanitary Shaft Coupling Instructions

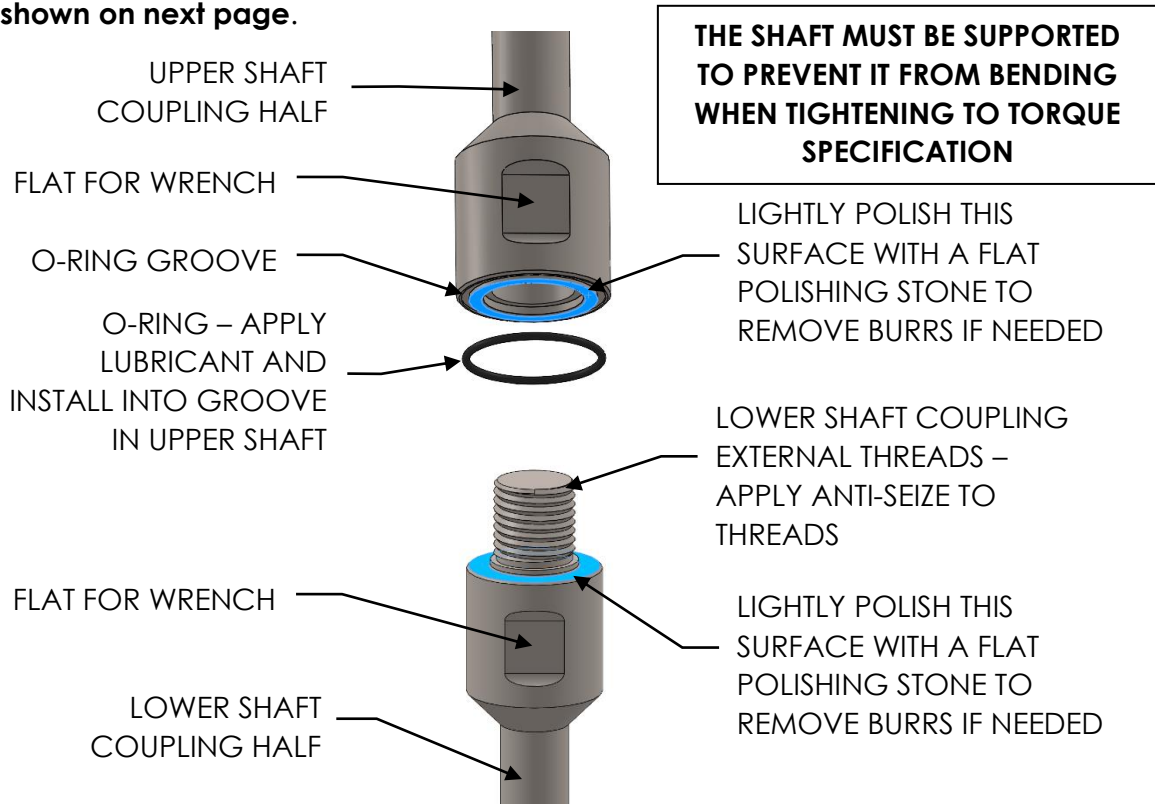


CAUTION: CHECK MOUNTING FACES FOR BURRS OR ANY OTHER PROTRUSION THAT MAY CAUSE PROBLEMS WITH ASSEMBLY. REMOVE BURRS AS NEEDED TO COMPLETE ASSEMBLY.

- 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.

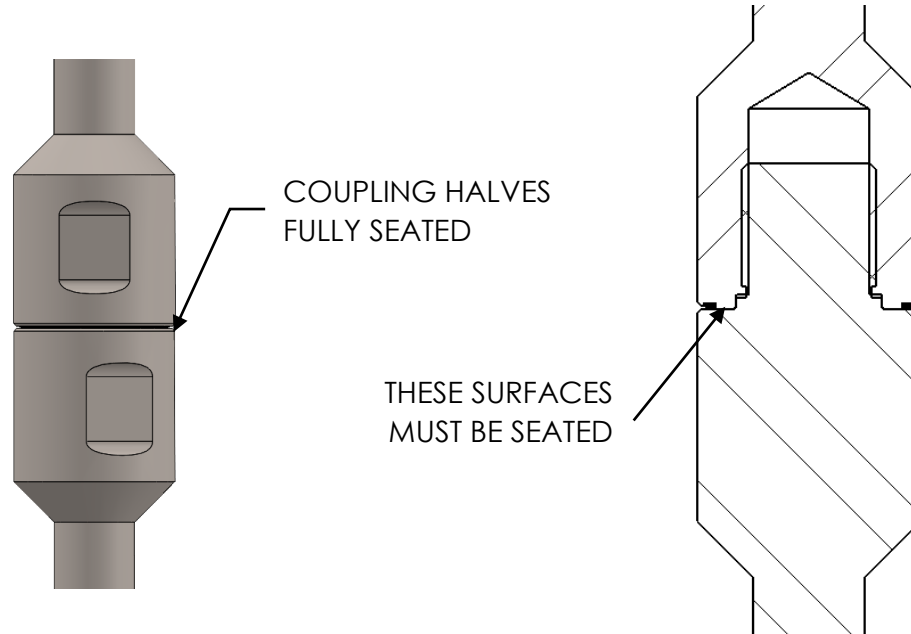
MOST WRENCH JAWS ARE MADE FROM ALLOY STEEL. THE COUPLING MAY SEE SOME CONTAMINATION OR RUST IF JAWS ARE NOT LINED WITH A MATERIAL SUITABLE FOR THE PROCESS. THE SANITARY SHAFT COUPLINGS ARE USUALLY MADE FROM 316.

- Once the two couplings are hand tight, tighten the rest of the way using two wrenches, one on each coupling flat. The shaft must be supported to prevent it from bending. 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.**



TORQUE SPECIFICATIONS

SHAFT DIA.	THREAD	316
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](#)

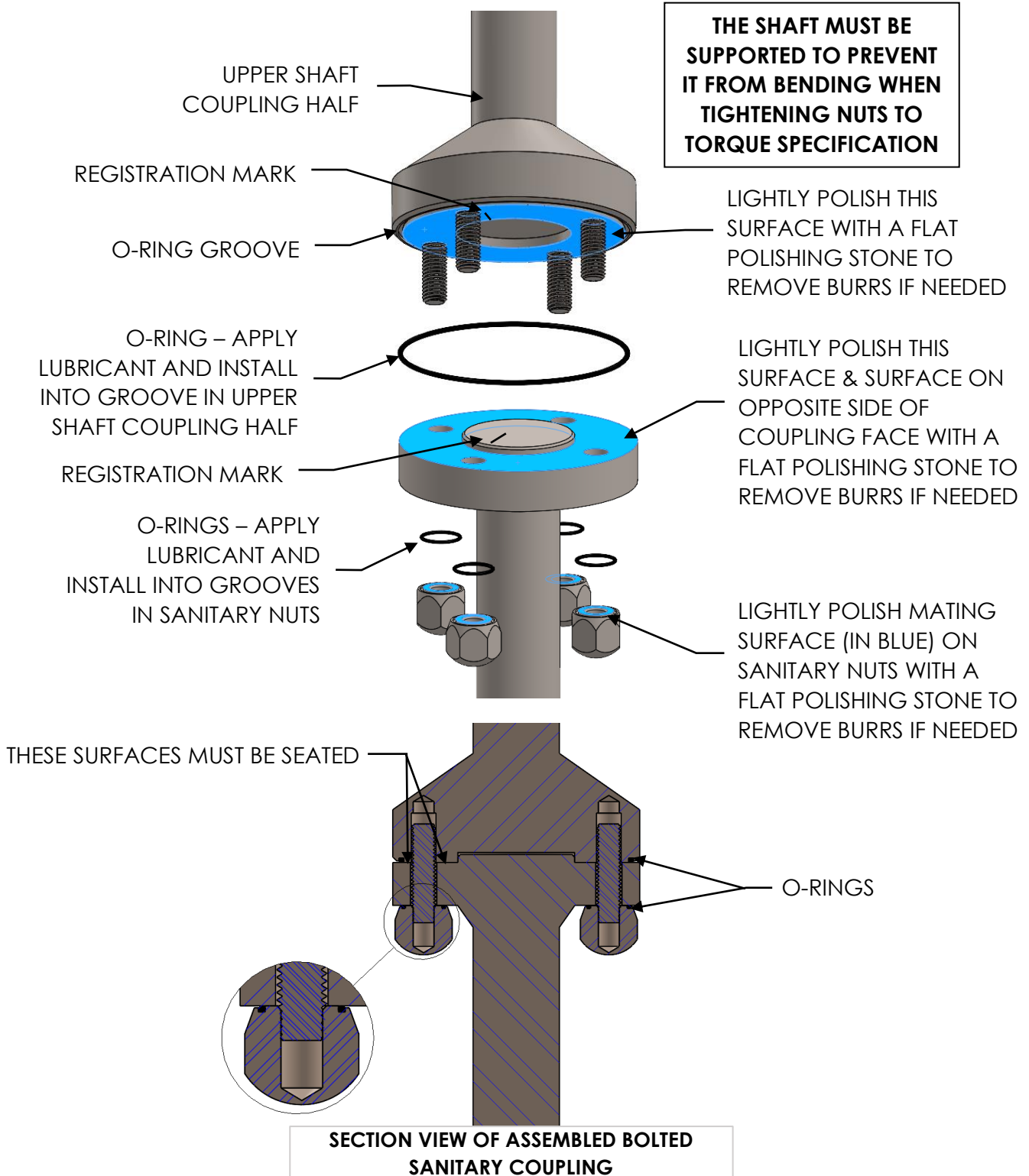
Bolted Sanitary Shaft Coupling Instructions



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

- 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 on next page.
- Apply process compatible lubricant to O-rings before inserting O-ring into groove in upper drive half & before inserting O-rings into grooves in Sanitary Acorn nuts.
- Once O-rings are installed into the coupling half & the sanitary nuts, then the coupling halves can be assembled together. **Make sure the registration marks on the coupling halves are aligned when assembling coupling halves.**

- Apply process compatible/service removable thread-locker to threads on studs. Thread nuts onto studs and tighten in a crisscross pattern. There may be 4-10 bolts depending on the size of the coupling. **Tighten nuts to Torque Specification chart found on Page 2 of FM-1004 or FM-1006 Installation Sections.**



COUPLING HALVES MUST BE FULLY TIGHTENED TO SEAT THE MATING FACES OF THE COUPLING HALVES. IF THE COUPLING IS NOT FULLY SEATED OR IF THE REGISTRATION MARKS ARE NOT ALIGNED, EXCESSIVE RUNOUT AND VIBRATION MAY OCCUR.



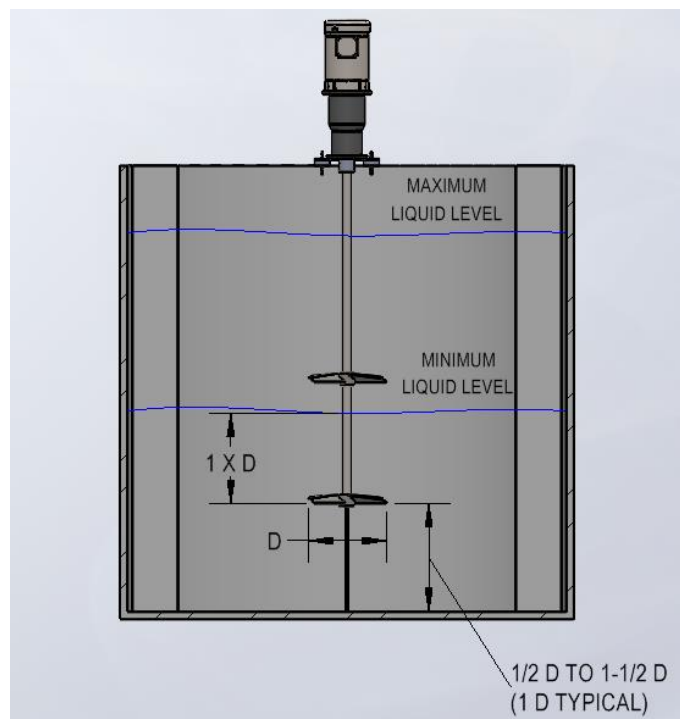
WARNING:

- **MAKE SURE TO TURN OFF POWER & DE-ENERGIZE ENERGY SOURCE TO THE MIXER.**
- **FOLLOW LOCK-OUT PROCEDURE BEFORE ANY SERVICE IS PERFORMED.**
- **WHERE APPLICABLE, FOLLOW CONFINED SPACE ENTRY PROCEDURES AND OBTAIN PERMITS IF NEEDED.**
- **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.

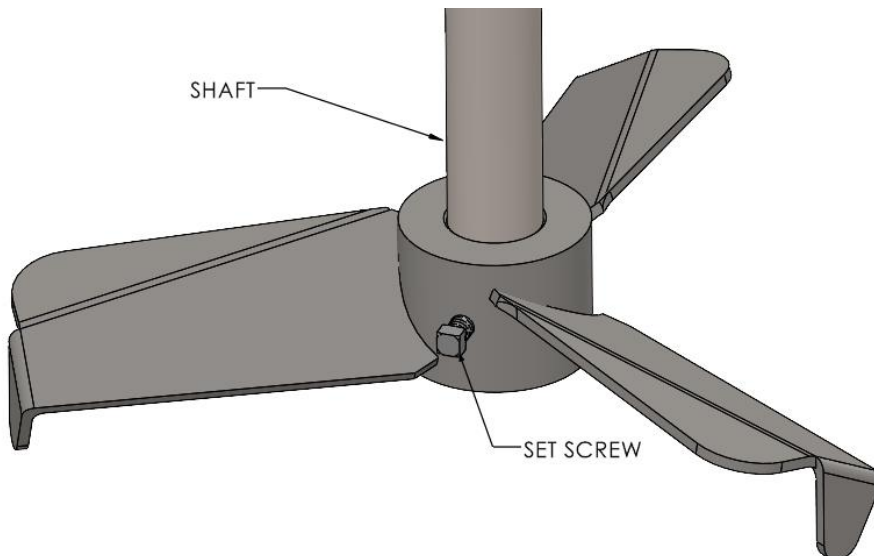
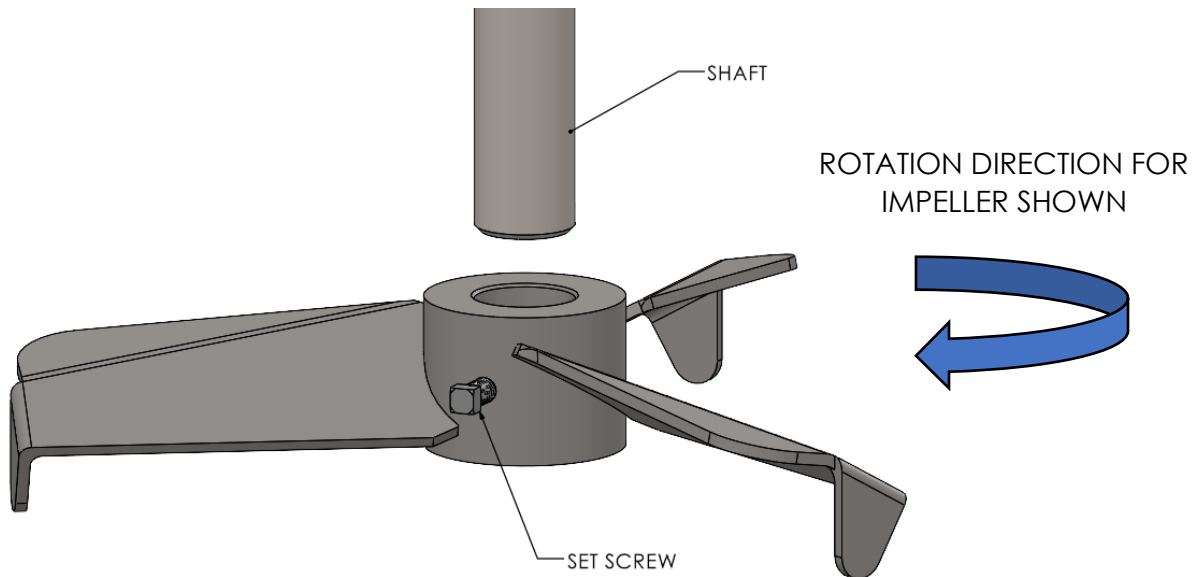


Slide the impeller(s) over the shaft until in their proper location(s). Snug the first set screw to locate the impeller. Snug the second set screw (if equipped) securely to the shaft. *The use of a process compatible service removable thread-locking compound is recommended where acceptable.* Remove the first set screw and apply service removable thread-locker (Blue 242 Loctite or similar) to the threads. Reinstall first set screw onto shaft, tighten and torque as required (**see Torque Chart – FM-1004 or FM-1006 Installation Sections**). 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.*

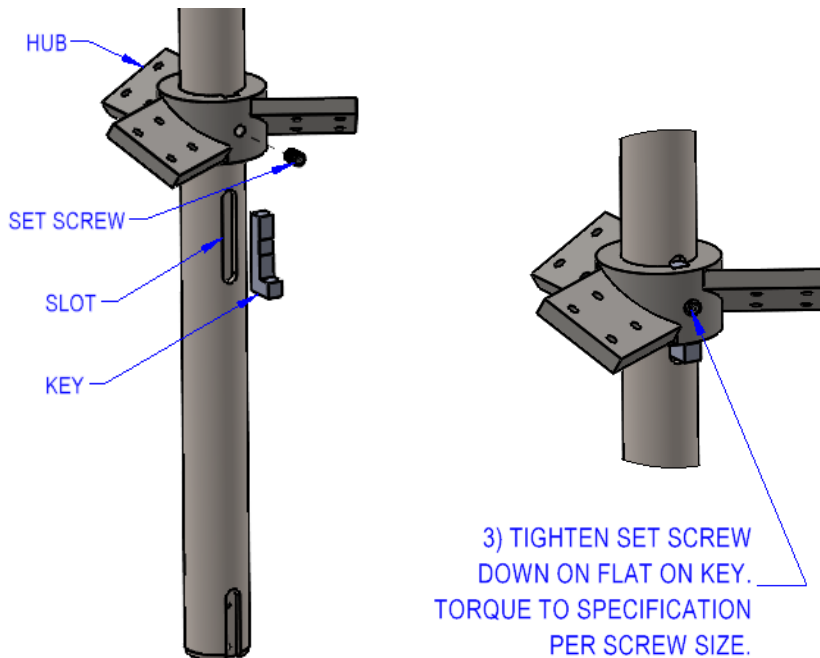
If use of a thread-locking compound is unacceptable, tighten set screws and torque as required (**see Torque Chart – FM-1004 or FM-1006 Installation Sections** for recommended dry torque settings).

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

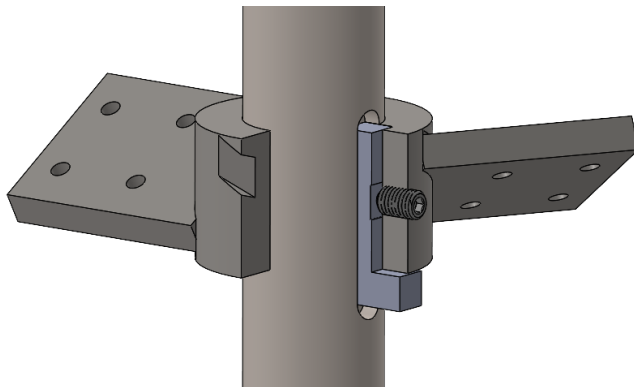


Impeller Installation – Hub & Key

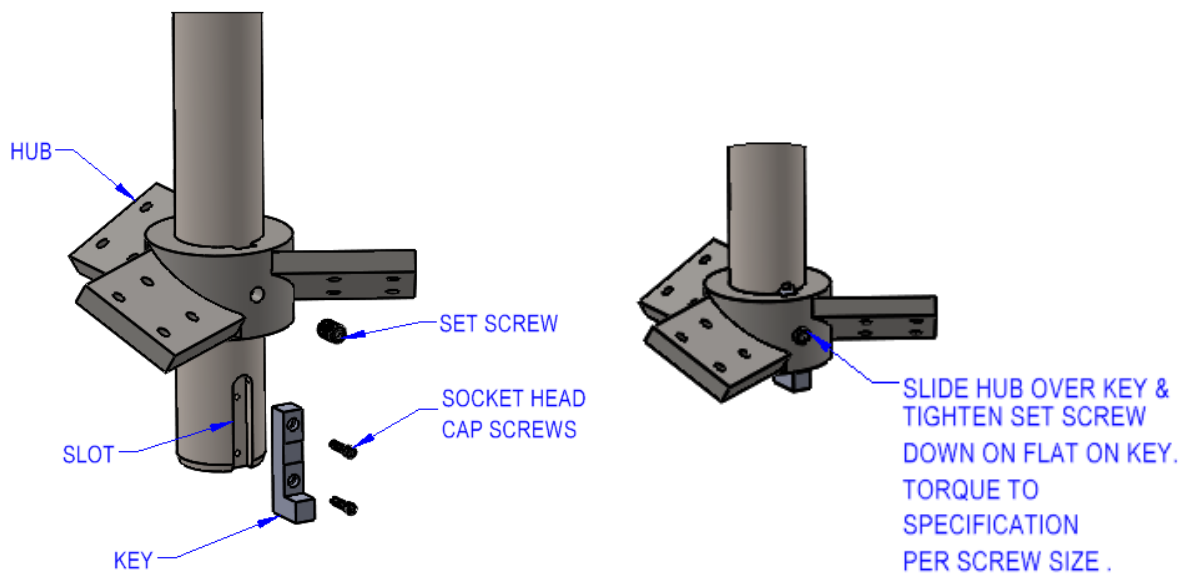
When installing multiple impellers & hubs on a shaft, start with the impeller closest to the drive. If your mixer is equipped with a Captured Key, slide impeller hub over the shaft & go past the slot for the key (start with slot closest to drive for multiple impellers) as shown below. Insert key into slot in shaft & slide the hub over key. Align the keyway in hub with the key. *The use of a process compatible service removable thread-locking compound is recommended where acceptable.* Apply thread-locker (Blue 242 Loctite or similar) to the threads if acceptable, then tighten set screw down on flat on key as shown below. Torque screw to specification per screw size (**see Torque Chart – FM-1004 or FM-1006 Installation Sections**).



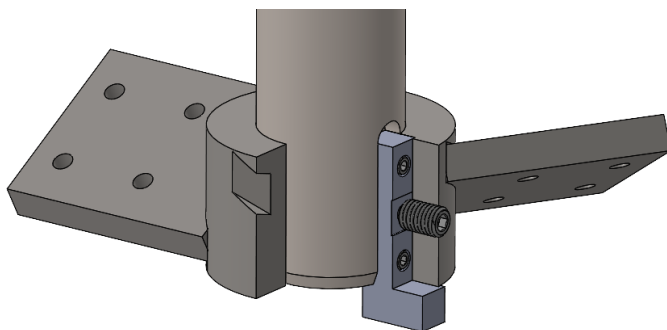
Hub sectioned to show set screw on flat on key in image below



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. *The use of a process compatible service removable thread-locking compound is recommended where acceptable.* Apply thread-locker (Blue 242 Loctite or similar) to the threads if acceptable, then tighten set screw down on flat on key as shown below. Torque screw to specification per screw size (**see Torque Chart – FM-1004 or FM-1006 Installation Sections**).

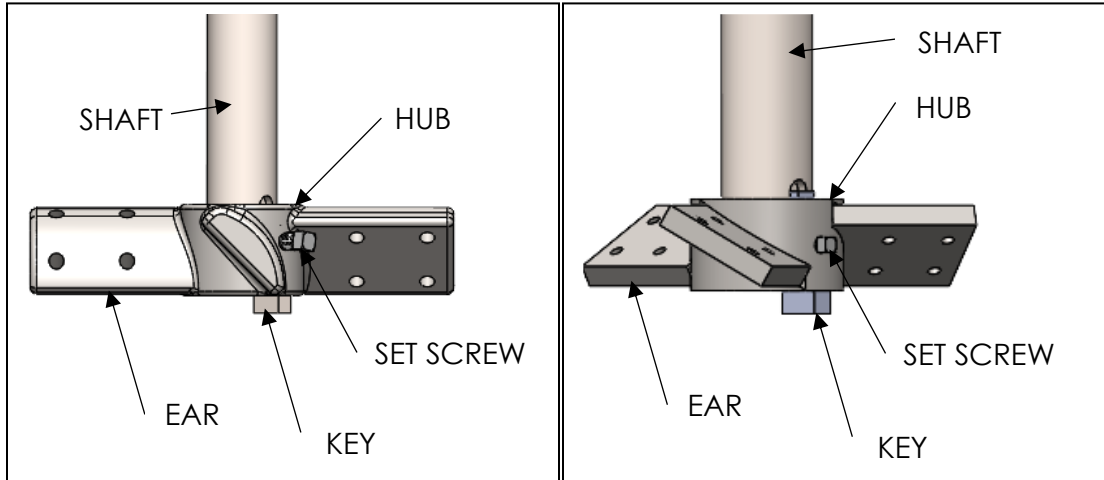


Hub sectioned to show set screw on flat on key in image below



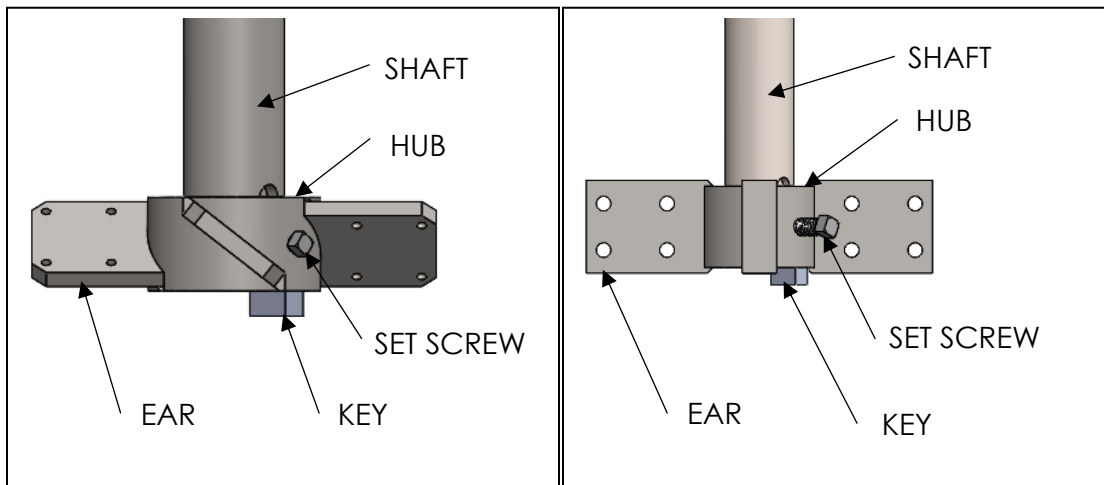
Impeller Installation – Bolted Impeller Blades

This manual section will cover Bolted Impeller Blade Installation for the following impeller models: PBT; PF3; PV3; PV4; & RP4 Radial Impellers. Below are images showing the impeller hubs for the bolted blade impeller models.



PBT IMPELLER HUB

PF3 IMPELLER HUB



PV3 & PV4 IMPELLER HUB

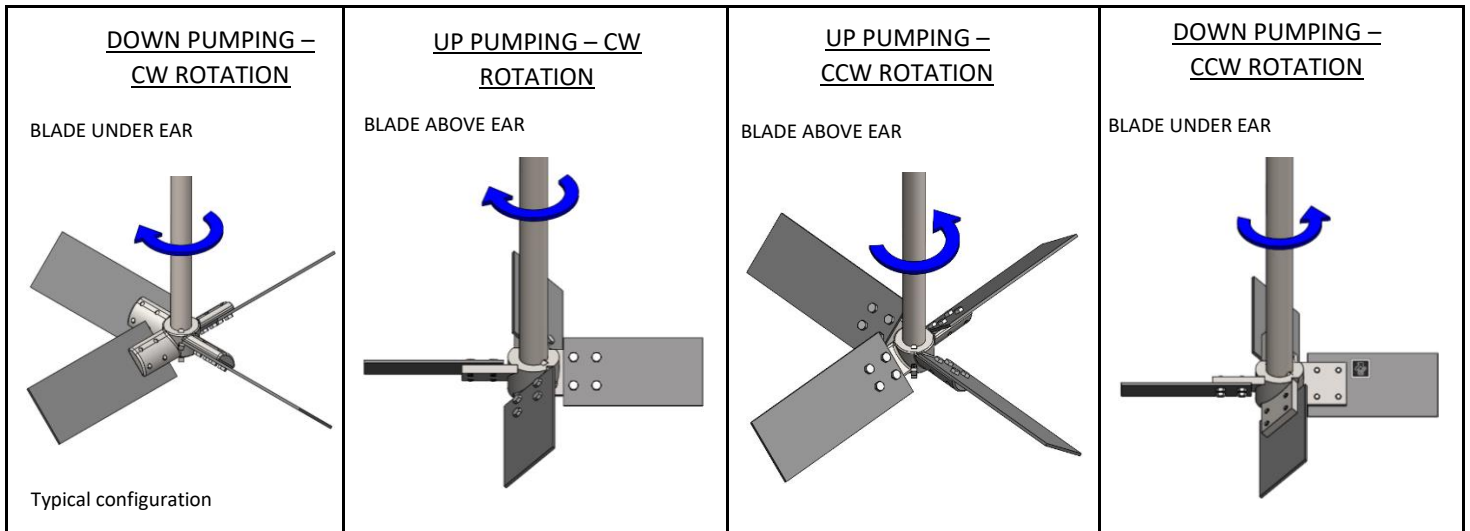
RP4 IMPELLER HUB

Impeller Installation - Rotation & Pumping Direction

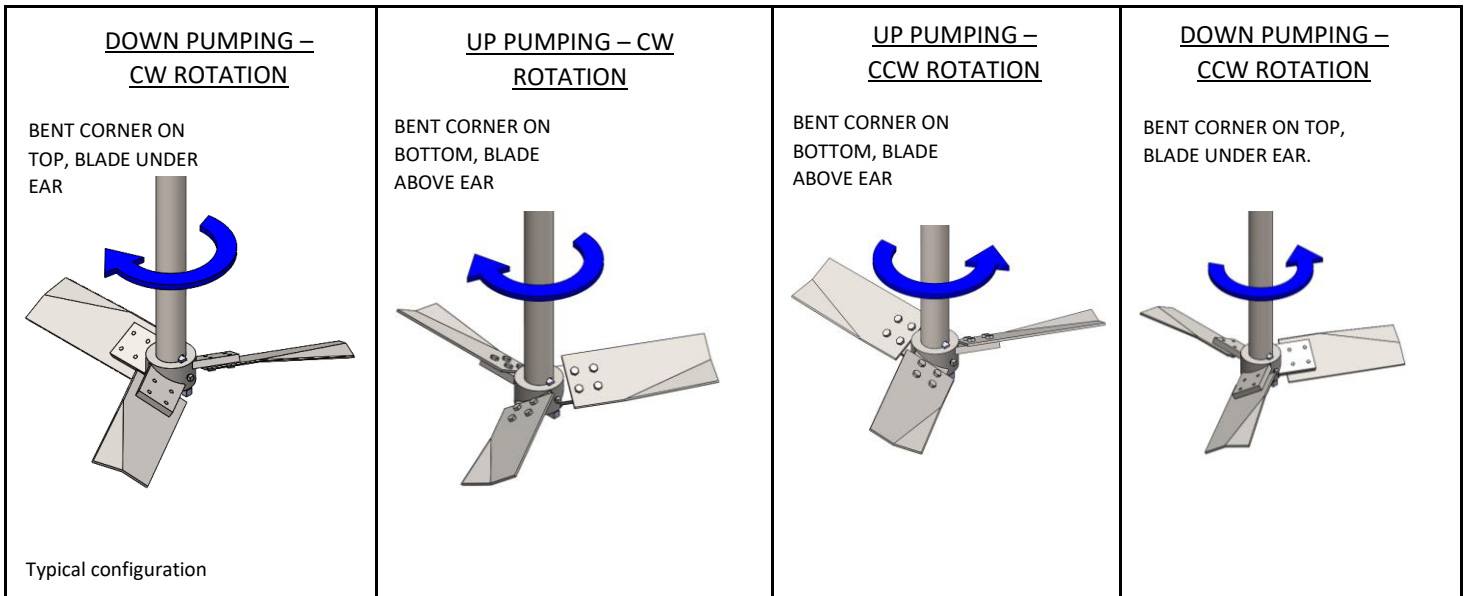
Refer to your mixer Approval or As Manufactured Drawing to determine the impeller rotation and pumping direction before bolting blades to the hub ears. Impeller rotation is determined as viewed from the mixer drive. **The Blades are always backed by the Hub's ears as determined by rotation direction.**

DAMAGE IS TO THE MIXER MAY OCCUR IF THE BLADES ARE MOUNTED ON THE WRONG SIDE OF THE HUB'S EARS OR ROTATION IS INCORRECT.

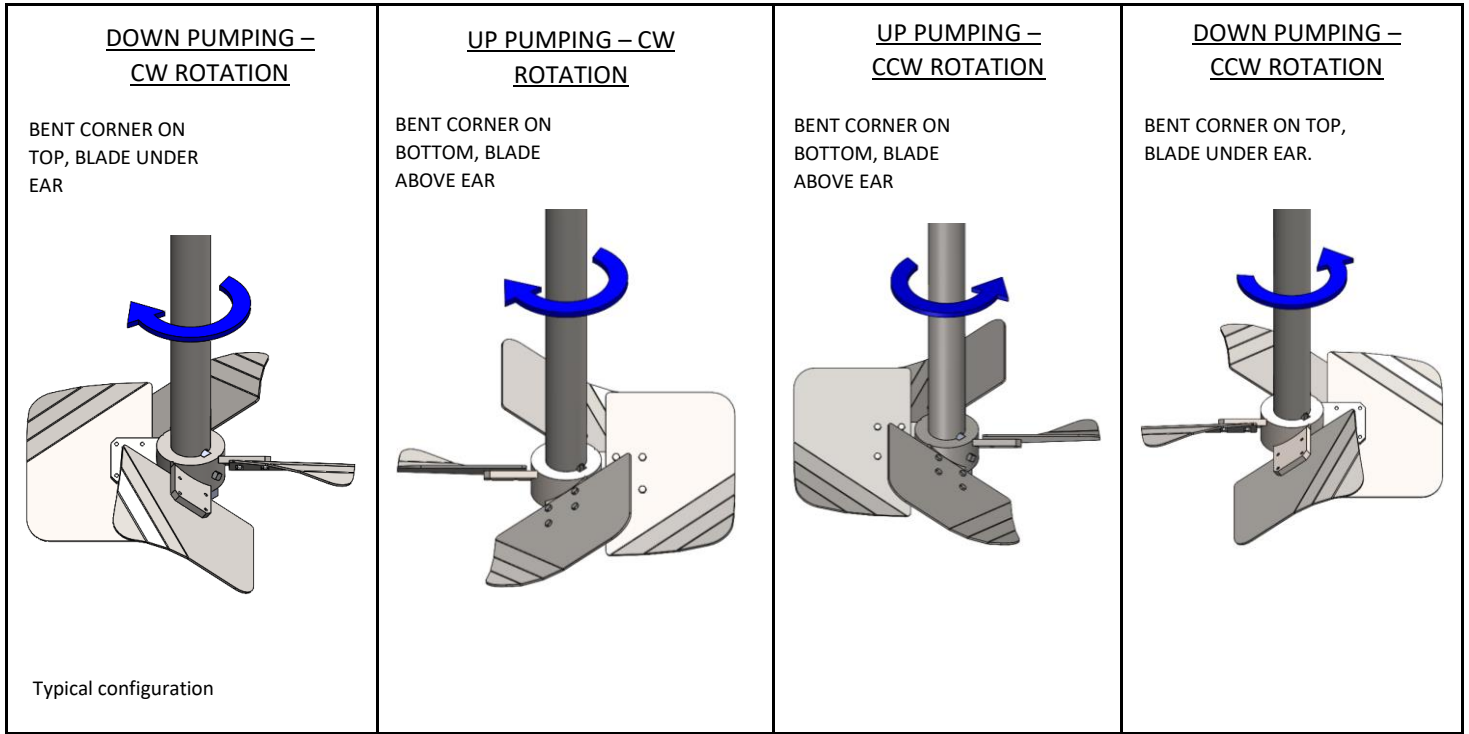
Below are the 4 possible impeller configurations for the PBT:



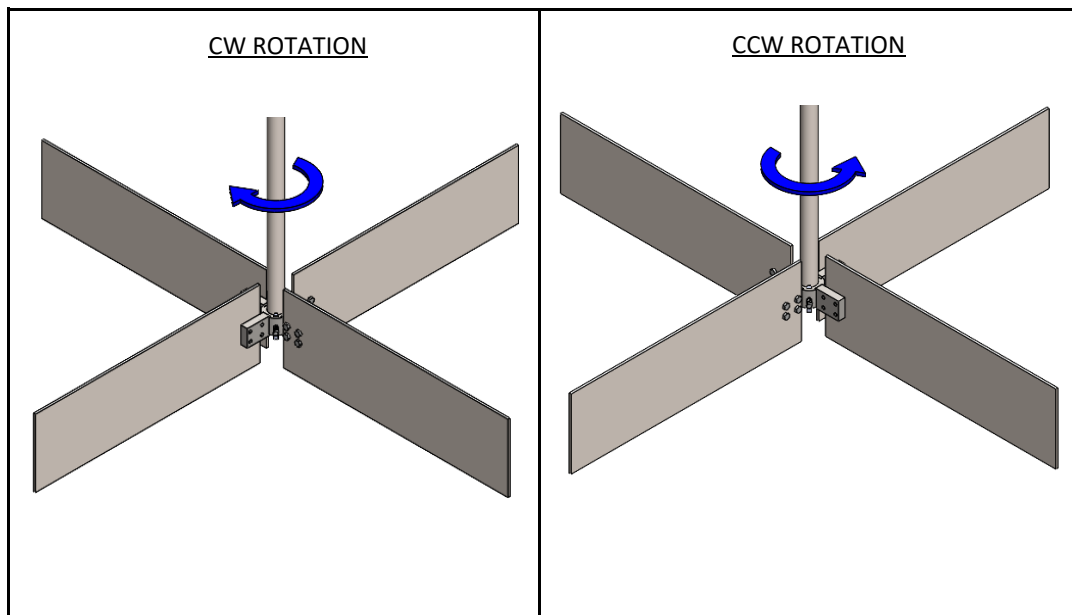
Below are the 4 possible impeller configurations for the PF3:



Below are the 4 possible impeller configurations for the PV3 & PV4:

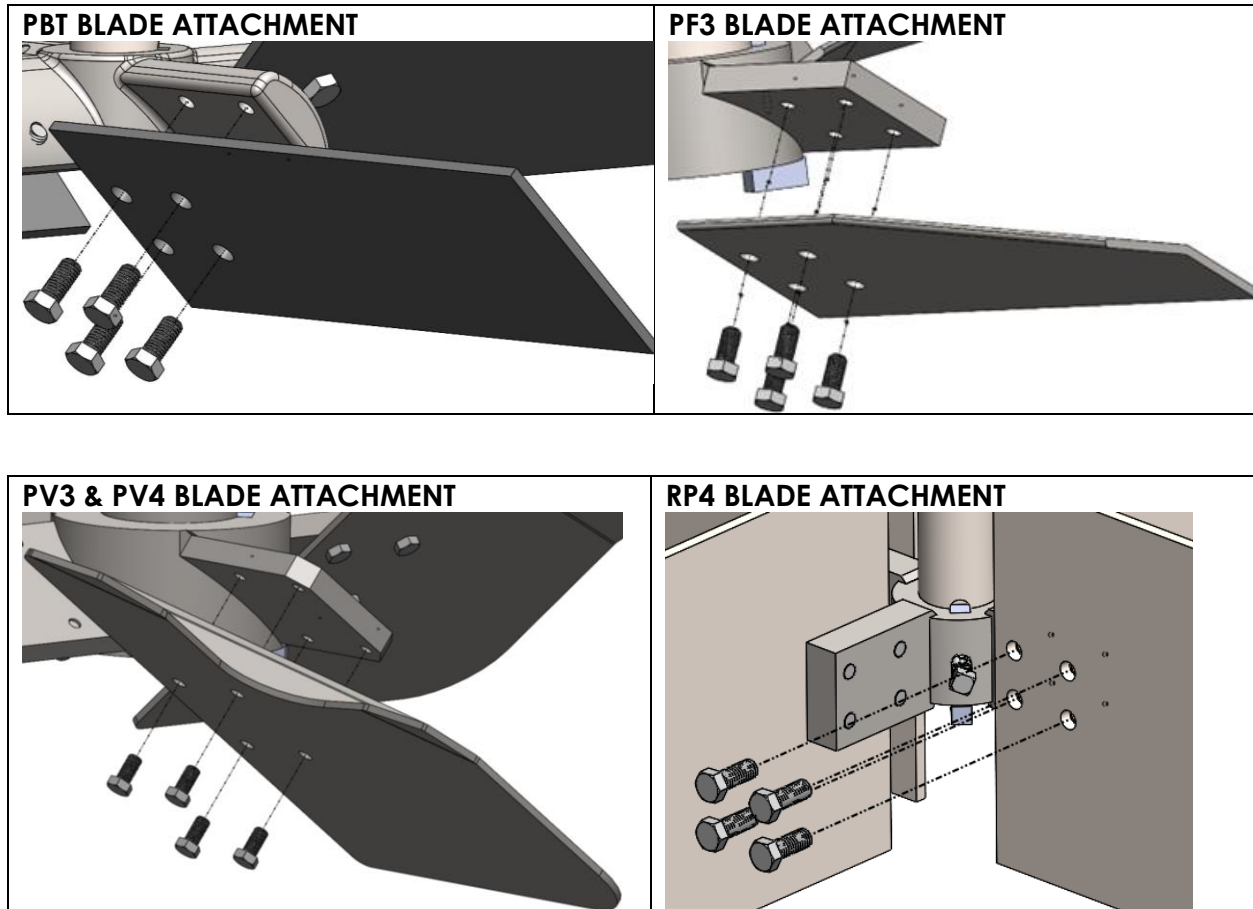


Below are the 2 possible impeller configurations for the RP4 (Radial):



Impeller Installation – Bolting Blades

Attach the blades to the hub's ears using the provided bolts. Apply Blue Loctite 242 or similar service removable thread locker to the bolt and tighten to the appropriate value per screw size (**see Torque Chart – FM-1004 or FM-1006 Installation Sections**).



**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.**

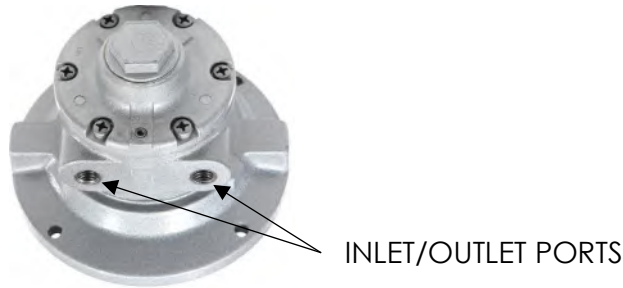
Installation

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.

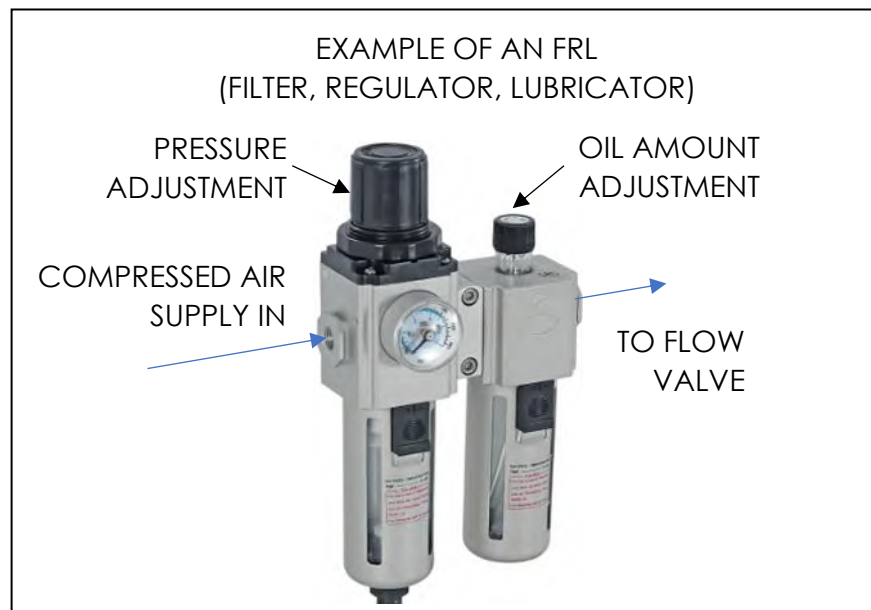




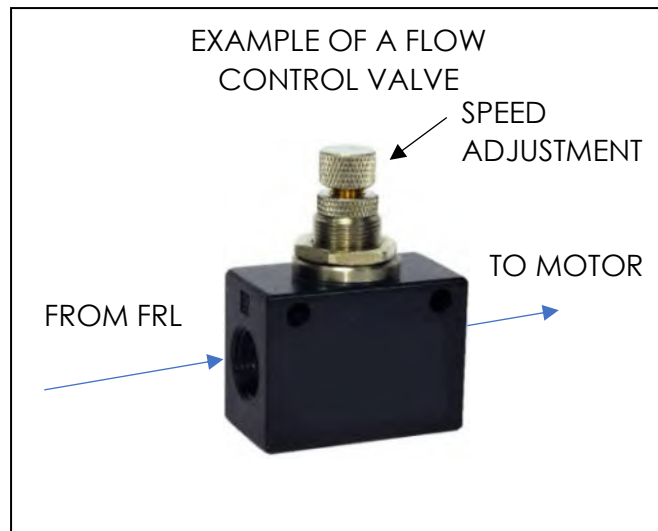
Air quality requirements

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.



- 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.

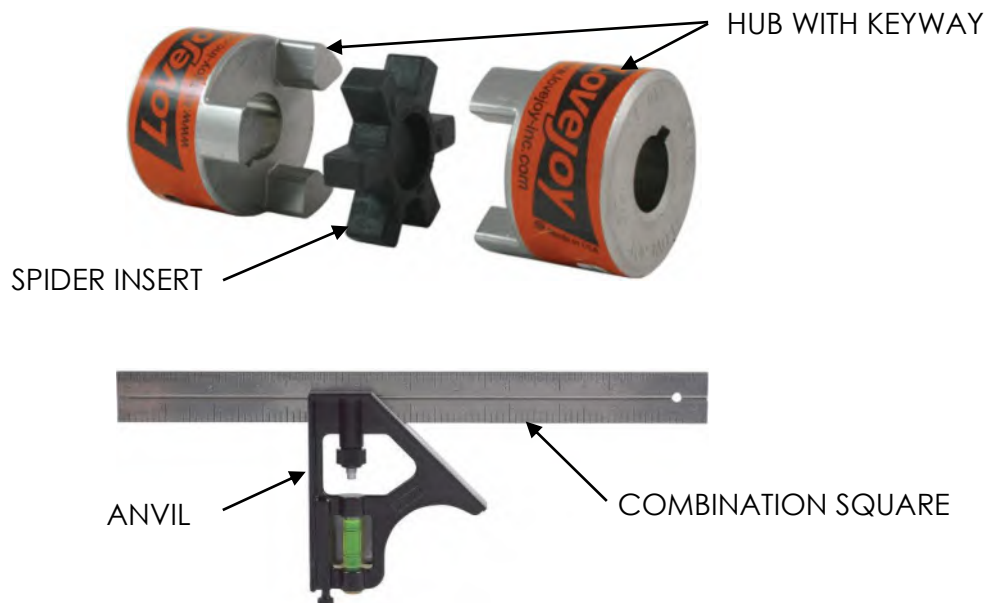
TYPICAL AIR CONSUMPTION	
1 HP	40 CFM @ 80 PSI
2 HP	60 CFM @ 70 PSI
3 HP	90 CFM @ 70 PSI

**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.

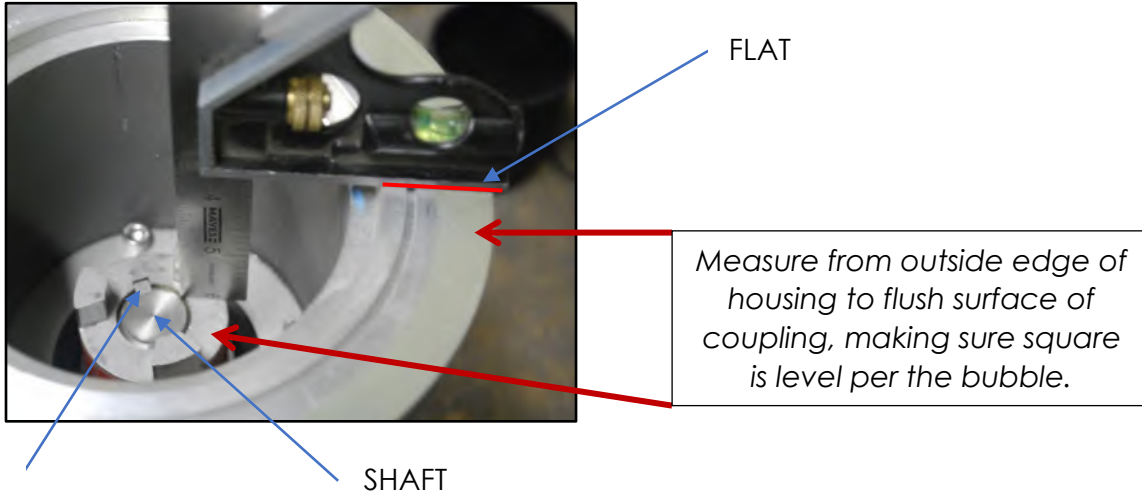


Begin Installation

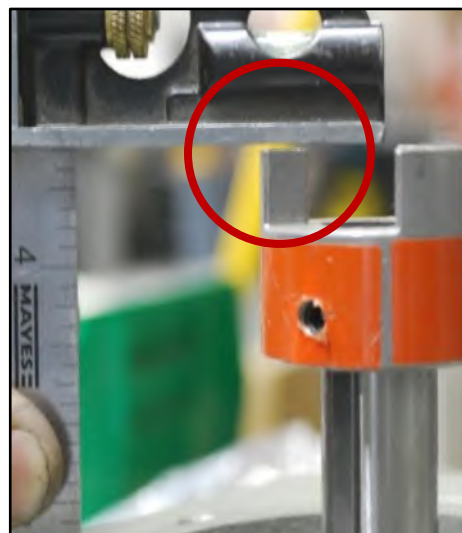
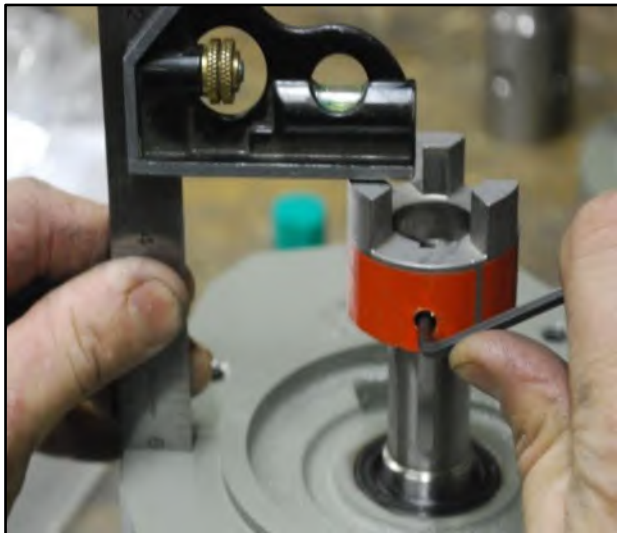
Make sure that all of the components in this assembly are free from any foreign materials, nicks, burrs, dents or gouges. Clean components and remove any nicks, burrs, dents or gouges before attempting installation.

- 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.

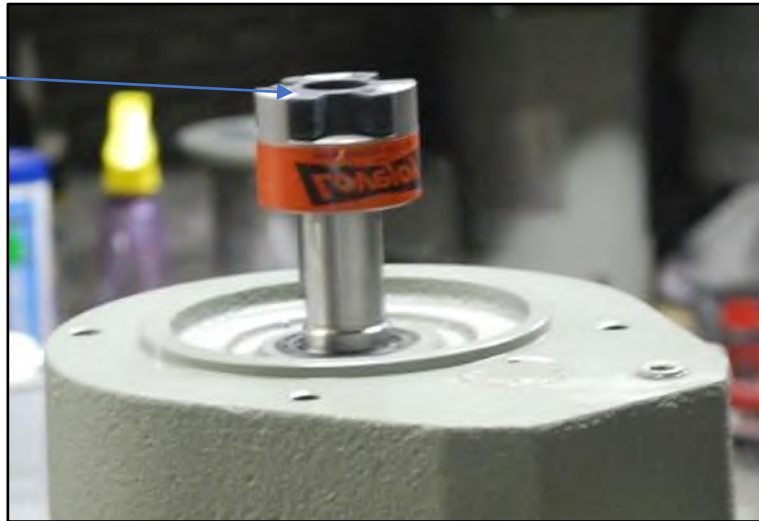


Note the **1/16"** gap between square's arm and coupling tooth. A penny can be used to set this spacing.

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.

SPIDER
INSERT

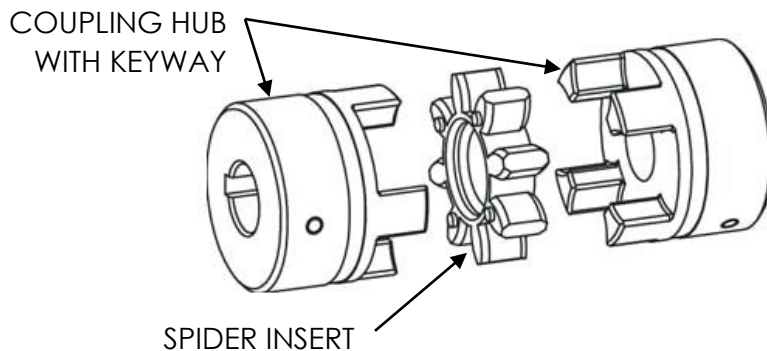


- 5) Once the drive coupling is in place mount the bearing housing using the appropriate bolts. Use lock washers or service removable thread locker on the bolt threads to prevent the bolts from vibrating loose. Ensure that the couplings are properly engaged without any excess pressure against the spider. 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

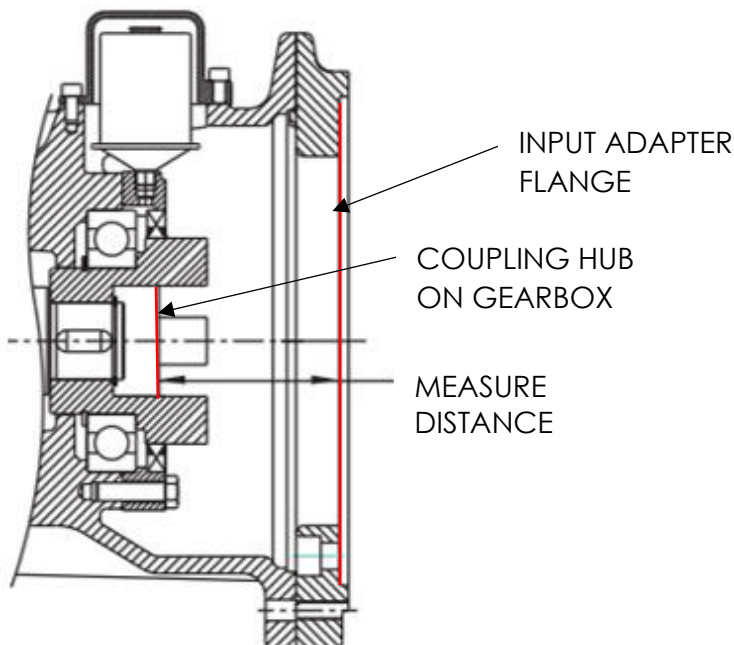
Correct installation and alignment/spacing practices will ensure longer coupling life, trouble free operation, and a safer operating environment for the coupling. Please thoroughly review all of the following instructions prior to installing this coupling and placing it in operation. Proper safety guidelines 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.



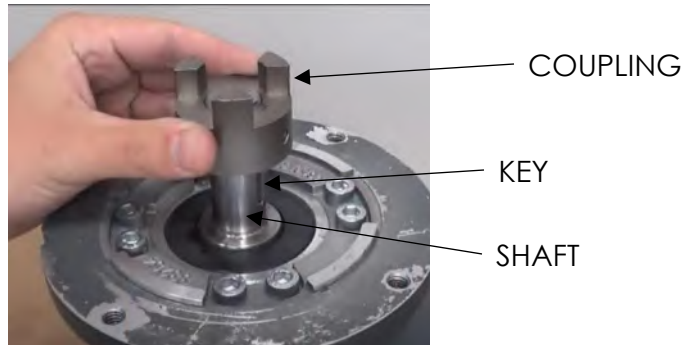
Begin Installation

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.

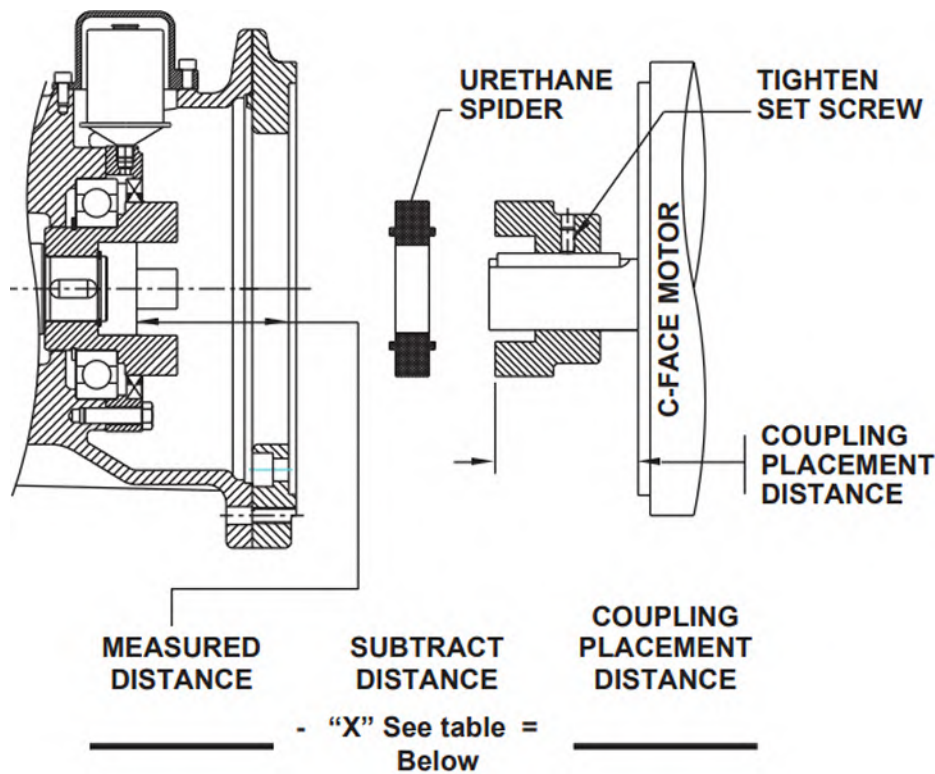
- 1) The coupling on the gearbox is already in place. Using a combination square, measure the distance from the gearbox input adapter flange to the lower surface of the coupling, as shown. Ensure the combination square's anvil is sitting flat on the gearbox input adapter flange.



- 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.

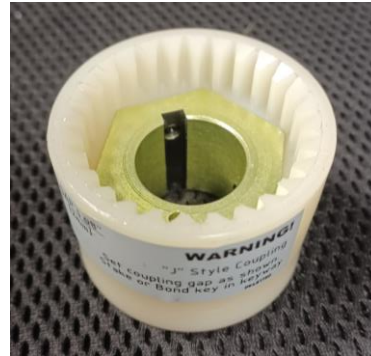
BOLT SIZE	18-8 SS	Gr5/Gr8
3/8"-16	16 ft-lb.	25 ft-lb.
1/2"-13	36 ft-lb.	61 ft-lb.
9/16"-12	48 ft-lb.	88 ft-lb.
5/8"-11	81 ft-lb.	121 ft-lb.
3/4"-10	114 ft-lb.	215 ft-lb.
7/8"-9	178 ft-lb.	251 ft-lb.
1"-8	269 ft-lb.	375 ft-lb.

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.

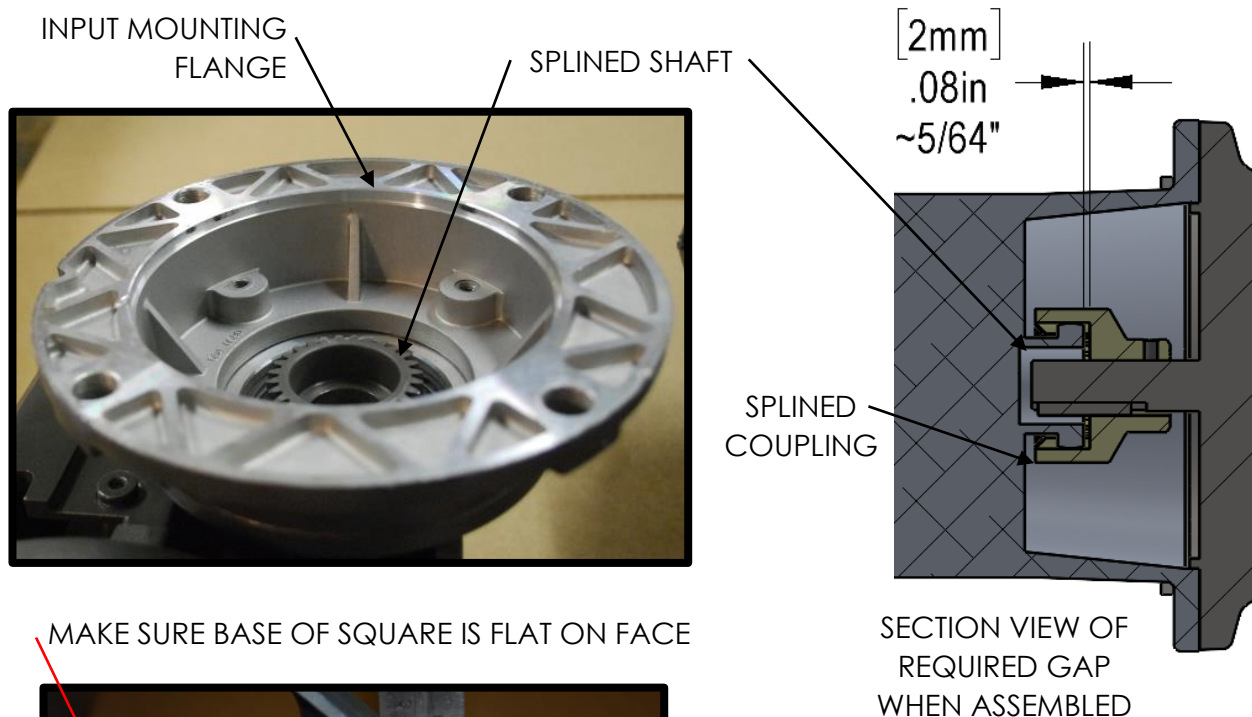


“J” Style Coupling 5/8” Bore

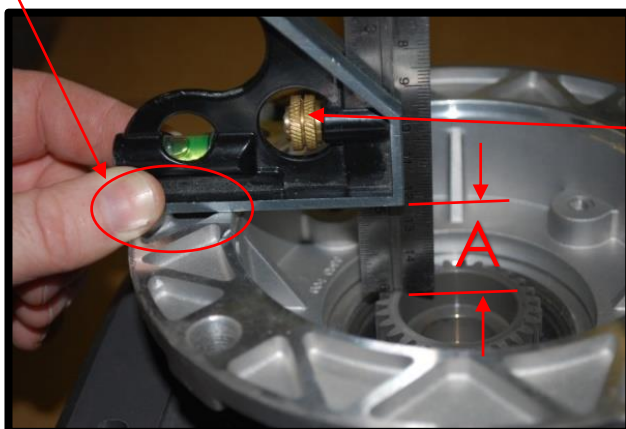


“J” Style Coupling 7/8” Bore

- 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.

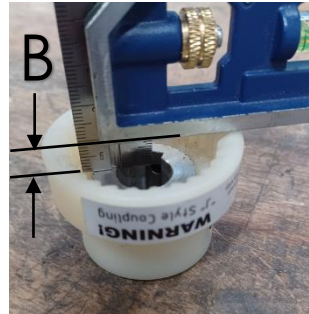
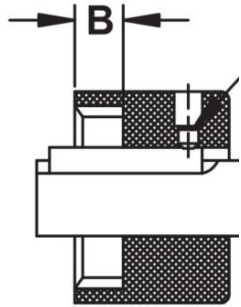


MAKE SURE BASE OF SQUARE IS FLAT ON FACE

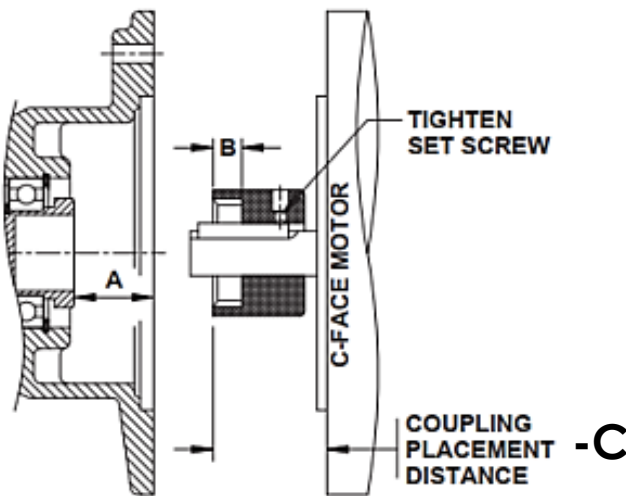


TIGHTEN SQUARE TO
KEEP MEASUREMENT

- 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.

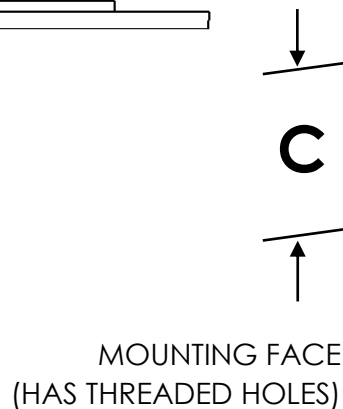
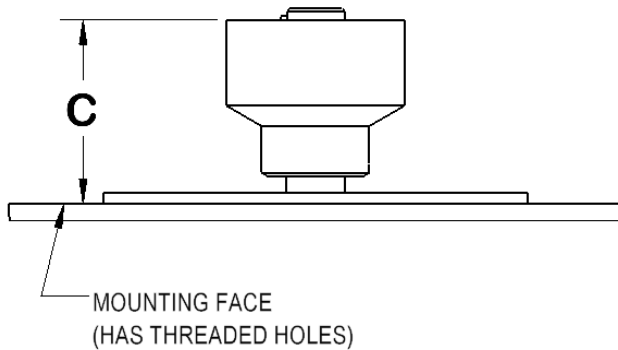


- 3) Add "A" + "B" and subtract 0.08" (2mm) ~5/64" from the distance. This needs to be done so that the coupling will not be axially preloaded after installation!

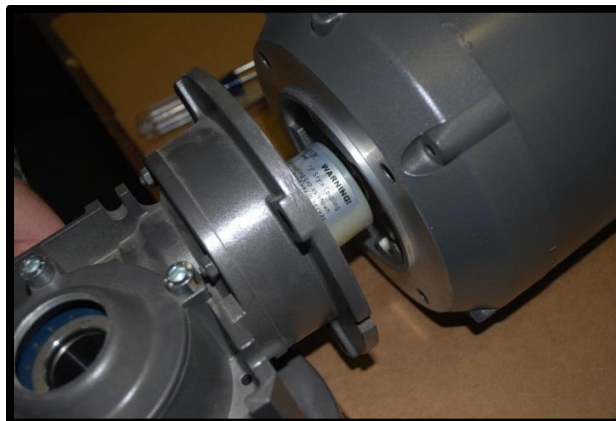


MEASURED DISTANCES		SUBTRACT DISTANCE		COUPLING PLACEMENT DISTANCE - C	
A	+	B	-	.08" (2mm)	=
_____	+	_____	-	~5/64"	= _____
			(minus)		

- 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.



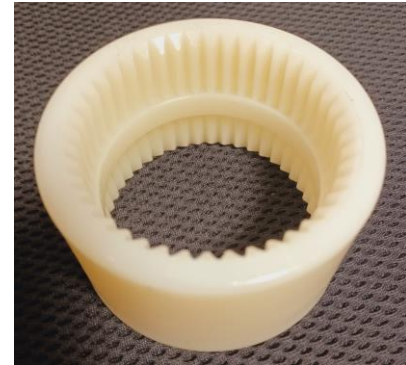
- One of the most common problems is a "noisy gearbox." This could be due to an improper gap causing the motor & gearbox shafts to be "axially loaded." We recommend disassembling and reassembling to ensure correct gap between spline adapter and coupling.

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.

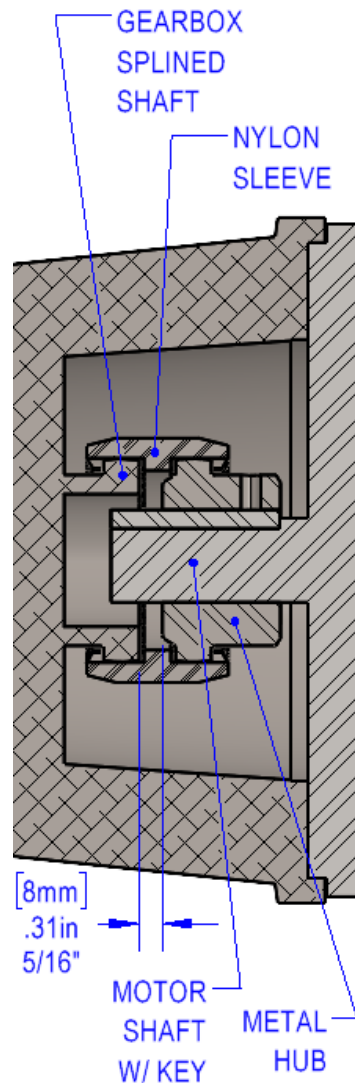


Metal Hub

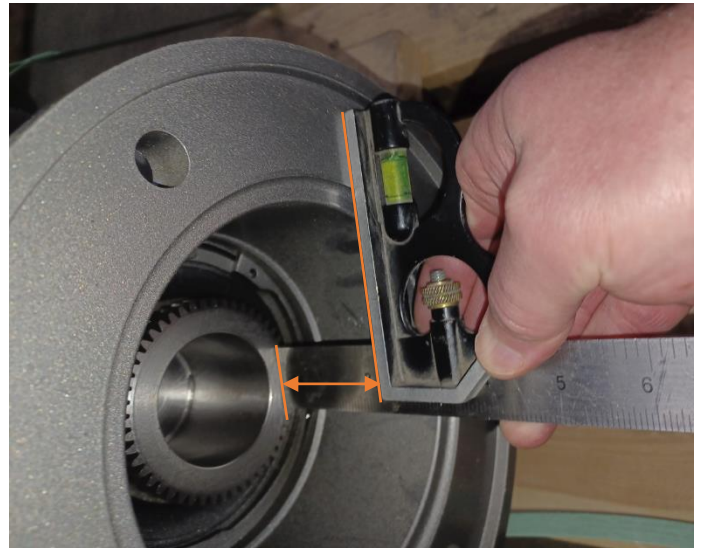
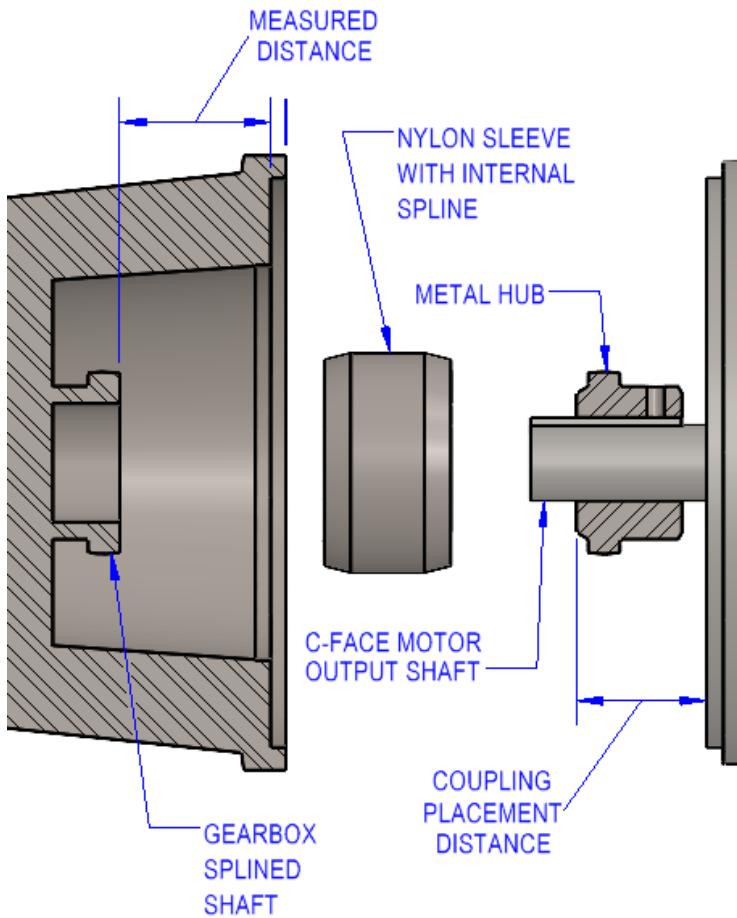


Nylon Sleeve with Spline

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



- 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.

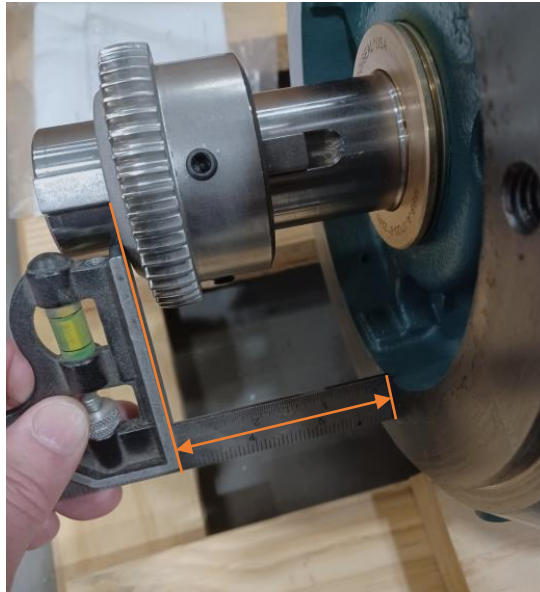


Measure from the face of the mounting face to the face of the splined shaft.

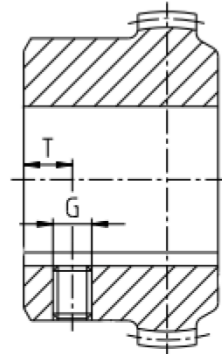
- Subtract 0.31" (8mm) 5/16" from the measured distance to get the coupling placement distance. This needs to be done so that the coupling assembly will not be axially preloaded after installation!

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.

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!

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

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

Atlas Copco

Atlas Copco Air Motors



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

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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 °C
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 °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.

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

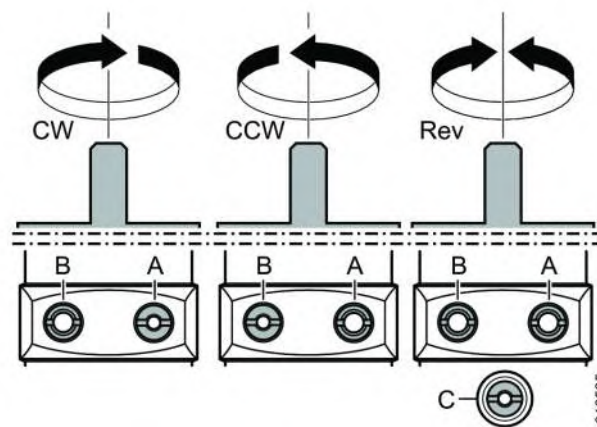
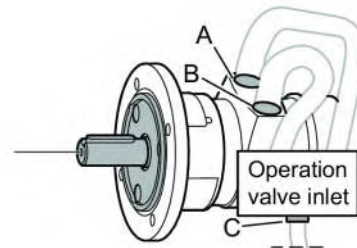
Rotation

⚠ 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

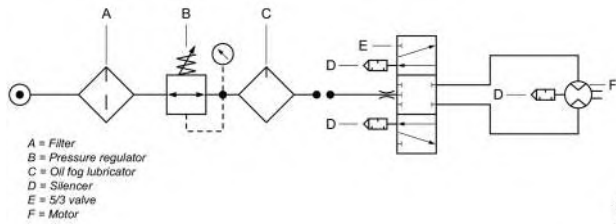
To achieve clockwise (CW) or counter clockwise (CCW) rotation, mount selected restrictor plates at the inlet/ outlet ports A and B. For reversible rotation (Rev) mount restrictor plates at the inlet port C and at the outlet ports A and B.



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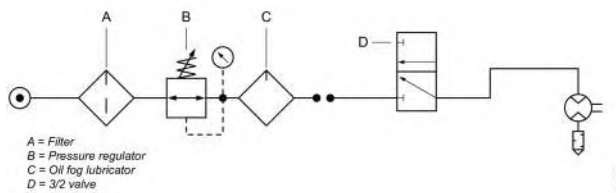
Installation diagram

Reversible motor

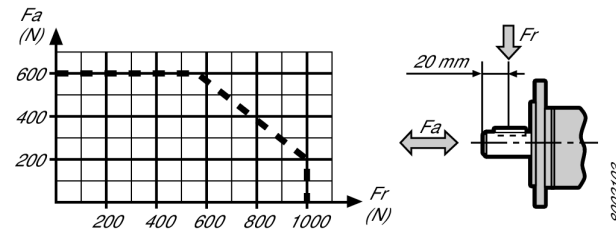


Installation diagram

Non-Reversible motor



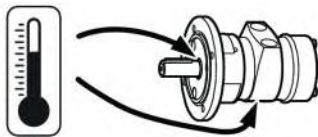
Shaft load diagram



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.**

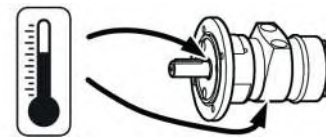
Overhaul

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.

i 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	2	High level of protection
Group II		<ul style="list-style-type: none"> • 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

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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 °C
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	2	High level of protection
Group II		<ul style="list-style-type: none"> ■ 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**

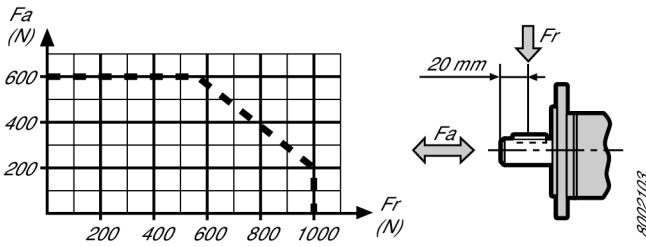
High air pressure can cause severe damage and bodily injury.

 - ▶ 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

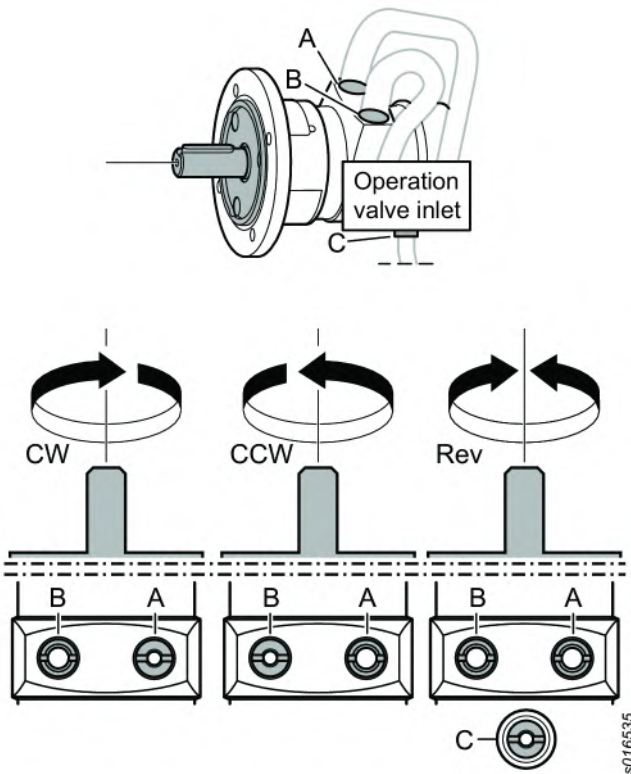
Rotation

⚠ 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.

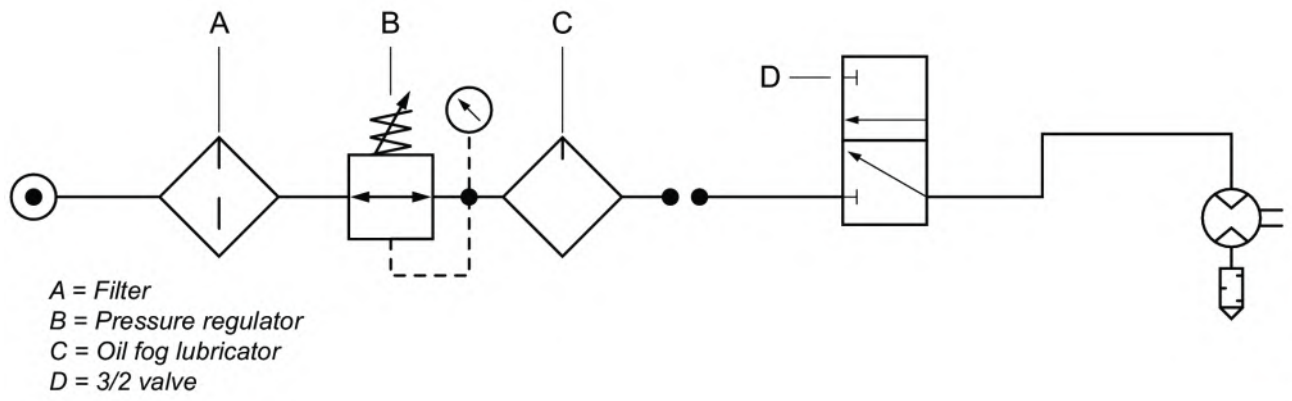
Restrictors

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.



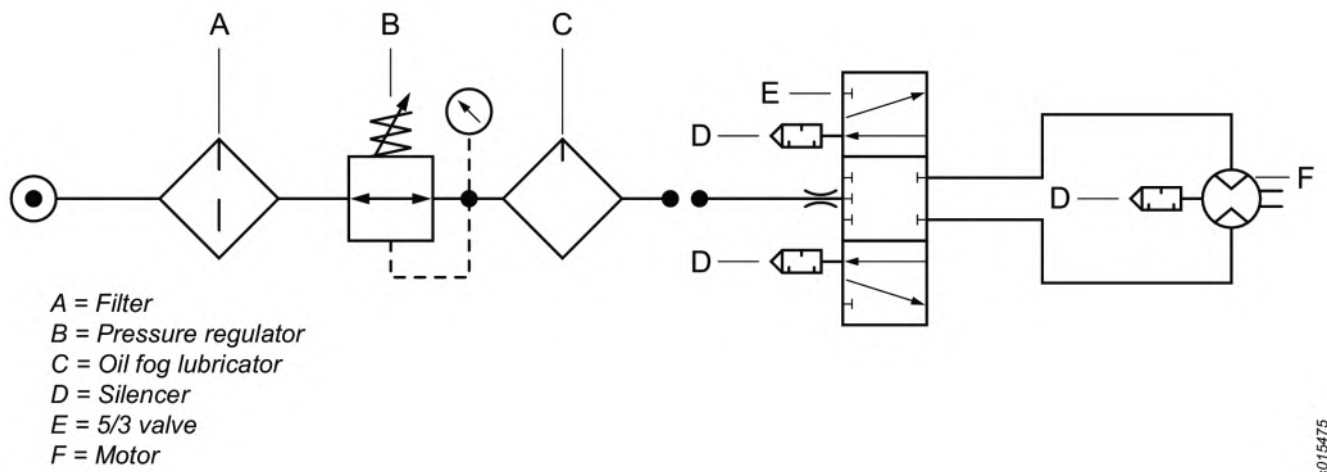
Installation diagram

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.

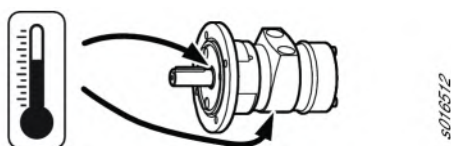
- Take frequent breaks and change work positions frequently.
- Adapt the work area to your needs and the work task.
 - Adjust for convenient reach range by determining where parts or tools should be located to avoid static load.
 - Use workstation equipment such as tables and chairs appropriate for the 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.

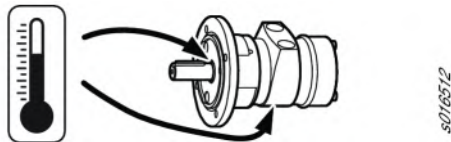
If no detailed information about preventive maintenance is included, follow these general guidelines:

- 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 excess 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

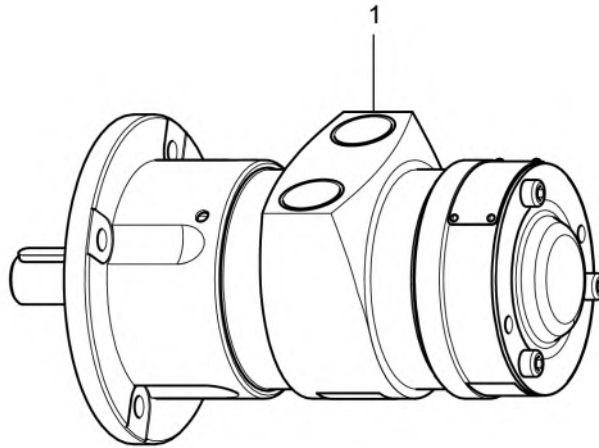
Lubrication

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



1758760843

	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

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Out of respect to wildlife and nature, our technical literature is printed on environmentally friendly paper.

GAST

Gast Air Motors



AM SERIES AIR MOTORS

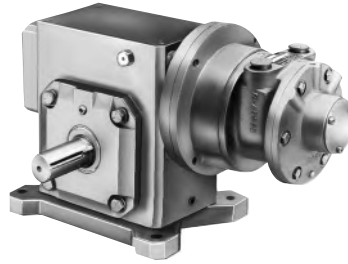
Operation and Maintenance Manual



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
1AM	100 psi / 7 bar
1UP	80 psi / 5.6 bar
2AM	100 psi / 7 bar
4AM	100 psi / 7 bar
6AM	100 psi / 7 bar
8AM	100 psi / 7 bar
16AM	100 psi / 7 bar

LL and NLP Models Pressure

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

Product Use Criteria:

- Non-hazardous conditions: Operate at ambient temperatures up to 250°F (121°C).
- Hazardous conditions: Operate at ambient temperatures up to 104°F (40°C).
- 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.
-  **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

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 precede 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



Dangerous Situation. Possible consequences: damage to the drive or the environment



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

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. 275°F/135°C

Ambient range (Ta) +1°C to +40°C (34°F/104°F)

- _____ 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: 34°F/1°C to 250°F/121°C

Hazardous conditions: 34°F/1°C to 104°F/40°C

- _____ 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 104°F/40°C.

- _____ 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.

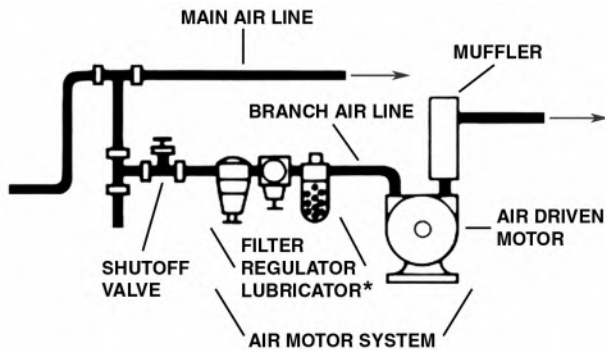
Wear eye protection when installing this product.

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 combustible 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 M³ 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 275°F/135°C. 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.

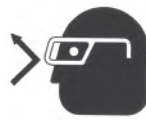
MAINTENANCE



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 warranted 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.

- 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.

Product Use Criteria

- All worm gear reducers require that the air motor be mounted so that the inlet and exhaust ports are at a 90° 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.

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



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Baldor-Reliance Electric Motors



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

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

INSPECTION

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

DRAIN PLUGS

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

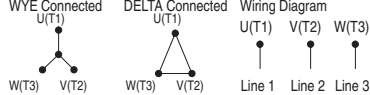
For single winding 3 phase motors, lead markings can be directly translated between IEC and NEMA designations.

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

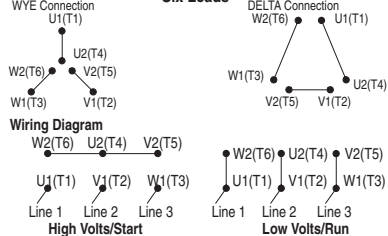


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1. INTRODUCTION

This and the following instruction address the more common situations encountered in motor installation, operation and maintenance. For the TWMC motor warranty to be and to remain in effect, the motor must be installed and operated in strict accordance with the outline drawing, motor nameplates and these instructions and must not be altered or modified in any unauthorized manner.

During the installation and operation of motors in heavy industrial applications there is a danger of live electrical parts and rotating parts. Therefore, to prevent injury and/or damage, the basic planning work for installation, transportation, assembly, operation, etc. needs to be done and checked by authorized and competent personnel only.

Since these instructions cannot cover every eventuality of installation, operation and maintenance, the following points should be considered and checked.

- The technical data and information on permissible use such as assembly, connection, ambient and operating conditions given in the related catalogue, operating instructions, nameplates and other production documentation.
- The general erection and safety regulations.
- The local and plant-specific specifications and requirements.
- The proper use of transport, lifting devices and tools.
- The use of personal protective equipment.

Following indications should be observed when reading these instructions.

Safety instructions are marked as follows:



Warning of electric hazards for personnel.



Warning of dangers for personnel.

ATTENTION!

Warning of damage for the motor or installation.

2. ACCEPTING, INSPECTION, STORAGE, TRANSPORTATION

Inspection upon receipt

Check the following points upon receipt:

- Are the nameplate ratings identical with what you ordered?
- Are dimensions and color in compliance with your specifications?
- Are the nameplate ratings for space heater, thermal protector, temperature detector, etc. identical with what you ordered?
- Is there any damage?
- Are all accessories and accompanying instruction manuals in good order?
- Please ensure that the arrow head indicator really indicates direction of rotation.
- If there are any specific requirements, please ensure they are in conformity with your specifications.
- Motor stator housing may be outfitted with condensation drain holes that are either open holes, drain holes with plugs or drain holes with breather drains. For horizontally mounted motors position the drain holes at the lowest point possible to allow for the egress of condensation. For vertical shaft installations the lower end bracket must be outfitted with drains at the lowest point possible. Prior to installation remove drain plugs if fitted.

2.1 Storage

When motors are not in operation, the following precautionary measures should be undertaken to assure best performance.

2.2 Place

- (a) High and dry, well ventilated without direct sun, dust or corrosive gas.
- (b) Not located near to a boiler or freezer.
- (c) Entirely free from vibration and easily accessible.
- (d) Motors should be put on pallets to prevent moisture.

2.3 Moisture prevention

Since moisture can be very detrimental to electrical components, the motor temperature should be maintained about 37°F (3 °C) above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

2.4

Even during storage, the insulation resistance should be kept above the specified values.

- (a) For measurement of insulation resistance and acceptable standard values, please refer to measures stated in 4.1.2 “Measurement of insulation resistance”.
- (b) Insulation resistance test should be performed once every three months.

2.5

If the motor is not in operation for a long period (one week and above) after installation or has been in operation but stopped for a period of time, the following precautions must be taken.

- (a) Protect the motor in accordance with measures stated in 2.3.
- (b) Insulation resistance test should be performed as stated in 2.4.

2.6 Bearing protection

- (a) If the motor has been provided with a shaft shipping brace to prevent shaft movement during transit, it must be removed before operating the motor. It is very important that this brace be re-installed exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. This prevents axial rotor movement that might damage the bearings.
- (b) Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with a good grade of rust inhibiting oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. While the shaft is rotating, it should be pushed to both extremes of the endplay.
- (c) Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage. The shaft should be rotated several revolutions about every month to maintain proper distribution of the grease within the bearings. **However, re-greasing is required if a significant period of time has elapsed between manufacture and use, or while in storage for extended time. It is a good practice to always replenish and purge with fresh grease at start up.**
- (d) Tilt-pad bearings are a type of sleeve bearing used in special design applications. Due to the nature of this bearing, a loose oil ring for delivering lubricant cannot be provided. Therefore, during the storage interval, oil must be periodically manually introduced into the pads and housing to prevent the occurrence of oxidation of the precision machined components.
 - (1) Remove the pipe plug from the bearing cap located above the tilt-bearing shell.
 - (2) Pour in approximately one cup of oil every month and rotate the shaft a few revolutions about every two (2) weeks.
 - (3) For long periods of storage, the oil that accumulates in the housing should be removed.

ATTENTION!

Care should be taken to keep parts such as fitting surfaces, key, shaft extension and axial central hole free from any foreign matter. Grease should also be generously applied to prevent rusting.

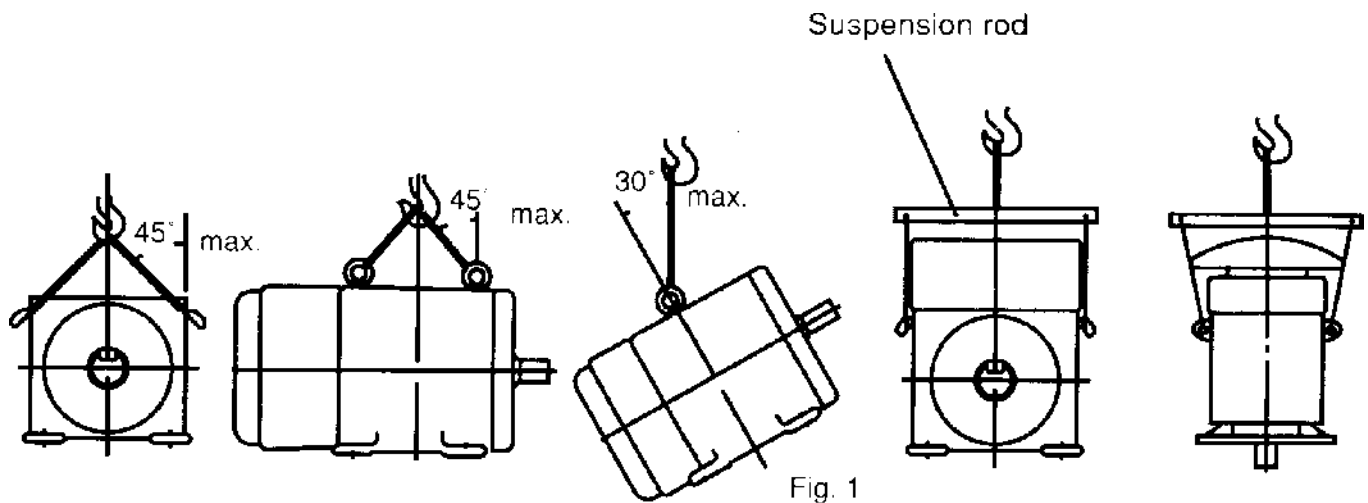
2.7 Transportation

To keep the rotating parts of motors from moving, thus preventing damage and scratching during transportation, they should be held securely with a locking device. Remove all transit clamps before operating the motor. It is very important that this device be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. The vertical mounting type motors should be transported in the vertical position.



Do not use the hoisting hook/eyebolts to lift more than the motor itself. They are designed to support the motor only. Make sure the hoisting hook is correctly attached to the eyebolt(s)/lug(s) and they are fully screwed in before hoisting. Also note such parts as fan cover, ventilation box, bracket, slip-ring, etc. may have their own hoisting lugs which can only carry their own weight. Nothing extra should be attached while hoisting.

Do not twist the steel wires and make sure the eyebolts have been firmly screwed in and the sling angle is correct. See figure 1.



3 INSTALLATION

Site and environment for motor installation

3.1.1

Standard environment and site conditions for the installation of motors are usually set as follows:

- Ambient temperature: $-14\sim 104^{\circ}\text{F}$ ($-10\sim 40^{\circ}\text{C}$)
- Humidity: Relative humidity below 90%RH for totally enclosed types, and below 80%RH for semi-enclosed types.
- Elevation: below 3,300 feet (1,000 meters).
- Harmful gases, liquids, dusts, high moisture should be absent.
- Foundations should be strong and free of vibration.

If there are any special environmental conditions, please inform TWMC prior to ordering.

3.1.2 Ventilation and space

- Installation area should be well ventilated.
- The installation space should be large enough to facilitate heat dissipation and maintenance.

3.2 Foundation

3.2.1

Use rigid and solid sole plate or common bed as foundation.

For best motor performance, it is advisable to use a sole plate or common bed, particularly when using a shaft coupling. See figure 2.

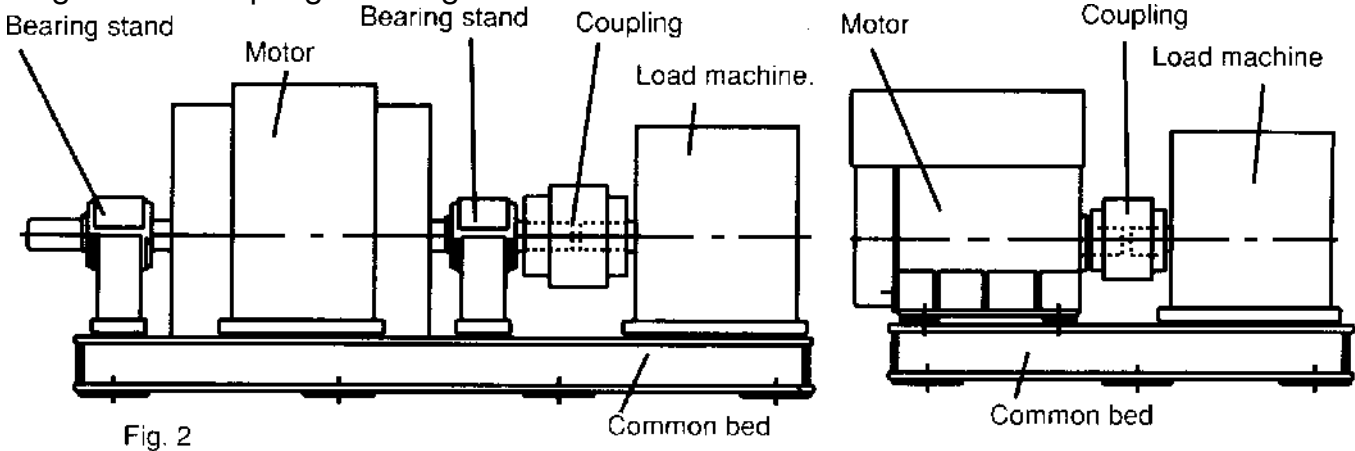


Fig. 2

3.2.2 Installation

- Select an appropriate foundation surface for the sole plate or common bed, which will be considered the final level.
- Align the position of the common bed with reference to that level.
- Align the level accuracy at a minimum of four points such as bearing mounting, shaft extension etc. The accuracy should be within .0015 inches (0.04mm).
- Sole plate or common bed should be embedded in concrete foundation as illustrated in Fig. 3. Stiff pads should also be installed beneath the wedges, which are welded together at various spots about 15.75-19.70 inches (400-500mm) apart etc., to enable the foundation to carry evenly the weight of the whole motor.
- The base should be sturdy and rigid to keep it flat and level.
- Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
- Accurately install shaft couplings, belt sheaves etc., then weld the wedges solid to prevent untoward change in position.

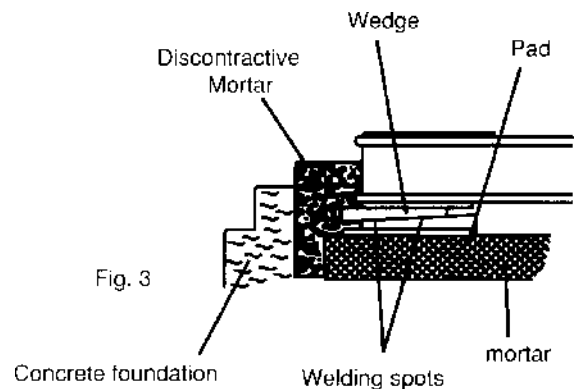


Fig. 3

3.2.3 The foundation of vertical induction motors: (Also the foundation of pump)

- Foundation of motor/pump must be rigid and secure to provide adequate support. There must be no vibration, twisting, misalignment etc. due to inadequate foundations.
- A massive concrete foundation is preferred in order to minimize vibration. Rigidity and

stability are enhanced by prop plate and foundation bolt. As shown in Fig. 4.

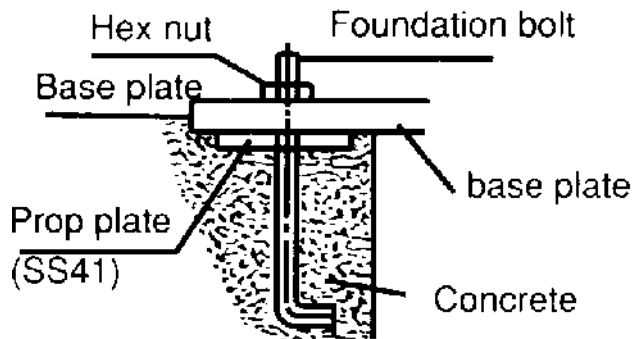


Fig. 4

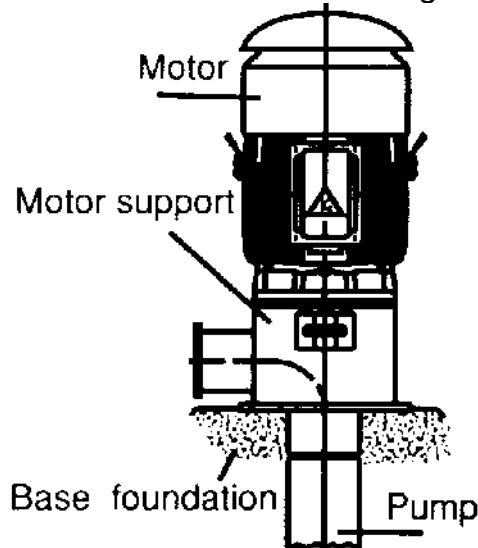


Fig. 5

3.2.4 Installation of vertical motors:

- All mounting surfaces must be clean and level.
- Foundation must be leveled at least at 4 points and guaranteed to be below .0015 in. (0.04mm) flat and level.
- Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
- Accurately install shaft couplings.

3.3 Installation of shaft coupling

ATTENTION!

Motors must always be accurately aligned, and this applies especially where they are directly coupled.

Incorrect alignment can lead to bearing failure, vibration and even shaft fracture. As soon as bearing failure or vibration is detected, the alignment should be checked.

3.3.1

Field application of a coupling to the motor shaft should follow the procedures recommended by the coupling manufacturer. The motor shaft extension must not be subjected to either extreme heat or cold during coupling installation.

ATTENTION!

Basically, the coupling should be heated and pushed onto the shaft extension with slight axial force. Do not hammer coupling to prevent bearing damage.

3.3.2

Although the sleeve bearings are equipped with thrust faces, these are intended only to provide momentary axial restraint of rotor movement either during start-up or when operating the motor disconnected from the driven equipment. They must not be operated under a constant thrust load unless they were originally designed for this condition.

Motors with either sleeve or anti-friction bearings are suitable for connection to the driven load through a flexible coupling. Coupling solidly to the load is not acceptable. With sleeve bearings, the flexible coupling should be of the limited end float type to prevent the possibility of any end thrust from the load being transmitted to the motor bearings, which could cause bearing damage. The recommended limits of end float are as follows:

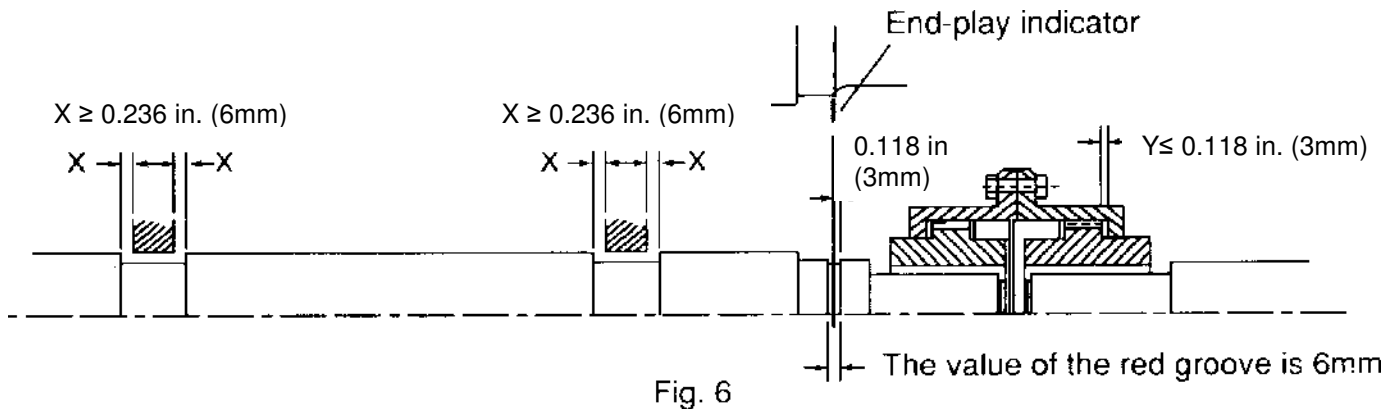


Fig. 6

- When the motor is in operation after installation, be sure that the end-play indicator is within the 0.236 in. (6mm) of the groove on the shaft or aligned to the shaft shoulder immediately outboard of the drive-end bearing to assure there is low friction between shaft and bearing.
- Unless otherwise specified, the designed end-play value X of the groove for TWMC motors in general is within 0.236 in. (6mm) as illustrated in Fig. 6. In essence, the endplay indicator is adjusted to point at the center of the groove or the drive-end shaft shoulder; thus X equals to $\pm 0.236 \text{ in (6mm)}$ so, and the endplay value (Y) of the couplings should equal or be smaller than 0.118 in. (3mm).
- If the desired value Y is greater than 0.118 in. (3mm) caused for instance by a thrust load and/or load machine with large end-play, please inform TWMC prior to entering an order.

3.3.3

In aligning the motor (and rotor) axially with the driven equipment, consideration should be given not only to the endplay indicator position but also to axial shaft expansion and increase in shaft centerline height due to thermal effects. In general, the axial shaft growth for motors can be disregarded since either bearing is fixed, and any shaft growth due to temperature increase will produce an elongation away from the coupling.

Shaft height growth (change in shaft centerline elevation) for TEFC machines can be calculated as follows:

$$L1 = (0.0005") \times (\text{motor foot to shaft centerline dimension})$$

For non-TEFC machines, divide the number by 2.

3.3.4

In normal operation, it is desirable that the motor operates on its magnetic center, so that no axial force is exerted on the coupling.

The motor shaft and the driven shaft should be aligned within the following tolerances in both angular and parallel alignment:

Unit: inches (mm)			
TIR	Range of rotating speed	Solid coupling	Flexible coupling
C	2500 rpm and above	0.0012" (0.03)	0.0012" (0.03)
	Below 2500 rpm	0.0016" (0.04)	0.0020" (0.05)
A	2500 rpm and above	0.0012" (0.03)	0.0012" (0.03)
	Below 2500 rpm	0.0012" (0.03)	0.0016" (0.04)

Angular misalignment is the amount by which the centerlines of driver and driven shafts are skewed. It can be measured using a dial indicator set up as shown in Fig. 7. The couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub face. The shafts should be forced against either the in or out extreme of their end float while being rotated.

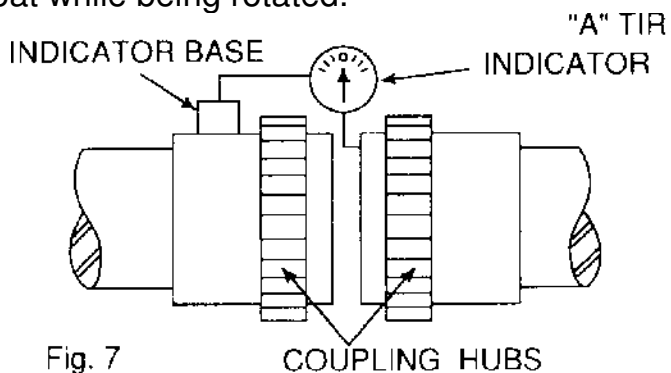


Fig. 7
TIR=Total indicator reading (by dial indicator)

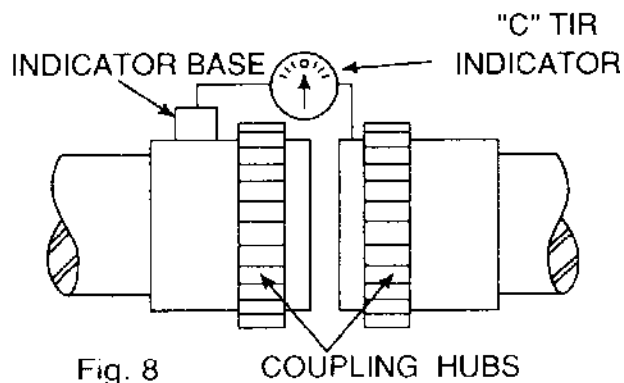


Fig. 8

Parallel misalignment is the amount by which the centerlines of the driver and driven shafts are out of parallel. It can be measured using a dial indicator set up as shown in Fig. 8. Again, the couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub outside diameter.

3.3.5

After the motor has been properly aligned with the driven equipment and the hold-down bolts have been installed and tightened, for motors with fabricated frames, at least two dowel pins should be installed in two diagonally opposite motor feet.

3.3.6 Installation of shaft coupling: (Vertical hollow shaft motor only)

- (a) Bearings are provided to absorb some upward shaft thrust when the coupling is fitted.
- (b) The coupling is fastened with bolts.
- (c) This coupling type is not auto-release type.

Note: Standard high thrust motors can absorb momentary up-thrust load up to 30% of the standard down thrust load. If the up-thrust is long in duration (over 10 Seconds) and/or exceeds 30% of the standard high thrust rating, special design arrangements are required and standard motor is not suitable.

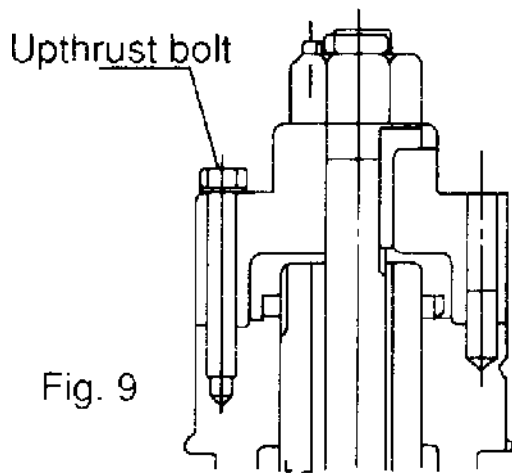


Fig. 9

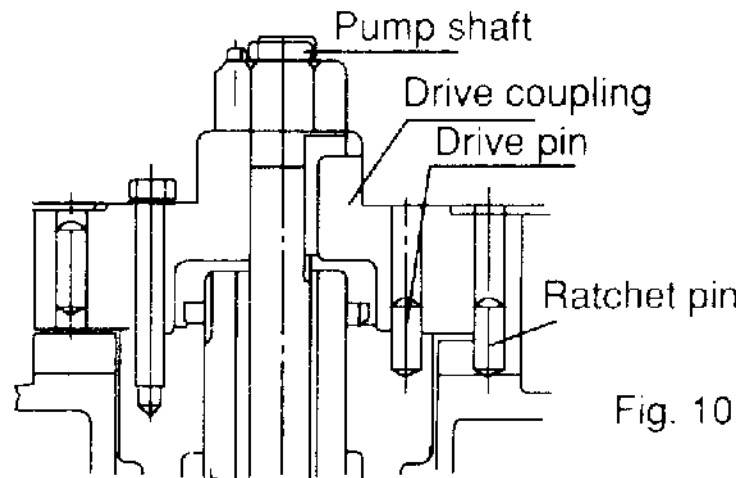


Fig. 10

3.3.7 Non-reverse ratchet/coupling: (If necessary)

The non-reverse coupling is also a bolted type and,

- (a) It prevents the pump and motor from rotating in the reverse direction.
- (b) It also prevents damage from over speeding and damage to pump shaft and bearings.
- (c) The ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed.
- (d) When power is removed, speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.
- (e) When installing the non-reverse coupling, do not use lubricant. Lubricant will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the plate.
- (f) As with the bolted coupling, the up-thrust capabilities are 30% of the standard high thrust rating for down thrust.

ATTENTION!

Do not apply non-reverse ratchets on applications in which the pump reversal time from shutdown (the instant the stop button is pressed) to zero speed is less than one second.

3.4 Installation for belt drive

In general, power transmission through direct flexible coupling is appropriate for large motors. Such motors are not suitable for belt, chain or gear connection unless specially designed for such service. However, for small and medium motors of outputs within the ranges shown on table below, it is acceptable to use belt transmission as indicated. Beyond these ranges, do not apply belt sheaves unless specially designed.

3.4.1

The diameter ratio between conveyance sheaves should not be greater than 5 to 1 for flat belts, and 8 to 1 for V-belts. It is also advisable to limit the belt velocity to under 115 ft/sec (35m/sec) to limit belt abrasion and vibration. The smaller the outer diameter of the V-belt sheave, the greater the shaft bending stress will be. If the bending stress is in excess of the shaft fatigue stress, the shaft may break. Therefore, please inform TWMC when you have decided the size of the sheaves and the length of the belts upon ordering.

ATTENTION!

Place the sheave and belt as close as possible to the motor body (it is advisable to make x as shown in Fig. 11 equal to 0) to reduce the bending moment and improve shaft life.

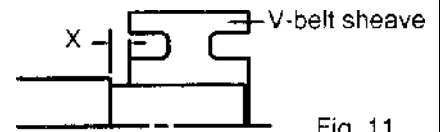


Fig. 11

3.4.2 Table of belt-sheave application for general electric motors

Output (KW/HP)			V-Belt Sheave							
			Conventional V-Belts				Narrow V-Belts			
4P	6P	8P	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)
11/15	-	-	B	4	160	82	3V	4	125	48
-	11/15	-	B	5	170	101	3V	5	140	59
-	-	11/15	B	5	190	101	3V	6	160	69
15/20	-	-	B	5	170	101	3V	6	125	69
-	15/20	-	B	5	224	101	3V	6	160	69
-	-	15/20	C	4	224	111	5V	3	180	60
18.5/25	-	-	B	5	200	101	3V	6	140	69
-	18.5/25	-	C	4	224	111	5V	3	180	60
-	-	18.5/25	C	5	224	136	5V	4	180	78
22/30	-	-	B	5	224	101	5V	6	160	69
-	22/30	-	C	5	224	136	3V	4	180	78
-	-	22/30	C	5	250	136	5V	4	200	78
30/40	-	-	C	5	224	136	5V	4	180	78
-	30/40	-	C	5	265	136	5V	4	224	78
-	-	30/40	C	6	265	162	5V	5	224	95
37/50	-	-	C	6	224	162	5V	4	200	78
-	37/50	-	C	6	265	162	5V	4	224	78
-	-	37/50	C	7	280	187	5V	5	250	95
45/60	-	-	C	6	265	162	5V	4	224	78
-	45/60	-	C	7	280	187	5V	5	224	95
-	-	45/60	C	7	315	187	5V	6	250	113
55/75	-	-	C	7	265	187	5V	5	224	95
-	55/75	-	C	8	300	213	5V	6	250	113
-	-	55/75	D	5	355	196	5V	6	280	113
75/100	-	-	C	8	315	213	5V	6	250	113
-	75/100	-	D	6	355	233	5V	6	315	113
-	-	75/100	D	6	400	233	5V	6	355	113
-	90/120	-	D	6	400	233	5V	6	355	113
-	-	90/120	D	6	425	233	8V	4	355	124
-	110/150	-	D	7	400	270	8V	4	355	124
-	132/175	110/150	D	7	450	270	8V	4	400	124
-	160/200	132/175	D	9	450	344	8V	4	450	124

3.5 Conveyance with chain or gear**3.5.1**

Make sure the loading capacity of shaft and bearings is appropriate for the size and installation position (overhang) of chain and gear. If necessary, please contact us to ensure the shaft and bearings will meet your requirements.

3.5.2

Pay close attention to ensure the parallelism of shafts.

3.5.3

The teeth of couplings should be correctly and precisely matched; the force conveyance centers should lie on the same line.

3.5.4

There should be no skip, jumping, vibration or unusual noises.

ATTENTION!

Do not hammer the conveyance devices such as couplings, belt sheaves, chain wheels, gears etc. onto the shaft. Those shaft fitments should be fitted and removed only by means of suitable devices. Heat shrinking may be a better alternative to avoid damaging bearings and components.



The exposed rotating parts should be covered to prevent accidents.

3.6 Electrical connections

All interconnecting wiring for controls and grounding should be in strict accordance with local requirements such as the USA National Electrical Code and UK IEE wiring regulations. Wiring of motor and control, overload protection and grounding should follow the instructions of connection diagrams attached to the motor.

3.6.1 Power

The rated conditions of operation for the motor are as shown on the nameplate. Within the limits given below of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at rated conditions:

±10% of rated voltage

±5% of rated frequency

±10% combined voltage and frequency variation so long as frequency variation is no more than ±5% of rated.

Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage to, or failure of, the motor.

3.6.2

The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables.



The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.

3.6.3

Either fabricated motors or fan cooled cast frame motors are all provided with grounding pads or bolts.



The motor must be grounded by proper connection to the electrical system ground.

3.6.4

The rotation direction of the motor will be as shown by either a nameplate on the motor or the outline drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner: While the motor is uncoupled from the load, start the motor and observe the direction of rotation. Allow the motor to achieve full speed before disconnecting it from the power source. Refer to the operation section of these instructions for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any two (2) incoming cables.

3.6.5 Auxiliary devices

Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate in their own enclosures elsewhere on the motor. Such information can be obtained by referring to the outline drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings or attached nameplates.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation.



Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.

4. OPERATION

4.1 Examination before start

4.1.1

When motors are installed in good manner, ensure the wiring is according to the diagram. Also, the following points should be noted:

- (a) Make sure all wiring is correct.
- (b) Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
- (c) Ensure all connections are properly insulated for the voltage and temperature they will experience.
- (d) Ensure the capacity of fuses, switches, magnetic switches and thermo relays etc. are appropriate and the contactors are in good condition.
- (e) Make sure the frame and terminal box are grounded.
- (f) Make sure that the starting method is correct.
- (g) Make sure switches and starters are set at their correct positions.
- (h) Motor heaters must be switched off when the motor is running.

4.1.2 Measurement of insulation resistance



During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.

- (a) For rated voltage below 1000V, measured with a 500 VDC megger.
- (b) For rated voltage above 1000V, measured with a 1000VDC megger.
- (c) In accordance with IEEE 43, clause 9.3, the following formula should be applied:

$$R \sim \left(\frac{\text{Rated voltage (v)}}{1000} + 1 \right) \times 10(\text{MQ})$$
- (d) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to the winding:
 - (1) If the motor is equipped with space heaters, they can be energized to heat the winding.
 - (2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 50% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the fully applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phases should be connected into one series circuit.



Ensure there is adequate guarding so live parts cannot be touched.

- (3) Heated air can either be blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

ATTENTION!

Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15-20 hours.

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 104°F (40°C) for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 50°F (10°C) increase in insulation temperature above the dew point temperature.

- (e) Should the resistance fail to attain the specified value even after drying, careful examination should be undertaken to eliminate all other possible causes, if any.

4.1.3 Power Source

- (a) Ensure the capacity of the power source is sufficient.
- (b) Ensure the supply voltage and frequency ratings are identical to those on the nameplate.
- (c) Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

4.1.4 Bearing lubrication

- (a) For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. On

self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. The proper oil is a rust and oxidation inhibited, turbine grade oil. Refer to the lubrication nameplate for the recommended viscosity.

- (b) Motors, which are supplied with provision for flood lubrication, have an inlet orifice to meter the oil flow to the bearing. Refer to the outline drawing for these values. If the supply pressure does not match that stated on the outline, the orifice size must be adjusted to produce the specified flow rate. The drain adapter (also provided) has a weir plate fixed to the inside of the pipe to permit the establishment of the proper oil level. This weir plate must be located at the bottom of the pipe and must be parallel to the plane of the motor feet. To ensure optimum flow, the drain line should be vented to the atmosphere.

Oil inlet temperature: Normal below 122°F (50°C)
 Alarm 140°F (60°C)
 Trip 149°F (65°C)

- (c) If the motor is in storage for over three (3) months, refilling of some new oil should be undertaken before operation to prevent bearing damage due to dry friction. The oil level should be kept at the center of the oil gauge. If necessary, drain some oil after refilling.
- (d) Motors that have been designed with anti-friction bearings for use with an oil mist lubrication system have been packed at the factory with a small amount of grease for short test runs. Continuous running should not be considered unless the oil mist system is installed and operating.
- (e) Grease lubricant type
- (1) The bearings have been well greased at the factory before delivery. However, regreasing is required if a significant period has elapsed between manufacture and use **or while in storage for extended time. It is a good practice to always replenish and purge with fresh grease at start up.**
- (2) *All motors with ZZ, or sealed bearings will have SHELL Alvania R3, or Multitemp SRL (Lithium base grease). Always check nameplate first.* All motors with open regreasable bearings will have Mobil Polyrex EM (polyurea base grease).

ATTENTION!

Do not mix different kinds of grease.

Mixing grease with different type of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

4.1.5 Cooling water for the cooler on water-cooled motors

Make sure the quality, volume and inlet temperature of cooling water for the motors are normal before the machine is in operation.

Water: General tower water or industrial water.

Volume: Please see outline drawing

Inlet temperature: Normal below 86°F (30°C)
 Alarm 95°F (35°C)
 Trip 104°F (40°C)

ATTENTION!

Make sure all locks, which fasten the movable parts of the motors during transportation, are dismantled and the shaft can rotate freely.

ATTENTION!

Ensure there is no foreign matter or tools inside the motors before starting motors

4.1.6

Make sure the transmission system, including belts, screws, bolts, nuts and set pins are in good condition.



The keys fitted to the shaft extensions are held by plastic tape only to prevent them from falling out during transportation or handling. The shaft key shall be removed to avoid flying out, when the motor is operated prior to the couplings etc. being fitted to the shaft extension.

4.1.7

Make sure the items above are examined. Test the motor running with or without load. Record and check according to "Maintenance" at 15-minute intervals during the first three hours of operation. Then regular examinations should take place at longer intervals. If all goes well, the motor can be classified as "in good order".

4.2 Starting operation**4.2.1 Starting load**

Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load, which is then gradually increased, proportional to the square of the speed and at last reaches 100% load at full load speed.

4.2.2 Starting

Too frequent starts can be harmful to the motors. The following restrictions should be observed:

- (a) Motor can be restarted should the initial start fail. Two starts are generally permissible when the motor is cold.
- (b) Motor can be started only once when it is at normal running temperature.
- (c) Should additional starts be necessary beyond the conditions stated above, the following restrictions should be noted:
 - (1) Let the motor cool down for 60 minutes before restarting, fully loaded.
 - (2) Let the motor cool down for 30 minutes before restarting, unloaded.
 - (3) Two inching starts can be regarded as one normal start.

ATTENTION!

If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately.

Investigate thoroughly and take corrective action before attempting a restart.

Possible reasons for not starting are:

- (1) Too low a voltage at the motor terminals.
- (2) The load is too much for the rotor to accelerate.
- (3) The load is frozen up mechanically.
- (4) All electrical connections have not been made.

- (5) Single-phase power has been applied.
- (6) Any combination of the above.

4.2.3 Rotating direction

- (a) Most TWMC motors are bi-directional. However, when some special types, such as high speed 2-Pole, certain large capacity motors, those with a non-reversing ratchet etc., should rotate in one direction, please ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.
- (b) To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases.

4.2.4 Power Source, Voltage, Current

- (a) Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate.
- (b) Voltage variation should be confined to within $\pm 10\%$ of the rating and the three phase voltages should be in full balance
- (c) Ensure the motor phase currents, when without load, are within $\pm 5\%$ of the average values.

4.2.5

Frequency variation should be confined to within $\pm 5\%$ of the rating. The aggregate variation of voltage and frequency should be confined to within $\pm 10\%$ of the absolute value of the ratings.

Starting time and unusual noises

ATTENTION!

Starting time is longer for the motors with large inertia. However, if starting time is longer than usual, or if there is difficulty in starting, or there is abnormal noise, do not run the motor and refer to TWMC Service representative.

4.2.6 Sleeve bearing oil rings (sleeve bearing types only)

As the oil ring is used to carry lubricant to sleeve bearings, frequently check to ensure the oil ring is in motion.

4.2.7 Bearing temperature rise

Following the initial start-up, the bearing temperatures should be closely monitored. The rate of rise in bearing temperature is more indicative of impending trouble than is the actual temperature.

ATTENTION!

If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperature stabilizes.

Recommended limits on bearing temperature are as follows:

Sleeve Bearings

- By permanently installed detector

Total measured temperature

194 °F (90 °C)

- By temporary detector on top of the bearing sleeve near the oil ring 185°F (85°C)

Anti-Friction Bearings

- By permanently installed detector 212°F (100°C)
- By temporary detector measuring the outside of the bearing housing 203°F (95°C)

ATTENTION! (For sleeve bearing)

- (1) It must be noted that when operating flood lubricated sleeve bearings without outside lubrication supplied, the bearing temperature must not be allowed to exceed 185°F (85°C) total temperature
- (2) Under normal condition, for the self-lube bearing, the rate of temperature rise should be from 52°F to 57°F (11°C to 14°C) for the first ten (10) minutes after starting up and approximately 72°F (22°C) at thirty (30) minutes. The rate of bearing temperature rise is a function of the natural ventilation and operating conditions.
- (3) When the rate of bearing temperature rise is less than 34°F (1°C) per half-hour, the bearing temperature is considered to be stabilized.
- (4) If the total bearing temperature exceeds 203°F (95°C), the motor should be shut down immediately.

Noise and Vibration

ATTENTION!

Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.

5. MAINTENANCE

5.1 Major points in regular inspections and maintenance.



For safety, maintenance and repairs must only be carried out by properly trained personnel.



Some testing, such as insulation resistance, usually requires the motor to be stopped and isolated from power supply.

Routine inspection and maintenance are usually performed by looking, listening, smelling and simple meters.



High temperature may arise under operating conditions on the motor surfaces, so touching should be prevented or avoided. Keep away from moving and live parts. Unless deemed necessary, do not remove guards whilst assessing the motor.

Timely replacement of worn parts can assure longevity and prevent breakdown.

Routine inspection and regular inspection and maintenance are important in preventing breakdown and lengthening service life.

Owing to the varied time and circumstances motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide, it is recommended to be performed periodically according to the factory maintenance program. Generally, the inspection scope is determined by the following factors:

- (a) Ambient temperature.
- (b) Starting and stopping frequency.
- (c) Troublesome parts usually affecting motor functions.
- (d) Easily abraded parts.
- (e) The important position of a motor in the operational system of a factory should be duly recognized. Therefore, its health and wellbeing should be fully protected especially when it is operating in severe conditions.

5.2 Motor windings:

- (a) For measurement of insulation resistance and standards to determine quality of insulation resistance, please refer to measures stated in 4.1.2 "Measurement of insulation resistance".
- (b) Inspection of coil-ends:
 - (1) Grease and dust accumulated on coils may cause insulation deterioration and poor cooling effect.
 - (2) Moisture must not accumulate. Keep coils warm when motor is not in use if moisture can be seen.
 - (3) Discoloring. This is mainly caused by overheating.
- (c) Ensure no movement of wedges from their original position.
- (d) Ensure the binding at the coil end is in its normal position.

5.3 Clean the interior of the motor:

- (a) After a motor is in operation for some time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage. Regular cleaning and examination is necessary to assure top performance.
- (b) Points to note during cleaning:
 - (1) If using compressed air or blower:
 - (a) Compressed air should be free of moisture.
 - (b) Maintain air pressure at 57psig (4 kg/cm²) since high pressure can cause damage to coils.
 - (2) Vacuum
Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tools should be non-metallic to avoid any damage to the winding insulation
 - (3) Wiping
Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent. In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

ATTENTION!

Solvents of any type should never be used on windings provided with abrasion protection. Abrasion protection is a gray, rubber-like coating applied to the winding end-turns.



Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an airline respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.

- (4) Keep core ducts completely clean. The difference in temperature rise could be around 50 °F (10 °C) before and after cleaning

5.4 Clean the exterior of the motor:

- (a) On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement.

ATTENTION!

Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

- (b) If the motor is equipped with air filters, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions. It is better to replace or recondition filters too often than not often enough.
- (c) Totally enclosed air to air cooled and totally enclosed fan cooled motors require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up not removed can lead to unbalance and vibration. All of the tubes of the air-to-air heat exchanger should be cleaned using a suitable tube brush having synthetic fiber bristles (not wire of any type).

5.5 Maintenance of anti-friction bearings**5.5.1 Frequency of re-lubrication:**

The life of grease varies greatly as a result of types of model, revolution speed, temperature, operational conditions etc. It is, therefore, impossible to be precise about replenishment intervals. However, for normal direct coupling transmission, the periods shown in Table 1 may be used as a guide.

Remarks:

- (a) The periods shown in Table 1 should be halved where bearings are used for belt drive and/or in dirty or high ambient temperature or high humidity environments.
- (b) Please refer to the lubrication nameplate, if attached to the motor.
- (c) For bearing numbers outside the range of Table 1, please contact TWMC
- (d) If the periods referred to in Table 1 for drive-end bearing and opposite drive-end are

different, for the convenience of maintenance operations, please take the shorter of the required grease replenishment periods of these bearings.

5.5.2 Kinds of grease:

All motors with ZZ, or sealed bearings will have SHELL Alvania R3, or Multitemp SRL (lithium base grease). All motors with open bearings will have Mobil Polyrex EM (polyurea base grease).

Certain T-frame models will utilize special grease and will be noted on the lubrication nameplate. Please use identical grease or its equivalents when maintaining lubrication schedule.

ATTENTION!

Do not mix different kinds of grease.

Mixing grease with different types of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

5.5.3 Grease quantity

The amount of grease per replenishment depends on the type, size and construction of the bearings. The maximum amount of one replenishment for each bearing is shown in Table 2.

This replenishment amount is also the amount used at the time the motor is initially started.

5.5.4 Re-greasing



If re-lubrication is to be performed when the motor is running, stay clear of rotating parts.

It is advisable to re-grease when the motor is running to allow the new grease to be evenly distributed inside the bearing. Before re-greasing, the inlet fitting should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The outlet for grease drainage should be opened to allow the proper venting of old grease. Use a grease gun to pump grease through the grease nipple into the bearings. After re-greasing, operate the motor for 10-30 minutes to allow any excess grease to vent out.

TABLE 1.

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	3000 RPM	3600 RPM
62XX 63XX 72XX 73XX	6202									2000 Hrs	
	03										
	04										
	05										
	06										
	07										
	08										
	09										
	10										
	12										
	13	3000 Hrs									1000 Hrs
	14										
	15									2000 Hrs	720 Hrs
	16										
	17										
	18										
	20									1500 Hrs	
	22										
	24									2000 Hrs	
	26										
28											
30											
32									1500 Hrs		
34											
36									2000 Hrs	1000 Hrs	
38											

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	
NU2XX NU3XX	NU214							2000 Hrs		
	15									
	16									
	17									1500 Hrs
	18	3000 Hrs								
	20									2000 Hrs
	22									
	24									
	26									
	28									1000 Hrs
	30									
	32									2000 Hrs
	34									
	36									
	38	2000 Hrs								
	40									1000 Hrs
44	1000 Hrs									
48										

TABLE 1 CONTINUED.

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	
222XX 223XX	22220								300 Hrs	
	22	1000 Hrs					500 Hrs			
	24									
	26									
	28									
	30						300 Hrs			
	32									
	34									
	36	500 Hrs								
	38									
	40						300 Hrs			
	44									
48	300 Hrs									

MAINTANCE GREASING QTY.

d = Bore (mm)
D = OD (mm)
B = Width (mm)
G = Grease Qty (g)

$G = D*B*0.005$

TABLE 2.

BRG#	d	D	B	G	Full Qty	BRG#	d	D	B	G	Full Qty
	mm	mm	mm	grams	grams		mm	mm	mm	grams	grams
2 SERIES						3 SERIES					
NU202/6202	15	35	11	2	8	NU302/6302	15	42	13	3	10
NU203/6203	17	40	12	3	10	NU303/6303	17	47	14	4	13
NU204/6204	20	47	14	4	13	NU304/6304	20	52	15	4	13
NU205/6205	25	52	15	4	15	NU305/6305	25	62	17	5	17
NU206/6206	30	62	16	5	15	NU306/6306	30	72	19	7	25
NU207/6207	35	72	17	6	15	NU307/6307	35	80	21	8	25
NU208/6208	40	80	18	7	20	NU308/6308	40	90	23	10	30
NU209/6209	45	85	19	8	25	NU309/6309	45	100	25	13	35
NU210/6210	50	90	20	9	30	NU310/6310	50	110	27	15	40
NU211/6211	55	100	21	11	35	NU311/6311	55	120	29	17	50
NU212/6212	60	110	22	12	40	NU312/6312	60	130	31	20	60
NU213/6213	65	120	23	14	50	NU313/6313	65	140	33	23	80
NU214/6214	70	125	24	15	50	NU314/6314	70	150	35	26	80
NU215/6215	75	130	25	16	60	NU315/6315	75	160	37	30	100
NU216/6216	80	140	26	18	60	NU316/6316	80	170	39	33	100
NU217/6217	85	150	28	21	80	NU317/6317	85	180	41	37	120
NU218/6218	90	160	30	24	80	NU318/6318	90	190	43	41	120
NU219/6219	95	170	32	27	90	NU319/6319	95	200	45	45	140
NU220/6220	100	180	34	31	100	NU320/6320	100	215	47	51	160
NU221/6221	105	190	36	34	110	NU321/6321	105	225	49	55	190
NU222/6222	110	200	38	38	120	NU322/6322	110	240	50	60	220
NU224/6224	120	215	40	43	120	NU324/6324	120	260	55	72	270
NU226/6226	130	230	40	46	140	NU326/6326	130	280	58	81	300

*Fill new grease until it overflows and the old grease is entirely replaced.

5.5.5 Oil re-lubrication (For oil lubrication types only)

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up to operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and on to the rotor, but also because too high an operating oil level prevents the bearing from clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gauge, drain enough oil to bring the level back within the recommended operating range. **Do not permit the operating level to fall below the minimum shown on the gauge.**

ATTENTION!
Should it ever become necessary to add excessive amounts of make-up oil, investigate immediately for oil leaks.

Change the oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions, such as high ambient temperature, may require more frequent changes. Avoid operating the motor with oxidized oil.

Use only good grade, oxidation-corrosion-inhibited turbine oils produced by reputable oil companies. The viscosity of the oil to be used depends upon the type and size of the bearings, its load and speed, the ambient temperature, and the amount and temperature of the cooling water (if used). The lubrication nameplate or instructions with each motor specifies the viscosity range of oil suitable for average conditions. The usual oil viscosity recommendations are summarized in Table 3. Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of special oil. Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Be sure that the oil-metering hole is clear, and then dry the housing thoroughly before re-assembly, and ensure all traces of cleaning solvent have been removed.

TABLE 3 Oil Viscosity**

Bearing function and location	Bearing Type / size	Oil Viscosity - SSU	
		@ 100°F (38°C)	@ 200°F (93°C)
Thrust Bearing	72XX, 73XX Angular contact ball And/or (62XX, 63XX)	150	45
	Spherical roller	300	53
	Plate (Kingsbury Type)	300	53

**Remark: When a lubrication nameplate is attached to the motor, use the lubrication oil it stipulates.

5.5.6 Cleaning and installation of bearings

- (a) Apply the proper amount of grease to the disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.
- (b) Bearing installation

ATTENTION!
Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.

Since the bearing is a high precision component, it is important to avoid ingress of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and ensure clean conditions during installation and assembly.

ATTENTION!
The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be absolutely avoided.

The bearings should be heated in a bath of clean oil at a temperature of approximately 176°F (80°C). After warming, slide the bearings in place quickly and nimbly so they do not shrink before being fully in position.

Grease the bearing after the temperature returns to normal, and then reassemble the motor.

5.6 Maintenance of sleeve bearings

5.6.1 Daily inspections

- (a) Ensure the volume and quality of lubrication oil are in compliance with specifications. See figure 12.

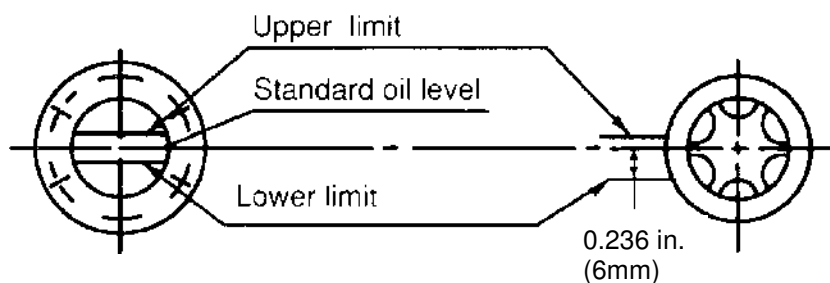
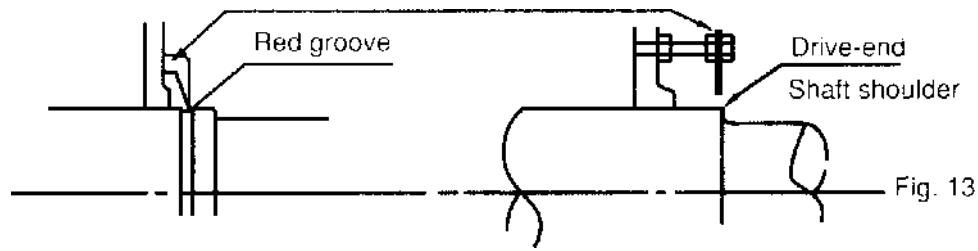


Fig. 12

- (b) Ensure there is motion of the oil ring and it is not clamped.
- (c) The indicator of the shaft endplay should be restricted within the specified range of the red groove of the shaft as shown in Figure 13. Or the ± 0.118 in. (± 3 mm) range of the drive-end shaft shoulder, or the bearing may be damaged.



5.6.2 Regular examination

(a) Periodical change of oil

The oil reservoirs of self (not flood) lubricated bearings should be drained and refilled about every six (6) months. More frequent changes may be needed on high speed (3600 rpm) motors or if severe oil discoloration or contamination occurs. In conditions where contamination does occur, it may be advisable to flush the reservoir with kerosene to remove any sediment before new oil is added. Proper care must be taken to thoroughly drain the reservoir of the flushing material before refilling with the new oil.

Refill the reservoir to the center of oil sight glass with a rust and oxidation inhibited turbine grade oil. Refer to the outline and lubrication nameplate for the correct viscosity.

(b) Quantity of lubrication oil

Please refer to the lubrication nameplate for oil quantity.

(c) Oil viscosity

ISO	Equivalents	Viscosity (SUS/100°F (38°C))
VG32	Esso Teresso 32	150
VG46	Esso Teresso 46	200
VG68	Esso Teresso 68	300

5.6.3 Disassembly



Prior to disassembling, ensure the power supplies are disconnected and there are no moving parts.

The bearing sleeve is of the spherically seated, self-aligning type. The opposite drive end bearing is normally insulated for larger motors (or when specified). On some motors, the insulation is bonded to the spherical seat of the bearing housing.

ATTENTION!

Extreme care must be exercised in removing the bearing sleeve from the insulated support to avoid damaging this insulation.

The following is the recommended procedure for removing the bearing sleeve:

- (a) Remove the oil drain plug in the housing bottom and drain the oil sump.
- (b) Remove all instrumentation sensors that are in contact with the bearing sleeve. These would include resistance temperature detectors, thermocouples, thermometers, etc..
- (c) Remove the socket head bolts holding the bearing cap and the inner air seal. The end cover plate must also be removed if the non-drive end bearing is being disassembled. Remove the bearing cap and top half of the inner air seal. Place them on a clean, dry surface to avoid damage to the parting surfaces.
- (d) Remove the top half of the bearing sleeve using suitable eyebolts in the tapped holes provided. Lift the bearing top straight up and avoid any contact with the shoulders of the shaft journals that might damage the thrust faces of the bearing. Place on a clean, dry surface taking care to prevent damage to either the parting surfaces or the locating pins that are captive in the top bearing half.
- (e) Remove the screws at the partings in the oil ring and dismantle the ring by gently tapping the dowel pin ends with a soft face mallet. Remove the ring halves and immediately reassemble them to avoid any mix up with parts or damage to the surfaces at the partings.
- (f) Pull up on the garter spring surrounding the floating labyrinth seal and carefully slip out the top half. Rotate the garter spring until the lock is visible. Twist counter-clockwise to disengage the lock, remove the garter spring then rotate the lower half of the seal out of the groove in the bearing housing. Note the condition of these floating labyrinth seals. If they are cracked or chipped, they must be replaced. Do not attempt to reuse a damaged seal.
- (g) To remove the bottom bearing half, the shaft must be raised a slight amount to relieve pressure on the bearing. On the drive end, this can be done by jacking or lifting on the shaft extension. Protect the shaft. On the non-drive, jacking or lifting can be done using bolts threaded into the tapped holes provided in the shaft end.
- (h) Roll the bottom bearing half to the top of the shaft journal and then lift it using suitable eyebolts threaded into the holes provided. Again avoid any contact with the shaft shoulders that could damage the bearing thrust faces. Place the lower bearing half on a clean, dry surface to protect the parting surfaces.



Use extreme care when rolling out the lower bearing half. Keep hands and fingers well clear of any position where they might be caught by the bearing half if it were accidentally released and rotated back to its bottom position. Serious personal injury could result.

- (i) Protect the shaft journal by wrapping it with clean, heavy paper or cardboard.

5.6.4 Re-assembly

Bearing re-assembly is basically a reverse of the disassembly procedures outlined above, with the following suggestions:

- (a) The interior of the bearing housing should be cleaned and then flushed with clean oil or kerosene.
- (b) The bearing halves and the shaft journal should be wiped clean using a lint-free cloth soaked with clean oil.
- (c) All parts should be carefully inspected for nicks, scratches, etc., in any contact surfaces. Such imperfections should be removed by an appropriate method such as stoning, scraping, filing, etc., followed by thorough cleaning.
- (d) Before installing the floating labyrinth seal halves, observe their condition. Do not attempt to use a cracked or chipped seal. The bottom half seal has a set of drilled holes in its side face. These must be placed at the bottom toward the inside of the bearing so that accumulating oil may drain back into the housing.
- (e) Put a bead of Curil-T around the seal half O.D.'s on both sides adjacent to the garter spring groove. This will prevent oil by-passing the seal around its outside.
- (f) Place the bottom seal half on top of the shaft and roll it into position. Install the top half and insert the garter spring pulling up on both ends to permit engaging the lock. Run a bead of Curil-T around the O.D's on both sides adjacent to the garter spring groove on this half also.
- (g) Carefully reassemble the two oil ring halves. Inspect the dowel pins for burrs and straightness and make any corrections required. Do not force the ring halves together. Excessive force may alter the roundness or flatness of the oil ring which can change its oil delivery performance.
- (h) Some of the pipe plugs in the housing are metric thread type and have a copper, lead, or similar material washer. If these plugs are removed, be careful not to lose the washers. Before re-assembly, inspect the washers and replace them as required.
- (i) Before installing the bearing cap, observe the position of the floating labyrinth seal. The "tab" must be on top to engage the pocket. Failure to position the seal properly will result in damage when the cap is assembled.

ATTENTION!

- (1) Curil-T is the only approved compound for use in the assembly of the bearings on this motor. Other products may harden and impede operation.**
- (2) During the re-assembly of the bearing parts, a thin layer of Curil-T should be applied to all gaskets and machined interface surfaces. This suggestion does not apply to the machined surfaces of the bearing liner halves.**
- (3) When seating the bearing shell, apply a thin layer of lube oil at the spherical surface of the liner. Slowly roll the lower bearing liner into the bearing housing making sure that the splined surface of the liner and the housing are flush. Gradually lower the shaft onto the bearing. The weight of the shaft will help rotate the bearing liner so that the babbitt surface of the liner will match the slope of the journal. Sometimes it is required to use a rubber mallet to tap lightly on the bearing housing while slowly rolling the shaft to help this seating operation.**

5.7 Maintenance of slip ring (For Wound Rotor Motors only)



Ensure motor is disconnected from power supplies and there are no accessible moving parts before maintenance operation.

5.7.1 Adjustment of carbon brush

- (a) Brush pressure for normal operation:
 - Electro-graphite brush 2.8 to 3.6 psi (0.2~0.25 kg/cm²)
When frequent vibrations are evident or the brush is small (area below 0.08 sq. in. (0.5 cm²), the pressure should be greater than as shown.
- (b) Adjustment of brush pressure:

The brush pressure should be adjusted to keep normal operation as it wears.

 - The brush pressure may be reduced after use, so it is necessary to re-adjust. For adjustment, please turn adjusting screw, pressure adjusting pin or pressure adjusting plate as shown in Fig. 14 to obtain the correct tension (= 3.27 x brush cross sectional area in inches²) +/- 0.2 lbs" (=0.23 x brush cross sectional area in cm²) ±10% kg).
- (c) Brush pressure need not be adjusted if constant force spring is used as shown in Fig. 15 and Fig. 16.

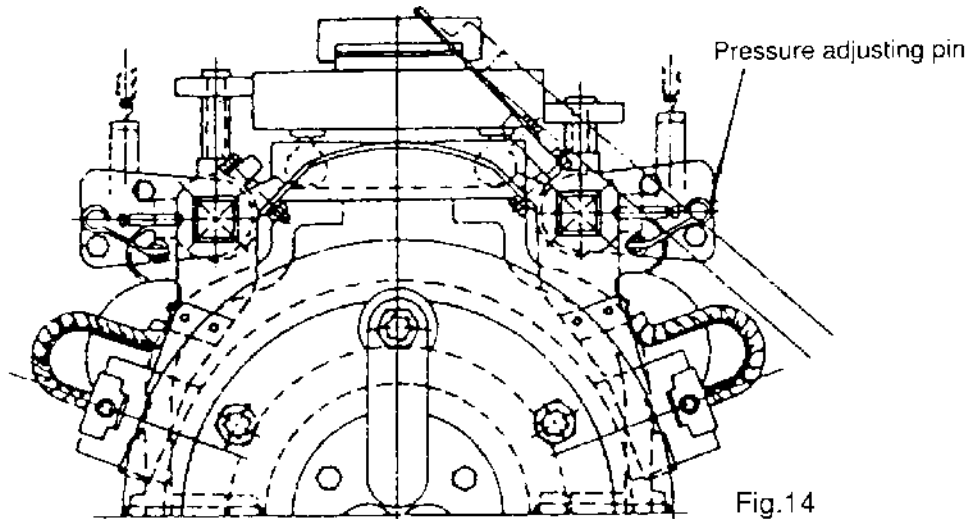


Fig.14

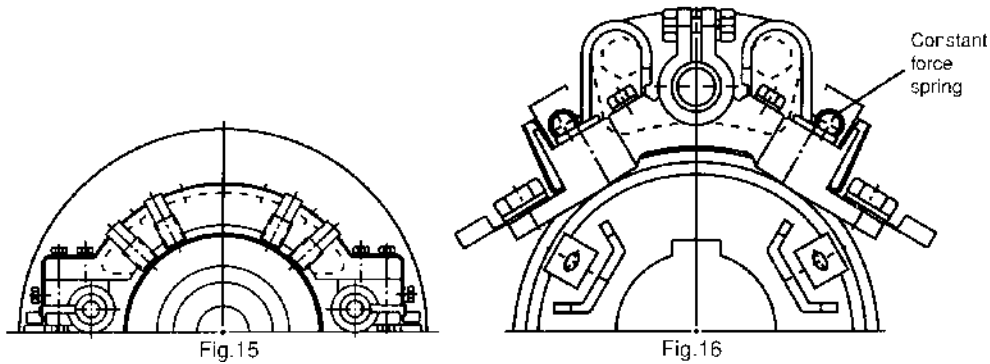


Fig.15

Fig.16

5.7.2 Brush replacement

The carbon brush is a part of the equipment which is easily worn away, replace it after it is worn to 1/2 ~ 3/4 of original size.

(a) Brush material

The brush material is important to the performance of the motor. Only the most appropriate materials are chosen by TWMC, and are listed on the nameplate of the motor. It is important to know this when you replace the brush, so a recommended type is used.

(b) Dimensions

Brush, holder and gap between them, please refer to CNS 2322 C4051 or JIS C2802.

ATTENTION!

The gap between a brush and its holder is important for good performance and safety of the motor.

(c) Adjustment of new brushes (Shown in Fig. 17)

- (1) Polish the new brush with a file until it assumes the appropriate contour of the slip ring which it touches.

- (2) Place sand-paper (JIS R6252 No. 40... 50) on the slip ring with the abrasive face of the paper against the brush to induce a closer contact by rubbing against each other.
- (3) Repeat item 2 with fine sandpaper (JIS R6252 No. 100 to 200) until the contact surface between brush and slip ring exceeds 80%.
- (4) Finally, clean the contaminated slip ring and brush with a clean cloth or compressed air.

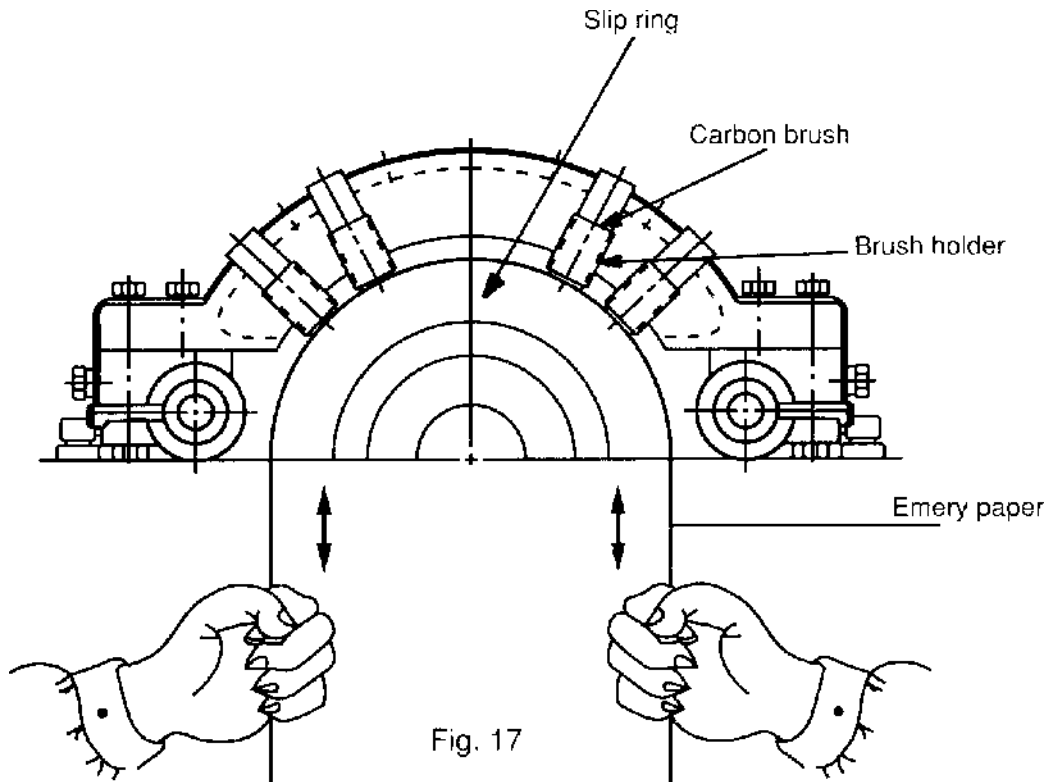


Fig. 17

5.8 Maintenance of non-reverse ratchet mechanism (For Vertical high Thrust Motor only)

5.8.1

In the pump piping system, a check valve and a stop valve should be installed in the discharge line. The check valve, placed between the pump and the stop valve, is to protect the pump from reverse flow and excessive backpressure. The stop valve is used in priming, starting and when shutting down the pump. It is advisable to close the stop valve before stopping the pump. This is especially important when the pump is operated against a high static head.

TWMC vertical high thrust motors are equipped with a non-reverse ratchet (N.R.R.) mechanism only when requested by the pump manufacturer. Typical construction of the N.R.R. mechanism is shown as Fig 18 below.

The N.R.R. mechanism keeps the pump and motor from rotating in the reverse direction. This prevents damage from over-speeding and damage to water-lubricated pump shaft bearings

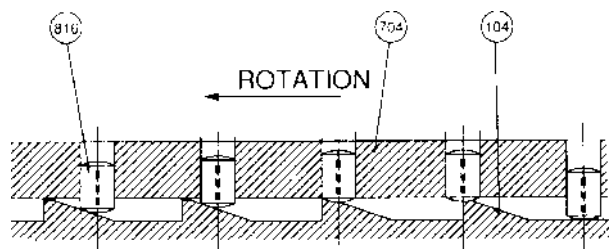
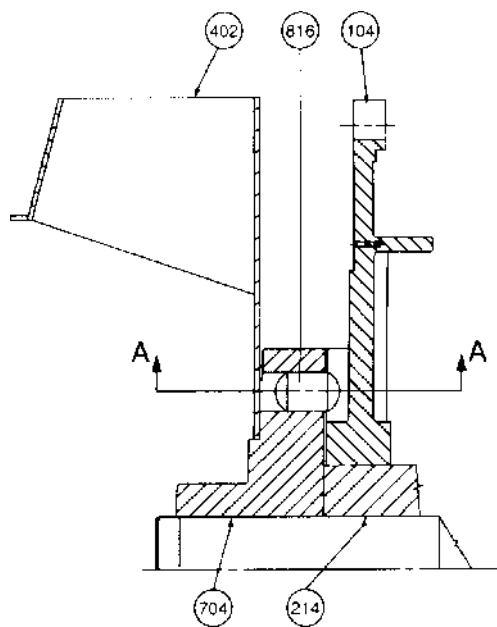
when, on shutdown, the falling water column tends to drive the pump in the reverse direction. In normal operation, the ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

5.8.2

The service life of ratchet pins depends not only on the reverse shock load between the pin and ratchet tooth when the pump is stopped but also the frequency of pump starting and stopping while in service. If the pins are deformed due to this reverse shock load, then the up and down motion of the ratchet pins could be sluggish or jammed and unusual noises shall arise.

The recommended replacement period for these ratchet pins is every three (3) years. If the reverse shock load is greater than 30% of motor rated torque or the starting frequency is more than twice per day, then the replacement period should be halved.

ATTENTION!
The check valve and stop valve in the discharge line should be regularly inspected and maintained to assure the normal function of these valves. This is important to protect the pump and motor from damage and increase the service life of the N.R.R. mechanism.



SECTION A-A

ITEM	NAME
104	RATCHET
214	BEARING SEAT
402	EXTERNAL FAN
704	RATCHET PIN CARRIER
816	RATCHET PIN

Fig. 18

6. FAULT FINDING AND RECOGNITION

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Fail to start without load	Motionless and soundless	Power-off	Consult power company
		Switch-off	Switch-on
		No fuse	Install fuse
		Broken wiring	Check wiring and repair
		Broken lead	Check wiring and repair
		Broken windings	Check windings and repair
	Fuse blowing. (Automatic switch trips off, slow start with electromagnetic noise)	Short circuit of circuit switches	Check circuit switches and replace
		Incorrect wiring	Check wiring according to nameplate
		Poor contact at terminal	Lock tightly
		Windings grounded	Factory repair
		Broken windings	Factory repair
		Poor contact of circuit switches	Check and repair
		Broken wiring	Check and repair
		Poor contact of starting switches	Check and repair
Loading after start	Fuse blowing. Fail to restart due to trip-off of automatic switch	Insufficient capacity of fuse	Replace fuse if wiring permits
		Overload	Lighten load
		High load at low voltage	Check circuit capacity and reduce load
	Overheating motor	Overload or intermittent overload	Lighten load
		Under-voltage	Check circuit capacity and power source
		Over-voltage	Check power source
		Ventilation duct clogged	Remove the foreign matter in the duct
		Ambient temperature exceeds 104°F (40°C)	Correct insulation class to B or F, or lower ambient temperature
		Friction between rotor and stator	Factory repair
		Fuse blown (Single-phase rotating)	Install the specified fuse
		Poor contact of circuit switches	Check and repair
		Poor contact of circuit starting switches	Check and repair
		Unbalanced three-phase voltage	Check circuit or consult power company

Kinds of Breakdown	Symptoms	Possible Causes	Remedies	
Loading after start	Speed falls sharply	Voltage drop	Check circuit and power source	
		Sudden overload	Check machine	
		Single-phase rotating	Check circuit and repair	
	Switch overheat	Insufficient capacity of switch	Replace switch	
		High load	Lighten load	
	Bearing over-heating	High belt tension	Adjust belt tension	
		Slack belt tension	Adjust belt tension	
		Misalignment between motor and machine shafts	Re-align	
		Over speed of bearing outer-ring	Adjust bracket	
		High bearing noise	Replace the damaged bearing	
Noise	Electromagnetic noise induced by electricity	Occurrence from its first operation	May be normal	
		Sudden sharp noise and smoking	Short circuit of windings should be repaired at the factory	
	Bearing noise	Noise of low shishi or Thru-Thru	May be normal	
		Kala-Kala as a result of poor lubrication	Grease	
		Kulo-Kulo as a result of poor lubrication	Clean bearing and grease	
		Sa-Sa or larger noise	Replace the damaged bearing	
	Mechanical noise caused by machinery	Loose belt sheave	Adjust key and lock the screw	
		Loose coupling or skip	Adjust the position of couplings, lock key and screw	
		Loose screw on fan cover	Lock fan cover screw tightly	
		Fan rubbing	Adjust fan position	
		Rubbing as a result of ingress of foreign matter	Clean motor interior and ventilation ducts	
		Wind noise	Noise induced by air flowing through ventilation ducts	
		Induced by conveyance machine	Repair machine	
	Vibration	Electromagnetic vibration	Short circuit of winding	Factory repair
			Open circuit of rotor	Factory repair
Mechanical vibration		Unbalanced rotor	Factory repair	
		Unbalanced fan	Factory repair	
		Broken fan blade	Replace fan	
		Unsymmetric centers between belt sheaves	Align central points	
		Central points of couplings do not lie on the same level	Adjust the central points of couplings to the same level	
		Improper mounting installation	Lock the mounting screws	
		Motor mounting bed is not strong enough	Reinforce mounting bed	

Remarks:

- (1) Circuit switches: These include knife switches, electromagnetic switches, fuses and other connection switches etc.
- (2) Starting switches: These include Delta-Star starters, compensate starters, reactance starters, resistor starters, starting controller's etc.



STERLING
ELECTRIC, INC.

Fusion Fluid Equipment Sterling Electric Motors



SINGLE PHASE MOTORS

INSTALLATION AND MAINTENANCE MANUAL

March 21, 2006

Irvine, California (800) 474-0520
Indianapolis, Indiana (800) 866-7973
Hamilton, Ontario (800) 809-0330

e-mail: sales@sterlingelectric.com

www.sterlingelectric.com

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 where 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.

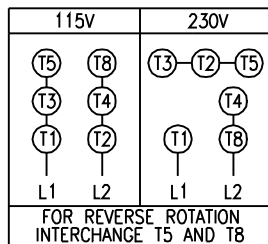
MOUNTING

- (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.

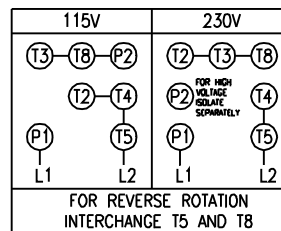
POWER SUPPLY AND CONNECTIONS

- (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.

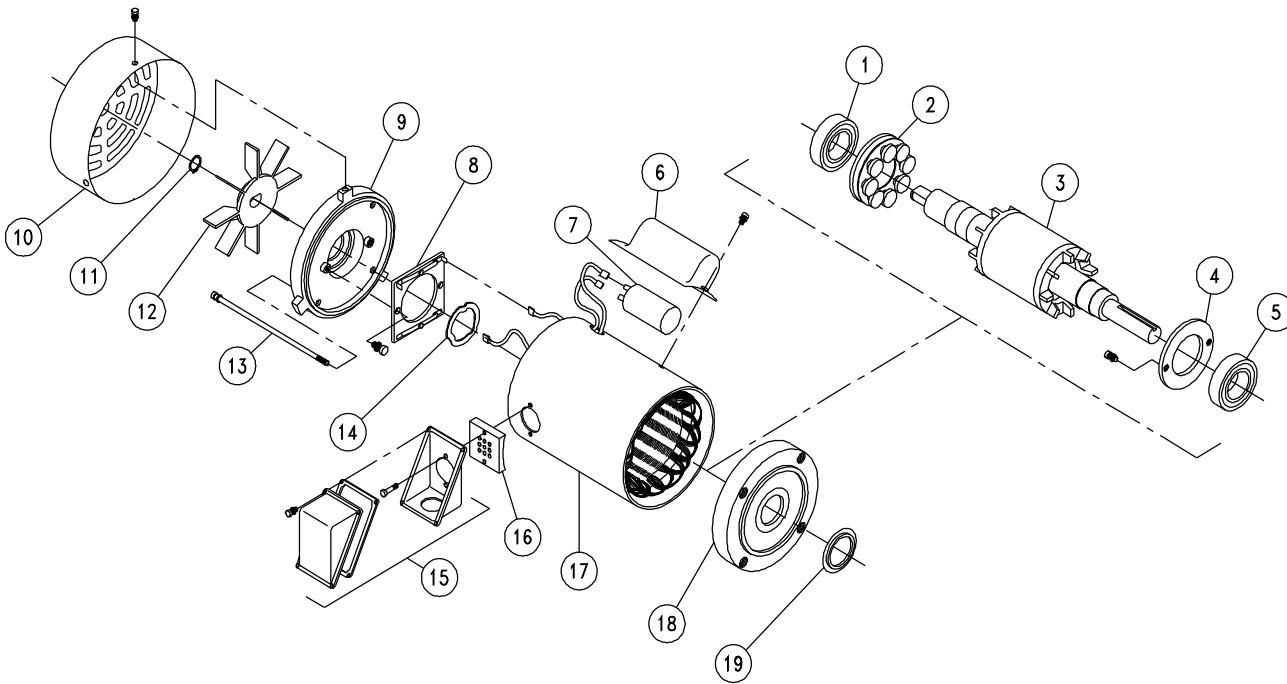
MAINTENANCE

- (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

Indianapolis, Indiana (800) 866-7973
e-mail: sales@sterlingelectric.com
www.sterlingelectric.com

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 where 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 frame, 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.

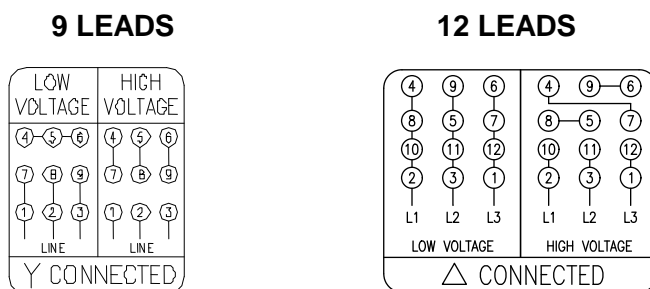
Foundation

- 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.



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

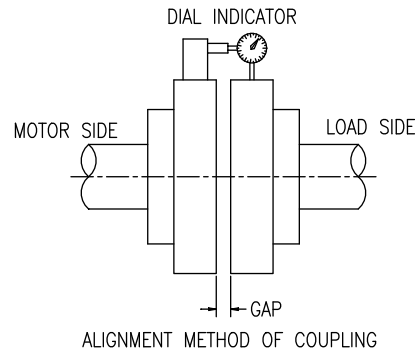
If the motor location is more than 3300 feet above sea level, the operating temperature of the motor will be 5 to 10°C higher. The motor may require de-rating to allow for this additional heating. Consult factory.

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.



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, it 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 if 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 recommended 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.

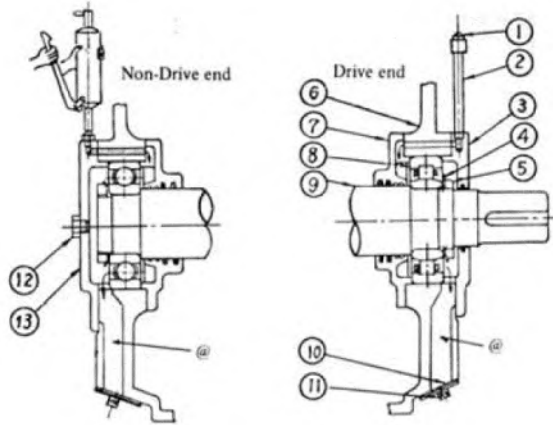


Figure 8

@ 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 Spherol 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.	<p>a. If 1800 RPM motor-four equally burned groups at 90° intervals.</p> <p>b. If 1200 RPM motor-six equally burned groups at 60° intervals.</p> <p>c. If 3600 RPM motor-two equally burned groups at 180° apart.</p> <p>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.</p>
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

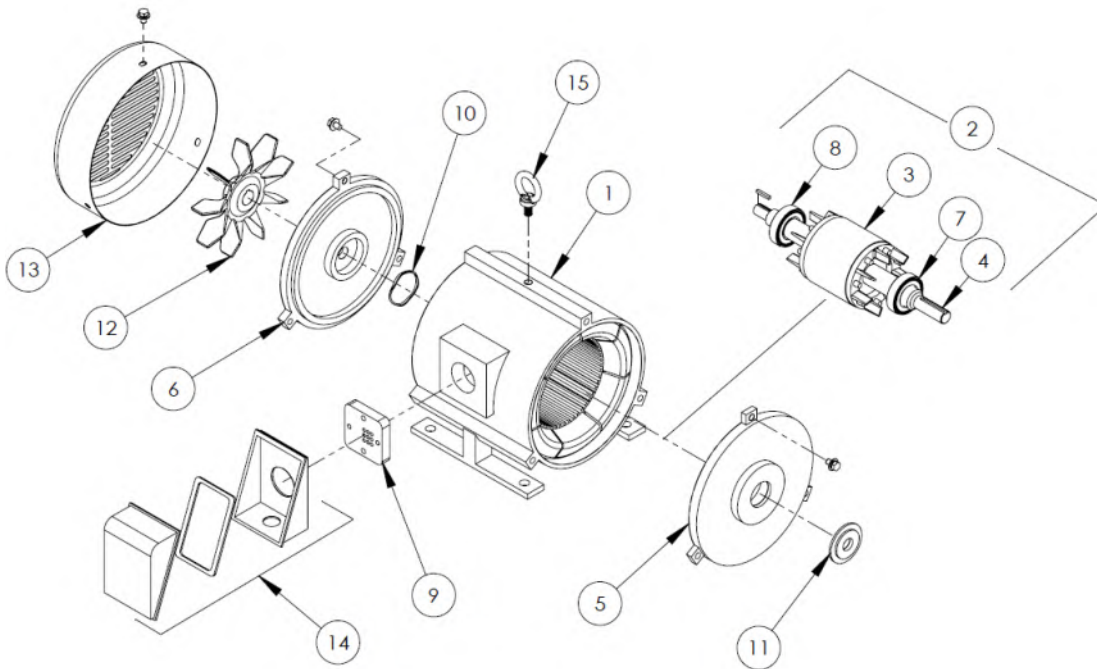
ITEM	DESCRIPTION
9	Lead Seal
10	Wave Washer 56 - 320T
	Bearing Shim 360T - 440T
11	Slinger
12	Outside Fan
13	Fan Cover
14	Conduit Box Assembly
15	Lifting Eye

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	6205LL	6205LL	6205ZZ	6205ZZ			6205LL	6204LL
180T	6206LL	6206LL	6207ZZ	6206ZZ			6306LL	6206LL**
210T	6208LL	6208LL	6308ZZ	6208ZZ			6308LL	6306LL
250T	6309LL	6309LL	6310ZZ	6208ZZ			6309LL	6309LL
280T	6311CLL	6311CLL	6310ZZ	6210ZZ			6311LL	6311LL
280TS	6311C3LL	6311C3LL	6310C3	6210C3			6311C3LL	6311C3LL
320T	6312C3	6312C3	6312ZZ	6212ZZ				
320TS	6312C3	6312C3	6312C3	6212C3				
360T	6314	6314	NU215	6312				
360TS	6314C3	6314C3	6312C3	6312C3				
400T	6316	6316	NU218	6313				
400TS	6316C3	6316C3	6313C3	6313C3				
440T	NU316	6316	NU220	6315				
440TS	6316C3	6316C3	6313C3	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.



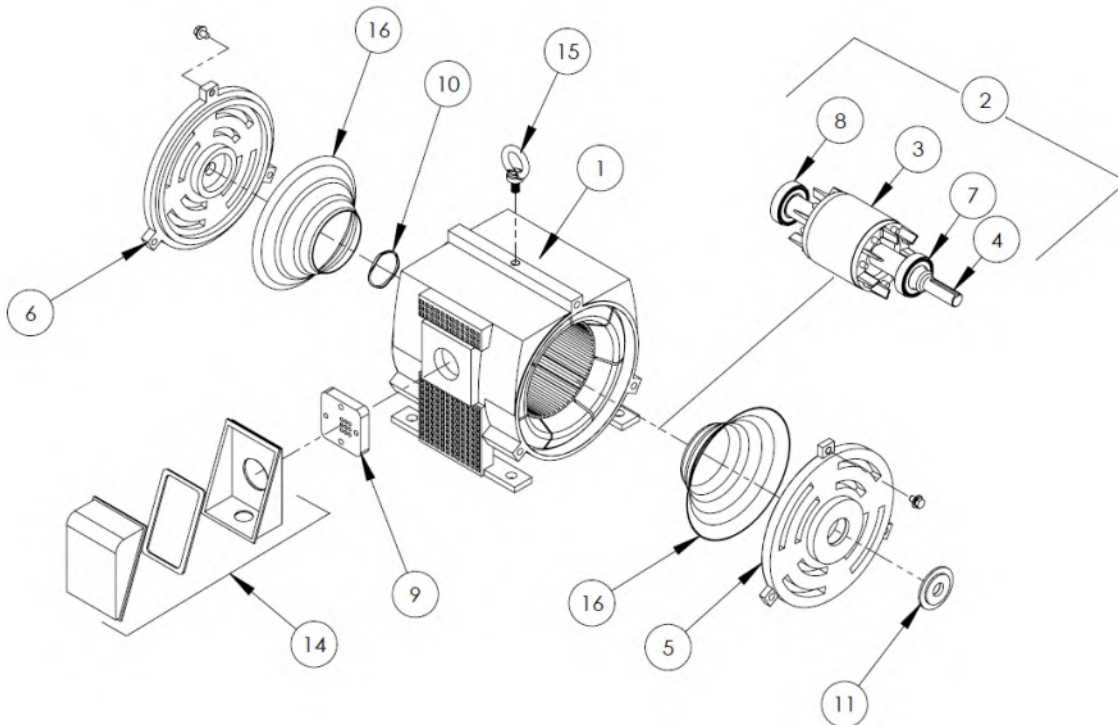
PARTS LIST ** OPEN DRIP PROOF (O.D.P)

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			6205ZZ	6205ZZ				
180T			6306ZZ	6206ZZ				
210T	6308ZZ	6208ZZ	6308ZZ	6208ZZ				
250T	6309ZZ	6208ZZ	6309ZZ	6208ZZ				
280T	6312ZZ	6211ZZ	6312ZZ	6211ZZ				
280TS	6311C3	6311C3	6311C3	6311C3				
320T	6313	6312	6313	6312				
320TS	6312C3	6312C3	6312C3	6312C3				
360T	6314	6314	6314	6314				
360TS	6313C3	6313C3	6313C3	6313C3				
400T	6317	6317	6317	6317				
400TS	6313C3	6313C3	6313C3	6313C3				
440T	NU318	6318	NU318	6318				
440TS	6313C3	6313C3	6313C3	6313C3				



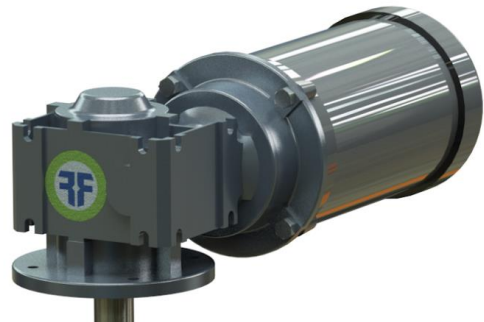


DRIVESYSTEMS

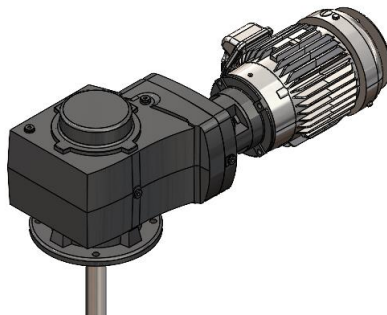
Nord Gear Units for Flow Series Open Tank Mixers



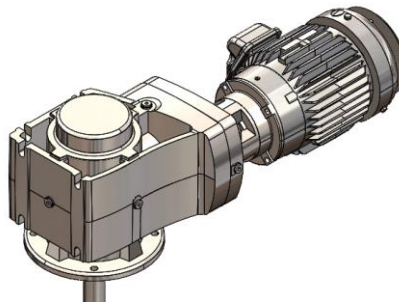
FG SERIES



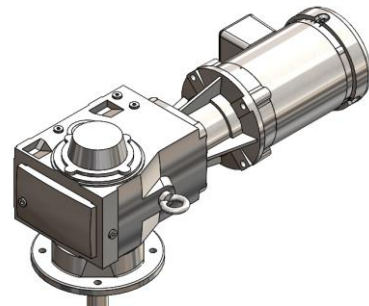
FW SERIES



FR2 SERIES



FR2E SERIES



FR3 SERIES

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1. Importance of the operating instructions

These operating instructions are intended to provide general information and safety guidelines. It is the responsibility of the buyer, machine builder, installer and user of the NORD product to make sure that all the proper safety notes and operating instructions have been reviewed and understood. If the contents of this instruction or any applicable operating instructions are not understood, please consult NORD.



WARNING

Electric motors, gearmotors, electrical brakes, variable frequency drives, and gear reducers contain potentially dangerous high-voltage, rotating-components and surfaces that may become hot during operation. All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians.

2. Inspect incoming freight

Before accepting shipment from the freight company, thoroughly inspect the NORD equipment for any shipping and handling damage. If any goods called for in the bill of lading or express receipt are damaged, or if the quantity is short, do not accept until the freight express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once, and request a formal review of your claim.

Claims for loss or damage in shipment must not be deducted from the NORD invoice, nor should payment of the NORD invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery. NORD will try to assist in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material.

3. Obtaining order specific user manuals and spare parts lists

One can receive the detailed installation and maintenance instructions by entering a serial number (or NORD order number) at the appropriate location on the NORD web site.

- Record the serial number from your gearmotor, gear reducer, or motor nameplate, or record the serial number found on your order confirmation.
- Go to <https://shop.nord.com/US-en/mynord/documentcenter> to download the appropriate operating instructions.
- Obtain order-specific parts lists and place orders online via the Parts shop at <https://shop.nord.com/US-en/home>

EXAMPLE: <https://shop.nord.com/US-en/mynord/documentcenter>

Home ▶ myNORD ▶ Online Service ▶ Serial Number Lookup

201360663-100 EN-US - English (United States)

Type	Name	Pages	Filesize	Download
PDF	Complete Manual for 201360663-100	5	1.14 MB	↓
ZIP	All Manuals for 201360663-100		454.10 KB	↓

▶ Manuals (1)

Detail

Order Number: 201360663-100

Product Name: Standard helical gearbox

NORD Model Type: SK0F-71L4 TF F T14

Ratio: 7,71

Mounting Position: M1

Lubricant: ISO VG 220 mineral oil

Lubrication Qty: 0,130 L

4. Intended use

NORD is a supplier of electric motors, gearmotors, reducers, electromechanical brakes, mechanical variators, and electrical variable frequency drives that are intended for commercial installations on larger systems and machines.



WARNING

NORD does not accept any liability for damage or injury caused by:

- Inappropriate use, operation or adaptation of the drive system.
- Unauthorized removal of housing covers, safety and inspection covers, guarding, etc.
- Unauthorized modifications to the drive system.
- Improper servicing or repair work on the drive system.
- Damage caused during shipment or transportation.
- Disregard of the important Safety Notes or Operating Instructions.



5. Notes concerning warranty and liability

All units are supplied according to the terms described in our standard "Conditions of Sale." The unit limited warranty is also defined in our "Conditions of Sale" and is located in the back of our product catalogs as well as the back of your order invoice.

All NORD Safety Notes and all related NORD Operating instructions shall be considered up-to-date at the time in which they were compiled by the buyer, machine builder, installer or user. NORD reserves the right to incorporate technical modifications and information updates to any safety/operating instructions that are within the scope of providing additional knowledge or clarification, communicating design changes, or product enhancements. Information updates may include any NORD product, or subsequent products purchased and supplied by NORD; No specific claims can be derived from the information or illustrations and descriptions contained in the safety notes or related operating instructions.



WARNING

NORD assumes no liability for personal injury, equipment damage or malfunctions resulting from failure to comply with any installation safety notes. The applicable national, regional, and local work regulations and safety requirements must also be complied with. Failure to comply with any safety notes or regulations may result in serious injury, damage to property, or even death.

6. Checklist for installation and operation

- Verify that the purchased NORD product has been supplied with the expected accessories & options. Check the received goods and packing slip to make sure items are properly received.
- Make sure that you have all of the required Operating Instructions for your NORD electric motor, gearmotor, reducer, electromechanical brake, mechanical variable speed drives, or electrical variable frequency drives.
- Consult NORD if you feel you are missing any documentation or if you have questions.



SAFETY NOTES



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.
	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

NORD GEAR CORPORATION-USA / WWW.NORD.COM

SK 1	
S/N 2	
RATIO 3	SF 4
TORQUE 5	LB-IN
SPEED 6	RPM
FOR GEAR LUBRICATION SEE MANUAL	7 MTG POS 120094630

UNIGASE™

- 1** Model/Type
- 2** Serial Number
- 3** Gear Ratio
- 4** Service Factor
- 5** Torque Rating
- 6** Output Speed RPM
- 7** Mounting Position

European Nameplate

Getriebebau NORD
GrbH&Co KG
D - 22934 Bargteheide

Type SK **1**

No. **2**

i= **3**

n2= **4** min⁻¹

085 0157-0

Siehe Wartungsanleitung
See maintenance instructions
Voir instructions d'entretien

- 1** Model/Type
- 2** Serial Number
- 3** Gear Ratio
- 4** 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.



SAFETY NOTES



5. DISPOSAL

	MATERIAL DISPOSAL
<p>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.</p>	

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:

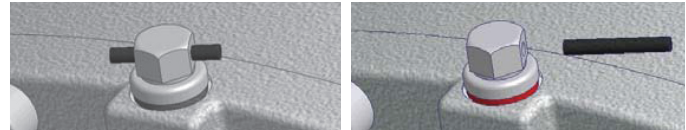
- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Fill the reducer 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 brinelling 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 manufacturer's 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 Straightness & 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 Straightness & 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.

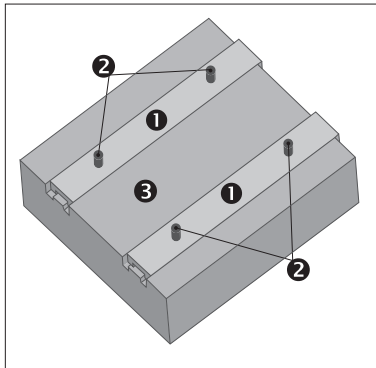
NOTICE

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



- ① Grouted Structural Steel Mounting Pads
- ② Mounting Bolts
- ③ 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 (in)	Grade SAE 5 / ASTM A449		Grade SAE 8	
	(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 (mm)	ISO Grade 8.8		ISO Grade 10.9		ISO Grade 12.9	
	(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.

- After the main gear drive is properly aligned and bolted in place, align the prime mover with respect to the reducer input shaft.
- 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. Keyed hollow shaft design

NORD uses high quality carbon steel to manufacture hollow-shafts. Upon request, NORD can provide alternate materials, such as stainless steel. NORD hollow shafts are designed with a bore relief (reduced contact area) between the mating shafts.

The bore relief provides a cavity to hold an anti-seize assembly paste. It also acts as a design feature intended to help prevent corrosion and to facilitate gearbox removal from the solid shaft.

NORD furnishes dual keys designed to be used in each of the bore land areas, as opposed to supplying a single long key. The dual keys are intended to simplify assembly onto the machine's solid shaft.



IMPORTANT NOTE

If a single shaft key or dual shaft keys are supplied by others, the key/s must engage the full bore-land length at each end of the hollow shaft.

2. Key and keyway dimensions

Unless otherwise indicated, inch keys and keyways follow the ANSI B17.1 standard and metric keys and keyways follow the DIN6885-1 standard. Inch bores will typically utilize square keys but in some instances the larger hollow shaft bore sizes utilize the alternate rectangular key shown in the ANSI B17.1 standard.

Key slots for the solid machine shaft should be made with a Class 2, transitional-fit class (slightly loose to slightly tight). Key slots in the female shaft are designed to be a low clearance fit. These suggested practices should allow for easier assembly with the mating solid shaft, without allowing excessive clearance which could cause keys to work loose during reducer operation.



IMPORTANT NOTE

If the key fit is too tight, light filing of the key sides and hand-fitting of the keys may be required.

3. Keyed hollow-shaft bore tolerances

Standard keyed hollow-shaft bore tolerances are shown in the following table.

Table 1 - Keyed hollow bore tolerances

Above ø [in]	To and Including ø [in]	Bore Diameter Tolerance ø [in]
0.4375	1.6250	+0.0010 / -0.0000
1.6250	3.2500	+0.0012 / -0.0000
3.2500	7.0000	+0.0014 / -0.0000

Above ø [mm]	To and Including ø [mm]	Bore Diameter Tolerance ø [mm]
10	18	+0.018 / -0.000
18	30	+0.021 / -0.000
30	50	+0.025 / -0.000
50	80	+0.030 / -0.000
80	120	+0.035 / -0.000
120	180	+0.040 / -0.000
180	190	+0.035 / -0.000

Metric hollow bore tolerances per ISO286-2, Class H7

4. Suggested solid shaft (machine shaft) tolerances

NORD recommends a close fit of the customer-supplied solid shaft or machine-shaft, for the following reasons:

- To help minimize the potential for fretting and corrosion.
- To help prevent excessive free play in the shaft connection that could lead to excessive load stress on the driven system, the gear drive, or both.

Table 2 - Suggested solid shaft tolerances

Above ø [in]	To and Including ø [in]	Shaft Diameter Tolerance	
		Uniform Load ø [in]	Shock Load ø [in]
0.4375	0.8750	+0.0000 / -0.0005	+0.0000 / +0.0005
0.8750	4.5000	+0.0000 / -0.0010	+0.0000 / +0.0010
4.5000	7.0000	+0.0000 / -0.0012	+0.0000 / +0.0015

Above ø [mm]	To and Including ø [mm]	Shaft Diameter Tolerance	
		Uniform Load ① ø [mm]	Shock Load ② ø [mm]
10	18	+0.000 / -0.011	+0.012 / +0.001
18	30	+0.000 / -0.013	+0.015 / +0.002
30	50	+0.000 / -0.016	+0.018 / +0.002
50	80	+0.000 / -0.019	+0.021 / +0.002
80	120	+0.000 / -0.022	+0.025 / +0.003
120	180	+0.000 / -0.025	+0.028 / +0.003
180	190	+0.000 / -0.029	+0.033 / +0.004

① Uniform load: Mating shaft diameter tolerance per ISO286-2, class h6

② Shock load: Mating shaft diameter tolerance per ISO286-2, class k6

As indicated in Table 2, different solid shaft tolerances are suggested depending upon the load type.

- If the machine load conditions are considered “Uniform” a clearance fit is allowed.
- If the machine load conditions are considered to have “Shock Load” a light clearance to interference fit condition is suggested.

Typically the machine builder will have good knowledge as to the load type. As an alternate method to classify load type, one could follow the “Mass Acceleration Factor Selection Method” that is discussed in NORD’s product catalog/s.

Straightness, roundness, and diameter tolerance variations of both shafts should be controlled as accurately as possible. When mating, solid shaft design features are not controlled, reducer installation may be very difficult without ordering special hollow-bore design features to accommodate.

NOTICE

The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.

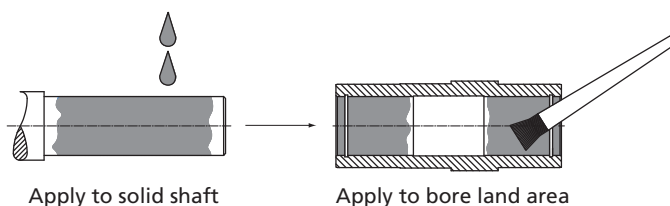
5. Suggested solid-shaft mating shaft surface finish

Controlling the mating shaft surface finish helps to assure proper fit and assembly while minimizing the possibility of corrosion and fretting. NORD recommends that the mating solid shaft surface should be at least 125 micro-inches (3.2 microns) or smoother.

6. Assembly to the machine shaft

- Clean and remove any dirt, grease, or rust-preventative coatings from both the reducer hollow shaft and the machine shaft.
- Make sure the edges of both the reducer hollow shaft and machine shaft are free from any nicks or burrs. If nicks or burrs are present remove them using an abrasive material such as an emery cloth.
- Before installing the gear reducer onto the machine shaft, apply an anti-seize compound or anti-corrosive lubricant to the mating shafts as shown in Figure 1. Assembly and subsequent dismantling will be aided by the anti-seize agent.

Figure 1 – Application of anti-seize to the mating shafts



- Fit the shaft key/s into place on the machine shaft. Depending upon the key slot design on the machine shaft, it may be necessary to stake or Loctite® the key/s into place so they do not slide axially while fitting the reducer to the shaft.
- Lift the gear unit assembly into place and align it carefully with respect to the machine shaft.
- Fit the gear unit assembly onto the machine shaft using a suitable pulling device.
- Secure the reducer onto the machine shaft in an axial direction, to prevent the reducer from shifting or walking out of place during operation.

NOTICE

Do not use excessive force or try to hammer the gear unit into place. The housing, shafting, bearings or gear wheels may become damaged.

7. Securing the reducer onto the machine shaft

There are slight shaft oscillations during operation in any rotating shaft equipment or any shaft-mounted reducer assembly. Therefore it is important to secure the reducer in an axial direction onto the machine shaft, to prevent the reducer from shifting or walking out of place during operation.

Possible methods to secure the reducer axially to the machine shaft include:

- Using commercial set collars, retaining rings, or snap rings.
- Using the optional “NORD Fixing Element Kit” (see U10280).

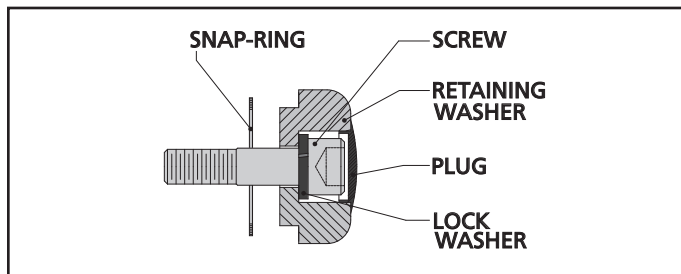
The NORD Fixing Element Kit includes all of the necessary parts to secure the shaft by using a tapped hole in the end of the mating male shaft.

Loctite® is a registered trademark of Loctite Corporation U.S.A. and Henkel.

1. Shaft fixing kit - basic design

The NORD Fixing Kit provides a method for securing the reducer in an axial direction, after the keyed-hollow shaft reducer is mounted onto the machine shaft. The fixing kit prevents the reducer from shifting or walking out of place during operation. NORD offers a variety of standard fixing kits, based upon bore size, as shown on Page 2 of this manual.

Figure 1 – Fixing kit components



IMPORTANT NOTE

For installation of the keyed-hollow bore reducer to the machine-shaft, see user manual U10270.

2. Assembly types

There are two types of assembly methods commonly used for securing the fixing kit.

Figure 2 – Fixing kit assembly methods

Type 1

The machine-shaft is located against a fixed snap-ring located inside the bore of the reducer.

Type 2

The machine shaft is shouldered and is pulled tight against the hollow-shaft; the snap-ring is no longer required.

NOTICE

The maximum edge break on the solid machine shaft must not exceed the values shown on Page 2 of this manual. Otherwise the load-bearing capacity of the snap-ring will be reduced and may result in failure.

3. Assembly

- If using a Type 1 assembly, secure the appropriate snap-ring into the bore of the reducer. With Type 2 assembly, no snap-ring is required.
- Draw the hollow bore gear reducer onto the machine shaft as instructed in U10270. Remember to apply a suitable assembly paste or anti-seize compound to the mating shafts.
- Install the retaining washer over the end of the hollow bore.
- Secure the appropriate cap-screw into the machine shaft and tighten the screw based upon the assembly type, as noted below. Then install the protective plug over the screw hole.

Type 1 - Screw tightening

Tighten until lightly snug and secure the screw with a thread-locking compound to prevent the screw from backing out.

NOTICE

Over tightening the retaining screw may cause the snap ring to be pulled out of its seating groove, causing damage to the hollow-bore or snap ring.

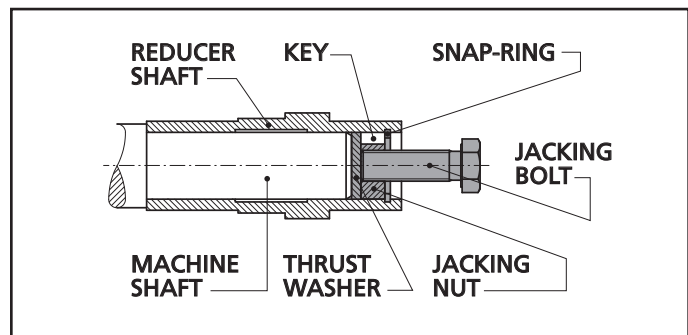
Type 2 - Screw tightening

Follow the cap screw manufactures guidelines and tighten the screw to the proper torque, based upon the bolt grade and material. For reference tightening torque values, also see manual U10060, Table 2.

4. Disassembly

When using Type 2 assembly, it is possible to design a simple disassembly tool to allow easier removal of the hollow-bore reducer. The solid shaft is shouldered to rest against the hollow-bore of the reducer. The machine shaft is supported in both of the hollow bore land areas, but the overall length is reduced compared to Type 1 assembly.

Figure 3 – Disassembly Tool



IMPORTANT NOTE

For suggestions on how to construct a disassembly tool for a particular reducer and bore size, please consult NORD's application engineering department.



SHAFT FIXING KIT



DRIVESYSTEMS

RETAIN FOR FUTURE USE

U10280 - 2 of 2

5. Standard fixing kit size offerings

NORD offers a variety of standard fixing kit sizes as shown by the following tables.

Table 1 - Standard fixing kit size offerings

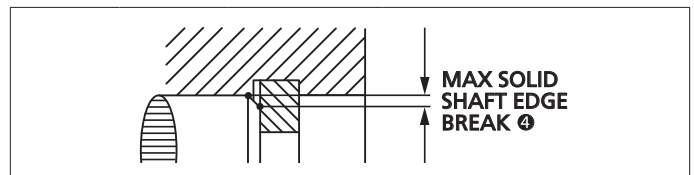
Shaft Bore [in]	Bolt Size	Allowable Thrust		Max. Edge Break ④ in [mm]
		Groove ② lb [N]	Ring ③ lb [N]	
0.500	10-32	730 [3255]	520 [2300]	0.02 [0.5]
0.750	1/4-20	1800 [7905]	560 [2500]	0.04 [1]
1.000	3/8-16	2900 [13020]	1000 [4600]	0.04 [1]
1.188	7/16-14	5100 [22630]	1000 [4700]	0.04 [1]
1.250	7/16-14	5100 [22630]	1000 [4700]	0.04 [1]
1.375	5/8-11	6500 [29140]	1400 [6400]	0.06 [1.5]
1.438	5/8-11	6900 [30690]	1500 [6500]	0.06 [1.5]
1.500	5/8-11	7800 [34875]	1500 [6700]	0.06 [1.5]
1.625	5/8-11	9900 [44020]	1900 [8400]	0.08 [2]
1.688	5/8-11	10500 [46810]	1800 [8200]	0.08 [2]
1.938	5/8-11	11100 [49600]	1900 [8400]	0.08 [2]
2.000	5/8-11	14100 [62775]	2700 [12100]	0.08 [2]
2.063	5/8-11	14100 [62775]	2700 [12100]	0.08 [2]
2.188	5/8-11	16800 [74865]	2900 [13000]	0.08 [2]
2.375	3/4-10	17400 [77190]	2900 [13000]	0.08 [2]
2.438	3/4-10	17400 [77190]	2900 [13000]	0.08 [2]
2.750	3/4-10	19600 [87110]	4700 [21000]	0.10 [2.5]
2.938	3/4-10	20900 [93000]	4700 [21000]	0.10 [2.5]
3.188	3/4-10	27700 [123225]	7000 [31200]	0.12 [3]
3.438	3/4-10	29300 [130200]	7000 [31400]	0.12 [3]
3.625	3/4-10	30900 [137330]	7000 [31400]	0.12 [3]
3.938	7/8-9	32400 [144305]	6900 [30800]	0.12 [3]
4.000	7/8-9	39000 [173600]	16400 [73000]	0.12 [3]
4.063	7/8-9	39000 [173600]	16400 [73000]	0.12 [3]
4.375	7/8-9	41500 [184450]	16200 [72000]	0.12 [3]
4.438	7/8-9	41500 [184450]	16200 [72000]	0.12 [3]
4.750	7/8-9	44200 [196850]	15700 [70000]	0.12 [3]
4.938	7/8-9	48000 [213900]	15500 [69000]	0.12 [3]

Upon request, additional hollow-bore sizes & fixing kit sizes may be offered.

Shaft Bore [mm]	Bolt Size	Allowable Thrust		Max. Edge Break ④ mm [in]
		Groove ② N [lb]	Ring ③ N [lb]	
16	M5	Not applicable ①		
20	M6	8370 [1900]	5600 [1300]	1.0 [0.04]
25	M10	12400 [2800]	7300 [1600]	1.0 [0.04]
30	M10	17515 [3900]	7200 [1600]	1.0 [0.04]
35	M12	29140 [6500]	8700 [1900]	1.5 [0.06]
40	M16	41850 [9400]	10900 [2400]	2.0 [0.08]
45	M16	46810 [10500]	10700 [2400]	2.0 [0.08]
50	M16	62775 [14100]	19000 [4300]	2.0 [0.08]
60	M20	74865 [16800]	29200 [6600]	2.0 [0.08]
70	M20	87110 [19600]	30300 [6800]	2.5 [0.10]
80	M20	115630 [26000]	56000 [12600]	2.5 [0.10]
90	M24	130200 [29300]	56000 [12600]	3.0 [0.12]
100	M24	144305 [32400]	55000 [12400]	3.0 [0.12]
110	M24	181350 [40800]	71000 [16000]	3.0 [0.12]
120	M24	196850 [44300]	70000 [15700]	3.0 [0.12]

Upon request, additional hollow-bore sizes and fixing kit sizes may be offered.

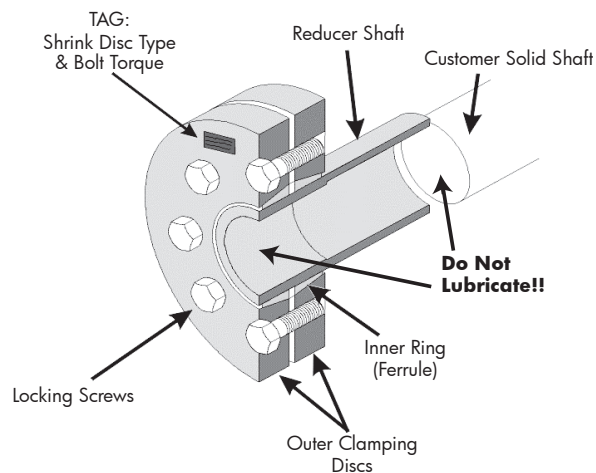
- ① This fixing kit is not supplied with a snap-ring. A Type 2 machine shaft is required.
- ② Thrust load-bearing capacity of the groove is based upon using a hollow-shaft material with a yield-strength of at least 45,000 psi (310 N/mm²).
- ③ Thrust load-bearing capacity of the snap-ring is based upon a typical snap-ring material with a yield-strength of at least 30,500 psi (210 N/mm²).
- ④ On the solid machine shaft, observe the maximum edge break (radius or chamfer) shown. A larger edge break will result in reduced load-bearing capacity of the snap-ring.



1. Shrink disc design concept

A shrink disc option is adaptable to many NORD hollow-bore reducers. The shrink disc applies a high-capacity, zero backlash, interference fit to the driven machine shaft. The double tapered inner ring converts most all of the screw clamping load into radial contact pressure, as the outer clamping discs are pulled together by proper tightening of the locking screws. As the inner ring is contracted, the clearance between the customer solid shaft and reducer shaft is absorbed.

- In their relaxed state, shrink discs provide a generous assembly clearance, thus eliminating the typical assembly and disassembly challenges of using interference fits.
- Shrink discs also reduce solid machine shaft stresses by eliminating the need for shaft keys and keyways.
- When properly applied, high shrink fits help eliminate shaft fretting corrosion and allow for easier shaft mounting and dismounting.



2. Solid (machine) shaft design guidelines

Always use a solid shaft material of adequate strength and apply proper shaft fits in order to establish adequate clamping force during assembly and assure proper shaft release during disassembly.

- Use solid shaft material with yield strength of at least 52,260 psi (360 N/mm²).
- The solid machine shaft should be machined according to ISO 286-2, Class h6 fit tolerances, with a shaft finish of 125 micro inches (3.2 μm) or smoother, per Table 1.
- The solid machine shaft must extend the full length of the reducer hollow shaft.



IMPORTANT NOTE

Contact NORD when using a shrink disc in an application where the shrink disc connection must simultaneously transmit torque and thrust.

3. Safety

NOTICE

- The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.
- The transmissible torque and the gripping capacity of the shrink disc may be reduced if shaft tolerances or clearances are larger than specified.
- Excessive tightening torque can result in permanent deformation of the inner ring and the reducer hollow bore, making disassembly very difficult. Do not over tighten the shrink disc to compensate for excessive clearance between the machine shaft and reducer bore.
- Observe the published ratings and safety factors for both the reducer and shrink disc. Overload conditions or excessively high torque can cause the shrink disc connection to slip. In extreme cases localized galling or welding of components may occur.

4. Shrink disc shaft tolerances

Recommended solid shaft tolerances and reducer bore tolerances are shown in the table below.

Table 1: Shrink disc shaft tolerances

Above & Including ø [in]	To & Including ø [in]	Solid Shaft Tolerance ø [in]	Reducer Bore Tolerance ø [in]	Max. Assembly Clearance [in]
0.7500	1.1250	+0.0000 / -0.0005	+0.0008 / -0.0000	0.0013
1.1250	1.9375	+0.0000 / -0.0006	+0.0009 / -0.0000	0.0015
2.0000	3.1250	+0.0000 / -0.0007	+0.0011 / -0.0000	0.0018
3.1875	4.6875	+0.0000 / -0.0008	+0.0013 / -0.0000	0.0021
4.7500	7.0625	+0.0000 / -0.0009	+0.0015 / -0.0000	0.0024
7.1250	7.5000	+0.0000 / -0.0011	+0.0018 / -0.0000	0.0029

Above ø [mm]	To & Including ø [mm]	Solid Shaft Tolerance ø [mm]	Reducer Bore Tolerance ø [mm]	Max. Assembly Clearance [mm]
18	30	+0.000 / -0.013	+0.021 / -0.000	0.034
30	50	+0.000 / -0.016	+0.025 / -0.000	0.041
50	80	+0.000 / -0.019	+0.030 / -0.000	0.049
80	120	+0.000 / -0.022	+0.035 / -0.000	0.057
120	180	+0.000 / -0.025	+0.040 / -0.000	0.065
180	190	+0.000 / -0.029	+0.046 / -0.000	0.075

Shaft/bore tolerances per ISO 282-6, Class h6/H7.

Solid shaft finish should be 125 micro inches (3.2 micro meters) or smoother.



HOLLOW SHAFT WITH SHRINK DISC



5. Installation

WARNING

Disconnect all power sources from the equipment before beginning this installation procedure. Gearmotors, variable frequency drives and gear reducers contain potentially dangerous high voltage, rotating components and surfaces that may become hot during operation. Handle the components with care and avoid all sharp machined edges to prevent personal injury.

NOTICE

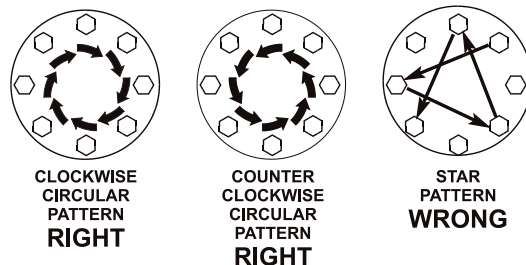
Do not tighten any of the shrink disc locking screws prior to installing the reducer with shrink disc onto the machine shaft. The inner ring of the shrink disc can become permanently contracted or damaged at relatively low tightening torque.

- Inspect the gear unit received. Make sure the shrink disc and extended hollow shaft projection is on the side of the reducer where it was specified or ordered.
- Loosen the shrink disc locking screws but do not take the shrink disc completely apart. Remove and discard any packaging material or transportation spacers that come with the shrink disc.
- Remove all burrs, rust, corrosion, lubricants, and foreign matter from the surfaces of the solid shaft and hollow-bore.
- Make sure the shrink disc is positioned onto the hollow shaft until the outer clamping ring is flush with the edge of the hollow shaft.
- To aid in assembly, it is acceptable to lightly grease the solid shaft, only in the area that will come in contact with the bronze-bushing side of the reducer hollow-shaft. **The reducer hollow shaft must be completely de-greased and free of lubricant, especially in the area of the shrink disc.**
- Position the gear reducer onto the solid machine shaft and make certain the area under the shrink disc is completely supported by the solid shaft.
- After confirming the proper positioning of gear reducer and the shrink disc, hand tighten (3) or (4) equally spaced locking screws to make sure the outer collars of the shrink disc are drawn together in a parallel fashion. Then hand-tighten the remaining screws.
- Refer to Table 2 for the specified tightening torques for the shrink disc locking screws. Using a properly set torque wrench using approximately ¼ (90°) turns; tighten the locking screws, by working in a circular clockwise or counterclockwise sequence around the shrink disc.
- Continue the tightening sequence (Step H.) even if some locking screws initially require very low tightening torque to achieve ¼ turns; do this for several passes until ¼ turns can no longer be achieved.
- Reset the torque wrench to approximately 3-5% over-torque and tighten the locking screws for 1 or 2 more passes. This procedure will compensate for relaxation of the locking screws, since tightening of a given screw will always tend to relax the adjacent screw. Without a slight overtightening of the screws, an infinite number of passes would be required to reach the desired tightening torque.

Table 2 - Shrink Disc Locking Screw Torque

Screw Size	Wrench Size [mm]	Tightening Torque		
		[Nm]	[lb-in]	[lb-ft]
M5	8	7	62	5.2
M6	10	12	106	8.9
M8	13	30	266	22
M10	17	59	522	44
M12	19	100	885	74
M16	24	250	2213	184
M20	30	490	4337	361
M24	36	840	7435	620
M30	46	1700	15050	1254

BOLT TIGHTENING PATTERN



- Reset the torque wrench to the correct tightening torque as indicated in Table 2. Make sure each locking screw has been properly tightened until the screws are no longer turning at the specified torque wrench setting. If necessary repeat Steps G. & H.

6. Removal

- Loosen the shrink disc locking screws in a circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and reducer shaft will return to their original fits.

WARNING

Do not completely remove the locking screws before the outer clamping disks of the shrink disc are disengaged from the inner ring. A sudden release of the outer collars will create high separating forces and could result in injury or even death.

- Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a **soft faced** hammer or prying lightly between the outer collars.
- Remove the gear reducer from the machine shaft.

7. Re-installation

- It may be possible to re-use the shrink disc. However the shrink disc should not be re-used if it becomes damaged during removal, or excessively rusty or corroded. Shrink discs must always be disassembled and thoroughly cleaned before re-using.
- After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multi-purpose grease.

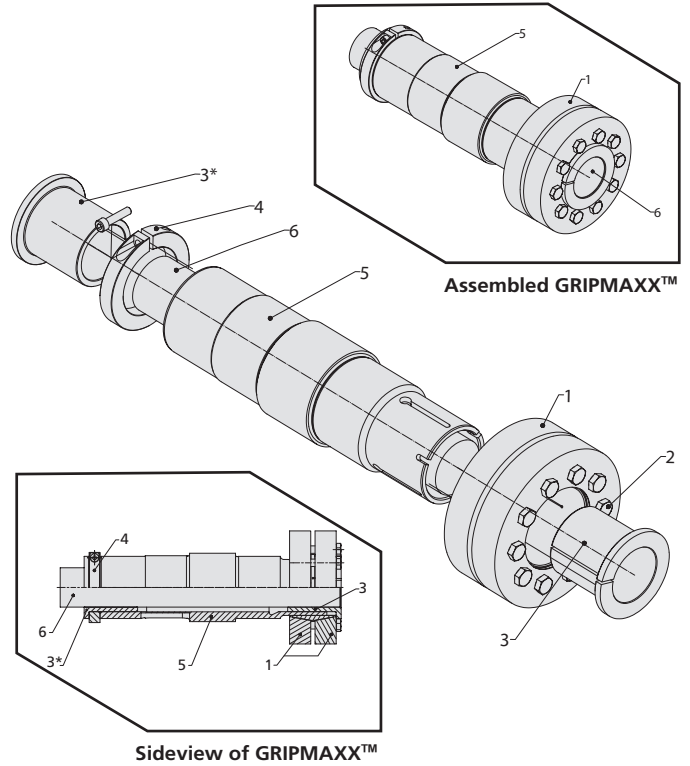
1. General information

The NORD GRIPMAXX™ keyless bushing system is adaptable to most all NORD shaft-mounted reducers. The bushing system offers interchangeable bushings to accommodate a large range of driven machine-shaft sizes.

The unique design of the NORD GRIPMAXX™ bushing system offers a number of distinct advantages as follows:

- The NORD GRIPMAXX™ allows the machine builder to utilize standard cold finished shaft stock, without the need for additional shaft machining or shaft keys.
- It uses a NORD shrink disc to apply a high-capacity, zero backlash, interference fit to the driven machine shaft, while eliminating the typical assembly and disassembly challenges of using interference fits.
- The built in clearance between the customer shaft and the bushing system helps to ensure easy installation and removal of the gearbox. To help ensure easy removal, the NORD GRIPMAXX™ bushings are prepared with a special low-wear, corrosion-resistant hardened surface treatment, that minimizes the formation of shaft corrosion and fretting.
- The NORD GRIPMAXX™ is ideal for start-stop operation and bi-directional loading because it does not depend on keys or keyways that transmit torque, which can also become loose or deform when subjected to these loading conditions.
- Unlike the typical conical or tapered bushing kits, the NORD GRIPMAXX™ design allows a tight fit against a shouldered machine shaft.
- The torque bushing and support bushing are the same part and are fully interchangeable with one another.

2. GRIPMAXX™ assembly detail



- | | |
|-----------------------------|-------------------------------|
| [1] NORD Shrink Disc | [4] Clamp Ring |
| [2] Locking Screw | [5] Gear Reducer Hollow Shaft |
| [3] Bushing (Torque Side) | [6] Machine Shaft |
| [3*] Bushing (Support Side) | |

IMPORTANT NOTE

NORD recommends that the machine shaft have a yield strength of at least 52,260psi (360N/mm²)

IMPORTANT NOTE

Observe the recommended machine shaft tolerances in table 1, page 2.

NOTICE

The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.

3. Installation

<h2 style="margin: 0;">WARNING</h2>
<p>Disconnect all power sources from the equipment before beginning this installation procedure. Gear-motors, variable frequency drives and gear reducers contain potentially dangerous high voltage, rotating components and surfaces that may become hot during operation. Handle the components with care and avoid all sharp or machined edges to prevent personal injury.</p>

<h2 style="margin: 0;">NOTICE</h2>
<p>Do not tighten any of the shrink disc locking screws prior to installing the reducer with shrink disc onto the machine shaft. The inner ring of the shrink disc can become permanently contracted or damaged at a relatively low tightening torque.</p>

Table 1 - Required Machined Shaft Tolerance

Inch Machine Shaft			Metric Machine Shaft		
From	To	ISO 286-2 Tolerance h11(-)	Over	Including	ISO 286-2 Tolerance h11(-)
∅ [in]	∅ [in]	[in]	∅ [mm]	∅ [mm]	[mm]
0.4375	0.6875	- 0.004	10	18	- 0.11
0.7500	1.0625	- 0.005	18	30	- 0.13
1.1250	1.9375	- 0.006	30	50	- 0.16
2.0000	3.1250	- 0.007	50	80	- 0.19
3.1875	4.6875	-0.008	80	120	-0.22
4.7500	7.0625	-0.009	120	180	-0.25

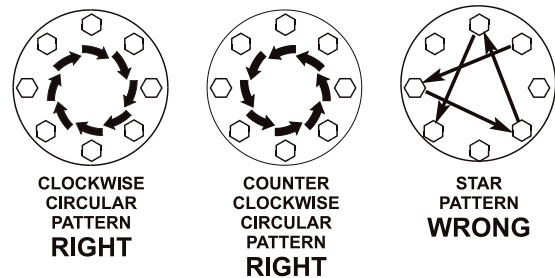
- A. Carefully inspect the machine shaft [6] and remove all burrs, rust, corrosion, lubricants, and foreign matter from the shaft surface. Verify that the diameter is within the dimensional tolerances shown in Table 1.
- B. Inspect the gear unit received to confirm the correct position of the shrink disc [1]. Make sure the hollow shaft [5] projection is on the side of the reducer where it was specified or ordered.
- C. In addition to cleaning the machine shaft [6], remove all dirt, grease or oils from the reducer hollow shaft [5], bushings [3], clamp ring [4], and shrink disc [1]. **Do not apply lubricants, corrosion preventatives, anti-sieze compounds or coatings to the mating surfaces of the shaft, bushings, clamp collars or shrink disc.**
- D. Position the clamp ring [4] and support bushing [3*] over the machine shaft [6], making sure the support bushing is in its desired location. Then secure the support bushing [3*] with the clamp ring [4] and tighten the clamp ring screw.
- E. Slide the gear reducer onto the machine shaft [6] until the gear reducer stops against the secured support bushing [3*].

- F. Without taking the shrink disc [1] apart, loosen the shrink disc locking screws [2]. Slide the shrink disc over the reducer shaft [5] and slide the torque bushing [3] onto the machine shaft, making sure it is seated completely.
- G. Confirm the positioning of the shrink disc [1] and torque bushing [3]. **Do not tighten the shrink disc until the machine shaft and torque bushing are in proper position, or the reducer shaft will be damaged.** Hand-tighten 3 or 4 or locking screws [2] and make sure the outer collars of the shrink disc are drawn together in a parallel fashion and then hand-tighten the remaining screws.
- H. Refer to Table 2 for the specified tightening torques for the shrink disc locking screws. Using a properly set torque wrench using approximately ¼ (90°) turns; tighten the locking screws, by working in a circular clockwise or counterclockwise sequence around the shrink disc.
- I. Continue the tightening sequence (Step H.) even if some locking screws initially require very low tightening torque to achieve ¼ turns; do this for several passes until ¼ turns can no longer be achieved.
- J. Reset the torque wrench to approximately 3-5% over-torque and tighten the locking screws for 1 or 2 more passes. This procedure will compensate for relaxation of the locking screws, since tightening of a given screw will always tend to relax the adjacent screw. Without a slight overtorquing of the screws, an infinite number of passes would be required to reach the desired tightening torque.

Table 2 - Shrink Disc Locking Screw Torque

Screw Size	Wrench Size [mm]	Tightening Torque		
		[Nm]	[lb-in]	[ft-lb]
M5	8	7	62	5.2
M6	10	12	106	8.9
M8	13	30	266	22
M10	17	59	522	44
M12	19	100	885	74
M16	24	250	2213	184
M20	30	490	4337	361

BOLT TIGHTENING PATTERN



- K. Reset the torque wrench to the correct tightening torque as indicated in Table 2. Make sure each locking screw has been properly tightened until the screws are no longer turning at the specified torque wrench setting. If necessary repeat Steps G. & H.

5. Bushing kit removal

- A. Loosen the shrink disc locking screws [2] in circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and reducer shaft will return to their original fits.



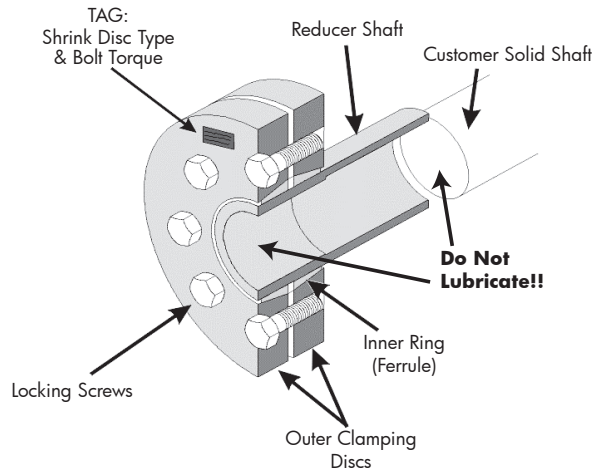
WARNING

Do not completely remove the locking screws before the outer clamping disks of the shrink disc are disengaged from the inner ring. A sudden release of the outer collars will create high separating forces and may result in injury or even death.

- B. Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a **soft faced** hammer or prying lightly between the outer collars.
- C. Remove the gear reducer from the machine shaft.

6. Re-installation

- A. It may be possible to re-use the bushings and shrink disc that are part of the NORD bushing system. However these components should not be re-used if they are damaged during removal, or excessively rusty or corroded.
- B. Never re-use any of the bushing kit components without prior cleaning. Shrink discs must always be disassembled and thoroughly cleaned before re-using.
- C. After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multipurpose grease.



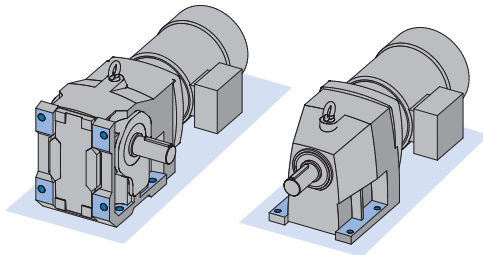


REDUCER MOUNTING FOOTED & FLANGE MOUNT GEAR UNITS



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.



i **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 Tugh please see table 2 on the following page.

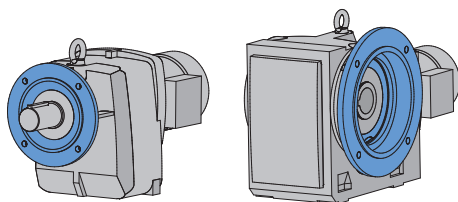


Table 1 : Flange Centering Shoulder Tolerance

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.

i **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.



REDUCER MOUNTING FOOTED & FLANGE MOUNT GEAR UNITS



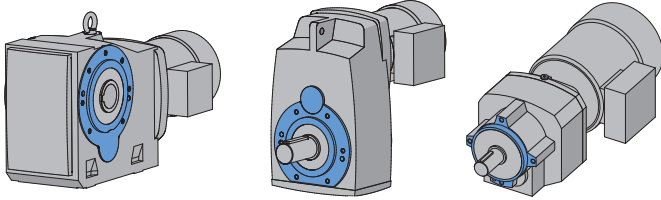
DRIVESYSTEMS

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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.



i **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

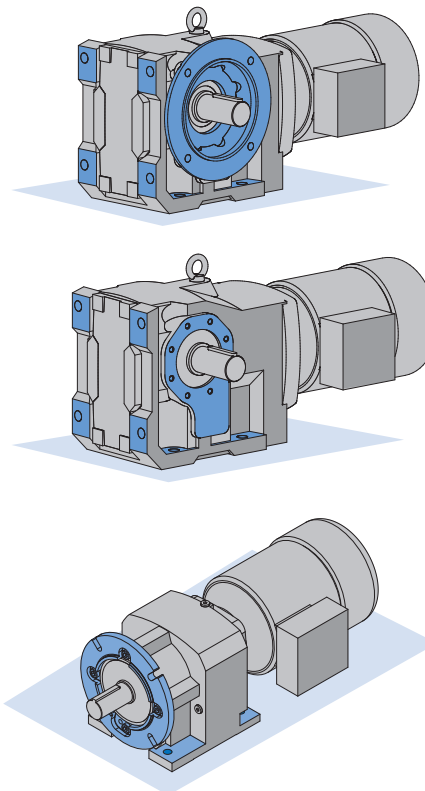
Above ø (mm)	To & Including ø (mm)	Tolerance (mm)
50	80	+0.052 / +0.033
80	120	+0.053 / +0.031
120	180	+0.054 / +0.029
180	230	+0.056 / +0.027

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 considered 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.





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 separate 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

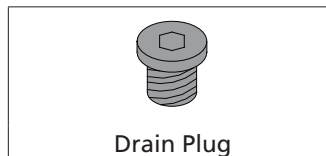
Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

8. Oil plug locations

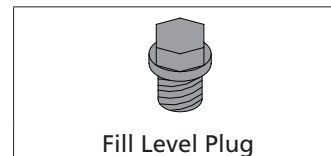
All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

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



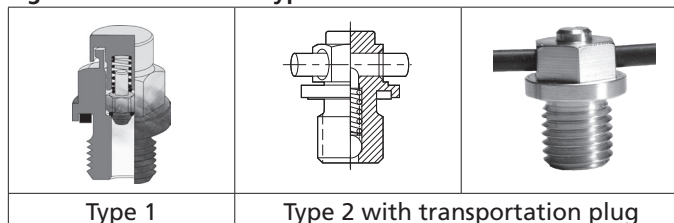
Fill Level Plug

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

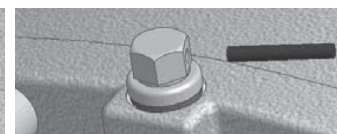
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

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-WORM 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.

NORD helical-worm 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

NORD helical worm gear reducers are filled with ISO VG 680 synthetic-hydrocarbon/polyalphaolefin (SHC/PAO) worm gear oil.

- SHC/PAO worm gear oils have good high and low temperature stability, are compatible with most paint and seal types, and are miscible with mineral oils.
- SHC/PAO worm gear oils also contain a small amount of organic ester and other antiwear (AW) packages to offer improved lubrication conditions, especially in the worm mesh, where a sideways sliding motion prevails.

Please see user manual U11020 for more specific information and for optional helical worm lubricants.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

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

The helical-worm gear oil 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. Efficiency

Helical worm gears reach efficiencies up to 92% and are generally much more efficient than worm-only gear units. However, it is important to consider the following, when using worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.

IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and lowering the oil viscosity

5. 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.

6. 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
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.

7. 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.

8. 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 separate 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

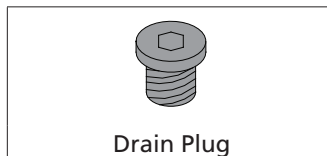
Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

9. Oil plug locations

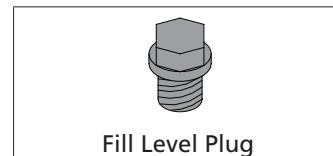
All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

10. 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



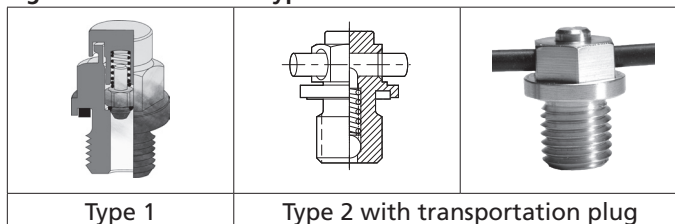
Fill Level Plug

11. 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

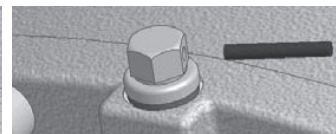
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

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.



FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION GUIDELINES



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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.

2. Factory Oil-Filled / Maintenance-Free

NORD modular worm gear units are inherently maintenance-free, factory oil filled, and supplied with a high-quality, long-life, synthetic oil which is intended to be suitable for the life of the gear unit.

FLEXBLOC™ SI worm gear units are filled at time of assembly to a universal oil fill, allowing for many mounting position possibilities. See user manual U13300.

3. Standard oil type

FLEXBLOC™ (SI/SID) worm gear units are factory filled with synthetic poly glycol oil. Food-grade polyglycol oil is optional. The specific oil type and viscosity grade are displayed on the reducer nameplate. See user manual 11060 for specific FLEXBLOC™ (SI/SID) worm lubrication types and options.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

4. Efficiency

It is important to consider the following, when ordering worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.



IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and lowering the oil viscosity

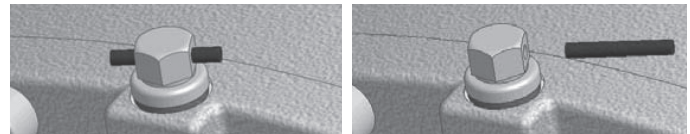
5. Optional Vent Kits

FLEXBLOC™ (SI) worm gear units are designed to operate sealed or vented. As a standard the modular worm gear units are factory oil filled and supplied with oil plugs in the housing, making vent plugs optional. See user manual U14800 for vent locations.

NORD can supply an AUTOVENT™ or an open vent with each gear unit size. If a vent is desired the type must be specified at the time of order. Reducer vents are sealed with a transportation plug that must be removed prior to gear unit start-up.

Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	66093510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a separate part number, vent kits include the housing gasket



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.

6. 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.

7. Open Vent

A typical gearbox industry open vent option can also be supplied by NORD. This option allows free exchange of air and does not build-up any back pressure inside the gear unit. This option is ideal for many operating conditions where the geared product is used in relatively clean and moisture-free environment.



FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION GUIDELINES



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8. When to Use a Sealed or a Vented Unit

There are many conditions that should be considered when deciding whether to use a sealed or vented unit.

1. If the duty cycle is intermittent, the run times are short, and any build-up of internal pressure or temperature is relatively low, the sealed unit option may be used.
2. If running continuous and under moderate to high load conditions, worm gears can generate higher operating temperatures and a build-up of internal pressure. In these instances a vent is strongly recommended. Consult NORD if operation at high load conditions is required.
3. If running continuous at 4-pole electric motor speeds (1800 rpm at 60 Hz) or higher, then a vent option is usually recommended. Consult NORD if operation at higher speeds is required.
4. Radial shaft seals produce a hydrodynamic pumping action to help push lubricant back into the gear unit, causing a small amount of ingested air and a small pressure increase (1-2 psi) that does not normally require a reducer vent; however when combined with continuous operation under high load (Condition 2), additional operating pressures will result and a vent should be used.
5. When the environment is contaminated with water, dirt, or other objects that may be ingested into the breather, increased wear of bearings, gearing, and lubrication breakdown can result. In these instances the sealed option or an AUTOVENT™ should be considered.

9. Maximum Oil Sump Temperature Limit

To prevent reducer overheating, the reducer's maximum oil-ump temperature limit must not be exceeded for prolonged periods of operation.

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
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.

10. Oil Viscosity

The viscosity rating determines the operating oil's resistance to shear under load conditions. Some important viscosity considerations include the following:

- Lightly loaded gears require lower viscosity oils than highly loaded gears.
- Lower viscosity will provide thin oil film, lower friction, higher mechanical efficiency, and better heat removal conditions.
- Higher viscosity will provide thicker oil film, and better resistance to sliding wear, scuffing wear, and galling at high pressure.
- Higher operating temperatures will cause a reduction in viscosity and lower operating temperatures, cause an increase in viscosity or a thickening of the oil.

The standard oil-fill is considered acceptable for most applications. In certain situations an oil viscosity change may be beneficial.

- If the gear unit is exposed to frequent high load conditions. A higher viscosity oil will have a higher film thickness offering better overall resistance to oil shear, sliding wear and scuffing wear in gears and roller element bearings.
- An oil viscosity correction or lubrication change may improve the overall performance when operating the gear unit at very low or high ambient temperature conditions.



IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

11. Viscosity Index

Viscosity index helps quantify the rate of oil viscosity change with respect to temperature changes. Oils with a reasonably high viscosity index tend to be more stable in a changing temperature environment. The ability of an oil to maintain a small viscosity differential over the operating range of the gearbox provides a more consistent lubricating film and better wear performance.

Synthetic oils typically have a higher viscosity index than mineral oils and polyglycol oils tend to have an exceptionally high viscosity index compared to other synthetic oils like polyalphaolefin or ester based products.



EXPANSION CHAMBERS INSTALLATION & MAINTENANCE MANUAL



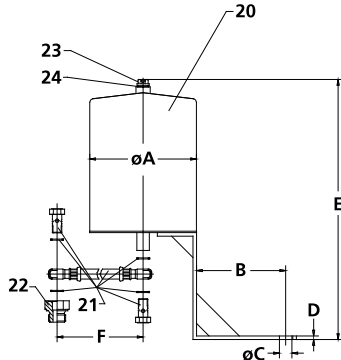
DRIVESYSTEMS

RETAIN FOR FUTURE USE

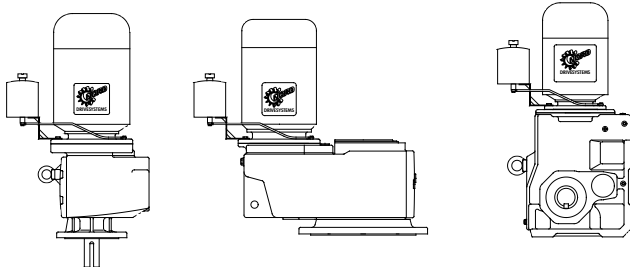
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Installation Instructions

Sometimes NORD requires the use of an oil expansion chamber when the motor or reducer input is mounted vertically. Consult your NORD catalog for additional information and application considerations.



1. Secure the gear reducer in the proper mounting position for the application and remove the vent plug from the gear reducer. The hose assembly kit (21) will be fitted to the reducer using the housing port provided.
2. When using the larger 2.7 and 5.4 liter chambers, screw the adapter fitting (22) into the reducer housing port. Use all sealing gaskets provided.
3. Mount the overflow tank (20) at the highest location from the reducer, as permitted by the hose assembly kit (21). Typical mounting configurations are represented below. Use one of the input cover's mounting bolts, to mount the chamber support leg to the reducer.



4. Be sure to use the proper fittings. Assemble one end of the vent-hose assembly (21) to bottom of the chamber and one-end to the reducer.
5. Secure the vent-plug (23) and gasket (24) that is supplied with the kit to the top of the expansion chamber.

NOTICE

Remove the protective "rubber element" from the supplied vent prior to use so that an open-vent is formed on top of the overflow tank. Avoid using a pressurized AUTOVENT™ breather on the overflow tank since this may create an undesired pressure-vacuum in the overflow tank.

Expansion Chamber Kit Dimensions & Parts List

Kit Part Number: 28390390 - 0.7 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390390 (0.7 Liter)	3.94 100	1.97 50	0.53 13.5	0.20 5	8.50 216	19.69 500	inch mm

Item	Part Number	Description
20	28300390	Overflow Tank - 0.7 Liter
21	28310020	Flexible Vent Hose Assembly - Includes: Hose, metal gaskets & 2 Hollow Bolts (1 Bolt. - M12 X 1.5 and 1 Pc. - G1/4)
22	None	Adapter Fitting
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Kit Part Number: 28390400 - 2.7 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390400 (2.7 Liter)	5.91 150	4.92 125	0.69 17.5	0.20 5	15.22 386.5	27.56 700	inch mm

Item	Part Number	Description
20	28300400	Overflow Tank - 2.7 Liter
21	28310030	Flexible Vent Hose Assy - Includes: Hose, metal gaskets & 2 Hollow Bolts (2 Pcs. - G1/4)
22	22024030	Adapter Fitting (M24 X 1.5 to G1/4)
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Kit Part Number: 28390410 - 5.4 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390410 (5.4 Liter)	7.09 180	3.54 90	0.69 17.5	0.20 5	15.18 385.5	31.50 800	inch mm

Item	Part Number	Description
20	28300410	Overflow Tank - 5.4 Liter
21	28310040	Flexible Vent Hose Assy - Includes: Hose, metal gaskets & 2 Hollow Bolts (2 Pcs. - G1/4)
22	22030030	Adapter Fitting (M30 X 1.5 to G1/4)
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Please see page 2 for gearbox compatibility



EXPANSION CHAMBERS INSTALLATION & MAINTENANCE MANUAL



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Expansion Chamber Compatibility Chart

Helical In-line	NORDBLOC™	NORDBLOC.1™	Clincher™	Helical-Bevel	Part Number	[lb]
SK 42/43 SK 52/53 SK 63	SK472/473 SK572/573 SK672/673 SK772/773 SK872/873 SK972/973	SK572.1/573.1* SK672.1/673.1* SK772.1/773.1 SK872.1/873.1 SK972.1/973.1	SK 4282/4382 SK 5282/5382 SK 6382	SK 9042.1/9043.1 SK 9052.1/9053.1	28390390	11.0
SK 62 SK 72/73			SK 6282 SK 7282/7382	SK 9072.1 SK 9082.1	28390400	13.2
SK 82/83 SK 92/93 SK 102/103			SK 8282/8382	SK 9086.1 SK 9092.1 SK 9096.1	28390410	15.4





* Need to additionally order part #28390380 which is sub-assembly shown below.

Expansion Chamber Compatibility Chart

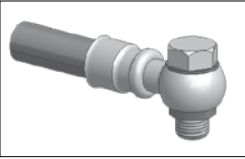
Helical Worm	Two-Stage Helical Bevel	NORDBLOC.1™	Clincher™	Part Number
SK 02040.1	SK 920072.1 SK 92072.1	SK 072.1 / 071.1 SK 172.1	N/A	28390840**
N/A	SK 92172.1	SK 171.1 SK 372.1	SK 0182.1 SK 0282.1 SK 1382.1	28390850**

* See page 3 for assembly information

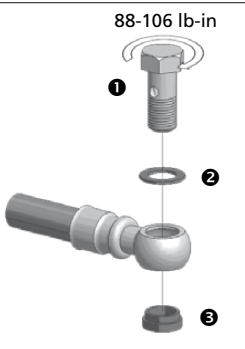
Sub-Assembly P/N 28390380 for NORDBLOC®.1 gear units with M10x1 air vent.

 1 1x DIN 7643 M10x1 283 00380	 2 1x DIN 7603A Cu 10x16x1 253 10166	 3 1x Ring 10x14x5 283 00370	 4 1xDIN 9021 ø8,4 227 10840
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Assembly of the expansion unit at the gear unit. Types SK 572.1/573.1, SK 672.1/673.1



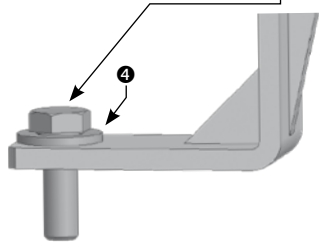
Vent Hose Sub-Assembly



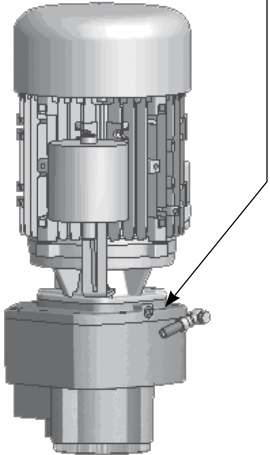
88-106 lb-in

4 For motor sizes 63, 71, 80, 90, 100 & 112

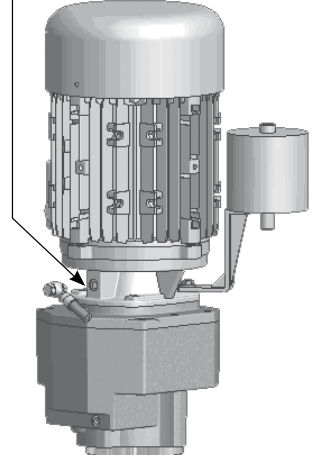
- Motor attachment bolt



Motor Sizes 63, 71 & 80:
Assembly vent-hose to port as shown.



Motor Sizes 90, 100 & 112:
Assembly vent-hose to port as shown.





EXPANSION CHAMBERS INSTALLATION & MAINTENANCE MANUAL



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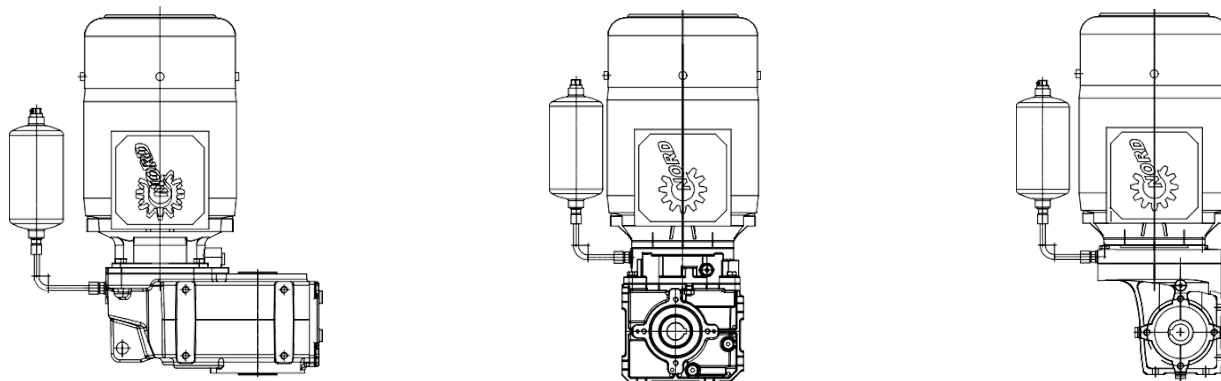
Assembly instruction for 0.25-liter oil expansion chamber (OA)

1. After fitting the drive in the find operating position remove vent-plug of the drive.
2. Assemble the expansion unit (suggestions for position listed below).

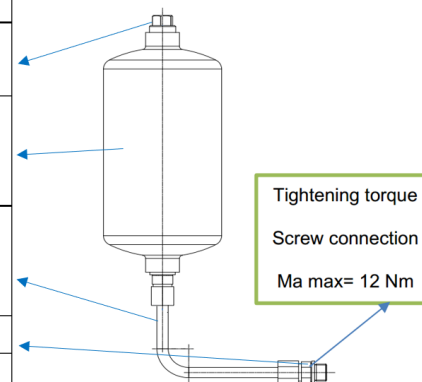
Attention: Terminal box position for the construction M4 in position 2 is not possible.

The expansion tank should be screwed straight, parallel to the motor axis.

Attention: On ATEX gearboxes, screw the pressure vent plug M10x1.0, into the expansion unit.



Designation	0 A	0 B
Vent plug M10x1.0 with oil seal	X	X
Expansion tank (l)	0.25	0.25
Pipe 6 mm	PR 06	PR 06
Gear connection	M8x1	M10x1
Part number	28390840	28390850





HELICAL & BEVEL REDUCER LUBRICATION TYPES



DRIVESYSTEMS

RETAIN FOR FUTURE USE

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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°F)	Mobilgear 600XP220	♠①
	PAO-EP	-35 to 60°C (-31 to 140°F)	Mobil SHC Gear 220	♠②
	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	♠①
	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	♠②
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	♠

♠ Stocked Lubricants

① Standard product on serviceable gear units

② 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 Polyalphaolefin 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.

NORD Gear Limited

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NORD Gear Corporation

Toll Free in the United States: 888.314.6673



HELICAL & BEVEL REDUCER LUBRICATION TYPES



DRIVESYSTEMS

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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.



HELICAL-WORM REDUCER LUBRICATION TYPES



Lubrication Tables – Helical Worm Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	◆

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO	0 to 50°C (32 to 122°F)	Mobil SHC 634	-
	FG-PAO	0 to 50°C (32 to 122°F)	Mobil SHC Cibus 460	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickeners	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	◆
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	◆

◆ Stocked Lubricants

IMPORTANT NOTE
<ul style="list-style-type: none"> • 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: Synthetic Oil: 105 °C (225 °F). • In the following instances, please consult NORD for specific recommendations: <ul style="list-style-type: none"> √ 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 U10770.

Oil Formulation Codes

- PAO - Synthetic Polyalphaolefin Oil
- PG - Synthetic Polyglycol Oil
- FG-PAO - Food-Grade, Synthetic Polyalphaolefin 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-WORM REDUCER LUBRICATION TYPES



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Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 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-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	PAO	-15 to 40°C (5 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	0 to 50°C (32 to 122°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	0 to 50°C (32 to 122°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	0 to 50°C (32 to 122°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	0 to 50°C (32 to 122°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	0 to 60°C (32 to 140°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	Klübersynth UH1 6-680

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.



FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION TYPES



DRIVESYSTEMS

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Lubrication Tables – FLEXBLOC™ (SI/SID Series) Worm Gear Units

Standard Oil Lubricants

NORD uses a semi automated assembly process to produce the FLEXBLOC™ gear unit assemblies. During this process the gear units are factory filled in accordance with the following table.

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	FG-PG	-25 to 80°C (-13 to 176°F)	Klübersynth UH1 6-680	Inch
	PG	-20 to 40°C (-4 to 104°F)	Klübersynth GH 6-680	Metric
VG220	FG-PG	-25 to 40°C (-13 to 104°F)	Klübersynth UH1 6-220	Inch
	PG	-25 to 40°C (-13 to 104°F)	Klübersynth GH 6-220	Metric

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	PAO	-25 to 80°C (-13 to 176°F)	Kluber / Petamo GHY133N	◆
0	Aluminum	FG	-25 to 40°C (-13 to 104°F)	Kluber / Klübersynth UH1 14-151	◆

◆ Stocked Lubricants



IMPORTANT NOTE

- Observe the general lubrication guidelines in User Manual U10800.
- Ambient temperature range is a guideline only. The allowed operating temperature range for the gear unit is dependent upon assembly components used, their individual temperature limits, and the actual operating conditions.
- The selected oil type and viscosity is considered appropriate for most applications utilizing the specified NORD gear unit type. Different oil types or viscosity grades may be recommended if the gear unit is exposed to frequent high load conditions or operating under extreme low or high ambient temperature conditions.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
Synthetic oil: 105 °C (225 °F).
- Consult NORD for recommendations in the following instances:
 - √ The gear unit is exposed to frequent high load conditions.
 - √ Ambient temperature conditions exceed 40 °C (104 °F) or approach 0 °C (32 °F) or lower.
 - √ Fluid grease is being considered or specified for lubricating the gear unit.
 - √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.

Oil Formulation Codes

- PAO - Synthetic Polyalphaolefin Oil
- PG - Synthetic Polyglycol Oil
- FG-PAO - Food-Grade, Synthetic Polyalphaolefin Oil
- FG-PG - Food-Grade, Synthetic Polyglycol Oil

NOTICE

- 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 or polyalphaolefin (PAO) oils.

NORD Gear Limited

Toll Free in Canada: 800.668.4378

NORD Gear Corporation

Toll Free in the United States: 888.314.6673



FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION TYPES



DRIVESYSTEMS

RETAIN FOR FUTURE USE

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Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 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-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	PAO	-35 to 40°C (-31 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	-5 to 40°C (23 to 104°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-5 to 40°C (23 to 104°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	-5 to 40°C (23 to 104°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	-25 to 80°C (-13 to 176°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	Klübersynth UH1 6-680

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.



STANDARD IN-LINE FOOTED OIL FILL QUANTITIES



DRIVESYSTEMS

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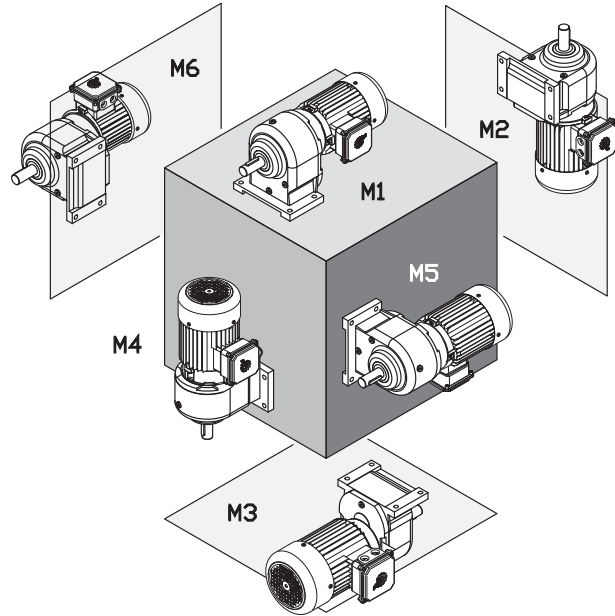
U11500 - 1 of 1

Standard In-line footed lubrication

All Standard In-line reducers are shipped from NORD with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. When filling these gear units the oil must be measured and added until one establishes the proper fill quantity. For additional information please refer to the "Oil & vent plug locations" documentation for your specified gear unit

i **IMPORTANT NOTE**

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
SK0 / SK05	0.14	0.13	0.23	0.22	0.14	0.13	0.23	0.22	0.14	0.13	0.14	0.13
SK000	0.25	0.24	0.42	0.40	0.25	0.24	0.42	0.40	0.25	0.24	0.25	0.24
SK01 / SK015	0.23	0.22	0.40	0.38	0.23	0.22	0.40	0.38	0.23	0.22	0.23	0.22
SK010 / SK0105	0.40	0.38	0.63	0.60	0.40	0.38	0.63	0.60	0.40	0.38	0.40	0.38
SK20 / SK205	0.58	0.55	1.06	1.00	0.58	0.55	1.06	1.00	0.58	0.55	0.58	0.55
SK200 / SK2005	0.85	0.80	1.37	1.30	0.85	0.80	1.37	1.30	0.85	0.80	0.85	0.80
SK25 / SK255	0.53	0.50	1.06	1.00	0.53	0.50	1.06	1.00	0.53	0.50	0.53	0.50
SK250 / SK2505	1.27	1.20	1.59	1.50	1.27	1.20	1.59	1.50	1.27	1.20	1.27	1.20
SK30 / SK305	0.95	0.90	1.37	1.30	0.95	0.90	1.37	1.30	0.95	0.90	0.95	0.90
SK300 / SK3005	1.27	1.20	2.11	2.00	1.27	1.20	2.11	2.00	1.27	1.20	1.27	1.20
SK33 / SK335	1.06	1.00	1.69	1.60	1.06	1.00	1.69	1.60	1.06	1.00	1.06	1.00
SK330 / SK3305	1.90	1.80	2.96	2.80	1.90	1.80	2.96	2.80	1.90	1.80	1.90	1.80



STANDARD IN-LINE FLANGED OIL FILL QUANTITIES



DRIVESYSTEMS

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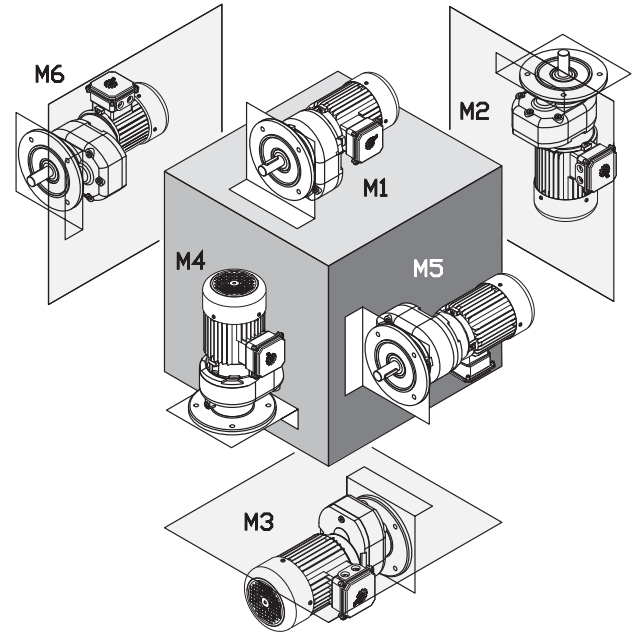
U11600 - 1 of 1

Standard In-line flanged lubrication

All Standard In-line reducers are shipped from NORD with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. When filling these gear units the oil must be measured and added until one establishes the proper fill quantity. For additional information please refer to the "Oil & vent plug locations" documentation for your specified gear unit

i **IMPORTANT NOTE**

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
SK0 F / SK05 F	0.14	0.13	0.23	0.22	0.14	0.13	0.23	0.22	0.14	0.13	0.14	0.13
SK000 F	0.25	0.24	0.43	0.41	0.25	0.24	0.43	0.41	0.25	0.24	0.25	0.24
SK01 F	0.23	0.22	0.40	0.38	0.23	0.22	0.40	0.38	0.23	0.22	0.23	0.22
SK010 F / SK0105 F	0.37	0.35	0.69	0.65	0.37	0.35	0.78	0.74	0.37	0.35	0.37	0.35
SK20 F	0.37	0.35	0.63	0.60	0.37	0.35	0.63	0.60	0.37	0.35	0.37	0.35
SK200 F / SK2005 F	0.69	0.65	1.00	0.95	0.69	0.65	1.16	1.10	0.69	0.65	0.69	0.65
SK25 F	0.53	0.50	1.06	1.00	0.53	0.50	1.06	1.00	0.53	0.50	0.53	0.50
SK250 F / SK2505 F	0.95	0.90	1.48	1.40	0.95	0.90	1.69	1.60	0.95	0.90	0.95	0.90
SK30 F	0.74	0.70	1.16	1.10	0.74	0.70	1.16	1.10	0.74	0.70	0.74	0.70
SK300 F / SK3005 F	1.32	1.25	1.59	1.50	1.32	1.25	1.90	1.80	1.32	1.25	1.32	1.25
SK33 F / SK335F	1.06	1.00	1.59	1.50	1.06	1.00	1.59	1.50	1.06	1.00	1.06	1.00
SK330 F / SK3305 F	1.69	1.60	2.64	2.50	1.69	1.60	3.06	2.90	1.69	1.60	1.69	1.60

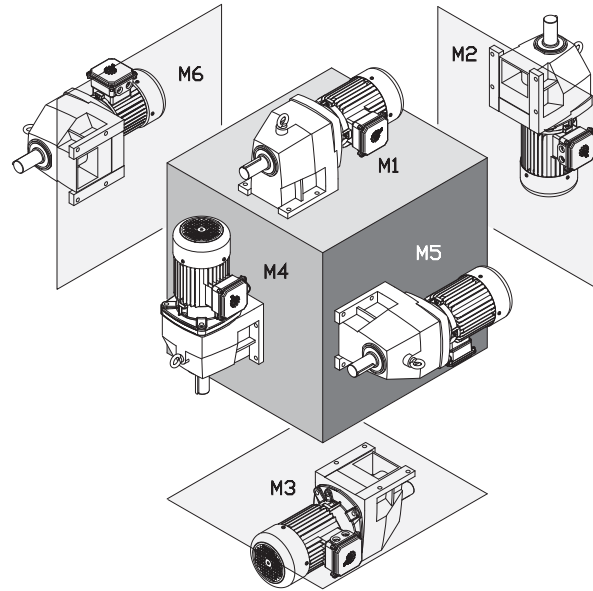


HELICAL IN-LINE FOOTED OIL FILL QUANTITIES



Helical In-line footed lubrication

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.



i **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.

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
SK02	0.21	0.20	0.79	0.75	0.79	0.75	0.69	0.65	0.63	0.60	0.63	0.60
SK 03	0.37	0.35	1.27	1.20	0.85	0.80	1.06	1.00	0.74	0.70	0.74	0.70
SK11E	0.26	0.25	0.53	0.50	0.69	0.65	0.53	0.50	0.42	0.40	0.42	0.40
SK12	0.26	0.25	0.85	0.80	0.90	0.85	0.79	0.75	0.58	0.55	0.58	0.55
SK 13	0.79	0.75	1.37	1.30	1.37	1.30	1.27	1.20	0.79	0.75	0.79	0.75
SK21E	0.63	0.60	1.27	1.20	1.37	1.30	1.06	1.00	1.06	1.00	1.06	1.00
SK22	0.53	0.50	2.01	1.90	2.22	2.10	1.90	1.80	1.48	1.40	1.48	1.40
SK 23	1.27	1.20	2.11	2.00	2.01	1.90	2.54	2.40	1.69	1.60	1.69	1.60
SK31E	1.16	1.10	2.11	2.00	2.32	2.20	1.80	1.70	1.59	1.50	1.59	1.50
SK32	0.95	0.90	2.64	2.50	3.28	3.10	3.28	3.10	2.11	2.00	2.11	2.00
SK 33N	1.85	1.75	3.17	3.00	3.59	3.40	4.23	4.00	2.43	2.30	2.43	2.30
SK41E	1.69	1.60	2.75	2.60	3.49	3.30	2.96	2.80	2.43	2.30	2.43	2.30
SK42	1.48	1.40	4.76	4.50	4.76	4.50	4.54	4.30	3.38	3.20	3.38	3.20
SK 43	3.17	3.00	5.92	5.60	5.49	5.20	6.97	6.60	3.80	3.60	3.80	3.60
SK51E	1.90	1.80	3.70	3.50	4.33	4.10	4.23	4.00	4.02	3.80	4.02	3.80
SK52	2.64	2.50	7.40	7.00	7.19	6.80	7.19	6.80	5.39	5.10	5.39	5.10
SK 53	4.76	4.50	9.19	8.70	8.14	7.70	9.19	8.70	6.34	6.00	6.34	6.00
SK62	6.87	6.50	15.9	15.0	13.7	13.0	16.9	16.0	15.9	15.0	15.9	15.0
SK 63	13.7	13.0	15.3	14.5	15.3	14.5	16.9	16.0	13.7	13.0	13.7	13.0
SK72	10.6	10.0	24.3	23.0	19.0	18.0	27.5	26.0	24.3	23.0	24.3	23.0
SK 73	21.7	20.5	21.1	20.0	23.8	22.5	28.5	27.0	21.1	20.0	21.1	20.0
SK82	14.8	14.0	37.0	35.0	28.5	27.0	46.5	44.0	33.8	32.0	33.8	32.0
SK 83	31.7	30.0	32.8	31.0	35.9	34.0	39.1	37.0	34.9	33.0	34.9	33.0
SK92	26.4	25.0	77.0	73.0	49.7	47.0	80.0	76.0	55.0	52.0	55.0	52.0
SK 93	56.0	53.0	74.0	70.0	62.0	59.0	76.0	72.0	52.0	49.0	52.0	49.0
SK102	38.0	36.0	84.0	79.0	70.0	66.0	108	102	75.0	71.0	75.0	71.0
SK 103	78.0	74.0	75.0	71.0	78.0	74.0	102	97.0	71.0	67.0	71.0	67.0

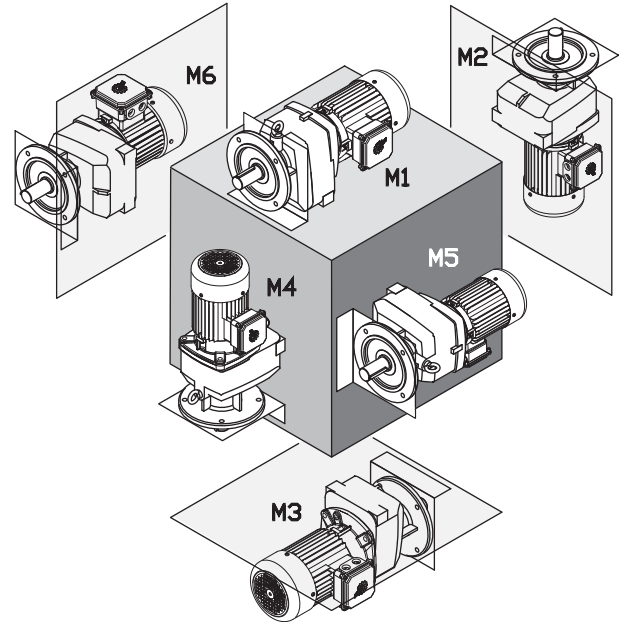


HELICAL IN-LINE FLANGED OIL FILL QUANTITIES



Helical In-line flanged lubrication

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.



i **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.

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
SK02F	0.26	0.25	0.74	0.70	0.74	0.70	0.74	0.70	0.53	0.50	0.53	0.50
SK 03 F	0.58	0.55	1.00	0.95	0.95	0.90	1.27	1.20	0.95	0.90	0.95	0.90
SK11E F	0.32	0.30	0.53	0.50	0.53	0.50	0.48	0.45	0.42	0.40	0.42	0.40
SK12F	0.37	0.35	0.90	0.85	0.95	0.90	0.95	0.90	0.74	0.70	0.74	0.70
SK 13 F	1.06	1.00	1.37	1.30	1.37	1.30	1.27	1.20	1.06	1.00	1.06	1.00
SK21E F	0.53	0.50	1.27	1.20	1.37	1.30	0.63	0.60	0.95	0.90	0.95	0.90
SK22F	0.74	0.70	1.90	1.80	1.90	1.80	1.90	1.80	1.48	1.40	1.48	1.40
SK 23 F	1.48	1.40	2.75	2.60	2.43	2.30	2.96	2.80	2.96	2.80	2.96	2.80
SK31E F	0.95	0.90	1.90	1.80	1.74	1.65	1.37	1.30	1.32	1.25	1.32	1.25
SK32F	1.27	1.20	2.96	2.80	3.28	3.10	3.28	3.10	2.32	2.20	2.32	2.20
SK 33N F	2.32	2.20	3.17	3.00	3.59	3.40	4.44	4.20	2.43	2.30	2.43	2.30
SK41E F	1.27	1.20	2.43	2.30	2.85	2.70	2.11	2.00	2.01	1.90	2.01	1.90
SK42F	1.90	1.80	4.65	4.40	4.76	4.50	4.23	4.00	3.91	3.70	3.91	3.70
SK 43 F	3.70	3.50	6.02	5.70	5.28	5.00	6.45	6.10	4.33	4.10	4.33	4.10
SK51E F	1.90	1.80	3.70	3.50	4.33	4.10	3.17	3.00	4.02	3.80	4.02	3.80
SK52F	3.17	3.00	7.19	6.80	6.55	6.20	7.82	7.40	5.92	5.60	5.92	5.60
SK 53 F	5.49	5.20	8.88	8.40	7.40	7.00	9.40	8.90	7.08	6.70	7.08	6.70
SK 62 F	7.40	7.00	15.9	15.0	14.8	14.0	19.5	18.5	16.9	16.0	16.9	16.0
SK 63 F	14.3	13.5	14.8	14.0	16.4	15.5	19.0	18.0	14.8	14.0	14.8	14.0
SK 72 F	10.6	10.0	24.3	23.0	19.5	18.5	29.6	28.0	24.3	23.0	24.3	23.0
SK 73 F	23.2	22.0	23.8	22.5	24.3	23.0	29.1	27.5	21.1	20.0	21.1	20.0
SK 82 F	15.9	15.0	39.1	37.0	30.6	29.0	47.6	45.0	36.5	34.5	36.5	34.5
SK 83 F	32.8	31.0	35.9	34.0	37.0	35.0	42.3	40.0	35.9	34.0	35.9	34.0
SK 92 F	27.5	26.0	77.0	73.0	49.7	47.0	82.0	78.0	55.0	52.0	55.0	52.0
SK 93 F	56.0	53.0	74.0	70.0	62.0	59.0	78.0	74.0	52.0	49.0	52.0	49.0
SK 102 F	42.3	40.0	86.0	81.0	70.0	66.0	110	104	76.0	72.0	76.0	72.0
SK 103 F	73.0	69.0	82.0	78.0	82.0	78.0	105	99.0	71.0	67.0	71.0	67.0

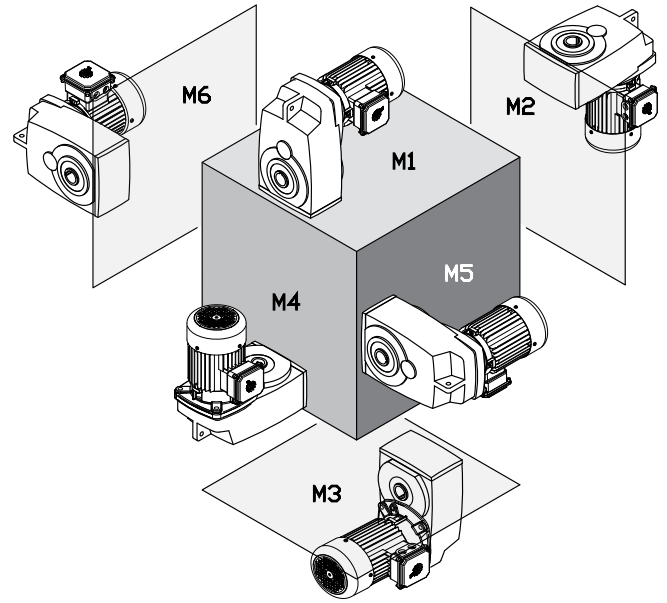


CLINCHER™ OIL FILL QUANTITIES



CLINCHER™ lubrication

Unless otherwise noted below, 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.



i	IMPORTANT NOTE
<p>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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.</p>	
<p>For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.</p>	

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 0182NB	0.42	0.40	0.58	0.55	0.58	0.55	0.42	0.40	0.42	0.40	0.42	0.40
SK 0182.1	0.74	0.7	1.14	1.08	0.66	0.62	0.93	0.88	0.63	0.6	0.68	0.64
SK 0282NB	0.74	0.70	1.16	1.10	0.85	0.80	1.16	1.10	0.95	0.90	0.95	0.90
SK 0282.1	1.08	1.02	1.48	1.4	0.85	0.8	1.41	1.33	0.85	0.8	0.92	0.87
SK 1282	1.00	0.95	1.37	1.30	0.95	0.90	1.37	1.30	1.06	1.00	1.06	1.00
SK 1282.1	1.77	1.67	2.28	2.16	1.11	1.05	2.06	1.95	1.35	1.28	1.42	1.34
SK 1382NB	1.48	1.40	2.43	2.30	2.32	2.20	2.32	2.20	2.11	2.00	2.11	2.00
SK 1382	1.53	1.45	1.69	1.6	1.22	1.15	1.8	1.7	1.16	1.1	1.16	1.1
SK 1382.1	1.77	1.67	2.11	2	1.11	1.05	2.06	1.95	1.35	1.28	1.42	1.34
SK 2282	1.80	1.70	2.43	2.30	1.80	1.70	2.32	2.20	2.01	1.90	2.01	1.90
SK 2382	2.43	2.30	2.85	2.70	2.22	2.10	3.38	3.20	2.11	2.00	2.11	2.00
SK 3282	2.96	2.80	4.23	4.00	3.49	3.30	4.02	3.80	3.17	3.00	3.17	3.00
SK 3382	4.02	3.80	4.54	4.30	3.17	3.00	5.81	5.50	3.17	3.00	3.17	3.00
SK 4282	4.44	4.20	5.71	5.40	4.65	4.40	5.28	5.00	4.44	4.20	4.44	4.20
SK 4382	6.45	6.10	7.29	6.90	5.18	4.90	8.88	8.40	5.28	5.00	5.28	5.00
SK 5282	7.93	7.50	9.30	8.80	7.93	7.50	9.30	8.80	7.61	7.20	7.61	7.20
SK 5382	13.2	12.5	12.7	12.0	7.08	6.70	14.8	14.0	8.77	8.30	8.77	8.30
SK 6282	18.0	17.0	16.4	15.5	13.2	12.5	18.5	17.5	11.6	11.0	14.8	14.0
SK 6382	16.9	16.0	13.7	13.0	10.6	10.0	19.0	18.0	14.8	14.0	13.2	12.5
SK 7282	26.9	25.5	22.2	21.0	21.7	20.5	28.5	27.0	16.9	16.0	22.2	21.0
SK 7382	23.2	22.0	22.2	21.0	16.9	16.0	26.4	25.0	24.3	23.0	23.2	22.0
SK 8282	39.6	37.5	34.9	33.0	32.2	30.5	46.5	44.0	32.8	31.0	32.8	31.0
SK 8382	36.5	34.5	34.3	32.5	26.4	25.0	40.2	38.0	37.0	35.0	31.7	30.0
SK 9282	79.2	75.0	74.0	70.0	58.1	55.0	76.1 †	72.0 †	63.4	60.0	62.4	59.0
SK 9382	78.2	74.0	74.0	70.0	47.6	45.0	79.2 †	75.0 †	68.7	65.0	63.4	60.0
SK 10282	95.0	90.0	95.0	90.0	42.3	40.0	95.0 †	90.0 †	63.0	60.0	87.0	82.0
SK 10382	90.0	85.0	95.0	90.0	77.0	73.0	106 †	100 †	85	80.0	85.0	80.0
SK10382.1	80.3	76.0	84.5	80.0	75.0	71.0	98.2	93.0	76.1	72.0	70.8	67.0
SK 11282*	174	165	169	160	153	145	206 †	195 †	106	100	148	140
SK 11382*	169	160	164	155	148	140	222 †	210 †	164	155	143	135
SK11382.1*	134.2	127	140.5	133	124.7	118	205	194	131	124	118.4	112
SK 12382*	169	160	164	155	148	140	222 †	210 †	164	155	143	135

* For shipping purposes the larger Clincher™ gear units are supplied without oil.

† Oil quantities shown are for the gearbox only. When the OT (oil tank) option is used, the oil must be filled to the level shown on the dipstick which is located inside of the oil tank. Even when the gear unit is filled by NORD, the user MUST add more oil until the oil is filled to the proper level.

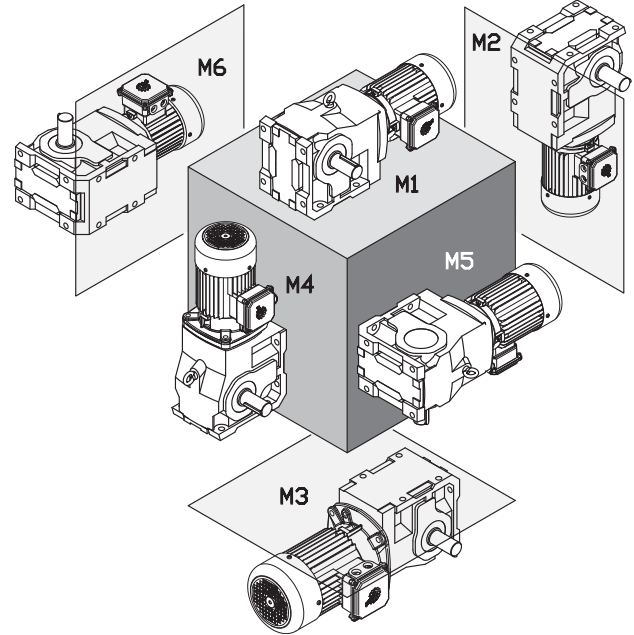


90.1 HELICAL-BEVEL FOOTED OIL FILL QUANTITIES



90.1 Helical-bevel footed lubrication

Unless otherwise noted below, 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.



i **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.

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 9012.1	0.74	0.70	1.80	1.70	2.01	1.90	2.22	2.10	1.16	1.10	1.59	1.50
SK 9013.1	1.43	1.35	2.22	2.10	2.27	2.15	2.91	2.75	1.06	1.00	1.90	1.80
SK 9016.1	0.74	0.70	1.80	1.70	2.01	1.90	2.22	2.10	1.16	1.10	1.59	1.50
SK 9017.1	1.37	1.30	2.11	2.00	2.22	2.10	2.85	2.70	1.06	1.00	1.80	1.70
SK 9022.1	1.37	1.30	3.06	2.90	3.49	3.30	4.02	3.80	1.80	1.70	2.96	2.80
SK 9023.1	2.32	2.20	3.38	3.20	3.80	3.60	4.97	4.70	2.32	2.20	3.06	2.90
SK 9032.1	1.90	1.80	5.71	5.40	6.45	6.10	7.19	6.80	3.17	3.00	4.86	4.60
SK 9033.1	3.28	3.10	6.02	5.70	6.66	6.30	8.45	8.00	3.59	3.40	5.07	4.80
SK 9042.1	2.85	2.70	9.51	9.00	10.6	10.0	11.3	10.7	5.49	5.20	8.14	7.70
SK 9043.1	5.28	5.00	10.7	10.1	11.6	11.0	14.1	13.3	6.02	5.70	8.56	8.10
SK 9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK 9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.9	24.5	12.2	11.5	17.4	16.5
SK 9062.1	10.6	10.0	29.1	27.5	33.8	32.0	38.0	36.0	19.0	18.0	25.4	24.0
SK 9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.0	36.0	19.0	18.0	25.4	24.0
SK 9082.1	18.0	17.0	54.0	52.0	66.0	63.0	76.0	72.0	34.9	33.0	49.1	46.5
SK 9086.1	30.6	29.0	77.0	73.0	90.0	85.0	108	102	51.0	48.0	66.0	62.0
SK 9092.1	43.3	41.0	166	157	180	170	182	172	85.0	80.0	95.0	90.0
SK 9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152

Oil Levels shown apply to base models and gear units ending in LX, AX, & VX.

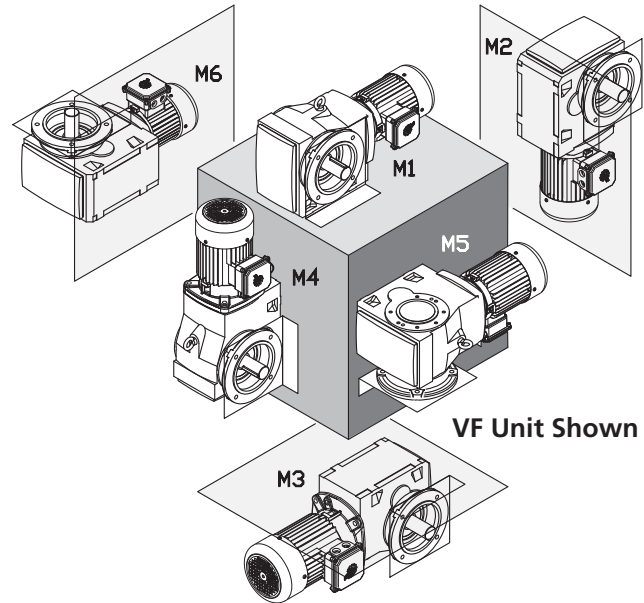


90.1 HELICAL-BEVEL FLANGED OIL FILL QUANTITIES



90.1 Helical-bevel flanged lubrication

Unless otherwise noted below, 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 additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below 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 9012.1	1.06	1.00	2.01	1.90	2.01	1.90	2.32	2.20	1.27	1.20	1.80	1.70
SK 9013.1	1.53	1.45	2.43	2.30	2.22	2.10	2.96	2.80	1.11	1.05	1.90	1.80
SK 9016.1	1.06	1.00	2.01	1.90	2.01	1.90	2.32	2.20	1.27	1.20	1.80	1.70
SK 9017.1	1.53	1.45	2.43	2.30	2.22	2.10	2.96	2.80	1.11	1.05	1.90	1.80
SK 9022.1	1.69	1.60	3.70	3.50	3.70	3.50	4.44	4.20	2.43	2.30	2.96	2.80
SK 9023.1	2.43	2.30	3.70	3.50	4.02	3.80	5.60	5.30	2.32	2.20	3.59	3.40
SK 9032.1	2.22	2.10	5.07	4.80	6.76	6.40	7.50	7.10	3.49	3.30	5.39	5.10
SK 9033.1	3.91	3.70	6.02	5.70	7.08	6.70	9.09	8.60	3.80	3.60	5.60	5.30
SK 9042.1	4.76	4.50	10.6	10.0	10.6	10.0	12.2	11.5	6.87	6.50	8.66	8.20
SK 9043.1	6.87	6.50	11.1	10.5	12.6	11.9	15.5	14.7	7.08	6.70	9.83	9.30
SK 9052.1	7.93	7.50	17.4	16.5	21.1	20.0	24.8	23.5	12.2	11.5	19.0	18.0
SK 9053.1	13.7	13.0	19.0	18.0	22.7	21.5	28.0	26.5	13.7	13.0	18.0	17.0
SK 9062.1	12.7	12.0	29.1	27.5	34.9	33.0	40.7	38.5	20.1	19.0	27.5	26.0
SK 9072.1	12.7	12.0	29.1	27.5	34.9	33.0	40.7	38.5	20.1	19.0	27.5	26.0
SK 9082.1	22.2	21.0	57.0	54.0	70.0	66.0	85.0	80.0	40.2	38.0	55.0	52.0
SK 9086.1	38.0	36.0	82.0	78.0	96.0	91.0	113	107	56.0	53.0	80.0	76.0
SK 9092.1	42.3	40.0	137	130	163	154	185	175	87.0	82.0	96.0	91.0
SK 9096.1	85.0	80.0	198	187	204	193	272	257	119	113	165	156

Oil Levels shown apply to base models and gear units ending in AZ, AF, VZ, & VF.



92 SERIES HELICAL-BEVEL FOOTED OIL FILL QUANTITIES



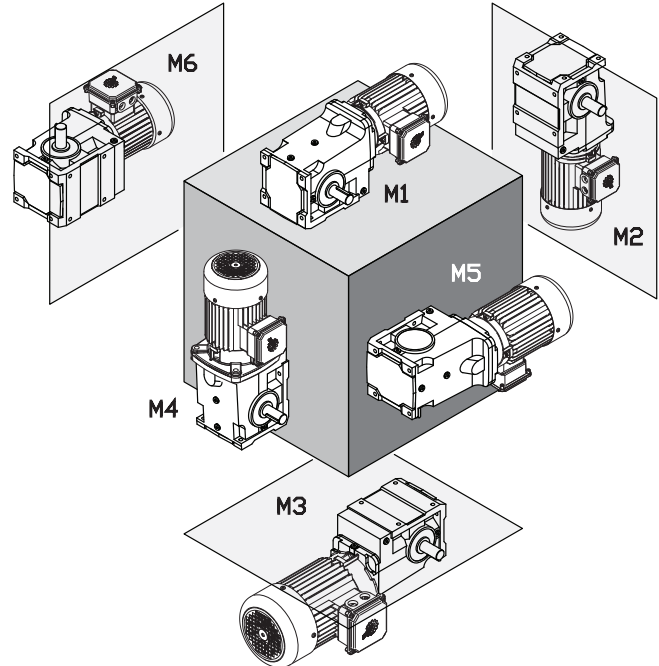
92 Helical-bevel footed lubrication

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.

i **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.

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 92072	0.42	0.40	0.63	0.60	0.53	0.50	0.58	0.55	0.42	0.40	0.42	0.40
SK 92172	0.63	0.60	0.95	0.90	1.06	1.00	1.16	1.10	1.16	1.10	0.85	0.80
SK 92372	0.95	0.90	1.69	1.60	1.59	1.50	2.01	1.90	1.59	1.50	0.95	0.90
SK 92672	1.90	1.80	3.70	3.50	3.80	3.60	3.59	3.40	2.75	2.60	2.75	2.60
SK 92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10

Oil Levels shown apply to base models and gear units ending in LX, AX, & VX.



92.1/93.1 SERIES HELICAL-BEVEL OIL FILL QUANTITIES



92.1/93.1 Helical-bevel mount lubrication

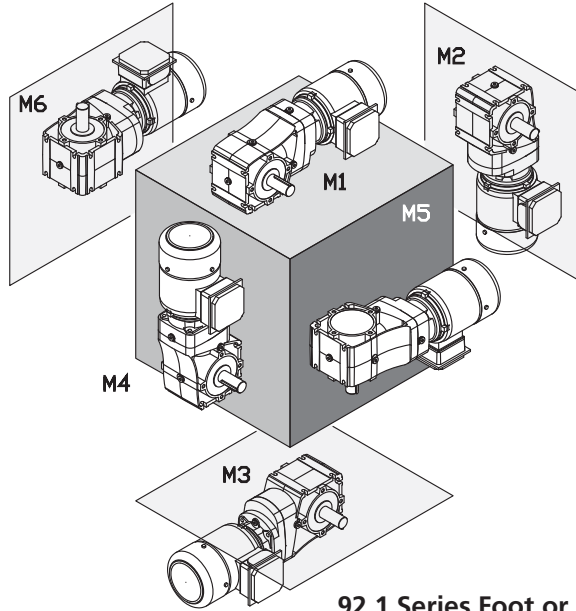
All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size & mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



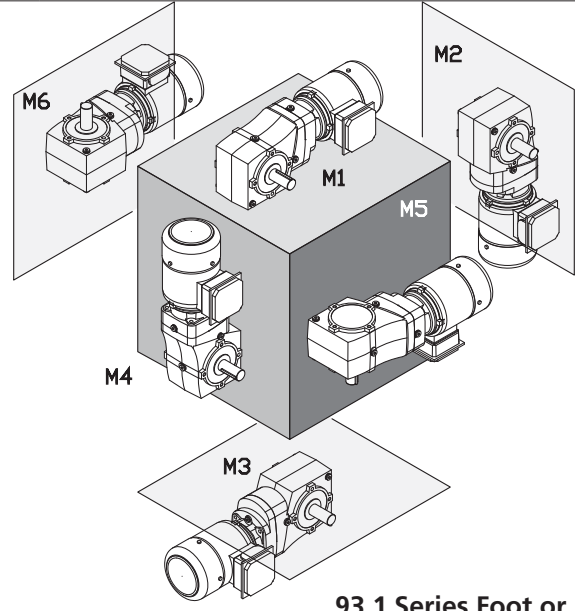
IMPORTANT NOTE

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 additional oil as needed.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



92.1 Series Foot or Flange Mount



93.1 Series Foot or Flange Mount

92.1 Series Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 920072.1	0.22	0.21	0.50	0.47	0.22	0.36	0.22	0.34	0.22	0.28	0.22	0.28
SK 92072.1	0.28	0.26	0.52	0.49	0.44	0.42	0.57	0.54	0.31	0.29	0.33	0.31
SK 92172.1	0.36	0.34	0.65	0.61	0.55	0.52	0.71	0.67	0.44	0.42	0.51	0.48
SK 92372.1	0.45	0.43	0.97	0.92	0.77	0.73	0.88	0.83	0.58	0.55	0.65	0.61
SK 92672.1	0.90	0.85	1.69	1.60	1.27	1.20	1.59	1.50	1.08	1.02	1.08	1.02
SK 92772.1	1.37	1.30	2.80	2.65	1.97	1.86	2.85	2.70	1.69	1.60	1.69	1.60

Oil levels shown apply to all foot & flange mounted units.

93.1 Series Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 930072.1	0.30	0.28	0.69	0.65	0.22	0.56	0.22	0.54	0.22	0.39	0.22	0.39
SK 93072.1	0.41	0.39	0.98	0.93	0.83	0.79	1.08	1.02	0.52	0.49	0.66	0.62
SK 93172.1	0.63	0.60	1.24	1.17	0.99	0.94	1.29	1.22	0.69	0.65	0.90	0.85
SK 93372.1	1.06	1.00	2.08	1.97	1.74	1.65	2.26	2.14	1.18	1.12	1.42	1.34
SK 93672.1	1.90	1.80	3.41	3.23	2.86	2.71	4.02	3.80	2.13	2.02	2.59	2.45
SK 93772.1	2.87	2.72	4.89	4.63	3.91	3.70	6.13	5.80	3.10	2.93	3.43	3.25

Oil levels shown apply to all foot & flange mounted units.



92 SERIES HELICAL-BEVEL FLANGED OIL FILL QUANTITIES



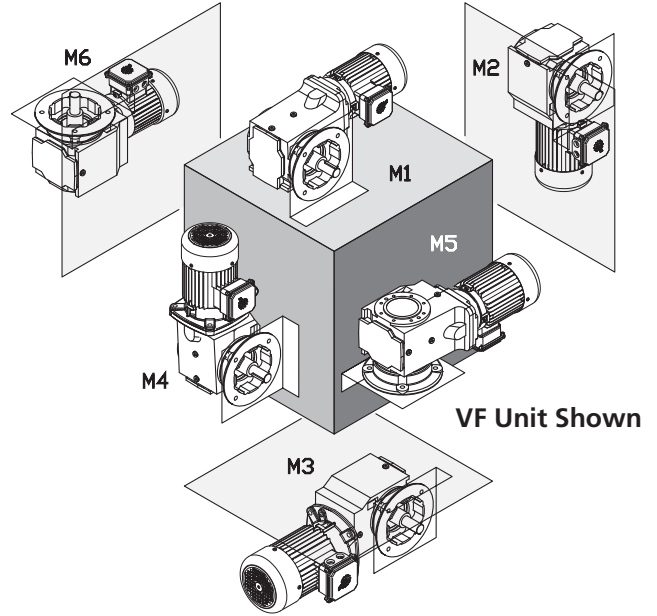
92 Helical-bevel flanged lubrication

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.

i **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.

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 92072	0.42	0.40	0.63	0.60	0.58	0.55	0.58	0.55	0.42	0.40	0.42	0.40
SK 92172	0.53	0.50	1.06	1.00	0.95	0.90	1.11	1.05	0.95	0.90	0.63	0.60
SK 92372	1.27	1.20	1.69	1.60	1.59	1.50	2.01	1.90	1.37	1.30	1.37	1.30
SK 92672	1.69	1.60	2.96	2.80	2.64	2.50	3.49	3.30	2.54	2.40	2.54	2.40
SK 92772	2.96	2.80	4.65	4.40	4.76	4.50	5.81	5.50	3.70	3.50	3.70	3.50

Oil Levels shown apply to gear units ending in AZ, AF, VZ, & VF.

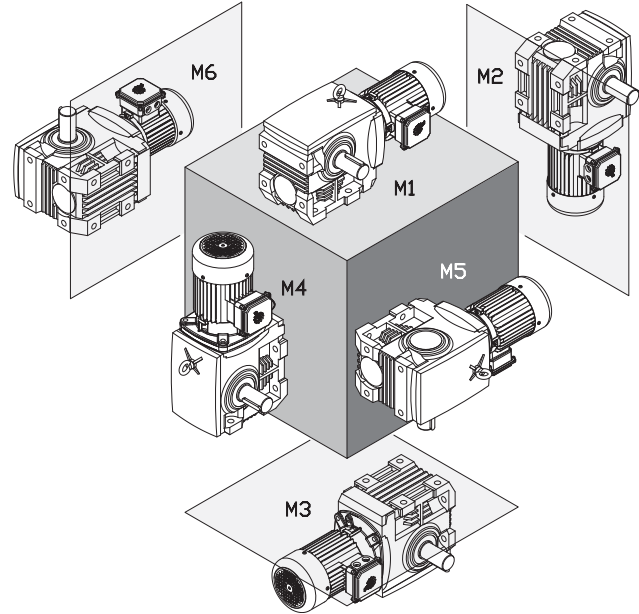


HELICAL-WORM FOOTED OIL FILL QUANTITIES



Helical-worm footed lubrication

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.



i **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.

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 02040	0.42	0.40	0.85	0.80	0.79	0.75	0.69	0.65	0.53	0.50	0.53	0.50
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050	0.42	0.40	1.48	1.40	1.16	1.10	1.37	1.30	0.74	0.70	0.74	0.70
SK 13050	0.79	0.75	1.85	1.75	1.37	1.30	1.85	1.75	0.79	0.75	0.79	0.75
SK 12063	0.63	0.60	1.90	1.80	1.27	1.20	1.69	1.60	1.06	1.00	1.06	1.00
SK 13063	1.06	1.00	2.43	2.30	1.59	1.50	2.32	2.20	1.16	1.10	1.16	1.10
SK 12080	0.95	0.90	3.28	3.10	2.54	2.40	3.17	3.00	1.90	1.80	1.90	1.80
SK 13080	1.80	1.70	3.70	3.50	3.70	3.50	3.70	3.50	2.11	2.00	2.11	2.00
SK 32100	1.59	1.50	6.66	6.30	5.92	5.60	5.81	5.50	3.80	3.60	3.80	3.60
SK 33100	2.54	2.40	6.76	6.40	5.71	5.40	6.87	6.50	3.59	3.40	3.59	3.40
SK 42125	2.96	2.80	12.5	11.8	10.8	10.2	10.6	10.0	6.55	6.20	6.55	6.20
SK 43125	4.49	4.25	13.7	13.0	11.1	10.5	14.3	13.5	7.61	7.20	7.61	7.20

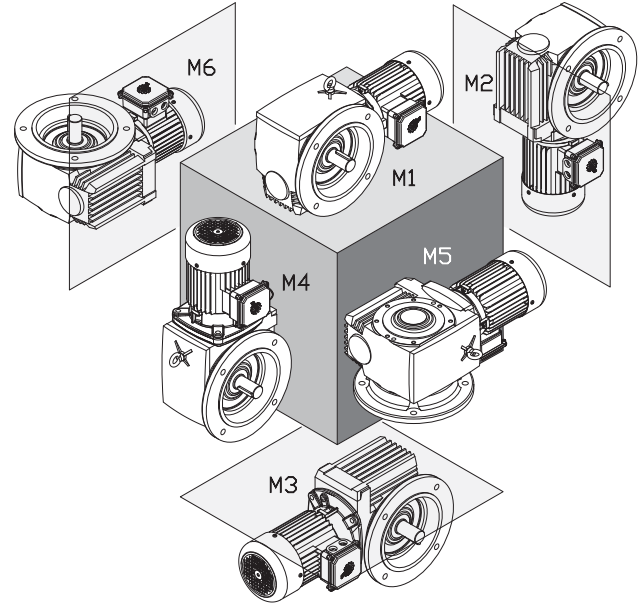


HELICAL-WORM SOLID SHAFT/FLANGED OIL FILL QUANTITIES



Helical-worm solid shaft/flanged lubrication

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.



i	IMPORTANT NOTE
<p>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.</p> <p>For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.</p>	

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 02040 VF	0.53	0.50	0.85	0.80	0.79	0.75	0.63	0.60	0.53	0.50	0.53	0.50
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050 VF	0.42	0.40	1.59	1.50	1.32	1.25	1.27	1.20	0.95	0.90	0.79	0.75
SK 13050 VF	0.79	0.75	1.90	1.80	1.59	1.50	1.80	1.70	1.11	1.05	0.95	0.90
SK 12063 VF	0.53	0.50	2.06	1.95	1.80	1.70	1.85	1.75	1.27	1.20	1.00	0.95
SK 13063 VF	1.06	1.00	2.43	2.30	2.01	1.90	2.32	2.20	1.43	1.35	1.16	1.10
SK 12080 VF	0.95	0.90	3.91	3.70	3.38	3.20	3.59	3.40	2.64	2.50	2.43	2.30
SK 13080 VF	1.69	1.60	4.02	3.80	3.70	3.50	4.12	3.90	2.85	2.70	2.64	2.50
SK 32100 VF	1.48	1.40	6.66	6.30	6.45	6.10	6.45	6.10	4.23	4.00	3.80	3.60
SK 33100 VF	2.80	2.65	7.61	7.20	6.76	6.40	8.03	7.60	4.54	4.30	4.02	3.80
SK 42125 VF	3.17	3.00	12.2	11.5	12.2	11.5	11.6	11.0	8.88	8.40	7.71	7.30
SK 43125 VF	4.97	4.70	15.9	15.0	13.7	13.0	16.9	16.0	9.51	9.00	8.14	7.70



HELICAL-WORM HOLLOW SHAFT OIL FILL QUANTITIES



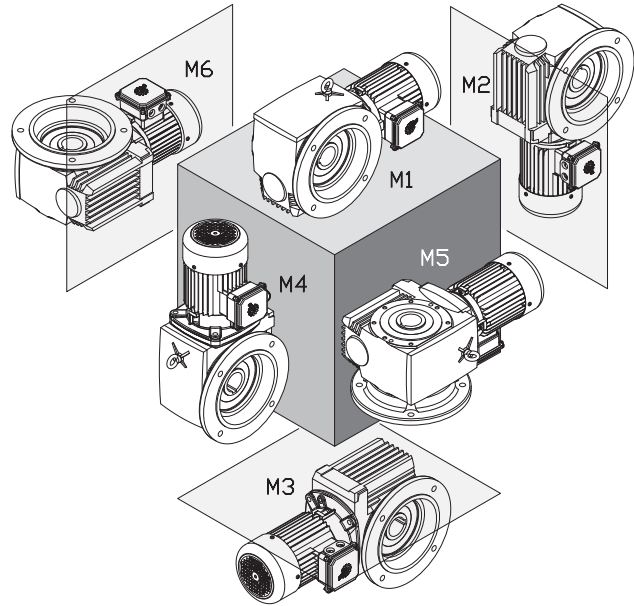
DRIVESYSTEMS

RETAIN FOR FUTURE USE

U12600 - 1 of 1

Helical-worm hollow shaft lubrication

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.



AF Unit Shown

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.

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 02040	0.42	0.40	0.74	0.70	0.69	0.65	0.69	0.65	0.58	0.55	0.58	0.55
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050	0.48	0.45	1.32	1.25	1.22	1.15	1.16	1.10	0.79	0.75	0.79	0.75
SK 13050	0.95	0.90	1.90	1.80	1.37	1.30	1.74	1.65	1.37	1.30	1.37	1.30
SK 12063	0.58	0.55	1.53	1.45	1.69	1.60	1.69	1.60	1.16	1.10	1.16	1.10
SK 13063	1.11	1.05	2.22	2.10	1.90	1.80	2.22	2.10	1.48	1.40	1.48	1.40
SK 12080	0.85	0.80	3.28	3.10	3.38	3.20	2.96	2.80	1.90	1.80	1.90	1.80
SK 13080	1.69	1.60	3.80	3.60	3.06	2.90	3.80	3.59	2.11	2.00	2.11	2.00
SK 32100	1.59	1.50	5.92	5.60	5.92	5.60	5.60	5.30	3.38	3.20	3.38	3.20
SK 33100	2.75	2.60	6.34	6.00	6.13	5.80	6.66	6.30	3.70	3.50	3.70	3.50
SK 42125	3.17	3.00	13.2	12.5	11.4	10.8	11.4	10.8	6.87	6.50	6.87	6.50
SK 43125	4.86	4.60	14.4	13.6	12.0	11.4	15.1	14.3	8.03	7.60	8.03	7.60

Oil Levels shown apply to gear units ending in AZ, AF.



FLEXBLOC™ (SI/SID SERIES) WORM GEAR OIL FILL QUANTITIES



DRIVESYSTEMS

RETAIN FOR FUTURE USE

U13300 - 1 of 1

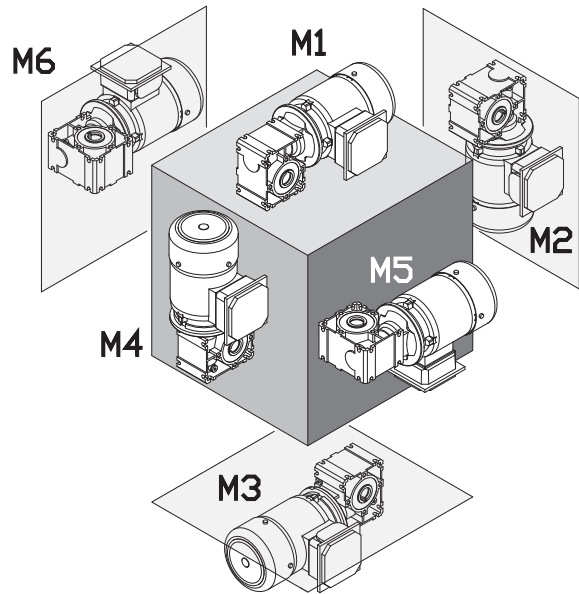
FLEXBLOC™ (SI/SID Series) Lubrication

NORD FLEXBLOC™ worm gear reducers are inherently maintenance free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. For lubrication types see User Manual U11060.

NORD FLEXBLOC™ worm gear reducers are equipped with oil plugs. Venting the gear unit is optional as discussed in User Manual U14800.

Related User Manuals

- U10810 FLEXBLOC™ (SI/SID Series) Worm – Lubrication Guidelines
- U11060 FLEXBLOC™ Worm (SI/SID Series) – Lubrication Types
- U14800 FLEXBLOC™ Worm (SI/SID Series) – Oil Plug Locations



FLEXBLOC™ (SI Series) Gear Reducer Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SI31	1.0	30	1.0	30	1.0	30	1.0	30	1.0	30	1.0	30
SK 1SI40	1.9	55	1.9	55	1.9	55	1.9	55	1.9	55	1.9	55
SK 1SI50	3.2	95	3.2	95	3.2	95	3.2	95	3.2	95	3.2	95
SK 1SI63	6.1	180	6.1	180	6.1	180	6.1	180	6.1	180	6.1	180
SK 1SI75	12.2	360	12.2	360	12.2	360	12.2	360	12.2	360	12.2	360

Oil Fill is universal and independent of mounting position.

FLEXBLOC™ (SID Series) Gear Reducer Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SID31	1.7	50	3.0	90	2.4	70	1.7	50	2.4	70	2.4	70
SK 1SID40	3.0	90	5.1	150	3.7	110	2.7	80	4.1	120	4.1	120
SK 1SID50	5.7	170	6.8	200	5.7	170	5.1	150	6.1	180	6.1	180
SK 1SID63	9.8	280	12.2	360	9.8	290	8.1	240	10.5	310	10.5	310

Integral gear motors only available upon special request.

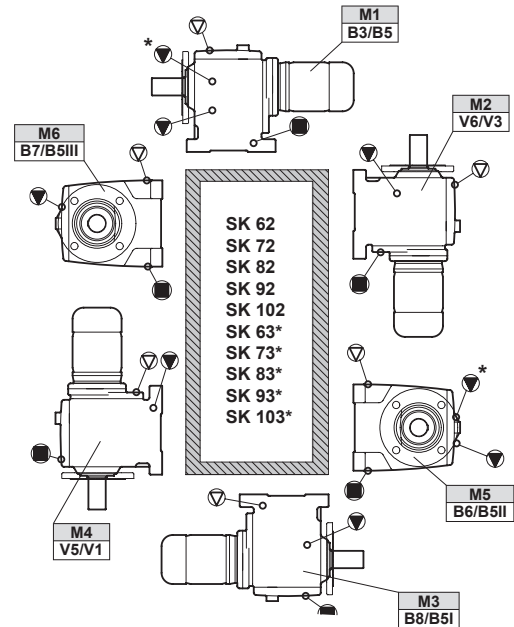
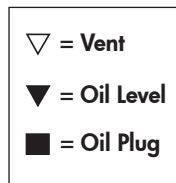
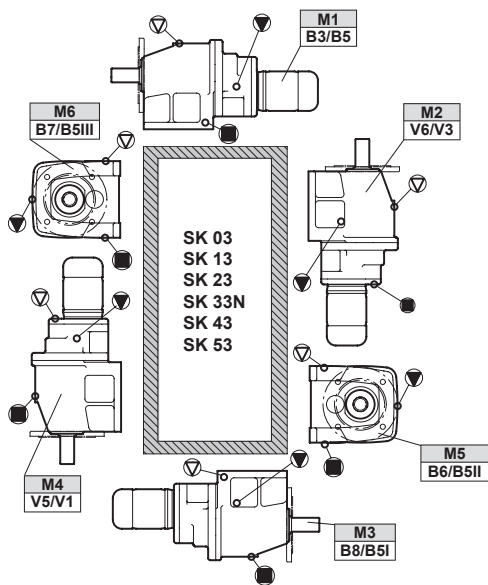
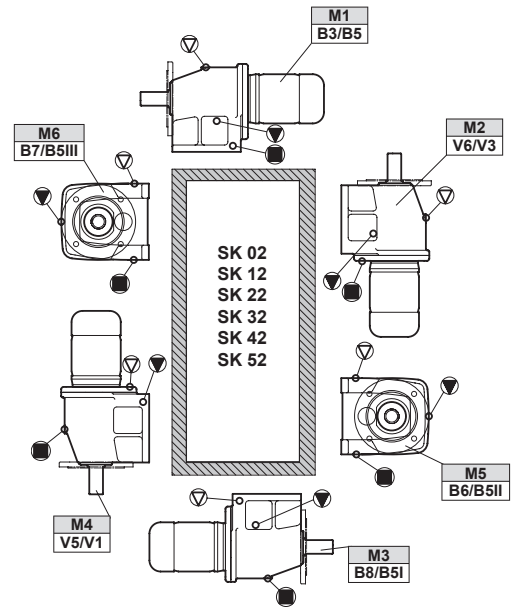
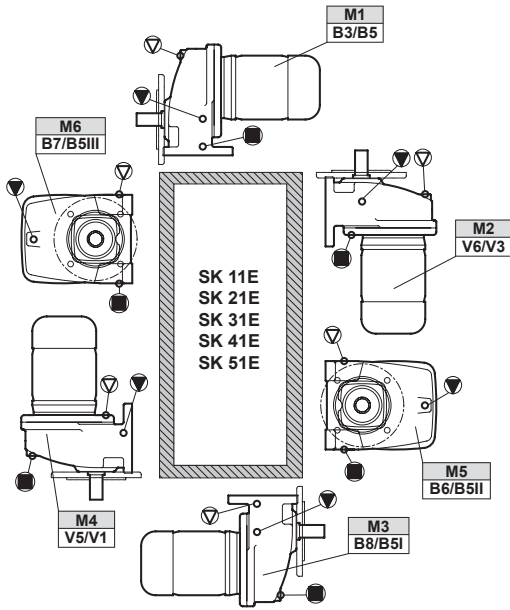


HELICAL IN-LINE OIL PLUG & VENT LOCATIONS



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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*



* Oil level for 3 stage gear units.



DRIVESYSTEMS

CLINCHER™ OIL PLUG & VENT LOCATIONS

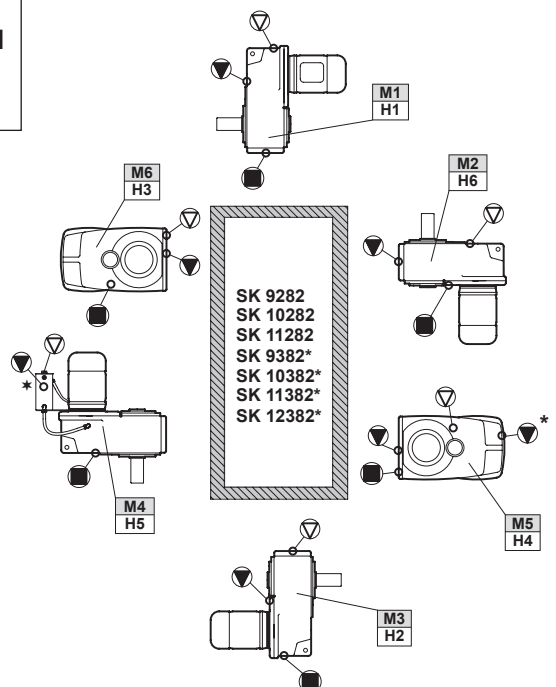
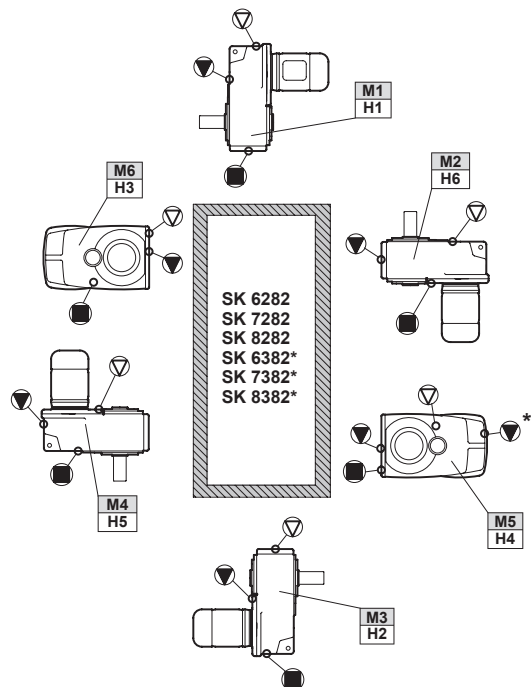
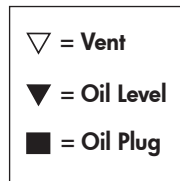
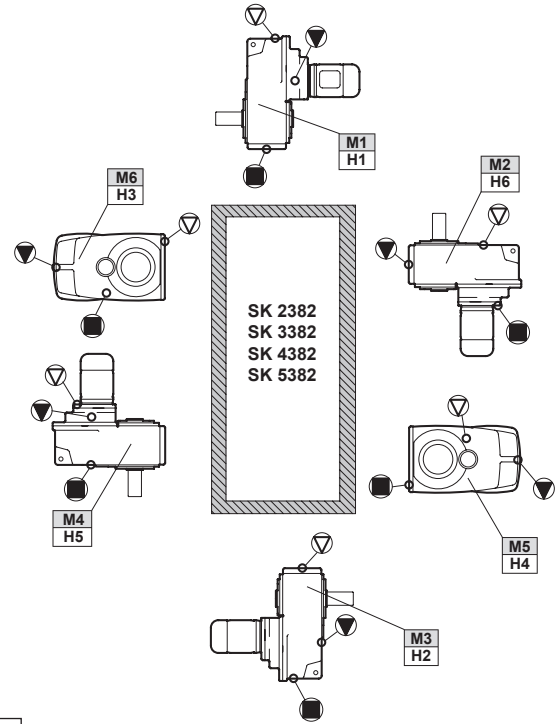
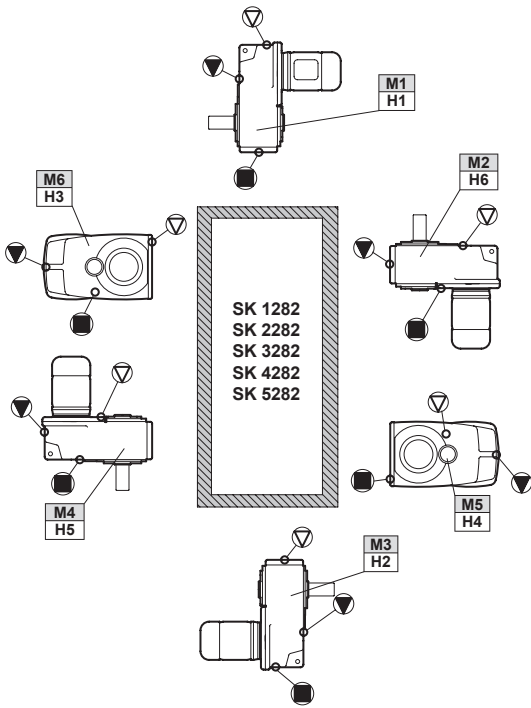


RETAIN FOR FUTURE USE

U14200 - 1 of 2

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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*



* Oil level for 3 stage gear units

* Oil level for 3 stage gear units

* Oil fill level should be verified using the dip stick located in the oil tank for the M4/H5 position.

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DRIVESYSTEMS

CLINCHER™ OIL PLUG & VENT LOCATIONS

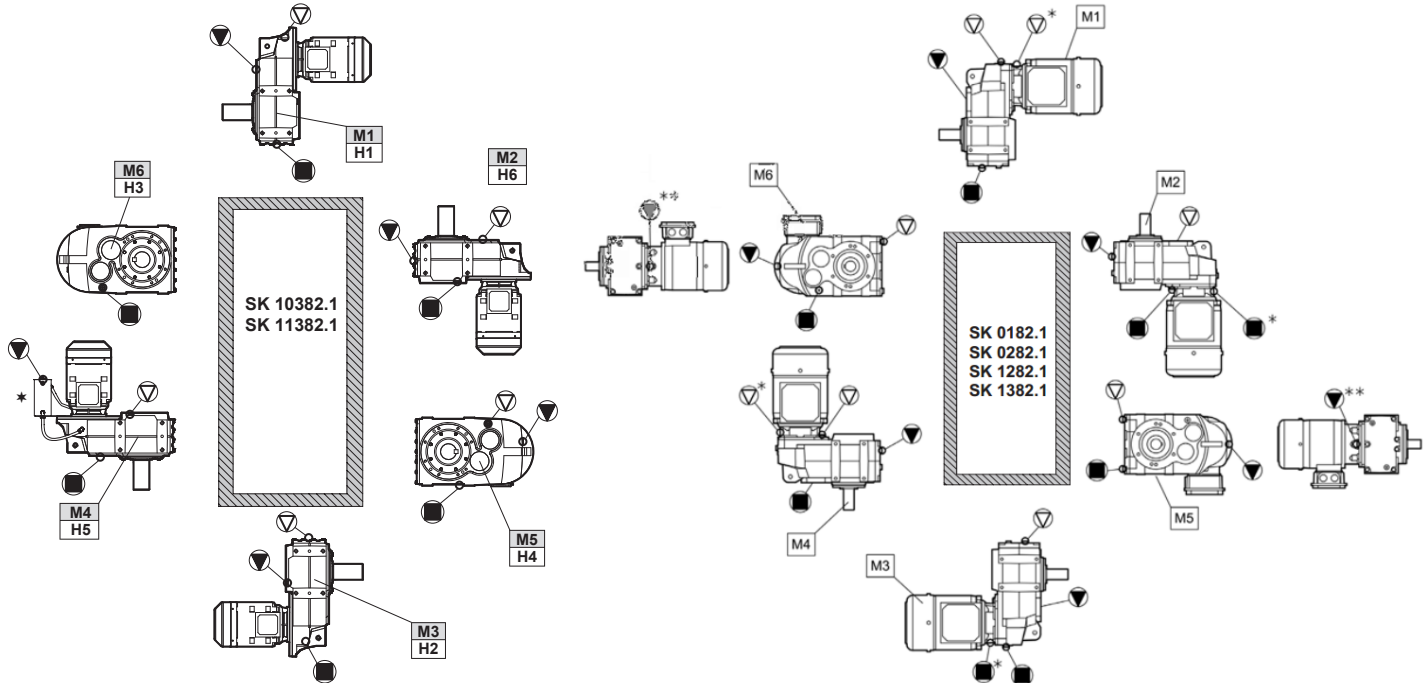


U14200 - 2 of 2

RETAIN FOR FUTURE USE

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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*



* Oil fill level should be verified using the dip stick located in the oil tank for the M4/H5 position.

▽	= Vent
▼	= Oil Level
■	= Oil Plug



92 SERIES HELICAL-BEVEL OIL PLUG & VENT LOCATIONS



DRIVESYSTEMS

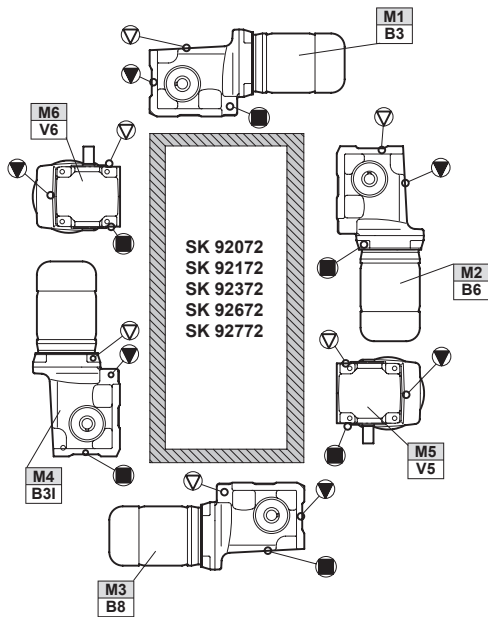
RETAIN FOR FUTURE USE

U14300 - 1 of 1

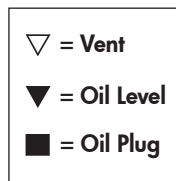
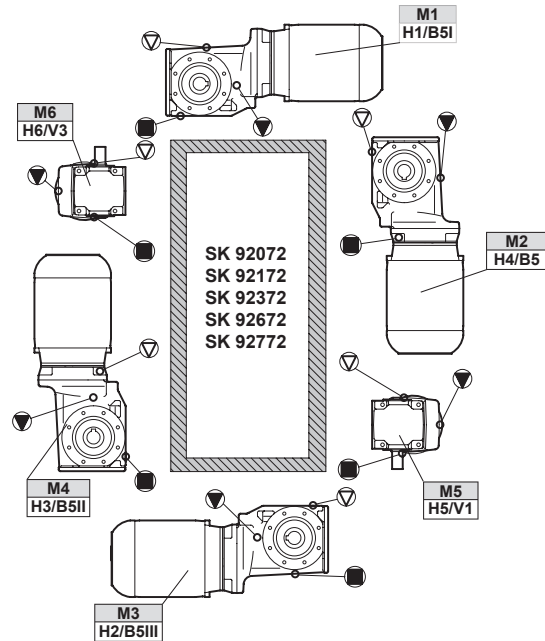
Oil plug connections

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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*

Foot Mount



Shaft/Flange Mount





92.1/93.1 SERIES HELICAL-BEVEL OIL PLUG & VENT LOCATIONS



DRIVESYSTEMS

RETAIN FOR FUTURE USE

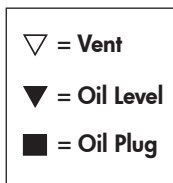
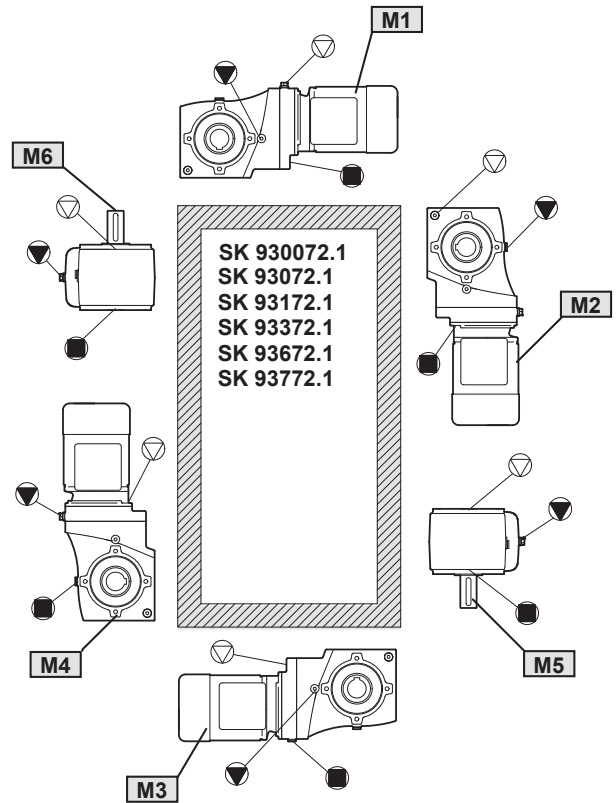
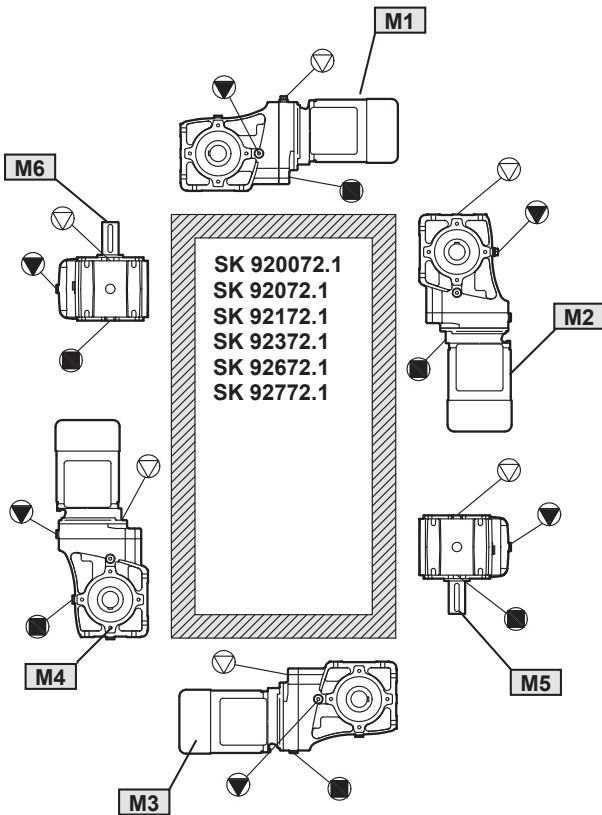
U14305 - 1 of 1

Oil plug locations

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. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*

92.1 Series

93.1 Series





90.1 HELICAL-BEVEL OIL PLUG & VENT LOCATIONS



DRIVESYSTEMS

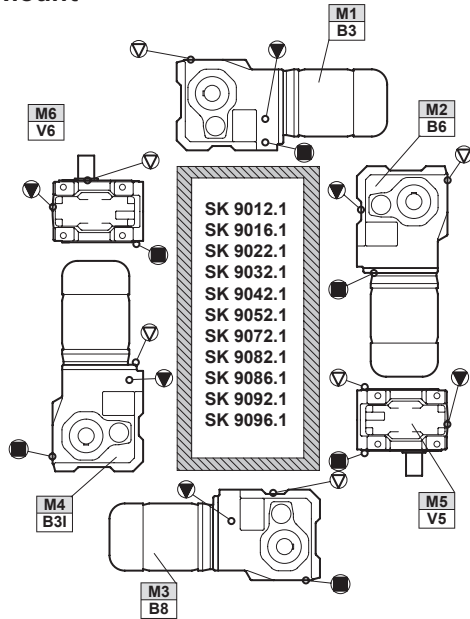
RETAIN FOR FUTURE USE

U14400 - 1 of 1

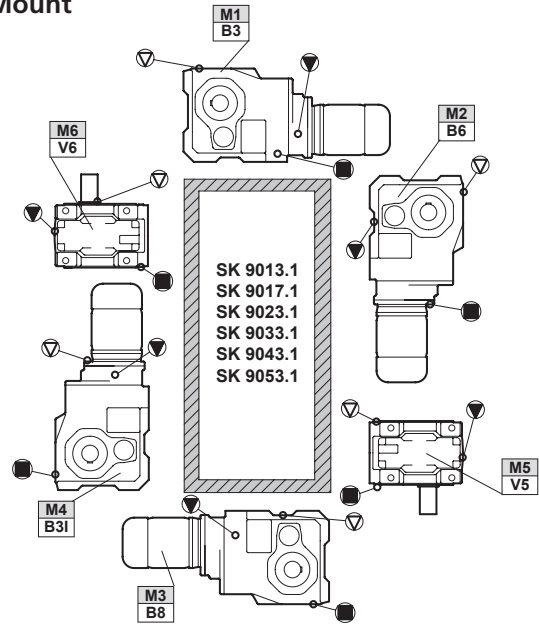
Oil plug connections

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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. *For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.*

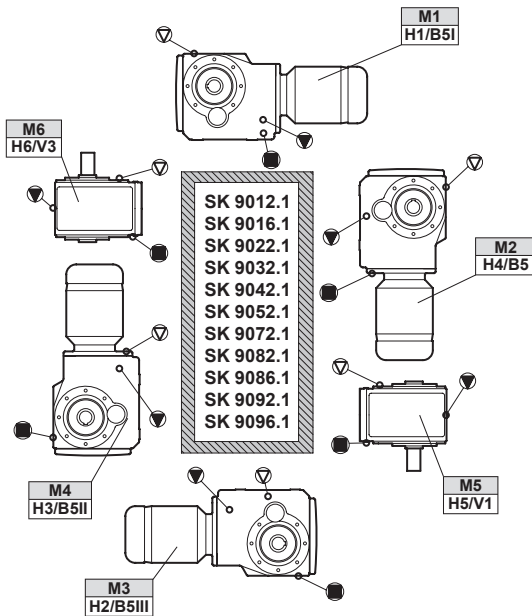
Foot Mount



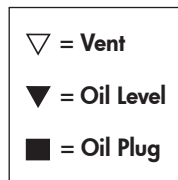
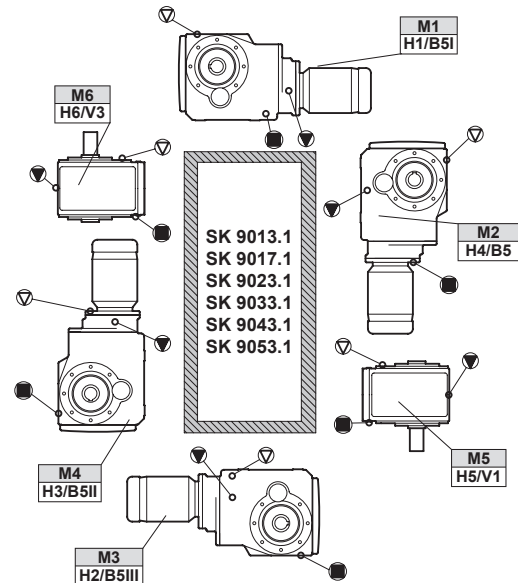
Foot Mount



Shaft/Flange Mount



Shaft/Flange Mount



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HELICAL-WORM OIL PLUG & VENT LOCATIONS



DRIVESYSTEMS

RETAIN FOR FUTURE USE

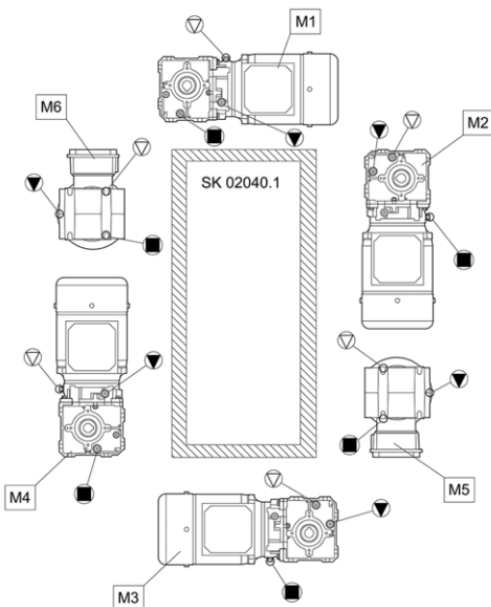
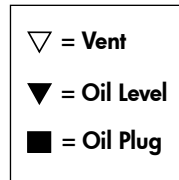
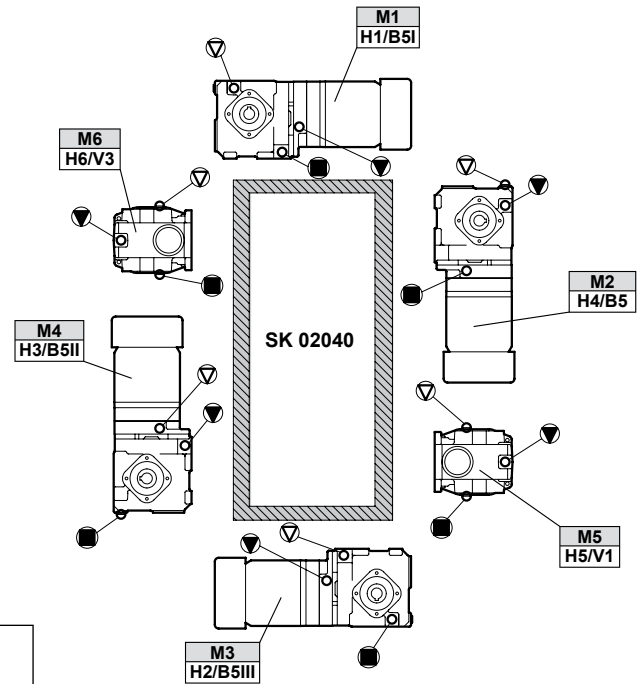
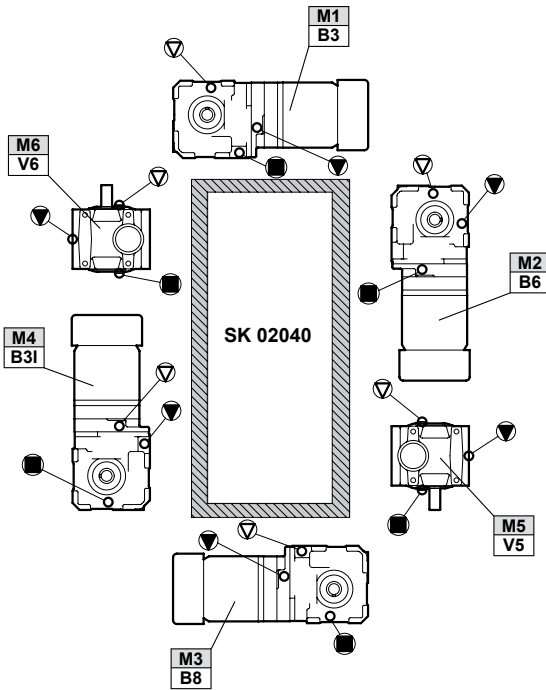
U14500 - 1 of 2

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 minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.

Foot Mount

Shaft/Flange Mount

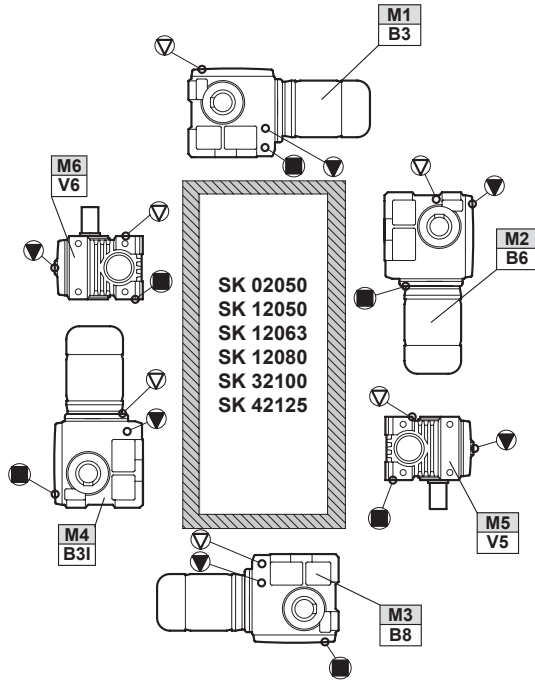




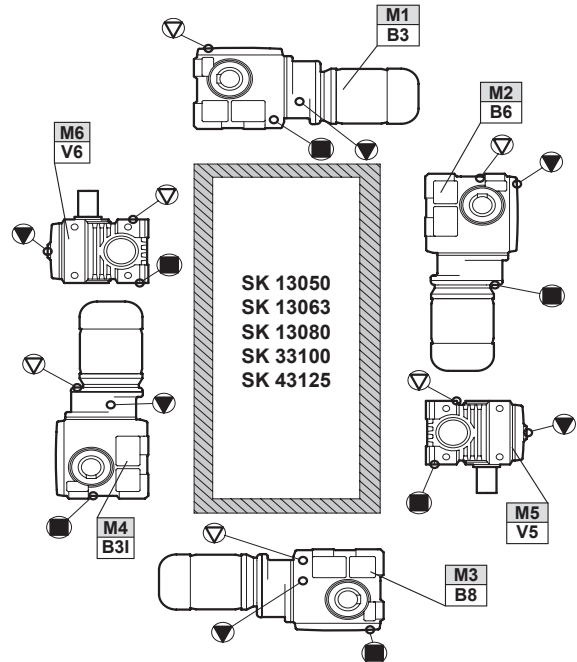
HELICAL-WORM OIL PLUG & VENT LOCATIONS



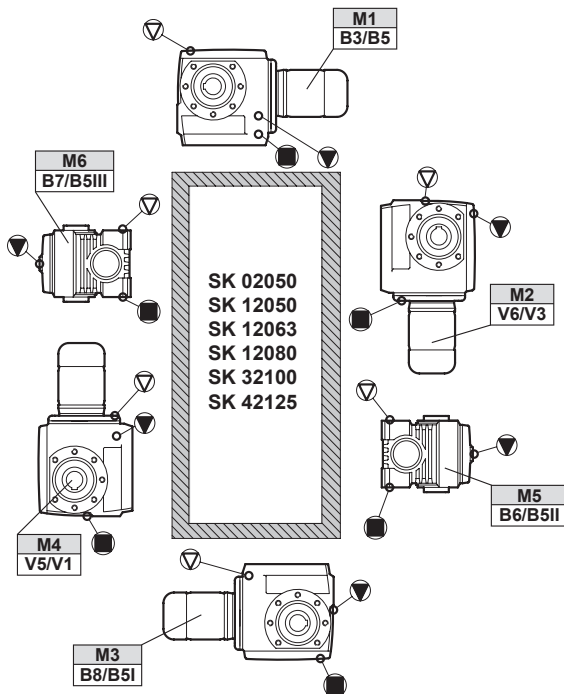
Foot Mount



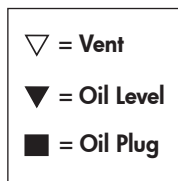
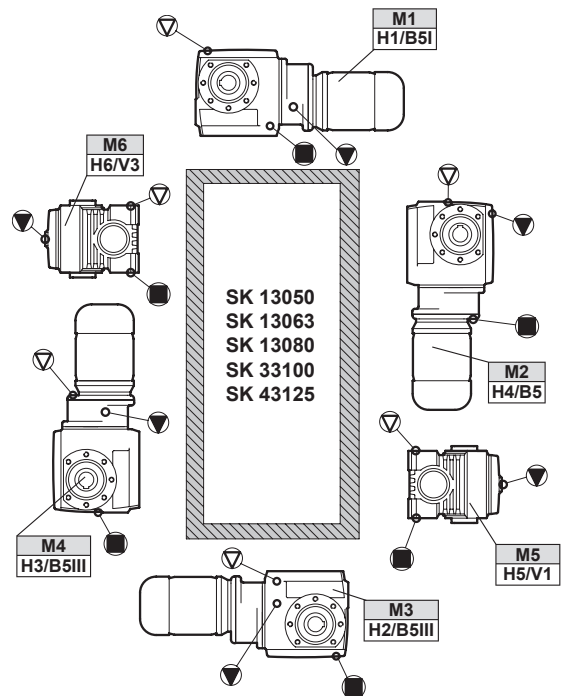
Foot Mount



Shaft/Flange Mount



Shaft/Flange Mount





FLEXBLOC™ (SI/SID SERIES) WORM GEAR OIL PLUG & VENT LOCATIONS



DRIVESYSTEMS

RETAIN FOR FUTURE USE

U14800 - 1 of 1

Vent locations

FLEXBLOC™ (SI/SID SERIES) reducers are fitted with oil plugs to allow for optional venting of the gear unit. NORD can supply either an AUTOVENT™ (valve-type) vent or an open vent. Vent options are available for most gear unit sizes and positions as indicated by the table below. For more complete details on vent options and when to consider reducer venting, see user manual U10810.

Vent Compatibility by Unit Size & Mounting Position

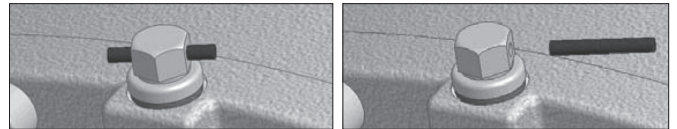
	M1	M2	M3	M4	M5	M6
SI/SID 31		✓	✓	✓		✓
SI/SID 40		✓	✓	✓		✓
SI/SID 50	✓	✓	✓	✓		✓
SI/SID 63	✓	✓	✓	✓	✓	✓
SI/SID 75	✓	✓	✓	✓		✓

Continuous Input speed ≤ 1800 rpm

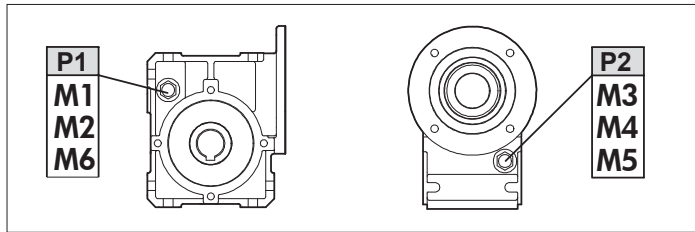
Vent Kit Part Numbers

Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	66093510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a separate part number, vent kits include the housing gasket



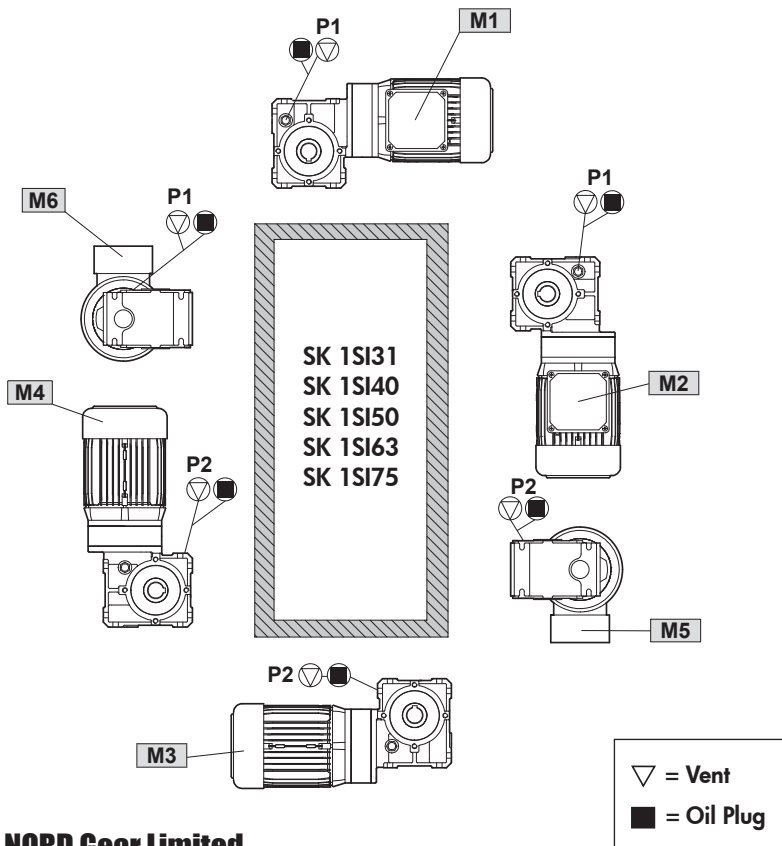
Optional Vent Locations



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.

FLEXBLOC™ (SI Series) Universal Housing



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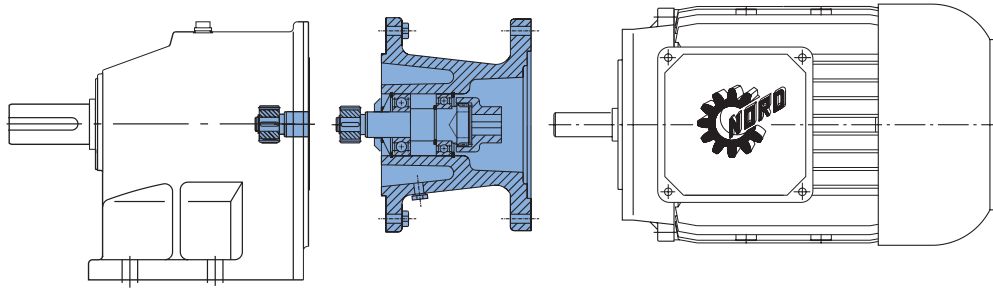
Troubleshooting

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 align 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.

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 it 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



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 and activation instructions, refer to user manual U45200. Motor adapter option AI and AN do not utilize an Automatic Lubricator and are lubricated for life.

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



DRIVESYSTEMS

RETAIN FOR FUTURE USE

U45100 - 2 of 5

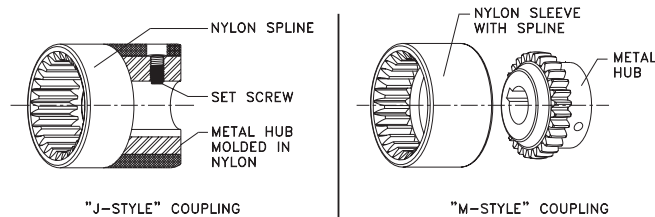
Couplings for the NEMA and IEC Adapters

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		Input Adapter Sizes	Bore Size
	Cont.	Peak		
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

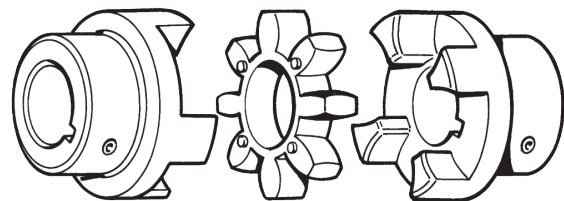
BoWex® Couplings Mechanical Ratings "M" Style (NEMA & IEC)

Coupling Type	Rated Torque		Input Adapter Sizes	Bore Size
	Cont.	Peak		
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 (HytreI) 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		Input Adapter Sizes	Bore Size
	Cont.	Peak		
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		Input Adapter Sizes	Reducer Input Flange	Bore Size
	Cont.	Peak			
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.

NORD Gear Limited

Toll Free in Canada: 800.668.4378

NORD Gear Corporation

Toll Free in the United States: 888.314.6673

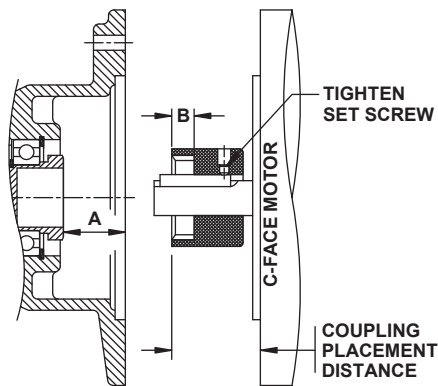


NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS



"J" Style Coupling NEMA C-face Motor Installation

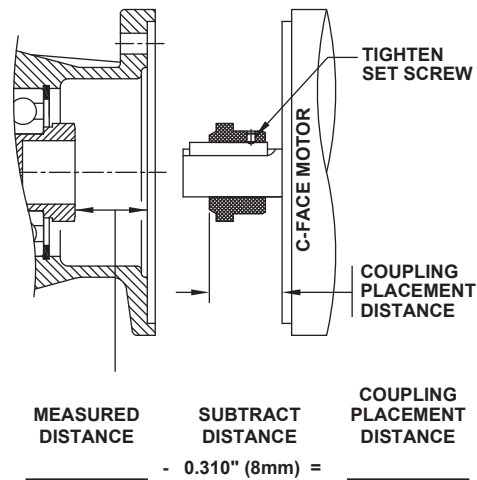
1. Measure the distance from the face of the input adapter to the face of the splined shaft and record that measurement as "A" in the equation below.
2. Measure depth of coupling engagement zone and record the measurement as "B" in the equation below.
3. Add "A" + "B" and subtract 0.08" (~2mm) from the 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	SUBTRACT DISTANCE	COUPLING PLACEMENT DISTANCE
A + B	- 0.080" (2mm) =	
+		
<hr/>		

"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) =	
<hr/>		

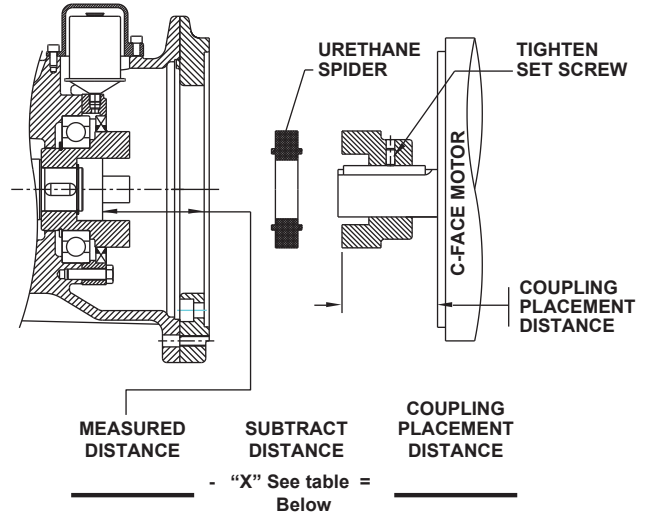


NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS



“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!

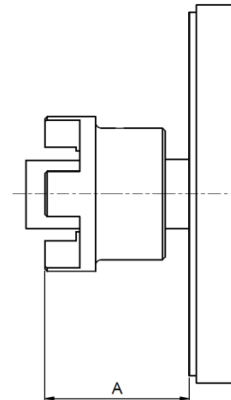
2. For the attachment of the coupling half, heat up the coupling half to approx. 212°F (100°C). Position the coupling half as follows:
 - Push AI160, AI180 and AI225 on to the spacer bushing.
 - Push AI200, AI250, AI280 and AI315 on to the motor shaft collar.
 - AN250TC–AN400TC until dimension A has 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.

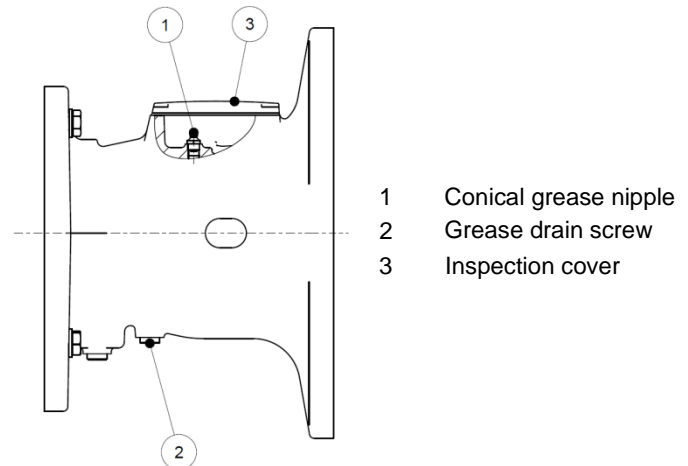
Motor Parallel Keys			
IEC/NEMA Type	Coupling	Shaft ø	Motor Shaft's Key
AI 160	R42	42 mm	12x8x45 mm
AI 180	R48	48 mm	14x9x45 mm
AN 250	R42	1.625 in	3/8x3/8x1 1/2 in
AN 280	R48	1.875 in	1/2x1/2x1 1/2 in
AI 200	R55	55 mm	16x10x50 mm
AN 320	R55	2.125 in	1/2x1/2x1 1/2 in
AI 225	R65	60 mm	18x11x70 mm
AN 360 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.



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 cm³ or 120 ml (4.8 oz) of grease. For reference, a single stroke of a typical grease gun delivers approximately 1.0-1.2 cm³ (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.

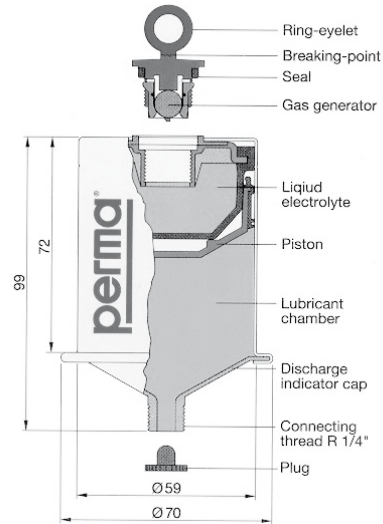


Figure 1 - PERMA® Automatic Lubrication Canister

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

- Loosen and remove the M8x16 assembly socket head cap screws (1251).
- Carefully remove the protective cover (1252) installed over the automatic lubricator (1250-1).
- Screw the activation screw (1250-2) into the automatic lubricator (1250-1) and twist the ring-eyelet until it reaches its breaking point.
- Re-fit the cartridge cover (1252) and re-install and tighten the assembly screws (1251).
- Mark the activation date on the adhesive label that is provided.

Figure 2 - Activating the Automatic Lubricator

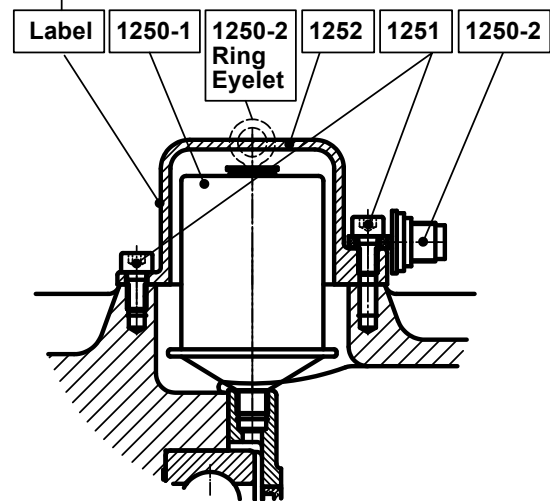
Attention!

Screw in the activation screw until the lug breaks off before commissioning the gear unit.

Dispensing time: 12 Months

Activation Date

Month	Year
1 2 3 4 5 6 7 8 9 10 11 12	11 12 13 14 15



- 1250-1 Automatic Lubricator
- 1250-2 Activation Screw
- 1251 Socket Head Cap Screws
- 1252 Protective Cover

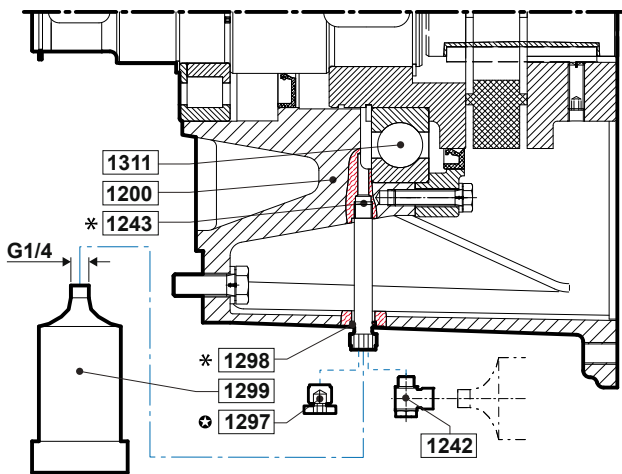
Grease Purge and Grease Drain Cup

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



NEMA OR IEC INPUT ADAPTER WITH GREASE FITTING



DRIVESYSTEMS

RETAIN FOR FUTURE USE

U45255 - 1 of 1

Application

NORD gear units listed in the table below that are supplied with a NEMA 250TC or IEC 160 and larger input adapter, may be supplied with an external grease fitting. The grease fitting allows the user to service the outboard bearing of the reducer's input assembly

Helical Inline	SK62, SK72, SK73, SK82, SK83, SK92, SK93, SK102 and SK103
Parallel-Shaft CLINCHER™	SK6282, SK7282, SK7382, SK8282, SK8382, SK9282, SK9382, SK10282, SK10382, SK11282, SK11382 & SK12382
90.1 Series Helical-Bevel	SK9072.1, SK9082.1, SK9086.1, SK9092.1 & SK9096.1

The grease fitting is an option which must be specified upon ordering, otherwise NORD will normally supply a PERMA Automatic Lubricator (See User Manual U45250).

Factory Supplied Grease

The bearing grease applied at the factory is as follows:

Brand	Mobil, Mobilith SHC220
Thickener	LI-Complex
NLGI Grade	2
Temperature Range	40°C to 120°C (-40°F to 250°F)



IMPORTANT NOTE

It is the user's responsibility to ensure that if replacement grease is used, that it is fully compatible with the factory supplied grease.

Service Instructions



WARNING

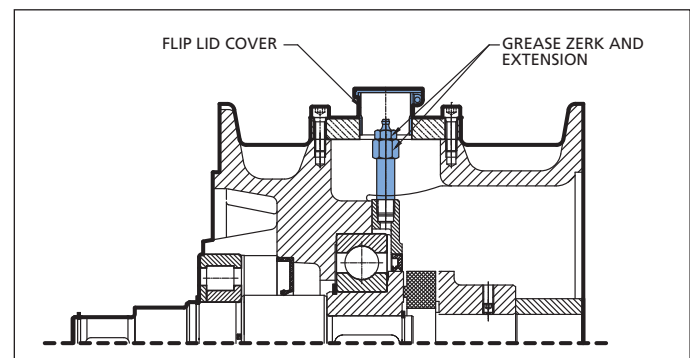
- While working on the gear drive system, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!
- Surfaces of motors and gear units may become hot during operation or shortly after start-up. In some instances additional protection against accidental contact may be necessary. Use caution to avoid burns or serious injury!

1. It is best to re-grease the bearing within a short period after the gear unit was operational because the old grease will be more viscous and will flow easier.
2. Ensure that the grease gun contains the right lubricant for the bearing to be re-greased.
3. Open the protective flip cover and clean the areas around the grease fitting to ensure that contaminants are not introduced into the bearing cavity.
4. Using a grease gun, apply 0.75 ounces (20-25 grams) of compatible bearing grease every 2,500 service hours.



IMPORTANT NOTE

Re-greasing should be carried out while the bearing is still warm from operation and/or while rotating (if it is safe).





Cone Drive Gear Units for Flow Series Open Tank Mixers



FWS SERIES

LUBRICATION, INSTALLATION, OPERATION, & MAINTENANCE INSTRUCTIONS FOR STAINLESS STEEL CONE DRIVE SPEED REDUCERS

Cone Drive double-enveloping worm gear speed reducers are used throughout industry to provide smooth and quiet speed reduction. When properly selected, applied and maintained, they will provide optimum performance.

IMPORTANT: In any applications of Cone Drive Products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a failsafe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

THE FOLLOWING INFORMATION IS FOR YOUR PROTECTION. PLEASE READ CAREFULLY.

1. Do not attempt to install or operate this reducer until these instructions are read and thoroughly understood. If you have any questions, please contact Cone Drive.
2. The horsepower or output torque capacity of this reducer and the service factor (maximum allowable operating cycle) are documented in the product catalog. These values are not to be exceeded as overloading can result in reducer failure. Exceeding the rating and duty cycle will void the warranty. Please contact Cone Drive with any questions regarding rating and service factors.
3. Do not alter the reducer without approval from Cone Drive.
4. This reducer has moving mechanical components and connected electrical devices, operating under high voltage to achieve its intended purpose. Operation and repair should only be done by qualified personnel.
5. Before servicing a speed reducer, the main electrical disconnect must be moved to and locked in the off position. The person performing the work should post on that disconnect a warning to others not to turn on the power.
6. It is normal for the reducer to operate at a housing temperature of up to 200°F. To prevent burns, proper guards or shields should be provided by the purchaser or user to prevent personnel from touching the reducer.
7. Cone Drive products are furnished without guard covers. It is the responsibility of the purchaser or user to provide guards for all exposed shafting, couplings, sprockets, sheaves, belts, chains, clutches, and any other moving parts in accordance with current local, state, and federal requirements.
8. Failure to follow the instructions contained in this bulletin may result in unit failure, property damage or personal injury.

INSTALLATION

1. The speed reducer must be securely mounted to a rigid foundation or base plate, flat enough to mate with the underside of the reducer housing to prevent creating an unsanitary trap.
2. Bolt the reducer to the foundation or mounting base using metric bolts that correspond to the threaded holes in the reducer housing. Be sure to use a bolt in all available threaded mounting holes. Mount the reducer using bolts of minimum SAE Grade A2, Property Class 70, 304 Stainless Steel.
3. Couplings, sheaves and sprockets should be mounted on the reducer shafts carefully. Do not pound or hammer them onto the shafts as this will damage bearings and oil seals. Angular and axial alignment of the output shaft to the rotating machine interface is critical to prevent premature output seal leaks.
4. Sprockets and sheaves should be mounted as close to the reducer as possible and “V” belts and chains adjusted to the proper tension to keep bearing loading and shaft deflection to a minimum. Too much tension in belts and improper location of sheaves and sprockets will lead to excessive chain pull, bearing wear and shaft deflection. For specific information on chain pull capacity, shaft stress and bearing life please contact Cone Drive.
5. Before starting motor review motor rotation, reducer rotation and required direction of driven machine to ensure that the motor is wired for proper direction of rotation. In many instances a machine must run in one direction and failure to wire the motor properly can result in damage to the driven machine.
6. **Note: only use the approved lubricants if oil level top-off is necessary, as the factory filled PAG oil is not compatible with other oil types.** Stainless steel speed reducers ship factory filled with oil and grease. For lubrication guidelines, see the Approved Lubricants and Lubrication Quantities tables in the maintenance section.
7. The speed reducer must be securely mounted to a rigid flat foundation or base plate, either directly to the speed reducer or via the provided mounting feet. **Note: stainless steel speed reducers are built for universal mounting, ready to mount in any position.**

START-UP

1. After the reducer has been properly mounted, aligned and lubricated, it is ready for startup.
2. Make sure driven machine is clear of all obstructions and all safety guards and covers are in place, according to appropriate local, state, and federal requirements. If possible, turn motor shaft by hand to confirm drive system is operating freely and in correct direction of rotation.
3. Jog motor to confirm proper rotation.
4. Operate reducer with minimum load for approximately 15 minutes (in both directions if applicable) to seat gears, bearings, and oil seals

OPERATION

1. All reducers require a few hours of “run-in” under load to achieve optimum efficiency. During this initial run-in the reducer will probably run warmer than normal and draw more current than after the run-in period. Reducers operating at a very low load or speed will take much longer to run-in and even if operated continuously at low load or speed may never achieve the efficiency that they would if operated at or near their catalog rating.
2. **IMPORTANT:** Normal reducer operating temperature measured at the oil sump area of the housing should not exceed 200°F. Excessive oil sump temperature is indicative of overloading, misalignment, or improper or marginal lubrication. Continuous operation of the reducer with the oil sump temperature above 200°F will result in premature breakdown of the oil and reduce the useful life of the reducer or result in premature failure

MAINTENANCE

1. All reducers and foundation bolts should be checked for tightness after three (3) months of service and annually thereafter.
2. If a reducer is to be repaired, contact Cone Drive for detailed instructions, drawings, parts lists, etc. If it is necessary, field service is available.
3. If a reducer is to be returned, contact Cone Drive for instructions and a return material authorization (CASE) number.

LUBRICATION

Stainless steel reducers are factory filled with a high-quality food Grade synthetic lubricant. They are “Lubricated for Life” and require no routine maintenance in service. In the event of a major overhaul involving strip-down and reassembly of the gear unit, refer to Table 1 for a list of approved lubricants. Lubricant quantities are given in Table 2.

If switching to the alternative lubricant, care should be taken to thoroughly flush out all the old lubricant before filling with new lubricant. Mixing of different lubricants can result in degraded performance or failure.

The Polyalkylene Glycol based synthetic lubricants listed in Table 1 are suitable for ambient temperatures of -10°F to 200°F (-23°C to 93°C); outside of the listed range, please contact our Application Engineers.

Table 1 Approved Lubricants

SUPPLIER	OIL SUPPLIERS' CORRESPONDING DESIGNATIONS	ISO VISCOSITY GRADE/POUR POINT
Kluber Lubrication	Klubersynth Synthetic UH1 6-460	460 (-22°F, -30°C)
Exxon Mobil Corporation	Synthetic Glygoyle 460	460 (-27°F, -33°C)

Table 2 Lubricant Quantities (applicable for all mounting positions)

SUPPLIER	SIZE										
	F039		F044		F050		F060		F076		
Ratio	< 60:1	> 60:1	< 60:1	> 60:1	< 60:1	> 60:1	< 60:1	> 60:1	< 60:1	> 60:1	
Oil Capacity	Quarts	0.36	0.44	0.39	0.5	0.5	0.65	0.56	0.7	1.4	1.85
	Liters	0.34	0.42	0.37	0.47	0.47	0.62	0.53	0.66	1.32	1.75

LUBRICATION

Cone Drive stainless steel speed reducers are fully corrosion resistant with an electro-polished coating which does not require a rust inhibitor. For extended storage periods of up to one year, rotate the worm and gearshaft every 90 days to keep the seals from sticking to the shaft. For storage periods exceeding one year, purchase a spare set of oil seals to have on hand in case of leaking at start-up.

AMBIENT TEMPERATURE

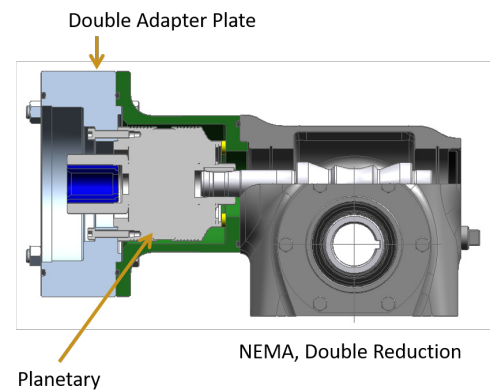
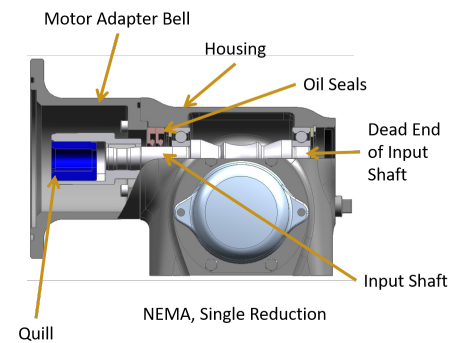
The oils shown in the Approved Lubricants table are for use in an ambient temperature range of approximately -10°F to 200°F with the low end of the range depending on the pour point of the specific oil used. If the ambient temperature will be below or above this range, please contact Cone Drive for specific recommendations on proper lubricant as well as proper oil seal materials

Lubrication is very important for successful operation of Cone Drive gearsets and speed reducers. Please review these lubrication recommendations and maintenance guidelines, as inadequate lubrication can result in increased power consumption, added maintenance, and gearset failure. Cone Drive recommends only the listed lubricants as the use of other lubricants can result in gearset failure food grade standards.

OIL SEAL REPLACEMENT INSTRUCTIONS

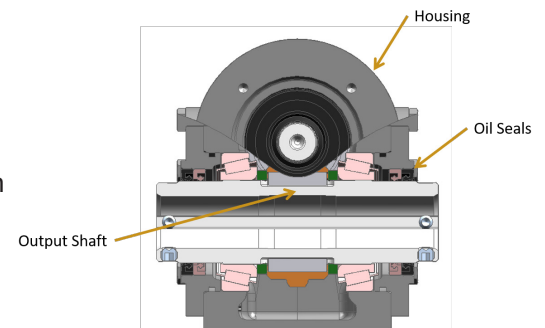
IF THE INPUT OIL SEALS REQUIRE REPLACEMENT

- Uninstall reducer
- Drain lubricant from reducer
- Remove exterior components (motor, adapter plate, motor bell, etc.)
 - Adapter Plate Removal (all motors)
- Tap each side of adapter plate using a brass hammer. leave planetary connected to adapter plate.
- Detach motor adapter bell
 - Quill removal
- 56c-143/145tc: M62 quill
- Detach motor adapter bell
- Use 2/3 jaw gear puller to remove quill
- 182/184tc: M66 quill
- Use 2/3 jaw gear puller to remove quill
- Detach motor adapter bell
- Remove seals
 - Be careful not to scratch housing or shaft, or create fragments that could enter reducer as damage or penetration could result in potential leaks and failure
- Install replacement seals
 - Press-up seals evenly and carefully to avoid damage to the seal and reducer components
- Re-press quill onto input shaft (single reduction only)
 - Dead end of shaft must be reacted to avoid damage to reducer components
 - For single-extended shafts the bore plug must be removed to support the shaft, then reinstalled
- Double reduction, re-install adapter plate with planetary
- Flush and refill the reducer with an approved lubricant (see Lubrication Table 1 and 2)
- Reattach motor adapter bell
- Reinstall reducer



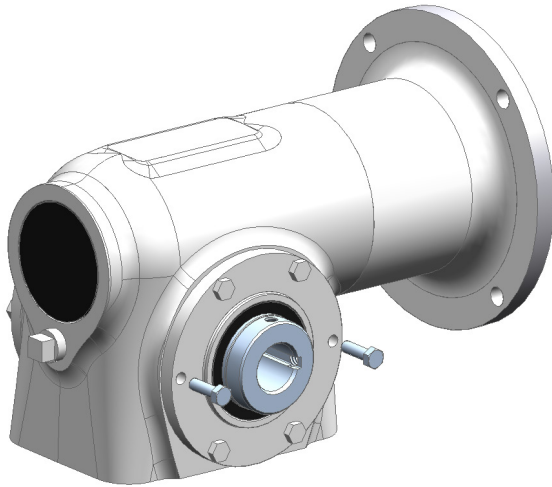
IF THE OUTPUT OIL SEALS REQUIRE REPLACEMENT

- Uninstall reducer
- Drain lubricant
- Remove exterior components (output flange)
- Remove seals
 - Be careful not to scratch housing or shaft, or create fragments that could enter reducer as damage or penetration could result in potential leaks and failure
- Install replacement seals
 - Press-up seals evenly and carefully to avoid damage to the seal and reducer components
- Flush and refill the reducer with an approved lubricant (See table 1 and 2)
- Reattach exterior components
- Reinstall reducer



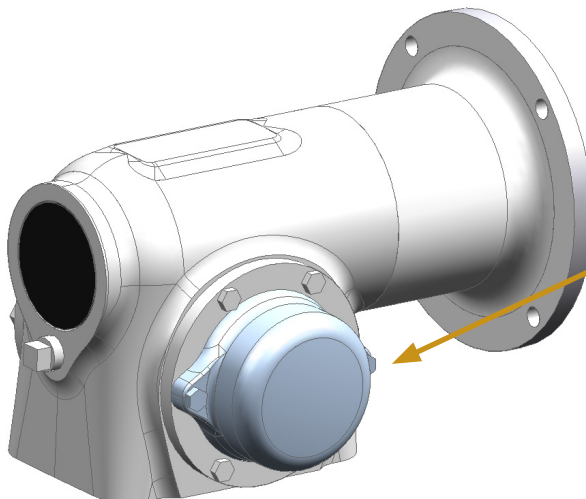
SHRINK DISC / HOLLOW SHAFT COVER ASSEMBLY

The shrink disc/hollow shaft cover is shipped loose and is to be assembled after the reducer is mounted and the customer's shaft (and shrink disc, if used) is assembled.



REMOVE ONLY TWO CAP BOLTS THAT ARE 180° APART ON THE SIDE OF THE HOUSING WHERE THE COVER WILL BE INSTALLED

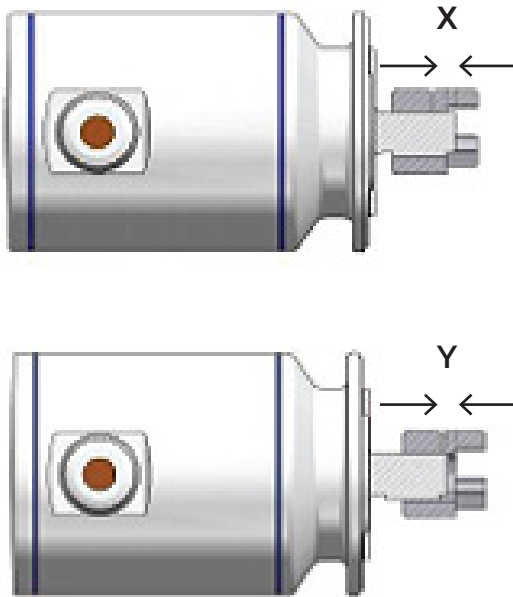
ENSURE THE O-RING IS PROPERLY SEATED IN THE GROOVE OF THE SHAFT COVER



MOUNT THE COVER. INSTALL THE LENGTHENED CARRIER BOLTS PROVIDED. TORQUE IN ALTERNATING PATTERN TO:
8 – 9.6 Nm (SIZE 39, 44, 50, 60)
19-23 Nm (SIZE 76)

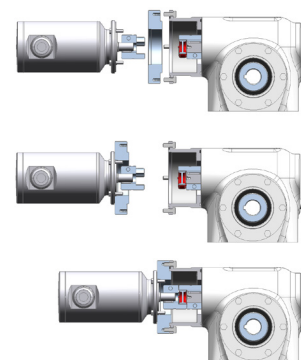
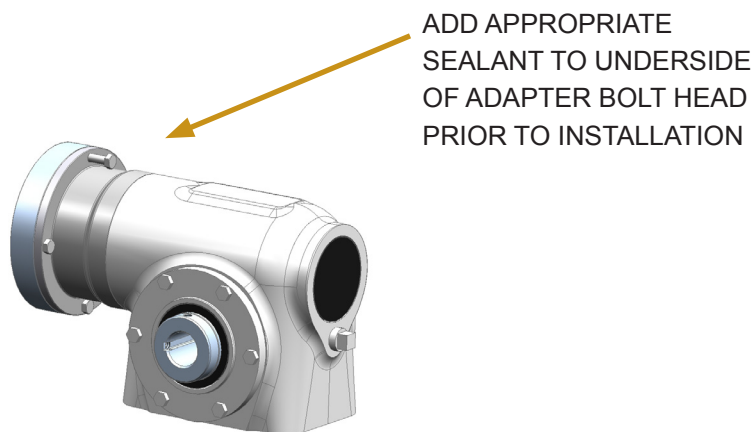
SERVO MOTOR INSTALLATION

- The coupling's three-piece design allows the hubs to be installed on each individual shaft, then joined axially.
- Mount the motor's coupling half on the motor shaft. Position to the dimension shown for the appropriate assembly.



Reducer Size	Kollmorgen	Allen-Bradley	"X" Shaft Protrudes Beyond Coupling Hub (mm)	"Y" Coupling Hub Extends Beyond Shaft (mm)	SetScrew Torque (Nm)	
39, 44, 50	AKMH3-ALL FACES			5.4	10.5	
	AKMH4-(BK, BN, DK, DN)		1.7		10.5	
	AKMH4-(AC, AN, CC, CN)			14.1	10.5	
	AKMH5-(AC, AN, CC, CN, GC, GN, HC, HN)			2.3	10.5	
	AKMH5-(BK, BN, DK, DN)		4.8		10.5	
	AKMH6-(AC, AN, CC, CN)				9.3	25.0
	AKMH6-(DK, DN)				7.4	25.0
		MPS-A/B 330P, VPH-(A1003F, B1001F, B1003F)			14.1	10.5
		VPH-(A0633F, B0632T, B0633M)			15.4	10.5
		VPH-A/B0753F			12.4	10.5
		MPS-A/B 4540F, VPH-B1304D, VPS-B1304D			2.3	10.5
		VPH - (A1152E, B1152F, A1153C, B1153E)			12.3	10.5
60	AKMH3-ALL FACES			5.4	10.5	
	AKMH4-(BK, BN, DK, DN)		1.7		10.5	
	AKMH4-(AC, AN, CC, CN)			14.1	10.5	
	AKMH5-(AC, AN, CC, CN, GC, GN, HC, HN)			2.3	10.5	
	AKMH5-(BK, BN, DK, DN)		4.8		10.5	
	AKMH6-(AC, AN, CC, CN)				9.3	25.0
	AKMH6-(DK, DN)				7.4	25.0
		MPS-A/B 330P, VPH-(A1003F, B1001F, B1003F)			14.1	10.5
		VPH-(A0633F, B0632T, B0633M)			15.4	10.5
		VPH-A/B0753F			12.4	10.5
		MPS-A/B 4540F, VPH-B1304D, VPS-B1304D			2.3	10.5
		MPS-B560F, VPH-B1653D, VPS-B1653			9.3	10.5
	VPH - (A1152E, B1152F, A1153C, B1153E)			12.3	10.5	
76	AKMH4-(BK, BN, DK, DN)		3.6		10.5	
	AKMH4-(AC, AN, CC, CN)			8.8	10.5	
	AKMH5-(AC, AN, CC, CN, GC, GN, HC, HN)		0.2		25.0	
	AKMH5-(BK, BN, DK, DN)		7.3		25.0	
	AKMH6-(AC, AN, CC, CN)				8.8	25.0
	AKMH6-(DK, DN)				6.9	25.0
		MPS-A/B 330P, VPH-(A1003F, B1001F, B1003F)			8.8	10.5
		VPH-A/B0753F			7.1	10.5
		MPS-A/B 4540F, VPH-B1304D, VPS-B1304D		0.2		25.0
		MPS-B560F, VPH-B1653D, VPS-B1653			6.8	25.0
		VPH - (A1152E, B1152F, A1153C, B1153E)			9.8	25.0

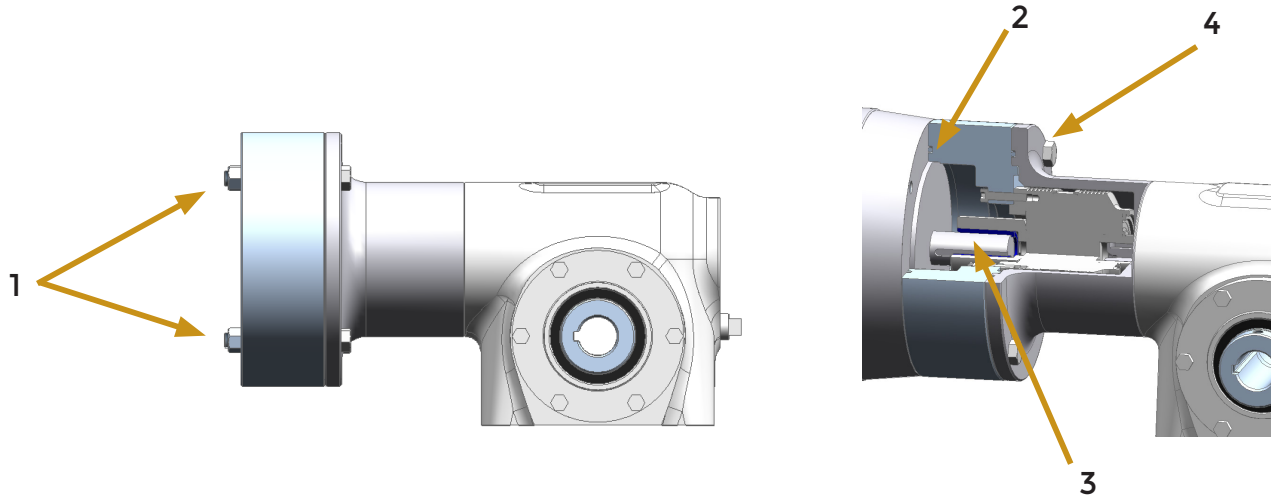
- For some motors (particularly face-mount motors), it will be necessary to remove the motor plate from the motor adapter.
- Fasten the plate to the motor, then mount the motor and plate back to the reducer.



MOUNT THE MOTOR'S COUPLING HALF ON THE MOTOR SHAFT. POSITION TO THE DIMENSION SHOWN FOR THE APPROPRIATE ASSEMBLY.

DOUBLE REDUCTION NEMA MOTOR INSTALLATION

1. Remove the nuts but keep the bolts that are between the motor adapter and motor bell
2. Insert O-Ring or apply gasket (182/184tc only) to motor adapter face
3. Align motor shaft and key with blue bushing and insert the motor
4. Tighten bolts

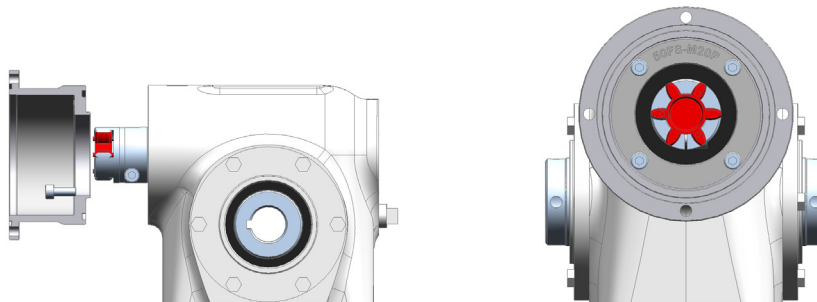


SERVO MOTOR INSTALLATION

IF IT IS NECESSARY TO REPOSITION THE COUPLING HALF MOUNTED TO THE GEARBOX

1. Remove the (4) M6 socket cap screws
2. Remove the motor adapter
3. Loosen and reposition coupling as required on previous page
4. Tighten the coupling setscrew.
5. Replace the motor adapter; tighten screws

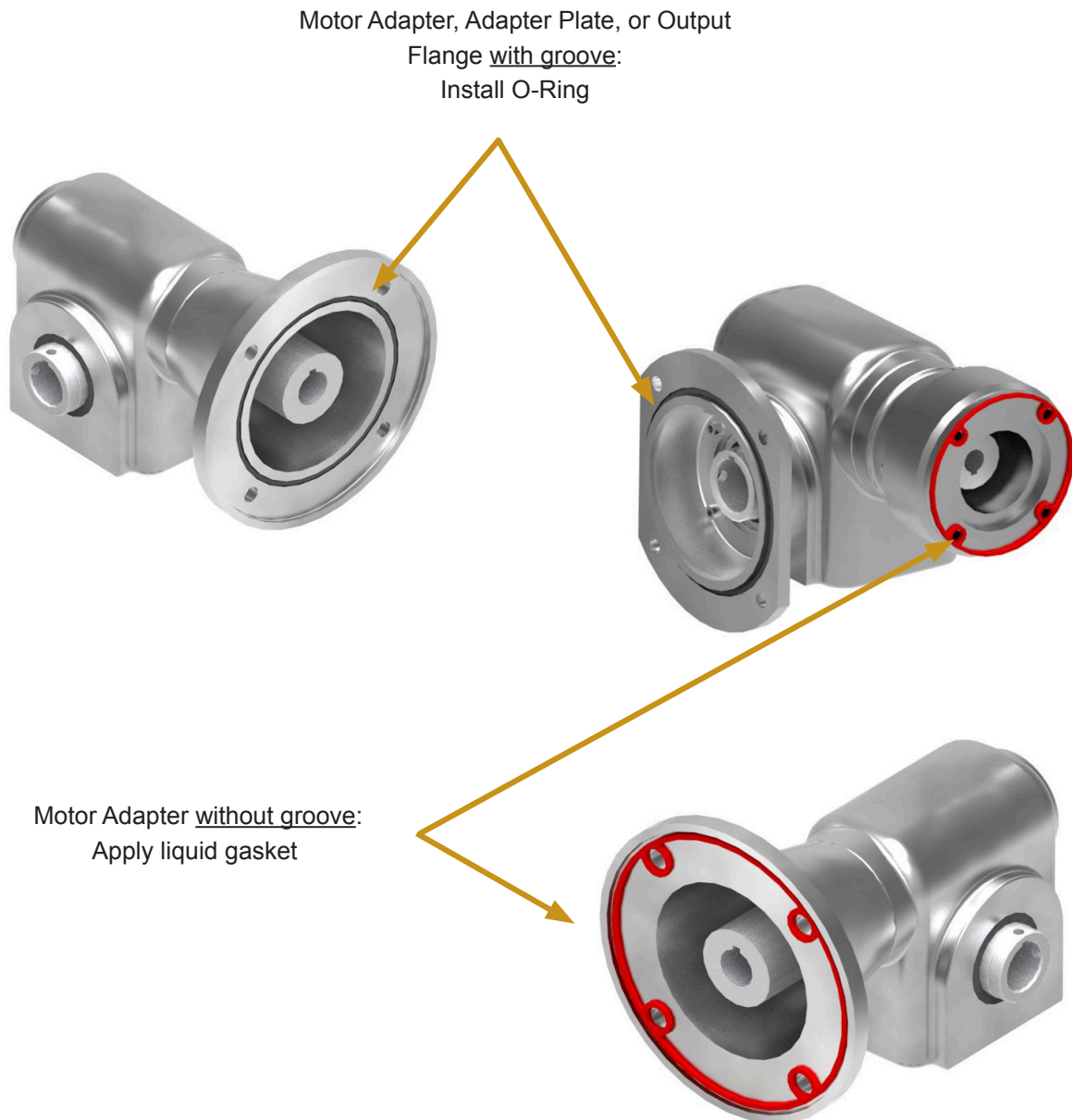
	SCREW TORQUES (Nm)	
	Standard Bolt	Stainless Bolt
M5	9.5-12	5-7
M6	16-20	8-9.6
M8	42-48	24-30
M10	---	38-46
1/4-20	10-14	---
5/16-18	---	24-29
3/8-16	33-54	27-40



DOUBLE REDUCTION NEMA MOTOR INSTALLATION

End user is responsible for sealing the motor and output flange interfaces. For flanges with O-ring grooves the reducer will be supplied with O-rings that are shipped loose. Install the O-ring in motor adapter groove or output flange groove prior to mounting the motor /reducer. Care should be taken to avoid damaging to the O-ring.

NEMA 182/184tc motor flanges and some servo motor adapters are supplied without O-ring grooves. For these, the end user must use a suitable liquid gasket. The gasket shall be applied as shown below (in red) around the bolt holes and pilot face prior to installing the motor.



SAFETY PRECAUTIONS

IMPORTANT: In any applications of Cone Drive Products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail-safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

THE FOLLOWING INFORMATION IS FOR YOUR PROTECTION. DO NOT ATTEMPT TO INSTALL OR OPERATE THIS GEARBOX UNTIL ALL OF THESE INSTRUCTIONS ARE READ AND THOROUGHLY UNDERSTOOD.

SELF-LOCKING

It is a common misconception that all worm gears are self-locking or non-overhauling. Actually, worm gear ratios up to 15:1 will overhaul quite freely. Ratios from 20:1 to 40:1 can generally be considered as overhauling with difficulty (particularly from rest). Ratios above 40:1 may or may not overhaul depending on loading, lubrication, and the amount of vibration present. Cone Drive cannot guarantee any worm gear ratio to be self-locking. There have been instances where single reduction ratios as high as 100:1 have overhauled. Therefore, it is not acceptable to rely on a worm gear to prevent movement in a system. Whenever a load must be stopped or held in place, a positive mechanical device must be incorporated into the system to prevent rotation of the gear set.

BACKDRIVING OR OVERHAULING

Applications such as wheel drives that require a brake on the motor or input shaft to decelerate a high inertial load require special attention to brake selection. Whenever possible, these applications should utilize freely overhauling ratios (15:1 or less). If self-locking ratios are used with a brake, the gear set can, under certain conditions, lock-up during decelerations and impose severe shock loading on the gearbox and driven equipment. Each reduction should be limited to 15:1 or less to allow the gearbox to overhaul. Contact Cone Drive for specific information on backdriving efficiency and brake selection.

RATINGS & SERVICE FACTORS

The horsepower or output torque capacity of this gearbox and the service factor (maximum allowable operating cycle) are documented in the product catalog. These values are not to be exceeded as overloading can result in gearbox failure. Exceeding the rating and duty cycle will void the warranty. Please contact Cone Drive with any questions regarding rating and service factors.

ALTERATION

Do not alter the gearbox without approval from Cone Drive.

OPERATION & REPAIR

This gearbox has moving mechanical components and may have connected electrical devices operating under high voltage. Operation and repair should only be done by qualified personnel.

PROTECTIVE GUARDING

Cone Drive products are furnished without guard covers. It is the responsibility of the purchase or user to provide guards for all exposed shafting, couplings, sprockets, sheaves, belts, chains, clutches, and any other moving parts in accordance with current local, state, and federal requirements.

LOCK-OUT/TAG-OUT

Before servicing a gearbox, the main electrical disconnect or other input power sources must be moved to and locked in the off-position. The person performing the work should post on that disconnect a warning to others not to turn on the power. Loads on the input and output shafts should be disconnected prior to working on the gearbox.

GEARBOX SURFACE IS HOT

It is normal for the gearbox to operate at temperatures up to and exceeding 200°F. To prevent burns, proper personal protective equipment, guards, or shields should be provided by the purchaser or user to prevent personnel from touching the gearbox.



Automation Direct Proximity Sensor



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

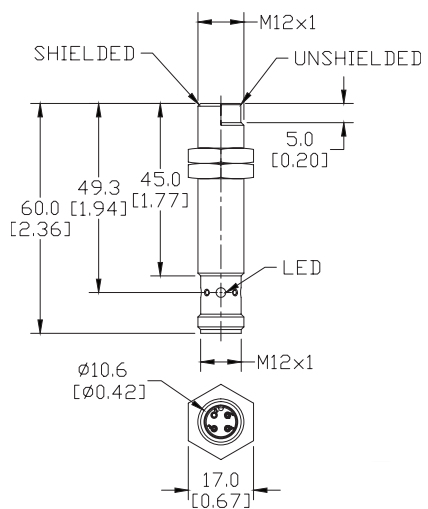
PN Series Specifications	M12 Models (PNM)	M18 Models (PNK)	M30 Models (PNT)
Mounting Type	Flush or Non-flush		
Nominal Sensing Distance	Flush: 4mm (0.16 in) Non-flush: 7mm (0.28 in)	Flush: 8mm (0.31 in) Non-flush: 12mm (0.47 in)	Flush: 15mm (0.6 in) Non-flush: 22mm (0.79 in)
Operating Distance	Flush: 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]

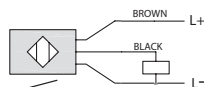
Figure 4



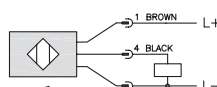
Wiring diagrams

Diagram 2

PNP Output

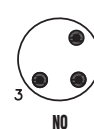


QC



Connector

M12 connector





Inverttek Drives VFD



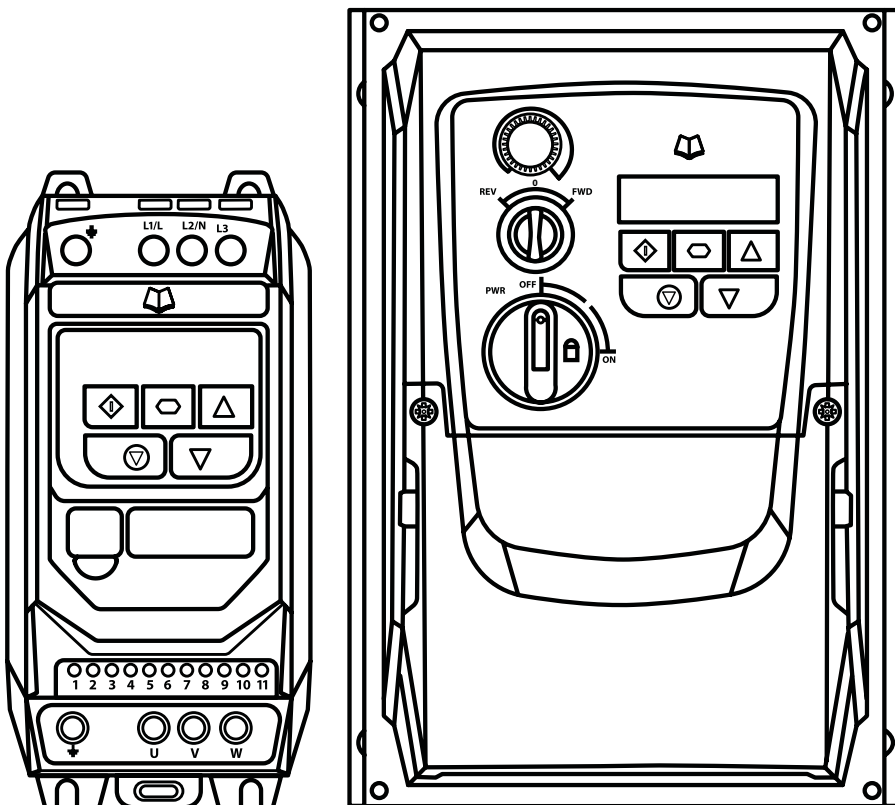
OPTIDRIVE™

Single Phase Output

IP20 & IP66 (NEMA 4X)

0.37 – 1.1kW (0.5 – 1.5HP)

110 – 230V



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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 wide 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.

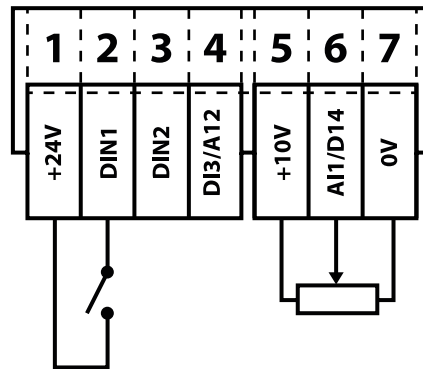
1.2. Quick Start Process

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

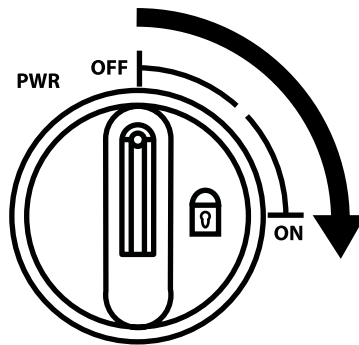
Quick Start – IP20 & IP66 Non Switched

- Connect a Start / Stop switch between control terminals 1 & 2
 - Close the Switch to Start
 - Open to Stop
- Connect a potentiometer (5k – 10kΩ) between terminals 5, 6 and 7 as shown
 - Adjust the potentiometer to vary the speed from P-02 (0Hz default) to P-01 (50 / 60 Hz default)



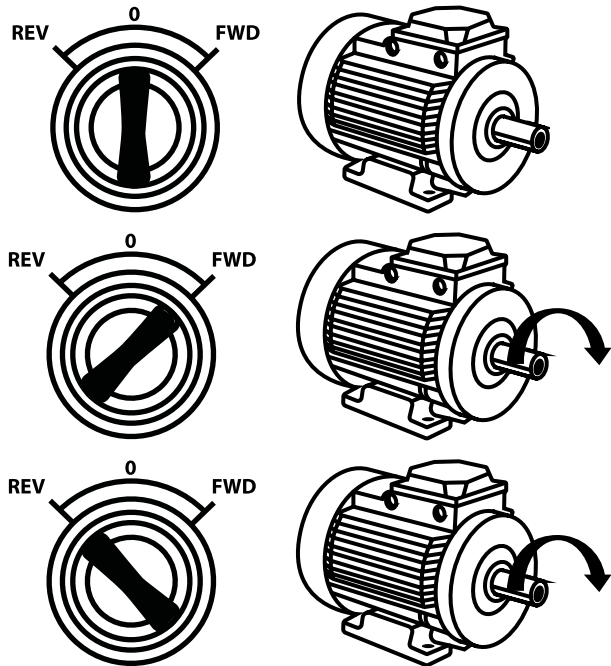
Quick Start – IP66 Switched

Switch the mains power on to the unit using the built in isolator switch on the front panel.

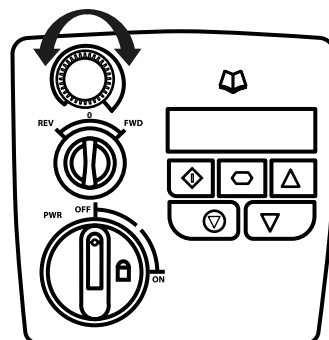


The OFF/REV/FWD will enable the output and control the direction of rotation of the motor.

NOTE: With single phase motors, forward rotation only is possible.



The potentiometer will control the motor shaft rotational speed.

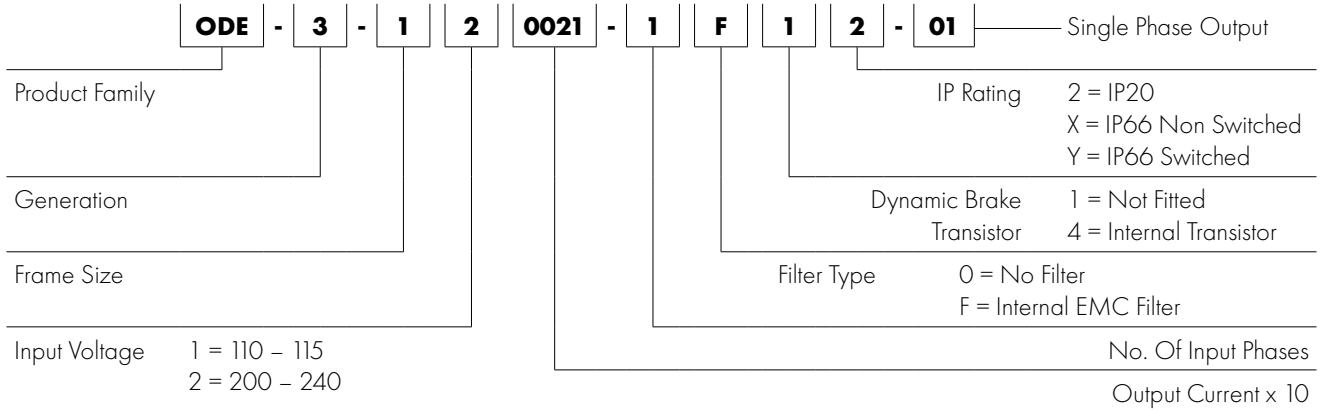


2. General Information and Ratings

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

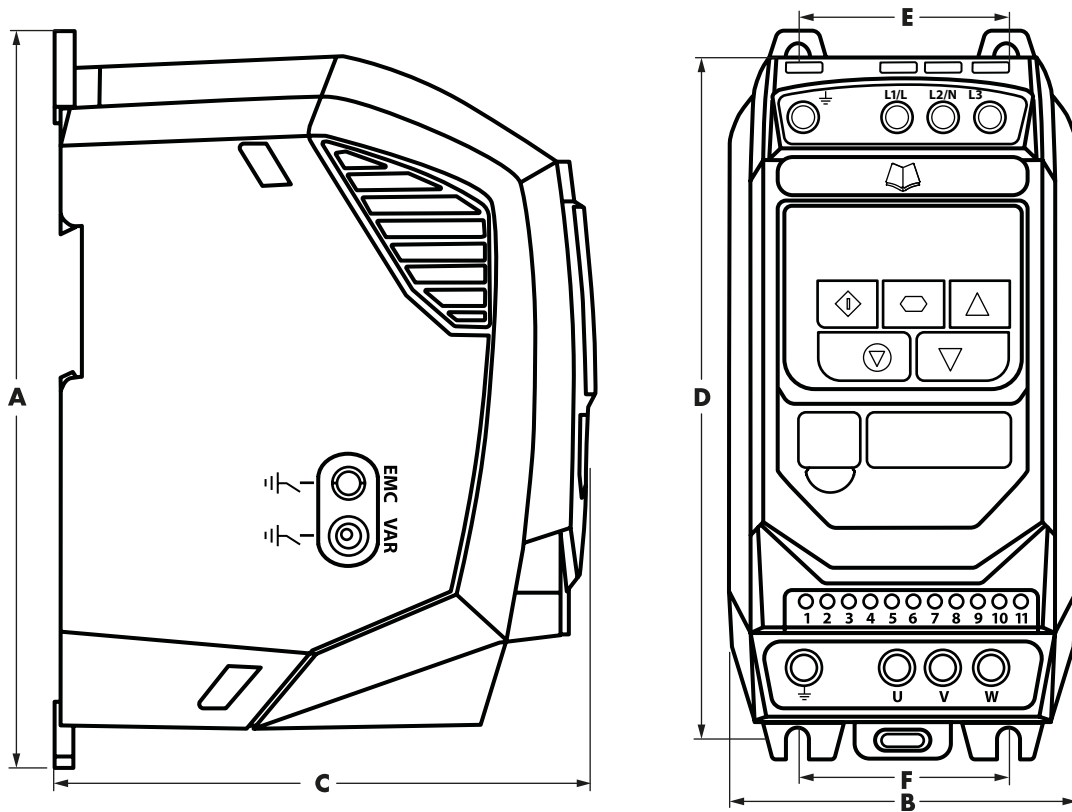
3.1. General

- 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)

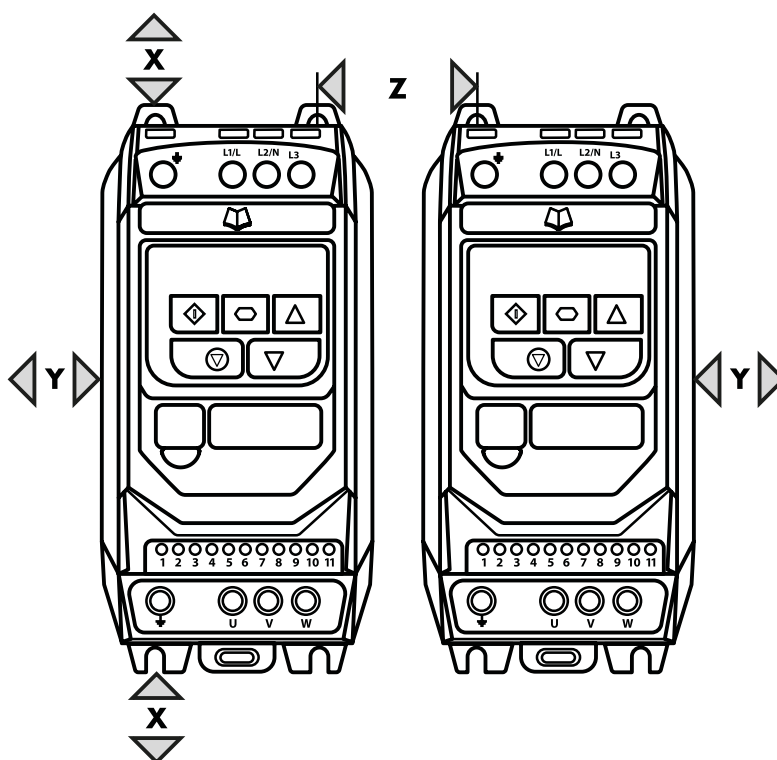




3.4. Guidelines for Enclosure Mounting – IP20 Units

- 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.

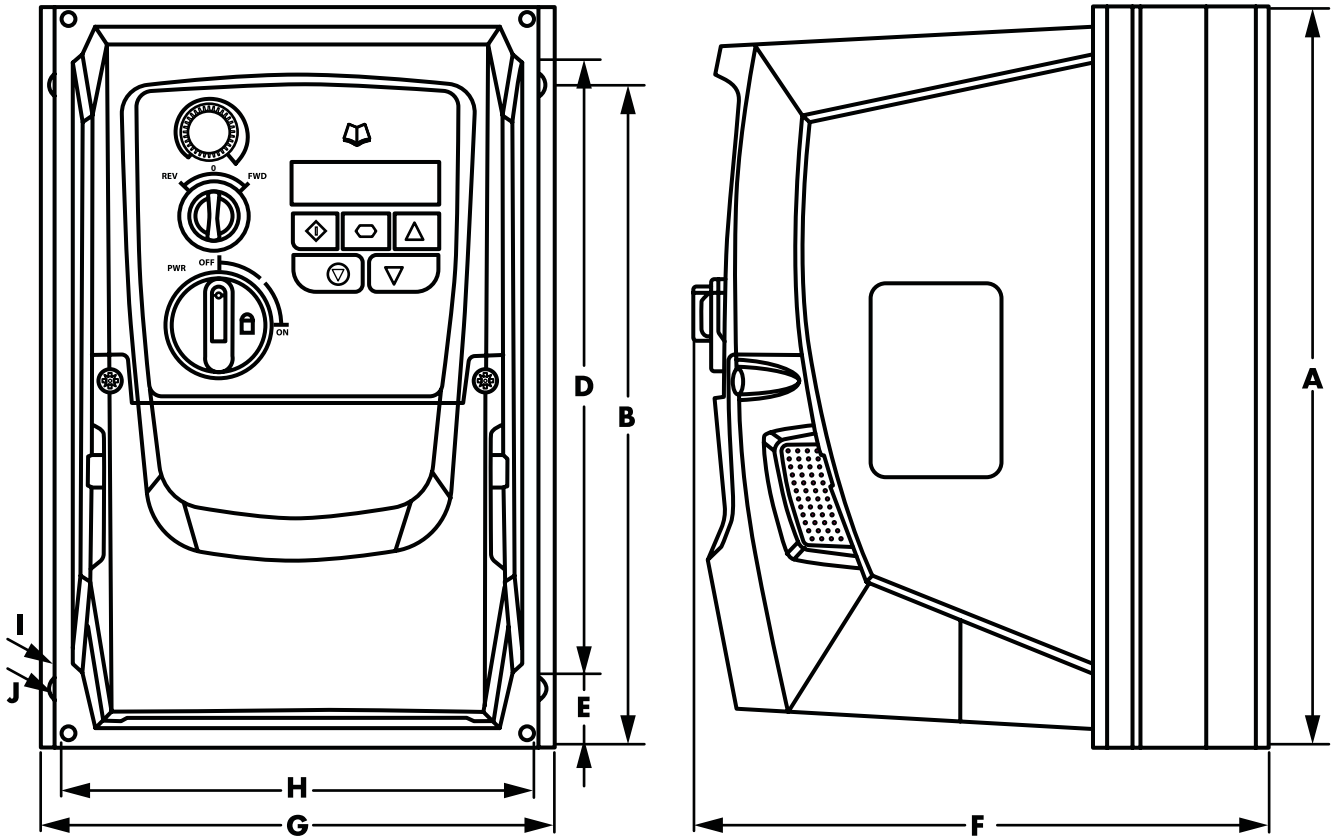
The enclosure design and layout should ensure that the adequate ventilation paths and clearances are left to allow air to circulate through the drive heatsink. Inverter Drives recommend the following minimum sizes for drives mounted in non-ventilated metallic enclosures:



Drive Size	X Above & Below		Y Either Side		Z Between		Recommended airflow CFM (ft ³ /min)
	mm	in	mm	in	mm	in	
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



Mechanical Installation

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	Mounting Bolts
All Frame Sizes	4 x M4 (#8)

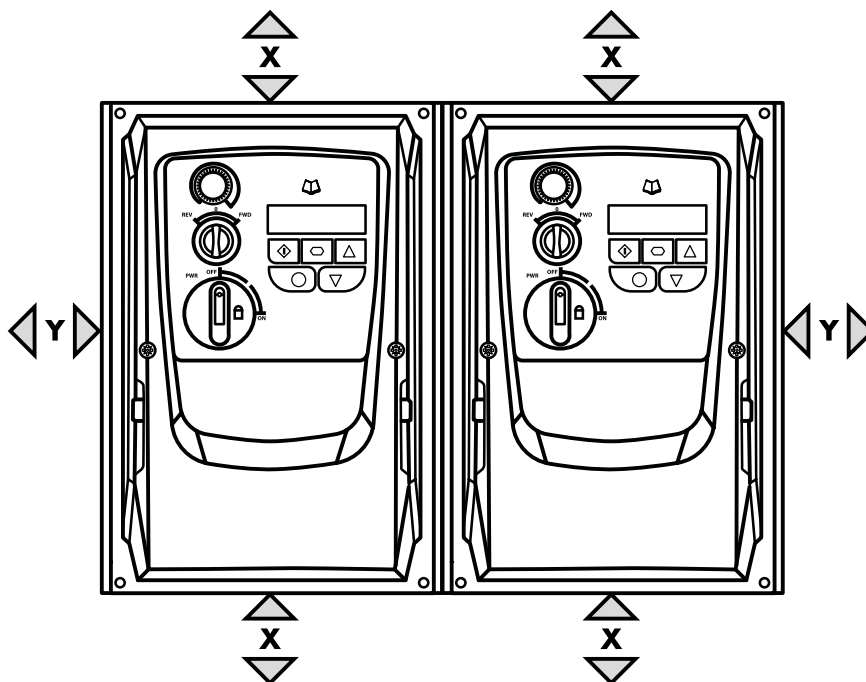
Tightening Torques

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		Drive Size	Cable Gland Sizes		
	mm	in	mm	in		Power Cable	Motor Cable	Control Cables
1	200	7.87	10	0.39	1	M20 (PG 13.5)	M20 (PG 13.5)	M20 (PG 13.5)
2	200	7.87	10	0.39	2	M25 (PG 21)	M25 (PG 21)	M20 (PG 13.5)

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:

Drive Size	Power & Motor Cables			Control & Signal Cables		
	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:

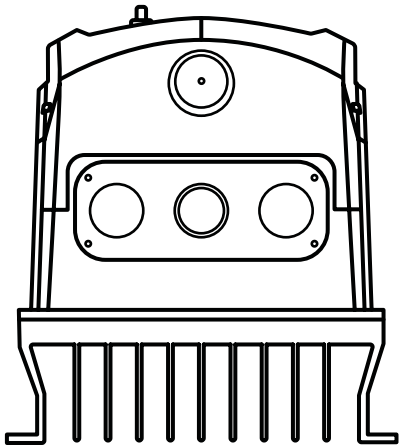
Drive Size	Drill Size	Trade Size	Metric
Size 1	28mm	¾ in	21
Size 2 & 3	35mm	1 in	27

- 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.

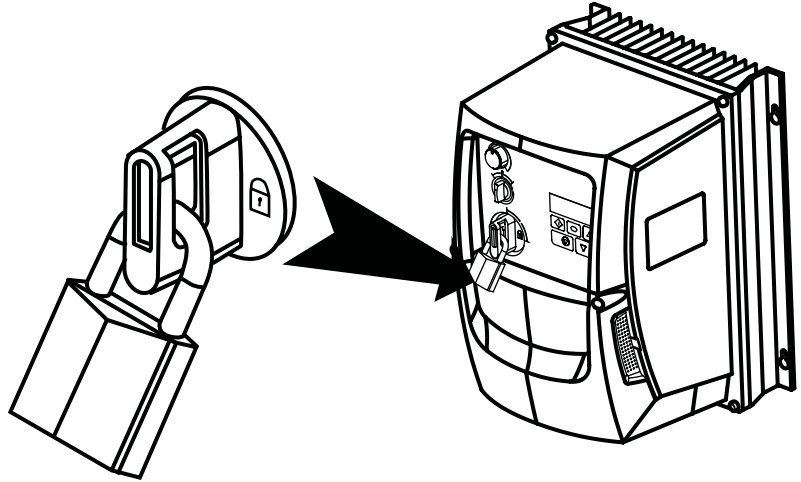
Power Isolator Lock Off

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

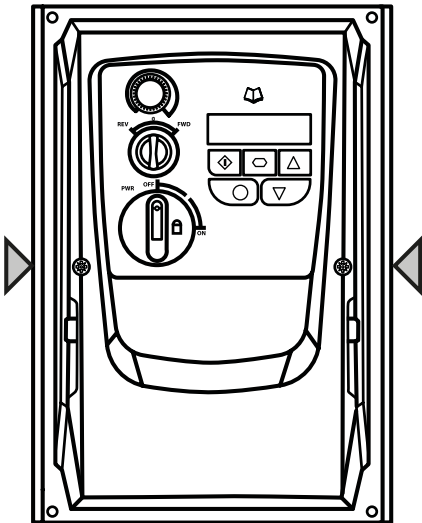


3.8. Removing the Terminal Cover

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:

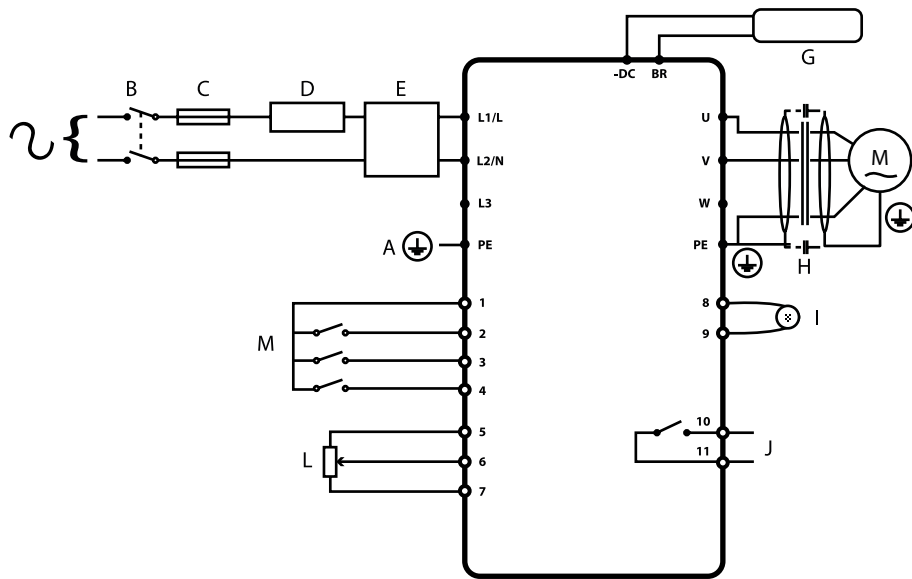
- Ambient temperature is at or below that set out in section 9.1. Environmental.
- Heat sink fans freely rotating and dust free.
- The Enclosure in which the drive is installed should be free from dust and condensation; furthermore ventilation fans and air filters should be checked for correct air flow.

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.

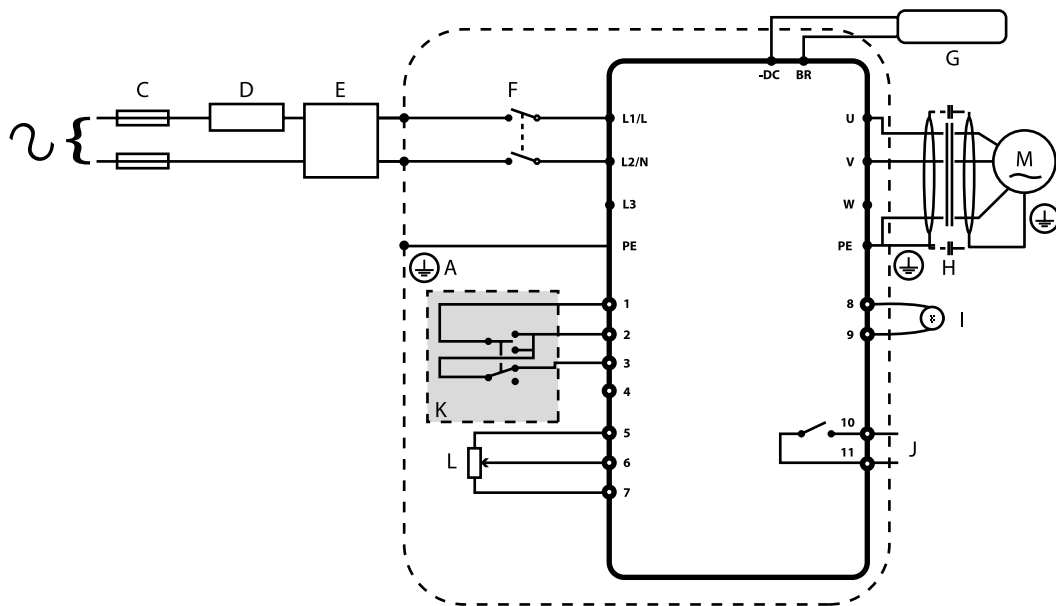
4. Power & Control Wiring

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 conform 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:
 - The incoming supply impedance is low or the fault level / short circuit current is high.
 - The supply is prone to dips or brown outs.
 - 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

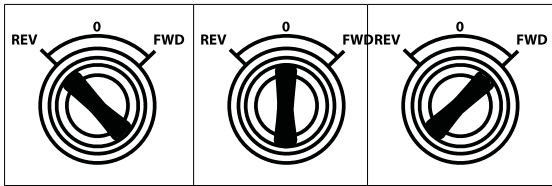
- All analog signal cables should be suitably shielded. Twisted pair cables are recommended.
- Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.
- Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be 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 from 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	
	3	Digital Input 2	"Logic 1" input voltage range: 8V ... 30V DC "Logic 0" input voltage range: 0V ... 4V DC	
	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
 - The output is a 0 – 10 volt DC signal, 20mA max load current.
- Digital Mode
 - 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.

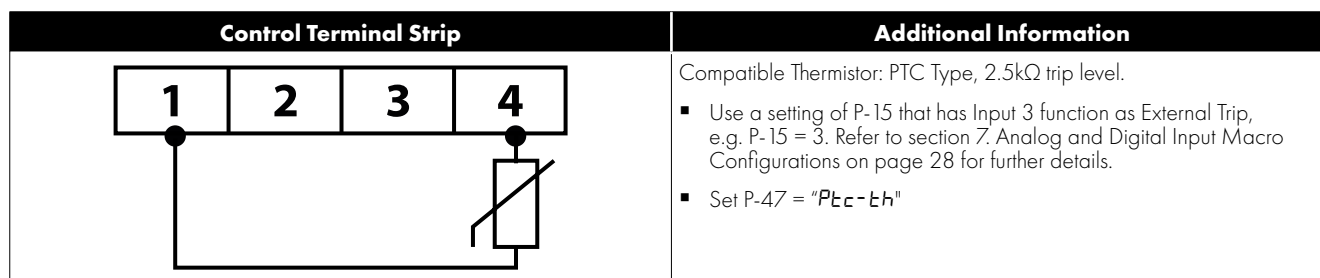
4.9. Motor Thermal Overload Protection

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:



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}		1M / 5M ⁷
C2	Shielded ²	Shielded ^{1,5}	Shielded ⁴	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.


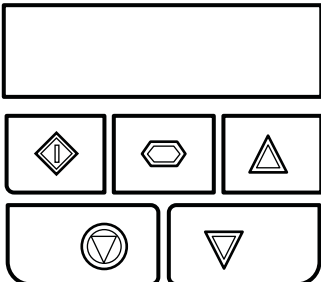




Allow a minimum of 10 minutes discharge after power off before attempting any connection to these terminals.

Suitable resistors and guidance on selection can be obtained from your Invertek Sales Partner.

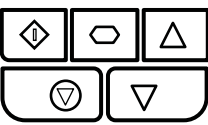
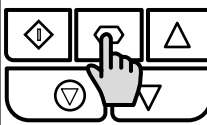
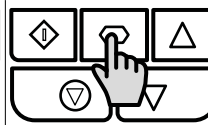
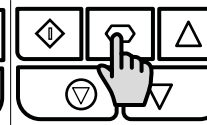
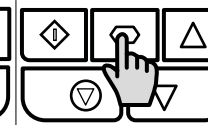
5. Operation

5.1. Managing the Keypad

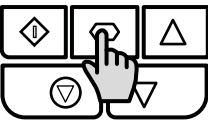
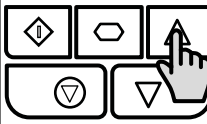
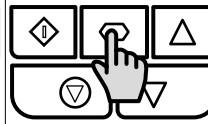
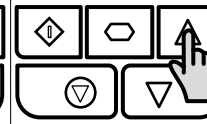
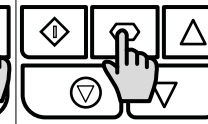
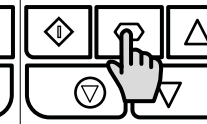
The drive is configured and its operation monitored via the keypad and display.

	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.	


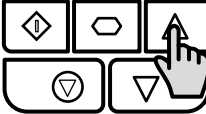

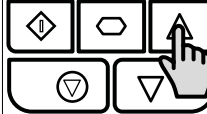


5.2. Operating Displays

StoP	H 50.0	A 2.3	P 1.50	1500
				
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)

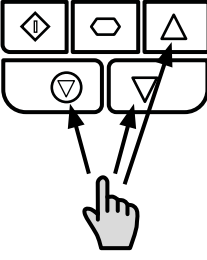
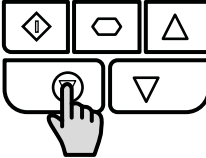
5.3. Changing Parameters

StoP	P-01	P-08	10	P-08	P-08
					
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

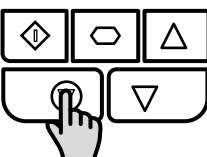
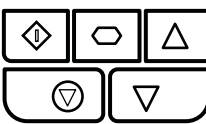
5.4. Read Only Parameter Access

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	-
	<p>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 $\leq 0.0\%$. 100% signal means the output frequency / speed will be the value set in P-01.</p> <p>A 0-20 = 0 to 20mA Signal.</p> <p>E 4-20 = 4 to 20mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA.</p> <p>r 4-20 = 4 to 20mA Signal, the Optidrive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA.</p> <p>E 20-4 = 20 to 4mA Signal, the Optidrive will trip and show the fault code 4-20F if the signal level falls below 3mA.</p> <p>r 20-4 = 20 to 4mA Signal, the Optidrive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA.</p> <p>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 $\leq 0.0\%$.</p>				
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	-
	<p>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.</p> <p>0: Drive Enabled (Running). Logic 1 when the motor is enabled.</p> <p>1: Drive Healthy. Logic 1 when power is applied to the drive and no fault exists.</p> <p>2: At Target Frequency (Speed). Logic 1 when the output frequency matches the setpoint frequency.</p> <p>3: Drive Tripped. Logic 1 when the drive is in a fault condition.</p> <p>4: Output Frequency \geq Limit. Logic 1 when the output frequency exceeds the adjustable limit set in P-19.</p> <p>5: Output Current \geq Limit. Logic 1 when the motor current exceeds the adjustable limit set in P-19.</p> <p>6: Output Frequency $<$ Limit. Logic 1 when the output frequency is below the adjustable limit set in P-19.</p> <p>7: Output Current $<$ Limit. Logic 1 when the motor current is below the adjustable limit set in P-19.</p> <p>8: Analog Input 2 $>$ Limit. Logic 1 when the signal applied to analog input 2 exceeds the adjustable limit set in P-19.</p> <p>9: Drive Ready to Run. Logic 1 when the drive is ready to run, no trip present.</p>				
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
	<p>Preset Speeds / Frequencies selected by digital inputs depending on the setting of P-15.</p> <p>If P-10 = 0, the values are entered as Hz. If P-10 > 0, the values are entered as RPM.</p> <p>NOTE Changing the value of P-09 will reset all values to factory default settings.</p>				
P-24	2nd Ramp Time (Fast Stop)	0.00	600.0	0.00	s
	<p>This parameter allows a 2nd ramp time to be programmed into the drive.</p> <p>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.</p> <p>When using a setting of P-15 that provides a "Fast Stop" function, this ramp time is also used.</p>				

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. <i>Edge-r</i> : 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. <i>Auto-D</i> : Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed. <i>Auto-1 To Auto-5</i> : 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	-
	<p>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.</p> <p>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>				
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	-
	<p>0: Disabled</p> <p>1: Enabled With Software Protection. Enables the internal brake chopper with software protection for a 200W, 100R resistor.</p> <p>2: Enabled Without Software Protection. Enables the internal brake chopper without software protection. An external thermal protection device should be fitted.</p> <p>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.</p> <p>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>				
P-35	Analog Input 1 Scaling / Slave Speed Scaling	0.0	2000.0	100.0	%
	<p>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).</p> <p>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>				
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	† 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	-
	<p>0: Unlocked. All parameters can be accessed and changed.</p> <p>1: Locked. Parameter values can be displayed, but cannot be changed except P-38.</p>				
P-39	Analog Input 1 Offset	-500.0	500.0	0.0	%
	<p>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.</p> <p>The resultant value is defined as a percentage, according to the following: $P00-01 = (\text{Applied Signal Level}(\%) - P-39) \times P-35$.</p>				

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. R 0-20 = 0 to 20mA Signal. E 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. E 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. PEE-EH = 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.				

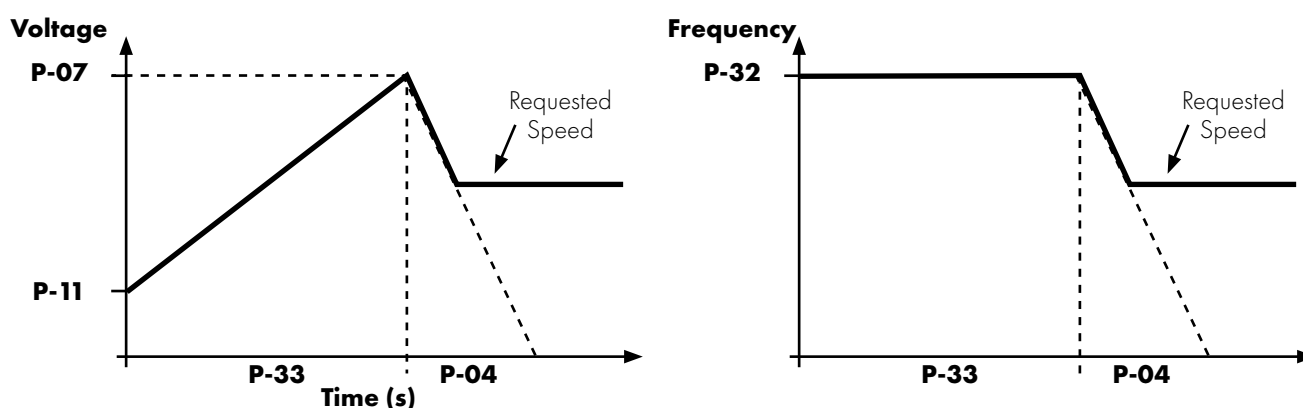
6.3. P-00 Read Only Status Parameters

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					
2	STOP	RUN	1	1	P-23		P-20 - P-23	P-01	3	
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
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					
8	STOP	RUN	No Function		1	1	P-23		9	
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
9	STOP	RUN	OK	FAST STOP (P-24) ↑	DI3	DI4	PR		10	
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
9	STOP	RUN	OK	FAST STOP (P-24) ↑	1	1	P-23		10	
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
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	14
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
14	STOP	RUN	DI2		E-TRIP ↓	OK	1	1	P-23	14
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
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	3
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
17	STOP	RUN	DI2		Fire Mode		1	1	P-23	3
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
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.

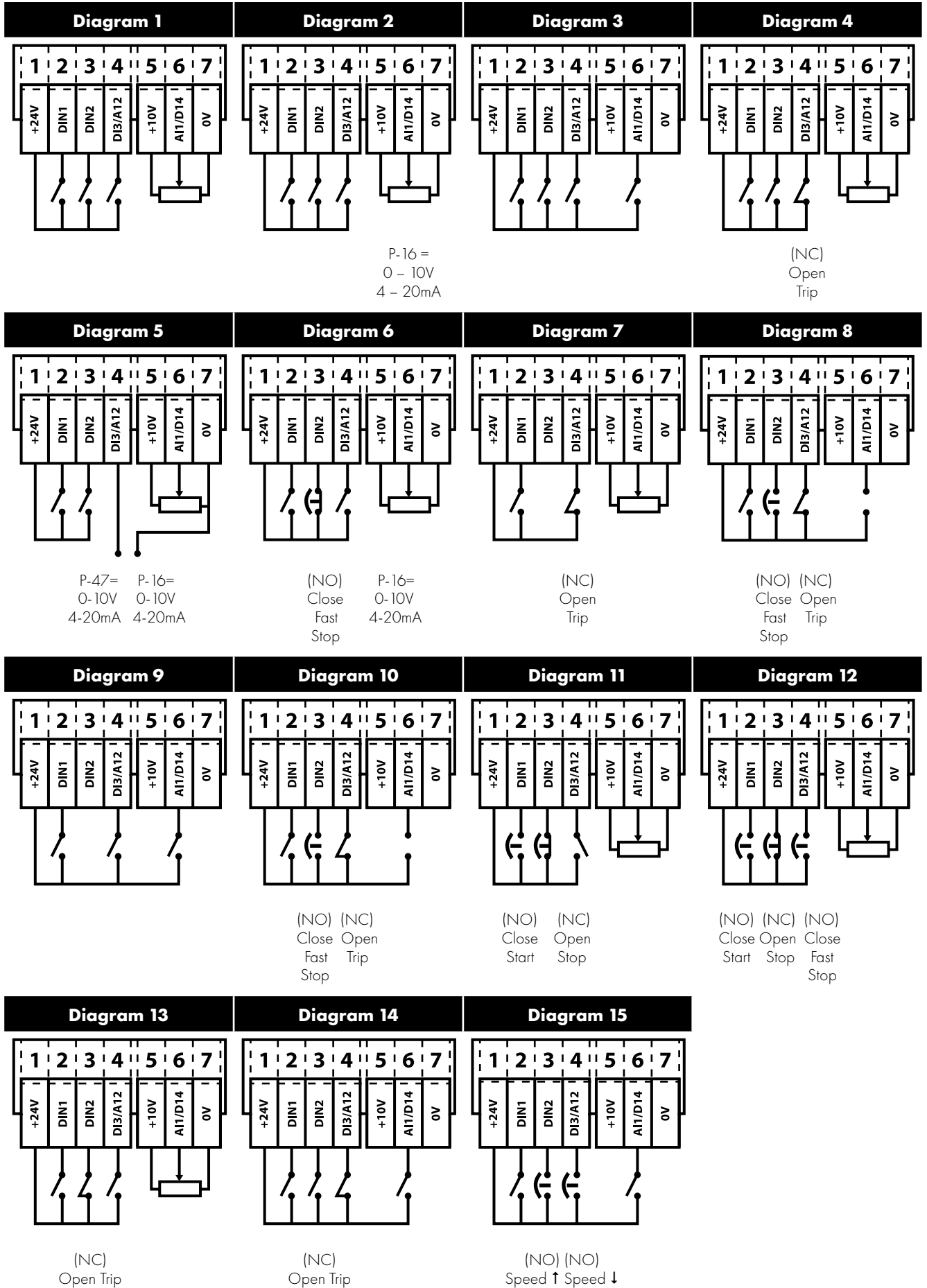
Fire Mode disables the following protection features in the drive:

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-trip (Communications Loss Trip), I.t-trip (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



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

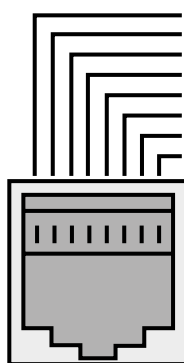
Protocol	Modbus RTU
Error check	CRC
Baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps (default)
Data format	1 start bit, 8 data bits, 1 stop bits, no parity
Physical signal	RS 485 (2-wire)
User interface	RJ45
Supported Function Codes	03 Read Multiple Holding Registers 06 Write Single Holding 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		
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 State 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.

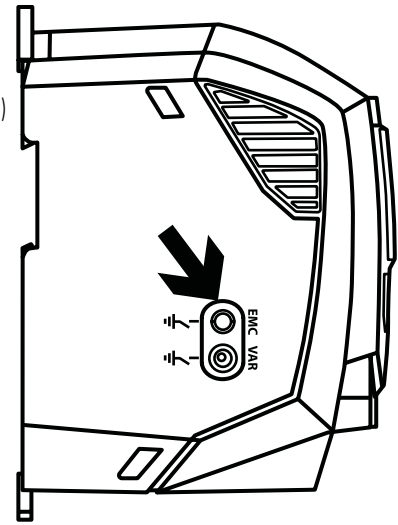
9.4. EMC Filter Disconnect

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.
Ol -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-tr iP	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	
dRAr-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).
dRAr-E	19	Internal memory fault (DSP)	Press the stop key. If the fault persists, consult you supplier.
F-PLc	21	Motor PTC thermistor trip	Connected motor thermistor over temperature, check wiring connections and motor.
FRn-F	22	Cooling Fan Fault (IP66 only)	Check / replace the cooling fan.
O-hEArE	23	Drive internal temperature too high	Drive ambient temperature too high, check adequate cooling air is provided.
SC-FD1	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-FD2	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



BIMBA MFD Pneumatic



Product Features

Technical Data

MGFC Series filters-regulator-lubricator combination units will be discontinued in 2021. Please contact your local salesperson for additional information.

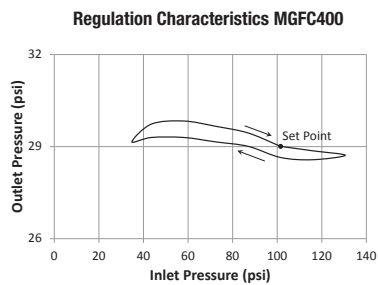
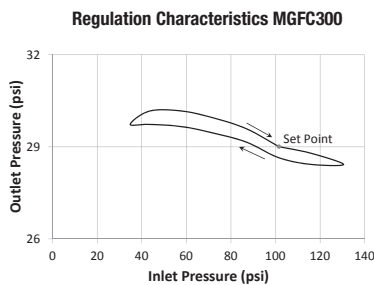
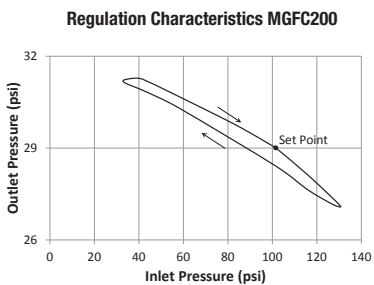
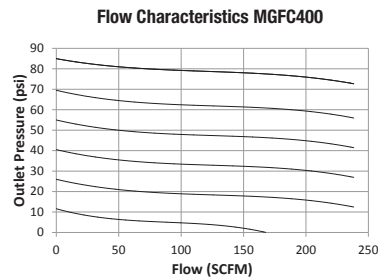
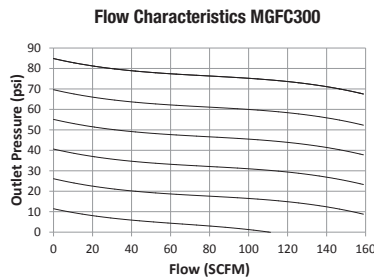
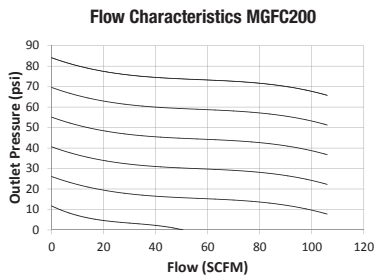
Engineering Specifications

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.

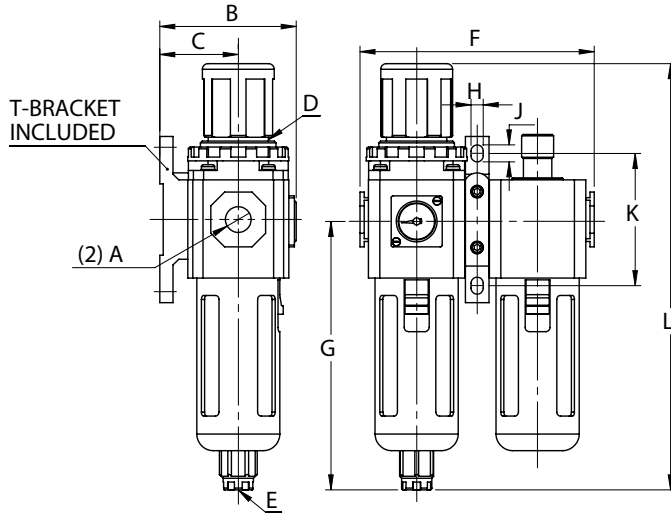


Performance Data MGFC



Product Information

Dimensions (mm)

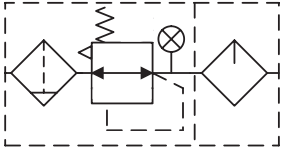


Model	A	B	C	D	E
MGFC200-06-S	1/8 NPT	62	30	M30X1.5	-
MGFC200-08-S	1/4 NPT	62	30	M30X1.5	-
MGFC300-08	1/4 NPT	72	41.5	M40X1.5	G 1/8
MGFC300-10	3/8 NPT	72	41.5	M40X1.5	G 1/8
MGFC400-15	1/2 NPT	89	50	M55X2.0	G 1/4

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

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				
			15	1/2 NPT (400 Series)			

¹ Not available on 200 series
² Not available on 300 & 400 series

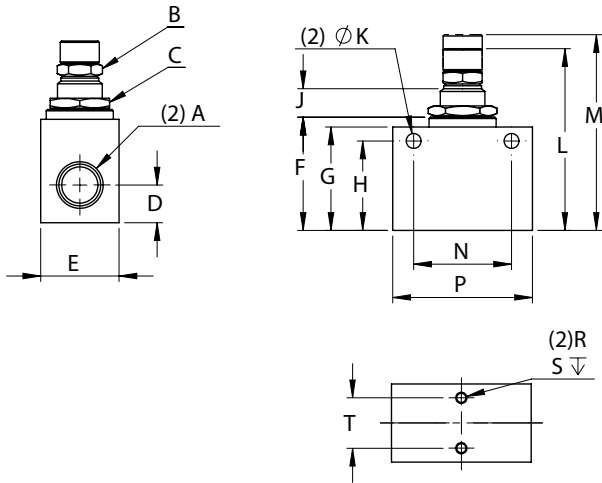
Technical Data

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
	Free	14.1	28.3	53.0
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

How to Order

MASC 200 08

Product Line	Model	Port Size
M4F Series	1 100 Series	06 1/8 NPT (100 Series)
	2 200 Series	08 1/4 NPT (200 Series)
	3 300 Series	10 3/8 NPT (300 Series)
		15 1/2 NPT (300 Series)

