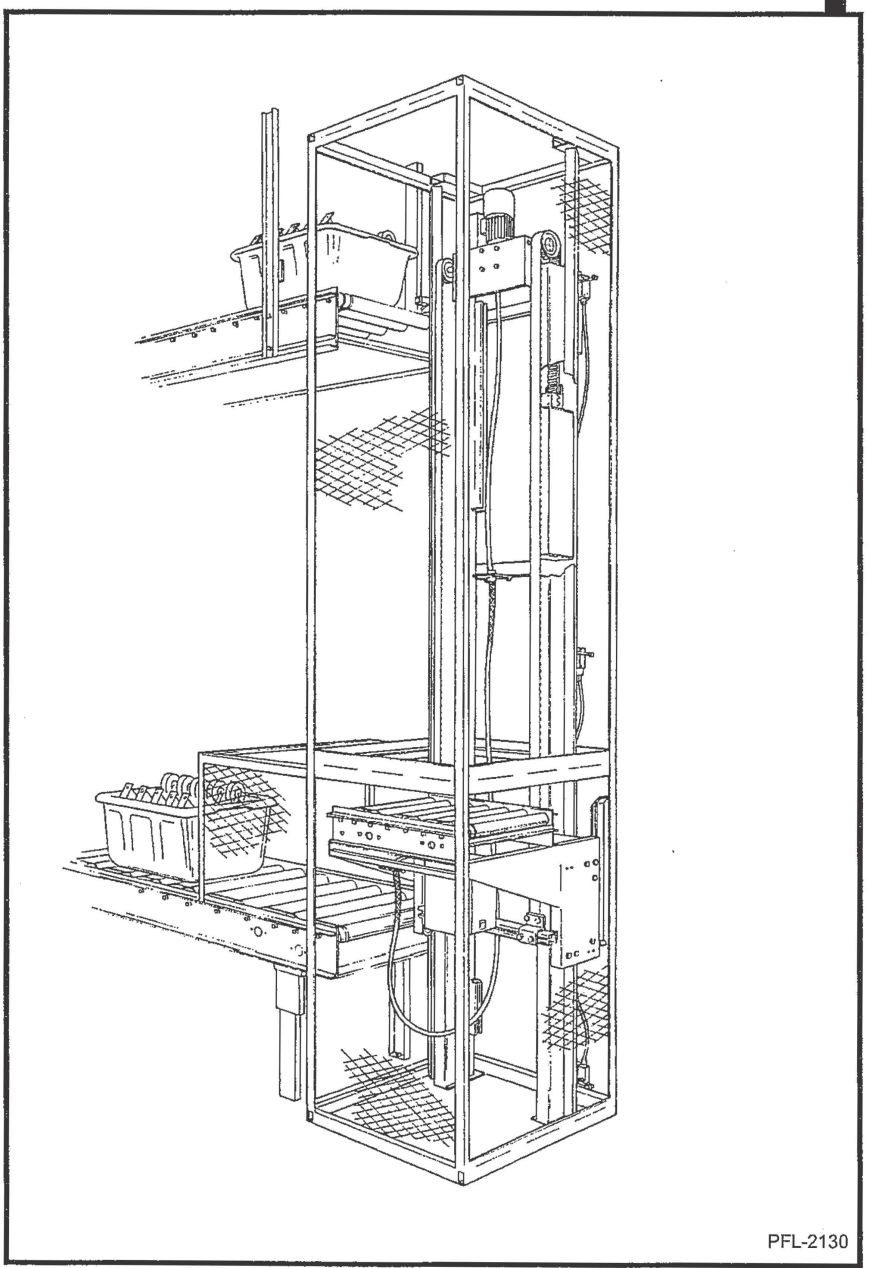
PFLOW VERTICAL LIFTS

The Nation's Largest Manufacturer of Vertical Lifts

PFlow Industries, Inc.



OWNER'S & INSTALLATION INSTRUCTIONS

SERIES DB2

READ THIS MANUAL IN ITS ENTIRETY AND VERIFY JOB SITE DIMENSIONS AGAINST THE PFlow GENERAL ARRANGEMENT DRAWING BEFORE STARTING THE INSTALLATION.

The illustrations depicted in this manual are not to scale or to detail and are for reference only.

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Documentation

PFlow Industries reserves the right to make changes or improvements to the standard VRC model line at any time.

System Modifications/Disclaimer

Mechanical or electrical modifications performed on the VRC not approved by PFlow Industries, Inc. may also void any warranty and/or service agreements. Please contact the PFlow Sales or Service Department at one of the numbers listed above for assistance with service modifications.

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INTRODUCTION

Thank you for purchasing a PFLOW INDUSTRIES, INC., Series DB2 Cantilever, Vertical Reciprocating Conveyor (VRC). We are confident that your unit will provide you with many years of reliable service.

CODE REQUIREMENTS - VRCs are NOT elevators. Your unit is designed for the movement of materials only, up to its rated capacity, from one level to the next. VRCs have their own national code (ANSI/ASME B20.1) and are specifically exempt from the National Elevator Code. All electrical designs and components are in accordance with National Electric Code (NEC) requirements. Local codes may require initial inspection of the installation and periodic inspection and testing of the unit.

Some states require special components and have specific guidelines regarding how the equipment must be installed, inspected, and tested. If we know in which state the equipment will be located, and if we are kept informed of state and local requirements, Pflow will incorporate the components into the order, as approved by the customer, and also provide any pertinent information, as called out on the general arrangement drawing, related to the installation of the equipment. We will not be on site for the testing, but we strongly advise that the installer be there.

If at any time you have questions about your state's requirements, please feel free to call.

NOTE

The information and illustrations in this manual are intended only as an aid to understanding the VRC's general installation. It does not cover every possible contingency or circumstance regarding non-standard options or site conditions.

If you have a problem, call Pflow at (414) 352-9000, between 8:30 A.M. and 5:00 P.M., CST, Monday through Friday. Ask for the Product Support Department and have your serial number ready.

Parts - Pflow Industries maintains a complete stock of, or has access to, all replacement components. We keep detailed records of all equipment sold. If something is damaged in shipment, is defective or missing, contact us immediately.

Service - Our Product Support Department is available to assist your maintenance personnel with any questions or problems they may have regarding the equipment.

Warranty - Our warranty procedures can be found in this manual. Prior authorization must be obtained from Pflow before commencing work of any kind.

Feedback - Let us know how we are doing. Each installation manual contains a questionnaire. Please fill it out and return it to us. We can't prevent a problem if we are not aware of it.

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SAFETY

To ensure your safety and the safety of those around you, it is important that you read, understand, and follow ALL the safety precautions relative to a particular task. Safety precautions in this manual are labeled with the alert symbol followed by the word DANGER, WARNING, or CAUTION.

⚠ DANGER

When you see this symbol, it means that serious injury or death is likely if the instructions are not followed carefully.

⚠ WARNING

When you see this symbol, it means that the potential for personal injury is high if directions are not followed carefully.

CAUTION

When you see this, it means that the potential for damage to the equipment is high if directions are not followed carefully.

NOTE

This term is used to provide additional information to help clarify instructions.

⚠ DANGER

HIGH VOLTAGE. Failure to follow proper procedures when performing electrical installation or service may result in serious injury or death.

⚠ DANGER

DO NOT ride this equipment. Riding may result in injury or death. VRCs ARE NOT ELEVATORS.

⚠ DANGER

DO NOT walk or work under a raised platform.

CAUTION

DO NOT exceed rated capacity.

EQUIPMENT ARRIVAL AND UNPACKING

1. The Series DB2 lift will arrive banded to a pallet. To ease handling and to prevent damage, leave lift on pallet until it is as near to the installation site as possible.

2. The carriage is banded in place to prevent it from moving during shipment.

   NOTE
   Do not remove bands until the lift is stood upright.

3. Keep counterweight secure.

PRE-INSTALLATION CHECKLIST

Site conditions can mean the difference between an installation that is smooth and one that is difficult.

We have provided a general checklist to help set up your installation. We recommend that the installer, or someone with installation experience, discuss not only these items but all other concerns directly with the people on site.

A pre-installation visit is always recommended and considered to be included in the responsibilities of the mechanical installer.

⚠ WARNING

Safety should always be first and foremost in your mind on this or any job. Besides following safe working procedures, items required by OSHA may include: a hard hat, safety shoes, safety glasses and belt, fire extinguisher, and other safety equipment.

Mechanical Installer Responsibilities

- Complete mechanical erection of the equipment as sold by Pflow, called out on the general arrangement (GA) drawing and in accordance with all instructions within this installation manual.
- Return trip upon completion of the electrical installation for final checkout, adjustments and training. (See Completion Checklist.)
- On non-union sites, mounting of all electrical devices.

Customer Responsibilities

- Unloading and transportation of the equipment to the installation area.
- Storage (if applicable). If unit is stored indoors or long-term storage is required, consult Pflow Industries for storage procedures required to keep warranty in effect.
- All necessary site work to prepare for the installation such as pit, floor opening, adequate bracing locations, and shaftway openings.
- Any site/building modifications necessary to get the equipment to the installation area.
- Adequate pick point or lifting mechanism capable of lifting the heaviest load. If weight of load is in question, please call Pflow Industries.

If you have any questions or concerns, please contact our Product Support Department prior to start of work.

__ Can the equipment pass through all doorways, hallways, etc.?

__ Can you use the customer's fork truck? Is the truck's capacity sufficient?

__ Are safety meetings required?

__ Are there any work procedure/safety guidelines particular to the job site?

__ Is welding permitted? Is a "hot permit" required? Is a fire watch required?

__ Is there a pick point capable of lifting the necessary components?

__ What hours are you allowed to work on site?

__ Who is the authorized site contact?

__ Is this a union or non-union site?

__ Bracing requirements - Will additional materials be required?

__ Is temporary power available within 10 ft. of the unit?

__ Do you have a well-lit area to work in?

__ Is the installation area ready (pit complete, floor opening cut and/or finished, etc.)?

__ Are shaftway openings complete?

__ Are there any discrepancies between the site dimensions/application and the Pflow GA drawings? Has this information been provided to Pflow?

__ Will customer doors and/or shaftway openings be completed prior to your arrival?

__ Will other trades or in-plant production cause conflict with your proposed work schedule?

SITE VS. GENERAL ARRANGEMENT

Comparison Check

1. Check your shipment to make sure that nothing is damaged or missing. Damaged or missing components must be reported to Pflow Industries immediately per instructions in the introduction of this manual.

2. The shipping packet contains a copy of the general arrangement drawing.

3. Compare the dimensions as called out on the general arrangement drawing to actual site conditions. Report any discrepancies to Pflow immediately. The following are just a few of the dimensions that could be a problem if they do not match:

   Overall Unit Width
   Overall Unit Length
   Load Height Clearance
   Overhead Clearance
   Elevation of Level 1
   Elevation of Level 2

   Are there any protrusions from the floor level or wall that could interfere with either the installation or operation?

   Floor-to-Floor Clearance - Upper Level

   CAUTION
   Discrepancies between the general arrangement drawing and site conditions must be addressed immediately. Contact the Product Support Department (414) 352-9000 for assistance.

TOOLS REQUIRED FOR VRC INSTALLATION

The following is a list of tools we feel are necessary to install a VRC in a professional and expedient manner. This is only a guideline. Individual sites and applications may require additional items as needed. If you have any questions regarding these items, contact Pflow Industries.

- Forklift - 2,000# capacity or alternative
- Chain fall - 2,000# capacity minimum
- Come-A-Long
- Cables or hook chains with 1,000# or greater capacity
- Carpenter's square
- 4' Level
- Socket set - 3/8" drive, sockets to 3/4"
- Hammer drill and bits for 3/8" anchors, 4" min.
- Drill and drill bits
- Extension cords
- Portable light
- Sledge hammer
- Allen wrenches to 3/8"
- Open or box end wrenches to 3/4"
- Chalk line
- Plumb bobs
- Grease gun
- 25' Measuring tape
- Rags

MECHANICAL OVERVIEW

NOTE

The standard DB2 enlists the use of a roller chain drive and worm gear reducer to raise and lower the carriage at a fixed speed. Certain applications will employ a belt drive using a high-efficiency reducer with adjustable speed capabilities.

See the Appendix for information regarding non-standard applications.

The standard Series DB2 Vertical Reciprocating Conveyor (VRC) consists of a frame, gearmotor, lift sprockets, roller chain, counterweight, carriage, and enclosures.

The frame consists of structural beam columns, drive mount, base, enclosure framing, and expanded metal enclosures.

The gearmotor and lift sprockets are mounted to the top of the frame. The roller chains run over the sprockets and are attached to the carriage at one end and the counterweight at the other end.

The carriage has a roller conveyor section mounted to it. Also included on the carriage are at least four guide wheel assemblies.

The enclosure panels will reject a ball 3/4" in diameter and are the full height of the VRC.

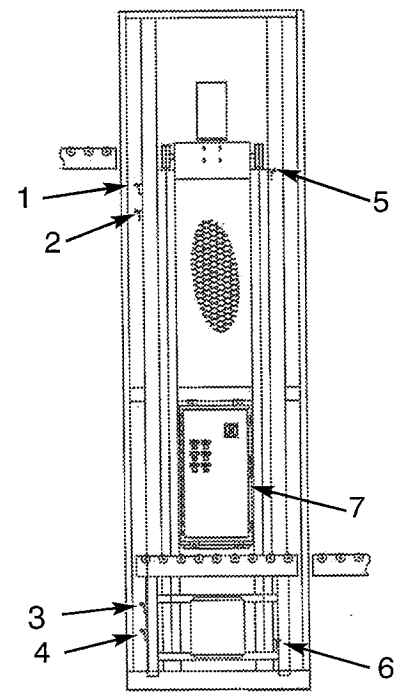
ELECTRICAL OVERVIEW
*Standard Arrangement

***NOTE**

The following is a standard description of the electrical wiring of the Series DB2 ONLY. It DOES NOT include specifics on options available or ordered. A copy of the schematic can be found in a manila envelope in the parts crate.

The Series DB2 VRC will arrive pre-wired from the main control panel to the brake motor, conveyor, limit switches, and photoeyes (if supplied by Pflow). All other devices and wiring are not the responsibility of Pflow Industries.

1. The standard two-level lift incorporates six limit switches: three switches at each level -- one each for decel, stop, and overtravel.



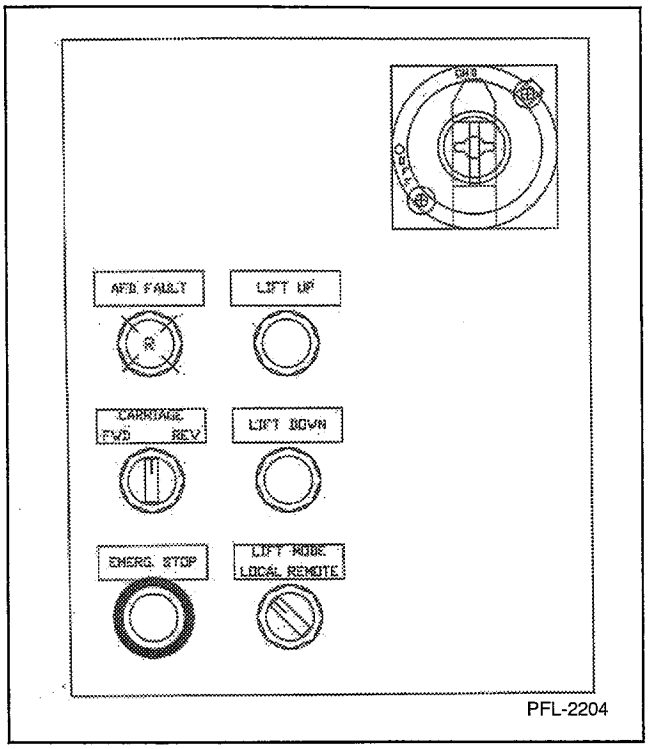
PFL-2201

1. Upper Level Limit Switch
2. Decel Upper Limit Switch
3. Decel Lower Limit Switch
4. Lower Level Limit Switch
5. Upper Overtravel Limit Switch
6. Lower Overtravel Limit Switch
7. Main Control Panel

Figure 1

2. All electrical devices are tied into the MAIN CONTROL PANEL. It contains a fused step-down transformer for the control circuit, motor starter, and VFD.

3. The main control panel includes a push button station with manual controls for running the lift in a "maintenance (local) mode" as well as an EMERGENCY STOP button. Power to the panel is controlled by a large main disconnect switch. See Figure 2.



PFL-2204

Figure 2

The LIFT MODE switch is a two-position selector switch. LOCAL is for manual operation, and REMOTE is for an external control unit. The UP and DOWN push button switches are momentary contact. This allows the operator to depress the button and let go. The CARRIAGE FWD and REV switch is a spring-return selector switch. It must be held in position to operate. The AFD (Motor Control) FAULT switch is a red illuminated momentary push button. The red light will indicate an AFD FAULT, and pushing the button will turn off the warning light. The EMERG. STOP button is pushed to activate but will stay in and must be pulled back out for the unit to operate.

SEQUENCE OF OPERATION

When the UP button is pressed or the controls receive an external UP signal, the coil in the motor starter magnetically closes the high voltage contacts, and the power circuit to the motor starter is completed to turn the motor in the needed direction.

Now the brake is released. The motor turns the gears in the reducer, which in turn rotate the output shafts. The sprockets or pulleys on the shafts also turn resulting in the raising or lowering of the lift roller chain. (Because the motor starter is reversible, the direction of travel can be alternated.) As the chains or belts are fastened to the carriage, this causes the carriage to raise or lower.

When the carriage arrives at a level, the limit switch arm contacts the cam on the carriage. It activates the floor level limit switch. When activated, this switch cuts the power to the motor circuit; the motor starter contacts drop out or open; and the motor stops and the brake is applied stopping the carriage.

The overtravel limit switch is a safety device mounted directly above (at upper level) or below (at lower level) the floor level level limit switch. The only time it activates is if there is a failure of the floor level limit switch. Again, activated by a limit switch arm contacting the carriage, it will send a signal to shut the unit down. Before reactivating the unit, find out why this occurred and correct the problem.

INSTALLATION INSTRUCTIONS

Unit Placement

1. Check general arrangement (GA) drawing. Contact Pflow Industries immediately concerning discrepancies.

2. Lay out position of lift on floor.

3. The carriage is banded in place to prevent it from moving during shipment.

   NOTE
   Do not remove bands until the lift is stood upright.

4. Keep the counterweight secure until the lift is stood upright.

5. To stand lift, sling through top of unit using lifting shackles supplied.

   CAUTION
   Do not sling around shaft, sprockets or belts. This will cause damage to the shafts, reducer and bearings.

6. Position lift with marks on floor and recheck position.

Checking Alignment

CAUTION
Rechecking the alignment is critical. Incorrect alignment will result in problems during operation and damage to the equipment.

1. It will be necessary to remove the front and rear removable enclosure panels on the unit for the rest of the installation. Take care not to damage the panels while they are off of the frame.

2. Plumb structural columns in both directions (side-to-side and front-to-back).

3. Level unit by shimming under base plates.

4. Check plumb and level of column weldment only at this time. The carriage level will be checked later.

Anchoring and Bracing

1. Recheck plumb and level in all directions. If everything checks out, anchor the base plates to the floor using minimum 3/8" diameter anchors and 4" imbedment.

2. Although the Series DB2 is designed to be self-standing, sway bracing at the top of the unit is highly recommended. Weld or bolt a piece of structural angle or tube from the top of the unit to a stationary part of the building structure. Make sure the structure being braced to is of adequate strength before bracing.

Removing Shipping Braces

1. Remove the banding and blocking that is holding the carriage and counterweight in place.

   CAUTION
   Do not stand underneath the carriage!

3. Check that the carriage is hanging level on the two chains or belts. It is possible that the chains/belts may have "jumped a tooth" on the sprocket/pulley during shipping or installation. If this is the case, they must be realigned before running the lift.

4. Jump the chains/belts back into their proper position.

   CAUTION
   Before servicing equipment, secure carriage and counterweight.

   All Series DB2 lifts are counterweighted to reduce horsepower requirements. Do not perform any type of maintenance on the drive components without first securing carriage from moving both up and down. If chains are to be removed from the carriage for any reason, the counterweight will drop.

5. If carriage is still out of level, but by less than one pitch of the chains or belts, adjust mounting brackets or studs on rear of carriage.

Before Operation

*Before putting the unit into operation:

1. Substitute the plug in the top of the gear reducer for the vent plug shipped with the installer packet. See Figure 1.

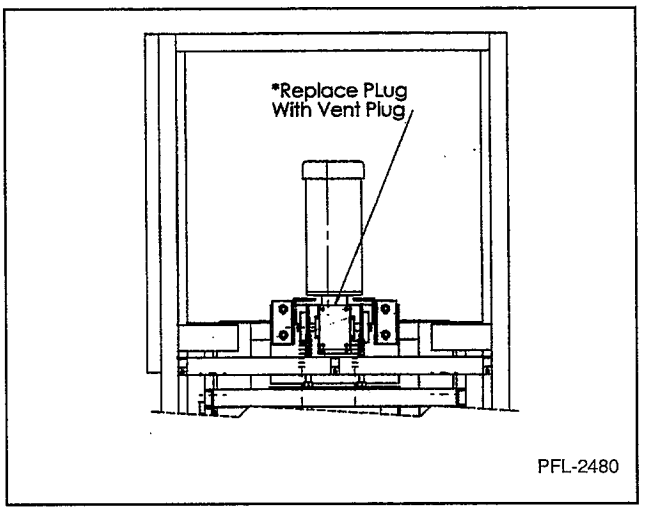


Figure 1
Standard Arrangement

2. Check to make sure that none of the limit switch arms were bent or damaged in shipping.

3. Check to make sure that the brake on the motor is disengaged.

4. Check to make sure that all shipping braces are removed and that carriage travel is free of obstructions

Setting Limit Switches

1. The limit switches, as discussed earlier in the Sequence of Operation, have been pre-wired and pre-set to the floor level heights on the general arrangement drawing. It will probably be necessary to adjust these up or down slightly to match your exact floor level.

2. When moving switches to match a floor level, all switches (floor, overtravel, and D-cell if unit is equipped with a VFD) for that level must be moved the same amount.

3. Loosen the hex-head bolts on the limit switch bracket and move the switch and bracket up or down to adjust the stopping position. Tighten bolts and check alignment.

Operation

CAUTION
Do not attach additional equipment or dead weight to carriage or exceed live load capacity. May cause damage to drive components.

The counterweight in each Series DB2 lift is manufactured specifically for the ordered live load and the corresponding dead load (carriage weldment, conveyor controls, wheels, etc.). Attaching additional weight to the carriage will off-set the effectiveness of the counterweight and may cause damage to the drive.

1. If the carriage or counterweight should hit the floor or the drive during initial start up or during operation, perform the following checks before re-starting:

   Check that carriage is level and both chains/belts are tight.

   Inspect sprockets or pulleys, shafts, chains or belts and adjustment brackets for damage.

   Inspect limit switch arms and cams for damage.

   *See Appendix for non-standard application-specific information.

INSTALLATION COMPLETION CHECKLIST

Please make sure all of the following steps are complete:

__ The VRC is braced from front to back and from side to side (if applicable). See GA.

__ Touch up all welds, marks, scrapes, etc. with paint.

__ Make sure that all electrical connections are properly made.

__ Check that the unit stops level at each floor.

__ Is there excessive noise during travel?

__ Do a full load test.

__ Are there any unsafe conditions that exist?

If so, please report them to Pflow Industries immediately.

__ Post all operational signs.

__ Remove all debris.

__ Instruct the customer on the proper operation.

__ Instruct the user on proper loading.

__ Instruct the customer on procedures if there is a problem.

__ Complete the Installation Questionnaire and Acceptance Certification. Return both to Pflow Industries.

MAINTENANCE SCHEDULE
*Standard Arrangement

1. Reducer Lubrication

   The standard Leeson worm gear reducer is properly filled at the factory with sufficient lubricant for all mounting positions.

   CAUTION

   For input speeds under 900 RPM, consult factory for lube requirements.

   Lubricant: The lubricant is Mobil SHC-634, a synthesized hydrocarbon formulated for extremely long life. Do not add or remove any oil at installation or change oil after break-in. Change oil only when performing maintenance that requires gearbox disassembly.

   If oil must be replaced, use only Mobil SHC-634.

   Do not confuse Mobil SHC-634 with Mobilgear 634. Mobilgear 634 is an EP type gear oil not suitable for use in the 800 series worm gear reducer.

   CAUTION

   In the food and drug industry (including animal food), consult the petroleum supplier for recommendations of lubricants which are acceptable to the Food and Drug Administration and/or the authoritative bodies having jurisdiction.

   Maintenance: Inspect vent plug periodically to ensure it is clean and operating.

   Your Leeson gear reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by Leeson to maintain the warranty.

   Class of Service: All capacity ratings are based on American Gear Manufacturers Association (AGMA) standards. Load conditions must be within cataloged ratings published in the Leeson catalog.

   Warranty: Contact Pflow Industries for warranty questions.

2. The wheels have sealed roller bearings. No maintenance should be required other than to inspect periodically for wear.

3. Inspect the chains or belts for wear or stretch every 60 days. If they are showing wear, check alignment of sprockets/pulleys with chains or belts.

4. Inspect gearmotor brake every 90 days. Check air gap and readjust if necessary.

***NOTES**

1. *For high-cycle or high-speed applications, more frequent maintenance may be required.*

2. *See Appendix for information regarding standard application.*

Standard Roller Chain Drive Lubrication

Each joint in a roller chain is a journal bearing, so it is essential that it receives an adequate amount of the proper lubricant to achieve maximum wear life. Some low speed roller chain drives operate successfully with only the initial factory lubrication. However, most roller chain drives must be either periodically or continuously re-lubricated to obtain their full potential service life. In addition to resisting wear between the pins and bushings, an adequate flow of lubricant smooths the engagement of the chain rollers with the sprocket, cushions roller to sprocket impacts, dissipates heat, flushes away wear debris and foreign materials, and retards rust.

LUBRICATION FLOW

Lubrication of the pin and bushing surfaces that articulate under load is most important, but some lubrication between the roller and bushing is also necessary. If possible, the lubricant should be applied to the upper edges of the link plates in the lower span of the chain shortly before the chain engages a sprocket (See Figure 1 - lubricant flow into the chain joint, and Figure 2 - application of lubricant to chain.) Then gravity and centrifugal force both will aid in carrying the lubricant to the critical pin and bushing surfaces. Surplus lubricant spilling over the link plate edges will supply the roller and bushing surfaces.

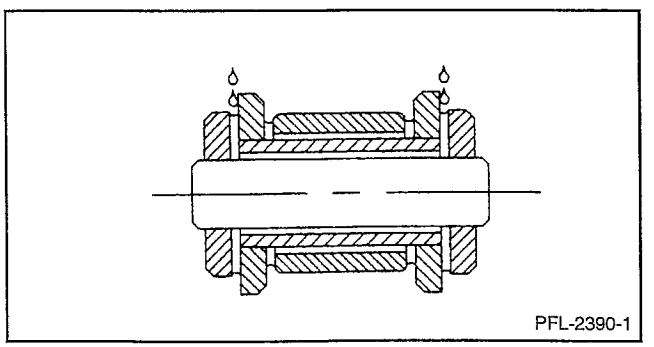


Figure 1

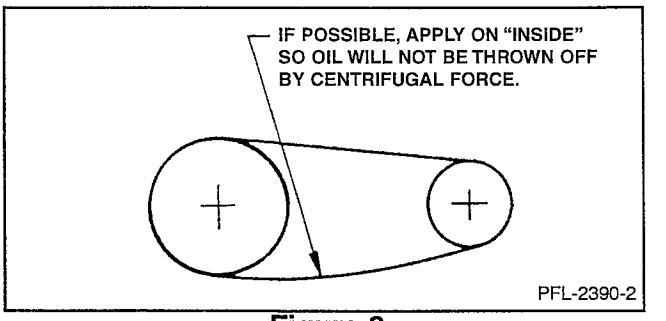


Figure 2

LUBRICANT CHARACTERISTICS

Lubricants for roller chain drives should have the following characteristics:

1. Sufficiently low viscosity to penetrate into the critical internal surfaces.
2. Sufficiently high viscosity, or appropriate additives, to maintain the lubricating film under the prevailing bearing pressures.
3. Clean and free of corrodents.
4. Capability to maintain lubricating qualities under the prevailing operating conditions.

These requirements usually are met by a **good grade of non-detergent, petroleum-base oil.** Detergents normally are not necessary, but anti-foam, anti-rust, and film strength improving additives often are beneficial.

Low-grade or impure oils should be avoided. Low-grade oils cannot provide effective lubrication, and acids or abrasive particles in the oil can damage the chain beyond repair. Heavy oils or greases should not be used because they are too thick to penetrate into the internal surfaces of the chain. The recommended oil viscosity for various surrounding temperature ranges is shown in the following chart:

Recommended Oil Viscosities for Various Temperatures

Recommended Grade	Temperature, °F	(Temperature, °C)
SAE 5	-50 to + 50	(- 46 to + 10)
SAE 10	-20 to + 80	(- 29 to + 27)
SAE 20	+10 to + 110	(- 12 to + 43)
SAE 30	+20 to + 130	(- 7 to + 54)
SAE 40	+30 to + 140	(- 1 to + 60)
SAE 50	+40 to + 150	(+ 4 to + 66)

Note: When the temperature range permits a choice, the heavier grade should be used.

TYPES OF LUBRICATION

The ANSI Standards list three types of lubrication for roller chain drives. In ANSI B29.1, they are:

Type A. Manual or Drip Lubrication.
Type B. Oil Bath or Slinger Disc Lubrication.
Type C. Oil Stream or Pressure Spray Lubrication.

In ANSI B29.3, they are:

Type I. Manual, Slow Drip (4 to 10 drops per minute), or Shallow Bath Lubrication.
Type II. Rapid Drip (20 or more drops per minute), Oil Bath, or Slinger Disc Lubrication.
Type III. Continuous Lubrication, with Slinger Disc or Circulating Pump.

The recommended type is shown in the horse power tables in the respective standards and is mainly influenced by the chain speed and the amount of horsepower being transmitted. The recommended types are minimum lubrication requirements. The use of a better type (Type B instead of Type A for example) is acceptable and may be required by operating conditions other than speed and power. Lubrication has a very significant effect on chain wear life, so it is vital to follow the lubrication recommendations in the horsepower rating tables. Consult a chain manufacturer when it appears desirable to use a lubrication type other than that recommended.

Manual Lubrication

Note: Manual lubrication is to be done **only** when the drive is stopped and power to the drive is locked out.

For manual lubrication, oil is applied periodically with a brush or a spout can, preferably once each eight hours of operation. The time may be longer than eight hours if it has proven adequate for that particular drive. The volume and frequency of oil application must be sufficient to prevent a red-brown (rust) discoloration of the oil in the joints. The red-brown discoloration indicates that the oil in the joints is inadequate. When the rust discoloration is found, remove, clean, relubricate, and re-install the chain before continuing operation.

Drip Lubrication

For drip lubrication, oil is dripped between the link plate edges from a drip lubricator. Drip rates range from 4 to 20 or more drops per minute, depending on chain speed. Here again, the drip rate must be sufficient to prevent a red-brown (rust) discoloration of the lubricant in the chain joints. Care must be taken to prevent windage from misdirecting the oil drops. The oil level in the reservoir should be checked after each eight hours of operation and the reservoir refilled when needed.

Roller Chain Drive Maintenance

A roller chain drive requires proper and timely maintenance to deliver satisfactory performance and service life. It is assumed that the shafts, bearings, and supports, the chain and sprockets, and the lubrication type have been properly selected and installed. Then a maintenance program must be established to ensure that:

1. The drive is correctly lubricated.
2. Drive interferences are eliminated.
3. Damaged chains or sprockets are replaced.
4. Worn chains or sprockets are replaced.
5. The sprockets are properly aligned.
6. The chain is correctly tensioned.
7. Guarding is in good condition and is properly installed.

A roller chain drive should be inspected after the first 50 hours of operation. After that, drives subject to heavy shock loads or severe operating conditions should be inspected after each 200 hours of operation, while more ordinary drives may be inspected after each 500 hours of operation. Experience may indicate a longer or shorter interval between inspections.

At each inspection, the following items should be checked and corrected when necessary. In addition, maintenance personnel should refer to B314 - "Roller Chain Drive Troubleshooting Guide."

LUBRICATION SYSTEM

For manual lubrication, be sure that the lubrication schedule is being followed and the correct grade of oil is being used. If the chain is dirty, clean it with kerosene or a nonflammable solvent and relubricate it.

For drip lubrication, check the flow rate and be sure that the oil is being directed into the chain correctly.

For oil bath, slinger disc, or oil stream lubrication, be sure that all orifices are clear and that the oil is being directed onto the chain correctly. Change the oil after the first 50 hours of operation and after each 500 hours thereafter (200 hours in severe service).

DRIVE INTERFERENCES

Inspect for any evidence of interference between the drive components and other parts of the equipment. If any is found, correct it immediately. Rubbing between the chain or sprockets and other parts of the machine can cause abnormal wear and damage. Impact between the chain link plates and a rigid object can cause link plate fatigue and chain failure.

Also inspect for and eliminate any buildup of debris or foreign material between the chain and sprockets. A relatively small amount of debris in the sprocket roller seat can cause tensile loads great enough to break the chain if forced through the drive.

DAMAGED CHAIN OR SPROCKETS

Inspect the chain for cracked, broken, deformed, or corroded parts, and for tight joints or turned pins. If any are found, find and correct the cause of the damage and REPLACE THE ENTIRE CHAIN. Even though the rest of the chain appears to be in good condition, it very probably has been damaged and more failures are likely to occur in a short time.

Inspect sprockets for chipped, broken, or deformed teeth. If any are found, find and correct the cause of the damage and REPLACE THE SPROCKET. Sprockets normally are stronger and less sensitive to damage than chain, but running a worn chain on new sprockets can ruin the sprockets in a short time. This is because a worn chain rides very high on the sprocket teeth and wears the sprocket teeth in an abnormal pattern.

CHAIN WEAR

In most roller chain drives, the chain is considered worn out when it has reached 3% wear elongation. With 3% wear, the chain does not engage the sprocket properly and can cause sprocket damage or chain breakage. On drives with large sprockets (more than 66 teeth), allowable wear is limited to 200/N (N = no. of teeth on largest sprocket) and may be substantially less than 3%. On fixed-center, non-adjustable drives, allowable wear elongation is limited to about one-half of one chain pitch.

Measure a representative section of chain as shown in Figure 1 - measurement of chain for wear elongation and Chain Wear Elongation Limits table, Table B313-1; and if wear elongation exceeds 3% or the functional limit, replace the entire chain. Do not connect a new sec tion of chain to a worn section because it may run rough and damage the drive.

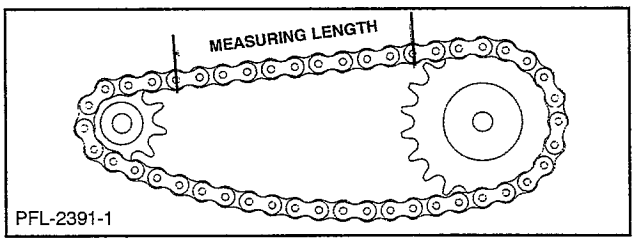


Figure 1

SPROCKET WEAR

A worn out sprocket is not nearly as well defined as a worn out chain. However, there are some sprocket characteristics that indicate when a sprocket should be replaced. Check for roughness or binding when a new chain engages or disengages the sprocket. Inspect for reduced tooth thickness and hooked tooth tips (See Figure 2 - worn sprocket). If any of these conditions are present, the sprocket teeth are excessively worn and the sprocket should be replaced.

Do not run new chain on worn out sprockets because it can cause the chain to wear rapidly. The pitch of the new chain is much shorter than the effective pitch of the worn sprocket, so the total chain load is concentrated on the final sprocket tooth before disengagement. Then when the chain disengages from the sprocket, the roller is jerked out of the hooked portion of the sprocket tooth and that results in a shock load on the chain as the load is transferred from one tooth to the next.

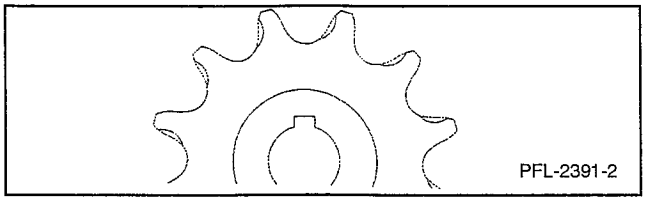


Figure 2

SPROCKET ALIGNMENT

Inspect for significant wear on the inside surface of the chain roller link plates and on the sprocket flange faces. If this type of wear is present, the sprockets may be misaligned. Realign the sprockets as described in the installation instructions to prevent further abnormal chain and sprocket wear. If 5% or more of the link plate thickness is worn away, or if there are sharp gouges in the link plate surface, the chain should be replaced immediately. If l0% or more of the sprocket tooth flange thickness is worn away, the sprocket should be replaced.

CHAIN TENSION

Measure the total mid-span movement (See Figure 3 - chain tension adjustment). If it exceeds the tabulated limit (see Bulletin B311, Table B311-1), adjust the center distance to obtain the desired amount of slack. If elonga tion exceeds the available adjustment and wear elongation still has not exceeded 3% or the functional limit, remove two pitches and reinstall the chain. If the minimum adjustment will not permit shortening the chain two pitches, the chain may be shortened one pitch by using an offset link or an offset section. Contact Pflow Product Support Department prior to any use of offset links.

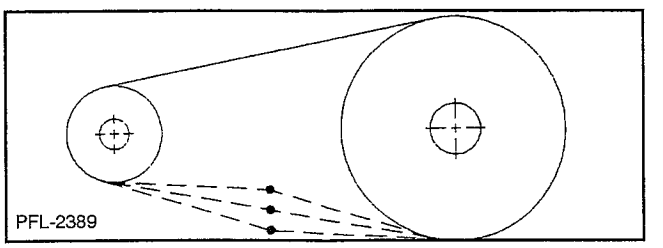


Figure 3

TABLE B313-1

Chain Wear Elongation Limits

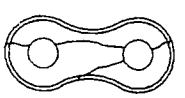
ANSI Chain Number	Chain Pitch in.	Chain Pitch mm	Measured Length: No. of Pitches	Measured Length: Nominal in.	Measured Length: Nominal mm	Measured Length: At 3% Wear in.	Measured Length: At 3% Wear mm
25	.250	6.35	48	12.00	305	12.375	314
35	.375	9.52	32	12.00	305	12.375	314
41	.500	12.70	24	12.00	305	12.375	314
40	.500	12.70	24	12.00	305	12.375	314
50	.625	15.88	20	12.50	318	12.875	327
60	.750	19.05	16	12.00	305	12.375	314
80	1.000	25.40	12	12.00	305	12.375	314
100	1.250	31.75	20	25.00	635	25.750	654
120	1.500	38.10	16	24.00	610	24.719	628
140	1.750	44.45	14	24.50	622	25.250	641
160	2.000	50.80	12	24.00	610	24.719	628
180	2.250	57.15	12	27.00	686	27.812	706
200	2.500	63.50	10	25.00	635	25.750	654
240	3.000	76.20	8	24.00	610	24.719	628

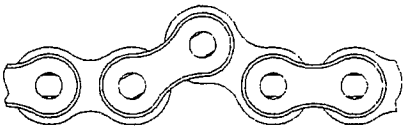
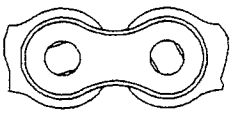
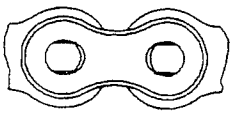
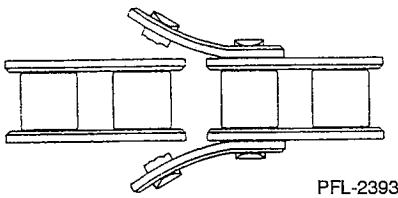
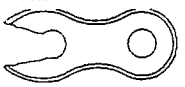
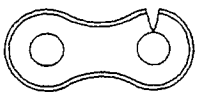
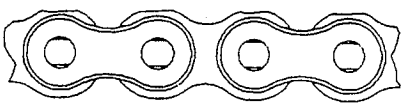
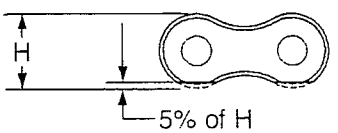
GUARDS

Inspect the guards to ensure they are in serviceable condition. The guards must not be bent or deformed so that intended clearance is reduced. Any designed openings in the guard (mesh) must not be enlarged. The guards must not be broken or damaged especially at or near the mounting points.

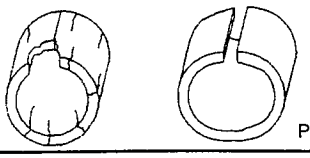
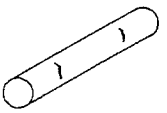
If the guards are in serviceable condition, reinstall them on the drive making sure that all fasteners are secure and that all safeguarding devices (such as presence sensors and interlocks) are functioning.

Roller Chain Drive Troubleshooting Guide

CONDITION / SYMPTOM	POSSIBLE CAUSE	WHAT TO DO
Missing Parts	Missing at assembly.	Replace chain.
	Broken and lost.	Find and correct cause of damage. Replace chain.
Rusted Chain	Exposed to moisture.	Replace chain. Protect from moisture.
	Water in lubricant.	Change lubricant. Protect lubrication system from water. Replace chain.
	Inadequate lubrication.	Provide or reestablish proper lubrication. Replace chain if needed.
Excessive Noise	Chain striking an obstruction.	Replace chain. Eliminate interference.
	Loose casing or shaft mounts.	Tighten fasteners.
	Excess chain slack.	Retension chain.
	Excessive chain wear.	Replace and retension chain.
	Excessive sprocket wear.	Replace sprockets and chain.
	Sprocket misalignment.	Replace chain and sprockets if needed. Realign sprockets.
	Inadequate lubrication.	Replace chain if needed. Reestablish proper lubrication.
	Chain pitch too large.	Redesign drive for smaller pitch chain.
	Too few sprocket teeth.	Check to see if larger sprockets can be used. If not, redesign drive.
Wear on Inside of Roller Link Plates and One Side of Sprockets.	Sprocket misalignment.	Replace sprockets and chain if needed. Realign drive. Retension chain.
Chain Clings to Sprocket	Excessive sprocket wear.	Replace sprockets and chain.
	Sprocket misalignment.	Replace sprockets and chain if needed. Realign sprockets.
Chain Climbs Sprocket Teeth	Excess chain slack.	Retension chain.
	Excess chain wear.	Replace and retension chain.
	Excessive sprocket wear.	Replace sprockets and chain.
	Extreme overload.	Replace chain. Eliminate cause of overload.
Missing or Broken Cotters	Cotters installed improperly.	Install new cotters per manufacturer's instructions.
	Vibration.	Replace chain. Reduce vibration. Use larger sprockets.
	Excessively high speed.	Replace chain. Reduce speed. Redesign drive for smaller pitch chain.
Exposed Chain Surfaces Corroded or Pitted	Exposure to corrosive environment.	Replace chain. Protect from hostile environment.
Cracked Link Plates (Stress Corrosion)  PFL-2392	Exposure to corrosive environment combined with stress from press fits.	Replace chain. Protect from hostile environment.

CONDITION / SYMPTOM	POSSIBLE CAUSE	WHAT TO DO
Tight Joints  PFL-2393-1	Dirt or foreign material in chain joints.	Clean and relubricate chain.
	Inadequate lubrication.	Replace chain. Reestablish proper lubrication.
	Misalignment.	Replace sprockets and chain if needed. Realign sprockets.
	Internal corrosion or rust.	Replace chain. Eliminate cause of corrosion or protect chain.
	Overload bends pins or spreads roller link plates.	Replace chain. Eliminate cause of overload.
Turned Pins  PFL-2393-2	Inadequate lubrication.	Replace chain. Reestablish proper lubrication.
	Overload.	Replace chain. Eliminate cause of overload.
Enlarged Holes  PFL-2393-3	Overload.	Replace chain. Eliminate cause of overload.
Broken Pins  PFL-2393-4	Extreme overload.	Replace chain. Replace sprockets if indicated. Eliminate cause of overload or redesign drive for larger pitch chain.
Broken Link Plates  PFL-2393-5		
Cracked Link Plates (Fatigue)  PFL-2394-1	Loading greater than chain's dynamic capacity.	Replace chain. Reduce dynamic loading or redesign drive for larger chain.
Battered Link Plate Edges  PFL-2394-2	Chain striking an obstruction.	Replace chain. Eliminate interference.
Worn Link Plate Contours  PFL-2394-3	Chain rubbing on casing, guide, or obstruction.	Replace chain if 5% or more of height worn away. Retension chain. Eliminate interference.

Roller Chain Drive Troubleshooting Guide

CONDITION / SYMPTOM	POSSIBLE CAUSE	WHAT TO DO
Broken, Cracked, or Deformed Rollers  PFL-2394-4	Speed too high.	Replace chain. Reduce speed.
	Sprockets too small.	Replace chain. Use larger sprockets, or possibly redesign drive for smaller pitch chain.
	Chain riding too high on sprocket teeth.	Replace chain. Retension chain more often.
Pin Galling  PFL-2394-5	Speed or load too high.	Reduce speed or load. Possibly redesign drive for smaller pitch chain.
	Inadequate lubrication.	Provide or reestablish proper lubrication.

DB2 Lift Assembly - See Dwg. #_____Rev.

Ctrwt Assembly, - See Dwg. #_____Rev.

Carriage Asembly - See Dwg. #_____Rev.

Drive Assembly - See Dwg. #_____Rev.

GA Dwg. #_____
Spec. Rev.___ - Dwg. Rev. ___

Carriage Conveyor Dwg. #_____Rev.

RECOMMENDED STORAGE REQUIREMENTS

ENVIRONMENT

All components should be stored indoors. The area of storage should be kept at a constant temperature above 55°F and relative humidity of approximately 40%, free from heavy dust and contaminants.

STACKING

Stacking of the various components is strictly forbidden. Enclosure and gate panels will warp. Objects on top of the columns and drive base assemblies may cause severe damage.

LONG-TERM STORAGE

For units stored longer than six months, it is recommended that you contact the Product Support Department of Pflow Industries for additional information that may be available prior to starting up your unit.

Our warranty policy does not cover damage as a result of improper storage.

ELECTRICAL TERMINOLOGY AND APPLICATIONS

Ruling Bodies:

NEMA - National Electrical Manufacturers Association - (National testing and manufacturing standards body of electrical apparatus.)

UL - Underwriters Laboratories, Inc. - (Independent testing laboratory - some cities require UL control panels and electrical apparatus.)

JIC - Joint Industry Council - (Advisory group to provide standards for production equipment, safety and dependability.)

NFPA - National Fire Protection Association - (Ruling board of NEC - sets national fire/safety standards for equipment/plants.)

CSA - Canadian Standards Association - (Regulatory agency of Canada - CSA required stamp on electrical devices in Canada.)

ANSI - American National Standards Institute - (Adopts code; sets committees.)

ASME - American Society of Mechanical Engineers - (Writes codes - Secretariat for ANSI.)

NEC - National Electrical Code - (Advisory board to NFPA - their recommendation/codes are usually adopted throughout the USA.)

OTHERS - GM, Ford, Dupont, etc. Customers may have special plant specifications incorporating several ruling bodies or their own electrical code specifications.

Pflow's Standard

NEMA type 1 classification is a general purpose, indoor only, usage. Only COMMERCIAL users generally accept this type: i.e., retail stores, mini storage, warehouses, etc.

NOTE

INDUSTRY does not accept (this NEMA type 1): i.e., auto manufacturing, chemical manufacturing, and paper manufacturing.

All other Pflow units are NEMA 12 classification in regard to the controls, push button stations, and electrical design built under the following standards:

JIC: EMP-1 Electrical standards for mass production equipment.

JIC: Electrical standards for general purpose machine tools.

NFPA 79: Electrical standard for industrial machinery

NEMA type 12 classification is an indoor only usage with gasket protection from dust, dirt, fiber flyings, dripping water, and external condensation of non-corrosive liquids.

NOTE

If JIC is to be strictly adhered to, they require that all devices be minimum NEMA 12, rigid conduit, specific wire coloring, etc. (controls and field wiring).

NOTE

You should note that the NEMA rating of equipment is based on the electrical device(s) with the lowest NEMA type.

EXAMPLES: 1) If we provide a JIC NEMA 12 standard control package with an Anderson or VA gate interlock, our NEMA rating goes to NEMA type 1; and we lose our JIC rating. 2) If we provide a GAL interlock, which has exposed electrical contacts, we rate no NEMA rating and lose our JIC rating. 3) If we provide EMT conduit or don't provide the proper JIC electrical field wiring techniques, we lose our JIC rating.

Outdoor Application

Outdoor units or electrical devices exposed to severe weather conditions should not be rated less than NEMA type 4. This is a watertight, dust-tight indoor-outdoor classification that will provide protection against splashing water, seepage of water, falling or hose-directed water, and severe external condensation.

Corrosive Application

The Chemical Industry on the whole usually specifies a minimum NEMA type 4X. A NEMA 4X rating is similar to a NEMA 4 with added corrosion resistance.

Hazardous Locations

Hazardous locations are an extremely specialized electrical classification. Few electrical experts exist in this field. All explosion-proof hazardous locations must be handled on an individual job site condition.

The NEC has three classes (I, II, III), - two divisions, (1 and 2) and seven group designations (A, B, C, D, E, F, and G).

Class Definitions:

CLASS I Locations: Those in which flammable gasses or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

CLASS II Locations: Those where the presence of combustible dust presents a fire or explosion hazard.

CLASS III Locations: Those where easily ignitable fibers or flyings are present but not likely to be suspended in the air in quantities sufficient to produce ignitable mixtures.

Division Definitions:

DIVISION 1 is an extremely dangerous explosive condition that exists normally.

DIVISION 2 is a dangerous explosive condition that could exist but usually does not.

GROUP designations are given by the NFPA, State Fire Marshals, insurance companies or consulting engineering firms according to the gasses/dust, etc. in the area and the spark or temperature needed to produce an explosion.

Currently, in order to provide competitive pricing in the hazardous location area, we are producing "intrinsically safe" control packages. Intrinsically safe is defined as: electrical devices provided cannot produce a spark or temperature hot enough to ignite the surrounding gasses/dust, etc.

Optional Control Packages and Devices for Hazardous Locations

NEMA type 7, Class I, Division 1 and 2, Group A, B, C, or D enclosures shall be capable of withstanding the pressures resulting from an internal explosion of specified gas and shall contain such an explosion sufficiently so that an explosive gas mixture existing in the atmosphere will not be ignited.

NEMA type 9 is similar to NEMA type 7 but is rated for dust ignition-proof - Class II, Division 1 and 2, Groups E, F, or G.

WARRANTY

PARTS		LABOR	
Structure	Lifetime	Structure	Lifetime
Manufactured Components	One Year	Manufactured Components	One Year
Purchased Components	One Year	Purchased Components	90 Days

The Small Print

The warranty period begins 30 days after shipment. All warranty work must be pre-authorized by Pflow Industries' Product Support Department prior to starting work. All billing must be in accordance with our Warranty Procedures. Replacement of defective parts will be handled in accordance with Pflow's Return Goods Authorization policy. If Pflow Industries determines that equipment failures were caused by abuse, improper installation, or lack of maintenance, they will not be covered. Pflow Industries will not accept consequential losses (missed production, etc.), premium time labor, or air freight charges. Manufactured items are defined as those components manufactured and/or assembled by Pflow. Structure is defined as columns and carriage (excluding carriage side guards). Purchased items are those components that are used as supplied by vendors. Gates and enclosures are excluded and covered for 90 days parts and labor. This warranty applies to all models and may not be modified or extended except by written authorization from Pflow Industries, Inc.

We, the manufacturer, sincerely hope that you do not experience problems with the equipment. If you do, the following procedures should be followed:

Pre-Authorization

Pflow Industries must be notified of the problem before we can authorize the repair. We need to determine the cause of the problem, who should be doing the work, and what is involved. If it is our decision to have your organization or your subcontractor do the work, you will be given an authorization number which must be referenced on all subsequent paperwork. During our non-working hours, we ask that you notify us by phone or FAX during the next business day.

Issuance of an authorization number does not guarantee approval and/or payment.

Invoices

1. You have 30 days from the date the work was completed to submit an invoice for approval. If approved, payment is made 30 days from the date of approval.
2. A deduction from outstanding payments to Pflow for warranty is NEVER authorized and will result in a 10% processing fee.
3. Invoices received without sufficient information will be returned. They will be reconsidered for approval when complete documentation is received. All invoices must include, in detail, the following:
   - Description of problem;
   - Pflow serial number;
   - Labor hours per problem;
   - Rate per hour;
   - Travel time incurred;
   - Date work was performed;
   - Copies of receipts for materials purchased locally or labor subcontracted.

Comments

Pflow Industries is not responsible for payment made on claims prior to our approval.

Local purchase of components must be pre-authorized.

Where distance and/or experience may be more cost-effective, Pflow Industries reserves the right to use alternate organizations.

Labor is defined as a maximum of two hours travel per call, plus reasonable on-site repair time as determined by Pflow Industries.

We want to provide equipment that is built correctly and shipped complete. To achieve that, we need to know what errors are being made or what field problems you are experiencing. Please answer the following questions and return this form to the Product Support Department at Pflow Industries, Inc. If more space is required for comments, please use the reverse side.

1. Was the unit received in good condition? Yes / No
   If not, please describe damage:_____

2. Was the unit received complete? Yes / No
   If not, what was missing?_____

3. Was the lift manufactured correctly? (Did it match the GA drawing?) Yes / No
   If not, please describe the errors:_____

4. Did the unit (i.e., lift, enclosures) fit? Yes / No
   If not, please describe in detail the problem areas:_____

5. Did you return after the electrical was completed for final adjustments, testing, and training?
   Yes / No

   If No, were you able to hook up temporary power to test the unit and make all final adjustments?
   Yes / No

   If Yes, were there electrical problems that you were aware of?
   Was there a problem with the components? Yes / No
   If yes, please describe:_____
   Was there a problem with the field wiring? Yes / No
   If yes, please describe:_____

6. Did you test the unit to full capacity? Yes / No

Comments:_____

_____

Pflow Job #:_____ Customer/User:_____

Questionnaire Completed By:_____ Date:_____

Company:_____ Phone:_____

PFLOW INDUSTRIES, INC., 6720 North Teutonia Avenue, Milwaukee, WI 53209
Phone (414) 352-9000; Fax (414) 352-9002; 110300

Acceptance Certification

We accept this equipment as being properly installed, tested, and performing to our satisfaction. This form covers both the mechanical and electrical installation of the equipment and is for the purpose of quality assurance by Pflow Industries, and in no way releases either Pflow Industries, Inc. or the installing contractor(s) of their warranty obligations. If there are any exceptions or unresolved items, please note.

JOB NO.:_____ **JOB NAME:**_____

Site Mailing Address:_____

City, State, Zip Code:_____

On-Site Contact for future follow-up:

Name:_____ Title:_____

Phone: (_____) _____ - _____ Ext._____

Tests Successfully Performed: _____Load test at _____% of capacity _____Operation

_____ Gate/Interlock Operation Other:_____

Personnel Instructed on the Operation:

Name:_____ Company:_____

Name:_____ Company:_____

ACCEPTED BY: Date:_____

Name:_____ Name:_____

Title:_____ Title:_____

Company:_____ Company:_____

Phone:_____ Phone:_____

PFLOW PERSONNEL / REPRESENTATIVE / INSTALLER PRESENT:

Name:_____ Company:_____

Please return a copy of this form to the Product Support Department.

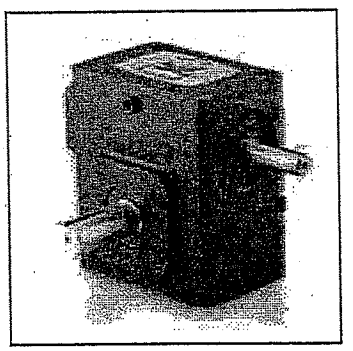
PFLOW INDUSTRIES, INC., 6720 North Teutonia Avenue, Milwaukee, WI 53209
Phone (414) 352-9000; Fax (414) 352-9002; 040199

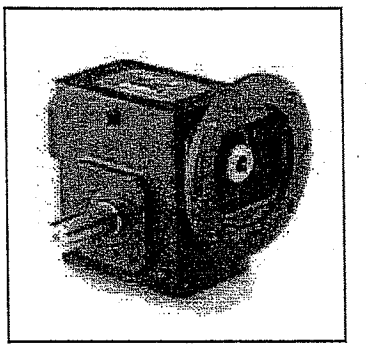
STANDARD COMPONENT INFORMATION

LEESON® OHIO GEAR

ELECTRIC MOTORS, GEARMOTORS AND DRIVES

Worm Gear Reducers Installation, Lubrication and Maintenance Instructions





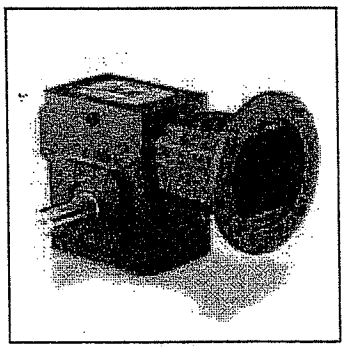


TABLE OF CONTENTS

Instruction Manual

Selection Information

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.

Safety Alert

WARNING

- Written authorization from LEESON ELECTRIC is required to operate or use reducers in man lift or people moving devices.
- Check to make certain application does not exceed the allowable load capacities published in the current catalog.
- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.
- For safety, Buyer 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.
- Hot oil and reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.
- 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.
- Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized. Reducers should not be used as a brake.
- Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.
- Lifting supports including eyebolts are to be used for vertically lifting the gearbox only and no other associated attachments or motors.
- Use of an oil with an EP additive on units with backstops may prevent proper operation of the backstop. Injury to personnel, damage to the reducer or other equipment may result.
- Overhung loads subject shaft bearings and shafts to stress which may cause premature bearing failure and/or shaft breakage from bending fatigue, if not sized properly.

CAUTION

- Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.
- If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants.
- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper 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 warranties or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods 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 the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential 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 instructions manual should be read together with all other printed information such as catalogs, supplied by LEESON ELECTRIC.

LEESON
OHIO GEAR

Instruction Manual

General Operation

1. Run the motor which drives the reducer and check the direction of reducer output rotation. Consult motor nameplate for instructions to reverse the direction of rotation.
2. Attaching the load: On direct coupled installations, check shaft and coupling alignment between speed reducer and loading mechanism. On chain/sprocket and belt/pulley installation, locate the sprocket or pulley as close to the oil seal as possible to minimize overhung load. Check to verify that the overhung load does not exceed specifications published in the catalog.
3. High momentum loads: If coasting to a stop is undesirable, a braking mechanism should be provided to the speed reducer output shaft or the driven mechanism.

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

Installation

1. Mount the unit to a rigid flat surface using grade 5 or higher fasteners. The mounting fasteners should be the largest standard size that will fit in the base mounting hole. Shim as required under flange or base feet which do not lie flat against the mounting surface.
2. For shipment, pipe plugs are installed in the unit and a vent plug is packed separately. After mounting the unit in position, remove the appropriate pipe plug and install the vent plug in the location shown on page 5. On double reduction units both the primary and the secondary must be vented. Failure to vent the unit can cause premature seal wear or loss of seal and oil. These conditions are not covered by warranty. Check for correct oil level. Contact the factory for level and vent recommendations on non-standard mounting positions. **WASHGUARD® (BISSC)** and **ALL-STAINLESS STEEL** reducers are factory supplied with an Enviro-Seal and do not use vents. See (Enviro-Seal) under **Lubrication** for further information.
3. **WASHGUARD® (BISSC)** and **ALL-STAINLESS STEEL** reducers include synthetic oil and an Enviro-Seal pre-installed at the factory. It is not necessary to vent these units, and they can be used as supplied from the factory. Do not loosen the nut holding the stem of the Enviro-Seal, and do not block the hole in the stem. Do not blow pressurized air into the hole, and avoid spraying washdown chemicals directly into the hole.
4. Connect motor to speed reducer.

⚠WARNING Depending upon gear geometry and operating conditions worm gear reducers may or may not backdrive. Special consideration should be given to high inertia loads connected to the output shaft. Consult the factory for further details.

⚠CAUTION DO NOT CHANGE MOUNTING POSITIONS WITHOUT CONTACTING FACTORY.
Altering the mounting position may require special lubrication provisions which must be factory installed.

⚠CAUTION Do not operate the reducer without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, reducer or other equipment may result. **WASHGUARD®** and **ALL-STAINLESS STEEL** reducers are lubed and sealed for life, so in most applications it will not be necessary to drain or re-fill the unit.

⚠CAUTION A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted either through a shaft-mounted arrangement, and any shaft mounted power transmitting device. *(e.g., sprockets, pulleys, couplings)*

⚠CAUTION For safe operation and to maintain the unit warranty, when changing a factory installed fastener for any reason, it becomes the responsibility of the person making the change to properly account for fastener grade, thread engagement, load, tightening torque and the means of torque retention.

Lubrication - Standard Units

With the exception of reducer sizes 870, 880 and 8100 (shipped dry), all standard worm reducers ordered from the factory are filled with synthetic lubricant to operate within a -10° to105° F ambient temperature range. Double reduction units have separate oil sumps and must be filled/checked independently. Prior to startup, verify that the oil is at the level shown on the drawings on page 5. If the ambient temperature will be outside of this range, drain and refill reducer with lubricant of proper viscosity prior to use.

Enviro-Seal: WASHGUARD® (BISSC) and **ALL-STAINLESS STEEL** reducers come standard with an Enviro-Seal and synthetic oil pre-installed at the factory. It is not necessary to vent these reducers, and they can be used as supplied from the factory.

⚠CAUTION In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction.

⚠CAUTION Do not mix different oils in the reducer. Oils should be compatible with Viton® seal material.

Instruction Manual

LEESON
OHIO GEAR

Lubrication

The reducer is properly filled at the factory with sufficient lubricant per customer specified mounting position. If position is not specified by customer, reducer will be filled to level in mounting position 1 (worm over) Reducer ordered with a "MOD" will be filled based on the factory assumed mounting position, mounting position should be specified with order to assure proper lubrication.

Factory Assumed Mounting Orientation	Applicable Unit Styles*	
Worm Over	B, T, F, H, FH, C D, DT, DF, DH, DFH DX, DXT, DXH, DXFH	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm
Worm Under	U DU	Single Reduction Double Reduction Worm-Worm
Vertical Output	VL, VH DVL, DVH DXVL, DXVH	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm
Vertical Input	J DJ DXJ	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm

* INCLUDES MOTORIZED COUPLING AND QUILL INPUT VERSIONS OF ALL STYLES LISTED

All standard IRONMAN® BY OHIO GEAR Worm Reducers are factory filled with MOBIL SHC-634 lubricant, a synthesized hydrocarbon formulated for long life and wide operating temperature range (-25°F to +220°F).
Change intervals: Standard compounded lubricants (non-synthetic) should be changed every six months or 2500 operating hours, whichever comes first. Factory installed synthetic lubricants should be changed only when performing maintenance that requires gearbox disassembly.

If oil must be replaced in IRONMAN® BY OHIO GEAR Worm Reducers, use only MOBIL SHC-634.

Do not confuse MOBIL SHC-634 with MOBILGEAR 634. MOBILGEAR 634 is an EP type gear oil NOT suitable for use in the IRONMAN® BY OHIO GEAR worm gear reducers.

SPECIAL LUBRICATION REQUIREMENTS - Size 830 & Larger
Please specify mounting position *with order* if any of the following applies:
1- Reducer is mounted with input or output shafts vertical
2- Input speed is less than 900 RPM
3- Reducer is mounted in inclined position
NOTE: The reducer may require modifications to assure proper lubrication in these applications.

For lubrication requirements of helical reducers (primaries of helical/worm reducers and ratio multipliers), refer to ratio multiplier maintenance manual or contact LEESON Electric.

Oil Capacities (ounces) - Standard Units

Mounting Position	UNIT SIZE													
	813	815	818	821	824	826	830	832	842	852	860	870*	880*	8100*
1-Worm Over	4	12	12	20	24	40	56	72	112	188	312	560	768	1152
2-Worm Under	8	16	20	28	40	60	84	108	152	304	328	524	820	1280
3-Vertical Output	4	16	16	28	32	48	68	88	128	248	320	332	460	640
4-Vertical Input	4	16	16	24	32	48	72	92	128	248	325	584	800	1200
5-Worm Over on Secondary Unit of Double Reduction	—	—	—	N/A	N/A	N/A	N/A	192	308	320	485	805	1144	1716

* Shipped dry

16 OZ.	=	1 PINT
2 PINTS	=	1 QUART
4 QUARTS	=	1 GALLON
1 GALLON	=	128 OZ.

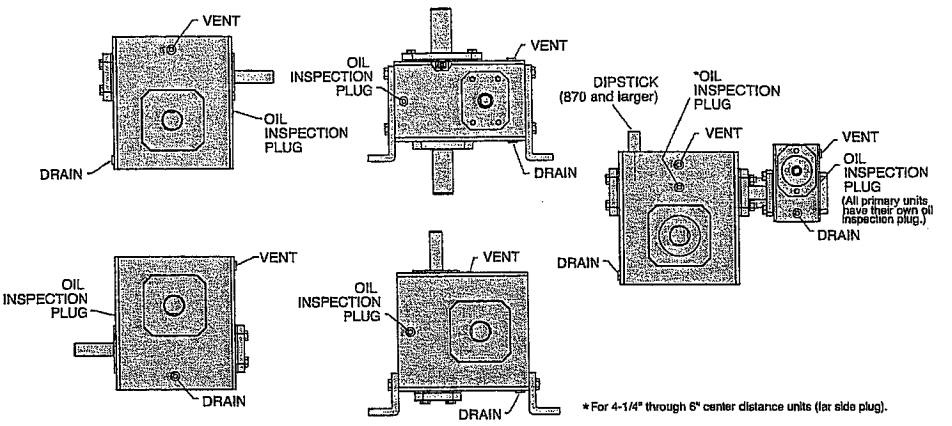
⚠CAUTION Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of level hole. Do not overfill.

LEESON
OHIO GEAR

Instruction Manual

IRONMAN BY OHIO GEAR

Standard Speed Reducer Mounting Positions & Vent Plug, Level and Drain Locations



Maintenance - Standard Units

Your IRONMAN® BY OHIO GEAR reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by LEESON to maintain the warranty.

Inspect vent plug or stem of the Environ-Seal (if equipped) often to insure it is clean and operating.

⚠CAUTION Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The IRONMAN® BY OHIO GEAR line of speed reducers utilize premium quality seals which are the state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can be easily accomplished by following the steps below:

1. Remove the worn seal without damaging the shaft surface or the seal bore. This can be done by drilling a .062" diameter hole in the seal casing (being careful not to drill into the bearing behind the seal). Screw a #10 sheet metal screw into the hole and pry out the seal.
2. Clean the seal bore of sealant.
3. Before installing the new seal, use electrical tape to cover any keyways on the shaft to prevent seal lip damage.
4. Grease the seal lips with bearing grease and apply a sealant to the seal bore.
5. Slide the seal over the shaft being careful not to fold the inner lip over on any shaft steps.
6. Press the seal into its bore with a sleeve that presses on the seal casing, being careful to keep the seal square in its bore.

If seal leakage has resulted in the loss of a significant amount of oil, it may be necessary to add more lubricant. For normal ambient temperature conditions, LEESON recommends Mobil SHC 634 synthetic gear oil for worm drives, and MOBILGEAR 629 (non-synthetic) oil for helical drives.

⚠CAUTION Always check for proper oil level after filling. Do not overfill or underfill with oil, or injury to personnel, reducer, or other equipment may result.

⚠CAUTION Do not mix different oils in the reducer. Oils should be compatible with Viton® seal material.

Instruction Manual

Maintenance - WASHGUARD® and ALL-STAINLESS STEEL Reducers

Your **LEESON WASHGUARD®** and **ALL-STAINLESS STEEL** reducer has been tested and adjusted at the Factory. Dismantling or replacement of components must be done by LEESON to maintain the warranty.

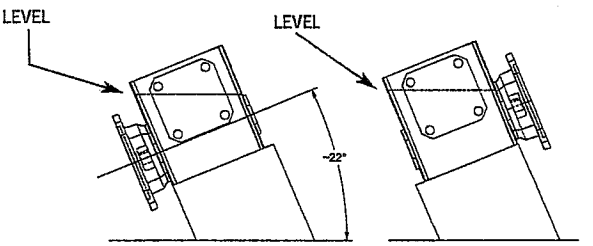
Inspect the stem of the Enviro-Seal often to ensure it is clean and operating properly.

⚠CAUTION Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The LEESON line of speed reducers utilize premium quality seals which are state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can easily be accomplished by following the procedure given under Maintenance - Standard Units on page 5.

If seal leakage has resulted in the loss of a significant amount of oil, it may be necessary to add more lubricant. For normal ambient temperature conditions, LEESON recommends Mobil SHC 634 synthetic gear oil for worm drives, and Mobil SHC 150 (synthetic) for helical drives. For all **WASHGUARD®** and **ALL-STAINLESS STEEL** worm drives, fill the gearbox to the level indicated in the diagram below.

Standard Oil Level for LEESON WASHGUARD® and ALL-STAINLESS STEEL Reducers



⚠CAUTION Always check for proper oil level after filling. Do not overfill or underfill with oil, or injury to personnel, reducer, or other equipment may result.

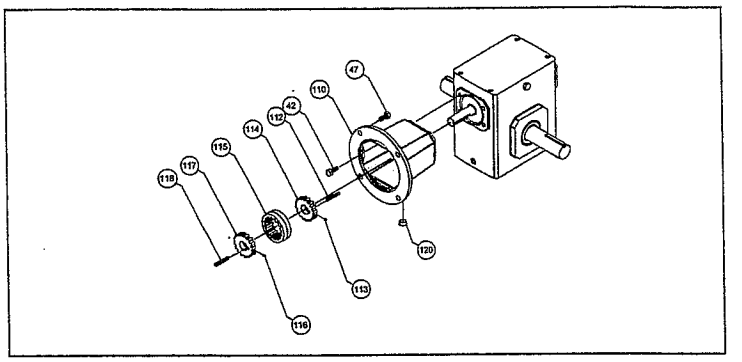
⚠CAUTION Do not mix different oils in the reducer. Oils should be compatible with Viton® seal material.

LEESON
OHIO GEAR

Instruction Manual

IRONMAN BY OHIO GEAR

Installation of "C" Flange Adapter Kits With Flexible Couplings (BM Style)



These instructions must be followed for proper installation of "C" Flange Adapter and Motor onto IRONMAN® BY OHIO GEAR Worm Reducers. These reducers have input ball bearings mounted directly in the housing, and no bearing cap on the input shaft side.

1. Make sure reducer pilot and face, and flange pilot and face are clean.
2. Install "C" Flange Adapter (ref. 110) onto reducer, being careful not to damage seal.
3. Install capscrews (ref. 42) and tighten to torque specified in tightening torque chart on page 6.
4. Install key (ref. 112) in the input shaft, key should be flush with shaft end. Install coupling hub (ref. 114) flush with end of reducer shaft.
5. Rotate input shaft of reducer to position the set screw (ref. 113) in line with access hole provided in the "C" flange adapter, tighten set screw (make sure key is properly in place under set screw).
6. Slide plastic sleeve (ref. 115) over reducer hub until it comes to a stop.
7. **Discard motor key** and install key supplied in kit (ref. 118) flush with motor shaft end. Install coupling hub (ref. 117) flush with end of motor shaft and tighten set screw (ref. 116), make sure key is under set screw.
8. Install motor by sliding hub into sleeve until it comes to a stop. Install capscrews (ref. 47) and tighten to torque specified on tightening torque chart.
9. **Install plastic plug (ref. 120) into the "C" Flange Adapter access hole.**

Items Included in "C" Flange Adapter Kit

1. One "C" Flange Adapter (ref. 110)
2. Four capscrews (ref. 42) adapter to reducer
3. One reducer coupling hub (ref. 114)
4. One reducer input key (ref. 112)
5. One reducer hub set screw (ref. 113)
6. Four capscrews (ref. 47), motor to adapter
7. One coupling sleeve (ref. 115)
8. One motor coupling hub (ref. 117)
9. One motor shaft key (ref. 118)
10. One motor hub set screw (ref. 116)
11. One access hole plug (ref. 120)

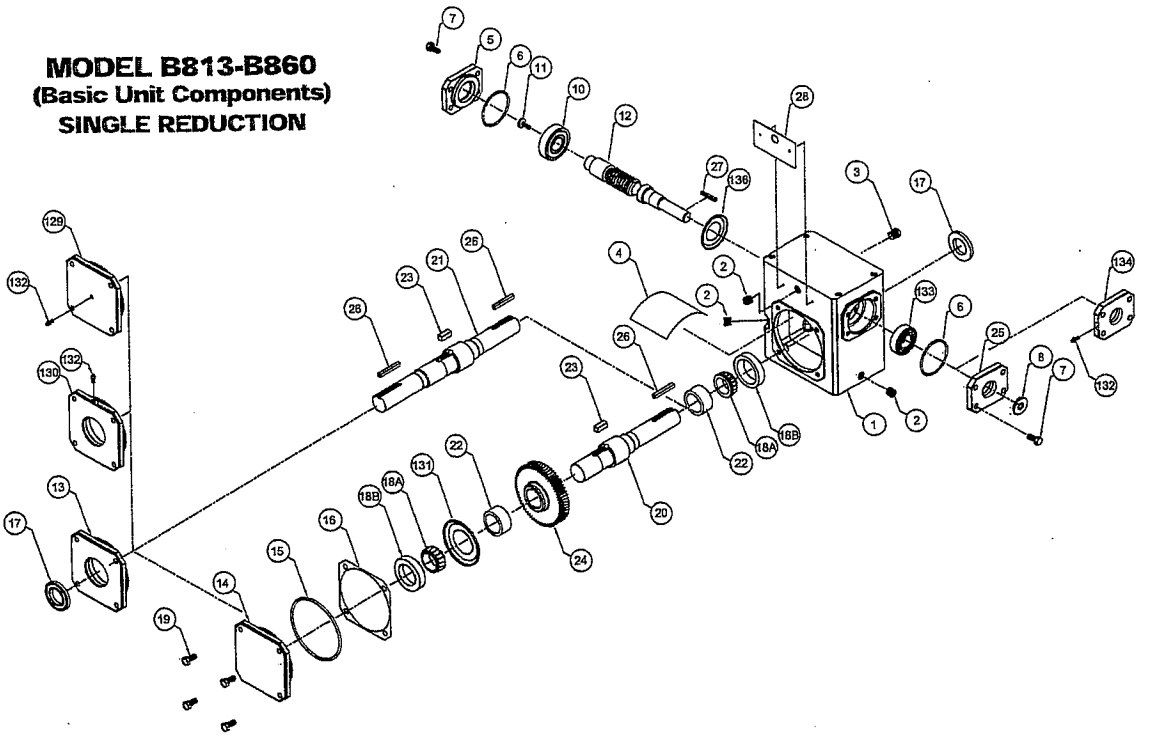
Capscrew Tightening Torque
Grade 5 Capscrews (dry, without lubricant)

Capscrew Size	Tightening Torque (lb.-in.)
1/4 UNC	75
5/16 UNC	155
3/8 UNC	275
1/2 UNC	780

Parts List

LEESON
OHIO GEAR

MODEL B813-B860
(Basic Unit Components)
SINGLE REDUCTION



BASIC SINGLE REDUCTION UNIT (B-STYLE)

ITEM # DESCRIPTION

1 HOUSING
2 PIPE PLUG
3 VENT PLUG
4 SPLASH GUARD
5 INPUT CAP
6 O-RING
7 HEX HEAD CAP SCREW
8 INPUT OIL SEAL
9 INPUT BEARING (cup and cone for 842 and larger units)
10 INPUT BEARING (cup and cone for 842 and larger units)
■11 RETAINING SCREW
12 INPUT WORM SHAFT
13 OUTPUT COVER - OPEN
14 OUTPUT COVER - CLOSED
15 O-RING
16 OUTPUT COVER SHIM (as required)
17 OUTPUT OIL SEAL
18 OUTPUT BEARING (18A. CONE, 18B. CUP)
19 HEX HEAD CAP SCREW
♣20 OUTPUT SHAFT - SINGLE
♣21 OUTPUT SHAFT - DOUBLE
22 GEAR SPACER
23 GEAR KEY (only used on size 826 and larger units)
♣24 OUTPUT GEAR
*25 INPUT COVER
26 KEY - OUTPUT EXTENSION
27 KEY - INPUT EXTENSION
28 NAMEPLATE

QUILL MOTOR FLANGE UNIT (BMQ-STYLE)

40 QUILL MOTOR FLANGE
41 INPUT OIL SEAL
42 HEX HEAD CAP SCREW (flange to housing)
43 RETAINING RING - SHAFT
*44 RETAINING RING - HOUSING
45 QUILL INPUT SHAFT
46 KEY - INPUT
47 HEX HEAD CAP SCREW (motor to flange)

HOLLOW OUTPUT SHAFT UNIT (H-STYLE)

51 OUTPUT COVER
52 OUTPUT OIL SEAL
53 OUTPUT BEARING (53A. CONE, 53B. CUP)
54 GEAR SPACER
♣55 OUTPUT SHAFT
56 SETSCREW
57 GEAR KEY (only used on size 826 and larger units)
♣58 OUTPUT GEAR
59 OUTPUT KEY

LONG MOTOR FLANGE AND COUPLING KIT (BM-STYLE)

110 "C" FACE MOTOR FLANGE
111 HEX HEAD CAP SCREW (flange to housing)
112 COUPLING KEY - REDUCER SHAFT
113 SETSCREW - REDUCER SHAFT
114 COUPLING GEAR - REDUCER SHAFT
115 COUPLING SLEEVE
116 SETSCREW - MOTOR SHAFT
117 COUPLING GEAR - MOTOR SHAFT
118 COUPLING KEY - MOTOR SHAFT
119 HEX HEAD CAP SCREW (motor to flange)
120 PLASTIC PLUG

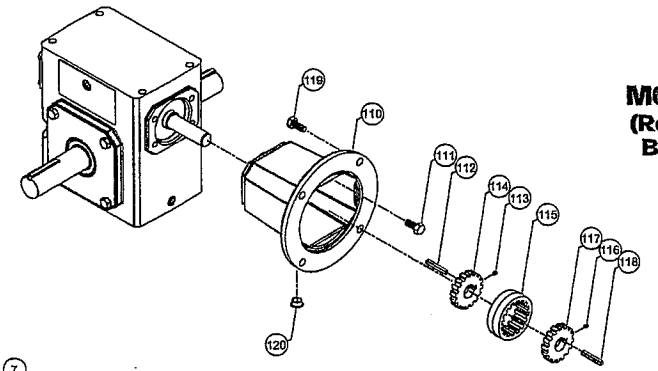
VERTICAL SHAFT REQUIRED PARTS (supplied only when mounting position involves a vertical shaft)

*129 OUTPUT COVER - CLOSED
*130 OUTPUT COVER - OPEN
*131 OUTPUT BEARING GREASE RETAINER
132 GREASE FITTING
133 SEALED BALL BEARING (only used on size 818 thru 826 units)
♦134 INPUT COVER
♦136 INPUT BEARING GREASE RETAINER

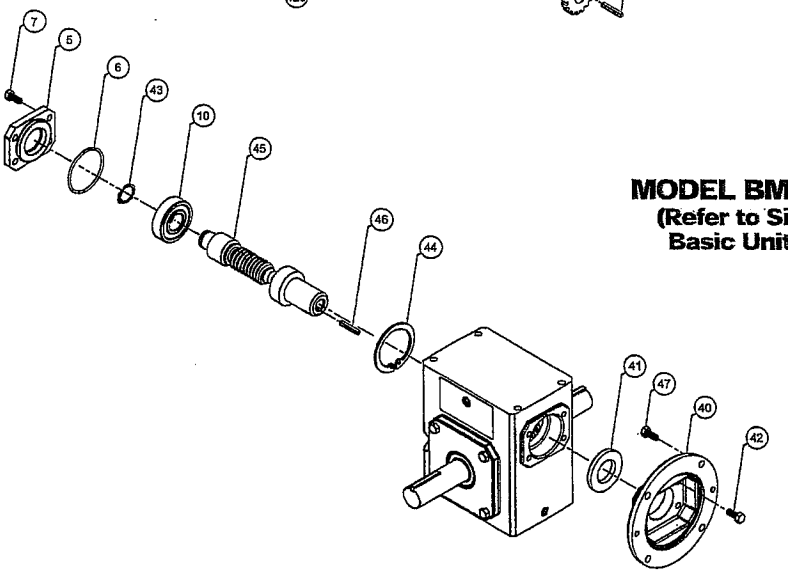
* ONLY USED ON SIZE 842 AND LARGER UNITS
♦ ONLY USED ON SIZE 830 AND LARGER UNITS
♣ SUPPLIED ONLY AS OUTPUT ASSEMBLY ON 813 THROUGH 824 UNITS
■ ONLY USED ON SIZES 813 - 832

LEESON
OHIO GEAR

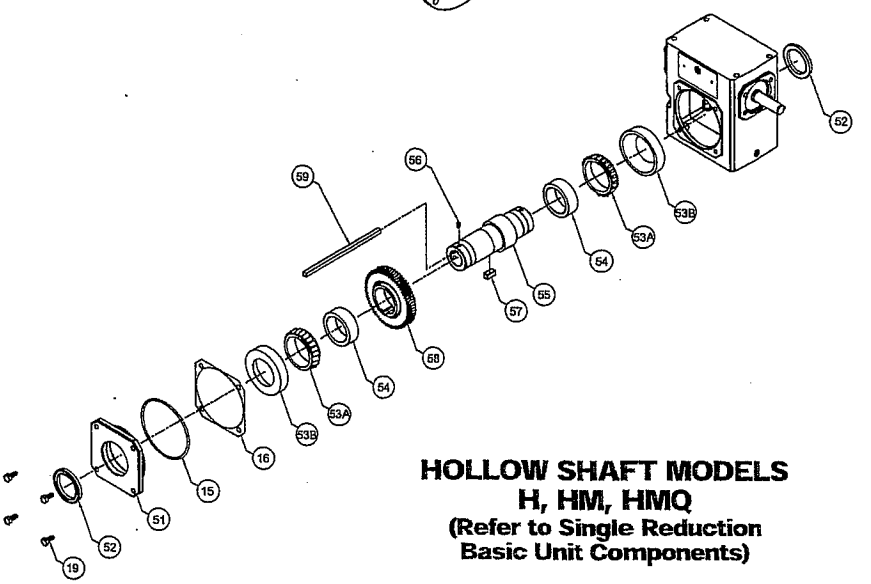
Parts List



MODEL BM813-BM860
(Refer to Single Reduction Basic Unit Components)



MODEL BMQ813-BMQ860
(Refer to Single Reduction Basic Unit Components)

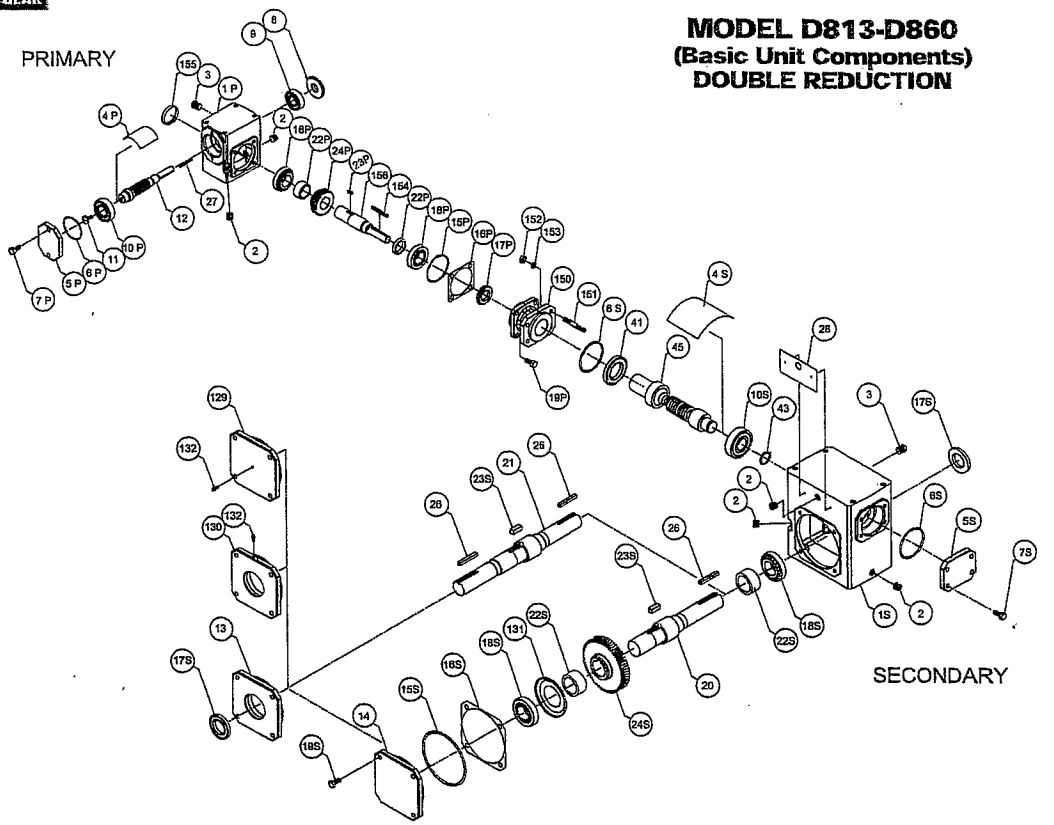


HOLLOW SHAFT MODELS
H, HM, HMQ
(Refer to Single Reduction Basic Unit Components)

Parts List

LEESON
OHIO GEAR

MODEL D813-D860
(Basic Unit Components)
DOUBLE REDUCTION



DOUBLE REDUCTION UNIT (D-STYLE)

ITEM #	DESCRIPTION
1	HOUSING
2	PIPE PLUG
3	VENT PLUG
4	SPLASH GUARD
5	INPUT CAP
6	O-RING
7	HEX HEAD CAP SCREW
8	INPUT OIL SEAL
9	INPUT BEARING (cup and cone for 842 and larger units)
10	INPUT BEARING (cup and cone for 842 and larger units)
■11	RETAINING SCREW
12	INPUT WORM SHAFT
13	OUTPUT COVER - OPEN
14	OUTPUT COVER - CLOSED
15	O-RING
16	OUTPUT COVER SHIM (as required)
17	OUTPUT OIL SEAL
18	OUTPUT BEARING (18A. CONE, 18B. CUP)
19	HEX HEAD CAP SCREW
♣20	OUTPUT SHAFT - SINGLE
♣21	OUTPUT SHAFT - DOUBLE
22	GEAR SPACER
23	GEAR KEY (only used on size 826 and larger units)
♣24	OUTPUT GEAR
26	KEY - OUTPUT EXTENSION
27	KEY - INPUT EXTENSION
28	NAMEPLATE
41	INPUT OIL SEAL
43	RETAINING RING - SHAFT
45	QUILL INPUT SHAFT
150	DOUBLE REDUCTION ADAPTER
151	STUD
152	HEX NUT
153	LOCK WASHER
154	PRIMARY SOLID OUTPUT KEY
155	EXPANSION PLUG
156	PRIMARY SOLID OUTPUT SHAFT

QUILL MOTOR FLANGE UNIT (DMQ-STYLE)

40	QUILL MOTOR FLANGE
41	INPUT OIL SEAL
42	HEX HEAD CAP SCREW (flange to housing)
43	RETAINING RING - SHAFT
*44	RETAINING RING - HOUSING
45	QUILL INPUT SHAFT
46	KEY - INPUT
47	HEX HEAD CAP SCREW (motor to flange)

HOLLOW OUTPUT SHAFT UNIT (H-STYLE)

51	OUTPUT COVER
52	OUTPUT OIL SEAL
53	OUTPUT BEARING (53A. CONE, 53B. CUP)
54	GEAR SPACER
♣55	OUTPUT SHAFT
56	SETSCREW
57	GEAR KEY (only used on size 826 and larger units)
♣58	OUTPUT GEAR
59	OUTPUT KEY

LONG MOTOR FLANGE AND COUPLING KIT (BM-STYLE)

110	"C" FACE MOTOR FLANGE
42	HEX HEAD CAP SCREW (flange to housing)
112	COUPLING KEY - REDUCER SHAFT
113	SETSCREW - REDUCER SHAFT
114	COUPLING GEAR - REDUCER SHAFT
115	COUPLING SLEEVE
116	SETSCREW - MOTOR SHAFT
117	COUPLING GEAR - MOTOR SHAFT
118	COUPLING KEY - MOTOR SHAFT
47	HEX HEAD CAP SCREW (motor to flange)
120	PLASTIC PLUG

VERTICAL SHAFT REQUIRED PARTS
(supplied only when mounting position involves a vertical shaft)

*129	OUTPUT COVER - CLOSED
*130	OUTPUT COVER - OPEN
*131	OUTPUT BEARING GREASE RETAINER
132	GREASE FITTING
133	SEALED BALL BEARING (only used on size 818 thru 826 units)
♦134	INPUT COVER
♦136	INPUT BEARING GREASE RETAINER

* ONLY USED ON SIZE 842 AND LARGER UNITS

♦ ONLY USED ON SIZE 830 AND LARGER UNITS

♣ SUPPLIED ONLY AS OUTPUT ASSEMBLY ON 813 THROUGH 824 UNITS

■ ONLY USED ON SIZES 813 - 832

P - PRIMARY

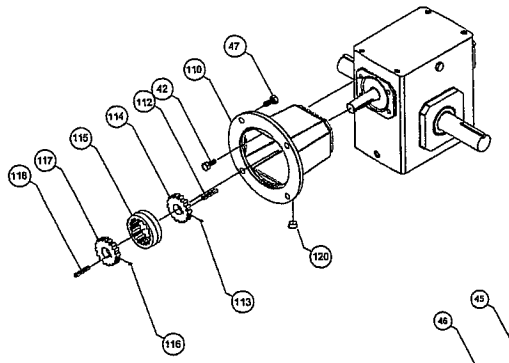
S - SECONDARY

LEESON
OHIO GEAR

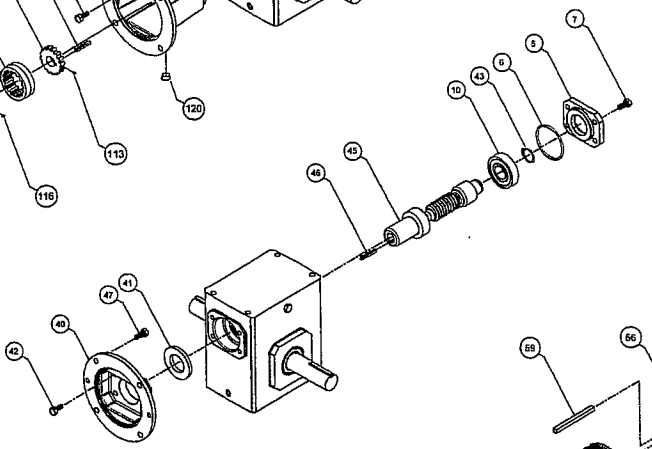
Parts List

IRONMAN BY OHIO GEAR

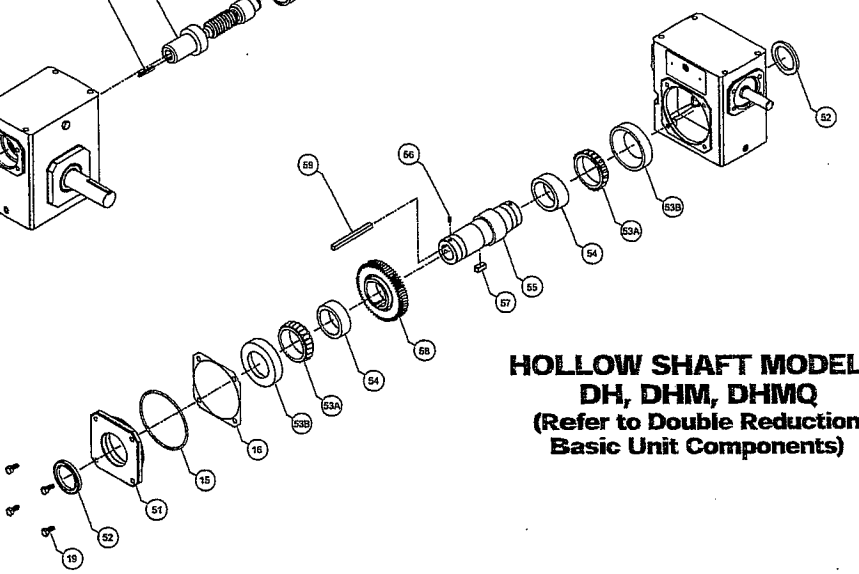
MODEL DM813-DM860
(Refer to Double Reduction Basic Unit Components)



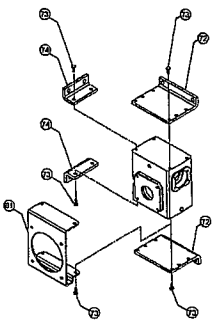
MODEL DMQ813-DMQ852
(Refer to Double Reduction Basic Unit Components)



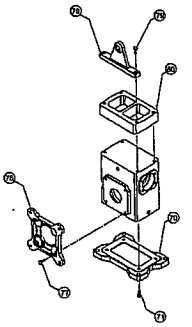
HOLLOW SHAFT MODELS DH, DHM, DHMQ
(Refer to Double Reduction Basic Unit Components)



STEEL MOUNTING ACCESSORIES

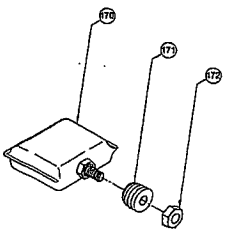


CAST MOUNTING ACCESSORIES



MOUNTING BRACKET OPTIONS			
70	HORIZONTAL MOUNTING BASE	77	HEX HEAD CAP SCREW
71	CAP SCREW	78	TORQUE BRACKET
72	HIGH AND LOW V-BRACKETS	79	HEX HEAD CAP SCREW
73	HEX HEAD CAP SCREW	80	RISER BLOCK
74	"J" MOUNT BRACKET	81	"FB" OUTPUT FLANGE (bent steel - only available thru size 826, excluding 815 units)
75	"F" OUTPUT FLANGE (CAST)		

ENVIRO-SEAL

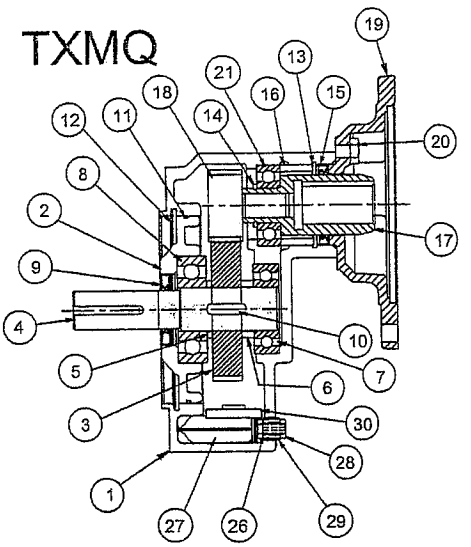


ENVIRO-SEAL ASSEMBLY	
170	ENVIRO-SEAL CHAMBER
171	ENVIRO-SEAL STEM PLUG
172	ENVIRO-SEAL STEM NUT

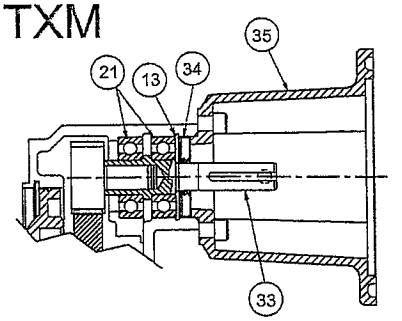
Parts List
Ratio Multipliers

LEESON
OHIO GEAR

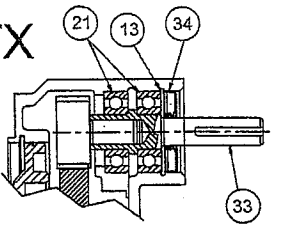
TXMQ



TXM



TX



TXMQ 1, 2 & 3 PARTS LIST;

ITEM #	DESCRIPTION
1	HOUSING
2	COVER, OUTPUT
3	GEAR, OUTPUT
4	OUTPUT SHAFT
5	SPACER, OUTPUT
6	SPACER, OUTPUT
7	BEARING, OUTPUT
8	BEARING, OUTPUT
9	SEAL, OUTPUT
10	KEY, OUTPUT
11	"O" RING, OUTPUT
12	SNAP RING, OUTPUT
13	SNAP RING, INPUT
14	SNAP RING, INPUT
15	SEAL, INPUT
16	SPACER, INPUT
17	QUILL, COUPLING
18	PINION, INPUT

ITEM #	DESCRIPTION
19	FLANGE, QUILL INPUT
20	BOLT, INPUT
21	BEARING, INPUT
26	"O" RING, INT. PRES. COMP.
27	INT. PRES. COMPENSATION
28	NUT, INT. PRES. COMP.
29	PLUG, STEM
30	SPLASH GUARD

*WASHGUARD® styles only.

TX & TXM (2 & 3) PARTS LIST
(SOLID INPUT)

ITEM #	DESCRIPTION
33	SHAFT, INPUT
34	SEAL, INPUT
35	FLANGE, MOTOR (TXM ONLY)

Class of Service

All capacity ratings are based on proper application of American Gear Manufacturers Association (AGMA) service factors as given on page 174 of the IRONMAN® BY OHIO GEAR 8050 Catalog. Load conditions must be within cataloged ratings published in the current LEESON Catalog (available upon request).

Warranty From LEESON Electric - See 8050 catalog pages 185-187 for warranty terms and conditions.

LEESON ELECTRIC
A REGAL-BELOIT COMPANY
GRAFTON, WISCONSIN 53024-0241 U.S.A.
TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

REV3 5285S/20K/3-06/TP/BH

LEESON®

ELECTRIC MOTORS
GEARMOTORS AND DRIVES

Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

Problem:	Like Causes:	What To Do:
Motor fails to start upon initial installation.	Motor is miswired.	Verify motor is wired correctly.
	Motor damaged and rotor is striking stator.	May be able to reassemble; otherwise, motor should be replaced.
	Fan guard bent and contacting fan.	Replace fan guard.
Motor has been running, then fails to start.	Fuse or circuit breaker tripped.	Replace fuse or reset the breaker.
	Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip.	Disassemble motor and inspect windings and internal connections. A blown stator will show a burn mark. Motor must be replaced or the stator rewound.
	Motor overloaded or load jammed.	Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating.
	Capacitor (on single phase motor) may have failed.	First discharge capacitor. To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals. If capacitor is OK, needle will jump to zero ohms, and drift back to high. Steady zero ohms indicates a short circuit; steady high ohms indicates an open circuit.
	Starting switch has failed.	Disassemble motor and inspect both the centrifugal and stationary switches. The weights of the centrifugal switch should move in and out freely. Make sure that the switch is not loose on the shaft. Inspect contacts and connections on the stationary switch. Replace switch if the contacts are burned or pitted.
Motor runs but dies down.	Voltage drop.	If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor.
	Load increased.	Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the air flow hasn't changed.
Motor takes too long to accelerate.	Defective capacitor	Test capacitor per previous instructions.
	Faulty stationary switch.	Inspect switch contacts and connections. Verify that switch reeds have some spring in them.
	Bad bearings.	Noisy or rough feeling bearings should be replaced.
	Voltage too low.	Make sure that the voltage is within 10% of the motor's name-plate rating. If not, contact power company or check if some other equipment is taking power away from the motor.
Motor runs in the wrong direction.	Incorrect wiring.	Rewire motor according to wiring schematic provided.
Motor overload protector continually trips.	Load too high.	Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate.
	Ambient temperature too high.	Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40°C. (Note: A properly operating motor may be hot to the touch.)
	Protector may be defective.	Replace the motor's protector with a new one of the same rating.
	Winding shorted or grounded.	Inspect stator for defects, or loose or cut wires that may cause it to go to ground.

Motor Trouble-Shooting Chart

10/13/00 (continued)

Problem:	Like Causes:	What To Do:
Motor vibrates.	Motor misaligned to load.	Realign load.
	Load out of balance. (Direct drive application.)	Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is .001" runout per every inch of shaft length.
	Motor bearings defective.	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Replace bearings. Add oil if a sleeve of bearing. Add grease if bearings have grease fittings.
	Rotor out of balance.	Inspect motor by itself with no load attached. If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory. Rotor must be replaced or rebalanced.
	Motor may have too much endplay.	With the motor disconnected from power turned shaft. It should move but with some resistance. If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming.
	Winding may be defective.	Test winding for shorted or open circuits. The amps may also be high. Replace motor or have stator rewound.
Bearings continuously fail.	Load to motor may be excessive or unbalanced.	Besides checking load, also inspect drive belt tension to ensure it's not too tight may be too high. An unbalanced load will also cause the bearings to fail.
	High ambient temperature.	If the motor is used in a high ambient, a different type of bearing grease may be required. You may need to consult the factory or a bearing distributor.
The motor, at start up, makes a loud rubbing or grinding noise.	Rotor may be striking stator.	Ensure that motor was not damaged in shipment. Frame damage may not be repairable. If you cannot see physical damage, inspect the motor's rotor and stator for strike marks. If signs of rubbing are present, the motor should be replaced. Sometimes simply disassembling and reassembling motor eliminates rubbing. Endbells are also sometimes knocked out of alignment during transportation.
Start capacitors continuously fail.	The motor is not coming up to speed quickly enough.	Motor may not be sized properly. Verify how long the motor takes to come up to speed, Most single phase capacitor start motors should come up to speed within three seconds. Otherwise the capacitors may fail.
	The motor is being cycled too frequently.	Verify duty cycle. Capacitor manufacturers recommend no more than 20, three-second starts per hour. Install capacitor with higher voltage rating, or add bleed resistor to the capacitor.
	Voltage to motor is too low.	Verify that voltage to the motor is within 10% of the nameplate value. If the motor is rated 208-230V, the deviation must be calculated from 230V.
	Starting switch may be defective, preventing the motor from coming out of start winding.	Replace switch.
Run capacitor fail.	Ambient temperature too high.	Verify that ambient does not exceed motor's nameplate value.
	Possible power surge to motor, caused by lightning strike or other high transient voltage.	If a common problem, install surge protector.

P/N 8-078-905-68
effective 03/25/2005

ELECTRIC MOTORS
GEARMOTORS AND DRIVES

Installation and Service Instructions for 56/143-5TC Double C-Face Coupler

For replacement parts refer to sheet part number 8-078-906-07. Instructions and parts list also available at **www.rexnord.com/stearns.**

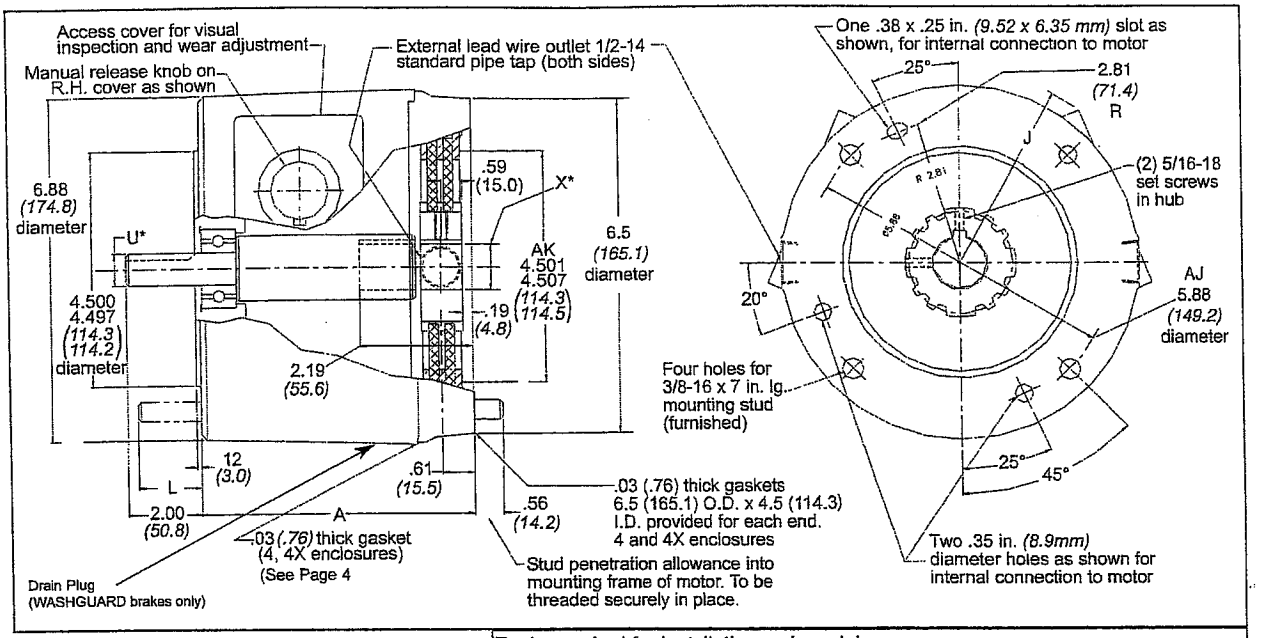


Figure 1

Tools required for installation and servicing:

3/8" hex wrench	5/16" nut driver	5/16" hex wrench	Torque wrench
1/4" screwdriver	3/16" hex wrench	8" adjustable wrench	

Important

Please read these instructions carefully before installing, operating, or servicing your brake. Failure to comply with these instructions could cause injury to personnel and/or damage to property if the brake is installed or operated incorrectly. For definition of limited warranty/liability, contact Leeson Electric Corporation, P.O. Box 241, 2100 Washington Street, Grafton, WI 53024-0241, (262) 377-8810.

Caution

1. Installation and servicing must be made in compliance with all local safety codes including Occupational Safety and Health Act (OSHA). All wiring and electrical connections must comply with the National Electric Code (NEC) and local electric codes in effect.
2. Do not operate the brake in atmospheres containing explosive gases or dusts.
3. To prevent an electrical hazard, disconnect power source before working on the brake. If power disconnect point is out of sight, lock disconnect in the *off* position and tag to prevent accidental application of power.
4. Make certain power source conforms to the requirements specified on the brake nameplate.
5. Be careful when touching the exterior of an operating brake. Allow sufficient time for brake to cool before disassembly. Surfaces may be hot enough to be painful or cause injury.
6. Do not operate brake with housing removed. All moving parts should be guarded.
7. Installation and servicing should be performed only by qualified personnel familiar with the construction and operation of the brake.
8. For proper performance and operation, only genuine Stearns parts should be used for repairs and replacements.
9. After usage, the brake interior will contain burnt and degraded friction material dust. This dust must be removed before servicing or adjusting the brake.

   DO NOT BLOW OFF DUST using an air hose. It is important to avoid dispersing dust into the air or inhaling it, as this may be dangerous to your health.

   a) Wear a filtered mask or a respirator while removing dust from the inside of a brake.

   b) Use a vacuum cleaner or a soft brush to remove dust from the brake. When brushing, avoid causing the dust to become airborne. Collect the dust in a container, such as a bag, which can be sealed off.
10. **Caution!** While the brake is equipped with a manual release to allow manual shaft rotation, the motor should not be run with the manual release engaged, to avoid overheating the friction disc(s).

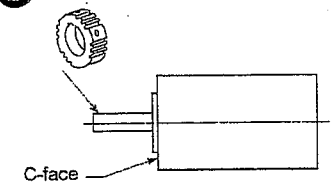
Warning! Do not apply overhung or side load to brake output shaft

General Description

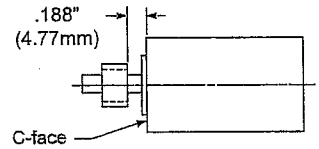
The 56,700 Series coupler is a spring-set, electrically released brake, containing either one or more rotating friction discs (4) driven by a hub (16) mounted on the motor shaft. The double C-face allows the brake to directly couple a C-face motor to a C-face gear reducer.

BRAKE MOUNTING (Manual Adjust)

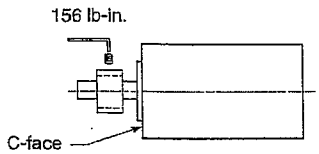
1 Place hub on motor shaft.



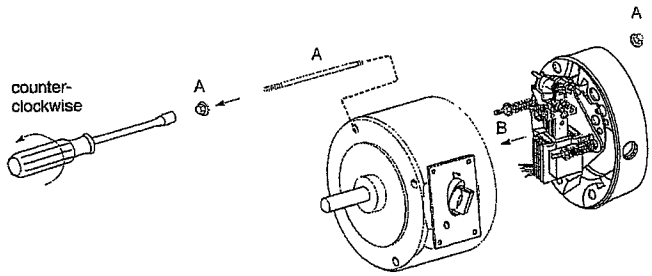
2 Position hub on shaft as shown.



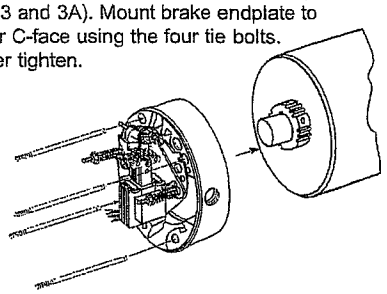
3 Tighten set screws to motor shaft.



4 A. Remove housing nuts and slide tie bolt out of brake.
B. Remove housing from endplate.

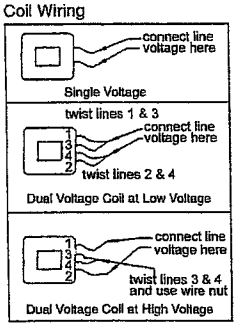


5 Slide endplate over hub noting position of stabilizer clips, if used. (Refer to Friction Disc Replacement view 3 and 3A). Mount brake endplate to motor C-face using the four tie bolts. Finger tighten.



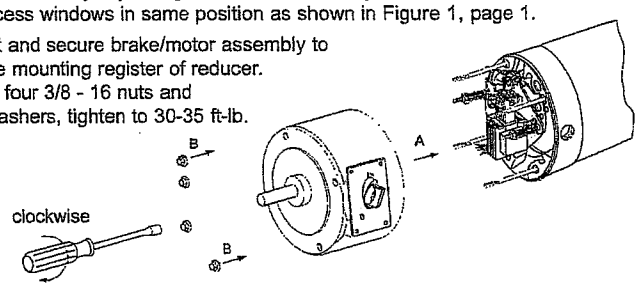
6 Connect coil lead-wires to power supply. Refer to nameplate for voltage rating.* **Caution**: Keep wiring away from pinch points and moving components.

Coil Wiring



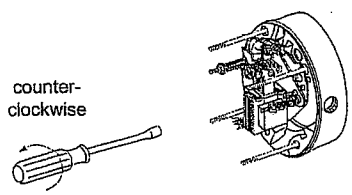
7 A. Slide housing and shaft assembly onto mounting studs, rotating shaft until keyway is aligned. Be sure housing is assembled with access windows in same position as shown in Figure 1, page 1.

B. Mount and secure brake/motor assembly to C-face mounting register of reducer. Using four 3/8 - 16 nuts and lockwashers, tighten to 30-35 ft-lb.

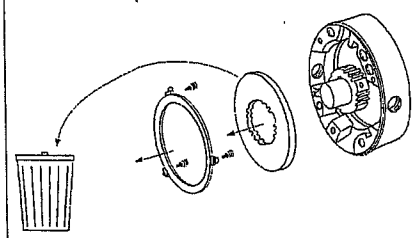


FRICTION DISC REPLACEMENT SERIES

1 Remove support plate screws and lift support from brake

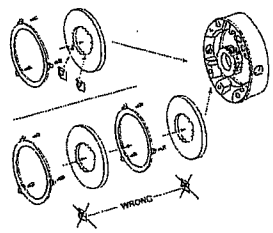


2 Remove and discard old friction disc.

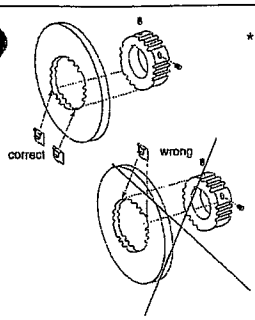


3 Install new friction disc(s) and stationary disc(s) as shown.

For brakes with vertical springs see *Vertical Spring Assembly Section.*

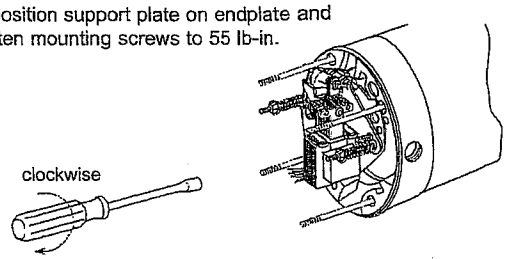


3A



*** Stabilizer clips are for use on single disc units only. Position clips opposite set screw holes.**

4 Reposition support plate on endplate and tighten mounting screws to 55 lb-in.



Note: Friction discs can wear to 1/2 their original thickness, or .093"

AIR GAP ADJUSTMENT

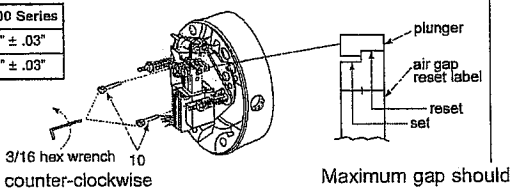
As friction disc wear the air gap will increase. When plunger gets to the reset position, the air gap must be adjusted.

1 To **increase** air gap, turn both adjusting screws (10) counterclockwise.

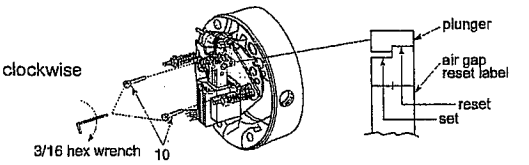
Air Gap Settings*

Torque (lb-ft)	56,X00 Series
3 & 6	.38" ± .03"
10 & 15	.45" ± .03"

*For reference only

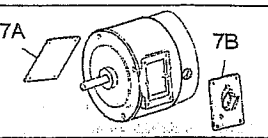


2 To **decrease** air gap, turn both adjusting screws (10) clockwise.



Maximum gap should never exceed .80".

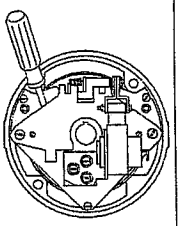
Note: Air gap can be adjusted witout disassembly. Remove cover plate (7A) and manual release plate (7B) and adjust as shown above.



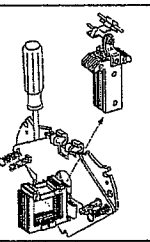
COIL REPLACEMENT SERIES

Remove housing and disconnect power and wiring to coil.

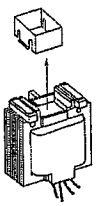
1 Insert screwdriver between support plate and lever arm and pry forward.



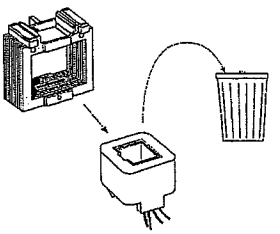
2 Lift plunger/solenoid lever assembly out of coil.



3 Remove plunger guide.

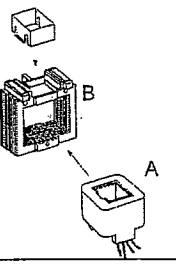


4 Discard coil.

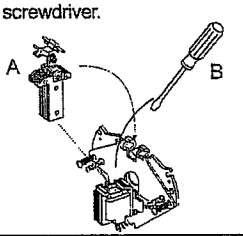


5

A) Insert new coil. (Lead wires in same position as old coil.)
B) Insert plunger guide.



6 A) Re-insert plunger into coil; drop pivot pin into cradle of support plate.
B) Remove screwdriver.



Reconnect coil and replace housing per installation instructions, page 2.

VERTICAL SPRING ASSEMBLY

Vertical Brake Assembly

Single disc brakes (3 & 6 lb-ft) are universal mount and do not require separator springs. Double disc brakes (10-15 lb-ft.) are universal mount but require separator springs which are preassembled to the stationary disc. These discs are inserted spring first into the brake. Refer to figure 2A.

2 Friction Disc

Vertical Above
Vertical Below

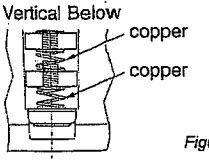


Figure 2A

TORQUE ADJUSTMENT

Torque Adjustment

Brake is factory set for nominal rated static torque which is maximum torque. Torque may be decreased up to 50% for increased stopping times up to 2 second stop time.

Turn both spring adjustment screws (11), Figure 3, equal amounts counterclockwise to decrease torque. See Table A for torque reduction permissible amounts.

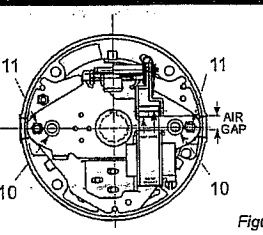


Figure 3

Table A

Nominal Static Torque (lb-ft)	Original Spring Height (inches)	Maximum Counter-clockwise Turns	% Torque Reduction per Turn
3	1.50"	5-1/2	9%
6	1.50"		
10	1.56"		
15	1.56"		

TROUBLESHOOTING

COIL FAILURE

SUPPLY VOLTAGE CAUSE	SUPPLY VOLTAGE CORRECTION
Line voltage >110% of coil rating	Reduce voltage or replace with proper rated coil
Excessive voltage drop during inrush time	Increase current rating of power supply.
WIRING CAUSE	**WIRING CORRECTION**
Leadwires interfering with plunger pull-in	Reroute wiring away from plunger and other moving components.
Excessive voltage drop during inrush time	Increase leadwires size from power supply
Coil leadwire shorted to ground	Replace coil or leadwire and protect with wire sleeving
SOLENOID ASSEMBLY CAUSE	**SOLENOID ASSEMBLY CORRECTION**
Plunger not seating flush against solenoid frame	Loosen solenoid mounting screws and reposition frame to allow full face contact
Plunger cocked in coil preventing pull-in	Realign solenoid frame
Excessive solenoid/plunger wear at mating surface	Replace solenoid assembly
Broken shading coils	Replace solenoid assembly
WORN PARTS CAUSE	**WORN PARTS CORRECTION**
Excessive wear of solenoid link arm and/or shoulder bolt	Replace link arm and link bolt; also inspect plunger thru-hole for elongation
Plunger guides worn down and interfering with plunger movement	Replace guides
APPLICATION CAUSE	**APPLICATION CORRECTION**
Machinery cycle rate is exceeding brake rating	Reduce brake cycle rate or use alternate control method
High ambient temperature (>110%) and thermal load exceeding coil insulation rating	Use Class H rated coil and /or find alternate method of cooling brake
Brake coil wired with windings of an inverter motor or other voltage/current limiting device	Wire coil to dedicated power source with instantaneous coil rated voltage
MISCELLANEOUS CAUSE	**MISCELLANEOUS CORRECTION**
Wrong or over tightened torque	Replace with proper spring or refer to Installation section for proper spring height
Excessive air gap	Reset, refer to Installation Section 4

EXCESSIVE WEAR / OVERHEATING

AIR GAP CAUSE	AIR GAP CORRECTION
Low solenoid air gap	Reset air gap (refer to Air Gap Adjustment)
Disc pack dragging	Inspect endplate, hub and discs for dirt, burrs, wiring and other sources of interference preventing disc "float"
CYCLE RATE CAUSE	**CYCLE RATE CORRECTION**
Brake "jogging" exceeding coil cycle rate	Reduce cycle rate or consider alternate control method
Thermal capacity is being exceeded	Reduce cycle rate, use alternate control method or increase brake size
ALIGNMENT CAUSE	**ALIGNMENT CORRECTION**
Broke endplate not concentric to motor C-Face	Motor register must be within .004" on concentricity;
Motor shaft runout is excessive	Must be within .002"; runout; consult motor manufacturer
Brake is being operated on a incline greater than 15° above or below horizontal	Vertical separator springs must be used to prevent discs from becoming cocked
WORN PARTS CAUSE	**WORN PARTS CORRECTION**
Friction disc excessively worn (disc can wear to 1/2 original thickness or .093")	Replace friction discs.
Endplate, stationary disc or pressure plate warped	Replace warped or worn component
Linkages and/or pivot pins worn	Replace all worn components
Motor shaft endfloat excessive	Endfloat must not exceed .020"; consult motor manufacturer
HUB CAUSE	**HUB CORRECTION**
Burr on hub interfering with disc "float"	File off burr
Set screw backed out and interfering with disc.	Retighten set screw; use Loctite® 242 to help secure
MISCELLANEOUS	**MISCELLANEOUS**
Solenoid plunger not pulling completely	Check line voltage (±10% of nameplate rating) or replace worn solenoid assembly
Wiring is restricting disc pack movement	Reroute wiring
Excessive stop time (2 seconds or greater)	Increase brake size/torque or use alternate control method
High Ambient temperature (in excess of 110°F)	Reduce cycle rate or use alternate method of cooling
Moisture in brake	Remove drain plug (WASHGUARD brakes only). After fluid has drained replace plug

PART NUMBERS

Torque lb. ft.	Leeson Part Number	Stearns Part Number	Brake Coil Rating (VAC)	NEMA Enclosure	Brake Bore/ Shaft Diameter (X/U)	NEMA Frame Size	Dimension A
3	175563.00	1056711051PF	115/208-230	2	5/8" / 5/8"	56C	4.91"
	175564.00	1056711051QF	208-230/460	2	5/8" / 5/8"	56C	4.91"
	175565.00	1056711051NF	575	2	5/8" / 5/8"	56C	4.91"
	175566.00	1056714051PF	115/208-230	4X	5/8" / 5/8"	56C	4.94"
	175567.00	1056714051QF	208-230/460	4X	5/8" / 5/8"	56C	4.94"
	175568.00	1056714051NF	575	4X	5/8" / 5/8"	56C	4.94"
6	175569.00	1056721081PF	115/208-230	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175570.00	1056721081QF	208-230/460	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175571.00	1056721081NF	575	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175572.00	1056724081PF	115/208-230	4X	7/8" / 5/8"	56C/143-5TC	4.94"
	175573.00	1056724081QF	208-230/460	4X	7/8" / 5/8"	56C/143-5TC	4.94"
	175574.00	1056724081NF	575	4X	7/8" / 5/8"	56C/143-5TC	4.94"
10	175575.00	1056731081PF	115/208-230	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175576.00	1056731081QF	208-230/460	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175577.00	1056731081NF	575	2	7/8" / 5/8"	56C/143-5TC	4.91"
	175578.00	1056734081PF	115/208-230	4X	7/8" / 5/8"	56C/143-5TC	4.94"
	175579.00	1056734081QF	208-230/460	4X	7/8" / 5/8"	56C/143-5TC	4.94"
	175580.00	1056734081NF	575	4X	7/8" / 5/8"	56C/143-5TC	4.94"
15	175581.00	1056741071QF	208-230/460	2	7/8" / 7/8"	143-5TC	4.91"
	175582.00	1056744071QF	208-230/460	4X	7/8" / 7/8"	143-5TC	4.94"

JOB SPECIFIC COMPONENT INFORMATION

Gearmotors and Gear Reducers

OPERATING INSTRUCTIONS
01 805 52 US

GENERAL
These operating instructions are intended to help you install and operate the drive. For trouble free service, proper installation and operation are essential. Additionally, these instructions contain important recommendations on maintenance.

Before shipment, every SEW-Eurodrive gear unit is tested, checked and properly packed. However, please inspect the drive immediately upon arrival for shortage or transit damage. Note the damage or shortage on the freight bill of lading and file a claim with the carrier. Also, notify SEW-Eurodrive of the shortage or damage.

LUBRICANTS
All gearmotors and gear reducers are supplied with the correct grade and quantity of lubricating oil for the specified mounting position. Exceptions include reducers shipped without input assemblies. The recommended lubricants are found on page 2.

LONG TERM STORAGE
If the drive is not installed immediately, it should be stored in a dry, protected area. If the drive is to be stored for an extended period of time and was not ordered from SEW for long term storage, contact your nearest SEW assembly plant for information on Long Term Storage or request **Document #2115.**

Drives which are used for standby service should be stored as a sealed gearcase.

INSTALLATION OF COMPONENTS ON DRIVE SHAFTS
Do not hammer on the shafts. Hammering can cause brinelling of the reducer's bearings shortening the bearing life. We recommend heating the components to approximately 175°F (when possible) and sliding them on the shaft. This will reduce possible damage to the reducer's bearings. **Document #2116.**

For both standard and metric SEW shaft tolerances, refer to the SEW Catalog or request **Document #2154.**

Shaft couplings should be properly aligned to prevent vibration, coupling wear, and premature failure of the shaft bearings.

To prevent the output shaft and bearings from being subjected to excessive loads, the maximum overhung load, as shown in SEW-Eurodrive catalogs, should not be exceeded. Please consult our engineering department if the load may exceed the recommended figure given or where there are combined radial and axial loads. In such cases, the exact operating conditions must be stated including speed, direction of rotation, position, magnitude and direction of the external radial and axial loads being applied.

SHAFT MOUNTED REDUCERS
SEW-Eurodrive supplies the recommended hollowshaft mounting paste with every hollowshaft reducer. The mounting paste is to be applied on the keyed output shaft. The mounting paste is to aid in the prevention of rusting and fretting corrosion between the reducer hollowshaft and the shaft of the driven machine. The mounting paste will aid in shaft removal when necessary.

Warning! Always ensure exposed, rotating parts are properly covered to ensure safety.

For additional information on shaft-mounted reducers, drive shaft configuration and tolerances, refer to the SEW-Eurodrive Catalog or request **Documents #2201 and #2202.**

INSTALLATION AND OPERATION
The drive installation site should be selected to ensure:

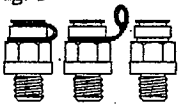
- Ambient temperatures below 40°C (104°F).
- Unimpeded flow of air to the motor and variable speed units.
- Accessibility to the drain, level and breather plugs.
- Adequate space for the removal of brakemotor fanguard for brake adjustment and maintenance.

The drive unit should be mounted on a flat, vibration damping, and torsionally rigid structure. Careful alignment is critical. Mounting to an uneven surface will cause housing distortion. The flatness tolerance of the supporting surface should not exceed:

- For gear units size 80 and smaller — 0.004 inch.
- For gear units above size 80 — 0.008 inch.

For transportation, the units are supplied with the breather plug already mounted. After the unit is installed, the black rubber seal located on the breather MUST BE REMOVED (Fig. 1). In addition, the oil level should be checked. Remove the plated (non-painted) oil level plug. The oil level is correct when the surface of the oil is level with the lowest point of that tapped hole, the exception is S37. Units W10, W20 and W30 are sealed in any position.

Fig. 1



After installation, the actual mounting position should be confirmed against the mounting postion shown on the gear reducer nameplate. Adequate lubrication is only guaranteed if the unit is mounted in the specific nameplated mounting position.

Refer to the SEW Catalog or request **Document #2111, #2112, #2113, or #2114 (R, F, K, or S, respectively)** if a specific mounting position diagram is needed.

MAINTENANCE
Warning! Always ensure equipment is secure and electrical power is off before removing or performing maintenance on the drive assembly. Oil levels and oil quality should be checked at regular intervals, determined by usage and the environment. Grease and oil should be changed per the recommendations on page 2. Check coupling alignment, chain or belt tension, and mounting bolt torque periodically. Keep the drive relatively free of dust and dirt.

For additional information, call the SEW FAXline, 1-800-601-6195, and request document number shown.

SEW EURODRIVE

SOUTHEAST MANUFACTURING & ASSEMBLY CENTER
1295 Old Spartanburg Hwy, Lyman, SC 29365
(864) 439-7537 Fax: (864) 439-7830

SOUTHWEST ASSEMBLY CENTER
3950 Platinum Way, Dallas, TX 75237
(214) 330-4824 Fax: (214) 330-4724

MIDWEST ASSEMBLY CENTER
2001 West Main Street, Troy, OH 45373
(937) 335-0036 Fax: (937) 332-0038

EAST COAST ASSEMBLY CENTER
200 High Hill Road, Bridgeport, NJ 08014
(856) 467-2277 Fax: (856) 330-4724

WEST COAST ASSEMBLY CENTER
30599 San Antonio Road, Hayward, CA 94544
(510) 487-3560 Fax: (510) 487-6381

ISO 9002

LUBRICANTS

	6) °C -50 0 +50 +100	DIN (ISO)	ISO,NLGI	Mobil®	Shell	Klüber	Aral	BP	Tribol		Optimol	FUCHS
R...	Standard -10 +40	CLP(CC)	VG 220	Mobilgear 630	Shell Omala 220	Klüberoil GEM 1-220	Aral Degol BG 220	BP Energol GR-XP 220	Tribol 1100/220	Meropa 220	Optigear BM 220	Renolin CLP 220
	-25 +80	CLP PG	VG 220	Mobil Glygoyle 30	Shell Tivela WB	Klübersynth GH 6-220	Aral Degol GS 220	BP Enersyn SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex-A 220	
K...(HK...)	4) -40 +80	CLP HC	VG 220	Mobil SHC 630	Shell Omala 220 HD	Klübersynth EG 4-220	Aral Degol PAS 220		Tribol 1510/220	Pinnacle EP 220	Optigear Synthetic A 220	Renolin Unisyn CLP 220
	4) -40 +40		VG 150	Mobil SHC 629		Klübersynth EG 4-150				Pinnacle EP 150		
	-20 +25	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Klüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150
F...	-30 +10	HLP (HM)	VG 68-46 VG 32	Mobil D.T.E. 13M	Shell Tellus T 32	Klüberoil GEM 1-68	Aral Degol BG 46		Tribol 1100/68	Rando EP Ashless 46	Optigear 32	Renolin B 46 HVI
	4) -40 +10	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46		
	4) -40 -20	HLP (HM)	VG 22 VG 15	Mobil D.T.E. 11M	Shell Tellus T 15	Isoflex MT 30 ROT		BP Energol HLP-HM 10		Rando HDZ 15		
S...(HS...)	Standard 0 +40	CLP (CC)	VG 680	Mobilgear 636	Shell Omala 680	Klüberoil GEM 1-680	Aral Degol BG 680	BP Energol GR-XP 680	Tribol 1100/680	Meropa 680	Optigear BM 680	Renolin CLP 680
	-20 +60	CLP PG	VG 680 1)	Mobil Glygoyle HE 680		Klübersynth GH 6-680		BP Enersyn SG-XP 680	Tribol 800/680	Synlube CLP 680		
	4) -30 +80	CLP HC	VG 460	Mobil SHC 634	Shell Omala 460 HD	Klübersynth EG 4-460				Pinnacle EP 460		
	4) -40 +10		VG 150	Mobil SHC 629		Klübersynth EG 4-150				Pinnacle EP 150		
	-20 +10	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Klüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 100	Optigear BM 100	Renolin CLP 150
	-25 +20	CLP PG	VG 220 1)	Mobil Glygoyle 30		Klübersynth GH 6-220			Tribol 800/220	Synlube CLP 220	Optiflex A 220	
	4) -40 0	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46		
R...,K...(HK...), F...,S...(HS...)	4) -30 +40	HCE	VG 460		Shell Cassida Fluid GL 460	Klüberoil 4UH1-460	Aral Eural Gear 460				Optileb GT 460	
	-20 +40	E	VG 460			Klüberbio CA2-460	Aral Degol BAB 460				Optisynt BS 460	
	Standard -20 +40	CLP PG	VG 460			Klübersynth UH1 6-460						
W...(HW...)	Standard -20 +40	SEW PG	VG 460 2)			Klüber SEW HT 460-5						
	4) -40 +10	API GL5	SAE 75W90 (~VG 100)	Mobilube SHC 75 W90-LS								
	-20 +40	CLP PG	VG 460 3)			Klübersynth UH1 6-460						
R32 R302	-25 +60	DIN 51 818 5)	00	Glygoyle Grease 00	Shell Tivela GL 00	Klübersynth GE 46-1200				Multifak 6833 EP 00		
	Standard -15 +40		000 - 0	Mobilux EP 004	Shell Alvania GL 00		Aralub MFL 00	BP Energrease LS-EP 00		Multifak EP 000	Longtime PD 00	Renolin SF 7 - 041

01 805 792 US

CLP	=	Mineral oil	1)	Helical-worm gear units with PG oil: Please contact SEW-EURODRIVE
CLP PG	=	Polyglycol (W gear units, conforms to USDA-H1	2)	Special lubricant for Spiroplan® gear units only
CLP HC	=	Synthetic hydrocarbons	3)	Recommendation: Select SEW $f_B \geq 1.2$
E	=	Ester oil (water pollution danger category WGK 1)	4)	Pay attention to critical starting behavior at low temperatures!
HCE	=	Synthetic hydrocarbons + ester oil (USDA - H1 certification)	5)	Low-viscosity grease
HLP	=	Hydraulic oil	6)	Ambient temperature
	=	Synthetic lubricant (= synthetic anti-friction bearing grease)		Lubricant for the food industry (food grade oil)
	=	Mineral lubricant (= mineral-based anti-friction bearing grease)		Biodegradable oil (lubricant for use in agriculture, forestry and water resources)

Oil levels and oil quality should be checked at frequent intervals, depending on usage. Oil changes are required at intervals of 10,000 operating hours or every two years, whichever comes first. If a synthetic oil lubricant is used, then this period can be extended to 20,000 operating hours or every four years, whichever comes first. In applications where hostile operating conditions exist, such as high humidity, corrosive environment, or large temperature changes, the lubricant should be changed at more frequent intervals.

The gear units W10, W20 and W30 are supplied with a synthetic oil which is good for the life of the reducer, independent of the mounting position.

Grease packed bearings should be cleaned and regreased every 10,000 hours or 20,000 hours for synthetic grease. Input (high speed) bearings should not be overgreased. They should be filled with grease not to exceed 1/3 of the bearing's free volume. For output bearings and bearings with replaceable grease shields, fill to 2/3 of their free volume.

ATTENTION

When the recommended lubricant is not avilable, it is permissible to use a lubricant having equivalent characteristics but we do not recommend that lubricants of different brands be mixed. Under no circumstances should synthetic lubricants be mixed with one another or with one having a mineral base.

LUBRICANTS

The approximate lubricant in US **gallons and liters** per mounting position is as follows:

Gear Unit	Mounting Positions											
	M1 [1]		M2 [1]		M3		M4		M5		M6	
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters
RX57	0.16	0.60	0.21	0.80	0.34	1.30	0.34	1.30	0.24	0.90	0.24	0.90
RX67	0.21	0.80	0.21	0.80	0.45	1.70	0.50	1.90	0.29	1.10	0.29	1.10
RX77	0.29	1.10	0.40	1.50	0.69	2.60	0.71	2.70	0.42	1.60	0.42	1.60
RX87	0.45	1.70	0.66	2.50	1.25	4.80	1.25	4.80	0.77	2.90	0.77	2.90
RX97	0.55	2.10	0.90	3.40	1.95	7.4	1.85	7.0	1.25	4.80	1.25	4.80
RX107	1.05	3.90	1.50	5.6	3.05	11.6	3.15	11.9	2.05	7.7	2.05	7.7
RXF57	0.13	0.50	0.21	0.80	0.29	1.10	0.29	1.10	0.18	0.70	0.18	0.70
RXF67	0.18	0.70	0.21	0.80	0.40	1.50	0.37	1.40	0.26	1.00	0.26	1.00
RXF77	0.24	0.90	0.34	1.30	0.63	2.40	0.53	2.00	0.42	1.60	0.42	1.60
RXF87	0.42	1.60	0.51	1.95	1.30	4.90	1.05	3.95	0.77	2.90	0.77	2.90
RXF97	0.55	2.10	0.98	3.70	1.85	7.1	1.65	6.3	1.25	4.80	1.25	4.80
RXF107	0.82	3.10	1.50	5.7	2.95	11.2	2.45	9.3	1.90	7.2	1.90	7.2
R07	0.032	0.12	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20
R17/R17F	0.065	0.25	0.15	0.55	.090	0.35	0.15	0.55	0.09	0.35	0.11	0.40
R27/R27F	0.065 (0.11)	0.25 (0.40)	0.18	0.70	0.13	0.50	0.18	0.70	0.13	0.50	0.13	0.50
R37/R37F	0.080 (0.25)	0.30 (0.95)	0.22	0.85	0.25	0.95	0.28	1.05	0.20	0.75	0.25	0.95
R47/R47F	0.18 (0.40)	0.70 (1.50)	0.42	1.60	0.40	1.50	0.44	1.65	0.40	1.50	0.40	1.50
R57/R57F	0.21 (0.45)	0.80 (1.70)	0.50	1.90	0.45	1.70	0.55	2.10	0.45	1.70	0.45	1.70
R67/R67F	0.29 (0.61)	1.10 (2.30)	0.69 (0.92)	2.60 (3.50)	0.74	2.80	0.84	3.20	0.48	1.80	0.53	2.00
R77/R77F	0.32 (0.79)	1.20 (3.00)	1.00 (1.10)	3.80 (4.10)	0.95	3.60	1.10	4.10	0.66	2.50	0.90	3.40
R87/R87F	0.61 (1.60)	2.30 (6.0)	1.75 (2.15)	6.7 (8.2)	1.90	7.2	2.05	7.7	1.65	6.3	1.70	6.5
R97	1.20 (2.60)	4.60 (9.8)	3.10 (3.70)	11.7 (14.0)	3.10	11.7	3.55	13.4	3.00	11.3	3.10	11.7
R107	1.60 (3.60)	6.0 (13.7)	4.30	16.3	4.45	16.9	5.1	19.2	3.50	13.2	4.20	15.9
R137	2.65 (6.6)	10.0 (25.0)	7.4	28.0	7.8	29.5	8.3	31.5	6.6	25.0	6.6	25.0
R147	4.05 (10.6)	15.4 (40.0)	12.3	46.5	12.7	48.0	13.7	52.0	10.4	39.5	10.8	41.0
R167	7.1 (18.5)	27.0 (70.0)	21.6	82.0	20.6	78.0	23.2	88.0	17.4	66.0	18.2	69.0
RF07	0.032	0.12	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20
RF17	0.065	0.25	0.15	0.55	.090	0.35	0.15	0.55	0.09	0.35	0.11	0.40
RF27	0.065 (0.11)	0.25 (0.40)	0.18	0.70	0.13	0.50	0.18	0.70	0.13	0.50	0.13	0.50
RF37	0.090 (0.25)	0.35 (0.95)	0.24	0.90	0.25	0.95	0.28	1.05	0.20	0.75	0.25	0.95
RF47	0.17 (0.40)	0.65 (1.50)	0.42	1.60	0.40	1.50	0.44	1.65	0.40	1.50	0.40	1.50
RF/RM57	0.21 (0.45)	0.80 (1.70)	0.48	1.80	0.45	1.70	0.53	2.00	0.45	1.70	0.45	1.70
RF/RM67	0.32 (0.66)	1.20 (2.50)	0.71 (0.95)	2.70 (3.60)	0.71	2.70	0.69	2.60	0.50	1.90	0.55	2.10
RF/RM77	0.32 (0.69)	1.20 (2.60)	1.00 (1.10)	3.80 (4.10)	0.87	3.30	1.10	4.10	0.63	2.40	0.79	3.00
RF/RM87	0.63 (1.60)	2.40 (6.0)	1.80 (2.10)	6.8 (7.9)	1.85	7.1	1.85	7.0	1.65	6.3	1.70	6.4
RF/RM97	1.35 (2.70)	5.1 (10.2)	3.15 (3.70)	11.9 (14.0)	2.95	11.2	3.70	14.0	2.95	11.2	3.10	11.8
RF/RM107	1.65 (3.95)	6.3 (14.9)	4.20	15.9	4.50	17.0	5.1	19.2	3.45	13.1	4.20	15.9
RF/RM137	2.50 (6.6)	9.5 (25.0)	7.1	27.0	7.7	29.0	8.6	32.5	6.6	25.0	6.6	25.0
RF/RM147	4.35 (11.1)	16.4 (42.0)	12.4	47.0	12.7	48.0	13.7	52.0	11.1	42.0	11.1	42.0
RF/RM167	6.9 (18.5)	26.0 (70.0)	21.6	82.0	20.6	78.0	23.2	88.0	17.2	65.0	18.7	71.0

[1] Standard level (increased oil level) - The larger gear unit of a multi-stage unit must be filled with the larger oil volume.

For additional information on R-Series mounting positions, refer to the SEW Catalog or call the SEW FAXline, 1-800-601-6195, and request Document #2111.

LUBRICANTS

The approximate lubricant in US **gallons and liters** per mounting position is as follows:

Gear Unit	Mounting Position											
	M1		M2		M3		M4		M5		M6	
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters
F27	0.16	0.60	0.21	0.80	0.17	0.65	0.18	0.70	0.16	0.60	0.16	0.60
F37	0.25	0.95	0.33	1.25	0.18	0.70	0.33	1.25	0.26	1.00	0.29	1.10
F47	0.40	1.50	0.48	1.80	0.29	1.10	0.50	1.90	0.40	1.50	0.45	1.70
F57	0.69	2.60	0.92	3.50	0.55	2.10	0.92	3.50	0.74	2.80	0.77	2.90
F67	0.71	2.70	1.00	3.80	0.50	1.90	1.00	3.80	0.77	2.90	0.84	3.20
F77	1.55	5.9	1.95	7.3	1.15	4.30	2.10	8.0	1.60	6.0	1.65	6.3
F87	2.85	10.8	3.45	13.0	2.05	7.7	3.65	13.8	2.85	10.8	2.90	11.0
F97	4.90	18.5	5.9	22.5	3.35	12.6	6.7	25.2	4.90	18.5	5.3	20.0
F107	6.5	24.5	8.4	32.0	5.1	19.5	9.9	37.5	7.1	27.0	7.1	27.0
F127	10.7	40.5	14.4	54.5	9.0	34.0	16.1	61.0	12.2	46.3	12.4	47.0
F157	18.2	69.0	27.5	104.0	16.6	63.0	27.7	105.0	22.7	86.0	20.6	78.0
FF27	0.16	0.60	0.21	0.80	0.17	0.65	0.18	0.70	0.16	0.60	0.16	0.60
FF37	0.26	1.00	0.33	1.25	0.18	0.70	0.34	1.30	0.26	1.00	0.29	1.10
FF47	0.42	1.60	0.49	1.85	0.29	1.10	0.50	1.90	0.40	1.50	0.45	1.70
FF57	0.74	2.80	0.92	3.50	0.55	2.10	0.98	3.70	0.77	2.90	0.79	3.00
FF67	0.71	2.70	1.00	3.80	0.50	1.90	1.00	3.80	0.77	2.90	0.84	3.20
FF77	1.55	5.9	1.95	7.3	1.15	4.30	2.15	8.1	1.60	6.0	1.65	6.3
FF87	2.85	10.8	3.50	13.2	2.05	7.8	3.70	14.1	2.90	11.0	2.95	11.2
FF97	5.00	19.0	5.9	22.5	3.35	12.6	6.8	25.6	5.00	18.9	5.4	20.5
FF107	6.7	25.5	8.4	32.0	5.1	19.5	10.2	38.5	7.3	27.5	7.4	28.0
FF127	11.0	41.5	14.7	55.5	9.0	34.0	16.6	63.0	12.2	46.3	12.9	49.0
FF157	19.0	72.0	27.7	105.0	16.9	64.0	28.0	106.0	23.0	87.0	20.9	79.0
FA/FH/FV27 FAF/FHF/FVF27 FAZ/FHZ/FVZ27	0.16	0.60	0.21	0.80	0.17	0.65	0.18	0.70	0.16	0.60	0.16	0.60
FA/FH/FV37 FAF/FHF/FVF37 FAZ/FHZ/FVZ37 FT37	0.25	0.95	0.33	1.25	0.18	0.70	0.33	1.25	0.26	1.00	0.29	1.10
FA/FH/FV47 FAF/FHF/FVF47 FAZ/FHZ/FVZ47 FT47	0.40	1.50	0.48	1.80	0.29	1.10	0.50	1.90	0.40	1.50	0.45	1.70
FA/FH/FV57 FAF/FHF/FVF57 FAZ/FHZ/FVZ57 FT57	0.71	2.70	0.92	3.50	0.55	2.10	0.90	3.40	0.77	2.90	0.79	3.00
FA/FH/FV67 FAF/FHF/FVF67 FAZ/FHZ/FVZ67 FT67	0.71	2.70	1.00	3.80	0.50	1.90	1.00	3.80	0.77	2.90	0.84	3.20
FA/FH/FV77 FAF/FHF/FVF77 FAZ/FHZ/FVZ77 FT77	1.55	5.9	1.95	7.3	1.15	4.30	2.10	8.0	1.60	6.0	1.65	6.3
FA/FH/FV87 FAF/FHF/FVF87 FAZ/FHZ/FVZ87 FT87	2.85	10.8	3.45	13.0	2.05	7.7	3.65	13.8	2.85	10.8	2.90	11.0
FA/FH/FV97 FAF/FHF/FVF97 FAZ/FHZ/FVZ97 FT97	4.90	18.5	5.9	22.5	3.35	12.6	6.7	25.2	4.90	18.5	5.3	20.0
FA/FH/FV107 FAF/FHF/FVF107 FAZ/FHZ/FVZ107	6.5	24.5	8.4	32.0	5.1	19.5	9.9	37.5	7.1	27.0	7.1	27.0
FA/FH/FV127 FAF/FHF/FVF127 FAZ/FHZ/FVZ127	10.3	39.0	14.4	54.5	9.0	34.0	16.1	61.0	11.9	45.0	12.3	46.5
FA/FH/FV157 FAF/FHF/FVF157 FAZ/FHZ/FVZ157	18.0	68.0	27.2	103.0	16.4	62.0	27.5	104.0	22.4	85.0	20.3	77.0

For additional information on F-Series mounting positions, refer to the SEW Catalog or call the SEW FAXline, 1-800-601-6195, and request Document #2112.

LUBRICANTS

The approximate lubricant in US **gallons and liters** per mounting position is as follows:

Gear Unit	Mounting Position											
	M1		M2		M3		M4		M5		M6	
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters
K37	0.13	0.50	0.26	1.00	0.26	1.00	0.33	1.25	0.25	0.95	0.25	0.95
K47	0.21	0.80	0.34	1.30	0.40	1.50	0.53	2.00	0.42	1.60	0.42	1.60
K57	0.32	1.20	0.61	2.30	0.66	2.50	0.74	2.80	0.69	2.60	0.63	2.40
K67	0.29	1.10	0.63	2.40	0.69	2.60	0.91	3.45	0.69	2.60	0.69	2.60
K77	0.58	2.20	1.10	4.10	1.15	4.40	1.55	5.8	1.10	4.20	1.15	4.40
K87	0.98	3.70	2.10	8.0	2.30	8.7	2.90	10.9	2.10	8.0	2.10	8.0
K97	1.85	7.0	3.70	14.0	4.15	15.7	5.3	20.0	4.15	15.7	4.10	15.5
K107	2.65	10.0	5.5	21.0	6.7	25.5	8.8	33.5	6.35	24.0	6.35	24.0
K127	5.5	21.0	11.0	41.5	11.6	44.0	14.3	54.0	10.6	40.0	10.8	41.0
K157	8.2	31.0	16.4	62.0	17.2	65.0	23.8	90.0	15.3	58.0	16.4	62.0
K/KH167	8.7	33.0	25.1	95.0	27.7	105.0	32.5	123.0	22.4	85.0	22.2	84.0
K/KH187	14.0	53.0	40.1	152.0	44.1	167.0	53.0	200	37.8	143.0	37.8	143.0
KF37	0.13	0.50	0.29	1.10	0.29	1.10	0.40	1.50	0.26	1.00	0.26	1.00
KF47	0.21	0.80	0.34	1.30	0.45	1.70	0.58	2.20	0.42	1.60	0.42	1.60
KF57	0.34	1.30	0.61	2.30	0.71	2.70	0.83	3.15	0.77	2.90	0.71	2.70
KF67	0.29	1.10	0.63	2.40	0.74	2.80	0.98	3.70	0.71	2.70	0.71	2.70
KF77	0.55	2.10	1.10	4.10	1.15	4.40	1.55	5.9	1.20	4.50	1.20	4.50
KF87	0.98	3.70	2.15	8.2	2.40	9.0	3.15	11.9	2.20	8.4	2.20	8.4
KF97	1.85	7.0	3.90	14.7	4.55	17.3	5.70	21.5	4.15	15.7	4.35	16.5
KF107	2.65	10.0	5.8	21.8	6.8	25.8	9.3	35.1	6.7	25.2	6.7	25.2
KF127	5.5	21.0	11.0	41.5	12.1	46.0	14.5	55.0	10.8	41.0	10.8	41.0
KF157	8.2	31.0	17.4	66.0	18.2	69.0	24.3	92.0	16.4	62.0	16.4	62.0
KA/KH/KV37 KAF/KHF/KVF37 KAZ/KHZ/KVZ37 KT37	0.13	0.50	0.26	1.00	0.26	1.00	0.37	1.40	0.26	1.00	0.26	1.00
KA/KH/KV47 KAF/KHF/KVF47 KAZ/KHZ/KVZ47 KT47	0.21	0.80	0.34	1.30	0.42	1.60	0.57	2.15	0.42	1.60	0.42	1.60
KA/KH/KV57 KAF/KHF/KVF57 KAZ/KHZ/KVZ57 KT57	0.34	1.30	0.61	2.30	0.71	2.70	0.83	3.15	0.77	2.90	0.71	2.70
KA/KH/KV67 KAF/KHF/KVF67 KAZ/KHZ/KVZ67 KT67	0.29	1.10	0.63	2.40	0.71	2.70	0.98	3.70	0.69	2.60	0.69	2.60
KA/KH/KV77 KAF/KHF/KVF77 KAZ/KHZ/KVZ77 KT77	0.55	2.10	1.10	4.10	1.20	4.60	1.55	5.9	1.15	4.40	1.15	4.40
KA/KH/KV87 KAF/KHF/KVF87 KAZ/KHZ/KVZ87 KT87	0.98	3.70	2.15	8.2	2.30	8.8	2.95	11.1	2.10	8.0	2.10	8.0
KA/KH/KV97 KAF/KHF/KVF97 KAZ/KHZ/KVZ97 KT97	1.85	7.0	3.90	14.7	4.15	15.7	5.30	20.0	4.15	15.7	4.15	15.7
KA/KH/KV107 KAF/KHF/KVF107 KAZ/KHZ/KVZ107	2.65	10.0	5.4	20.5	6.3	24.0	8.6	32.4	6.3	24.0	6.3	24.0
KA/KH/KV127 KAF/KHF/KVF127 KAZ/KHZ/KVZ127	5.5	21.0	11.0	41.5	11.4	43.0	13.7	52.0	10.6	40.0	10.6	40.0
KA/KH/KV157 KAF/KHF/KVF157 KAZ/KHZ/KVZ157	8.2	31.0	17.4	66.0	17.7	67.0	23.0	87.0	16.4	62.0	16.4	62.0

For additional information on K-Series mounting positions, refer to the SEW Catalog or call the SEW FAXline, 1-800-601-6195, and request Document #2113.

LUBRICANTS

The approximate lubricant in US **gallons and liters** per mounting position is as follows:

Gear Unit	Mounting Position											
	M1		M2		M3 [1]		M4		M5		M6	
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters
S37	0.065	0.25	0.11	0.40	0.13	0.50	0.15	0.55	0.11	0.40	0.11	0.40
S47	0.090	0.35	0.21	0.80	0.18 (0.24)	0.70 (0.90)	0.26	1.00	0.21	0.80	0.21	0.80
S57	0.13	0.50	0.32	1.20	0.26 (0.32)	1.00 (1.20)	0.38	1.45	0.34	1.30	0.34	1.30
S67	0.26	1.00	0.53	2.00	0.58 (0.82)	2.20 (3.10)	0.82	3.10	0.69	2.60	0.69	2.60
S77	0.50	1.90	1.10	4.20	0.98 (1.45)	3.70 (5.4)	1.55	5.9	1.15	4.40	1.15	4.40
S87	0.87	3.30	2.15	8.1	1.80 (2.75)	6.9 (10.4)	3.00	11.3	2.20	8.4	2.20	8.4
S97	1.80	6.8	3.95	15.0	3.55 (4.75)	13.4 (18.0)	5.8	21.8	4.50	17.0	4.50	17.0
SF37	0.065	0.25	0.11	0.40	0.13	0.50	0.15	0.55	0.11	0.40	0.11	0.40
SF47	0.11	0.40	0.24	0.90	0.24 (0.28)	0.90 (1.05)	0.28	1.05	0.26	1.00	0.26	1.00
SF57	0.13	0.50	0.32	1.20	0.26 (0.40)	1.00 (1.50)	0.41	1.55	0.37	1.40	0.37	1.40
SF67	0.26	1.00	0.58	2.20	0.61 (0.79)	2.30 (3.00)	0.84	3.20	0.71	2.70	0.71	2.70
SF77	0.50	1.90	1.10	4.10	1.05 (1.55)	3.90 (5.8)	1.70	6.5	1.30	4.90	1.30	4.90
SF87	1.00	3.80	2.10	8.0	1.85 (2.65)	7.1 (10.1)	3.15	12.0	2.40	9.1	2.40	9.1
SF97	1.95	7.4	3.95	15.0	3.65 (4.95)	13.8 (18.8)	6.0	22.6	4.75	18.0	4.75	18.0
SA/SH37 SAF/SHF37 SAZ/SHZ37 ST37	0.065	0.25	0.11	0.40	0.13	0.50	0.13	0.50	0.11	0.40	0.11	0.40
SA/SH47 SAF/SHF47 SAZ/SHZ47 ST47	0.11	0.40	0.21	0.80	0.18 (0.24)	0.70 (0.90)	0.26	1.00	0.21	0.80	0.21	0.80
SA/SH57 SAF/SHF57 SAZ/SHZ57 ST57	0.13	0.50	0.29	1.10	0.26 (0.40)	1.00 (1.50)	0.40	1.50	0.32	1.20	0.32	1.20
SA/SH67 SAF/SHF67 SAZ/SHZ67 ST67	0.26	1.00	0.53	2.00	0.48 (0.69)	1.80 (2.60)	0.77	2.90	0.66	2.50	0.66	2.50
SA/SH77 SAF/SHF77 SAZ/SHZ77 ST77	0.48	1.80	1.05	3.90	0.95 (1.30)	3.60 (5.0)	1.55	5.8	1.20	4.50	1.20	4.50
SA/SH87 SAF/SHF87 SAZ/SHZ87 ST87	1.00	3.80	1.95	7.4	1.60 (2.30)	6.0 (8.7)	2.85	10.8	2.10	8.0	2.10	8.0
SA/SH97 SAF/SHF97 SAZ/SHZ97 ST97	1.85	7.0	3.70	14.0	3.00 (4.20)	11.4 (16.0)	5.4	20.5	4.15	15.7	4.15	15.7

[1] Standard level (increased oil level) - The larger gear unit of a multi-stage unit must be filled with the larger oil volume.

The approximate lubricant in US **gallons and liters** for **ALL** mounting positions for the W-Series is as follows

Gear Unit	Gallons	Liters
W/WF/WA/WAF10	0.042	0.116
W/WF/WA/WAF20	0.065	0.24
W/WF/WA/WAF30	0.11	0.40

Note: The Spiroplan® series gear units are mounting position indepedent of oil filling.

For additional information on S-Series mounting positions, refer to the SEW Catalog or call the SEW FAXline, 1-800-601-6195, and request Document #2114.

Motors and Brakemotors

Type BM (G) Brakes

OPERATING INSTRUCTIONS

09 793 77 US

General

Every SEW-Eurodrive motor is thoroughly tested, checked, and properly packed prior to shipment. However, please check immediately upon arrival for shortage of parts or transit damage. Note the damage or shortage on the freight bill of lading and file a claim with the carrier. Also, notify SEW-Eurodrive of the shortage or damage.

Typical Installation

For motors mounted integrally to a gear unit, please refer to the Operating Instructions for Gearmotors and Gear Reducers for proper installation of the drive. The drive installation site should be selected to ensure:

- Ambient temperatures between 0-40°C (32-104°F).
- Unimpeded flow of air to the motor and variable speed units.
- Accessibility to gear unit, oil plugs.
- Adequate space for the removal of the brakemotor fanguard for brake adjustment and maintenance.

The drive unit should be mounted on a flat, vibration damping, and torsionally rigid structure. The flatness tolerance of the supporting surface should not exceed:

For motor size 180 and smaller — 0.004 inch
For motor size above 180 — 0.008 inch

Do not hammer on the shafts to install couplings, sheaves, etc. Hammering can cause brinelling of the bearings and a reduction in bearing life. We recommend heating the components to approximately 175°F and sliding them on. This will reduce possible damage to the bearings. In addition, there is a metric tapped hole in the center of the motor shaft that can be utilized with a tool to press on or remove the coupling, sheaves, etc.

The motor shaft diameters are metric and have tolerances as listed in the SEW-Eurodrive catalogs. Shaft couplings should be properly aligned to prevent vibration, coupling wear and premature failure of the shaft bearings.

Maximum Parallel Offset — 0.003 inch
Maximum Angular Offset — 0.030°

To prevent the output shaft and bearings from being subjected to excessive loads, the maximum overhung loads, as shown in SEW-Eurodrive catalogs, should not be exceeded. Please consult our engineering department if the load may exceed the recommended figure given or where there are combined radial and axial loads. In such cases, the exact operating conditions must be stated including speed, direction of rotation, position, magnitude and direction of the external radial and axial loads being applied.

Long Term Storage

If the motor must be stored for a long period of time without operating, the motor must be stored in a dry, protected area, and in the mounting position indicated on the unit nameplate. In order to ensure that the motor has not been damaged by moisture after a prolonged storage, the insulation resistance should be checked. An insulation tester with a measurement voltage of at least 500V (e.g. magneto generator) should be used for this purpose. The insulation resistance is sufficient if it has an ohmic value of at least 1000 x V_N (e.g. at V_N = 230VAC: $R_{insul} \geq 230000$ ohms = 0.23M ohms). If the measured value is smaller, the motor should be dried before use (for example, with hot air up to a maximum of 90°C or by resistance heating with an auxiliary AC voltage of 10% of V_N via an isolating transformer). Care should be taken to ensure that the motor is heated with not more than 20% of its rated current and that the rise in temperature is not more than 90°C. The drying procedure can be stopped when the insulation resistance has reached 500000 = 0.5M ohms.

Severe Duty Units

Severe Duty Units are indicated with the letters "-KS" at the end of the motor type on the motor nameplate. Severe Duty units include drain holes in the motor end bells and conduit box at the lowest points allowing condensation to drain out of the motor.

CAUTION!

The drain holes are installed for the mounting position listed on the gearbox nameplate. Installing a unit in a mounting position other than what is shown on the nameplate will reposition the condensation drain holes. As a result, the drain holes may not be located at the lowest point and may not allow water to drain. This can cause premature drive failure.

Electrical Connection

The motor must be installed and connected by a qualified electrician who is knowledgeable with the NEC article 430 and local regulations. He must make sure that the voltage and frequency of the electrical supply correspond with the data stamped on the motor nameplate before connecting the motor in accordance with the wiring diagram, which can be found in the terminal box. For brake connections, see the following pages.

At installation the electrician must make sure that the terminal block jumpers are positioned correctly and that all electrical connections including the ground connection are secure. In order to effectively protect the motor from overloads, appropriate motor protection must be provided. Fuses do not always provide adequate motor protection. For motors which are required to operate with a very high start-stop frequency, the overload heater type motor protection is insufficient. It is advisable in such applications to provide the motor with temperature sensors (thermistors) in the windings. Monitor the thermistors by means of an external trip device. In this way, the motor will be fully protected against practically all possible overloads.

When using motors outdoors or in washdown applications the cable entries into the terminal box must be directed downward to prevent water from entering the conduit box. The unused cable entries must be closed off properly.

Lubrication and Maintenance

WARNING! **Always ensure equipment is secure and electrical power is off before removing or performing maintenance on the drive assembly.** The motor bearings are sealed and the grease content is adequate for the life of the bearing.

SEW EURODRIVE

SOUTHEAST MANUFACTURING & ASSEMBLY CENTER
1295 Spartanburg Highway/Lyman SC 29365
(864) 439-7537 Fax: (864) 439-7830

SOUTHWEST ASSEMBLY CENTER
3950 Platinum Way/Dallas TX 75237
(214) 330-4824 Fax: (214) 330-4724

MIDWEST ASSEMBLY CENTER
2001 West Main Street/Troy OH 45373
(937) 335-0036 Fax: (937) 332-0038

EAST COAST ASSEMBLY CENTER
200 High Hill Road/Bridgeport NJ 08014
(856) 467-2277 Fax: (856) 845-3179

WEST COAST ASSEMBLY CENTER
30599 San Antonio Road/Hayward CA 94544
(510) 487-3560 Fax: (510) 487-6381

Appendix

Brake Coil Resistance

Motor Frame		DT71-80	DT80	DT90-100	DT100	DV112-132S	DV132M-160M	DV160L-225	DV250-280
Brake Size		BM(G)05	BM(G)1	BM(G)2	BM(G)4	BM(G)8	BM15	BM30/31/32/62	BMG61/122
Brake Torque (lb-ft)		0.89 - 3.7	4.4 - 7.4	3.7 - 14.8	17.7 - 29.5	7.00 - 55.3	18.4 - 110.6	36.9 - 442.5	147.5 - 885
BRAKE VOLTAGE		$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$	$R_B(\Omega)$
AC (to rectifier V_B)	DC	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$	$R_T(\Omega)$
—	24	4.4 13.4	3.9 12.1	3.4 10.2	2.7 8.2	1.4 7.5	0.8 5.0	0.67 5.0	—
105 - 116	48	17.6 53.4	15.6 48.1	13.6 40.5	10.9 32.7	5.7 29.8	3.1 20.1	2.2 16.8	—
186 - 207	80	55.6 169	49.5 152	42.9 128	34.5 103	17.9 94.2	9.8 63.5	7.1 53.0	—
194 - 217	80	—	—	—	—	—	—	—	4.0 32.6
208 - 233	96	70.0 213	62.3 192	54.0 161	43.4 130	22.5 119	12.4 80.0	8.9 66.7	—
218 - 243	96	—	—	—	—	—	—	—	5.0 41.0
330 - 369	147	176 534	157 481	136 405	109 327	56.5 298	31.1 201	22.3 168	—
344 - 379	147	—	—	—	—	—	—	—	12.6 103
370 - 414	167	221 672	197 606	171 510	137 411	71.2 375	39.2 253	28.1 211	—
380 - 431	167	—	—	—	—	—	—	—	15.8 130
415 - 464	185	279 846	248 762	215 643	173 518	89.6 472	49.3 318	35.4 266	—
432 - 484	185	—	—	—	—	—	—	—	19.9 163
465 - 522	208	351 1066	312 960	271 809	218 652	113 594	62.1 401	44.6 334	—
485 - 542	208	—	—	—	—	—	—	—	25.1 205

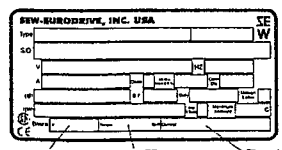
Voltage
AC - The voltage shown is the nameplate AC brake voltage supplied to the brake rectifier.
DC - The voltage shown is the effective DC voltage required by the brake coil. The measured voltage from the rectifier will be 10-20% lower than that shown.

Brake Coil Resistance - values must be measured with the brake coil disconnected from the rectifier.
R_B - Accelerator coil resistance in Ω, measured from the red to the white brake coil wire at 20° C.
R_T - Fractional coil resistance in Ω, measured from the white to the blue brake coil wire at 20° C.

Brake Connection (AC Voltage)

SEW-Eurodrive motor brakes can be connected in a number of different ways. In order to connect the brake for each application, it is important to refer to the data on the motor nameplate that describes the brake system. The brake fields are: brake voltage, brake torque and brake control.

This operating instruction covers AC brake voltages with the following brake control components. If the brake voltage is DC, or if the brake control components differ from those listed below, an additional operating instruction must be consulted for connection information.



Brake Voltage Brake Torque Brake Control

SEW-Eurodrive fail-safe mechanical brakes are DC controlled. Standardly, a brake rectifier (halfwave) is provided to convert the AC line voltage to the DC voltage required to drive the brake. 24VDC brakes do not include a rectifier. When voltage (V_B) is applied to the brake, it will release. When voltage (V_B) is removed from the brake, it will set.

The brake rectifier can be wired either for normal brake reaction time (setting, stopping) or fast brake reaction time.

Brake Control (Rectifier)	Part Number
BG1.5	825 384 6
BG3.0	825 386 2
BGE1.5	825 385 4
BGE3.0	825 387 0

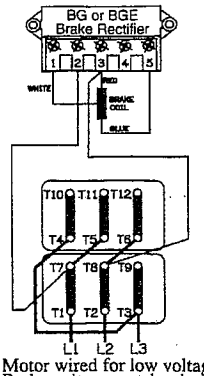
The fast brake reaction will set the brake more quickly which will provide a shorter and more repeatable stopping distance. There are two basic types of brake rectifiers, BG and BGE. The BG brake rectifier is standard on motor sizes DT71 - DT100. The BGE rectifier is standard on motor sizes DV112 - DV280. The BGE rectifier can be ordered with motor sizes DT71 - DT100 and will provide faster brake release times allowing the motor to cycle more frequently.

The wiring diagrams for brake connections are located on the inside of the motor conduit box lid. The brake will release and allow the motor to rotate when the nameplate AC brake voltage V_B is supplied to the brake rectifier terminals. There are certain cases where the brake rectifier can receive its voltage from the motor's terminal block, meaning that when power is applied to the motor it will simultaneously release the brake and start the motor. See page 3 for this description.

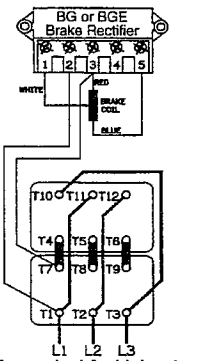
Brake Voltage Supplied from the Motor

There are specific instances when the brake voltage can be tapped from the motor's terminal block. The advantage of brake systems wired in this way is when power is applied to the motor, the brake releases, (requiring no additional brake supply power wiring). The brake can be wired to the motor terminal block under the following conditions: a single speed motor; the motor is started and run across the line (i.e., no inverter or electronic soft start). The connections shown on this page are for normal brake reaction time. For rapid brake reaction time, incorporate the contact as shown on the brake diagram located on the inside of the motor conduit box lid.

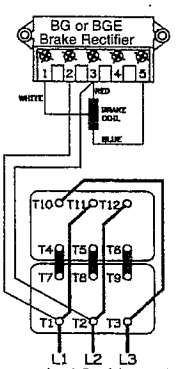
Brake Motor Connection
Single Speed Dual Voltage - ΔΔ/Δ
Connection Diagram DT72
Example Motor Voltages:
230ΔΔ/460Δ Volts - 60 Hz



Motor wired for low voltage.
Brake voltage matches low motor voltage.
Example: 230/460V Motor
Motor wired 230V
Brake voltage 230V

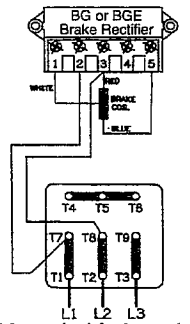


Motor wired for high voltage.
Brake voltage matches low motor voltage.
Example: 230/460V Motor
Motor wired 460V
Brake voltage 230V

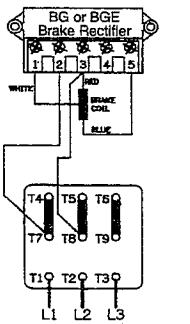


Motor wired for high voltage.
Brake voltage matches high motor voltage.
Example: 230/460V Motor
Motor wired 460V
Brake voltage 460V

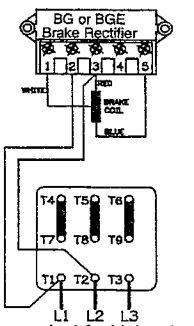
Brake Motor Connection
Single Speed Dual Voltage - YY/Y
Connection Diagram DT79
Example Motor Voltages:
230YY/460Y Volts - 60 Hz
200YY/400Y Volts - 50 Hz



Motor wired for low voltage.
Brake voltage matches low motor voltage.
Example: 230/460V Motor
Motor wired 230V
Brake voltage 230V

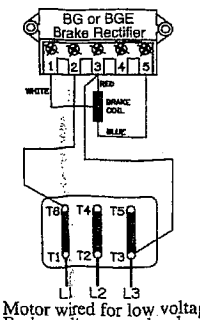


Motor wired for high voltage.
Brake voltage matches low motor voltage.
Example: 230/460V Motor
Motor wired 460V
Brake voltage 230V

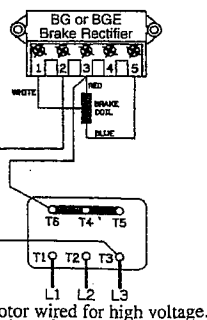


Motor wired for high voltage.
Brake voltage matches high motor voltage.
Example: 230/460V Motor
Motor wired 460V
Brake voltage 460V

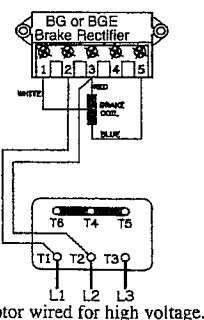
Brake Motor Connection
Single Speed Dual Voltage - Δ/Y
Connection Diagram DT13
Examples Motor Voltages:
200Δ/346Y Volts - 60 Hz
330Δ/575Y Volts - 60 Hz
220Δ/380Y Volts - 50 Hz



Motor wired for low voltage.
Brake voltage matches low motor voltage.
Example: 200/346V Motor
Motor wired 200V
Brake voltage 200V

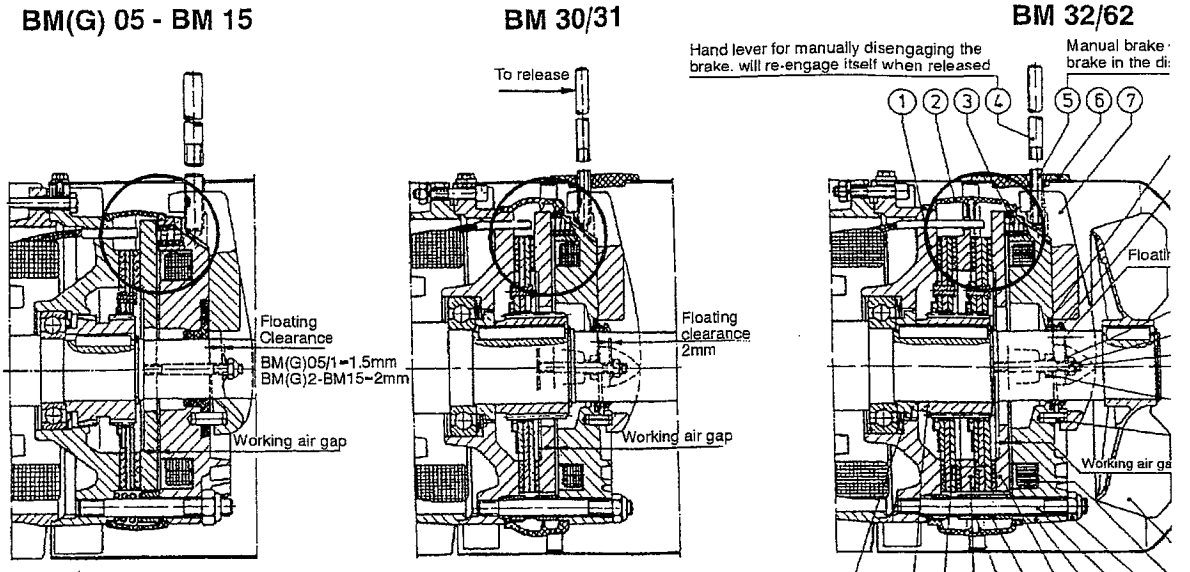


Motor wired for high voltage.
Brake voltage matches low motor voltage.
Example: 220/380V Motor
Motor wired 380V
Brake voltage 220V



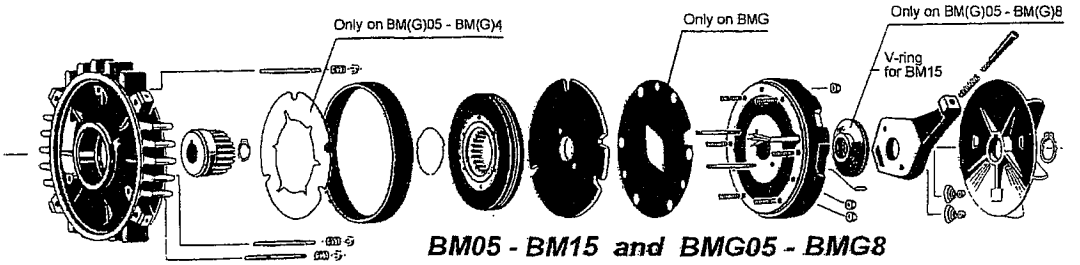
Motor wired for high voltage.
Brake voltage matches high motor voltage.
Example: 220/380V Motor
Motor wired 380V
Brake voltage 380V

BM(G) Brake Cross Section and Exploded Views



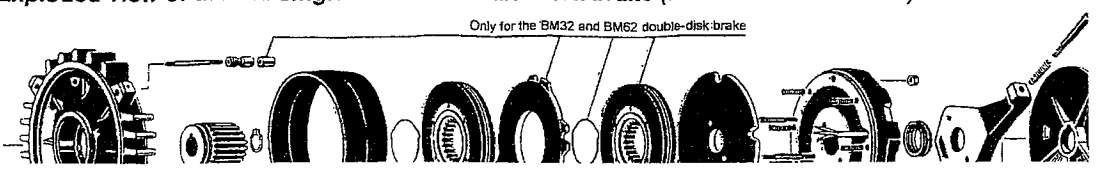
(1) Brake end shield
(2) Rubber sealing collar
(3) Braking springs
(4) Hand release lever
(5) Releasing screw
(6) Closing plate
(7) Release arm
(9) Sealing ring
(10) V-ring
(11) Conical spring
(12) Release
(13) Stud
(14) Fanguard
(15) Grommet
(16) Dowel pin
(17) Fan
(18) N/A
(19) Brake adjustment nut
(20) Retaining stud
(21) Brake coil body
(22) Stationary disc
(23) Pressure ring
(24) Setting sleeve
(25) Dual brake pad stationary disc
(26) Brake disc complete
(27) Carrier
(29) Cup Spring

Exploded view of the BM and BMG single-disk brake (motor sizes 71-160M)

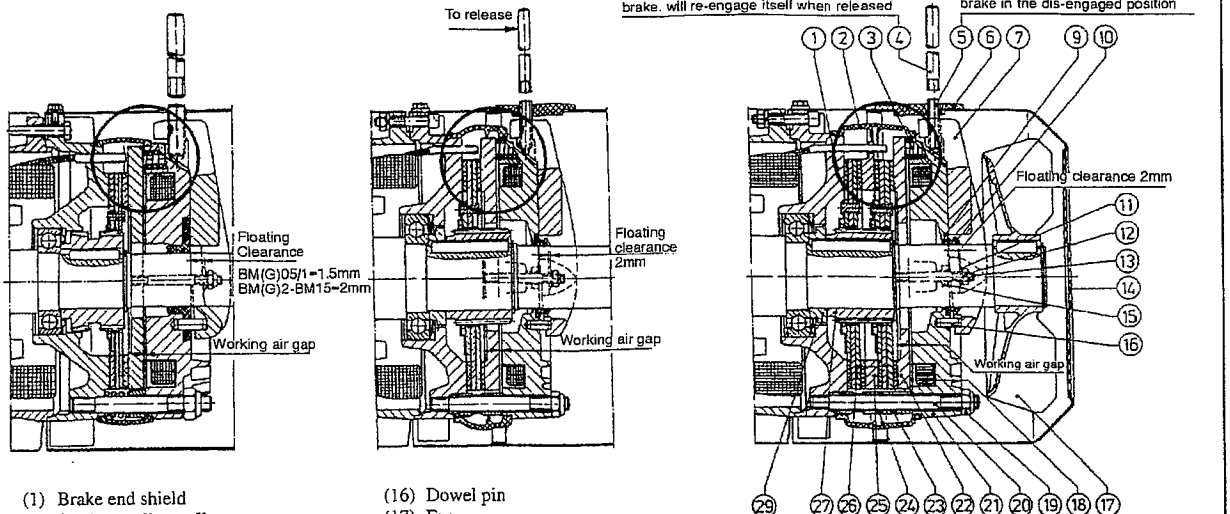


BM05 - BM15 and BMG05 - BMG8

Exploded view of the BM single-disk and double-disk brake (motor sizes 160L-225)

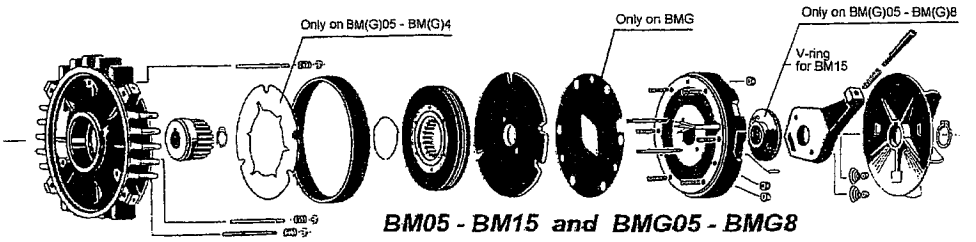


BM(G) Brake Cross Section and Exploded Views



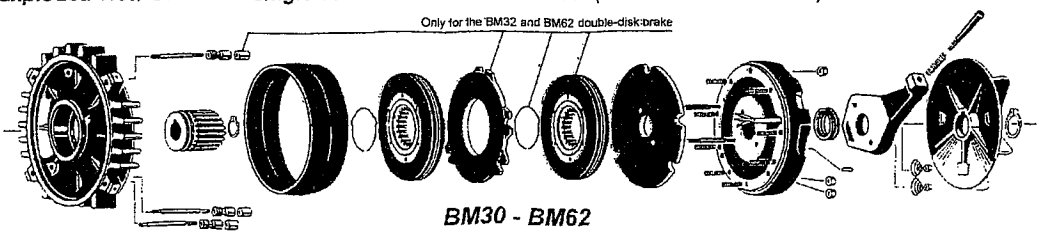
(1) Brake end shield
(2) Rubber sealing collar
(3) Braking springs
(4) Hand release lever
(5) Releasing screw
(6) Closing plate
(7) Release arm
(9) Sealing ring
(10) V-ring
(11) Conical spring
(12) Release
(13) Stud
(14) Fanguard
(15) Grommet
(16) Dowel pin
(17) Fan
(18) N/A
(19) Brake adjustment nut
(20) Retaining stud
(21) Brake coil body
(22) Stationary disc
(23) Pressure ring
(24) Setting sleeve
(25) Dual brake pad stationary disc
(26) Brake disc complete
(27) Carrier
(29) Cup Spring

Exploded view of the BM and BMG single-disk brake (motor sizes 71-160M)



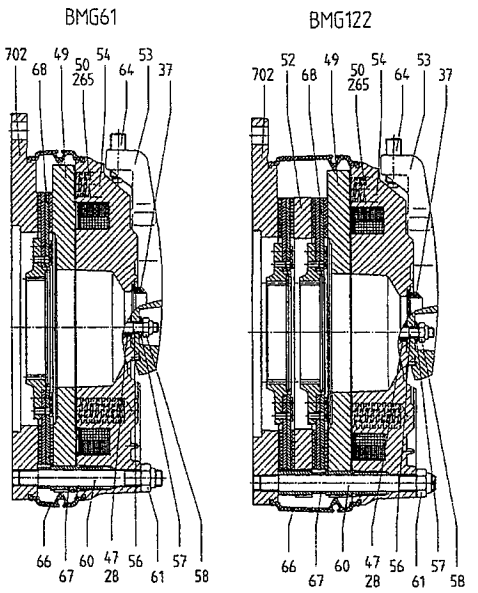
BM05 - BM15 and BMG05 - BMG8

Exploded view of the BM single-disk and double-disk brake (motor sizes 160L-225)



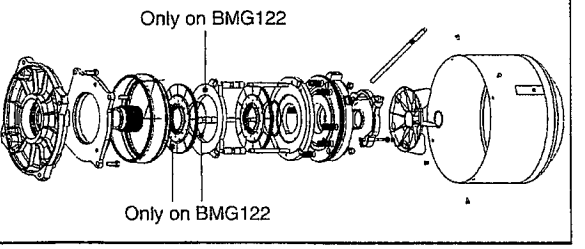
BM30 - BM62

Brake Cross Section and Exploded View of DV250/DV280



No.	Description	No.	Description
28	Closing Cap	54	Brake coil body 460VAC
37	V-Seal	54	Brake coil body 500VAC
47	O-Ring [1]	56	Stud [1]
49	Pressure plate	57	Conical coil spring [1]
50	Brake spring	58	Hex Nut [1]
52	Brake stationary disc	60	Stud
53	Releasing lever [1]	61	Hex Nut
54	Brake coil body 208VAC	64	Stud Bolt [1]
54	Brake coil body 230VAC	66	Rubber sealing ring
54	Brake coil body 254VAC	67	Setting sleeve
54	Brake coil body 290VAC	68	Brake disc compl.
54	Brake coil body 318VAC	265	Brake spring red
54	Brake coil body 360VAC	702	Adapter flange
54	Brake coil body 400VAC		

[1] Parts for manual brake release



Troubleshooting Chart

PROBLEM	CAUSE	REMEDY
Motor Overheats (Check temperature with instrumentation)	Motor not connected for proper supply voltage	Check connection diagram on conduit box cover and correct the wiring.
	Supply voltage varies outside the allowable tolerance causing an undervoltage or overvoltage condition.	Assure correct supply voltage.
	Insufficient cooling air volume due to: a.Low frequency operation on variable frequency drive. b.Obstructed air flow.	Increase air flow: a.Continuous running auxiliary fan. b.Ensure unobstructed air flow.
	Ambient temperature is too high.	Ensure cool air gets to the motor. Ducting may be required.
	Overload at rated voltage. Unit will draw current in excess of nameplate rating and run below rated speed.	Select a larger unit.
	Motor's allowable duty cycle is exceeded (too many starts per hour required).	The problem may or may not be solved with a larger motor. Contact SEW-Eurodrive.
	Single phasing due to break or loose connection in supply line or blown fuse.	Repair supply lines. Replace fuses.
Motor does not run.	Blown fuse.	Determine and correct cause of failure and replace fuse.
	Motor protection device activated.	Reset protective device. Identify and correct cause for device activation.
	Motor protection device faulty or will not reset.	Check protection device for faults.
Motor will not start or starts sluggishly.	Motor not connnected for proper voltage.	Check connection diagram in conduit box cover and correct the wiring.
	Large voltage and/or frequency fluctuation at starting.	Ensure stable power supply.
For reduced voltage starting, motor will not start in Star Connection but will start in Delta connection.	Insufficient torque in Star Connection.	Start motor directly in Delta Connection if possible. Otherwise use a larger motor.
	Faulty contact in Star/Delta starter.	Correct fault condition.
Motor hums and draws high current.	Faulty or defective winding. Rotor dragging.	Have motor repaired by qualified service shop.
Fuses blow or motor overcurrent protection trips immediately.	Short circuit in power supply conductors or in the motor.	Correct the fault condition.
	Motor has ground fault or winding to winding short circuit.	Have motor repaired by qualified service shop.
	Motor improperly connected.	Check connection diagram in conduit box cover and correct the wiring.
Motor runs in wrong direction.	Motor supply leads misconnected.	Switch two supply leads.

Note: If, after proceeding through the Troubleshooting Chart, the motor is found to be defective, contact your nearest SEW-Eurodrive Assembly Center for warranty assistance or replacement parts.

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SICK-STEGMANN Motor Feedback Systems
Assembly Instructions

⚠ Safety Notes

- ▶ Observe the professional safety regulations and accident prevention regulations applicable to your country.
- ▶ Switch off the voltage for all devices/machines and systems affected by the assembly.
- ▶ Impacts and shocks to the shaft MUST be avoided, as this may lead to damage to the ball bearings.
- ▶ Never make or undo electrical connections to the motor feedback system when voltage is applied, otherwise this may result in defective devices.
- ▶ Never pull or press the motor feedback system housing.

Tools Required

3 mm Allen key
Torx T-20
Diameter 3,5 mm round steal

Preparation for Attachment

The drive shaft must be free from burrs and grease.

Beware of damage!

Generally Applicable Notes

Using the torque support for the motor feedback system, the housing must be correctly seated in the customer's flange arrangement.

The more precise the centring for the motor feedback system, the less the angle and shaft offset during assembly and the less load on the bearing of the motor feedback system.
For motor feedback systems with a connector exit, the connector housing is connected to the device housing so as to be electrically conductive while, for devices with outgoing cable, the screening and the braided screen, resp., will be connected to the device housing. EMC considerations make it mandatory to connect the device housing and the cable screen, resp., to earth. For motor feedback systems with spring mounting plate, this is provided by the torque support.

To ensure trouble-free operation, it is imperative to ensure a clean screen connection on both sides.

SICK|STEGMANN

Motor Feedback Systems SinCos®
SEW Special Version

SRS 64, SRM 64

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E-Mail sales@stegmann.com

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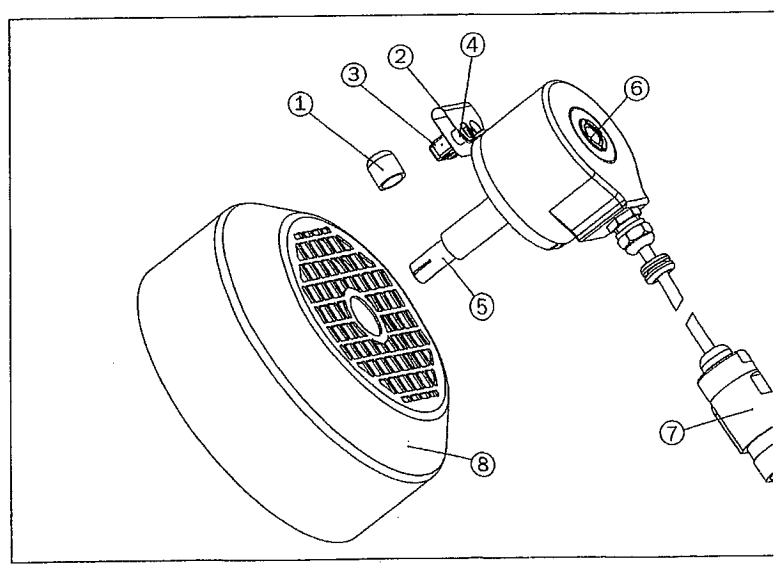
Motor feedback system with special shaft and spring plate stator coupling

Assembley

Remove protective cap (1). Push the motor feedback system onto the drive shaft and ensure that the stator coupling (2) is not being bent. The clamping element (3) must snap into the grid of the fan cover (8) and be fixed with the clamping screws (4). Affix the motor feedback system with screw (6) in the hole of the drive shaft, while holding the encoder shaft (5) in the radial hole (Ø 4 mm) between fan cover and motor feedback system.

Torque: 2.9 Nm

Perform run-out check (≤ 0.07). Make electrical connection with the supply switched off (7).



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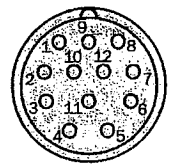
Dismantling

Disconnect the electrical connection with (7). Undo fixing screws of the stator cou Loosen central fixing screw by about 2-3 internal taper by pressing onto the screw motor feedback system.

PIN and wire allocation			
PIN	**Signal**	**Cable coulours**	**Description**
1	N. C.	–	not connected
2	N. C.	–	not connected
3	+ COS	pink	Process data channel. + COS is a cosine signal of 1 V_{PP} with a static offset of REFCOS.
4	REFCOS	black	Process data channel: a static voltage of + 2.5 V, which serves as reference voltage for + COS
5	+ SIN	white	Process data channel. + SIN is a sine signal of 1 V_{PP} with a static offset of REFSIN.
6	REFSIN	brown	Process data channel: a static voltage of + 2.5 V, which serves as reference voltage for + SIN.
7	Data –	green	Parameter channel; negative data signal. The parameter channel is an asynchronous, half-duplex interface, which physically corresponds to the EIA RS485 specification. For this, data can be requested from the encoder through different commands; this also makes it possible to write user-specific data such as offset in the electronic rating plate of the encoder.
8	Data +	grey	Parameter channel; positive data signal. The parameter channel is an asynchronous, half-duplex interface, which physically corresponds to the EIA RS485 specification. For this, data can be requested from the encoder through different commands; this also makes it possible to write user-specific data such as offset in the electronic rating plate of the encoder.
9	N. C.	–	not connected
10	N. C.	–	not connected
11	GND N. C.	blue	Encoder ground connection; galvanically separated from the housing. The voltage relating to GND is + U_s.
12	+ U_s	red	Encoder supply voltage. The operating voltage at the encoder ranges from + 7 V to + 12 V. The recommended supply voltage is + 8 V.
Plug housing	Screen	–	
Pins and cable colours not listed, must not be damaged.			



View of the plug-in face

Phone +43 (0)22 36 62 28 8-0

MAINTENANCE OF HORIZONTAL CONVEYOR

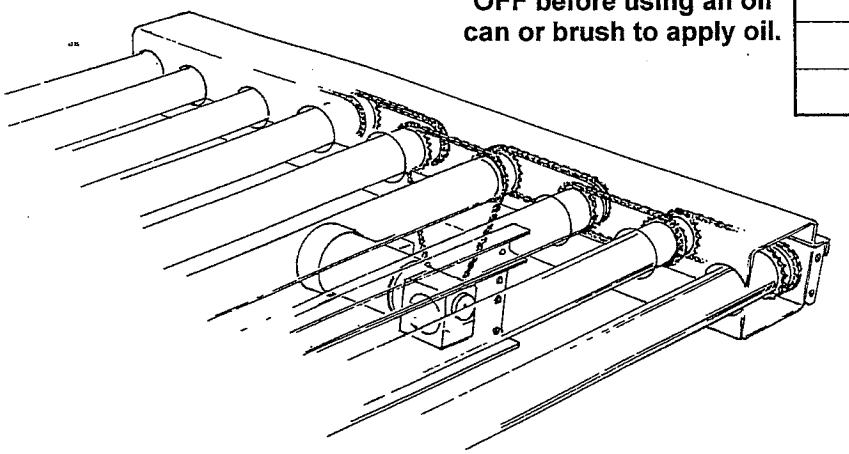
CHAIN & SPROCKETS

For longest chain life, a constant film of oil on the chain is recommended. We recommend a good quality non-detergent petroleum base oil. Use the following chart to determine the oil viscosity to use for the ambient temperature that your conveyor is running in:

Temperature (Degree F)	Oil Viscosity (Recommended)
20-14	SAE 20
40-100	SAE 30
100-200	SAE 40
120-140	SAE 50

CAUTION

Conveyor must be SHUT OFF before using an oil can or brush to apply oil.



WARNING

Maximum individual roller capacity is 600 lbs.

BEARINGS

Lubrication - Bearings are normally pre-lubed for life. If however, relubricated bearings are provided, the use of a # 2 consistency lithium-based greased is advised. Greasing frequency should be as many times as necessary to maintain a small film of grease leaking at the seals. This will protect against foreign materials entering the bearing.

Replacement - If this becomes necessary, remember to clean off the shaft, file smooth any grooves or set screw marks, and oil the shaft before slipping on the new bearing. (Note: If it does not slide on easily, use a soft metal bar to tap against the inner race to assemble.)

General - Set up a weekly check to ensure they remain tightly bolted down and set screws remain securely fastened.

MOTORS

Cleaning - All motors should be kept free of dirt and grease accumulations. Open motors should be periodically vacuumed to remove dust and dirt from windings.

Ventilation - Motors should be operated in an area where adequate ventilation is available.

Temperature - The smooth body T.E.N.V. AND T.E.F.C. motors run hot to the touch. As long as ambient temperatures are not exceeded and, more importantly, ampere draw is within the allowable range, there should be no need to worry. Both of these limits are found on the motor nameplate.

Lubrication - Most electric motors are lubricated for life. Under normal circumstances no more lubrication is required. Under severe conditions where additional will be required, please use the chart as a guide.

Note: Sleeve bearings require a yearly oiling of 10 to 15 drops of SAE # 20 non-detergent or electric motor oil.

Typical lubricants:
Chevron Oil Co. - SR # 2
Shell Oil Co. - Alvania # 2, Dolium R
Texaco Inc. Premium RB

CONDITION	LUBRICATING FREQUENCY
Normal 8 hr. day - light loads	2 to 3 years
24 hr. day - heavy loads or dirty conditions	1 year
Extreme shock loads or high temperatures	3 to 6 months

REDUCERS
The following reducer information is concerened primarily with worm gear reducers. If you conveyor is equipped with another type, refer to the manufacturer's recommendations for installation and maintenance sent along at time of shipment.

Ventilation - During normal operation, gear reducerrs build up heat and pressure that MUST be vented to protect the seals and gears. If not pre-installed, a vent plug will be attached to the reducer for field installation. Remove the topmost drain plug annd install the vent plug securely in place.

Cleaning - After approximately two to three weeks of operation the reducer should be drained, flushed out, and refilled to the proper level with fresh oil. (This is required to remove brass particles caused during the normal wear-in period of the worm gear.) Afterwards, the oil should be changed in your reducer every 2,500 hours or six months, whichever occurs first. Where high temperatures and/or dirty atmosphere exist, more frequent changes may be necessary. Periodically check reducer to ensure that the proper level of oil is in the reducer. Too little oil will cause accelerated wear on the gears. Too much oil can cause overheating, seal deterioration, and leakage.

Lubrication - The proper oil to use in your reducer depends on worm R.P.M.'s, ambient temperature, and severity of use. The chart below can be referred to for reducers with 1,750 R.P.M. worm travel, under normal duty, and with ambient temperatures from 18 degrees F through 125 degrees F. (For other temperatures, consult factory.)

Temperature - Most units are supplied with worm gear reducers. These units may run at temperatures between 100 to 200 degrees F. (Higher temperatures are especially common during start up.) There is no need to worry unless temperatures exceed 200 degrees F.

15° to 60° F **A.G.M.A. #7 Compound**	**50° to 125° F** **A.G.M.A. #8 Compound**
Mobil-Compound #DD	Mobil-# 600W Super Cyl. Oil
Shell-Macoma Oil # 69	Shell-Valvata Oil J81 & J182
Sinclair-# 87 HD Oil	Sinclair-Superheat Valve Oil
Sun-Sun EP 1110	Sun-Sun EP1150
Texaco-Vanguard Cyl Oil	Texaco-650 Cyl Oil
Keystone-WG 1X Oil	Keystone-WG B Oil
Gulf-EP Lubricant # 115	Gulf-EP Lubricant #145

Reducer Size	**45**	**60**	**70**	**80**	**100**
Worm Over	7	12	21	30	64
Worm Under	18	16	28	42	81
Vert. Output	12	14	25	36	72

MATERIAL SAFETY DATA SHEETS

PORT 16

MATERIAL SAFETY DATA SHEET - COMPLIES WITH 29 CFR 1910-1200

FORMAT A/GP

DATE PRINTED - 05/08/96 REVISED - 02/14/96

********** SECTION I **********

MANUFACTURERS NAME:
CUSTOM-PAK PRODUCTS, INC.
N115 W19150 EDISON DRIVE
GERMANTOWN, WI 53022

MANUFACTURERS CODE I.D.: 13E006N-12A

PRODUCT CLASS: AEROSOL PAINT

HMIS INFORMATION:
HEALTH. 2
FLAMMABILITY. . 4
REACTIVITY. 1
PROTECTIVE EQ. .

INFORMATION TELEPHONE: (414) 251-6180

PRODUCT DESC: 00002871-0000-N NEW PFLOW BLUE ENAMEL

24 HR. EMERGENCY TELEPHONE: 1-800-688-4005

MANUFACTURED FOR: C1113
PFLOW INDUSTRIES, INC.
MILWAUKEE, WI 53209

FOR EMERGENCY SITUATIONS REFERENCE 13E006N-12A

******* SECTION II - HAZARDOUS INGREDIENTS *******

INGREDIENT	CAS #	VOLATILE % BY WEIGHT	LEL	VAPOR PRESSURE mm Hg. @20C	OSHA PEL-PPM	ACGIH TLV-PPM	SARA 313 LISTED	LISTED CARCINOGEN NTP	IARC	OSHA
ACETONE	67-64-1	32.00	12.8	181.0	750.0	750.0	N	N	N	N
VM&P NAPHTHA/NAPHTHA	64742-89-8	18.40	1.0	15.0	300	300	N	N	N	N
PROPANE	74-98-6	18.24	2.2	110.0	1000	1000	N	N	N	N
N-BUTANE	106-97-8	5.76	1.8	17.0	800	800	N	N	N	N
XYLENE	1330-20-7	5.36	1.9	5.1	100	100	Y	N	N	N
*TOLUENE	108-88-3	3.12	1.2	22.0	100	50	Y	N	N	N
N-BUTYL ACETATE	123-86-4	1.68	1.7	8.4	150	150	N	N	N	N

*SEE WARNING SECTION V

****** SECTION III - PHYSICAL DATA ******

BOILING RANGE: -43F TO 340F

% VOLATILE BY VOLUME: 80-88

VAPOR DENSITY: Heavier than Air

APPEARANCE: Opaque Spray

WEIGHT PER GALLON: 6.179

WATER SOLUABILITY: Negligible

ODOR: Solvent Odor

EVAPORATION RATE: Faster than Ether

******** SECTION IV - FIRE AND EXPLOSION HAZARD DATA ********

DOT PROPER SHIPP.NG NAME: CONSUMER COMMODITY

ID NO.: UN1950

HAZARD CLASS: ORM-D-AIR

PACKAGE GROUP:

LABEL REQUIREMENT:

EXTINGUISHING MEDIA: See (NFPA) CLASS B extinguisher, C02 or foam.

FLASH POINT: 12F

LEL: See Section II

UNUSUAL FIRE AND EXPLOSION HAZARDS: Pressure build up due to heat exposure may cause containers to explode. Water may be used to cool ruptured containers.

SPECIAL FIRE FIGHTING PROCEDURES: Fight fire from safe distance. Wear full protective equipment, including self-contained breathing gear.

LEVEL 3 AEROSOL (NFPA 30B)

PFL-MSDS1

******** SECTION V - HEALTH HAZARD DATA ********

EFFECTS OF OVEREXPOSURE: (ACUTE) Anesthetic effect. Irritation of the respiratory tract or acute nervous system depression characterized by headache, dizziness, staggering gait, confusion, unconsciousness, or coma. EYE: Contact may cause redness, irritation, tearing, and blurred vision. SKIN: Contact may dry skin causing cracks and irritation. INGESTION: May be harmful or fatal if swallowed.

(CHRONIC) Reports have associated repeated and prolonged occupational overexposure to solvents with liver, kidney, brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY EXPOSURE: Asthma and other respiratory ailments. Chemical sensitization.

PRIMARY ROUTE(S) OF ENTRY: (X) DERMAL (X) INHALATION ( ) INGESTION ( ) ABSORPTION

EMERGENCY AND FIRST AID PROCEDURES: VAPORS: Remove from exposure. Administer oxygen if necessary. Call a physician. EYES: Immediately flush eyes with water for at least 15 minutes. Get medical attention. SKIN: Remove contaminated clothing and shoes. Wash contact area with soap and water. Wash clothing and shoes before reuse. INGESTION: Drink one or two glasses of water to dilute. Do not induce vomiting. Consult a physician or Poison Control Center immediately.

* WARNING: Product contains a chemical(s) known to the State of California to cause cancer, birth defects or other reproductive harm.

******** SECTION VI - REACTIVE DATA ********

STABILITY: STABLE (X) UNSTABLE ( ). HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WILL NOT OCCUR (X).

CONDITIONS TO AVOID: High temperatures and open flames. INCOMPATIBLE MATERIALS TO AVOID: Unknown

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon Dioxide Carbon Monoxide.

******** SECTION VII - SPILL OR LEAK PROCEDURE ********

STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED OR RELEASED: Eliminate all ignition sources. Provide ventilation. Collect spills with absorbent materials and non-sparking tools. See Section VIII for protective equipment.

WASTE DISPOSAL METHOD: Dispose of in accordance with Federal, State, and Local regulations. Do not incinerate containers.

******** SECTION VIII - SPECIAL PROTECTION INFORMATION / CONTROL MEASURES********

RESPIRATORY PROTECTION: In open areas with unrestricted ventilation, an NIOSH/MSHA approved respirator to remove solid airborne particles of overspray may be used if prolonged and repeated exposure is likely. In areas with restricted ventilation, the use of an approved chemical/mechanical filter designed to remove both particles and organic vapors is recommended.

VENTILATION: Supply sufficient ventilation to keep air contaminant concentration below current OSHA (PEL) or ACGIH (TLV).

PROTECTIVE GLOVES: Use protective gloves if contact with product is likely.

OTHER PROTECTIVE EQUIPMENT: Safety glasses to prevent eye contact.

HYGIENIC PRACTICES: Wash hands before eating or using washroom.

******** SECTION IX - SPECIAL PRECAUTIONS ********

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Do not store in areas above 100F or near fire or open flame. When storing large quantities, storage conditions should comply with OSHA 1910.106.

OTHER PRECAUTIONS: Prevent prolonged or repeated breathing of vapor or spray mist. Do not take internally. Keep out of reach of children. Use with adequate ventilation.

Prime Coatings
Division of Prime Leather Finishes
1002 Hickory St. • Pewaukee, WI 53072
(414) 691-1930 • FAX (414) 691-3892

TECHNICAL INFORMATION

COATING NUMBER: 170GY023 **DATE:** September 24,1999

DESCRIPTION: Grey H.S. Primer

WEIGHT PER GALLON, LBS: 11.99

TOTAL SOLIDS, % BY WEIGHT: 71.8

TOTAL SOLIDS, % BY VOLUME: 50.22

VISCOSITY: 21 " Zahn 3

VOC, AS SUPPLIED (LBS/GAL): 3.40

FLASHPOINT, CLOSED CUP (SETAFLASH): 70° F

APPLICATION METHOD: Spray

REDUCTION FOR APPLICATION: None

CURE SCHEDULE: Air Dry

GLOSS:

VOC AT APPLICATION, LBS/GAL: 3.40

MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : GREY H S PRIMER
IDENTIFICATION NUMBER: 170GY023 DATE PRINTED: 09/29/99
PRODUCT USE/CLASS : Air dry primer

SUPPLIER:
Prime Coatings
1002 Hickory Street
Pewaukee WI 53072

EMERGENCY TELEPHONE: 414-691-1930
7:30 am - 4:00 pm

MANUFACTURER:
Prime Coatings
1002 Hickory Street
Pewaukee WI 53072

EMERGENCY TELEPHONE: 414-691-1930
7:30 am - 4:00 pm

PREPARER: Lori Schneider, PHONE: 414-691-1930, PREPARE DATE: 09/21/99

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

ITEM	CHEMICAL NAME	CAS NUMBER	WT/WT % EQUAL TO
01	VM&P Naphtha	8032-32-4	11.1 %
02	Xylene	1330-20-7	6.7 %
03	Toluene	108-88-3	5.0 %
04	Isobutanol	78-83-1	3.2 %
05	Ethyl benzene	100-41-4	1.7 %

EXPOSURE LIMITS

ITEM	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-CEILING	COMPANY TLV-TWA	SKIN
01	300 ppm	N.E.	300 ppm	N.E.	N.E.	NO
02	100 ppm	150 ppm	100 ppm	150 ppm	N.E.	NO
03	50 ppm	N.E.	100 ppm	150 ppm	N.E.	YES
04	50 ppm	N.E.	50 ppm	N.E.	N.E.	NO
05	100 ppm	125 ppm	100 ppm		N.E.	NO

(See Section 16 for abbreviation legend)

SECTION 3 - HAZARDS IDENTIFICATION

*** EMERGENCY OVERVIEW ***: Flammable liquid! May cause eye irritation on contact. Overexposure to vapors may cause dizziness or headache.

EFFECTS OF OVEREXPOSURE - EYE CONTACT: Can cause eye irritation, redness, tearing.

(Continued on Page 2)

SECTION 3 - HAZARDS IDENTIFICATION

EFFECTS OF OVEREXPOSURE - SKIN CONTACT: Prolonged or repeated contact can result in defatting and drying of the skin which may result in skin irritation and dermatitis (rash).

EFFECTS OF OVEREXPOSURE - INHALATION: Excessive inhalation of vapors can cause nasal and respiratory irritation, and central nervous system effects such as dizziness, fatigue, nausea, headache.

EFFECTS OF OVEREXPOSURE - INGESTION: Can cause gastrointestinal irritation, nausea, vomiting, or diarrhea.

EFFECTS OF OVEREXPOSURE - CHRONIC HAZARDS: Possible reproductive hazard. Overexposure may cause kidney damage. May cause liver disorder (e.g., edema, proteinuria) and damage. May cause cardiovascular disorder and damage. May cause brain cell damage from deliberate and abusive inhalation of vapors. May affect the blood, causing anemia. Toluene and xylene have been found to be orotoxins, that is, exposure to these solvents may cause hearing loss. More severe effects can result when chemical exposure is combined with noise exposure, even if these exposures are below the recommended limits.

PRIMARY ROUTE(S) OF ENTRY: SKIN CONTACT INHALATION

SECTION 4 - FIRST AID MEASURES

FIRST AID - EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation persists.

FIRST AID - SKIN CONTACT: Wash with soap and water. Get medical attention if irritation develops or persists. Wash contaminated clothing before reuse.

FIRST AID - INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

FIRST AID - INGESTION: If swallowed, do NOT induce vomiting. Give victim a glass of water or milk. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. Aspiration of this material into the lungs may cause chemical pneumonitis, which may be fatal.

SECTION 5 - FIRE FIGHTING MEASURES

FLASH POINT: 70 F
(TAGLIABUE CLOSED CUP)

LOWER EXPLOSIVE LIMIT: 0.9 %
UPPER EXPLOSIVE LIMIT: 7.0 %

AUTOIGNITION TEMPERATURE: N.D.

(Continued on Page 3)

SECTION 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: ALCOHOL FOAM CO2 DRY CHEMICAL FOAM

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors can travel along the ground to a source of ignition and flashback. Flammable Liquid. Can release vapors that form explosive mixtures at temperatures at or above the flashpoint.

SPECIAL FIREFIGHTING PROCEDURES: Containers can build up pressure if exposed to heat (fire). As in any fire, wear self-contained breathing apparatus pressure-demand (MSHA/NIOSH approved or equivalent) and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Use water with caution. Since this material may be lighter than water and insoluble, use of water may spread the fire.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Avoid runoff into storm sewers and ditches which lead to waterways. Absorb small spills with inert material and place in chemical waste container. For a large spill: dike area of spill and pump to salvage container. Collect remainder on inert material and place in chemical waste container. Wear organic vapor respirator. Remove all sparks, flames, and other sources of ignition from the area and allow any hot surfaces to cool. Use non-sparking tools only. Ventilate area thoroughly.

SECTION 7 - HANDLING AND STORAGE

HANDLING: "Empty" containers retain product residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed of. Wash thoroughly after handling. Use with adequate ventilation. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment.

STORAGE: Keep away from heat, sparks and flame. Keep container closed when not in use.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

RESPIRATORY PROTECTION: NIOSH/MSHA approved respirator should be worn to

(Continued on Page 4)

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

avoid inhalation. Local exhaust ventilation may be necessary to control any air contaminants to within their TLVs during the use of this product. Ventilation rates must be maintained to keep exposure below the TLV or PEL. Otherwise, an approved organic vapor respirator must be used. A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

SKIN PROTECTION: Gloves should be worn to avoid prolonged skin contact. Chemically resistant gloves should be worn if contact is likely.

EYE PROTECTION: Wear safety glasses with side shields or goggles.

OTHER PROTECTIVE EQUIPMENT: Where splashing is possible, an impermeable apron and boots should be worn.

HYGIENIC PRACTICES: Wash hands before eating. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Avoid contact with eyes, skin, and clothing.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

BOILING RANGE	: 226 - 285 F	VAPOR DENSITY	: Is heavier than air
ODOR	: Solvent	ODOR THRESHOLD	: N.D.
APPEARANCE	: Liquid	EVAPORATION RATE	: Is faster than Butyl Acetate
SOLUBILITY IN H2O	: None	SPECIFIC GRAVITY	: 1.4457
FREEZE POINT	: N.D.	pH @ 0.0 %	: N.D.
VAPOR PRESSURE	: N.D.	VISCOSITY	: N.D.
PHYSICAL STATE	: N.D.		
WEIGHT % SOLIDS	: 71.80		

(See Section 16 for abbreviation legend)

SECTION 10 - STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Hazardous polymerization will not occur.

INCOMPATIBILITY: Avoid contact with oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Burning may produce carbon dioxide and carbon monoxide. Products containing nitrocellulose produce oxides of nitrogen if burned.

HAZARDOUS POLYMERIZATION: Will not occur under normal conditions.

STABILITY: This product is stable under normal storage conditions.

(Continued on Page 5)

SECTION 11 - TOXICOLOGICAL PROPERTIES

No product or component toxicological information is available.

Toxic section 11B: No Information.

SECTION 12 - ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: No Information.

SECTION 13 - DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: This material is a RCRA hazardous waste due to ignitability. Some components may be listed wastes or on the land ban form. Comply with all applicable federal, state, and local regulations when disposing of this material. This material may be fuel blended. This material may be sent to a recycler for solvent recovery.

SECTION 14 - TRANSPORTATION INFORMATION

DOT PROPER SHIPPING NAME: Paint

DOT TECHNICAL NAME:

DOT HAZARD CLASS: 3 HAZARD SUBCLASS:

DOT UN/NA NUMBER: UN 1263 PACKING GROUP: II RESP. GUIDE PAGE: 127

SECTION 15 - REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS: AS FOLLOWS -

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200)

CERCLA - SARA HAZARD CATEGORY:
This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD FIRE HAZARD

(Continued on Page 6)

SECTION 15 - REGULATORY INFORMATION

SARA SECTION 313:
This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

---------- CHEMICAL NAME ----------	CAS NUMBER	WT/WT %
Xylene	1330-20-7	6.7 %
Toluene	108-88-3	5.0 %
Ethyl benzene	100-41-4	1.7 %
Cobalt compounds		0.1 %

INTERNATIONAL REGULATIONS: AS FOLLOWS -

CANADIAN WHMIS: This MSDS has been prepared in compliance with Controlled Product Regulations except for use of the 16 headings.

CANADIAN WHMIS CLASS: No information available.

SECTION 16 - OTHER INFORMATION

HMIS RATINGS - HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0

PREVIOUS MSDS REVISION DATE: 09/21/99

VOLATILE ORGANIC COMPOUNDS (VOCS): 3.40 lbs/gal, 407 grams/ltr

LEGEND: N.A. - Not Applicable, N.E. - Not Established,
N.D. - Not Determined

The information contained on this MSDS has been checked and should be accurate. However, it is the responsibility of the user to comply with all Federal, State, and Local laws and regulations.

<END OF MSDS>

Prime Coatings
Division of Prime Leather Finishes
1002 Hickory St. • Pewaukee, WI 53072
(414) 691-1930 • FAX (414) 691-3892

TECHNICAL INFORMATION

COATING NUMBER: 170BE031 **DATE:** 27 September 1999

DESCRIPTION: High-Solids Blue Enamel

WEIGHT PER GALLON, LBS: 11.86

TOTAL SOLIDS, % BY WEIGHT: 71.4

TOTAL SOLIDS, % BY VOLUME: 51.5

VISCOSITY: 19 Seconds Zahn 3/ 74° F

VOC, AS SUPPLIED (LBS/GAL): 3.4

FLASHPOINT, CLOSED CUP (SETAFLASH): Per MSDS

APPLICATION METHOD: Conventional spray

REDUCTION FOR APPLICATION: None Required

CURE SCHEDULE: Dry to touch 30- 1 hour

GLOSS: 12-16 (60°)

VOC AT APPLICATION, LBS/GAL: 3.40

MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : BLUE ENAMEL
IDENTIFICATION NUMBER: 170BE031 DATE PRINTED: 09/29/99
PRODUCT USE/CLASS :

SUPPLIER:
Prime Coatings
1002 Hickory Street
Pewaukee WI 53072

EMERGENCY TELEPHONE: 414-691-1930
7:30 am - 4:00 pm

MANUFACTURER:
Prime Coatings
1002 Hickory Street
Pewaukee WI 53072

EMERGENCY TELEPHONE: 414-691-1930
7:30 am - 4:00 pm

PREPARER: Brenda Schoenike, PHONE: 414-691-1930, PREPARE DATE: 09/29/99

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

ITEM	CHEMICAL NAME	CAS NUMBER	WT/WT % EQUAL TO
01	Xylene	1330-20-7	9.3 %
02	VM&P Naphtha	8032-32-4	5.2 %
03	Toluene	108-88-3	4.9 %
04	Isobutanol	78-83-1	3.4 %
05	Methoxy propyl acetate	108-65-6	2.6 %
06	Ethyl benzene	100-41-4	2.3 %

	EXPOSURE LIMITS					
	ACGIH		OSHA		COMPANY	
ITEM	TLV-TWA	TLV-STEL	PEL-TWA	PEL-CEILING	TLV-TWA	SKIN
01	100 ppm	150 ppm	100 ppm	150 ppm	N.E.	NO
02	300 ppm	N.E.	300 ppm	N.E.	N.E.	NO
03	50 ppm	N.E.	100 ppm	150 ppm	N.E.	YES
04	50 ppm	N.E.	50 ppm	N.E.	N.E.	NO
05	N.E.	N.E.	N.E.	N.E.	N.E.	NO
06	100 ppm	125 ppm	100 ppm		N.E.	NO

(See Section 16 for abbreviation legend)

SECTION 3 - HAZARDS IDENTIFICATION

*** EMERGENCY OVERVIEW ***: Flammable liquid! May cause eye irritation on contact. Overexposure to vapors may cause dizziness or headache.

EFFECTS OF OVEREXPOSURE - EYE CONTACT: Can cause eye irritation, redness,

(Continued on Page 2)

SECTION 3 - HAZARDS IDENTIFICATION

tearing.

EFFECTS OF OVEREXPOSURE - SKIN CONTACT: Prolonged or repeated contact can result in defatting and drying of the skin which may result in skin irritation and dermatitis (rash).

EFFECTS OF OVEREXPOSURE - INHALATION: Excessive inhalation of vapors can cause nasal and respiratory irritation, and central nervous system effects such as dizziness, fatigue, nausea, headache.

EFFECTS OF OVEREXPOSURE - INGESTION: Can cause gastrointestinal irritation, nausea, vomiting, or diarrhea.

EFFECTS OF OVEREXPOSURE - CHRONIC HAZARDS: Possible reproductive hazard. Overexposure may cause kidney damage. May cause liver disorder (e.g., edema, proteinuria) and damage. May cause cardiovascular disorder and damage. May cause brain cell damage from deliberate and abusive inhalation of vapors. May affect the blood, causing anemia. Toluene and xylene have been found to be orotoxins, that is, exposure to these solvents may cause hearing loss. More severe effects can result when chemical exposure is combined with noise exposure, even if these exposures are below the recommended limits.

PRIMARY ROUTE(S) OF ENTRY: SKIN CONTACT INHALATION

SECTION 4 - FIRST AID MEASURES

FIRST AID - EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation persists.

FIRST AID - SKIN CONTACT: Wash with soap and water. Get medical attention if irritation develops or persists. Wash contaminated clothing before reuse.

FIRST AID - INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

FIRST AID - INGESTION: If swallowed, do NOT induce vomiting. Give victim a glass of water or milk. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. Aspiration of this material into the lungs may cause chemical pneumonitis, which may be fatal.

SECTION 5 - FIRE FIGHTING MEASURES

FLASH POINT: 70 F
(TAGLIABUE CLOSED CUP)

LOWER EXPLOSIVE LIMIT: 0.9 %
UPPER EXPLOSIVE LIMIT: 13.1 %

AUTOIGNITION TEMPERATURE: N.D.

(Continued on Page 3)

SECTION 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: ALCOHOL FOAM CO2 DRY CHEMICAL FOAM WATER FOG

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors can travel along the ground to a source of ignition and flashback. Flammable Liquid. Can release vapors that form explosive mixtures at temperatures at or above the flashpoint.

SPECIAL FIREFIGHTING PROCEDURES: Containers can build up pressure if exposed to heat (fire). As in any fire, wear self-contained breathing apparatus pressure-demand (MSHA/NIOSH approved or equivalent) and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Use water with caution. Since this material may be lighter than water and insoluble, use of water may spread the fire.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Avoid runoff into storm sewers and ditches which lead to waterways. Absorb small spills with inert material and place in chemical waste container. For a large spill: dike area of spill and pump to salvage container. Collect remainder on inert material and place in chemical waste container. Wear organic vapor respirator. Remove all sparks, flames, and other sources of ignition from the area and allow any hot surfaces to cool. Use non-sparking tools only. Ventilate area thoroughly.

SECTION 7 - HANDLING AND STORAGE

HANDLING: "Empty" containers retain product residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed of. Wash thoroughly after handling. Use with adequate ventilation. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment.

STORAGE: Keep away from heat, sparks and flame. Keep container closed when not in use.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

RESPIRATORY PROTECTION: NIOSH/MSHA approved respirator should be worn to

(Continued on Page 4)

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

avoid inhalation. Local exhaust ventilation may be necessary to control any air contaminants to within their TLVs during the use of this product. Ventilation rates must be maintained to keep exposure below the TLV or PEL. Otherwise, an approved organic vapor respirator must be used. A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

SKIN PROTECTION: Gloves should be worn to avoid prolonged skin contact. Chemically resistant gloves should be worn if contact is likely.

EYE PROTECTION: Wear safety glasses with side shields or goggles.

OTHER PROTECTIVE EQUIPMENT: Where splashing is possible, an impermeable apron and boots should be worn.

HYGIENIC PRACTICES: Wash hands before eating. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Avoid contact with eyes, skin, and clothing.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

BOILING RANGE	: 226 - 285 F	VAPOR DENSITY	: Is heavier than air
ODOR	: Solvent odor	ODOR THRESHOLD	: N.D.
APPEARANCE	: Blue liquid	EVAPORATION RATE	: Is faster than Butyl Acetate
SOLUBILITY IN H2O	: None		
FREEZE POINT	: N.D.	SPECIFIC GRAVITY	: 1.4248
VAPOR PRESSURE	: N.D.	pH @ 0.0 %	: N.D.
PHYSICAL STATE	: N.D.	VISCOSITY	: N.D.
WEIGHT % SOLIDS	: 71.36		

(See Section 16 for abbreviation legend)

SECTION 10 - STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Hazardous polymerization will not occur.

INCOMPATIBILITY: Avoid contact with oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Burning may produce carbon dioxide and carbon monoxide. Products containing nitrocellulose produce oxides of nitrogen if burned.

HAZARDOUS POLYMERIZATION: Will not occur under normal conditions.

STABILITY: This product is stable under normal storage conditions.

(Continued on Page 5)

SECTION 11 - TOXICOLOGICAL PROPERTIES

No product or component toxicological information is available.

Toxic section 11B: No Information.

SECTION 12 - ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: No Information.

SECTION 13 - DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: This material is a RCRA hazardous waste due to ignitability. Some components may be listed wastes or on the land ban form. Comply with all applicable federal, state, and local regulations when disposing of this material. This material may be fuel blended. This material may be sent to a recycler for solvent recovery.

SECTION 14 - TRANSPORTATION INFORMATION

DOT PROPER SHIPPING NAME: Paint

DOT TECHNICAL NAME:

DOT HAZARD CLASS: 3 HAZARD SUBCLASS:

DOT UN/NA NUMBER: UN-1263 PACKING GROUP: II RESP. GUIDE PAGE: 127

SECTION 15 - REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS: AS FOLLOWS -

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200)

CERCLA - SARA HAZARD CATEGORY:
This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD FIRE HAZARD

(Continued on Page 6)

SECTION 15 - REGULATORY INFORMATION

SARA SECTION 313:
This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	WT/WT %
Xylene	1330-20-7	9.3 %
Toluene	108-88-3	4.9 %
Ethyl benzene	100-41-4	2.3 %
Cobalt compounds		0.1 %

INTERNATIONAL REGULATIONS: AS FOLLOWS -

CANADIAN WHMIS: This MSDS has been prepared in compliance with Controlled Product Regulations except for use of the 16 headings.

CANADIAN WHMIS CLASS: No information available.

SECTION 16 - OTHER INFORMATION

HMIS RATINGS - HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0

PREVIOUS MSDS REVISION DATE: 09/29/99

VOLATILE ORGANIC COMPOUNDS (VOCS): 3.40 lbs/gal, 407 grams/ltr

LEGEND: N.A. - Not Applicable, N.E. - Not Established,
N.D. - Not Determined

The information contained on this MSDS has been checked and should be accurate. However, it is the responsibility of the user to comply with all Federal, State, and Local laws and regulations.

<END OF MSDS>

MATERIAL SAFETY DATA BULLETIN

1. PRODUCT AND COMPANY IDENTIFICATION

APPROVAL DATE: 03/12/98

PRODUCT NAME: MOBIL SHC 634
SUPPLIER: MOBIL OIL CORP.
NORTH AMERICA MARKETING AND REFINING
3225 GALLOWS RD.
FAIRFAX, VA 22037

24 - Hour Emergency (call collect):	609-737-4411	
Product and MSDS Information:	800-662-4525	609-224-4644
CHEMTREC:	800-424-9300	202-483-7616

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAMES AND SYNONYMS: SYN. HYDROCARBONS AND ADDITIVES

INGREDIENTS CONSIDERED HAZARDOUS TO HEALTH:

This product is not formulated to contain ingredients which have exposure limits established by U.S. agencies. It is not hazardous to health as defined by the European Union Dangerous Substances/Preparations Directives. See Section 15 for a regulatory analysis of the ingredients.

See Section 15 for European Label Information.

See Section 8 for exposure limits (if applicable).

3. HAZARDS IDENTIFICATION

US OSHA HAZARD COMMUNICATION STANDARD: Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined not to be hazardous.
EFFECTS OF OVEREXPOSURE: No significant effects expected.
EMERGENCY RESPONSE DATA: Straw Liquid. DOT ERG No. - NA

4. FIRST AID MEASURES

EYE CONTACT: Flush thoroughly with water. If irritation occurs, call a physician.
SKIN CONTACT: Wash contact areas with soap and water.
INHALATION: Not expected to be a problem.
INGESTION: Not expected to be a problem. However, if greater than 1/2 liter(pint) ingested, immediately give 1 to 2 glasses of water

(Section continued next page)

and call a physician, hospital emergency room or poison control center for assistance. Do not induce vomiting or give anything by mouth to an unconscious person.

5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA: Carbon dioxide, foam, dry chemical and water fog.
SPECIAL FIRE FIGHTING PROCEDURES: Water or foam may cause frothing. Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply.
SPECIAL PROTECTIVE EQUIPMENT: For fires in enclosed areas, fire fighters must use self-contained breathing apparatus.
UNUSUAL FIRE AND EXPLOSION HAZARDS: None. Flash Point C(F): > 210(410) (ASTM D-92). Flammable limits - LEL: NA, UEL: NA.
NFPA HAZARD ID: Health: 0, Flammability: 1, Reactivity: 0
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide. Elemental oxides. Metal oxides.

6. ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES: Report spills as required to appropriate authorities. U. S. Coast Guard regulations require immediate reporting of spills that could reach any waterway including intermittent dry creeks. Report spill to Coast Guard toll free number (800) 424-8802. In case of accident or road spill notify CHEMTREC (800) 424-9300.
PROCEDURES IF MATERIAL IS RELEASED OR SPILLED: Adsorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up and dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulations, and product characteristics at time of disposal.
ENVIRONMENTAL PRECAUTIONS: Prevent spills from entering storm sewers or drains and contact with soil.
PERSONAL PRECAUTIONS: See Section 8

7. HANDLING AND STORAGE

HANDLING: No special precautions are necessary beyond normal good hygiene practices. See Section 8 for additional personal protection advice when handling this product.
STORAGE: Do not store in open or unlabelled containers. Store away from strong oxidizing agents or combustible material.

Mobil

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION: No special requirements under ordinary conditions of use and with adequate ventilation.
RESPIRATORY PROTECTION: No special requirements under ordinary conditions of use and with adequate ventilation.
EYE PROTECTION: Normal industrial eye protection practices should be employed.
SKIN PROTECTION: No special equipment required. However, good personal hygiene practices should always be followed.
EXPOSURE LIMITS: This product does not contain any components which have recognized exposure limits. However, a threshold limit value of 5.00 mg/m3 is suggested for oil mist.

9. PHYSICAL AND CHEMICAL PROPERTIES

Typical physical properties are given below. Consult Product Data Sheet for specific details.

APPEARANCE: Liquid
COLOR: Straw
ODOR: Mild
ODOR THRESHOLD-ppm: NE
pH: NA
BOILING POINT C(F): > 316(600)
MELTING POINT C(F): NA
FLASH POINT C(F): > 210(410) (ASTM D-92)
FLAMMABILITY: NE
AUTO FLAMMABILITY: NE
EXPLOSIVE PROPERTIES: NA
OXIDIZING PROPERTIES: NA
VAPOR PRESSURE-mmHg 20 C: < 0.1
VAPOR DENSITY: > 2.0
EVAPORATION RATE: NE
RELATIVE DENSITY, 15/4 C: 0.849
SOLUBILITY IN WATER: Negligible
PARTITION COEFFICIENT: > 3.5
VISCOSITY AT 40 C, cSt: > 418.5
VISCOSITY AT 100 C, cSt: 45.8
POUR POINT C(F): -40(-40)
FREEZING POINT C(F): NE
VOLATILE ORGANIC COMPOUND: NA
NA=NOT APPLICABLE NE=NOT ESTABLISHED D=DECOMPOSES

FOR FURTHER TECHNICAL INFORMATION, CONTACT YOUR MARKETING REPRESENTATIVE

Mobil

10. STABILITY AND REACTIVITY

STABILITY (THERMAL, LIGHT, ETC.): Stable.
CONDITIONS TO AVOID: Extreme heat.
INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizers.
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide. Elemental oxides. Metal oxides.
HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL DATA

---ACUTE TOXICOLOGY---

ORAL TOXICITY (RATS): Practically non-toxic (LD50: greater than 2000 mg/kg). ---Based on testing of similar products and/or the components.

DERMAL TOXICITY (RABBITS): Practically non-toxic (LD50: greater than 2000 mg/kg). ---Based on testing of similar products and/or the components.

INHALATION TOXICITY (RATS): Not applicable ---Harmful concentrations of mists and/or vapors are unlikely to be encountered through any customary or reasonably foreseeable handling, use, or misuse of this product.

EYE IRRITATION (RABBITS): Practically non-irritating. (Draize score: greater than 6 but 15 or less). ---Based on testing of similar products and/or the components.

SKIN IRRITATION (RABBITS): Practically non-irritating. (Primary Irritation Index: greater than 0.5 but less than 3). ---Based on testing of similar products and/or the components.

OTHER ACUTE TOXICITY DATA: The acute toxicological results summarized above are based on testing of representative Mobil products. Representative Mobil formulations have shown no acute effects, administered via the inhalation route, when tested at maximum attainable oil mist or vapor concentrations.

---OTHER TOXICOLOGY DATA---

This product is formulated with a synthetic hydrocarbon as the base stock. The Mobil Environmental and Health Sciences Laboratory has tested representative synthetic base stocks to assess their potential adverse effects on human health. Assessment of human health effects was based on acute oral, dermal, and inhalation toxicity; eye and skin irritation; subchronic dermal toxicity and reproductive studies; guinea pig sensitization; and mutagenicity and chromosomal damage assays. None of these base stocks appears to pose a health hazard to humans under conditions of expected use.

Mobil

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL FATE AND EFFECTS: This product is expected to be inherently biodegradable. There is no evidence to suggest bioaccumulation will occur.

Acute LC/EC50 Fish: Juvenile Rainbow Trout: Practically non-toxic ---Based on testing of similar products.

Accidental spillage may lead to penetration in the soil and groundwater. However, there is no evidence that this would cause adverse ecological effects.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL: Product is suitable for burning in an enclosed, controlled burner for fuel value or disposal by supervised incineration. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at an appropriate government waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

RCRA INFORMATION: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

14. TRANSPORT INFORMATION

USA DOT: NOT REGULATED BY USA DOT.

RID/ADR: NOT REGULATED BY RID/ADR.

IMO: NOT REGULATED BY IMO.

IATA: NOT REGULATED BY IATA.

Mobil

15. REGULATORY INFORMATION

Governmental Inventory Status: All components comply with TSCA, AICS and DSL.

EU Labeling: EU labeling not required.

U.S. Superfund Amendments and Reauthorization Act (SARA) Title III:
This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

SARA (311/312) REPORTABLE HAZARD CATEGORIES: None.

This product contains no chemicals reportable under SARA (313) toxic release program.

THIS PRODUCT HAS BEEN AUTHORIZED BY USDA FOR USE UNDER THE FOLLOWING CATEGORY: H2 - Lubricants With No Food Contact

The following product ingredients are citec on the lists below:

CHEMICAL NAME	CAS NUMBER	LIST CITATIONS

*** NO REPORTABLE INGREDIENTS ***

--- REGULATORY LISTS SEARCHED ---

1=ACGIH ALL	6=IARC 1	11=TSCA 4	16=CA P65 CARC	21=LA RTK
2=ACGIH A1	7=IARC 2A	12=TSCA 5a2	17=CA P65 REPRO	22=MI 293
3=ACGIH A2	8=IARC 2B	13=TSCA 5e	18=CA RTK	23=MN RTK
4=NTP CARC	9=OSHA CARC	14=TSCA 6	19=FL RTK	24=NJ RTK
5=NTP SUS	10=OSHA Z	15=TSCA 12b	20=IL RTK	25=PA RTK
				26=RI RTK

Code key: CARC=Carcinogen; SUS=Suspected Carcinogen; REPRO=Reproductive

Mobil

16. OTHER INFORMATION

USE: GEAR AND BEARING LUBRICANT

NOTE: MOBIL PRODUCTS ARE NOT FORMULATED TO CONTAIN PCBS.

Please call the Customer Response Center on 800-662-4525 for formulation disclosure.

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For Internal Use Only: MHC: 1* 1* NA 1* 1*, MPPEC: A, REQ: US - MARKETING, SAFE USE: L

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