How to Use This Manual

This manual provides detailed instructions on installation and maintenance of parallel shaft Types A, AR, AXV and right angle Types AB, ABR, ABX, and ABRC gear drives. Use the table of contents below to locate required information.

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE OF YOUR FALK™ GEAR DRIVE.

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Introduction

Credit for long service and dependable operation of a gear drive is often given to the engineers who designed it, or the craftsmen who constructed it, or the sales engineer who recommended the type and size. Ultimate credit belongs to the mechanic on the job who worked to make the foundation rigid and level, who accurately aligned the shafts and carefully installed the accessories, and who made sure that the drive received regular lubrication. The details of this important job are the subject of this manual.

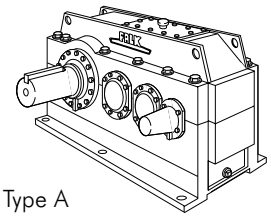
NAMEPLATE — Operate Falk™ gear drives only at power, speed and ratio shown on the nameplate. Before changing any one of these, submit complete nameplate data and new application conditions to the Factory for correct oil level, parts, and application approval.

DISASSEMBLY AND ASSEMBLY — Disassembly & assembly instructions and parts guides are available from the Factory or Rexnord Account Executive. When requesting information, please give complete data from the nameplate on the gear drive; Model, M.O.Number, Date, RPM, and Ratio.

WARNING: Consult applicable local and national safety codes for proper guarding of rotating members. Lock out power source and remove all external loads from drive before servicing drive or accessories.

Warranty

WARRANTY — Rexnord Industries (the "Company") warrants that, for a period of three years from the date of shipment, the product described herein will deliver successfully its rated output as indicated on the nameplate, provided, it is properly installed and maintained, correctly lubricated, and operated in the environment and within the limits of speed, torque or other load conditions for which it was sold. Such product is expressly not warranted against failure or unsatisfactory operation resulting from dynamic vibrations imposed upon it by the drive system in which it is installed unless the nature of such vibrations has been fully defined and expressly accepted in writing by the Company as a condition of operation.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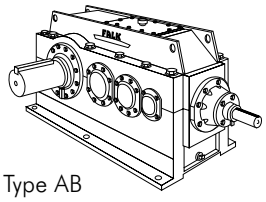
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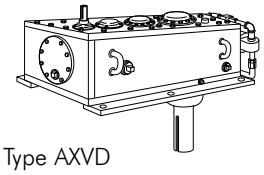
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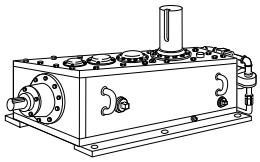
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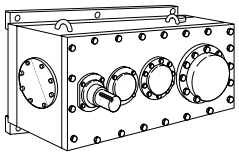
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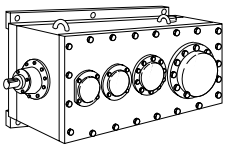
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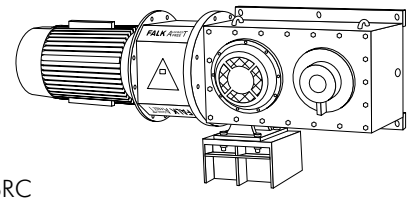

Type ABRC

Installation Instructions

The following instructions apply to standard Falk™ Type A, AB, AXV, ABX, AR, ABR, & ABRC (Alignment Free) drives. If a drive is furnished with special features, refer to the supplementary instructions shipped with the drive.

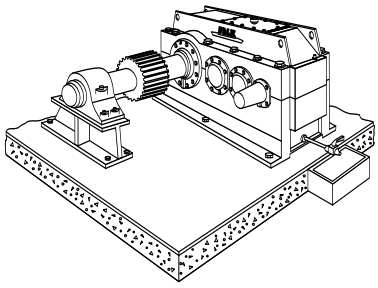
NOTE: Quadruple Reduction Type "A" Gear Drives: Removal of backstop and mounting bracket may be required for adequate clearance when installing foundation fasteners. Removal of fan assemblies may be required for adequate clearance when installing foundation fasteners.

WELDING — Do not weld on the gear drive or accessories without prior approval from Rexnord Industries, LLC. Welding on the drive may cause distortion of the housing or damage to the bearings and gear teeth. Welding without prior approval could void the warranty.

EFFECTS OF SOLAR ENERGY — If the gear drive operates in the sun at ambient temperatures over 100°F(38°C), then special measures should be taken to protect the drive from solar energy. This protection can consist of a canopy over the drive or reflective paint on the drive. If neither is possible, a heat exchanger or other cooling device may be required to prevent the sump temperature from exceeding the allowable maximum.

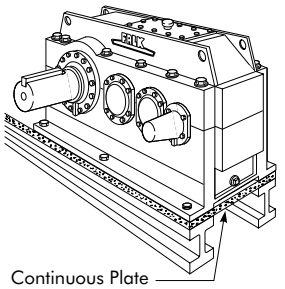
MOUNTING POSITION — Standard mounting positions for types A, AB, , and ABX are with the base horizontal, and for types AR, ABR, and ABRC with the input and output shafts horizontal. If a gear drive is ordered for non-standard mounting positions, refer to the instructions provided with the drive for oil levels and bearing lubrication. If it is necessary to mount the gear drive in a different position from which it was ordered, refer to Falk for required changes to provide proper lubrication.

FOUNDATION, GENERAL — To facilitate oil drainage, elevate the gear drive foundation above the surrounding floor level. If desired, replace the drive oil drain plug with a valve, but provide a guard to protect the valve from accidental opening or breakage.

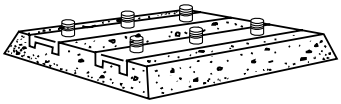


When an outboard bearing is used, mount drive and outboard bearing on a continuous foundation or bedplate, and dowel both in place.

FOUNDATION, STEEL — When mounting gear drive on structural steel, it is recommended that an engineered design be utilized for a pedestal, adapter base or bed to provide sufficient rigidity, to prevent induced loads from distorting the housing and causing gear misalignment. In the absence of an engineered design, it is recommended that a base plate, with thickness equal to or greater than the thickness of the drive feet, be securely bolted to steel supports and extend under the entire drive as illustrated.



FOUNDATION, CONCRETE — If a concrete foundation is used, allow the concrete to set firmly before bolting down the gear drive. For the best type of mounting, grout structural steel mounting pads into the mounting base, as illustrated, rather than grouting the drive directly into the concrete.



Motors and other components mounted on motor plates or motor brackets may become misaligned during shipment. ALWAYS check alignment after installation. Refer to Page 4 for coupling alignment instructions.

MOTOR BRACKETS — Falk™ motor brackets provide an economical "soft mounting" for standard NEMA and IEC foot mounted AC induction electric motors. The weight, location, and starting torque of the motor will cause cantilevered motor brackets to deflect downward or to twist to varying degrees.

The motor bracket/motor selections are engineered to be within acceptable deflection limits as determined by Rexnord.. Because the bracket is a "soft motor support", deflection and vibration magnitude of the bracket may exceed levels normally considered acceptable for rigidly mounted machinery.

For applications using other than standard selections, use of a motor plate is recommended. If a motor bracket is to be used, it becomes the customer's responsibility to support the rear of the motor bracket to limit deflection and vibration to within satisfactory levels as determined by the customer.

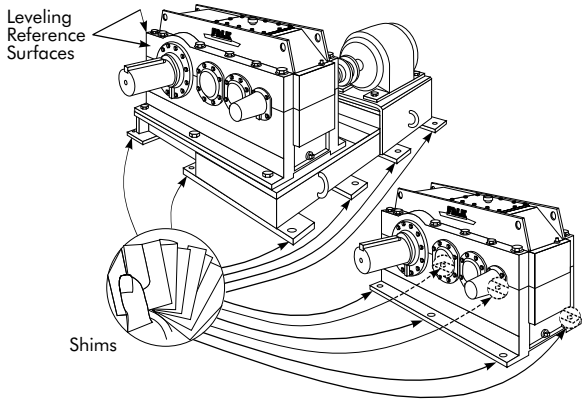
Gear Drive Alignment

FOOT MOUNTED DRIVES – Align drive with driven equipment by placing broad, flat shims under all mounting pads. Start at the low speed shaft end and level across the length and then the width of the drive. Check with a feeler gauge to make certain that all pads are supported to prevent distortion of housing when drive is bolted down. After drive is aligned with driven equipment and bolted down, align prime mover to drive input shaft. Refer to Page 4 for coupling alignment.

If equipment is received from Rexnord mounted on a bedplate, the components were accurately aligned at the Factory with the bedplate mounted on a large, flat assembly plate. Shim under the bedplate foot pads until the gear drive is level and all feet are in the same plane.

Check high speed shaft coupling alignment. If the coupling is misaligned, the bedplate is shimmed incorrectly. Re-shim bedplate and recheck high speed coupling alignment. If necessary, realign motor.

SHAFT MOUNTED DRIVES — Shaft mounted drive alignment occurs when the gear drive is attached to the driven shaft. The standard hollow low speed shaft is connected to the driven shaft with a shrink disc connection. Solid low speed shafts are typically connected with an MCF moment type coupling. Refer to the Shaft Connection section for coupling installation.



There may be some visible movement of the drive while operating due to shaft and coupling . Torque arm assemblies must be aligned such that the gear drive movement is not restricted during operation. Refer to torque arm instructions on Page 3.

The Alignment Free drive flange motor adapter provides registration for the motor which eliminates the adjustments normally required for high speed coupling alignment.

Torque Arms

The torque arm connects a shaft mounted gearbox to the foundation. In static condition, it helps to support the weight of the gearbox/motor assembly. In the dynamic condition, it supports the weight and also transmits the torque reaction to the foundation. The torque arm may be loaded in compression or tension. Maximum torque arm loads should be considered when designing the foundation for the torque arm anchor.

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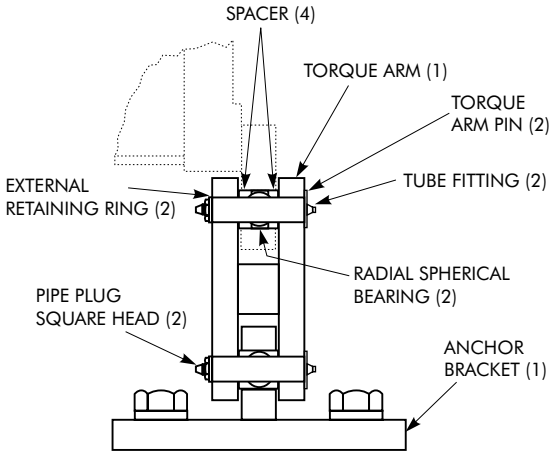
TORQUE ARM ASSEMBLY — The torque arm components are to be assembled according to the following illustration. A plain spherical bearing is fitted into the gearbox housing or bedplate. A pin engages the spherical bearing and connects it to the torque arm. Spacers center the bearing on the pin. The pin is retained by a snap ring. A similar connection is made between the torque arm and anchor bracket. In operation, the torque arm is to be perpendicular to the edge of the gear drive.

Warning: Angular misalignment of the torque arm may restrict gear drive gear drive movement and cause excessive loading on the low speed shaft and driven equipment.

TORQUE ARM MOVEMENT — Movement of the gear drive while operating is natural. The movement is due to shaft and coupling runouts. The standard torque arm is designed to accommodate this movement. It allows the gearbox to move



slightly with the driven shaft. This prevents transmitting unnecessary additional loads to the driven shaft through the gearbox. DO NOT restrain free movement of the gear drive, to do so will adversely load the low speed shaft and driven shaft and may result in shaft or hub failure. Recheck torque arm movement during regular maintenance intervals.

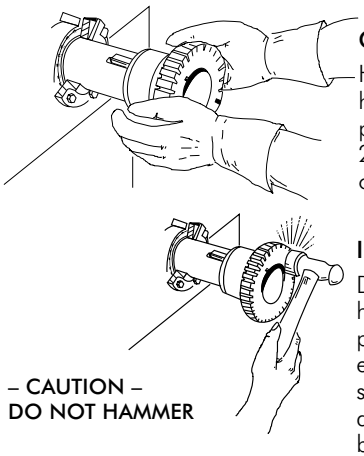
Shaft Connections

WARNING: Provide suitable guards in accordance with local and national standards.

SHRINK DISC CONNECTIONS — Shrink disc assemblies used on hollow low speed shafts and on some MCF coupling hubs require special installation procedures. Refer to the following Falk™ bulletins for detailed instructions:

Shrink Discs 138-850
MCF couplings 458-862

COUPLING CONNECTIONS — The performance and life of any coupling depends largely upon how well the coupling is installed and serviced. Refer to the coupling manufacturer's manual for specific instructions.



CORRECT METHOD
Heat interference fitted hubs, pinions, sprockets or pulleys to a maximum of 275°F (135°C) and slide onto gear drive shaft.

INCORRECT METHOD
DO NOT drive coupling hub, pinion, sprocket or pulley onto the shaft. An endwise blow on the shaft/coupling may damage gears and bearings.

FLANGED MOTOR ADAPTERS — Accurate axial positioning of the coupling hub on the motor shaft is required to ensure proper coupling gap. To establish the correct overhang on the motor shaft, measurements are required. Refer to Figure 1 below. First measure the distance from the motor mounting face of the motor to the end of the motor shaft (A). Then measure the distance from the motor mounting face of the motor adapter to the face of the gear drive hub (B). Refer to the coupling installation and maintenance instructions to determine the desired coupling gap. The coupling overhang is determined from the following equation:

$$\text{Overhang} = A + \text{Gap} - B$$

If the calculated overhang is a positive value, the motor shaft extends beyond the hub by that amount.

NOTE: For couplings where the coupling gap does not occur at the end of the motor hub, an additional adjustment must be made. See dimension C in Figure 1 below.

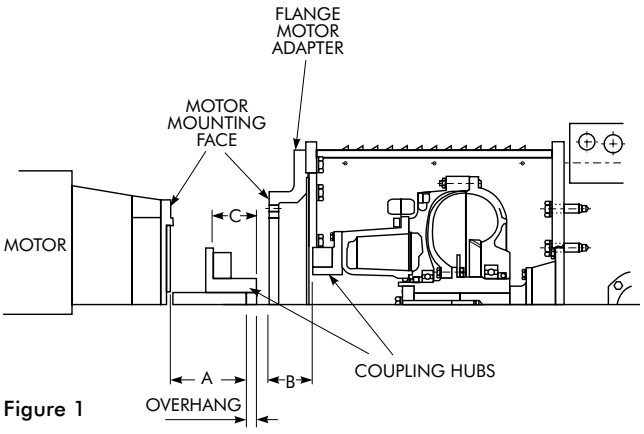


Figure 1

FALK™ COUPLINGS — (Except fluid type) Detailed installation manuals are available from Rexnord, your local Rexnord Account Executive or Distributor—just provide size and type designations stamped on the coupling. For lubricant requirements and a list of typical lubricants meeting Rexnord specifications, refer to appropriate coupling service manual.

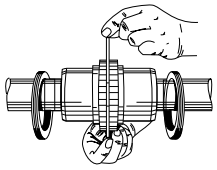
Flanged Type Rigid Couplings are typically used on drives with vertical output shafts. The low speed shaft extension ends of the solid vertical shaft drives are drilled and tapped to accommodate coupling keeper plates. Tightening torques for fasteners, including keeper plate fasteners are listed in Table 1, Page 5.

FALK ™FLUID COUPLINGS — Refer to the installation manual furnished with the Falk fluid coupling for installation and startup instructions.

Type ABRC — The Alignment Free flange motor adapter has two side inspection openings. On solid shaft gear drives, the opening opposite the low speed shaft extension has been marked to indicate the vertical midpoint of the adapter. On hollow shaft gear drives, the opening on the shrink disk side of the gear drive has been marked to indicate the vertical midpoint of the adapter. These marks are used to establish the proper fill angle for the fluid coupling.

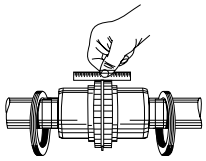
The fluid coupling outside diameter has been marked with two separate match marks. The recommended fill can be obtained by lining up the correct match mark on the fluid coupling with the mark in the inspection opening and filling the fluid coupling until fluid appears at the lip of the fill hole. To determine the correct mark on the fluid coupling begin by aligning the fill hole with the match mark in the inspection opening. For fill angles less than 90°, rotate the fill plug upward till the match marks line up. For fill angles greater than 90°, rotate the fill plug downward till the match marks line up.

GAP AND ANGULAR ALIGNMENT — If possible, after mounting coupling hubs, position the driving and driven equipment so that the distance between shaft ends is equal to the coupling gap. Align the shafts by placing a spacer block, equal in thickness to required gap, between hub faces, as shown at right, and also at 90° intervals around the hub. Check with feelers.



Steelflex® Illustrated

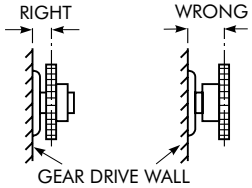
OFFSET ALIGNMENT — Align driving and driven shafts so that a straight edge will rest squarely on both couplings hubs as shown to the right and also at 90° intervals. Tighten foundation bolts of the connected equipment and recheck alignment and gap.

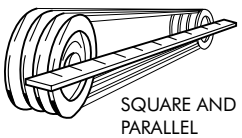


Steelflex Illustrated

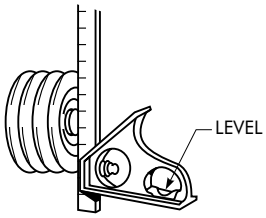
SPROCKETS, PULLEYS OR SHEAVES — Mount power take-offs as close to the gear drive housing as possible to avoid undue bearing load and shaft deflection.

Align the output shaft of the gear drive square and parallel with the driven shaft by placing a straightedge across the face of the sprockets or sheaves as illustrated.Check horizontal shaft alignment by placing one leg of a square against the face of the sheave or sprocket with the spirit level on the horizontal leg of the square.





SQUARE AND PARALLEL



DO NOT over tighten belts or chains. Adjust chains to manufacturers' specifications. Adjust belts as follows:

The ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Check the belt tension frequently during the first 24 to 48 hours of run-in operation. Over tightening belts shortens belt and bearing life. Keep belts free from foreign material which may cause slippage. Inspect the V–belt periodically; tighten the belts if they are slipping.

OUTBOARD BEARING — Mount the outboard bearing and gear drive on a common foundation so that they will shift as an assembly if settling should occur. Bring the outboard bearing to the correct horizontal position with broad flat shims under the mounting pad. Align accurately so that the load is equally divided between the two drive bearings and the outboard bearing. Mount a stop bar against the pillow block foot on the load side when large horizontal load components are exerted on the pillow block.

PINION MOUNTING — Mount pinion as close to the drive as possible to avoid undue bearing load and shaft deflection. Refer to Factory for pinion alignment instructions.

Non Falk™ Couplings — Refer to manufacturer's installation and maintenance instructions.

BACKSTOPS — To prevent damage to backstops due to incorrect motor shaft rotation at start up, couplings are NOT assembled when gear drives are furnished with backstops for all types except ABRC. For type ABRC drives, remove the backstop before electrically connecting the motor. AB, ABR, and ABRC backstops are held in place by a retaining ring on the intermediate shaft.

After completing electrical connections, check motor and gear drive shaft rotations. If rotations are correct, complete alignment and assembly of coupling or re-install the backstop.

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Fastener Tightening Torques

Use the tightening torque values specified in Table 1 for fastening Falk™ gear drives, motors and accessories to their mounting surfaces with un-lubricated fasteners. DO NOT use these values for "torque locking" fasteners or for fastening components with aluminum feet or soft gaskets or vibration dampeners on the mounting surface. If the tightening torque exceeds the capacity of the torque wrench, use a torque multiplier. For inch fasteners, use Grade 5 for diameters though 1.500 inch and ASTM A 354 grade BC for larger diameter fasteners. Use ISO property class 8.8 for metric fasteners.

TABLE 1 — Tightening Torques: +/-5%
DO NOT Lubricate Fasteners

Inch Fasteners – Grade 5				
Fastener Size	Metal to Metal		Metal to Concrete	
	lb-ft	Nm	lb-ft	Nm
.250-20	7	10	6	8
.3125-18	15	21	12	16
.375-16	27	37	22	30
.500-13	67	91	54	73
.625-11	134	184	108	146
.750-10	242	330	194	265
.875-9	395	530	315	425
1.000-8	590	800	475	640
1.125-7	740	1000	590	800
1.250-7	1060	1420	840	1140
1.375-6	1360	1860	1100	1480
1.500-6	1840	2480	1460	1980
1.750-5	3900	5300	2700	4240
2.000-4.5	5900	7900	4100	6300
2.250-4.5	8600	11800	6000	9400
2.500-4	11800	16000	8300	12800
2.750-4	14600	19800	10200	15800
3.000-4	19400	26400	13600	21100

TABLE 1A — Tightening Torques: +/-5%
DO NOT Lubricate Fasteners

Metric Fasteners – Property Class 8.8				
Fastener Size	Metal to Metal		Metal to Concrete	
	lb-ft	Nm	lb-ft	Nm
M4 x .7	2	3	1.5	2
M5 x .8	4.5	6	3.5	5
M6 x 1.0	7.5	10	6	8
M8 x 1.25	18	24	14	19
M10 x 1.5	36	50	29	39
M12 x 1.75	62	84	50	68
M16 x 2	56	210	126	170
M20 x 2.5	305	415	246	330
M30 x 3.5	1060	1 440	850	1 150
M36 x 4	1680	2 520	1500	2 030
M42 x 4.5	3000	4 050	2400	3 250
M48 x 5	4500	6 100	3600	4 880
M56 x 5.5	7300	9 850	5800	7 860

Water Cooling

WATER COOLED HEAT EXCHANGERS — Install a shut-off or control valve in the water line to the heat exchanger to regulate the water flow through the exchanger. Also install a water flow gauge between the control valve and the exchanger to determine actual flow rate. Discharge water to an OPEN DRAIN to prevent back pressure.

INTERNAL COOLING TUBES — Refer to Manual 138-310 for installation, operation, and maintenance of internal cooling tubes.

Lubrication Systems

SPLASH LUBRICATED DRIVES — Standard type A, AR, AB, ABR, and ABRC drives are splash lubricated. The lubricant is picked up by the revolving elements and distributed to the bearings and gear meshes.

OIL PUMP LUBRICATED DRIVES — Types AXV and ABX are equipped with an external oil pump to provide oil to the upper bearings and gear meshes. The system is composed of an electric motor driven gear pump, oil filter, flow indicator with switch, and an internal distribution network with relief valve (set at 30 psi). The pump system may be furnished with a 50 or 60Hz, 3 phase electrical motors based on the selection. Refer to the pump motor nameplate and Table 2 for electrical requirements. Wire the motor for correct rotation as indicated by the rotation arrow. The flow indicator has a single pole, double throw switch rated at 15A, 125V/7A, 250V maximum. Connect the flow indicator switch with the prime mover control circuitry to prevent drive operation without the lubrication system.

TABLE 2 — Oil Pump Electrical Specifications

DRIVE SIZE	405 & 425		445-485		505-535	
HP	1		2		3	
Cycles, Hz	50	60	50	60	50	60
RPM	1425	1725	1425	1725	1425	1725
Voltage	220/380/440	208-230/460	220/380/440	208-230/460	220/380/440	208-230/460

Other types of gear drives may also be equipped with oil pumps for special lubrication considerations or external cooling.

Caution: *Refer to Factory for drives that use pumps to distribute lubricants with temperatures below 30°F (-1°C).*

Lubrication Recommendations

Carefully follow lubrication instructions on the gear drive nameplate, warning tags, and installation manuals furnished with the gear drive.

Lubricants listed in this manual are typical ONLY and should not be construed as exclusive recommendations. Industrial type petroleum based rust and oxidation inhibited (R & O) gear lubricants or industrial type sulfur-phosphorus extreme pressure (EP) gear lubricants are the recommended lubricants for ambient temperatures of 15°F to 125°F(-9°C to +50°C).

For drives operating outside the above temperature range refer to "Synthetic Lubricants" paragraphs, Page 7. Synthetic lubricants can also be used in normal climates.

VISCOSITY (IMPORTANT) — The proper grade for R & O and EP lubricants is found in Table 3. For cold climate conditions refer to Table 6, Page 7 and the "Synthetic Lubricant" paragraphs.

If a gear drive operates in a typical indoor environment where the ambient temperature is within 70°F to 125°F (21°C to 52°C), the oil viscosity should be increased one AGMA grade above that shown for the 50°F to 125°F(10°C to 52°C) range. That is, an AGMA Number 6 or 7 should be substituted for a 5 or 6 respectively, under these ambient conditions.

OIL PUMPS — When selecting a lubricant for a gear drive equipped with an oil pump, cold temperature oil viscosity is important. Lubricant viscosity at start-up generally should not exceed 1725 cSt (8,000 SSU). When exceeding this viscosity, pump cavitation is possible, reducing oil circulation and possibly damaging the pump. A sump heater may be required or it may be possible to use a lower viscosity oil to minimize pump cavitation, refer to Factory.

TABLE 3 — Viscosity Grade Recommendations for Petroleum Based R & O or EP Lubricants

Output RPM	Normal Climates			
	15° to 60°F (-9° to +16°C)		50° to 125°F (10° to 52°C)	
	ISO-VG	AGMA	ISO-VG	AGMA
Output RPM Below 80	150	4	320	6
Output RPM 80 & Above	150	4	220	5

Petroleum Based Lubricants

R & O GEAR LUBRICANTS (Table 4) — Industrial type petroleum based rust and oxidation inhibited (R & O) gear lubricants are the most common and readily available general purpose gear lubricants.

EXTREME PRESSURE (EP) LUBRICANTS (Table 5) — For highly loaded gear drives or drives loaded in excess of original estimates, industrial type petroleum extreme pressure lubricants are preferred. The EP lubricants currently recommended are of the sulfur-phosphorus type.

TABLE 5 — Extreme Pressure Lubricants †

Maximum Operating Temperature 200°F(93°C)

Manufacturer	Lubricant
Amoco Oil Co. BP Oil Co. Chevron U.S.A. Inc. Citgo Petroleum Corp.	Permagear/Amogear EP Energear EP Gear Compounds EP Citgo EP Compound
Conoco Inc. Exxon Co. U.S.A. E.F. Houghton & Co. Imperial Oil Ltd.	Gear Oil Spartan EP MP Gear Oil Spartan EP
Kendall Refining Co. Keystone Div. Pennwalt Corp. Lyondell Petrochemical (ARCO) Mobil Oil Corp. Petro–Canada Products	Kendall NS-MP Keygear Pennant NL Mobilgear Ultima EP
Phillips 66 Co. Shell Oil Co. Shell Canada Limited Sun Oil Co. Texaco Lubricants	Philgear Omala Oil Omala Oil Sunep Meropa
Valvoline Oil Co.	AGMA EP

† Minimum viscosity index of 90.

TABLE 4 — Petroleum Based R & O Gear Oils † Maximum operating temperature of lubricants 200°F (93°C)

AGMA Viscosity Grade	4	5	6	7
ISO Viscosity Grade	150	220	320	460
Viscosity SSU @ 100°F	626-765	918-1122	1335-1632	1919-2346
Viscosity cSt @ 40°C	135-165	198-242	288-352	414-506
Manufacturer	**Lubricant**	**Lubricant**	**Lubricant**	**Lubricant**
Amoco Oil Co.	Amer.Ind. Oil 150	Amer.Ind. Oil 220	Amer. Ind. Oil 320	Amer. Ind. Oil 460
BP Oil Co.	. . . . .	Energol HLP-HD 220		
Chevron U.S.A., Inc.	Machine Oil AW 150	Machine Oil AW 220	Machine Oil AW 320	
Citgo Petroleum Corp.	Citgo Pacemaker 150	Citgo Pacemaker 220	Citgo Pacemaker 320	Citgo Pacemaker 460
Conoco Inc.	Dectol R&O Oil 150	Dectol R&O Oil 220	Dectol R&O Oil 320	Dectol R&O Oil 460
Exxon Company, U.S.A.	Teresstic 150	Teresstic 220	Teresstic 320	Teresstic 460
Houghton International, Inc.	Hydro–Drive HP 750	Hydro–Drive HP 1000		
Imperial Oil Ltd.	Teresso 150	Teresso 220	Teresso 320	
Kendall Refining Co.	Four Seasons AW 150			
Keystone Lubricants	KLC–40	KLC-50		
Lyondell Petrochemical (ARCO)	Duro 150	Duro 220	Duro 32	
Mobil Oil Corp.	DTE Oil Extra Heavy	DTE Oil BB	DTE Oil AA	DTE Oil HH
Pennzoil Products company	Pennzbell AW Oil 150	Pennzbell AW Oil 220	Pennzbell AW Oil 320	Pennzbell AW Oil 460
Petro–Canada Products	Premium R & O 150	Premium R & O 220	Premium R & O 320	
Phillips 66 Co.	Magnus Oil 150	Magnus Oil 220	Magnus Oil 320	
Shell Oil Co.	Morlina 150	Morlina 220	Morlina 320	Morlina 460
Shell Canada Limited	Tellus 150	Tellus 220	Tellus 320	
Sun Oil Co.	Sunvis 9150	Sunvis 9220		
Texaco Lubricants	Regal Oil R&O 150	Regal Oil R&O 220	Regal Oil R&O 320	Regal Oil R&O 460
Unocal 76 (East)	Unax RX 150	Unax RX 220	Unax AW 320	Turbine Oil 460
Unocal 76 (West)	Turbine Oil 150	Turbine Oil 220	Turbine Oil 320	Turbine Oil 460
Valvoline Oil Co	Valvoline AW ISO 150	Valvoline AW ISO 220	Valvoline AW ISO 320	

† Minimum viscosity index of 90.

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WARNING: EP LUBRICANTS IN FOOD PROCESSING INDUSTRY — EP lubricants may contain toxic substances and should not be used in the food processing industry without the lubricant manufacturers' approval. Lubricants which meet USDA "H1" classification are suitable for food processing applications.

Synthetic Lubricants

Synthetic lubricants of the polyalphaolefin type are recommended for cold climate operation, high temperature applications, extended temperature range (all season) operation, and/or extended lubricant change intervals. The proper viscosity grade of synthetic lubricant is given in Table 6 Refer to Table 7 for Synthetic lubricants.

TABLE 6 — Viscosity Grade Recommendations for Synthetic Lubricants ★

Output RPM	Cold Climates				Normal Climates					
	–30° to +10°F (–34° to –12°C)		–15° to +50°F (–26° to +10°C)		0° to +80°F (–18° to +27°C)		+10° to +125°F (–12° to +52°C)		+20° to +125°F (–7° to +52°C)	
	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA
Below 80	32	0S	68	2S	150	4S	320	6S	320	6S
80 & Above	32	0S	68	2S	150	4S	220	5S	320	6S

★ Refer to Falk for viscosity recommendations when ambient temperatures are below –30°F (–34°C) or above 125°F (52°C).

TABLE 7 — Synthetic Lubricants – Polyalphaolefin Type ★

AGMA Viscosity Grade	0S	2S	4S	5S	6S
ISO Viscosity Grade	32	68	150	220	320
Viscosity SSU @ 100°F	134–164	284–347	626–765	918–1122	1335–1632
Viscosity cSt @ 40°C	28.8–35.2	61.2–74.8	135–165	198–242	288–352
Manufacturer	Lubricant				
Chevron U.S.A., Inc.	. . .	. . .	. . .	Clarity Synthetic PM Oil 220	. . .
	. . .	. . .	. . .	Syn. Gear Lube Tegra 220 ‡	. . .
Conoco, Inc.	Syncon 32	Syncon 68	. . .	. . .	. . .
	. . .	Syncon EP 68 ‡	. . .	Syncon EP 220 ‡	. . .
Dryden Oil Co.	Drydene SHL Lubricant 32	Drydene SHL Lubricant 68	Drydene SHL Lubricant 150	Drydene SHL Lubricant 220	Drydene SHL Lubricant 320
Exxon Co. U.S.A.	Teresstic SHP 32	Teresstic SHP 68	Teresstic SHP 150	Teresstic SHP 220	Teresstic SHP 320
	. . .	. . .	Spartan Synthetic EP 150 ‡	Spartan Synthetic EP 220 ‡	Spartan Synthetic EP 320 ‡
Mobil Oil Corp.	SHC 624	SHC 626	SHC 629	SHC 630	SHC 632
	. . .	. . .	Mobilgear SHC 150 ‡	Mobilgear SHC 220 ‡	Mobilgear SHC 320 ‡
Pennziol Products Co.	Pennzgear SHD 32	Pennzgear SHD 68	Pennzgear SHD 150	Pennzgear SHD 220	Pennzgear SHD 320
	. . .	Super Maxol "S" 68 ‡	Super Maxol "S" 150 ‡	Super Maxol "S" 220 ‡	Super Maxol "S" 320 ‡
Petro-Canada Products	. . .	. . .	Super Gear Fluid 150EP ‡	Super Gear Fluid 220EP ‡	Super Gear Fluid 320EP ‡
Shell Oil Co.	. . .	. . .	. . .	Hyperia 220	Hyperia 320
	. . .	. . .	. . .	Hyperia S220 ‡	Hyperia S320 ‡
Sun Co.	. . .	. . .	. . .	Sunoco Challenge 220	Sunoco Challenge 320
	. . .	. . .	. . .	Sunoco Challenge EP 220 ‡	Sunoco Challenge EP 220 ‡
Texaco Lubricants Co.	Pinnacle 32	Pinnacle 68	Pinnacle 150	Pinnacle 220	Pinnacle 320
	. . .	. . .	Pinnacle EP 150 ‡	Pinnacle EP 220 ‡	. . .
Whitmore Mfg. Co.	. . .	. . .	Decathlon 4EP ‡	Decathlon 5EP ‡	Decathlon 6EP ‡

★ Minimum viscosity index of 130. Consult lubricant supplier/manufacturer for maximum operating temperature.
‡ Extreme Pressure EP lubricant (contains sulphur phosphorus).

WARNING: *SYNTHETIC LUBRICANTS IN FOOD PROCESSING INDUSTRY — Synthetic lubricants may contain toxic substances and should not be used in the food processing industry without the lubricant manufacturers' approval. Lubricants which meet USDA "H1" classification are suitable for food processing applications.*

Bearing and Seal Greases

All drives and some backstops have grease lubricated seals. Some vertical shaft and specially mounted drives have grease lubricated bearings. Drives are shipped with NLG1 or #2 grease in the seal housing cavities unless otherwise specified. Refer to Table 8 for grease recommendations.

TABLE 8 — Greases for Bearings and Seals

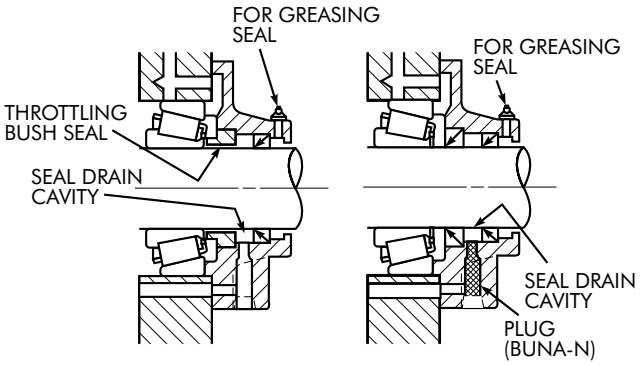
(0° to 200°F(-18° to +93°C)

Manufacturer	Lubricant
Amoco Oil Co. BP Oil Co. Chevron U.S.A., Inc. Citgo Petroleum Corp.	Amolith Grease No. 2 Energrease LS–EP2 Industrial Grease Medium Premium Lithium Grease No. 2
Conoco Inc. Exxon Company, U.S.A. E.F. Houghton & Co. Imperial Oil Ltd.	EP Conolith Grease No. 2 Unirex N2 Cosmolube 2 Unirex N2L
Kendall Refining Co. Keystone Div. Pennwalt Corp. Lyondell Petrochemical (ARCO) Mobil Oil Corp. Mobil Oil Corp Petro–Canada Products	Multi–Purpose Lithium Grease L421 Zeniplex 2 Litholine H EP 2 Grease Mobilith 22 Mobilith SHC 460 ★ Multipurpose EP2
Phillips 66 Co. Shell Oil Co. Shell Canada Limited Sun Oil Co. Texaco Lubricants	Philube Blue EP Alvania Grease 2 Alvania Grease 2 Ultra Prestige EP2 Premium RB Grease
Unocal 76 (East & West) Valvoline Oil Co.	Unoba EP2 Multilube Lithium EP Grease

★ High performance synthetic alternate.

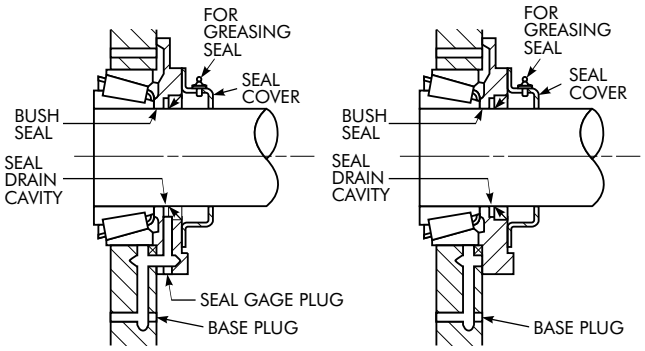
GREASE LUBRICATED SEALS — Most gear drives and backstops are furnished with grease purged seals which minimize the entry of contaminants into the drive or backstop. Gear drives and backstops are shipped with #2 grease in the seal housing cavities unless otherwise specified. If grease could contaminate the product, as in the food and drug industries, it should be removed. A grease that meets USDA "H1" classification is suitable for food processing applications.

TYPICAL SEAL ASSEMBLIES



LOW OIL LEVEL
Sizes 385 & 405 thru 585
Inner Bush Seal and Outer Lip Type Seal

HIGH OIL LEVEL
Sizes 385 & 405 thru 585
Two Lip Type Oil Seals



LOW OIL LEVEL
Sizes 305 thru 365 & 395
Inner Bush Seal and Outer Lip Type Seal

HIGH OIL LEVEL
Sizes 305 thru 365 & 395
Inner Bush Seal and Outer Lip Type Seal

GREASE LUBRICATED BEARINGS — Vertical shaft drives with hollow shafts or with drywells have grease lubricated lower low speed bearings. These bearings are lubricated at the Factory with an NLGI#2 grease. Refer to the preventive maintenance instructions for greasing instructions.

BACKSTOPS — For types AB, ABR, and ABX model C and later, backstops are furnished filled with oil. Remove plug from top of backstop and replace with vent wired to torque arm. Earlier models had backstops that are grease lubricated, do not use greases with molybdenum disulfide or other EP additives.

Type "A" and "AR" drives may have a Falk™ pawl type backstop or a **Falk™ PRT** wedge ramp type backstop. Falk pawl backstops are prelubricated and sealed at assembly and require no future lubrication. These backstops also contain grease purgeable seals (see paragraph above for grease lubricated seals).

Falk™ PRT backstops are shipped filled with oil. Remove plug from top of backstop and replace with vent wired to torque arm.

Oil Levels

Types A & AB Prior to filling gear drive or after storage/inactivity of the drive for greater than 1 month, remove the inspection cover and flood the oil troughs with oil. The oil troughs sit directly beneath the inspection cover and can be filled to flooding, typically with a volume of approximately 10% of the sump lube. This will provide oil to the bearings. Fill the drive with oil to the level indicated on the oil dipstick. The approximate oil capacity is given on the gear drive nameplate. For reference, approximate capacities are also given in Table 9. These quantities are for high oil levels. Actual capacities can be more or less depending on the type of cooling, total ratio and input speed. Always fill to proper level indicated on the dipstick.

Types ABR, ABRC, and AR Fill the drive with oil to the level indicted on the oil dipstick. Approximate oil capacities are given on the nameplate and in Table 10.

Drives with Oil Pumps Types , AXV, and occasionally other types of gear drives will be equipped with oil pumps for cooling or special lubrication considerations. If a drive is equipped with an oil pump, fill the drive to the level marked on the dipstick. Run the lubrication system for several minutes to fill the system components. Verify that the pump is circulating oil properly, then recheck oil level. If necessary, add oil to compensate for filter and/or cooler.

Before starting the gear drive, rotate the input shaft to check for obstructions. Then start the drive and allow it to run without load for several minutes. Shut down and recheck oil level. If everything is satisfactory, the drive is ready for operation.

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Preventive Maintenance

AFTER FIRST WEEK — Check alignment of total system and realign where necessary. Also tighten all external bolts and plugs where necessary. DO NOT readjust the internal gear or bearing settings in the drive, these were permanently set at the Factory.

AFTER FIRST MONTH — Proceed as follows:

1. Operate drive until old sump oil reaches normal operating temperature. Shut down drive and drain immediately.
2. Immediately flush drive with an oil of the same type and viscosity grade as the original charge (warmed to approximately 100°F (38°C) in cold weather) by rapidly pouring or pumping a charge equal to 25 - 100% of the initial fill volume or until clean oil flows through the drain.
3. Close the drain and refill the drive to the correct level with new oil of the correct type and viscosity.

PERIODICALLY —

1. Check the oil level of the drive when it is stopped and at ambient temperature. Add oil if needed. If the oil level is ABOVE the high oil level mark on the dipstick, have the oil analyzed for water content. Moisture in the oil may indicate that a seal or the heat exchanger is leaking. If so, replace the defective part immediately and change the oil. DO NOT fill above the mark indicated as leakage or undue heating may result.
2. Check coupling alignment to make certain that foundation settling has not caused excessive misalignment.
3. If drive is equipped with a fan, periodically clean accumulated foreign matter from the fan, guard, and deflector.
4. If drive is equipped with a torque arm, check for free movement.

Lubricant Changes

OIL ANALYSIS REPORT— Checking oil condition at regular intervals is recommended. In the absence of more specific limits, the guidelines listed below may be used to indicate when to change oil:

1. Water content is greater than 0.05% (500 ppm).
2. Iron content exceeds 150 ppm.
3. Silicon (dust/dirt) exceeds 25 ppm.
4. Viscosity changes more than 15%.

PETROLEUM LUBRICANTS — For normal operating conditions, change gear oils every 6 months or 2500 operating hours, whichever occurs first. Change oil more frequently when gear drives operate in extremely humid, chemical or dust laden atmospheres. In these cases, R & O and EP lubricants should be changed every 3 to 4 months or 1500 to 2000 hours. If the drive is operated in an area where the temperatures vary with seasons, change oil viscosity grade to suit temperature. Lubricant suppliers can test oil periodically and recommend economical change intervals.

SYNTHETIC LUBRICANTS — Synthetic lube change intervals can be extended to 8000 - 10,000 hours depending upon operating temperatures and lubricant contamination. Change oil more frequently when gear drives operate in extremely humid, chemical or dust laden atmospheres. In these cases, synthetic lubricants should be changed every 4 to 6 months or 4000 to 6000 hours. Laboratory analysis is recommended for optimum lubricant life and gear drive performance. Change lube with change in ambient temperature, if required. Refer to Table 6 for synthetic lubricant viscosity recommendations.

GREASE LUBRICATED SEALS — Depending on the frequency and degree of contamination (at least every six months), purge contaminated grease from seals by slowly pumping fresh bearing grease , WITH A HAND GREASE GUN, through the seal until fresh grease flows out along the shaft. Wipe off purged grease. Refer to Table 8 for NLGI #2 greases. Some of these greases are of the EP type and may contain toxic substances not allowed in the food processing industry. A grease that meets the USDA "H1" classification is suitable for food processing applications.

CAUTION: Rapid greasing with a power grease gun can force grease inward past the seals and plug the oil drainback system causing seal leaks.

GREASE LUBRICATED BEARINGS (TYPES AXV AND ABX) — All hollow and most solid vertical low speed shaft drives have a grease lubricated lower low speed bearing. Grease bearings during oil changes or at intervals of every 6 months or 2500 hours of operation whichever is less. Table 11 contains low speed bearing grease capacities.

HOLLOW SHAFT DRIVES — Remove the pressure relief plug before greasing. Pump grease into bearing cage until fresh grease appears at the plug. Replace the pressure relief plug when finished. See Figure 2 below.

Refer to Table 8 for NLGI #2 greases. Some of these greases are of the EP type and may contain toxic substances not allowed in the food processing industry. A grease that meets the USDA "H1" classification is suitable for food processing applications.

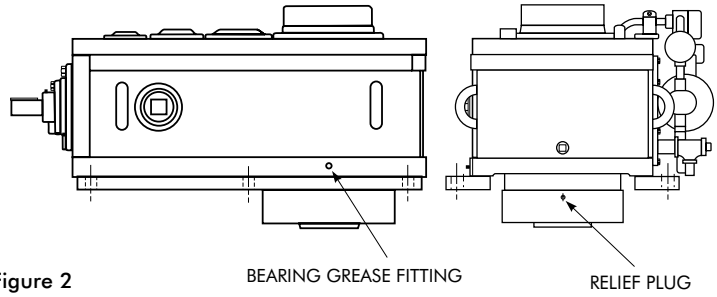

Figure 2

BACKSTOPS — For types AB, , and ABX refer to the supplemental backstop installation and maintenance instructions provided with the drive for recommended lubricants. It is recommended to lubricate backstops during regular drive lubrication intervals. If backstops are grease lubricated, do not use greases with molybdenum disulfide or other EP additives.

Type "A" and "AR" drives may have a Falk™ pawl type backstop or a **Falk™ PRT** wedge ramp type backstop. Falk™ pawl backstops are prelubricated and sealed at assembly and require no future lubrication. These backstops also contain grease purgeable seals (see paragraph above for grease lubricated seals).

Falk™ PRT backstops are a wedge ramp type and are oil lubricated. Follow lubrication recommendations as outlined in the supplemental backstop instructions furnished with the drive.

TABLE 9 — Types A & AB Approximate Oil Capacities ‡

DRIVE SIZE	Type A								Type AB						DRIVE SIZE
	A1		A2		A3		A4		AB2		AB3		AB4		
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	
305	3	11	4	15	4	15									**305**
325	5	19	6	23	6	23									**325**
345	6	23	8	30	9	34									**345**
365	10	38	13	49	13	49									**365**
385	10	38	10	38	10	38	10	38	11	42	11	42	11	42	**385**
395	12	45	16	61	17	64									**395**
405	10	38	15	57	15	57	14	53	11	42	15	57	15	57	**425**
425	14	53	20	76	21	79	20	76	14	53	20	76	22	83	**405**
445	22	83	22	83	29	110	28	106	22	83	29	110	30	114	**445**
465	29	110	30	114	39	148	38	144	30	114	39	148	39	148	**465**
485	32	121	38	144	57	216	56	212	31	117	52	197	58	220	**485**
505	42	159	50	189	78	295	77	291	39	148	70	265	80	303	**505**
525	53	201	59	223	95	360	93	352	48	182	87	329	100	379	**525**
545	...	...	115	435	135	511	...	...	...	...	111	420	138	522	**545**
565	...	...	130	492	160	606	...	...	...	...	142	538	170	644	**565**
585	...	...	215	814	250	946	...	...	...	...	220	833	275	1 041	**585**

‡ Capacities vary with ratio, speed and type of cooling. Follow values on the gear drive nameplate. Always fill to proper level indicated on the dipstick.

TABLE 10 — Types AR, AVX, ABR, and ABX Approximate Oil Capacities

DRIVE SIZE	Vertical Output				Horizontal Output				DRIVE SIZE
	ABX3 & AXV2		ABX4, AXV3, & AXV4		ABR3 & AR2		ABR4, AR3, & AR4 ★		
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	
405	10	38	10	38	14	53	14/18	53/68	**405**
425	15	57	15	57	19	72	19/27	72/102	**425**
445	25	95	25	95	35	132	35/50	132/189	**445**
465	30	114	30	114	40	151	40/55	151/208	**465**
485	40	151	45	170	50	189	60/80	227/303	**485**
505	50	189	60	227	65	246	80/100	303/379	**505**
535	70	265	80	303	95	360	110/140	416/530	**535**
555	100	379	120	454	130	492	160/220	606/833	**555**

★ Values to right of slash mark are for type AR4 drives when HS Shaft is above drive center line.

TABLE 11 — Types AXV and ABX – LS Shaft Lower Bearing Grease Capacity

DRIVE SIZE	Solid Shaft				Hollow Shaft		DRIVE SIZE
	Down		Up		oz	mL	
	oz	mL	oz	mL			
405	8	237	12	355	12	355	**405**
425	12	355	18	532	12	355	**425**
445	12	355	18	532	24	710	**445**
465	30	890	40	1180	30	890	**465**
485	30	890	40	1180	60	1770	**485**
505	40	1180	50	1480	60	1770	**505**
535	50	1480	50	1480	80	2370	**535**
555	50	1480	60	1770	80	2370	**555**

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Stored & Inactive Gear Drives

Each gear drive is protected with a rust preventative that will protect parts against rust for a period of 4 months in an outdoor shelter or 12 months in a dry building after shipment from the Factory. ***CAUTION:*** *Drives are not to be stored outdoors without shelter. Standing water on drives significantly increases risk of water ingression and rust. Installer assumes risk.*

If a gear drive is to be stored or inactive after installation for 1 to 6 months, prepare the drive for storage according to the "Customer Preparation for Storage" instructions in the "Customer Intermittent Storage" section of Manual 128-014. Refer to Table 12 for Motorstor quantities if required. Rotate the shafts several times by hand. Before operating, drives which have been stored or inactive must be filled to the proper level with oil meeting the specifications given in this manual. Refer to Manual 128-014 for "Start-up after Storage" instructions.

Periodically inspect stored or inactive gear drives and spray or add rust inhibitor every six months, or more often if necessary. Indoor dry storage is recommended.

Gear drives ordered for extended storage can be treated at the Factory with a special preservative and sealed to rust-proof parts for periods longer than those cited previously.

The vented dipstick should be replaced with a plug (vented dipstick should be attached to gear drive for future use) so that the protective rust inhibiting atmosphere is sealed inside the drive. Install vented dipstick when preparing drive for operation.

TABLE 12 — Motorstor/VCI–10★

(Add to stored or inactive drives)

DRIVE SIZE	Motorstor	
	Ounces Per Drive	Milliliters Per Drive
305 thru 425	2	60
445 thru 485	6	180
505 thru 535	10	300
545 thru 585	30	890

★ Product of Daubert Chemical Company, Chicago, IL.