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OPERATING AND MAINTENANCE INSTRUCTIONS FOR AMARILLO RIGHT ANGLE GEAR DRIVES

INSTALLATION

All units for domestic shipment by surface transportation and export shipments of models 450A and larger, are shipped with the proper amount and type of lubricant installed. Export shipments of models 350 and smaller are shipped with initial oil fill in separate containers. Air freight shipments do not have any lubricant included.

Install oil to the required level or add oil if spillage has occurred.

Inspect and clean top of pump discharge base and bottom of gear drive to assure removal of burrs or foreign material that might cause misalignment.

Install gear drive on discharge base and slide non-reverse clutch over headshaft. The headshaft should be concentric to the hollow shaft so that the non-reverse clutch will engage the drive sleeve without forceful alignment of the headshaft. Install and tighten the two hold down screws to fasten the non-reverse clutch to the drive sleeve. Lubricate the headshaft threads and bottom of the adjusting nut before raising the pump impellers.

Remove rust preventive from shaft extension and clean thoroughly. Install coupling half or flange. Hammering or mechanically forcing the coupling on the shaft can damage the bearings or disturb the setting of the gears and is not permissible. Interference fits are permissible if the coupling can be heated for installation and fitted without hammering or mechanically forcing on the gear drive shaft. Check runout of aligning surfaces on both coupling halves before installing connecting members.

Align the driver and gear drive to obtain parallel and angular alignment. Misalignment should be as close to zero as possible for smoothest operation and maximum life, but in no case should misalignment be greater than that specified by the coupling or drive shaft manufacturer. Offset of universal type drive shafts should also be within the limits specified by the manufacturer. Use only the specified tools and procedures when aligning the driver and gear drive. Recheck the alignment at regular intervals after start of operation and correct the alignment if drifting or settling has occurred.

Excessive noise and vibration in a new gear drive is almost always an indication of a poor installation as all drives are tested at the factory. Failure to correct the installation can result in damage to the pump and gear drive. Our warranty will not apply unless the drive is properly installed. Proper installation includes alignment of power unit, right angle drive and pump. It is also necessary to provide an adequate foundation for the pump and engine and a positive method of preventing the power unit from shifting to assure that alignment will be maintained.

On engine drive systems, it is not uncommon for one or more resonant speeds to exist between zero rpm and the operating speed. Continued operation at a resonant speed will result in torsional vibrations which can be damaging to all components of the system. The most common indication of torsional vibrations is an unusual rumbling or clattering noise from the gear drive at a sharply defined speed. The noise will disappear when the speed is increased or decreased. This noise is not indicative of a defect but results when the vibratory torque exceeds the drive torque causing the gear teeth to separate and clash together very rapidly. Transition through a resonant speed range to operating speed is not normally damaging but operation close to a resonant speed should be avoided. To avoid operation at a resonant speed it may be necessary to change the elastic characteristics of the rotating components, install a flexible coupling, or change the speed of the engine with respect to the pump (change gear ratio). Contact Amarillo Gear for more information on resonant speeds and torsional vibrations.

LUBRICATION

Use only rust and oxidation inhibited (R&O) gear oils in accordance with American Gear Manufacturers Association (AGMA) Standard 9005-E02, or most recent edition. All models are shipped with oil meeting the AGMA lubricant number shown in Table 1. When changing oil, select the AGMA lubricant number based on the operating temperature of the gear drive as shown in Table 1. Determine the operating oil temperature by inserting a thermometer in the oil sump after the gear drive has operated for at least two hours.

In general, the mineral oils listed are adequate for ambient temperatures between 20°F (-7°C) and 120°F (49°C). If the gear drive will be started when the ambient temperature is below 20°F (-7°C), use a lube oil heater or one of the recommended synthetic lubricants in Table 3.

TABLE 1 AGMA LUBRICANT NUMBER

Model	Factory Oil Fill	Operating Oil Temperature			
		Less than 160°F (71°C)	Greater than 160°F(71°C) & less than 180° F (82°C)	Greater than 180°F(82°C) 3 month interval	Greater than 180°F(82°C) 6 month interval
20 through 350	4	3	4	5	5S
450A through 1500	5	4	5	5	5S
P3, P5, P6, and P8	5	4	5	5	5S

**TABLE 2 RECOMMENDED MINERAL OILS

AGMA LUBRICANT NUMBER	3	4	5
ISO Grade	100	150	220
ARCO	Duro 100	Duro 150	Duro 220
Chevron Oil Company	Rando HD 100	Rando HD 150	Rando HD 220
Cities Services Oil Company	100	150	220
Conoco	Hydroclear Multipurpose R & O Oil 100	Hydroclear Multipurpose R & O Oil 150	Hydroclear Multipurpose R & O Oil 220
Exxon Company	Teresstic 100	Teresstic 150	Teresstic 220
Gulf Oil Corporation	Harmony 90	Harmony 150 D	Harmony 220
Mobil Oil Company	DTE Oil Heavy	DTE Oil Extra Heavy	DTE Oil BB
Pennzoil	Pennzbell TO 100	Pennzbell TO 150	Pennzbell TO 220
Phillips Petroleum Company	Magnus 100	Magnus 150	Magnus 220
Shell Oil Company	Morlina SD 100	Morlina SD 150	Morlina SD 220
Sun Oil Company	Sunvis 7100	Sunvis 7150	Sunvis 9220
Texaco Inc.	Regal 100 R&O	Regal 150 R&O	Regal 220 R&O

**List of brand names is for purpose of identifying types and is not to be construed as exclusive.

CHANGE INTERVAL

Change oil every 2500 hours of operation or every six months, whichever comes first. The change interval should be decreased if the gear drive is subjected to conditions that tend to decrease oil quality, such as water or dirt contamination or high operating temperatures. Drives that are operated intermittently or in climates with hot days and cool nights will accumulate moisture more rapidly than drives operating at constant temperature. Frequency of oil change will depend on the rate of water condensation in the gear drive. Operating temperatures above 180°F (82°C) will cause mineral oils to oxidize more rapidly and require more frequent oil changes. For high operating temperatures, change mineral oils every 1000 operating hours or every three months, whichever comes first. To extend the change interval to 2500 operating hours or six months, use one of the recommended synthetic oils shown in Table 3.

With the oil at or near operating temperature, completely drain the oil by removing the drain plug in the base flange. Refill the gear drive, with the correct AGMA lubricant number (Table 1), through the filler plug located directly below the nameplate. If changing AGMA lubricant number or lubricant brand, flushing is not required. For models equipped with a sight gauge, fill to hole. Approximate oil capacities are shown in Table 4.

**TABLE 3 SYNTHETIC LUBRICANTS

AGMA LUBRICANT NUMBER	5S
ISO Grade	220
Chevron	Clarity 220 Synthetic
Conoco	Syncon 220 R&O Oil
Mobil	SHC 630, SHC 630*

**List of brand names is for purpose of identifying types and is not to be construed as exclusive.

SYNTHETIC LUBRICANTS

Synthetic lubricants offer advantages of extended service life, a broader operational temperature range, reduced friction, and the ability to maintain a higher film strength which can extend the service life of the gear drive. When the operating temperature exceeds 180° F (82°C) or the gear drive is started when the ambient temperature is below 20° F (-7°C), a synthetic lubricant is recommended. Synthetic lubricants can be made of various base stocks which are incompatible with certain gear drive components; therefore, any synthetic lubricant not listed in this bulletin should be approved by Amarillo Gear Company LLC.

TABLE 4 OIL CAPACITY

MODEL	GALLONS	LITERS	MODEL	GALLONS	LITERS
20, 30	.4	1.5	1000A	15	57
40	1	4	1000G	17	64
60A, 80A, 100A, 125A	2.3	8.5	1200	18	72
150A	2.3	8.5	1500	18	72
200A, 200, 250	4	15	P3	4	15
300, 350	4.5	17	P5	5.5	21
450A, 500A, 600A	11	42	P6	15	57
750A	12	45	P8	18	68

WATER COOLING

Amarillo Gear Drive Models 100A, 125A, 150A, 200A, 200, 250, 450A, 500A, 600A, 750A and 1000G are assembled with cooling coils as standard equipment. Models 300, 350, 1000A, 1200 and 1500 are assembled with an external heat exchanger. Cooling coils are available on special order in models 40, 60A and 80A. The oil is cooled by circulating water through the coils or the tube side of the heat exchanger. Cooling water is piped from a service connection on the discharge head of the pump to the lower cooling water connection on the gear drive. The upper connection is then piped to a spillway or back into the well casing. If there is not sufficient pressure, the water can be started by siphoning through the drive.

The operating temperature of the drive will depend on many factors. Water cooling should always be used if the operating oil temperature exceeds 180° F (82° C) and the drive is to be operated for periods greater than eight hours per day. Water cooling will usually be required on model 100A and larger drives. Smaller drives may require water cooling if speeds are over 1760 rpm or if they are exposed to high ambient temperatures, limited air circulation, direct rays of the sun or other external sources of heat.

Table 5 is the coolant flow required when fresh water at 70° F (21° C) is used and other operating conditions are normal.

AIR COOLING

Propeller pump drives, models P3, P5, P6 and P8 are equipped with a fan for air cooling. These units require no additional cooling.

TABLE 5

COOLANT FLOW REQUIRED WITH FRESH WATER AT 70° F (21° C) AND NORMAL OPERATING CONDITIONS
MAXIMUM ALLOWABLE COOLING WATER PRESSURE FOR COOLING COILS @ 100 PSI (689 kPa) AND HEAT EXCHANGERS @ 150 PSI (1034 kPa)

MODEL	GALLONS PER MINUTE	LITERS PER MINUTE	MODEL	GALLONS PER MINUTE	LITERS PER MINUTE
40	1	3	350	5 1/2	21
60A	1	3	450A	6 1/2	25
80A	1	4	500A	9	34
100A	1 1/2	6	600A	9 1/2	36
125A	2	8	750A	11	42
150A	2 1/2	9	1000	11	42
200A, 200	3	11	1200	12	45
250	4	15	1500	13	49
300	4	15			

NON-REVERSE CLUTCH INSTRUCTIONS

The four enclosed pins are for the non-reverse clutch. They are to be placed in the drilled holes in the clutch if non-reverse protection is desired, or they can be left out if non-reverse protection is not needed. Pins and holes must be clean and free of oil so that the pins will fall freely. **Drives used in fire pump applications must be provided with anti-reverse mechanism. The anti-reverse is not to be disabled for these applications.**

The non-reverse protection is not guaranteed. Settings of over 400 feet (122 meters) deep will require special procedures and in some cases the pin and ratchet type non-reverse will not work. Consult supplier for the proper procedure to follow in shutting down the well. The gear drive may be damaged by accidental shock engagement of the non-reverse. This can be caused by the engine backfiring with the clutch engaged or by the pump starting to backspin before the pins engage the ratchet. Check the gear drive carefully after any shock engagement of the non-reverse. On some models the driving nut could unscrew from the hollow shaft. If this happens the nut must be tightened before resuming operation.

Amarillo Right Angle Pump Drive Limited Warranty

Amarillo Gear Company LLC ("Amarillo") warrants that the Amarillo Right Angle Pump Drive ("Product") will be free from defects in material and workmanship for a period ending on the earlier to occur of twenty four months from the date of installation or thirty months from the date of shipment from Amarillo's factory.

This Limited Warranty covers only parts manufactured by Amarillo. It does not cover bearings, seals, trade accessories, machinery, customer supplied products, or other articles or parts not manufactured by Amarillo.

This Limited Warranty shall be void if the Product is not installed, operated, serviced and maintained in accordance with Amarillo's published instructions for the Product or if transmitted loads are not within the published limits for the Product. In addition, this Limited Warranty shall be void if the Product is in any way subjected to: (i) improper storage; (ii) accident, damage, abuse or misuse; (iii) abnormal operating conditions or applications; or (iv) repair or modification by Buyer or any third party without the prior written consent of Amarillo.

With respect to any defect in material or workmanship covered by this Limited Warranty, if Buyer notifies Amarillo of such defect in writing within the warranty period, Amarillo will repair or replace, at its sole option, any such defective Product or part. This shall be Buyer's exclusive remedy. Any claims not made within the warranty period are deemed waived by Buyer. Before returning any Product or part hereunder, Buyer must contact Amarillo for a Return Goods Authorization number and to arrange for transportation. Amarillo will not pay any transportation costs incurred without its prior approval.

In no event will Amarillo be liable, whether in tort, contract or otherwise, for any bodily injury, death or property damage resulting from or in any way arising out of any goods or services provided by Amarillo or their sale, use or manufacture. Amarillo shall be not liable for any costs for removal or re-installation of the Product. **IN NO EVENT SHALL AMARILLO BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES.**

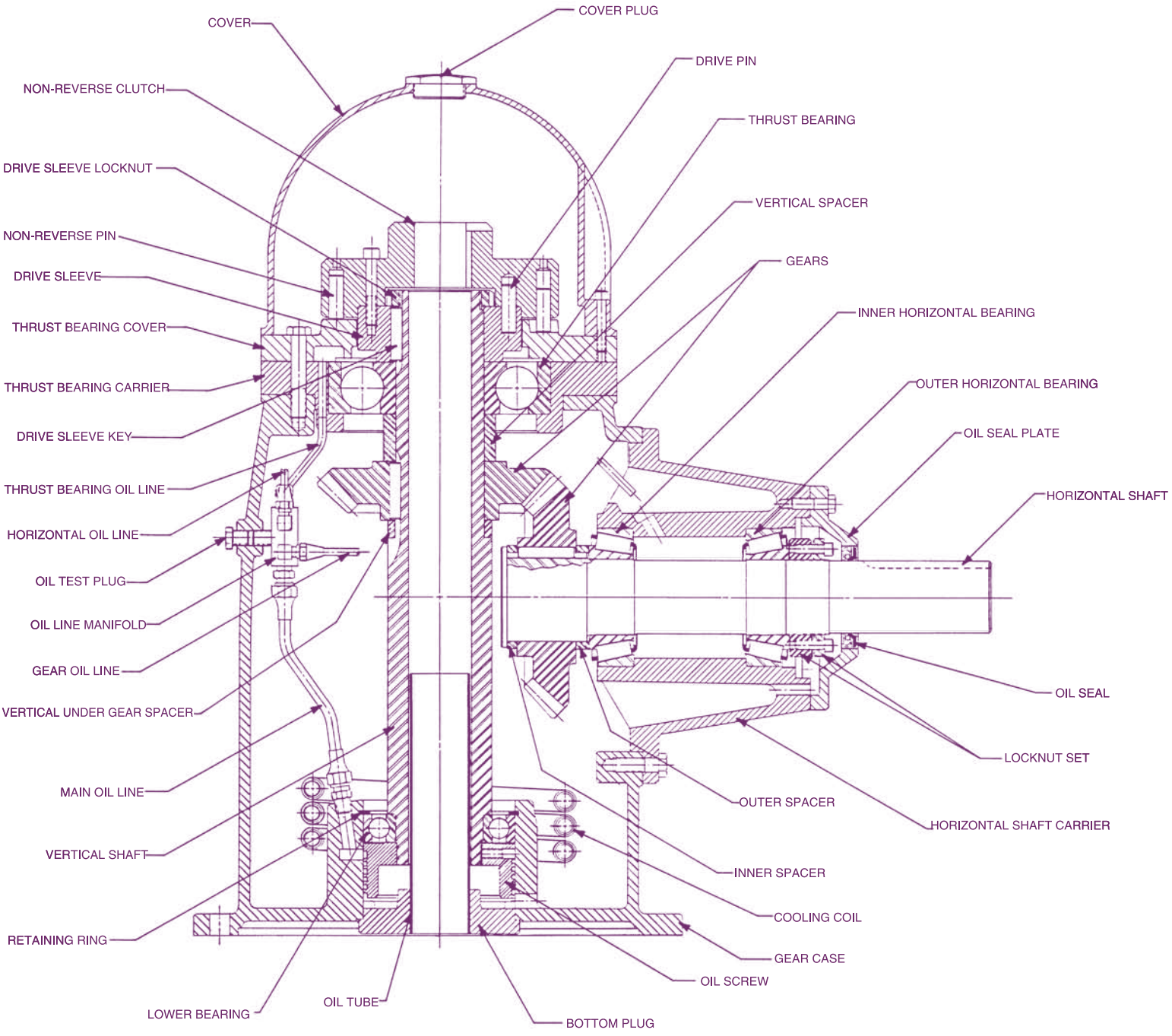
No change in any provision in this Limited Warranty may be made without the prior written agreement of an authorized officer of Amarillo.

THIS IS AMARILLO'S ONLY WARRANTY. AMARILLO MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR ANY PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED BY AMARILLO.

WARNING

All rotating shafts and couplings must be adequately guarded before operating the gear drive. The top cover supplied with the gear drive must be installed over the non-reverse coupling and the top of the headshaft before operating the gear drive.

An adequate guard (supplied by others) must be installed around the drive shaft or coupling between the gear drive and the engine before operating the gear drive.



Manufactured by

AMARILLO GEAR COMPANY LLC

AMARILLO, TEXAS