

# ENDURANCE

## RIGHT ANGLE GEAR DRIVE LARGE PUMP

### OPERATING AND MAINTENANCE INSTRUCTIONS



Each **Endurance Series Pump Drive** is the result of careful design and manufacturing techniques. As with any precision machine component, proper installation, maintenance and operating procedures are imperative for long life and trouble-free service. Do not install or operate until you have read and understand this manual; failure to do so will void the warranty.

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The following instructions are offered to cover most conditions. Our engineers will be pleased to assist when unusual conditions require special procedures. A copy of the document is to be sent and maintained by the end user of the Endurance Pump drive.

## 1. SAFETY INFORMATION

### 1.1 SYMBOLS AND SIGNS



Indicates a hazardous situation that, if not avoided, will result in death or serious injury.



Indicates a hazardous situation that, if not avoided, could result in death or serious injury.



Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury, and may result in damage to the pump drive.

### 1.2 GENERAL SAFETY INFORMATION

It is the sole responsibility of the owner/operator to carefully read this manual and to observe and ensure the continued practice of all safety statements including dangers, warning, and cautions. **Failing to do so may result in death, serious injury, or pump drive failure.**

*MAINTAIN A COPY OF THIS MANUAL FOR THE FULL SERVICE LENGTH OF THE PUMP DRIVE.*

<b>⚠ WARNING</b>
<p>This product contains a chemical known to the State of California to cause cancer.</p> <p>This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.</p>
<b>⚠ WARNING</b>
<p>The pump drive should be operated only within its design and performance specifications; <b>injury or damage to the system may occur if operated outside of these specifications.</b></p> <p>Keep hands and all foreign objects from all internal and external moving parts of the pump drive; <b>failing to do so may cause injury or damage to the system.</b></p> <p>Damaged pump drives must be taken off-line until properly repaired.</p>

## **⚠ DANGER**

Transport, installation, plumbing, operation, maintenance, and inspections should be handled by properly trained technicians; **failing to do so will shorten product life, cause injury, or damage to the fan drive.**

Never stand directly under any suspended equipment by a crane or other lifting mechanism; **personal injury or death may result.**

Do not install or operate any equipment or machinery provided by Amarillo® Gear Co. until this manual has been fully read and understood; **failing to do so will void warranty and may cause injury due to incorrect operation.**

## **⚠ CAUTION**

Failing to maintain the pump drive as described in this manual will result in voiding of warranty and pump drive failure

Do not attempt to modify or disassemble the pump drive in any way; **doing so will void warranty, may cause permanent damage to pump drive, or injury.**

## **2. RECEIVING INSPECTION**

Pump Drives may be shipped via crate or skid. Inspect the drive for any damage that may have been caused during shipping.

Upon receiving a crated pump drive, a crate panel should be carefully removed to verify there is no evidence of shipping damage. Contents of crate may have shifted during transport. Use caution to avoid any injury.

### **2.1 INSPECT NAME PLATE**

Ensure model number and ratio of received pump drive matches what was ordered.



**NOTE: To better assist with any inquires to Amarillo Gear Co., please provide model number, serial number, and ratio.**

## **3. STORAGE INSTRUCTIONS**

### **3.1 SHORT-TERM STORAGE**

Dry, indoor storage is required. Pump drives are typically shipped upright on skid with first fill of operation oil included, unless shipped via air, or requested to ship “dry”.

During the storage period prior to installation, the input shaft shall be rotated a minimum of twenty (20) revolutions once monthly to prevent bearing brinelling.

Wrapping crates with a tarp or loose plastic is not an acceptable means of covering and will not fully protect the pump drive. Tarping the drive may result in damage.

### **3.2 LONG-TERM STORAGE**

Contact Amarillo® Gear for long-term storage options and instructions for periods greater than 12 months or in adverse ambient storage conditions. Gearboxes can be ordered prepared for long-term storage.

## **⚠ CAUTION**

Failing to follow storage maintenance guidelines may result in pump drive damage. Amarillo® Gear is not responsible for drives damaged due to improper

## **4. INSTALLATION**

Endurance pump drives are shipped upright on skid with the first fill of mineral oil as standard product.

Please refer to Amarillo® Endurance Right Angle Pump Drives catalog for external locations (oil fill, cooling coil inlet and outlet, etc.) and dimensional information. Cross sections and parts lists can be provided upon request.

## **⚠ CAUTION**

Failing to fill the pump drive with the proper amount and type of lubricant prior to operation will cause pump drive damage.

Do not attempt to modify or disassemble the pump drive; **doing so will void warranty, may cause permanent damage to pump drive, or injury.**

Do not overfill pump drive; doing so may have adverse effects on operation and may cause leaks and/or pump drive failure.

### **4.1 OIL FILL**

Check oil level before operation. The correct oil level is to the middle of the oil level sight glass. If needed, install the correct type of oil in pump drive as directed in this O&M prior to operation (see Section 9).

Flushing of any residual factory supplied oil is not required prior to filling when using products listed in Section 9, Table 2-3. After installation, follow the oil change interval specification provided in the scheduled maintenance (Section 7) of this document. Contact Amarillo® Gear for recommendations on oils not listed in this document.

## 4.2 CLEAN RUST PREVENTATIVE

Remove rust preventive from shaft extensions using a cloth soaked in mineral spirits, alkaline cleaner, or aliphatic solvent.

## 4.3 MOUNTING LOCATION INSTALLATION

Place pump drive on desired mounting location. Do not torque mounting bolts before checking for “soft foot”.

## 4.4 CONNECT PUMP TURBINE HEAD SHAFT

Install four non-reverse pins by inserting the non-chamfered ends into the clutch. Pins and holes must be clean and free of oil/grease so that the pins will fall freely. Tape over pin holes in such a way that the tape can be removed following installation. This is to maintain capture of the pins. Place the clutch, pin side down, on top of the drive sleeve. Install clutch hold down bolts and torque to 200 lb\*ft. Align pump turbine head shaft keyway and install gib key to the clutch and tighten to manufacturers specifications.

The non-reverse protection is not guaranteed. Settings of over 400 feet (122 meters) deep will require special shutdown procedures and in some cases the pin and ratchet type non-reverse will not work.

## 4.5 LEVELING PUMP DRIVE / CHECKING FOR SOFT FOOT

Level the pump drive and securely fasten it to its support. Shimming may be required to ensure the pump drive is level with no instance of “soft foot”. Soft footing may distort the pump drive case, which will cause misalignment in gearing and bearings. This can be verified after all hold down bolting has been properly torqued (see Section 4.6) by releasing the torque on one bolt at a time and measuring any deflection with a dial indicator.

If deflection exceeds 0.002 inches (0.05 mm), use proper shim thicknesses to eliminate the deflection. Once complete with the first hold down bolt, re-torque and move to the next hold down bolt. Proceed until all hold down bolting has been properly verified to have deflection less than 0.002 inches (0.05 mm).

## 4.6 MOUNTING BOLTS

Torque all bolts to the required values.

**Table 1: Gearbox Mounting Bolt – Grade 5 Course Torque Values (Dry)**

MODEL	BOLT SIZE (INCH)	TORQUE (lb·ft)
450B – 1000B	3/4 - 10	200

### WARNING

Failing to properly torque bolts to the correct value may result in injury or premature pump drive failure

## 4.7 CHECKING PRIME MOVER ROTATION

Verify that prime mover rotation is correct prior to connection to the drive shaft or pump drive. Damage may occur during start-up if the prime mover rotation is not verified prior to connection.

## 4.8 INSTALL DRIVE SHAFT

Connect drive shaft to prime mover and pump drive in accordance with manufacturer’s instructions. Align drive shaft in accordance with drive shaft manufacturer’s guidelines.

## 4.9 ELECTRICAL CONNECTIONS

If necessary, make required electrical connections to the pump drive. A qualified electrician is required to ensure proper installation.

## 4.10 COOLING WATER CONNECTION

Amarillo® Endurance Pump Drive models E450B-E1000B are assembled with cooling coils as standard equipment. Models EH450B-EH1000B are assembled with an external heat exchanger. The oil is cooled by circulation water through the coils or the tube side of the heat exchanger.

The operating temperature of the drive will depend on many factors. Water cooling should always be used.

Table 2 lists the coolant flow required when the coolant water temperature is 70°F (21°C) and other operating conditions are normal. Please note that the maximum allowable cooling water pressure for cooling coils is 100 psi (689 kPa) and the maximum allowable pressure for heat exchangers is 150 psi (1034 kPa).

**Table 2: Coolant Flow Requirement**

MODEL	GALLONS PER MINUTE	LITERS PER MINUTE
<b>450B – 750B</b>	<b>9.5</b>	<b>36</b>
<b>1000B</b>	<b>11</b>	<b>42</b>

## 5. OPERATION

### **ATTENTION:**

**NO SPECIAL BREAK-IN PROCEDURES ARE NECESSARY.**

Each pump drive is factory tested prior to shipment to ensure smooth and quiet operation that meets or exceeds AGMA 6000 vibration limit of 0.3 in/sec overall vibration. Excessive noise or vibration at initial operation can be an indication of one or more of the following: (1) imbalance of the prime mover, companion coupling, and/or pump, (2) improperly adjusted pump turbine, (3) torsional vibration, (4) unstable mounting. If noise or vibration persists, discontinue operation, and correct the problem before further operation. High vibration can be damaging to all components of the system.

### 5.1 REVERSING OPERATIONS

Reversing operation is not permitted. Operating the pump drive in the reverse direction will result in major pump drive damage and lead to complete failure. Non-reverse clutch or sprag non-reverse should be installed to prevent any reverse operation and potential shock loads.

## 5.2 EXTREME COLD OPERATION

Pump drives operated in ambient temperatures at or below -20°F (-29°C) must be equipped with an oil sump heater and operated with synthetic oil. The pump drive's oil sump must be preheated to a minimum of 20°F (-7°C) before operation begins.

## 6. ENGINE/DRIVER SELECTION

### 6.1 TWO-SPEED

On installations with two speed motors, allow a suitable time delay before switching from high speed to low speed. The pump must be at, or below, the slow speed before energizing the slow speed winding.

### 6.2 VARIABLE SPEED

On installations with variable speed motors, do not operate gear drive below 450 rpm vertical speed. For operation at vertical speeds less than 450 rpm, pump drives will require a gerotor oil pump for proper lubrication. The addition of this option will allow operation at no less than 250 vertical rpm.

On most pump drive systems, it is common for one or more resonant speeds to exist between stop and motor nameplate maximum speed. Continued operation at resonant speed will result in lateral or torsional vibrations, which can be damaging to all components of the system. The most common specific indicator of torsional vibrations is an unusual rumbling or clattering noise from the gear drive at specific speed. The noise will disappear when the speed is increased or decreased. This type of noise does not indicate a defect of the pump drive but results when the vibratory torque exceeds the drive torque causing the gear teeth to separate and clash together very rapidly.

On variable speed applications, operation within ±10% of a resonant speed should be avoided, and the transition through a resonant speed range should be swift.

## **7. SCHEDULED MAINTENANCE**

Maintenance logs shall be kept that detail all maintenance work.

Pump drives require an accelerated oil change after the first **500 hours** of runtime; after this initial oil change, continue to follow the scheduled maintenance detailed in this section.

### **7.1 DAILY**

Visual inspections/observation for oil leaks, unusual noises/vibrations are recommended. If any of these occur, the pump drive should be shut down and the problem corrected.

### **7.2 WEEKLY**

Check oil level using the oil level sight glass when pump drive is static (not rotating) for a minimum of 20 minutes. Add oil to pump drive if necessary.

Check the pump drive for any oil leaks.

#### **⚠ CAUTION**

A plugged breather may cause leak, or damage to gear drive if not corrected.

### **7.3 EVERY SIX MONTHS OR 2500 HOURS WHICHEVER COMES FIRST**

- Check alignment of all components in the system.
- Check all oil plugs and pipe fittings for leaks.
- Change the pump drive lubricant
  - Completely drain the oil by removing the drain plug
  - Inspect the lubricant for sludge, metal shavings, foreign material, and free water. Oil samples can also be sent to a lab for further evaluation.
  - If the oil condition is acceptable, the pump drive may be refilled with new oil without flushing.
  - Refill the pump drive through the filler plug, with a recommended mineral oil or synthetic oil listed in this publication (See Section 9).

*Very humid environments, rapid changes in ambient temperature, and high operating oil temperature are some of the extreme operating conditions that lead to poor oil quality and formation of sludge inside the pump drive.*

#### **⚠ CAUTION**

Poor oil quality after six months of operation indicates extreme operating conditions, and the change interval should be reduced to 2 to 3 months; failure to do so will cause shortened gearbox life.

### **7.4 EXTENDED OIL CHANGE INTERVALS**

Users should sample and analyze oil every three months, with samples taken shortly after gearbox shut down while oil is still well mixed. A hand pump should be used to pull the sample through the side inspection opening a few inches below the surface of the oil, but well above the bottom of the oil sump. Remote sampling may be used if sample is representative of the oil circulating in the gearbox (e.g., remote sample line must be circulated to bring active oil from the gearbox sump to the sampling location).

**Used oil acceptance criteria for continuing use is as follows:**

- Water Content: < 400 ppm
- Total Acid Number (TAN): < 2.0
- Wear Metals
  - Iron: < 300 ppm
  - Lead: < 75 ppm
  - Copper: < 275 ppm
  - Chromium: < 30 ppm
  - Aluminum: < 40 ppm
  - Tin: < 30 ppm
  - Silver: < 30 ppm
  - Silicon: < 60 ppm

If these limits are exceeded, change pump drive oil per Section 7.3.

#### **⚠ CAUTION**

Ensure that all moving parts have stopped before attempting to service or inspect pump drive.

Dispose of lubricants in an appropriate manner in accordance with local, state, and federal regulations.

Failing to follow the recommended oil change intervals as well as intervals in extreme conditions may result in premature failure of the drive.

## 8. INACTIVE PUMP DRIVES

Special precautions are necessary during periods of inactivity more than one week. When the internal parts are not continually bathed by the lubricant as during operation, the pump drive is vulnerable to rust and corrosion.

For best results, run the pump drive at a minimum of 450 rpm vertical speed for five minutes once per week throughout the shutdown period to maintain the oil film on the internal parts of the pump drive.

## 9. LUBRICATION

Use only Rust and Oxidation Inhibited Gear Oils in accordance with AGMA 9005-F16, or more current standard. Use a lubricant ISO VG 220.

### **9.1 MINERAL OILS**

AMBIENT TEMP AT GEAR DRIVE	20°F TO 120°F (-7°C TO 49°C)
ISO GRADE	220
Chevron Oil Co.	Rando HD 220
Chevron Oil Co.	Regal 220 R&O
Citgo	Citgo Pacemaker 220
Conoco Phillips	Multipurpose R&O 220
Gulf Oil. Corp	Harmony 220
Mobil Oil Corp.	Teresstic 220
Mobil Oil Corp.	DTE Oil BB
Shell Oil Co.	Morlina SD 220
Sunoco	Sunvis 9220

*\*\*LIST OF BRAND NAMES IS FOR PURPOSE OF IDENTIFYING TYPES & IS NOT TO BE CONSTRUED AS EXCLUSIVE RECOMMENDATIONS*

### **9.2 SYNTHETIC OILS/OIL HEATERS**

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 pump drive

Synthetic lubricants can be made using various base stocks which are incompatible with certain pump drive components; therefore, any synthetic lubricant not listed in this bulletin should be approved by Amarillo® Gear Company. Change intervals for synthetic lubricants should not be extended beyond the change interval for mineral oil without a comprehensive oil quality monitoring program (Section 7.4).

If the operating oil temperature exceeds 180°F (82°C) for extended periods of time or the pump drive is started when the ambient temperature is below 20°F (-7°C), a synthetic oil is required.

AMBIENT TEMP AT GEAR DRIVE	-20°F TO 150°F (-29°C TO 66°C)
ISO GRADE	220
Chevron/Texaco	Clarity 220 Synthetic
Conoco Phillips	Syncon 220 – R&O Oil
Mobil	SHC 630, SHC 630*
Shell	Morlina S4 B 220

*\*\*LIST OF BRAND NAMES IS FOR PURPOSE OF IDENTIFYING TYPES & IS NOT TO BE CONSTRUED AS EXCLUSIVE RECOMMENDATIONS*

### **9.3 OIL CAPACITY**

**Table 3: Oil Capacity**

MODEL	GALLONS	LITERS
450B – 750B	11	42
1000B	12	45

By following the above procedures, each Amarillo® Endurance Pump Drive will provide years of useful service. In the event that repairs are necessary, contact service representative for available parts. Prompt factory re-build service is also available.

## DRIVE INFORMATION/ MAINTENANCE LOG

MODEL \_\_\_\_\_

RATIO \_\_\_\_\_

S.N. \_\_\_\_\_

DATE OF INSTALLATION \_\_\_\_\_

**OIL CHANGE LOG.**

<b>DATE</b>	<b>OIL TYPE</b>