

Quantum® FAN DRIVE

FOR AIR-COOLED CONDENSERS

OPERATING AND MAINTENANCE INSTRUCTIONS



Each **Amarillo® Fan 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 warranty. Contact Amarillo® Gear Co. if required.

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 this document is to be sent and maintained by the end user of the Quantum® fan drive.

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1. SAFETY INFORMATION

1.1 SYMBOLS AND SIGNS USED

1.1.1



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

1.1.2



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

1.1.3



: Indicates a hazardous situation that, if not avoided, **could result in minor or moderate injury and may result in damage to fan 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, warnings, and cautions. **Failing to do so may result in death, serious injury, or fan drive failure.**

Maintain a copy of this manual for the full service length of the fan drive.

WARNING

- **This product contains a chemical known to the State of California to cause cancer.**
- **This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.**

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.**

WARNING

- The fan drive should be operated only within its design and performance specifications; **injury or damage to the system may occur if operated outside of these specifications.**
- Keep hands and all foreign objects from all internal and external moving parts of the fan drive; **failing to do so may cause injury or damage to the system.**
- Damaged fan drives must be taken off - line until properly repaired.

CAUTION

- Failing to maintain the fan drive as described in this manual will result in voiding of warranty and fan drive failure.
- Do not attempt to modify or disassemble the fan drive in any way; **doing so will void warranty, may cause permanent damage to fan drive, or injury.**



2. RECEIVING INSPECTION

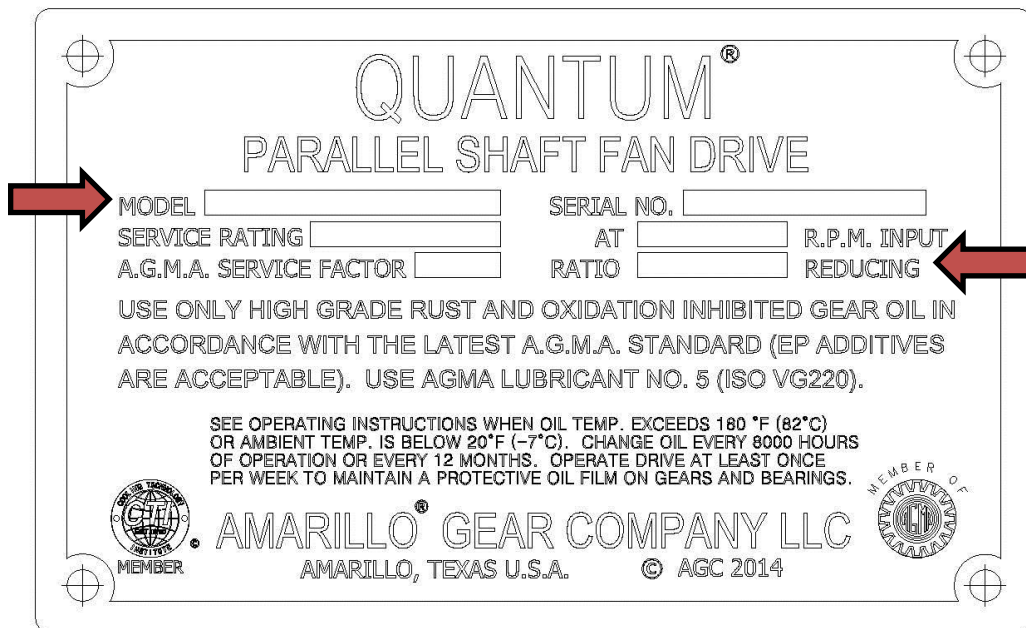
Upon receiving a crated fan drive, a crate panel should be carefully removed to verify there is no evidence of shipping damage.

WARNING

- Contents of crate may have shifted during transport. **Open cautiously to avoid any injury.**
- Verify that the fan drive received is in fact the one ordered. **Installation of the incorrect drive may result in injury, incorrect operation, or damage to the system.**

2.1 INSPECT NAME PLATE

- 2.1.1 Ensure model number of received fan drive matches model number ordered.
- 2.1.2 Ensure reducing ratio on received fan drive matches ordered ratio.



ATTENTION: To better assist with any inquiries to Amarillo® Gear Co., please make ready model number, serial number, and ratio.

3. STORAGE INSTRUCTIONS

3.1 ACCEPTABLE STORAGE

Dry, indoor storage is required. Fan drive is typically shipped upright on skid with first fill of mineral oil as standard product. Synthetic oil is also available upon customer request. Operator must follow initial oil change requirements in Section 7, Page 9.

3.2 UNACCEPTABLE STORAGE

Wrapping crates, such as with a tarp, is not an acceptable means of covering and will not fully protect the fan drive. Tarping the drive may result in damage.

3.3 STORAGE MAINTENANCE

During the storage period prior to installation, the input shaft shall be rotated a minimum of twenty (20) revolutions once monthly. Installing oil in the fan drive will be required prior to storing if shipped dry. See Section 9, Page 12-14 for lubrication.

3.4 LONG TERM STORAGE

Contact Amarillo® Gear for detailed storage instructions for periods greater than 12 months or in adverse ambient storage conditions.

CAUTION

- Failing to follow storage maintenance guidelines may result in fan drive damage. Amarillo® Gear is not responsible for drives damaged due to unacceptable storage practices.

4. INSTALLATION

Quantum® fan drives are shipped with the fan shaft thrust bearing properly set and shipped upright on skid with first fill of mineral oil as standard product.

WARNING

- Do not place any flammable objects near the fan drive or any objects that impede ventilation; doing so may result in fire or overheating of equipment.
- **Avoid pinch point areas when installing fan drive; failing to do this may result in serious injury or death.**



CAUTION

- Failing to fill the fan drive with the proper amount and type of lubricant prior to operation will cause gear drive damage or leaks.
- Do not attempt to modify or disassemble the fan drive; **doing so will void warranty, may cause permanent damage to fan drive, or injury.**
- Do not overfill fan drive; doing so may have adverse effects on operation and may cause leaks.

4.1 OIL FILL

- 4.1.1 The correct oil level is to the middle of the oil level sight glass or to the level indicated on the oil level dip stick. Install the correct type of oil in fan drive as directed in this O&M prior to operation (See Section 9, Page 12-14).
- 4.1.2 Flushing of any residual factory test 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, Page 9) of this document. Contact Amarillo® Gear for recommendations on oils not listed in this document.
- 4.1.3 An initial oil change after 500 hours of runtime is required.

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 INSTALL AT MOUNTING LOCATION

Once fan drive is positioned at desired mounting location, continue to 4.4. Do not torque bolts for mounting at this time before checking for “soft foot.”

DANGER

- Never hoist a fan drive that exceeds the rating of the crane or other mechanism being used; **damage to the fan drive and/or lifting device, injury, or death may occur.**
- Never stand directly under any suspended equipment by a crane or other lifting mechanism; **personal injury or death may result.**
- Ensure all personnel are using the correct personal protective equipment as specified by local, state, and federal authorities.

4.4 INSTALL FAN BLADES

Install fan blades per fan manufacturer’s specifications and recommendations.

DANGER

- **Failing to follow fan manufacturer’s specifications and recommendations when installing fan blades may result in fan drive damage, tower damage, or death.**

4.5 LEVELING FAN DRIVE

- 4.5.1 Level the fan drive and securely fasten it to its support. Shimming may be required to ensure the fan drive is level with no instance of “soft foot” that may distort the fan drive case which will cause misalignment in gearing and bearings. This can be verified after all hold down bolting has been properly torqued (See Table 1, Section 4.6) by releasing the torque one at a time and measuring with a dial indicator to see if there is any deflection.
- 4.5.2 If deflection exceeds 0.002 inch (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 inch (0.05 mm).
- 4.5.3 Check fan tip clearance per manufacturer’s specifications before torquing bolts or operating fan drive.

4.6 TORQUE BOLTS

Torque all bolts to required values.

Table 1
Gearbox Mounting Bolt - Torque Values (Dry)

MODEL	BOLT SIZE (Inch)	BOLT SIZE (Metric)	N·m	lb·ft
Q400 - Q600	1 1/4 - 7	M30 x 3.5	1345	990
Q400 - Q600	1 3/8 - 6	M33 x 3.5	1760	1300

WARNING

- **Failing to properly torque bolts to the correct value may result in injury and premature fan drive failure.**

4.7 CHECK MOTOR ROTATION

Verify correct motor rotation before installing onto fan drive.

CAUTION

- If the fan drive is equipped with a non-reverse mechanism, ensure that the direction of rotation of the electric motor is correct before coupling to fan drive; otherwise, damage may occur upon startup.

4.8 INSTALL MOTOR & MOTOR COUPLING

Remove the motor coupling guard from the motor stand. Motor coupling should be machined for a clearance fit (See Figure 2, Page 15).

CAUTION

- Hammering or mechanically forcing the coupling will cause fan drive bearing damage.

4.8.1 Install the motor coupling half on the electric motor. Clean the motor flange and motor stand surfaces (See Figure 2, Page 15) and remove any burrs or foreign material that could cause misalignment.

4.8.2 Install the motor/coupling assembly on the gear drive. Verify that the run-out of aligning surfaces on both coupling halves is within the coupling manufacturer's tolerances. Assemble the coupling halves according to the manufacturer's installation instructions.

4.8.3 Securely tighten the electric motor to the motor stand and re-install the coupling guard. The motor mounting bolts shall be tightened to motor manufacturer recommendations.

DANGER

- **Failing to reinstall the coupling guard may cause serious injury or death if coupling fails during operation.**
- **Never approach or touch any rotating parts during operation or maintenance of the fan drive, doing so may result in severe injury or death.**

4.9 SERVICE PIPING

Installation of piping to the service openings will expedite routine maintenance and may be installed if desired. Service openings include oil fill and oil drain (Figure 1, Page 15). Use a suitable sealer for all pipe joints and coat all exposed threads to prevent corrosion.

4.10 ELECTRICAL CONNECTIONS

Make required electrical connections to the fan drive. A qualified electrician is required to ensure proper installation.

DANGER

- Electrical shock hazard. Remove all power sources from all equipment before servicing; **failing to do this will result in electrical shock causing injury or death.**

4.11 HYGROSCOPIC BREATHER

Remove all protective caps and plugs before installing breather.

5. OPERATION

ATTENTION: No special break-in procedures are necessary.

Each fan drive is factory tested, prior to shipping, to assure smooth and quiet operation. Excessive noise or vibration at initial operation is an indication of one or more of the following: (1) imbalance of the motor, coupling, or fan (2) improperly adjusted fan blades (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 OPERATION

When reversing direction of rotation, allow the fan to come to a complete stop before restarting the motor.

CAUTION

- If fan drive is equipped with an optional non-reverse (back-stop), reverse rotation will not be possible. Attempting to reverse rotation will cause fan drive damage. If you are unsure if the fan drive has the optional non-reverse feature, please contact Amarillo® Gear for further instructions.
- Do not start the electric motor if the fan is wind-milling in the reverse direction or at an rpm higher than operating speeds in the forward direction; doing so will cause damage to fan drive.

5.2 NON-REVERSE (BACK-STOP) OPTION

If equipped with a non-reverse (back-stop) option, the non-reverse components are internal to the fan drive and shall not be operated in the reverse direction; doing so will result in major fan drive damage.

5.3 EXTREME COLD OPERATION

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



6. MOTOR SELECTION PRECAUTIONS

6.1 TWO SPEED

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

6.2 VARIABLE SPEED

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

CAUTION

- 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. Fan drives with the optional extended bearing housing on the fan shaft contain a sealed bearing that does **NOT** need re-lubrication.

Fan 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.

CAUTION

- The surface and shafts of the Amarillo® fan drive may become hot during operation; **injury due to burns may result if touched while maintenance is being performed.**
- Do not change the oil during operation; **this will result in damage to fan drive or injury.**
- Use caution when changing oil soon after shutdown of fan drive; **oil may be hot and splashing oil may cause injury due to burns.**
- Ensure all personnel are using the correct personal protective equipment as specified by local, state, and federal authorities.
- Change lubricant according to the maintenance manual; not following recommended procedure may result in system damage.

7.1 DAILY

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

7.2 WEEKLY

- 7.2.1 Check oil level using the oil level sight glass or dip stick when fan drive is static (not rotating). Add oil to fan drive if necessary.
- 7.2.2 Check the desiccant breather to make sure that the hygroscopic agent is BLUE. If the agent is PINK, the breather must be replaced. If a brand other than the factory installed desiccant breather is supplied, follow manufacturer's maintenance instructions.
- 7.2.3 Check the fan drive for any oil leaks.

CAUTION

- A plugged breather may cause damage to gear drive if not removed and replaced.

7.3 EVERY TWELVE MONTHS OR 8000 HOURS, WHICHEVER OCCURS FIRST

- 7.3.1 Check alignment of all components in the system.
- 7.3.2 Check all external fasteners for tightness.
- 7.3.3 Check all oil plugs and pipe fittings for leaks.
- 7.3.4 Change the fan drive lubricant
 - 7.3.4.1 With the oil at operating temperature, completely drain the oil by removing the drain plug.
 - 7.3.4.2 Inspect the lubricant for sludge, metal shavings, foreign material, and free water, or send a lubricant sample to a lab for analysis.
 - 7.3.4.3 If the oil condition is acceptable, the fan drive may be refilled without flushing.
 - 7.3.4.4 Refill the fan drive through the filler plug on the top cover, with a recommended mineral oil or synthetic oil listed in this publication (See Section 9, Page 12-14)
- 7.3.5 Replace the oil filter element (if equipped).
 - 7.3.5.1 Remove spin-on filter using a band type filter wrench or by hand if possible.
 - 7.3.5.2 Dispose of used filter element properly according with local, state, and federal regulations.



7.3.5.3 Clean underside of spin on filter housing and ensure the area is free of debris or contaminants.

7.3.5.4 Install replacement spin-on oil filter tightening hand tight or snugly with band type filter wrench. Contact Amarillo® Gear Co. for replacement filter elements as needed.

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 fan drive.

CAUTION

- Poor oil quality after 12 months of operation indicates extreme operating conditions, and the change interval should be reduced to 6 months; failure to do so will cause premature failure.

7.4 EXTENDED OIL CHANGE INTERVALS USING OIL SAMPLE ANALYSIS

7.4.1 Sample every quarter.

7.4.2 How to take sample from port. Sample ports are optional available upon customer request. See Figure 2, Page 15.

7.4.2.1 Take sample while fan drive is running and in operation.

7.4.2.2 Take sample while fan drive is at normal operating temperatures.

WARNING

- The surface and oil of the Amarillo® fan drive may become hot during operation; **Injury due to burns may result if touched while sampling is being performed.**
- Never approach or touch any rotating parts during operation or maintenance of the fan drive, **doing so may result in severe injury or death.**

7.4.3 Limits of sample.

7.4.3.1 Water content < 400 ppm

7.4.3.2 TAN < 2.0

7.4.3.3 Viscosity $\pm 5\%$ change from previous sample, $\pm 10\%$ from original fill sample.

7.4.4 If above limits, change fan drive oil (See Section 9, Page 12-14).



CAUTION

- Never attempt to use bore scope ports while fan drive is in operation; **this may result in damage to equipment or injury.**
- Ensure that all moving parts have stopped before attempting to service or inspect fan 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

7.5 PROTECTION DURING POWER WASHING OF ACC COILS

- 7.5.1 Make sure dip stick is fully inserted.
- 7.5.2 Remove hygroscopic breather & plug hole to avoid oil contamination
- 7.5.3 Cover fan drive using a tarp.
- 7.5.4 Uncover and reinstall breather after washing is completed.

8. INACTIVE FAN DRIVES

Special precautions are necessary during periods of inactivity in excess of one week. When the internal parts are not continually bathed by the lubricant as during operation, the fan drive is vulnerable to attack by rust and corrosion. For best results, run the fan for five minutes once per week, throughout the shutdown period, to maintain the oil film on the internal parts of the fan drive.

9. LUBRICATION

Use only Rust and Oxidation Inhibited Gear Oils in accordance with AGMA (American Gear Manufacturers Association) 9005-F16 or more current standard. Use a lubricant having an AGMA lubricant number of 5, 5S, or 5EP (ISO 220).

CAUTION

- Lubricants with EP (extreme pressure) additives are acceptable for use only when adequate oil condition monitoring is in place.

9.1 MINERAL OILS

Table 2
¹ Recommended Mineral Oils

AMBIENT TEMPERATURE AT GEAR DRIVE	20°F to 120°F (-7°C to 49°C)
AGMA LUBRICANT NUMBER	5
ISO GRADE	220
Atlantic Richfield Co. Chevron Oil Co. Cities Service Oil Co. Conoco Exxon Company Gulf Oil Corp. Mobil Oil Corp. Pennzoil Phillips Petroleum Co. Shell Oil Co. Sun Oil Co. Texaco Inc. Total	Duro 220 Rando HD 220 Citigo Pacemaker 220 Hydroclear Multipurpose R&O Oil 220 Teresstic 220 Harmony 220 DTE Oil BB Pennzbell R&O 220 Magnus 220 Morlina SD 220 Sunvis 9220 Regal 220 R&O, Code 1531 Carter 220

¹ LIST OF BRAND NAMES IS FOR PURPOSE OF IDENTIFYING TYPES AND IS NOT TO BE CONSTRUED AS EXCLUSIVE RECOMMENDATIONS.

9.2 SYNTHETIC OILS

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 fan drive.

Synthetic lubricants can be made of various base stocks which are incompatible with certain fan 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.

- 9.2.1 If the fan drive is started when the ambient temperature is below 20°F (-7°C), use a lube oil heater or a recommended synthetic oil. Optional lube oil heaters may be ordered on a new fan drive or easily added in the field.
- 9.2.2 Fan drives operated in extreme cold ambient temperatures of below -20°F (-29°C) must be equipped with an oil sump heater and operated with synthetic oil. The fan drive’s oil sump must be preheated to a minimum of 20°F (-7°C) before operation begins.
- 9.2.3 If the operating oil temperature exceeds 180°F (82°C) for extended periods of time or the fan drive is started when the ambient temperature is below 20°F (-7°C), a synthetic oil is recommended.

Table 3
¹ Recommended Synthetic Lubricants

AMBIENT TEMPERATURE AT GEAR DRIVE	-20°F to 150°F (-29°C to 66°C)
AGMA LUBRICANT NUMBER	5S
ISO GRADE	220
Chevron/Texaco Conoco/ Phillips 66/76 Mobil Shell	Clarity 220 Synthetic Syncon 220 – R & O Oil SHC 630, SHC 630* Morlina S4 B 220

¹ LIST OF BRAND NAMES IS FOR PURPOSE OF IDENTIFYING TYPES AND IS NOT TO BE CONSTRUED AS EXCLUSIVE RECOMMENDATIONS.

Table 4
Oil Capacity

MODEL	GALLONS	LITERS
Q400	8.5	32
Q500	10	38
Q600	11.5	44

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

10. EXTERNAL PART LOCATIONS

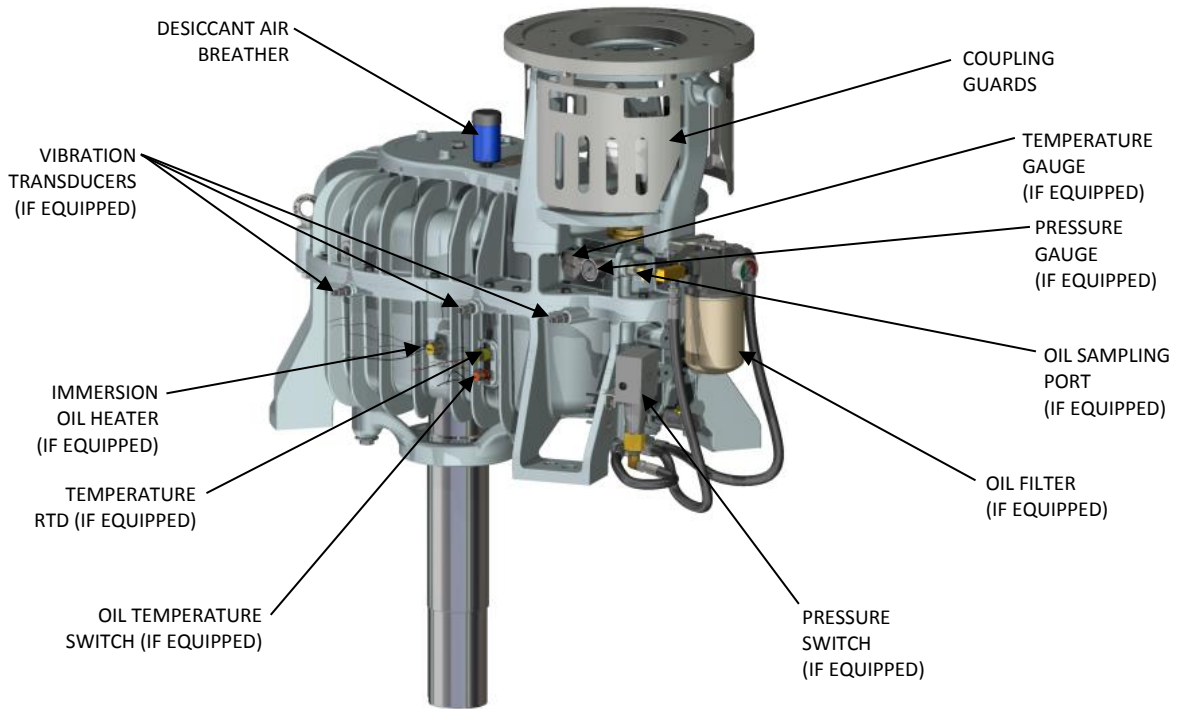


Figure 1: External Locations.

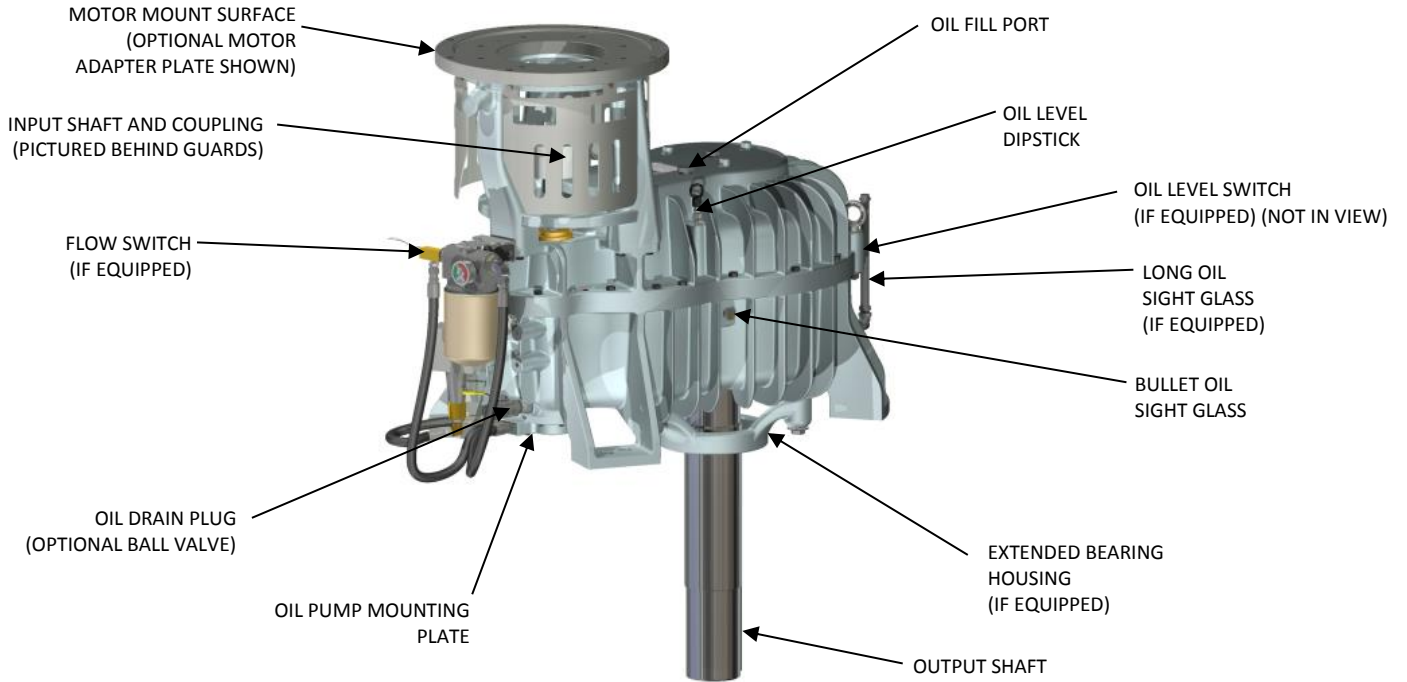


Figure 2: External Locations.