HALE

09/16/96

MGA and RGA SERIES SPLIT-SHAFT PTO DRIVE GEARBOX

INSTALLATION MANUAL

All Hale products are quality components: ruggedly designed, accurately machined, precision inspected, carefully assembled and thoroughly tested. In order to maintain the high quality of your unit, and to keep it in a ready condition, it is important to follow the instructions on care and operation. Proper use and good preventive maintenance will lengthen the life of your unit. ALWAYS INCLUDE THE UNIT SERIAL NUMBER IN CORRESPONDENCE.

HALE PRODUCTS, INC. ● A Unit of IDEX Corporation ● 700 Spring Mill Avenue ● Conshohocken, PA 19428 ● TEL: 610-825-6300 ● FAX: 610-825-6440

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IDEX CORPORATION

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ISO 9001
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NOTE TO INSTALLER

IMPORTANT: Please provide two copies of the Split-Shaft PTO Gearbox manual to the end user of the equipment. For additional manuals, contact Hale Products, Inc. at (610) 825-6300.
Ask for Manual P/N 029-0020-46-0.

1 SAFETY

Before attempting to install a Hale Gearbox, read all of the following safety precautions and follow carefully.

1. WARNING: The gearbox is heavy. When lifting gearbox into position use proper lifting devices to support the gearbox.

2. WARNING: Any electrical system has the potential to cause sparks. Take care to eliminate explosive or hazardous environments during installation or service.

3. CAUTION: Before lay out and installation of the drive line, consult apparatus and/or drive line component manufacturer for guidance in drive line design.

4. CAUTION: Drive shafts less than 15 inches (381 mm) long should have no more than 1° 30' angularity.

5. CAUTION: The gearboxes are shipped without oil. Before placing the apparatus in service fill the gearbox to the proper level with SAE EP90 or SAE 80W-90 gear oil.

6. CAUTION: Make sure interlocks and indicator lights required by NFPA standards are properly installed.

7. CAUTION: DO NOT exceed the rated current of the shift switch, 4 AMPS at 12 VDC, when connecting other devices.

8. CAUTION: The gearbox IS NOT a "hot shift" device. Before shifting from ROAD to PUMP or back make sure the apparatus drive shaft has stopped turning. Attempting to shift with the drive shaft turning will result in damage to the gears.

9. CAUTION: When driving high inertia auxiliary equipment such as a generator, make sure the equipment shaft stops rotating before shifting back to ROAD position. Shifting to road position before the shaft stops turning will result in damage to gears.

2 DESCRIPTION

Hale MGA and RGA Series Split-Shaft PTO gearboxes provide a cost effective means for driving a pump, generator, air compressor, winch or other auxiliary equipment from the truck engine without resorting to high cost, heavy, dedicated engines.

The gearboxes are heavy duty drive units capable of withstanding drive line input torque during road use of up to 16,000 lb-ft (21,693 N-m).

The gearboxes are installed in a midship position on the truck between two sections of a split drive shaft. (See figure 1) Mounting holes on the gearboxes permit attaching the gearbox directly to the truck frame or through the use of brackets manufactured by the gearbox installer. The main drive shaft sections connect to the gearboxes by drive flanges piloted and predrilled for compatibility with 1600, 1700 and 1800 series Spicer drive flanges.

Each gearbox model (the MGA and RGA) can be ordered with the rear drive flange blanked off for operation with a transmission mounted PTO. When the PTO drive option is used the gearbox is not mounted in the apparatus drive line. (Refer to figure 1)

When shifted from road to auxiliary output operation the RGA gearbox transmits up to 2300 lb-ft (3188 N-m) torque from the apparatus drive shaft to the 2 inch by 10 spline rear facing auxiliary drive shaft to drive the auxiliary equipment.

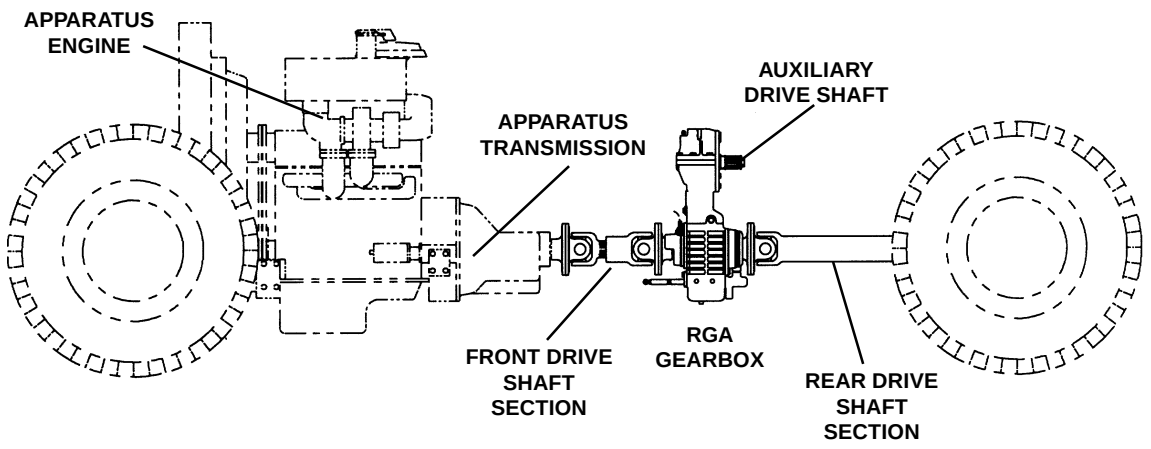
The MGA gearbox transmits up to 1200 lb-ft (1627 N-m) torque from the apparatus drive shaft to the auxiliary drive shaft. The auxiliary drive shaft on the MGA gearbox has a 1-½ inch by 10 spline on one end and a 1-$^{3}/_{8}$ inch by 10 spline on the other and can drive two pieces of auxiliary equipment simultaneously. The MGA gearbox can be configured with the auxiliary drive shaft positioned with either spline facing in either the front or rear position. Additionally the MGA gearbox can be mounted in either a vertical or horizontal position.

Chrome nickel steel spur gears provide the necessary rotational energy transmission. The auxiliary drive shaft of each gearbox is rigidly supported by two ball bearings with double lip oil seals to prevent gearbox contamination.

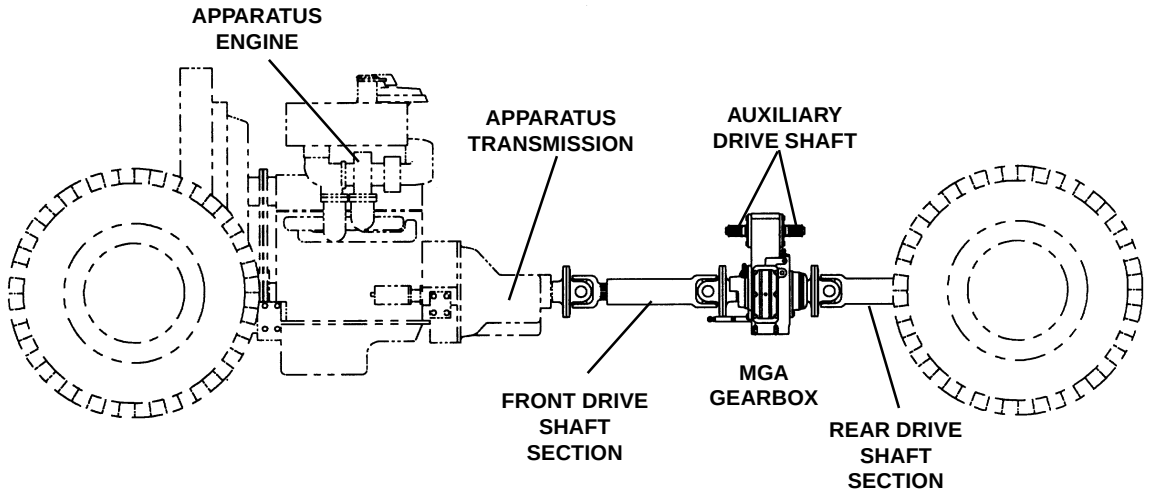
> **CAUTION:** The gearbox IS NOT a "hot shift" device. Before shifting from ROAD to PUMP or back make sure the apparatus drive shaft has stopped turning. Attempting to shift with the drive shaft turning will result in damage to the gears.

The standard gearboxes are shifted from road to auxiliary output operation with a manual shift lever. Other shift options available are vacuum power and air power shift mechanisms. Movement of the shift controls while the apparatus transmission is in neutral will engage the drive shaft to drive the auxiliary equipment. After shifting the gearbox from road to auxiliary output mode, placing the transmission back into drive gear provides power to the gearbox.

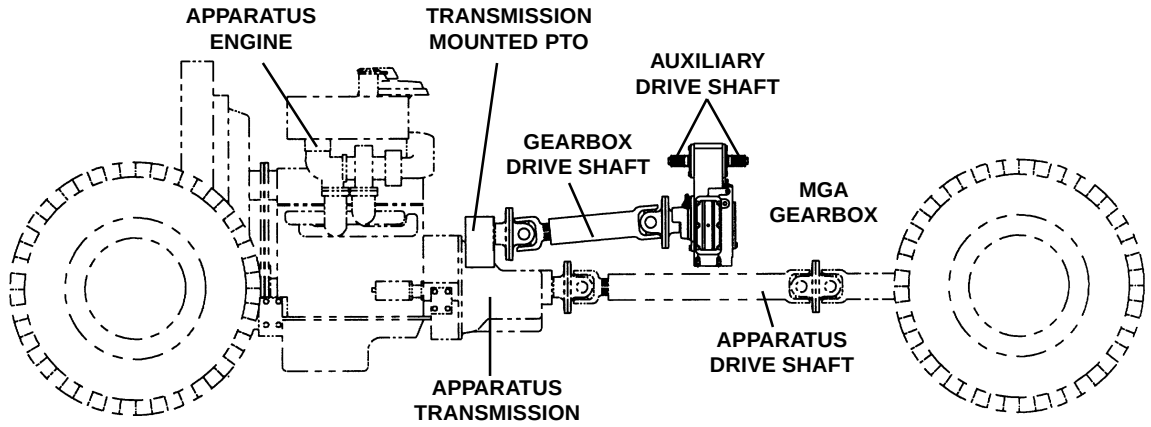
Indicator lights mounted in the driver's compartment and at the pump operator's panel provide visual indication as to when the gearbox has been shifted from road to auxiliary output mode and when all interlock conditions have been met for safe operation. Electrical signals for these lights are provided by switches that are actuated by the gearshift shaft.



RGA GEARBOX DRIVE LINE MOUNTED



MGA GEARBOX DRIVE LINE MOUNTED



TRANSMISSION PTO DRIVEN GEARBOX (MGA SHOWN)

Figure 1. Gearbox Location in Drive line

SPLIT-SHAFT PTO GEARBOX

CAUTION: When driving high inertia auxiliary equipment such as a generator, make sure the equipment shaft stops rotating before shifting back to ROAD position. Shifting to road position before the shaft stops turning will result in damage to gears.

The gearbox is shifted back to road position by placing the apparatus transmission in neutral and waiting until auxiliary component shaft has stopped turning. Movement of the shift controls while the apparatus transmission is in neutral will engage the drive shaft to drive the apparatus.

NOTE: In most cases cooling water must be connected to the gearbox when the power required for the auxiliary component is 200 hp (149 kw) or greater.

Gearbox coolers permit operation in a wide range of ambient temperatures. An integral gearbox cooler is standard on the RGA gearbox and an optional auxiliary cooler can be ordered to attach to the MGA gearbox. For operation in temperate climates the gearbox cooler must be connected when the power required for the auxiliary component is 200 hp (149 kw) or greater. When apparatus is operated in environments where high ambient temperatures are normally encountered, such as tropical regions, the gearbox cooler must be connected when the power requirement for auxilary components is less than 200 hp (149 kw). Conversely when the apparatus is normally operated in environments where low ambient temperatures are encountered the gearbox cooler may not be required unless the auxiliary equipment power requirement is well above 200 hp (149 kw). ALWAYS

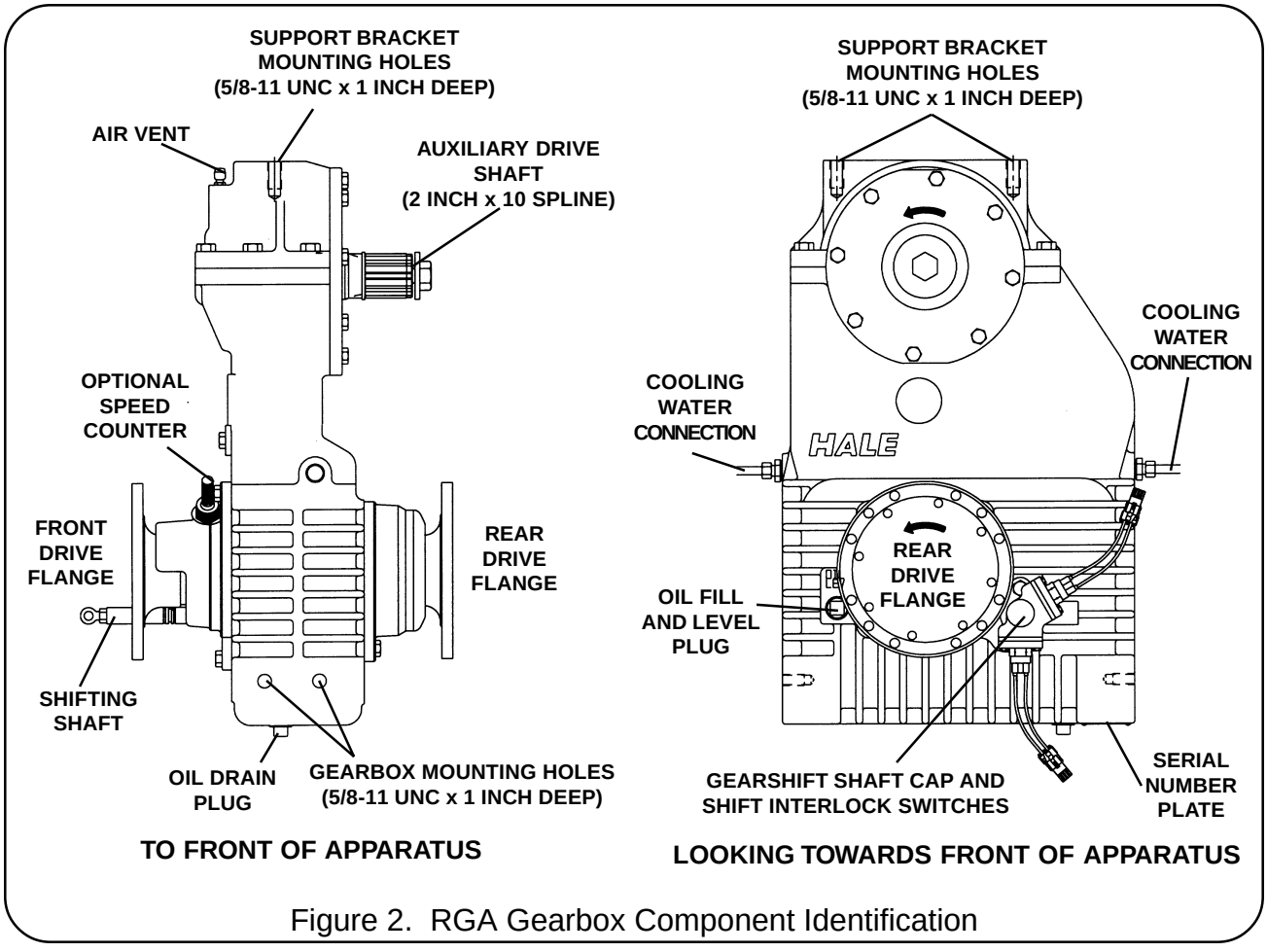


Figure 2. RGA Gearbox Component Identification

consult with Hale Products to determine gearbox cooler requirements.

Cooling water for the gearbox cooler is provided from the fire pump discharge or the apparatus engine cooling system.

The RGA Series Split-Shaft gearbox is available with five different gear ratios to provide a wide range of output speeds from a large variety of engine and transmission combinations. The available RGA models and ratios are as follows:

MODEL	RATIO
RGA-23	2.28:1
RGA-21	2.05:1
RGA-19	1.86:1
RGA-17	1.71:1
RGA-15	1.58:1

The MGA Series Split-Shaft gearbox is available with seven different gear ratios to provide a wide range of output speeds from a large variety of engine and transmission combinations. The available MGA models and ratios are as follows:

MODEL	RATIO
MGA-30	3.00:1
MGA-26	2.67:1
MGA-21	2.18:1
MGA-19	1.92:1
MGA-17	1.71:1
MGA-12	1.27:1
MGA-10	1.00:1

SPECIFICATIONS:

	RGA	MGA
Final Drive Ratios Available:	1.58:1, 1.71:1, 1.86:1, 2.05:1, 2.28:1	3.00:1, 2.67:1, 2.18:1, 1.92:1, 1.71:1, 1.27:1, 1.00:1
Weight:	325 lbs (147 kg)	200 lbs (91 kg)
Dimensions:		
Overall Height:	25-9/16 inches (649 mm)	19 inches (483 mm)
Overall Width:	16 inches (406 mm)	11-½ inches (292 mm) 13 inches (330 mm) with optional oil cooler
Face-to-face Length Between Input Flanges:	14-7/16 inches (367 mm)	14-7/16 inches (367 mm)
Bottom of Gearbox to Center of Input Flange:	7 inches (178 mm)	**MGA-30, MGA-26, MGA-21, MGA-19, MGA-17:** 6-¾ inches (171 mm) **MGA-12, MGA-10:** 7 inches (178 mm)
Center of Input Flange to Center of Output Shaft:	**RGA-23:** 13-3/8 inches (340 mm) **RGA-21:** 13-9/16 inches (344 mm) **RGA-19:** 13-¾ inches (349 mm) **RGA-17:** 13-15/16 inches (354 mm) **RGA-15:** 14-1/8 inches (359 mm)	**MGA-30, MGA-26, MGA-21, MGA-19, MGA-17:** 9-½ inches (241 mm) **MGA-12, MGA-10:** 9-¼ inches (235 mm)
Maximum Input Speed (RPM):	**RGA-23:** 2630 **RGA-21:** 2920 **RGA-19:** 3220 **RGA-17:** 3500 **RGA-15:** 3800	**MGA-30:** 2090 **MGA-26:** 2350 **MGA-21:** 2880 **MGA-19:** 3270 **MGA-17:** 3670 **MGA-12:** 4940 **MGA-10:** 6270
Maximum Auxiliary Drive Shaft Torque:	2300 lb-ft (3118 N-m)	1200 lb-ft (1627 N-m)
Maximum Input Torque:	16,000 lb-ft (21,693 N-m)	16,000 lb-ft (21,693 N-m)
Auxiliary Drive Shaft:	2 inch x 10 spline	1-½ inch x 10 spline 1-3/8 inch x 10 spline
Oil Capacity:	8 pints (3.8 Liters)	**Vertical:** 5-½ pints (2.6 Liters) [**MGA-12, MGA-10:** 7 pints (3.3 Liters)] **Horizontal:** 6 pints (2.8 Liters)

Oil Type: SAE EP 90 (or 80W-90)

Drive Flanges: One piece shaft/flange design. Flanges are piloted and predrilled for compatibility with 1600, 1700 and 1800 series Spicer Flanges. Drive shaft is 2-¾ inches (70 mm) in diameter.

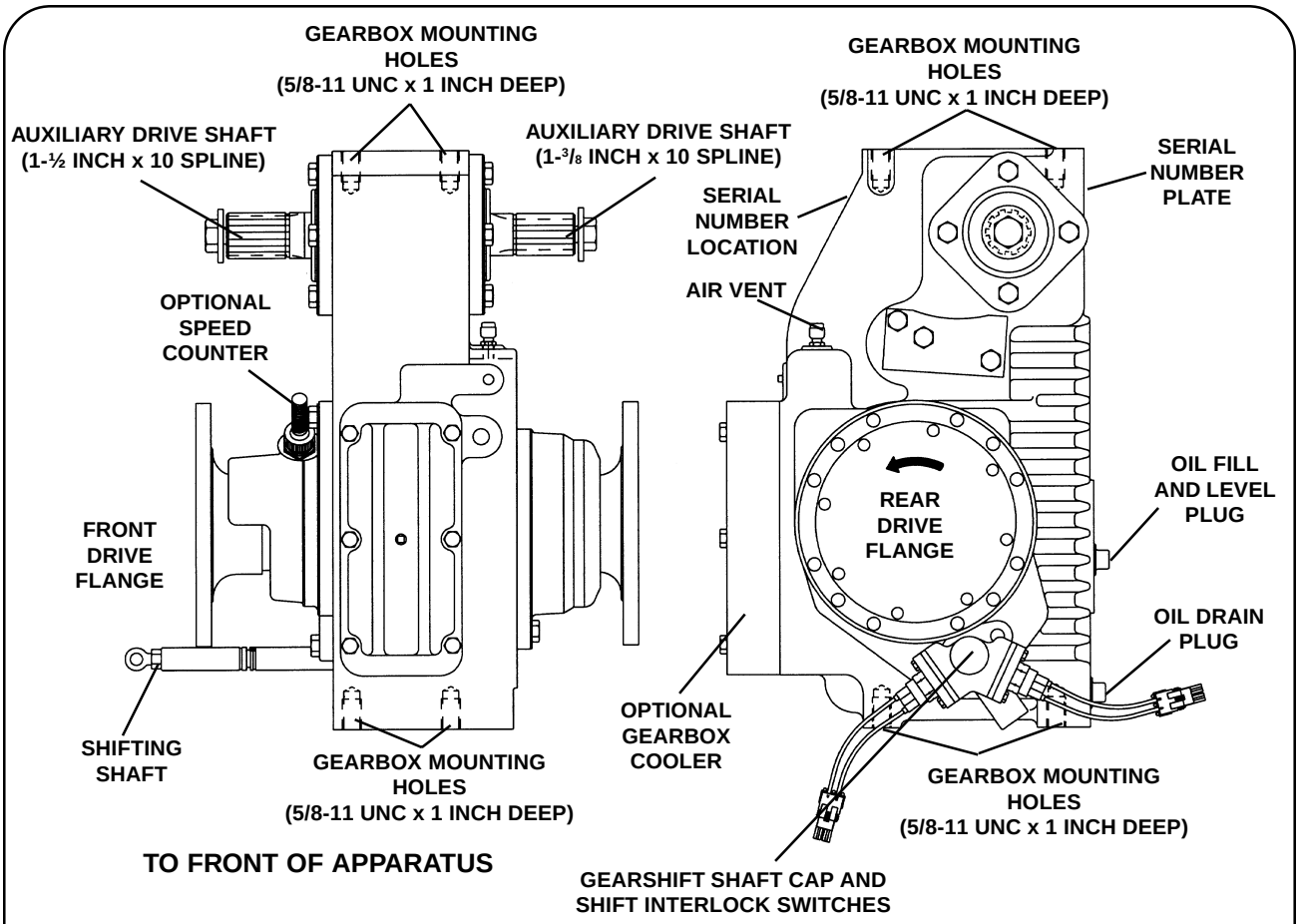
Controls:

Shift: Manual (standard), Air Power (optional), Vacuum Power (optional)

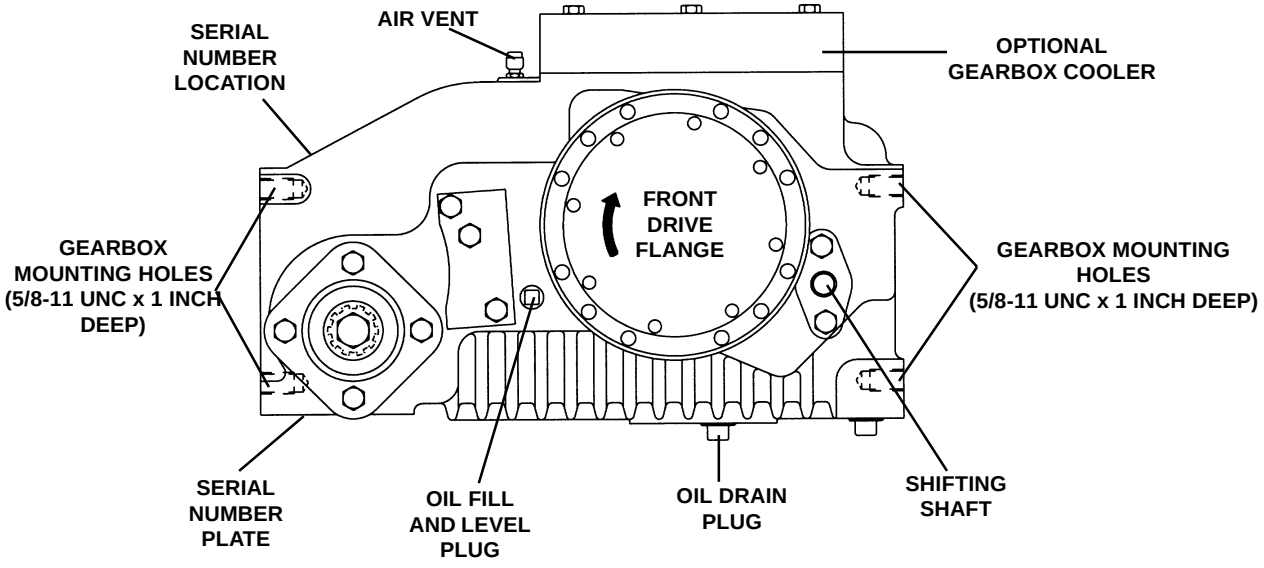
Warning Lights:

In cab: Two GREEN; “OK TO OPERATE”, “PUMP ENGAGED”

Operator Panel: GREEN; “WARNING: DO NOT OPEN THROTTLE UNLESS LIGHT IS ON”



GEARBOX MOUNTED IN VERTICAL POSITION



GEARBOX MOUNTED IN HORIZONTAL POSITION

Figure 3. MGA Gearbox Component Identification

3 DRIVE LINE INSTALLATION PLANNING

Before installing either the MGA or RGA gearbox careful planning is necessary. When planning the layout for the installation of the gearbox careful attention must be given to all factors that will affect total system performance. To reduce the possibility of drive line failure, proper layout is necessary. When laying out the drive line the following must be considered:

CAUTION: Before lay out and installation of the drive line, consult apparatus and/ or drive line component manufacturer for specific guidance in drive line design.

1. The drive shaft assembly between the truck transmission and the split shaft PTO gearbox must be independently phased with u-joint angles cancelled. Likewise the drive shaft assembly between the split shaft PTO gearbox and the rear axle must also be independently phased with u-joint angles cancelled.

2. Drive shaft angularity should be less than that listed as maximum in drive line component specifications. For specific guidance consult with driveline component manufacturer. The following chart provides general guidance on maximum drive shaft angularity based on drive shaft input speed for normal length drive shafts:

RPM	ANGLE
2500	7° 00′
3000	5° 50′
3500	5° 00′
4000	4° 15′
4500	3° 40′
5000	3° 15′

CAUTION: Drive shafts less than 15 inches (381 mm) long should have no more than 1° 30′ angularity.

3. The maximum length of a drive shaft section should not exceed a length which allows the drive line to run at or above:

$$\frac{\text{SHAFT CRITICAL} \times 0.85}{2}$$

4. The maximum drive shaft speed shall not exceed 5000 RPM.

5. Consideration must be given to all load conditions.

6. The drive shafts must be concentric and dynamically balanced to the standard listed by the apparatus drive line and transmission manufacturer.

7. Drive shaft joint and tube size must match the chassis manufacturers original design.

4 INSTALLATION

WARNING: The gearbox is heavy. When lifting gearbox into position use proper lifting devices to support the gearbox.

NOTE: Lock all bolts in place using Loctite #242 (or equal) thread sealing compound.

1. Fabricate brackets and attach to apparatus frame at the location where the gearbox is being mounted. When fabricating brackets and attaching to the frame, pay close attention to gearbox mounting hole location, refer to figure 4 for MGA mounting hole locations and refer to figure 5 for RGA mounting hole locations.

2. Position gearbox at proper location on apparatus frame. Support the gearbox and clamp into place.

3. Apply a light coating of Loctite #242 (or equal) thread sealing compound to the 5/8-11 UNC grade 5 mounting bolts. Insert the 5/8-11 UNC grade 5 mounting bolts through frame brackets into tapped mounting holes on the side of the gearbox. See figure 4 and 5 for mounting hole locations. Make sure the mounting bolts are long enough to allow 15/16 inch (23 mm) thread engagement in the gearbox housing.

4. The RGA Gearbox requires a support bracket attached to the top of the gearbox housing. Manufacture and install a support bracket from the apparatus frame to the top housing of the RGA gearbox. Apply a light coating of Loctite #242 (or equal) thread sealing compound to the 5/8-11 UNC grade 5 mounting bolts. Secure bracket in place using 5/8-11 UNC grade 5 bolts. Make sure the bolts are long enough to allow 15/16 inch (23 mm) thread engagement in the screw holes on the gearbox housing.

5. Attach Spicer flange yokes to the companion flanges on the gearbox. Make sure the flange yokes are capable of withstanding the torque generated by the apparatus drive line during road operations (16,000 lb-ft (21,693 N-m) maximum).

6. Connect the sections of the apparatus drive shaft to the flange yokes. Use only grade 8 or better bolts when connecting the drive line flanges together. 1600 and 1700 series flanges require 3/8 inch (10 mm) diameter bolts and 1800 series flanges require 7/16 inch (11 mm) diameter bolts.

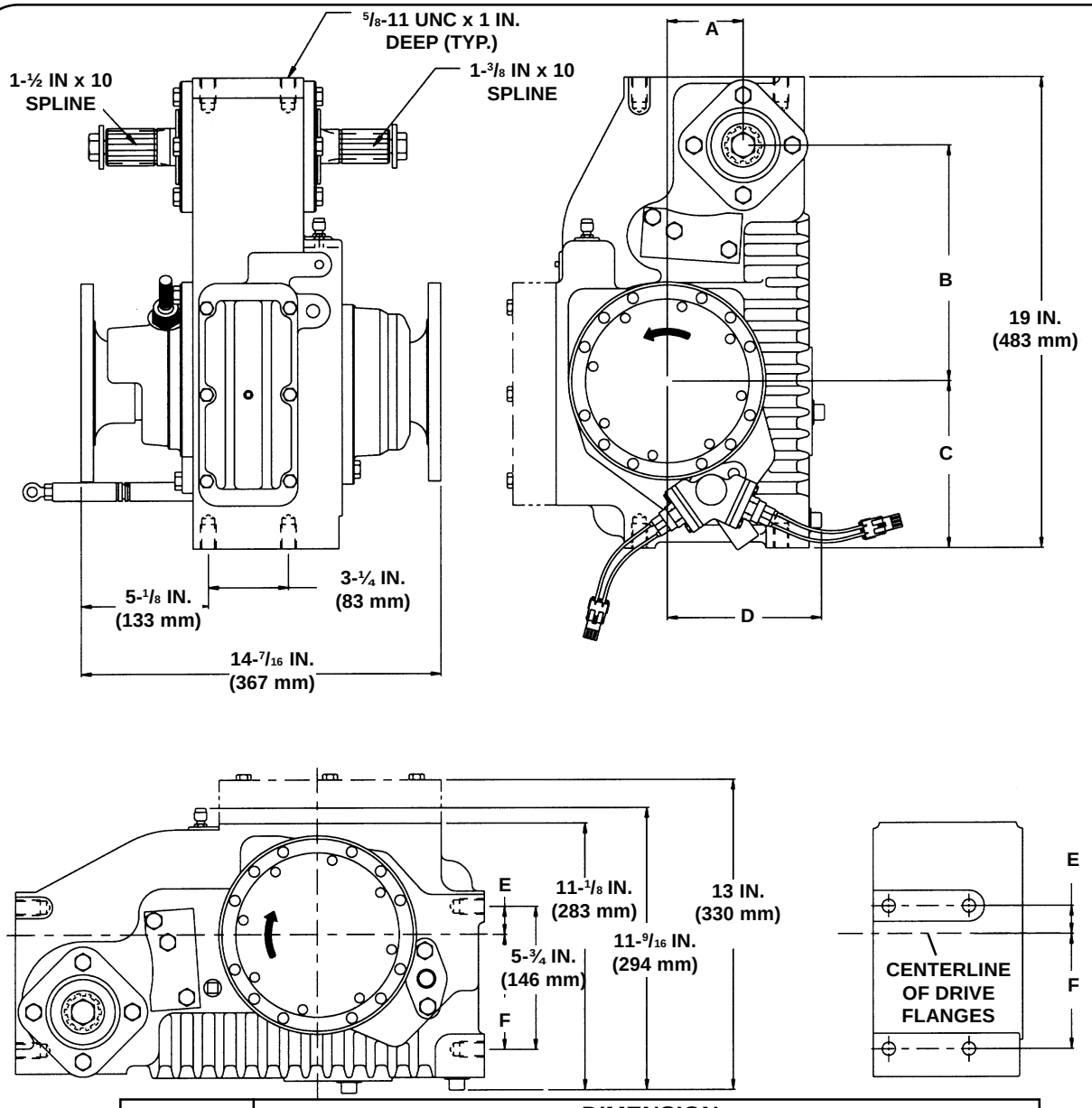
7. Check and correct the following in accordance with the apparatus and drive line component manufacturer instructions:

   a. Drive line phasing
   b. Pinion angle
   c. Transmission angle
   d. Gearbox drive flange angles
   e. Drive shaft section angles
   f. Drive line offset

   CAUTION: The gearboxes are shipped without oil. Before placing the apparatus in service fill the gearbox to the proper level with SAE EP90 or SAE 80W-90 gear oil.

8. Remove the ¾ inch NPT oil fill and level plug and fill the gearbox with SAE EP 90 (or SAE 80W-90) oil. Once the oil level is correct (oil at the bottom of the oil fill and level hole) replace and tighten the oil fill and level plug.

SPLIT-SHAFT PTO GEARBOX



MODEL	DIMENSION					
	A	B	C	D	E	F
MGA-30	2-3/4 IN (70 mm)	9-1/2 IN (241 mm)	6-3/4 IN (171 mm)	6-3/8 IN (162 mm)	1-1/8 IN (29 mm)	4-5/8 IN (117 mm)
MGA-27	3-1/16 IN (78 mm)	9-1/2 IN (241 mm)	6-3/4 IN (171 mm)	6-3/8 IN (162 mm)	1-1/8 IN (29 mm)	4-5/8 IN (117 mm)
MGA-21	2-3/4 IN (70 mm)	9-1/2 IN (241 mm)	6-3/4 IN (171 mm)	6-3/8 IN (162 mm)	1-1/8 IN (29 mm)	4-5/8 IN (117 mm)
MGA-19	3-1/16 IN (78 mm)	9-1/2 IN (241 mm)	6-3/4 IN (171 mm)	6-3/8 IN (162 mm)	1-1/8 IN (29 mm)	4-5/8 IN (117 mm)
MGA-17	3 IN (76 mm)	9-1/2 IN (241 mm)	6-3/4 IN (171 mm)	6-3/8 IN (162 mm)	1-1/8 IN (29 mm)	4-5/8 IN (117 mm)
MGA-12	3 IN (76 mm)	9-1/4 IN (235 mm)	7 IN (178 mm)	6-5/8 IN (168 mm)	7/8 IN (22 mm)	4-7/8 IN (124 mm)
MGA-10	3 IN (76 mm)	9-1/4 IN (235 mm)	7 IN (178 mm)	6-5/8 IN (168 mm)	7/8 IN (22 mm)	4-7/8 IN (124 mm)

Figure 4. Gearbox Mounting Dimensions (MGA Gearbox)

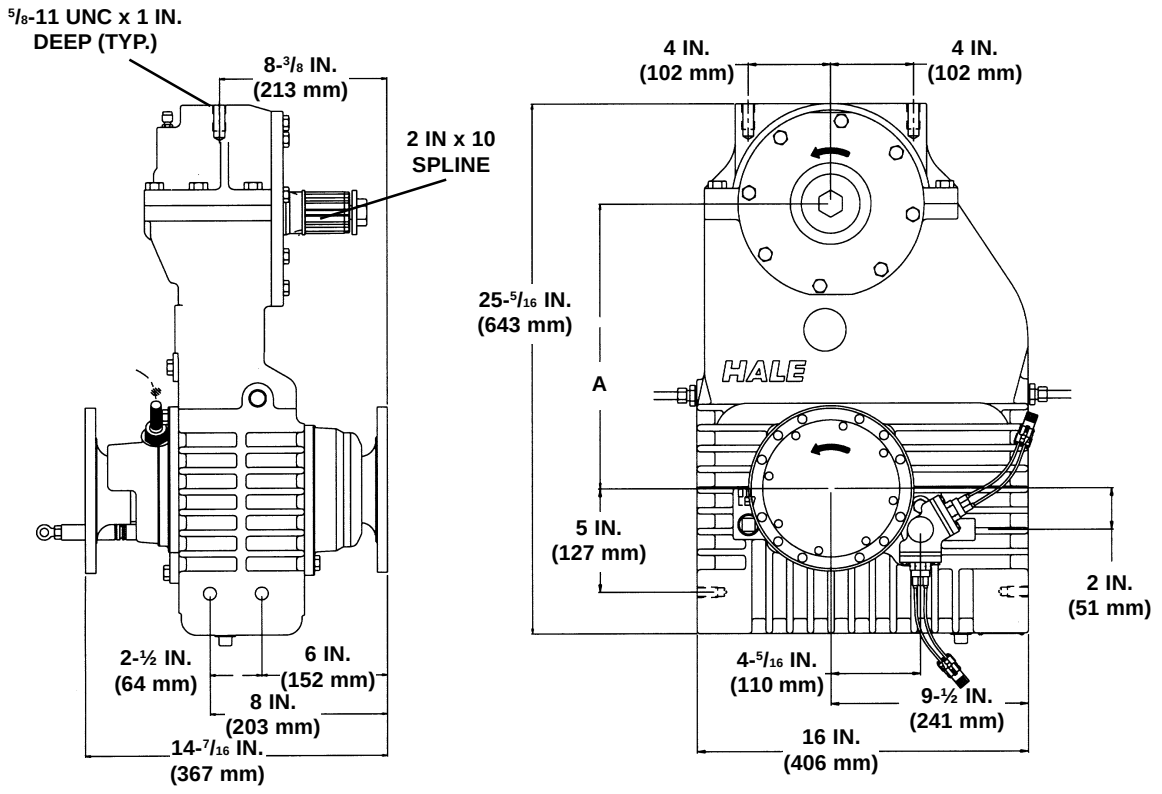
Gearbox Oil Capacity:

RGA (All Models) ..... 8 pints (3.8 liters)
MGA:
Vertical:
MGA-30, MGA-26, MGA-21, MGA-19, MGA17 ..... 5-½ pints (2.6 liters)
MGA-12, MGA-10 . 7 pints (3.3 liters)
Horizontal:
All Models ..... 6 pints (2.8 liters)

NOTE: The direction of water flow through the gearbox cooler does not matter. Either end of the gearbox cooler can be selected as the water inlet.

NOTE: Cooling water must be connected to the gearbox when the power required for the auxiliary component is 200 hp (149 kw) or greater.

9. Remove the protective shipping caps and/or plugs from gearbox cooler tube connections. Connect 3/8 inch (10 mm) diameter hose, with minimum working



MODEL	DIMENSION A
RGA-23	13-3/8 IN (340 mm)
RGA-21	13-9/16 IN (344 mm)
RGA-19	13-¾ IN (349 mm)
RGA-17	13-15/16 IN (354 mm)
RGA-15	14-1/8 IN (359 mm)

Figure 5. Gearbox Mounting Dimensions (RGA Gearbox)

pressure of 500 PSI (34 BAR), from the water pump discharge to the gearbox cooler inlet fitting.

10. Connect 3/8 inch (10 mm) diameter tube, with minimum working pressure of 500 PSI (34 BAR), from the gearbox cooler outlet fitting to the water pump suction.

> **CAUTION:** Gearbox oil cooler and associated tubing must drain during cold weather to prevent damage to the cooler and tubing from freezing.

11. Unless the gearbox cooler is attached to the apparatus engine cooling system, install water drains in the gearbox cooler lines.

12. Remove the 1-¼ inch long cap screw and washer from the end of the auxiliary output shaft(s).

13. Place the auxiliary equipment drive adapter on the auxiliary output shaft(s). Secure in place using the washer and 1-¼ inch long cap screw.

14. Torque the cap screw to 50 lb-ft (68 N-m) and lock in place by applying Loctite #242, or equal, thread locking compound to the threads.

15. Connect the auxiliary equipment to the drive adapter in accordance with drive component manufacturer instructions.

> **CAUTION:** Make sure interlocks and indicator lights required by NFPA standards are properly installed.

> **WARNING:** Any electrical system has the potential to cause sparks. Take care to eliminate explosive or hazardous environments during installation or service.

16. Mount the indicator lights in the driver compartment and on the pump operator panel. A typical shift switch and indicator light wiring diagram is provided as figure 6.

NOTE: The gearboxes are equipped with two shift switches.

One of the shift switches must be used to control **ONLY** the "ENGAGED" indicator light in the driver's compartment.

> **CAUTION:** DO NOT exceed the rated current of the shift switch, 4 AMPS at 12 VDC, when connecting other devices.

The other switch can be used to energize relay coils providing circuit completion for other apparatus interlocks such as transmission lockup, parking brake engaged, OK to OPERATE indicator light, etc. DO NOT use this switch to achieve these interlocks directly as the current rating of the switch may be exceeded.

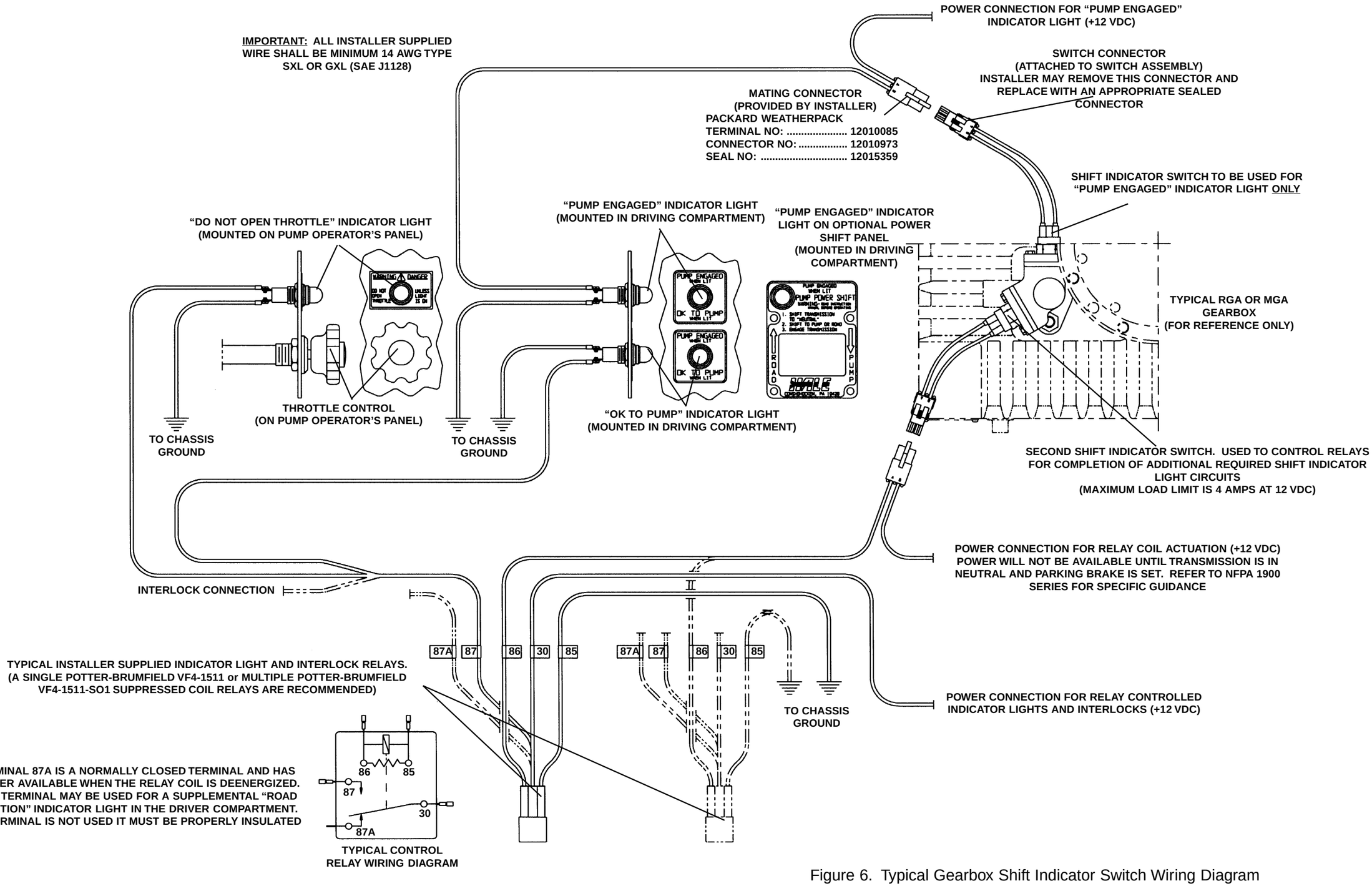


Figure 6. Typical Gearbox Shift Indicator Switch Wiring Diagram