

INSTALLATION AND MAINTENANCE MANUAL

for

MODEL SS 1600/1329A TURBINE STARTER

The Ingersoll-Rand Starter is a precision piece of equipment intended to give efficient, economical performance over a long period of time. However, as with any product, performance, economy and durability are determined for the most part by a few simple common sense procedures that can be recommended only by the manufacturer and adhered to only by the customer.

The recommendations outlined in this manual are based on 30 years of experience in the air and gas starter field. Study these recommendations and follow them. They can save you considerable time and expense.

FOR TOP PERFORMANCE AND MAXIMUM DURABILITY OF PARTS, DO NOT OPERATE THIS STARTER AT AIR PRESSURES OVER THE PRESSURE RATING STAMPED ON THE NAMEPLATE.

WARNING

SS1600/1329A Starter is designed for gas operation. It is not totally sealed in dynamic operation since the exhaust must be vented or piped away and there is a possibility of leakage around the output shaft when rotating.

Caution should be taken when operating this Starter on gas because of the danger of fire, explosion, or inhalation.

After reassembling the Starter, always test it in accordance with the procedures outlined in this manual. Never install a reassembled Starter that has not been tested in accordance with the procedures outlined.

LUBRICATION

We cannot too strongly emphasize the importance of proper lubrication of the Starter. It is the prime requisite for top performance and maximum durability, yet requires so little time there is really no excuse for disregarding it.

We recommend two Ingersoll-Rand Lubricators No. NL-24-8 installed as close to each inlet as possible. Use a good quality 10W non-detergent oil and adjust the lubricators to flow 3 drops per second minimum.

INSTALLATION

General Information

1. Always make certain your Starter is properly installed. A little extra time and effort spent in doing a top quality job will contribute considerably toward a reliable starting system that does a superior job of starting your engine quickly under all conditions.
2. We strongly recommend that on all turbine engine installations, and on stationary engines subject to vibration, you use hoses of the specified diameter instead of rigid pipe connections. Turbine engine vibration will soon loosen rigid pipe connections, whereas hoses will absorb the vibration, and connections will remain tight.
3. In the actual mounting of a Starter, it is best to have the hose connections already made at the receiver, and to have the Starter end of the hose handy for attaching to the Starter. Wherever possible—and many times it is necessary—attach the air hoses to the Starter before mounting the Starter on the engine housing. The reason for following this procedure is twofold:
 - (a) After mounting the Starter, it is often impossible to make hose connections due to space limitations.
 - (b) Once the hoses are attached, they carry some of the weight of the Starter and make it easier to complete the mounting.
4. When installing the Starter, you will usually need a regular ratchet wrench, sockets, socket extension, Allen wrenches, and a torque wrench.
5. The efficiency of a Starter can be greatly impaired by an improper hook-up. Hoses smaller than those recommended will reduce the volume of air to the motor, and the use of reducers in the exhaust port will restrict the exhaust and choke the motor. The number of tees and elbows, and the length of the supply line should be kept to a minimum. Use 2" hose or pipe for supply lines up to 15 feet long; use 2-1/2" hose or pipe if the supply line is over 15 feet long.

Notice: The use of other than genuine Ingersoll-Rand replacement parts may result in decreased Starter performance and increased maintenance, and may invalidate all warranties.

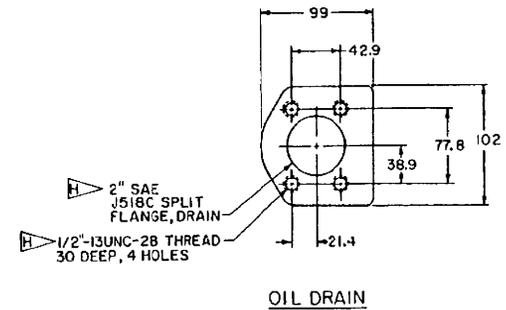
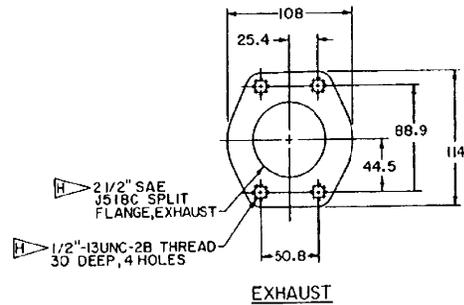
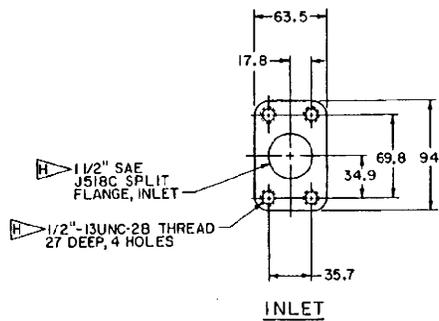
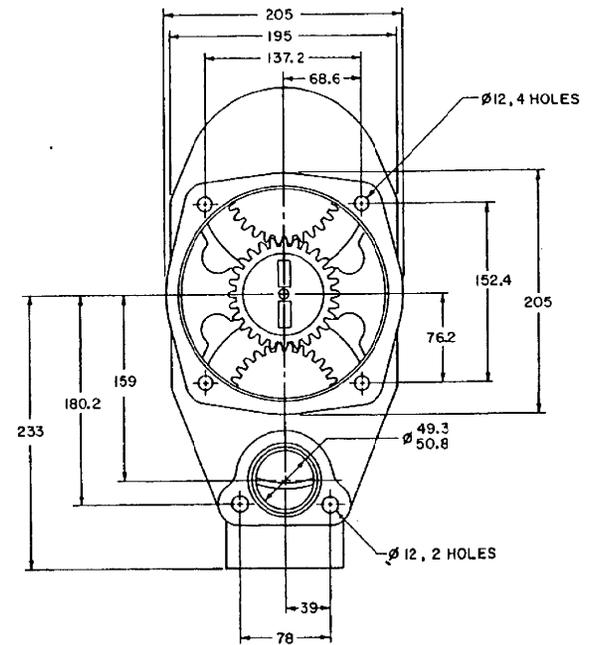
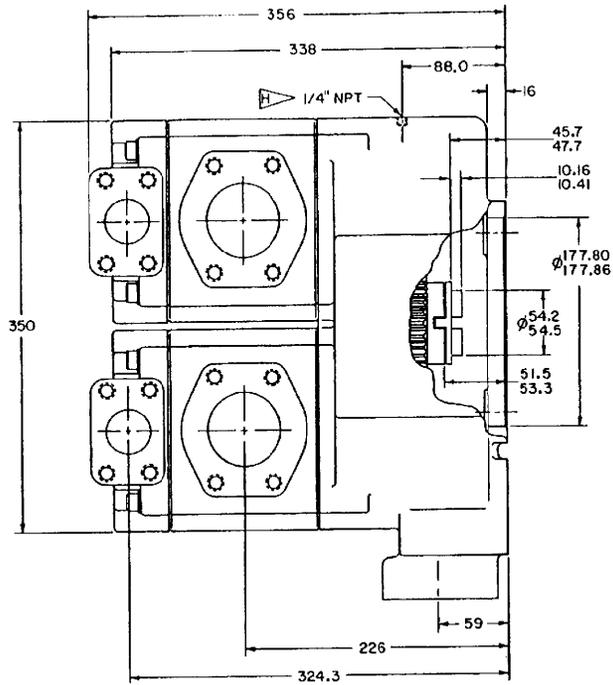
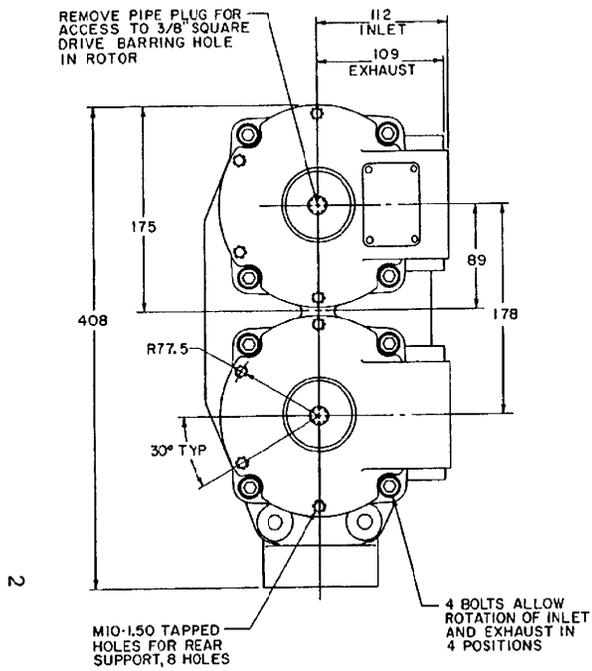
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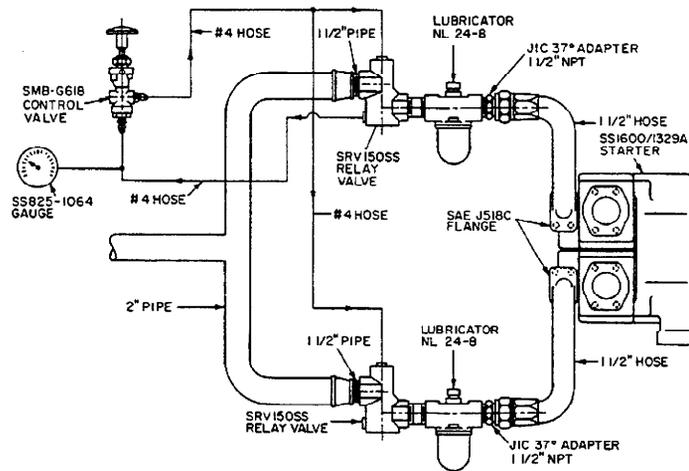
INGERSOLL-RAND®

ENGINE STARTING SYSTEMS



(Dwg. TPA1204)

MOUNTING DIMENSIONS



(Dwg. TPD1076)

PIPING AND INSTALLATION DIAGRAM

6. A leak in any of the connections means that the system will drain overnight and will have to be repressurized the next morning by use of another vehicle or compressor. **Make your connections right the first time to avoid unnecessary costs and delays.**

On all threaded connections throughout the system, use Ingersoll-Rand No. SMB-441 Sealant, non-hardening No. 2 Permatex or Loctite®* Pipe Sealant.

Always run your air supply line from the side or top of the receiver—never at or near the bottom. Moisture in the air collects at the bottom of the receiver and could cause corrosion in the starter motor or, worse yet, freeze solid in cold weather so that the Starter would be inoperative.

After all connections have been made, check each joint with a soap bubble test. **There must be no leaks.**

7. Whenever a flammable gas is being used to operate the Starter, all discharges should be piped away to a safe area.
8. Whenever possible, always mount the Starter so that the exhaust port is downward. This will help prevent any accumulation of water in the starter motor.

MOUNTING THE STARTER

1. Study the piping diagram above.
2. Install the Drive Clutch Jaw (supplied by customer).
3. Grease the O-ring with Parker O-ring lubricant and set in the Gear Case.
4. Place the coupling (supplied by customer) on the Drive Clutch Jaw.
5. Mount the Gear Case onto the engine.
6. Check for proper alignment of the lugs on the gear and driven jaw with the coupling.
7. Tighten the mounting nuts to the recommended torque.
8. Insert one motor assembly into the Gear Case, meshing motor pinion with Drive Gear. Check for proper orientation.
9. Alternately tighten the motor bolts to 60 ft-lb (81 N m) torque.
10. Repeat Steps 8 and 9 for the other motor.
11. Remove one of the Pipe Plugs in the Motor Housing Cover and insert a 3/8" square drive wrench into the square drive recess in the rear of the Rotor.
12. Manually rotate the Rotor and check for proper alignment.
13. Using a 1-1/2" NPT Close Nipple, install the SRV150SS Relay Valve just before the in-line lubricator at each motor.
NOTE: Make certain the connection is made to the outlet side of the Relay Valve indicated by the word "OUT" cast on the valve body.
14. Install the No. SMB-G618 Starter Control Valve on an appropriate panel.
15. Attach No. TA-STR-100 Starter Instruction Label adjacent to the Starter Control Valve.
16. Mount an SS825-1064 Pressure Gauge on, or adjacent to, the control panel. It should be located where it is readily visible to the operator of the control valve.
17. Connect the Control Valve to the Relay Valve with 1/4" hose. Install a Tee in this line with a short feeder hose to the Pressure Gauge. **NOTE:** Make certain the hose is connected to the "SUP" side of the Control Valve.
18. Attach the required 1-1/2" hose, 2" pipe, and Lubricator/Relay Valve Assembly.
19. Install a 1/4" hose line from the "DEL" side of the Starter Control Valve to the top of the Relay Valve. Install a Tee in this line and a short length of hose to the top of the other Relay Valve.
20. Install the required Exhaust System.
21. There are four M10-1.50 tapped holes in each Motor Housing Cover for additional support if needed.
22. Pressurize the complete system and check every connection with a soap bubble test. **There must be no leaks.**

* Registered trademark of Loctite Corporation.

DISASSEMBLY OF THE STARTER

General Information

1. Always mark adjacent parts on the Motor Housing Cover (2), Motor Housing (1), and Gear Case (23) so these members can be located in the same relative position when the Starter is reassembled.
2. Do not disassemble the Starter any further than necessary to replace a worn or damaged part.
3. Do not remove any part which is a press fit in or on a subassembly unless the removal of that part is necessary for replacement or repairs.
4. Always have a complete set of vanes, seals and O-rings on hand before starting any overhaul of Starter. Never reuse old seals or O-rings.
5. When grasping a part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members.

Motor Housing

1. Unscrew and remove the Motor Housing Cover Cap Screws (4).
2. Pull the Motor Housing Cover (2) from the Motor Housing (1). It may be necessary to dislodge the Motor Housing Cover by tapping it with a plastic hammer.
3. Tap the Gear Case (23) with a plastic hammer to dislodge it from the Motor Housing.
4. Grasp the Rotor Pinion (20) in a vise and using a wrench, remove the Rotor Pinion Retaining Screw (19).
5. Remove the Rotor Pinion from the rotor shaft.
6. Slide the Front End Plate (16), Front Rotor Bearing (18), Bulkhead (21) and Motor Wave Washers (17) off rotor shaft.
7. Remove the Rotor (13) and Rear End Plate (9) from the Cylinder.
8. Remove and examine each Vane (15). Install a new set of Vanes if any Vane is cracked, spalled or worn to the extent that its width is 15/16" (24 mm) or less at either end.
9. Grasp the Rotor in a vise. Using a 5/32" (4 mm) hex wrench, loosen the Rotor Clamp Nut Screw (14). Unscrew and remove the Rotor Clamp Nut (12).
10. Remove the Large Rear Rotor Bearing O-ring (11).
11. Remove the Rear End Plate (9) from the rotor shaft.
12. Remove the Small Rear Rotor Bearing O-ring (10A) from the rotor shaft.
13. If the Rear Rotor Bearing (10) needs to be replaced, remove it from the Rear End Plate.
14. Push the Cylinder (5) out of the Motor Housing.
15. Remove the Cylinder O-rings (8) from the Cylinder.

Gear Case

1. With the Gear Case (23) facing up, the Drive Gear (25) should be visible.
2. Remove the Retaining Ring (29) from the Shaft (24).
3. Using a gear puller, remove the Drive Gear.
4. Remove the Retaining Ring (28) from the Drive Gear.
5. Remove the Bearings (26) and Spacer (27).
6. Using a hex socket, remove the Shaft from the Gear Case. NOTE: These are left-hand threads.

ASSEMBLY OF THE STARTER

General Information

1. Always press on the inner ring of a ball-type bearing when installing the bearing on a shaft.
2. Always press on the outer ring of a ball-type bearing when pressing the bearing in a bearing recess.
3. Whenever grasping a part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members.
4. Always clean every part, and wipe every part with a thin film of oil before installation.

Motor Housing

1. Clamp the Rotor (13) in a vise, threaded end up.
2. Install the Rear Rotor Bearing (10) into the Rear End Plate (9).
3. Using O-ring lubricant, lubricate and install the Small Rear Rotor Bearing O-ring (10A) onto the rotor shaft until it butts against the rotor shaft shoulder.
4. Install the Rear End Plate (9), bearing end up, onto the rotor shaft.
5. Screw the Rotor Clamp Nut (12) onto the rotor shaft with the shoulder toward the bearing. Tighten the nut until there is .001" (.02 mm) to .003" (.07 mm) clearance between the Rear End Plate and Rotor.
6. Using a 5/32" (4 mm) hex wrench, tighten the Rotor Clamp Nut Screw (14) to 8 ft-lb (10.8 N m) torque. Recheck the clearance between the Rear End Plate and Rotor, after tapping the End Plate away from the rotor face with a plastic hammer.

7. Check the two End Plate Alignment Pins (6). If they are bent or broken, remove them from the Cylinder and press in a new pin or pins.
8. Check the Cylinder Alignment Pin (7). If it is bent or broken, remove it from the Cylinder and press in a new pin.
9. Using O-ring lubricant, lubricate and install the two inside Cylinder O-rings (8).
10. Position the Motor Housing (1) vertically, on two blocks of wood, locating slot up.
11. Using a plastic hammer, tap the Cylinder (5) into the Motor Housing making sure the Cylinder Alignment Pin (7) seats into the slot of the Motor Housing.
12. Using O-ring lubricant, lubricate and install the two outside Cylinder O-rings (8).
13. Insert the Rotor (13) into the Cylinder, pinion end toward the Cylinder Alignment Pin. **NOTE:** Make sure the protruding End Plate Alignment Pin (6) in the Cylinder aligns with the dowel hole in the SS800L-12 Rear End Plate (9). Make sure the air ports of the Cylinder and the Rear End Plate align.
14. Lightly lubricate each Vane (15) and insert one in each of the rotor vane slots.
15. Slide the Front End Plate (16) over the pinion end of the Rotor. The other protruding End Plate Alignment Pin (6) in the face of the Cylinder should align with the dowel hole in the Front End Plate.
16. Insert the two Motor Wave Washers (17) into the Front End Plate well.
17. Install the Front Rotor Bearing (18) into the Front End Plate well.
18. Press a new Seal (22) into the Bulkhead (21). The Seal should be pressed in from the chamfered side of the Bulkhead with the lip of Seal facing the motor.
19. Install the Retaining Ring (21A).
20. Grease the seal bore with a good quality grease. Very carefully work the Rotor Pinion (20) into the Bulkhead/Seal Assembly.
21. Install the Rotor Pinion on the rotor shaft so that the lugs on the Pinion engage those on the shaft.
22. Screw the Rotor Pinion Retaining Screw (19) into the rotor shaft and tighten to 90 ft-lb (122 N m) torque.
23. Using O-ring lubricant, lubricate and install the Rear Rotor Bearing O-ring (11) onto the Rear Rotor Bearing.
24. Set the Motor Housing Cover onto the Motor Assembly. Carefully tap the cover onto the motor. Check for proper orientation.
25. Check freeness of the motor by turning the Rotor Pinion. If necessary, tap the Front End Plate with a soft hammer to align the motor.

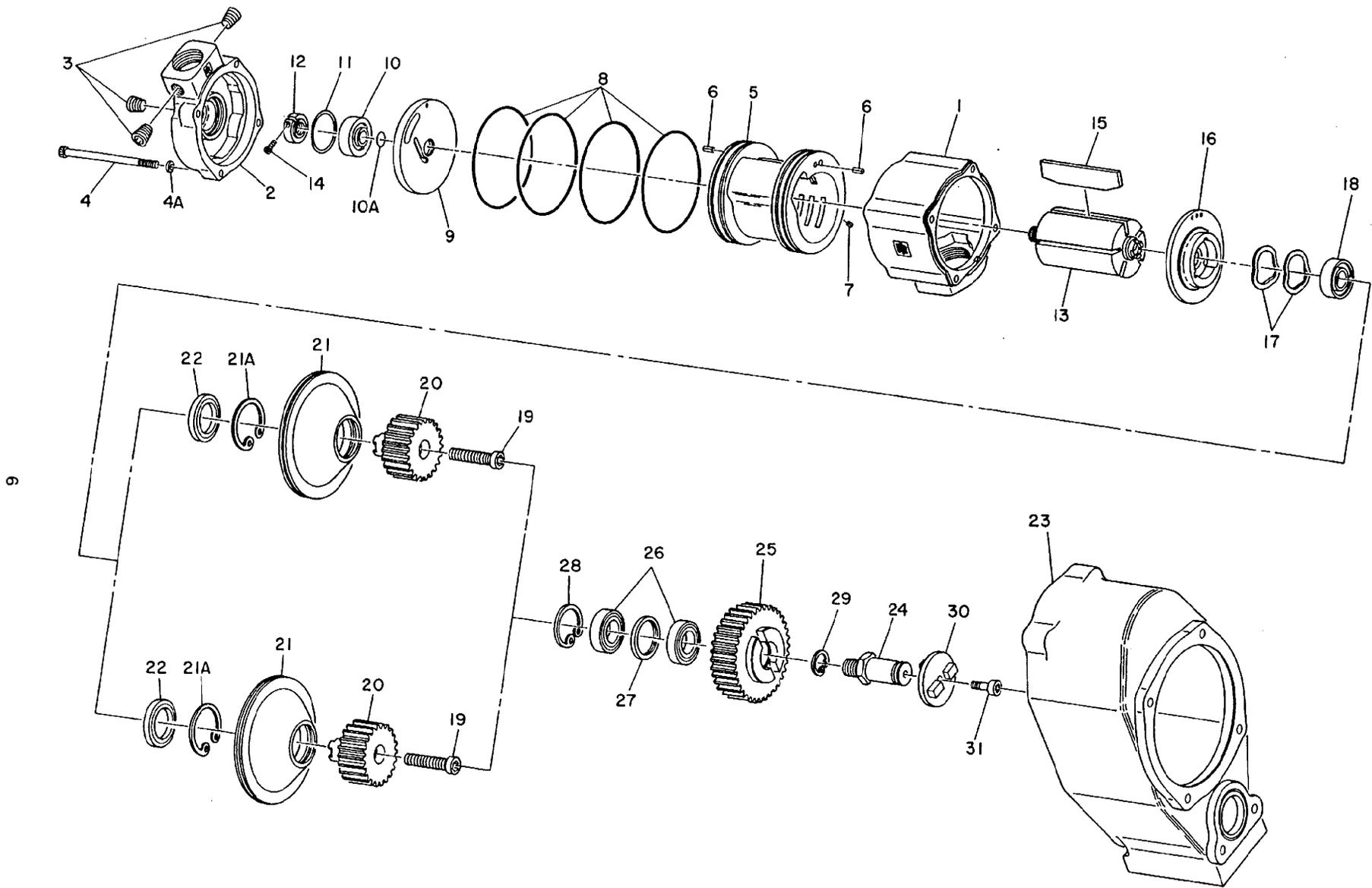
Gear Case

1. With the Gear Case (23) facing up (the large single bore), install the Drive Gear Shaft (24). Tighten to 150 ft-lb (203 N m) torque. **NOTE: These are left-hand threads.**
2. Insert one Drive Gear Bearing (26), Spacer (27) and the other Drive Gear Bearing (26) into the Drive Gear (25).
3. Install the Retaining Ring (28).
4. Press the Drive Gear Assembly onto the Drive Gear Shaft and install the Retaining Ring (29).

TORQUE CHART

Illustration Number	Part Number	Assembly Torque	Sealant Required
* 3	HSPPS-3	30 ft-lb (40.7 N m)	No*
4	SS800-25	60 ft-lb (81.4 N m)	No
14	SS800-63	8 ft-lb (10.8 N m)	No
19	WE205-817	90 ft-lb (122 N m)	Yes, under head
24	SS1600-8	150 ft-lb (203 N m)	No
31	SS1600-182	45 in-lb (5.1 N m)	No

*Part Number HSPPS-3 has pre-applied sealant.



(Dwg. TPA1203)

PART NUMBER FOR ORDERING

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1	Motor Housing (with 2-1/2" SAEJ518C Flanged Exhaust)	SS800-140	18	Front Rotor Bearing	SS800-22
2	Motor Housing Cover (with 1-1/2" SAEJ518C Flanged Inlet)	SS800-A202	19	Rotor Pinion Retaining Screw	WE205-817
4	Motor Housing Cover Cap Screw (4)	SS800-25	20	Rotor Pinion (2)	SS1600K-17C
4A	Motor Housing Cover Cap Screw Washer (4)	SS800-26	21	Motor Bulkhead (2)	SS1600-150
5	Cylinder Kit	SS800-K3	21 A	Retaining Ring (2)	SS1600-270
6	End Plate Alignment Pin (2)	SS800-98	● 22	Bulkhead Seal (2)	SS1600-151
7	Cylinder Alignment Pin	SS800-99	23	Gear Case	SS1600-37
● 8	Cylinder O-ring (4)	SS800-67	24	Drive Gear Shaft	SS1600-8
9	Rear End Plate	SS800L-12	25	Drive Gear	SS1600K-9C
10	Rear Rotor Bearing	SS800-24	26	Drive Gear Bearing (2)	G7-24
● 10A	Rotor Shaft O-ring	C321-606	27	Bearing Spacer	SS1600-265
● 11	Rear Rotor Bearing O-ring	HRA20A-990	28	Bearing Retaining Ring	SS1600-366
12	Rotor Clamp Nut	SS800-65	29	Shaft Retaining Ring	SS1600-179
13	Rotor	SS825-53	30	Coupling	SS1600-181
14	Rotor Clamp Nut Screw	SS800-63	31	Shoulder Screw	SS1600-182
● 15	Vane Packet (set of 5 Vanes)	M800-42-5	*	Nameplate	SS800-301
16	Front End Plate	SS800G-11	*	Nameplate Screw (4)	R4K-302
17	Motor Wave Washer (2)	SS800-224	*	Relay Valve (2)	SRV150SS
			*	In-Line Lubricator (2)	NL-24-8
			*	Starter Control Valve	SMG-G618
			*	Pressure Gauge	SS825-1064

* Not illustrated.

● To keep downtime to a minimum, it is desirable to have on hand certain repair parts. We recommend that you stock one (pair or set) of each part indicated by a bullet (●) for every four tools in service.

