



TL-ST2000-MIM

Edition 2

February 2023

Turbine Powered Starters

Series ST2000

Installation, Maintenance and Parts Information



Save These Instructions

IR *Ingersoll Rand*

Product Safety Information

Intended Use:

The ST2000 Series air starters are intended for use in starting reciprocating internal combustion engines. These starters are designed to be operated from a remote location after proper installation on the engine requiring starting.

For additional information, refer to Air Starters for Internal Combustion Engines Product Safety Information Manual Form 45558624. Manuals can be downloaded from ingersollrand.com

Operating Guidelines

WARNING

- Never exceed the nameplate operating pressure rating.
- Always release the start button immediately after the engine starts.
- For piped exhaust starters, the outlet screen must not be removed unless the exhaust is piped away.
- For natural gas operation, starter main exhaust must be piped away. To pipe the drive housing vent, remove the drive housing plug and replace it with a suitable tubing line. The tubing must vent at a safe location and must not be interconnected with any other exhaust lines which might introduce a back pressure on the drive housing vent.

NOTICE

- If the engine has not started after 30 seconds of cranking, refer to the engine maintenance guides for information on starting, ignition, and fuel systems.

- When using the starter for dynamic timing measurements, rest the starter for 2 ½ minutes between 30 second measurements.
- An ST1000-267 strainer or equivalent 40 mesh strainer is recommended to maximize the durability of the starter.
- Supply must be free of contaminants. New piping must be free of scale and welding slag.
- Allow 30 seconds “wind down” time between any two successive starting attempts.
- Ingersoll Rand is not responsible for customer modifications of starters for applications on which Ingersoll Rand was not consulted.
- It is the responsibility of the employer to place the information in this manual into the hands of the operator.

Placing Starter in Service

NOTICE

For maximum performance, read this manual prior to the installation or operation of ST2000 series turbine-powered starters. All parts references are for pre-engaged starters unless otherwise noted.

General Installation Information

1. We recommend that on all vehicular installations and on stationary engines subject to vibration that hoses of the specified diameter be used instead of rigid pipe connections to the starter. Engine vibration will loosen rigid pipe connections, whereas hoses will absorb the vibration and connections will remain tight.
2. This starter is designed for flange mounting at the inlet. The ST700-K166 flange mounting kit is available for installation. All piping, hoses and valving must be clean prior to installation. Make sure that the starter inlet is free of dirt and foreign material during installation.
3. In mounting a starter, have the hose connections already made at the receiver and to have the starter end of the hose handy for attaching to the starter.
4. Engine design often requires mounting the starter underneath in extremely close quarters, and even though two of the mounting bolt holes are easy to reach, the third one is often less accessible. To install a starter, the following tools are required; regular ratchet wrench, sockets, universal joint, socket extension, and single or double-end box wrench.
5. Improper hook-up impairs the efficiency of an air starter. Hoses smaller than those recommended will reduce the volume of air to the motor and the use of reducers for piped-away applications in the exhaust port will restrict the exhaust causing back pressure to the motor resulting in reduced performance. Keep the number of tees and elbows and the length of the supply line to a minimum. Use 1.5" hose or pipe for supply lines up to 15 feet long; use 2" hose or pipe if the supply line is over 15 feet long.

6. We recommend that you install a strainer in the inlet line for each starter. These 40 mesh strainers provide 420 micron filtration and offer significant protection against supply line contaminants which could damage the turbine components. **Ingersoll Rand** offers 2 sizes; ST1000-267-24 for 1 1/2" lines and ST1000-267-32 for 2" lines. Replacement 40 mesh elements are: ST1000-266-24 for 1 1/2" lines and ST1000-266-32 for 2" lines.
7. A leak in any live air line 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 connections bubble tight to avoid unnecessary costs and delays. On all threaded connections throughout the system, use **Ingersoll Rand** No. SMB-441 sealant or non-hardening No.2 Permatex. Always run the 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 resulting in damage which could cause the valves to become inoperative. Periodically, open the petcock at the bottom of the tank to drain the water.
8. Whenever using a hazardous gas to operate the starter, there must be no leaks in inlet or exhaust piping or from any other starter joints. Pipe away all discharges to a safe area.

Orientation of the Starter

We recommend that starters be ordered to proper orientation of your specific mounting or installation requirements. However, if the starter must be reoriented for installation, proceed as follows:

1. Refer to the orientation illustrations under “How to order a starter” and note that the drive housing can be located in any one of eight positions relative to the gear case. The air exhaust can be located in any one of four radial positions relative to the gear case.
2. Study the engine mounting requirements and determine the required orientation of the drive housing relative to the gear case. If the drive housing has to be reoriented, remove the eight drive housing cap screws and rotate the drive housing to its required position. Separation of the drive housing from the gear case is not required. Reinstall the drive housing cap screws and tighten to 20-25 ft-lb of torque.

NOTICE

“Intermediate Gear Housing – Assembly and Installation”:

NOTICE

Do not separate the motor housing, intermediate gear case, and ring gear as gear lubrication oil will be lost.

- Reinstall the starter assembly cap screws and lock washers and alternately tighten them to 10-13 ft-lb of torque.

Mounting the Starter

- Study the appropriate piping diagrams and install as indicated.
- The air receiver tank for a starter installation must have a working pressure rating equal to or greater than the maximum pressure at which the starter will be operated.
- When connecting the starter to a receiver tank that is already in service, bleed off the air pressure in the tank prior to installing the starter.

WARNING

Bleed off the air pressure through a valve or petcock. Do not remove a plug from the tank while the tank is still pressurized.

- Drain off any water that may have accumulated in the bottom of the tank.
- Using a 1½" short nipple, install the starter relay valve SRV150 for air applications SRV150S5 for gas on the end of the receiver tank as shown in the appropriate piping diagram.

NOTICE

Make certain the connection is made to the inlet side of the starter relay valve indicated by the word “IN”, cast on the valve body.

- Install the starter control valve SMB-618 for air applications or SMB-G618 for gas on the dash panel for vehicular installations or some other appropriate panel for stationary installations. An optional control circuit utilizing an electric solenoid control valve and a panel mounted switch are available. Mount the solenoid valve 150-BMP-1051B (12V) or 150BMP-2451B (24V) securely and preferably in a vertical position away from any concentration of heat, vibration or contamination. Connect the leads to the operator’s starting switch which should be located on the dashboard or control panel.

- Mount the 150 psi air pressure gauge 150BMP-1064 on or adjacent to the control panel. It should be located where it is readily visible to the operator.
- Connect the starter control valve to the starter relay valve with ¼" hose. Install a tee in this line with a short feeder hose to the pressure gauge.

NOTICE

Make certain the hose is connected to the supply side (marked “SUPP”) of the starter control valve.

- To determine the exact length of 1½" air hose required, run a piece of heavy duty hose or some other flexible tubing of the same diameter from the starter relay valve on the receiver to the starter location on the engine.
- Once the 1½" hose of correct length has been obtained, attach the air hose to the outlet side of the starter relay valve and run the hose through the frame, etc. to its final position at the starter location.
- At this point determine whether or not it is feasible or practical to attach the hose to the starter before or after the starter is actually mounted. In many cases it may be necessary to attach the hose to the starter before mounting.
- If possible, liberally grease the teeth on the ring gear with a good quality, sticky gear grease. This will help promote the life of the ring gear and the starter pinion.
- Move the starter into position and mount it on the flywheel housing. Tighten the mounting bolts to 100 ft-lb (136 Nm) of torque or to engine manufacturer’s recommended torque settings.
- Install a ¼" hose line from the delivery side (marked “DEL”) of the starter control valve or solenoid valve to the “IN” port on the starter drive housing.
- Install a ¼" hose line from the “OUT” port on the starter drive housing to the top of the starter relay valve or solenoid valve.
- Pressurize the complete starting system and check every connection with a soap bubble test. **There must be no leaks in the live air lines or other connections.**

Performance Data

ST2060 B Ratio

Pressure (psig)	Breakaway Torque (lbf-ft)	Speed @ Max. Power (rpm)	Max. Power (hp)	Flow @ Max. Power (scfm)
30	50	1560	8	370
60	120	2000	23	590
90	190	2270	40	820
120	257	2460	55	1050
150	321	2540	70	1290

ST2099 B Ratio

Pressure (psig)	Breakaway Torque (lbf-ft)	Speed @ Max. Power (rpm)	Max. Power (hp)	Flow @ Max. Power (scfm)
30	82	1425	13	540
60	200	1850	36	890
90	347	2060	68	1240

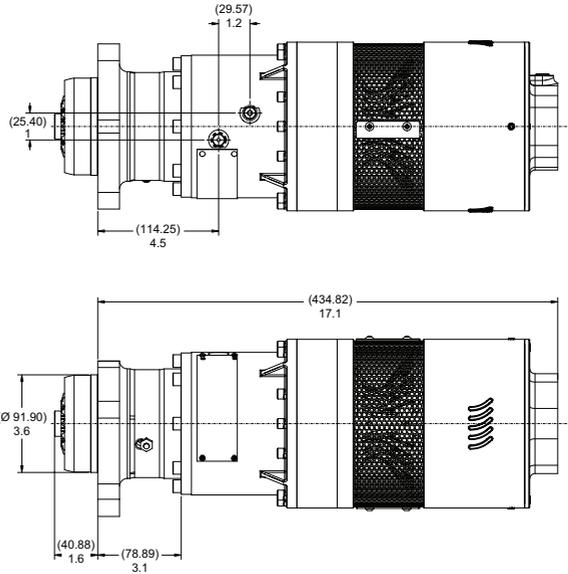
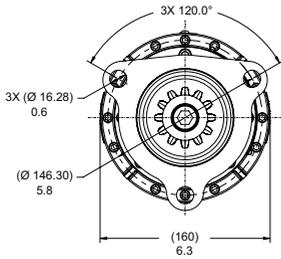
Mounting Dimensions

Pre-Engaged B Ratio

Dual Dimension	(MM)	(IN)
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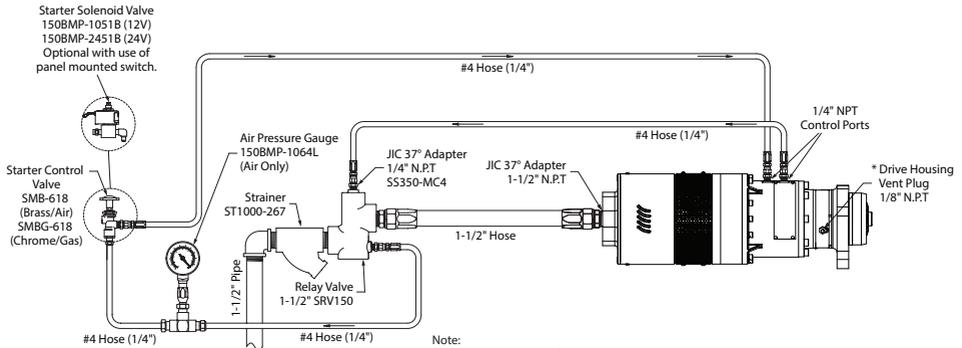
Note:

1. For orientation information, see starter orientation method section.
2. Starter weight: Approximately 40 Lb.
3. Apply pipe thread sealant (IR SMB-441 or equivalent) on all pipe connections to prevent leaks.
4. *For natural gas operation, piped exhaust must be used and drive housing vent plug removed. The drive housing must be vented to a safe location not interconnected with any other exhaust lines which may introduce a back pressure in the drive housing.



Piping Diagrams

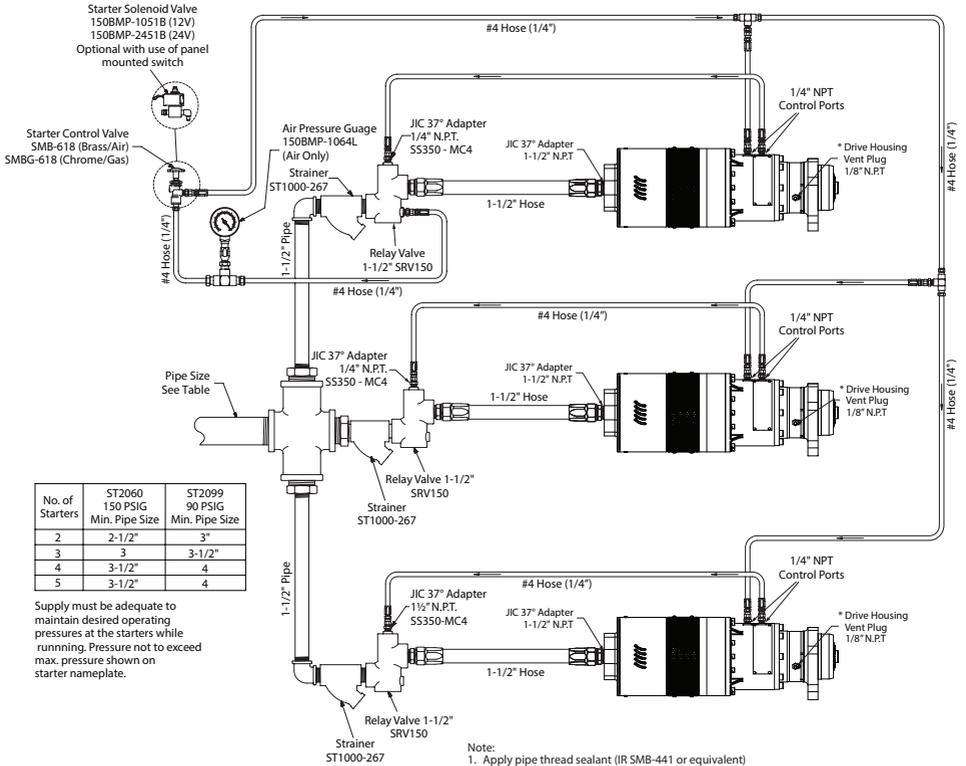
Typical Single Starter Installation, Pre-Engaged



Note:

1. Supply pressure must be adequate to maintain desired operating pressure at the starter with starter running and not to exceed max. pressure shown on starter.
2. Apply pipe thread sealant (IR SMB-441 or equivalent) on all pipe connections to prevent leaks.
3. *For natural gas operation, piped exhaust must be used and drive housing vent plug removed. The drive housing must be vented to a safe location not interconnected with any other exhaust lines which may introduce a back pressure in the drive housing.

Typical Multiple Starter Installation, Pre-Engaged

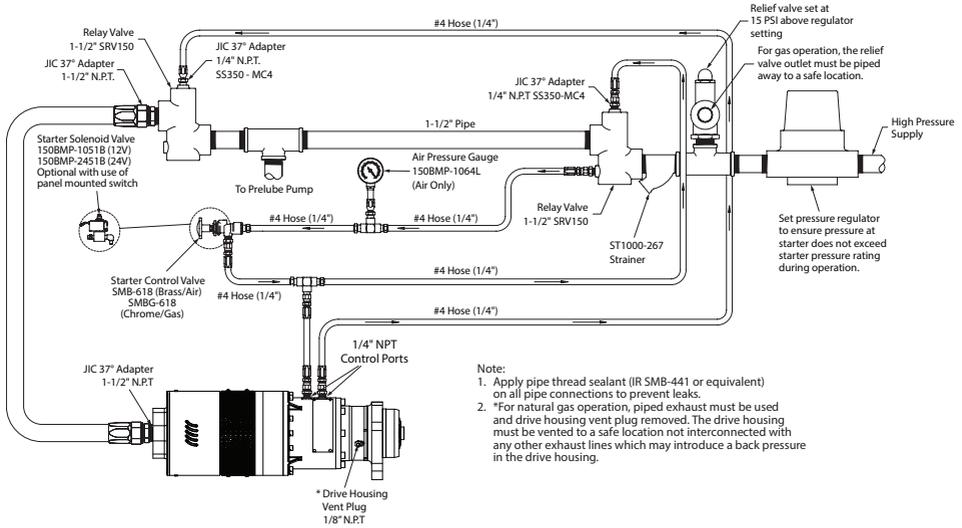


Supply must be adequate to maintain desired operating pressures at the starters while running. Pressure not to exceed max. pressure shown on starter nameplate.

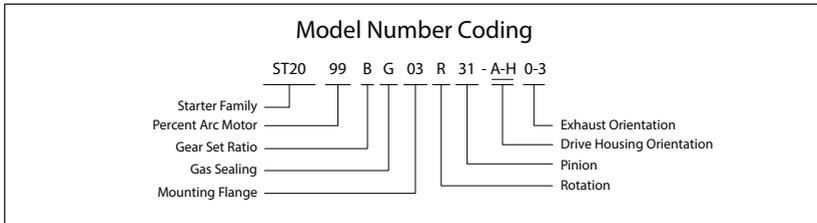
Note:

1. Apply pipe thread sealant (IR SMB-441 or equivalent) on all pipe connections to prevent leaks.
2. *For natural gas operation, piped exhaust must be used and drive housing vent plug removed. The drive housing must be vented to a safe location not interconnected with any other exhaust lines which may introduce a back pressure in the drive housing.

Standard High Pressure System when Supply Pressure is over Pressure Rating of Starter, Pre-Engaged



How to Order a Starter



Percent Arc Motor*

60 : 60% Arc Motor
99 : 100% Arc Motor

Gear Set Ratio

B : 11.1 : 1

Gas Sealing

No Letter : Radial Exhaust
G : Gas Sealed (Piped Away)

Mounting Flange

03 : SAE 03 Flange

Rotation

L : Left Hand
R : Right Hand

Pinion

See Pinion Selection Table

Drive Housing Orientation

A = 000° (Standard)
B = 045°
C = 090°
D = 135°
E = 180°
F = 225°
G = 270°
H = 315°

Exhaust Orientation

If Exhaust Type is Directional : 0 = Up
1 = Right
2 = Down
3 = Left (Standard)

If Exhaust Type is Radial : No Number

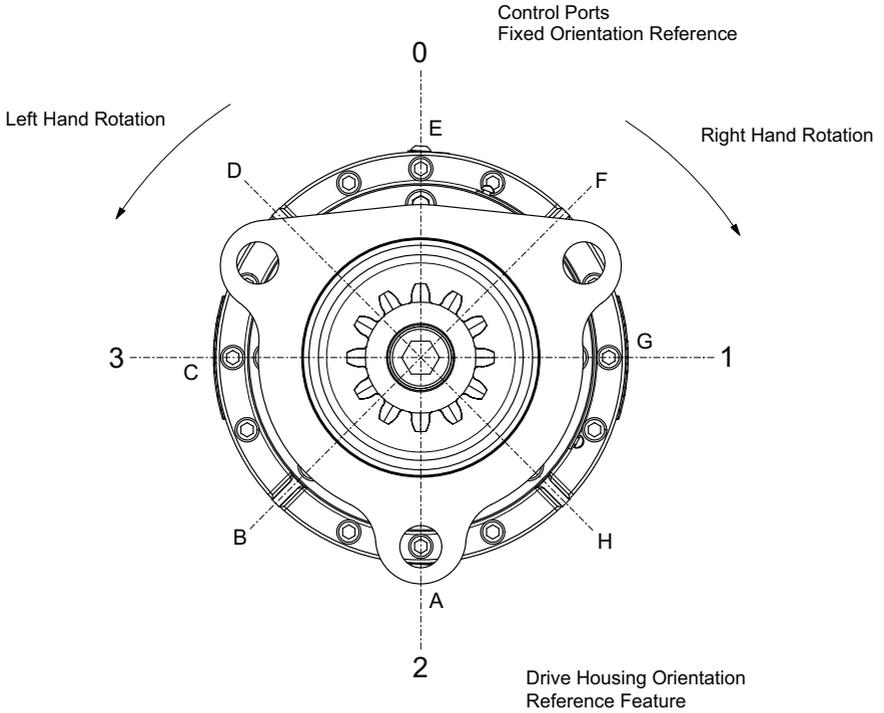
* For available arc percentages, visit ingersollrand.com or contact your nearest **Ingersoll Rand** distributor or **Ingersoll Rand** Engine Starting Systems.

For different models or special applications, contact your nearest **Ingersoll Rand** distributor or **Ingersoll Rand** Engine Starting Systems at:

1-888-STARTAIR
1-888-78278247

Orientation

Pre-Engaged Starter Orientation Method



Orientation Shown : A

Pinion Selection Table

Pinion Data									
Part Number	Number of Teeth	Blank	DP/MOD	PD		PA	Rotation	OD	
				inches	mm			inches	mm
ST600-13-31	12	12	6/8	2.000	50.80	20.0	R/L	2.250	57.15
ST600-13-51	15	15	6/8	2.500	63.50	20.0	R/L	2.750	69.85
ST600-13-83	12	12	3.5 Module	1.515	38.50	20.0	R/L	1.882	47.80
ST600-13-91	14	16	3.5 Module	1.929	49.00	20.0	R/L	2.441	62.00

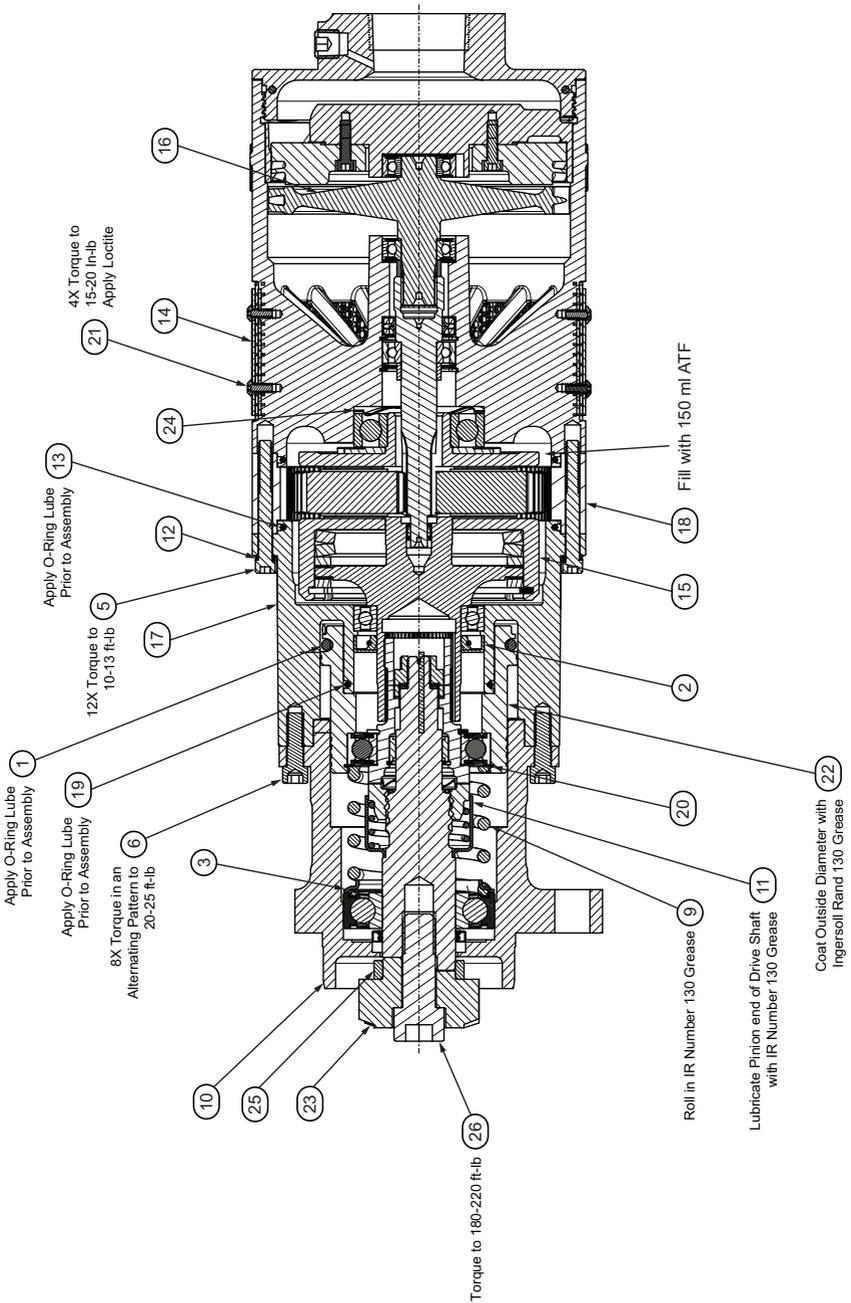
* Pinion code must be specified when ordering.

For special applications, contact your nearest **Ingersoll Rand** distributor or **Ingersoll Rand** Engine Starting Systems at:

1725 US 1 North
Southern Pines, NC 28387
(910) 692-8700

Construction - Pre-Engaged

ST2000 Turbine Starter (Pre-Engaged)



ST2000 Turbine Starter (Pre-Engaged) - Parts List

Item	Part Description	Qty.	Part Number (CCN)
* 1	O-ring	1	Order O-ring Kit
2	Seal	1	SS350-272 (03697299)
3	Seat	1	SS350-191 (03697497)
†	Screw, Drive, Round Head, Type U	4	Y60-43 (04060414)
** 5	Screw	12	Order Hardware Kit
** 6	Screw, Cap, Socket Head, Coarse Thread	8	
†	Name Plate	1	ST400-301 (04185856)
†	Plug, Pipe	1	Y17-50-S (04560215)
9	Spring - Return	1	ST600-700 (04561619)
10	Assy - Drive HSG	1	ST600-K300 (04614459)
11	Assy - Drive PKG	1	See below Table
** 12	Lock Washer, HI Collar, Spring Type	12	Order Hardware Kit
* 13	O-ring	2	Order O-ring Kit
14	Screen, Exhaust	2	ST2000-310
15	Clutch and Gear Assembly	1	ST2000C-APGR
16	Motor Module, Straight	1	See below Table
17	Housing, Gear Case	1	(ST2000-37)
18	Ring Gear	1	ST2000-406
* 19	O-ring	1	Order O-ring Kit
** 20	Ring	1	Order Hardware Kit
** 21	Screw, Button-Head	4	
22	Piston	1	ST600-703 (04561478)
23	Drive Pinion	1	See below Table
** 24	Spring - Wave	1	Order Hardware Kit
25	Collar - Pinion	1	ST600-175 (04561668)
26	Screw, Pinion	1	See below Table
†	Screen Kit for Piped Exhaust	1	ST2000-SK

† Indicates not illustrated.

* O-ring Kit (TK-ST2000-OSK)

** Hardware Kit (TK-ST2000-HWK)

Table

Model	Motor Module	Drive Package	Drive Pinion	Pinion Screw	* Orientation	Rotation	Inlet Pressure
ST2060B03R31-A	ST2060R-37S	ST600R-APDR	ST600-13-31	ST600R-394	A	Right	150 psig / 10.3 bar
ST2060B03L31-A	ST2060L-37S	ST600L-APDR	ST600-13-31	ST600L-394	A	Left	150 psig / 10.3 bar
ST2099B03R31-A	ST2099R-37S	ST600R-APDR	ST600-13-31	ST600R-394	A	Right	90 psig / 6.2 bar
ST2099B03L31-A	ST2099L-37S	ST600L-APDR	ST600-13-31	ST600L-394	A	Left	90 psig / 6.2 bar
ST2060BG03R31-A3	ST2060R-37P	ST600R-APDR	ST600-13-31	ST600R-394	A3	Right	150 psig / 10.3 bar
ST2060BG03L31-A3	ST2060L-37P	ST600L-APDR	ST600-13-31	ST600L-394	A3	Left	150 psig / 10.3 bar
ST2099BG03R31-A3	ST2099R-37P	ST600R-APDR	ST600-13-31	ST600R-394	A3	Right	90 psig / 6.2 bar
ST2099BG03L31-A3	ST2099L-37P	ST600L-APDR	ST600-13-31	ST600L-394	A3	Left	90 psig / 6.2 bar

* POS is non-standard position specified on sales order.

Maintenance, Disassembly / Assembly Instructions

WARNING

Always wear eye protection when operating or performing any maintenance on this starter. Always turn off the air or gas supply and disconnect the air or gas supply hose before installing, removing or adjusting any accessory on this starter or before performing any maintenance on this starter.

Lubrication

Each time an ST2000 series starter is disassembled for maintenance or repair, lubricate the starter as follows:

For Models with Pre-Engaged Drive

1. Wipe a thin film of **Ingersoll Rand** No. 130 grease in the bore of the drive housing.
2. Roll the piston return spring in **Ingersoll Rand** No. 130 grease.
3. Coat the outside of the piston with **Ingersoll Rand** No. 130 grease.
4. Lubricate the drive gear with 8 oz. (240 ml) of **Ingersoll Rand** No. 130 grease.

For all models (refer to "Lubrication and Torque Specifications")

1. Lubricate all O-rings with O-ring lubricant.
2. Add 150 ml of Automatic Transmission Fluid through the side plug hole in the gear case.

General Assembly and Disassembly Instructions

- Always press on the bearing race or seal diameter that makes contact with the wall of the bore or shaft in which the bearing is being pressed in or on.
- Whenever grasping the starter or any parts in a vise, use leather or copper covered vise jaws and take extra care with threaded parts and housings.
- Excluding bearings, always clean every part and wipe each part with a thin film of oil before installing.
- Clean all threads and ensure they are free of any foreign matter before reusing.
- Check every bearing for roughness. If an open bearing must be cleaned, wash it thoroughly in a suitable clean cleaning solution and dry with a clean cloth. Sealed or shielded bearings should never be cleaned. Work grease thoroughly into every open bearing before installation.
- Apply O-ring lubricant to all O-rings prior to assembly.

NOTICE

These steps outline the complete disassembly of each module that makes up an ST2000 series starter. It is not always necessary to completely disassemble the components listed in the instructions. Only disassemble as far as necessary to perform the appropriate maintenance or repairs.

Gearing

Removal and Disassembly

Transmission fluid is used in gear assembly. Handle gear disassembly with care.

1. Remove the 12 socket head cap screws from the gear housing.
2. Remove the motor housing from the ring gear, or ring gear from the gear housing.
3. Place starter gear housing over drip pan. Allow transmission fluid to drain.
4. Remove gear assembly from the gear housing.

WARNING

Do not remove Slip Clutch Retaining Ring.

Assembly and Installation

Gear assembly should be installed to the drive assembly.

For installation to the drive assembly

1. Place drive assembly on a workbench with pinion end down.
2. Grease the internal spline on the gear assembly.
3. Align the drive spline and lower the gear assembly to the drive assembly.
4. Assemble ring gear on gear housing. Align the screw holes with the holes in the ring gear.
5. Fully seat the ring gear over the O-ring seal.
6. Fill the ring gear with automatic transmission fluid, 150 ml.
7. Place wave washer on gear bearing.
8. Coat the motor housing O-ring with O-ring lube.
9. Align the gear assembly needle bearing with the adapter shaft and engage the gearing until motor assembly is fully seated.
10. Tighten the 12 socket head cap screws with lock washers to 10-13 ft-lb in an alternating pattern.

Drive

Removal and Disassembly

1. Remove the drive pinion retaining screw.

NOTICE

Models identified with R rotation have a left-hand thread. Models identified with L rotation have a right-hand thread.

2. Remove the drive pinion with pinion collar attached off the drive shaft.
3. Unscrew and remove the eight drive housing cap screws.
4. Remove drive housing.
5. Remove spring and seat.
6. Slide the drive package assembly from the drive housing.

Assembly and Installation

1. Apply O-ring lube to piston O-ring and assemble.
2. With O-ring side of piston facing down, install the drive assembly bearing in the piston.
3. Install retaining ring to piston.
4. Lubricate the inside of the gear housing with grease for smooth piston travel.
5. Install piston and drive assembly on the gear housing.
6. Install spring and seat on drive assembly bearing.
7. Lightly grease the drive shaft.
8. Align drive housing assembly with drive shaft and lower.
9. Align screw holes to proper orientation. Torque the socket head cap screws (x8) to 20-25 ft-lb.
10. Assemble pinion ring and pinion gear on drive shaft.
11. Assemble pinion screw on drive shaft. Torque to 180 ft-lb.

Troubleshooting Guide

Trouble	Probable Cause	Solution
Motor will not run	No air supply.	Check for blockage or damage to air supply lines or tank.
	Damaged motor assembly.	Inspect motor assembly and power train and repair or replace if necessary.
	Foreign material in motor and/or piping.	Remove motor assembly and/or piping and remove blockage.
	Blocked exhaust system.	Remove housing exhaust cover and check for blockage.
	Defective control valve or relay valve.	Replace control valve or relay valve.
Loss of Power	Low air signal pressure to start valve.	Check air supply.
	Low air pressure to starter.	Check air supply.
	Restricted air supply line.	Check for blockage or damage to air lines.
	Relay valve malfunctioning.	Clean or replace lines or relay valve. Lube relay valve.
Drive will not engage	Exhaust flow restricted.	Check for blocked or damaged piping. Clean or replace piping. Check for dirt or foreign material and clean or remove. Check for ice build-up. Melt ice and reduce moisture build-up to starter.
	Damaged motor assembly.	Replace motor assembly.
	No pressure to drive housing port.	Check air supply.
	Internal drive housing ports blocked.	Remove blockage.
	Fluid in drive unit components.	Remove fluid.
	Damaged or worn piston assembly, O-rings or seals.	Replace damaged or worn parts.
Motor runs, pinion engages, but does not rotate flywheel	O-rings and seals dry.	Re-lube O-rings and seals.
	Defective control valve.	Replace control valve.
Excessive butt engagement	Damaged or broken drive train.	Disassemble drive train and replace worn or damaged parts.
	Motor turning in wrong rotation.	Wrong combination of clutch jaws and motor. Replace with correct rotation parts.
	Damaged drive pinion or flywheel.	Inspect drive pinion and flywheel and replace if necessary.
Oil blowing out of exhaust	Damaged starter drive or components.	Inspect drive components and replace worn or damaged parts.
	Low air pressure.	Check air supply.
Oil leaking from gear Case	Wrong drive pinion.	Replace with proper drive pinion.
	Oil in air supply line.	Inspect air line and remove source of oil including inline lubricators.
	Worn or damaged rotor seal.	Replace motor module.
	Worn or damaged O-rings.	Replace O-rings.
Air or gas leakage	Loose joints.	Make sure that joints fit properly and that starter assembly cap screws are tightened. Make sure that all seals and O-rings fit and seal properly at their perimeters. If they do not, replace with new seals and O-rings.
	Excessive high-speed operation.	Operate according to recommendations.
	High number of start cycles.	Replace worn components.
Air or gas leakage	Loose or leaking pipe plugs.	Tighten or replace pipe plugs using Ingersoll Rand SMB-441 pipe sealant.
	Loose joints.	Make sure that joints fit properly and that starter assembly cap screws are tightened. Make sure that all seals and O-rings fit and seal properly at their perimeters. If they do not, replace with new seals and O-rings.
	Excessive high-speed operation.	Operate according to recommendations.
Air or gas leakage	High number of start cycles.	Replace worn components.
	Loose or leaking pipe plugs.	Tighten or replace pipe plugs using Ingersoll Rand SMB-441 pipe sealant.

Parts and Maintenance

CAUTION

The use of other than genuine Ingersoll Rand replacement parts may result in safety hazards, decreased motor performance, and increased maintenance, and may invalidate all warranties.

Ingersoll Rand is not responsible for customer modification of motors for applications in which Ingersoll Rand was not consulted. Repairs should be made only by authorized trained personnel. Consult your nearest Ingersoll Rand Authorized Service center.

When tool life has expired, it is recommended that the tool be disassembled, degreased and parts separated by material for proper recycling.

Manuals can be downloaded from ingersollrand.com

Refer all communications to the nearest **Ingersoll Rand** office or distributor.

[ingersollrand.com](https://www.ingersollrand.com)

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