Turbine Powered Starter
ST600 Series

Installation and Maintenance Information

Save These Instructions
General Product Safety Information

- Read and understand this manual before operating this starter.
- It is your responsibility to make this safety information available to others that will operate this starter.
- Failure to observe the following warnings could result in injury.

- For safety, maximum performance and maximum durability of parts, do not operate ST600 Starters at air pressures over the pressure rating stamped on the nameplate. Use supply lines of adequate size as directed in the installation instructions in this manual.
- Do not use damaged, frayed or deteriorated air hoses & fittings.
- Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this starter, or before performing any maintenance on this starter.
- Operate Model ST600 Starters on compressed air only. They are not designed or sealed for operation on compressed gas.
- Do not lubricate starters with flammable or volatile liquids such as kerosene or jet fuel.
- For personal protection, do not remove any labels. Replace any damaged labels.
- Use only recommended Ingersoll Rand accessories.
- Operate this starter only when properly installed on the engine.
- Always wear eye protection when operating or performing maintenance on this Starter.
- Always wear hearing protection when operating this Starter.
- This product is not designed for working in explosive environments, including those caused by fumes & dust, or near flammable materials.
- This product is not insulated against electric shock.
- Keep hands, loose clothing, long hair and jewelry away from working end of product.
- Shaft and/or accessories may briefly continue their motion after throttle is released.
- Never use a damaged or malfunctioning product or accessory.
- Do not modify this product, safety devices, or accessories.
- Do not use this product for purposes other than those recommended.

- The use of other than genuine Ingersoll Rand Replacement parts may result in safety hazards, decreased starter performance, increased maintenance, and may invalidate all warranties.
- Repairs should be made only by authorized trained personnel. Consult your nearest Ingersoll Rand Authorized Service Center.
- 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.

Safety Information - Explanation of Safety Signal Words

- **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.
- **NOTICE** Indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property.

Safety Symbol Identification

- Wear Respiratory Protection
- Wear Eye Protection
- Wear Hearing Protection
- Read Manuals Before Operating Product
Placing Starter in Service

--- HOW TO ORDER A STARTER ---

<table>
<thead>
<tr>
<th>ST6</th>
<th>50</th>
<th>B</th>
<th>P</th>
<th>03</th>
<th>R</th>
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</table>

* Pinion Code must be specified when ordering.
Installation

For maximum performance, read this manual prior to installation or operation of Series ST600 Starters.

General Information
1. This starter is designed for flange mounting at the inlet. The Flange Mounting Kit is required 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.
2. 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 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.
3. Improper hook-up impairs the efficiency of a Starter. Pressure Lines 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 up to a minimum. Use 1-1/2" 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.
4. Install a 300 mesh strainer in the inlet line for each starter. These 300 mesh strainers provide 50 micron filtration and offer significant protection against supply line contaminants which could damage the turbine components. Ingersoll Rand offers 3 sizes: ST900-267-24 for 1-1/2 inch lines, ST900-267-32 for 2 inch lines and ST900-267-64 for 4 inch lines. Replacement elements are: ST900-266-24 for 1-1/2 inch, ST900-266-32 for 2 inch and ST900-266-64 for 4 inch lines.
5. Make your connections bubble tight 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 always run the appropriate panel (for stationary installations.)
6. We recommend installation of a “glad hand” in vehicular applications for emergency re-pressurizing of the system. To keep the “glad hand” clean and free of dirt and to protect it from damage, a second “glad hand” closed by a pipe plug can be mated to it, or a “glad hand” protector bracket can be used.

Orientation of the Starter
If the factory orientation will not fit your engine due to radial location of the Drive Housing or location of the inlet and/or exhaust ports, re-orient the starter as follows:
1. Refer to the dimension illustration and note that the drive housing can be located in anyone of eight radial positions relative to the air inlet (motor housing).
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.

Mounting the Air Starter
1. Study the Piping diagram on Page 5.
2. The air receiver tank for a starter installation must meet SAE J10B specifications. It must have a working pressure capability equal to or greater than the maximum pressure at which the starter will be operated.
3. When connecting the starter to a receiver tank that is already in service, bleed off the air pressure by opening the drain valve.

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 has accumulated in the bottom of the tank.

6. Mount the No.150BMP-1064 Air 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.
7. Connect the Starter 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.

Make certain the hose is connected to the “SUPPLY” side of the Starter Control Valve.
8. To determine the exact length of 1-1/2” air hose required, run a piece of heavy-duty hose or some other flexible tubing of the same diameter from the Relay Valve on the receiver to the starter location on the engine.
9. Attach the 1-1/2” air hose to the outlet side of the Relay Valve, and run the hose through the frame to its final position at the starter location.
10. At this point, determine if 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.
11. If possible, liberally grease the teeth on the ring gear with a good, sticky gear grease or motorcycle chain lube. This will help promote the life of the ring gear and the Starter Pinion.
12. Place the starter into position, and mount it on the flywheel bell housing. Tighten the mounting bolts to 100-ft-lb (135 Nm) of torque.
13. Pressurize the complete starting system and check every connection with a soap bubble test. There must be no leaks.
PIPING DIAGRAM FOR A TYPICAL STATIONARY INSTALLATION: PRE-ENGAGED

PIPING DIAGRAM FOR A TYPICAL VEHICULAR INSTALLATION: PRE-ENGAGED

NOTE:
FOR ALL APPLICATIONS USE SEALANT * SMB-441 OR EQUIVALENT ON ALL PIPE CONNECTIONS.
* INDICATES INGERSOLL RAND PART NUMBER

04662995_ed4 5
NOTES:
1. Please read instructions before attempting to reorient.
2. Starter weight is 39 Lbs.
3. Not to be used with natural gas.
# ST600 Turbine Powered Starter - Parts List

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
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<td>Screw</td>
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<td>Spring</td>
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Maintenance

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

Lubrication
Each time a Series ST600 Starter is disassembled for maintenance or repair, lubricate the starter as follows:
1. Lubricate the inside diameter of the Drive Shaft (17) with Ingersoll Rand No.130 Grease.
2. Lubricate the Pinion end of the Drive Shaft with Ingersoll Rand No.11 Grease.
3. Wipe a thin film of Ingersoll Rand No.130 Grease in the bore of the Drive Housing (12).
4. Roll the Piston Return Spring (18) in Ingersoll Rand No.130 Grease.
5. Coat the outside of the Piston (15) with Ingersoll Rand No.130 Grease.
6. Lubricate all O-Rings with O-Ring lubricant.

Disassembly

General Information
1. Do not disassemble the Starter any further than necessary to replace worn or damaged parts.
2. 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.
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 seals and O-Rings on hand before starting any overhaul of a Series ST600 Turbine Starter. Never reuse old seals or O-Rings.
5. Do not press any needle bearing from a part unless you have a new needle bearing on hand for installation. Needle bearings are always damaged during the removal process.

Disassembly of the Starter
1. Place the Starter on a workbench with Exhaust end down.
2. Remove the Drive Pinion Retaining Screw (24).
3. Remove the Drive Pinion (23) with Pinion Collar attached off the Drive Shaft.
4. Unscrew and remove the eight Drive Housing Cap Screws (20).
5. Remove Drive Housing (21).
6. Remove Spring (18) and seat (19).
7. Slide the Drive Package Assembly (17) from the Drive Housing. 
8. Place Motor Housing (12) in a copper faced vise clamping on the flats of the Exhaust Cap (4).
9. Insert a rod in the inlet and turn counterclockwise to remove exhaust cover (4).
10. Remove Motor Housing from vise and place on workbench with Exhaust end upward.
11. Grasp the rear of the Motor Assembly (6) and pull it from the rear of the Motor Housing.
12. Place Motor Housing in drip pan with Exhaust end down to allow transmission fluid to drain.
13. Press on clutch Shaft through the front end to release Gear Package (10) and Front Deflector (7).

Assembly

General Instructions
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 into a bearing recess.
3. Whenever grasping a starter or part in a vise, always use leather-covered or copper-covered vise jaws. Take extra care with threaded parts or housings.
4. Except for bearings, always clean every part and wipe every part with a thin film of oil or stated type of grease before installation.
5. Check every bearing for roughness. If an open bearing must be cleaned, wash it thoroughly in a suitable 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.
6. Apply a film of O-ring lubricant to all O-rings before final Assembly.
7. Unless otherwise noted, always press on the stamped end of a needle bearing when installing the needle bearing in a recess. Use a bearing inserting tool similar to the one shown in Dwg.TPD786.
Assembly of the Starter

1. Place Motor Housing on a workbench, exhaust end up.
2. Grasp Gear Package Assembly (10) and insert into Motor Housing. Rotate Gear Package to align Planet Gear Teeth with Ring Gear Teeth.
3. Place Wave Spring (9) onto Front Deflector (7).
4. Insert Front Deflector (7) into Motor Housing applying force until it seats against Ring Gear.
5. Add 275 ml of Dextron® II Automatic Transmission fluid through the hole in the Front Deflector.
6. Before installing the Motor Assembly, coat the O-Rings on the Motor Assembly and the inside of the Cylinder with O-Ring lubricant. Install the Motor Assembly through the rear of the Motor Housing with geared end of the rotor toward the front.
7. Coat the Exhaust O-Ring (5) with O-Ring lubricant and install in the groove on the Exhaust Cap (4).
8. Align the Exhaust Cap in the rear of the Motor Housing and rotate until it seats. Tighten the Exhaust Cap to a final torque of 50 ft.-lb.

** NOTICE **
Be careful not to damage O-Rings during assembly. If necessary a .010” thick sleeve may be inserted to cover inlet hole. Remove once Motor Assembly has been installed.

9. Install the Deflector (3), Spring (2) and Screw (1) in the rear of the Housing Exhaust Cover.

** NOTICE **
Coat the threads of the Deflector Retaining Screw with Ingersoll Rand SMB-441 Sealant.

10. Place Starter in vise with exhaust end down clamping on flats of Exhaust Cap.
11. Grasp Drive Package Assembly and align the spline teeth of Drive Package Assembly with spline teeth of the Gear Package Assembly. Apply pressure until Piston is seated.
12. Install Spring (18) and Seat (19).
13. Carefully position the Drive Housing (12) onto the Motor Housing.
14. Install the Drive Housing Cap Screws (20) and torque to 20-25 ft-lbs.
15. Refer to TPE_1027 for proper orientation.
16. Install Pinion (23) with Collar (22) attached. Align the notches of the Pinion with notches in the Drive Shaft.
17. Install the Drive Pinion Retaining Screw (24) into the end of the Drive Shaft and torque to 180-220 ft-lb.

NOTICE
Models ending in R31, R51, R83, R91 and R942 have a left-hand thread. Models ending in L31, L51, L83, L91 and L942 have a right-hand thread.

** Troubleshooting Guide **

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable Cause</th>
<th>Solution</th>
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</thead>
<tbody>
<tr>
<td>Motor will not run</td>
<td>No air supply</td>
<td>Check for blockage or damage to air supply lines or tank.</td>
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<tr>
<td></td>
<td>Damaged motor assembly</td>
<td>Inspect Motor Assembly and power train and repair or replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Foreign material in motor and/or piping</td>
<td>Remove Motor Assembly and/or piping and remove blockage.</td>
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<tr>
<td></td>
<td>Blocked exhaust system</td>
<td>Remove Housing Exhaust Cover (1) and check for blockage.</td>
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<tr>
<td></td>
<td>Defective Control Valve or Relay Valve</td>
<td>Replace Control Valve or Relay Valve.</td>
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<tr>
<td>Low air pressure to Starter</td>
<td>Check air supply.</td>
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<tr>
<td>Restricted air supply line.</td>
<td>Check for blockage or damage to air lines.</td>
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<tr>
<td>Relay Valve malfunctioning</td>
<td>Clean or replace lines or Relay Valve. Lube relay Valve.</td>
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<tr>
<td>Loss of Power</td>
<td>Exhaust flow restricted</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Worn motor parts</td>
<td>Remove the motor from the Motor Housing (17) and disassemble the motor. Examine all parts and replace any that are worn or damaged.</td>
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<tr>
<td></td>
<td>Lack of air to starter</td>
<td>Check for clogged or damaged air line between relay valve and starter. Check relay valve to determine if it is functioning properly. Check air tank.</td>
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</tbody>
</table>
Parts and Maintenance

**NOTICE**

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 on which Ingersoll Rand was not consulted.

Repairs should be made only by authorized trained personnel. Consult your nearest Ingersoll Rand Authorized Service center.

When the life of the motor has expired, it is recommended that the motor be disassembled, degreased and parts be separated by material so that they can be recycled.

Manuals can be downloaded from www.irtools.com.

Refer all communications to the nearest Ingersoll Rand Office or Distributor.