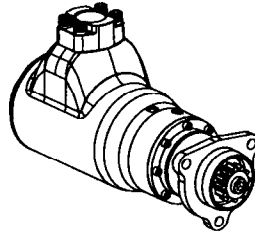
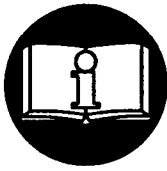


# INSTALLATION AND MAINTENANCE MANUAL for ST600 TURBINE STARTER



TPE\_1031



## ⚠ WARNING

**IMPORTANT SAFETY INFORMATION ENCLOSED.  
READ THIS MANUAL BEFORE OPERATING 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.
- 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.
- After assembling a 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 in this manual.
- Do not lubricate starters with flammable or volatile liquids such as kerosene or jet fuel.
- Operate this starter only when properly installed on the engine.
- Do not remove any labels. Replace any damaged label.
- Use accessories recommended by Ingersoll-Rand.

## NOTICE

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

Ingersoll-Rand is not responsible for customer modification of starters for applications on which Ingersoll-Rand was not consulted.

Repairs should be made only by authorized, trained personnel. Consult your nearest Ingersoll-Rand Authorized Servicerenter.

It is the responsibility of the employer to place the information in this manual into the hands of the operator.



Refer All Communications to the Nearest  
Ingersoll-Rand Office or Distributor.

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**INGERSOLL-RAND**  
**PRODUCTION EQUIPMENT**



# WARNING LABEL IDENTIFICATION



## WARNING

FAILURE TO OBSERVE THE FOLLOWING WARNINGS COULD RESULT IN INJURY.

	 <b>WARNING</b>
	Always wear eye protection when performing maintenance on this starter.

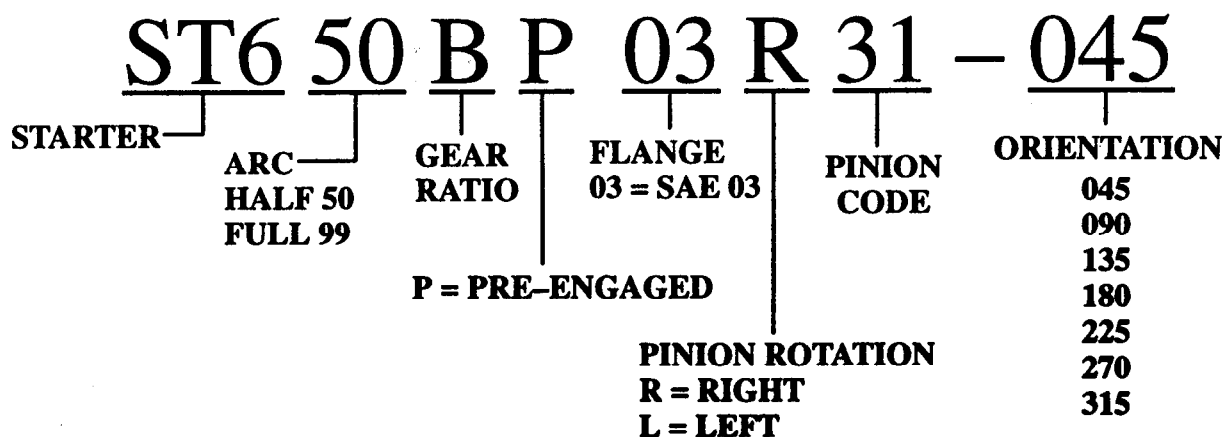
	 <b>WARNING</b>
	Always wear hearing protection when testing this starter.

	 <b>WARNING</b>
	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.

	 <b>WARNING</b>
	Do not use damaged, frayed or deteriorated air hoses and fittings.

# PLACING STARTER IN SERVICE

## HOW TO ORDER A STARTER



### 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	Right/Left	2.250	57.15
ST600-13-51	15	15	6/8	2.500	63.50	20.0	Right/Left	2.750	69.85
ST600-13-83	12	12	3.5 Module	1.515	38.50	20.0	Right/Left	1.882	47.80
ST600-13-91	14	16	3.5 Module	1.929	49.00	20.0	Right/Left	2.441	62.00
ST600-13-942	14	15	3.5 Module	1.929	49.00	15.0	Right/Left	2.301	58.45

\*Pinion Code must be specified when ordering.

# PLACING THE STARTER IN SERVICE

## INSTALLATION

### NOTICE

**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 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 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.
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 6.
2. The air receiver tank for a starter installation must meet SAE J10B specifications or conform to ASME 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.

### 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 has accumulated in the bottom of the tank.**

4. Using a 1-1/2" short nipple, install the SRV150 Starter Relay Valve on the end of the receiver tank as shown in the piping diagram.

### NOTICE

**Make certain the connection is made to the inlet side of the Relay Valve indicated by the word "IN" cast on the valve body.**

5. Install the No. SMB-G618 Starter Control Valve on the dash panel (for vehicular installations) or some other appropriate panel (for stationary installations).
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.

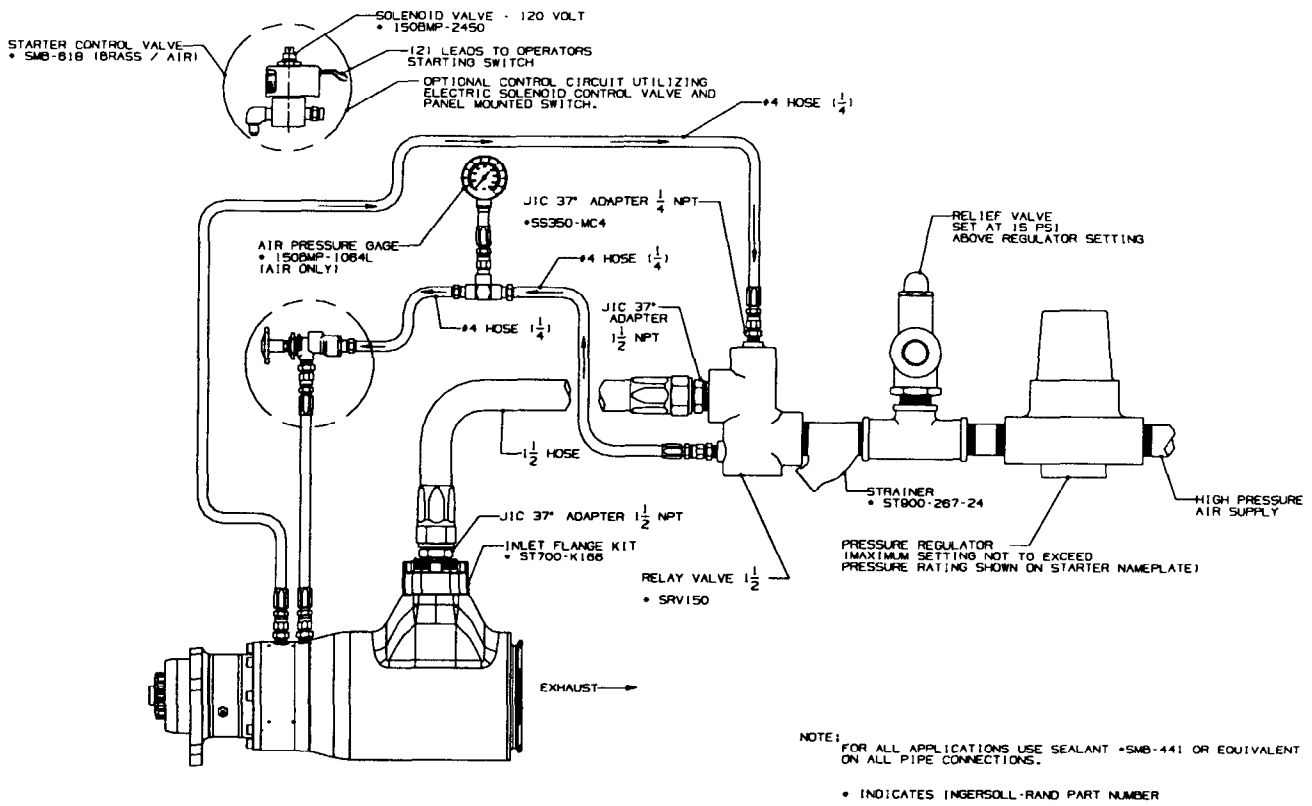
7. Connect the Starter Control Valve to the Relay Valve with 1/4" hose. Install a Tee in this line with a short feeder hose to the Pressure Gauge.

### NOTICE

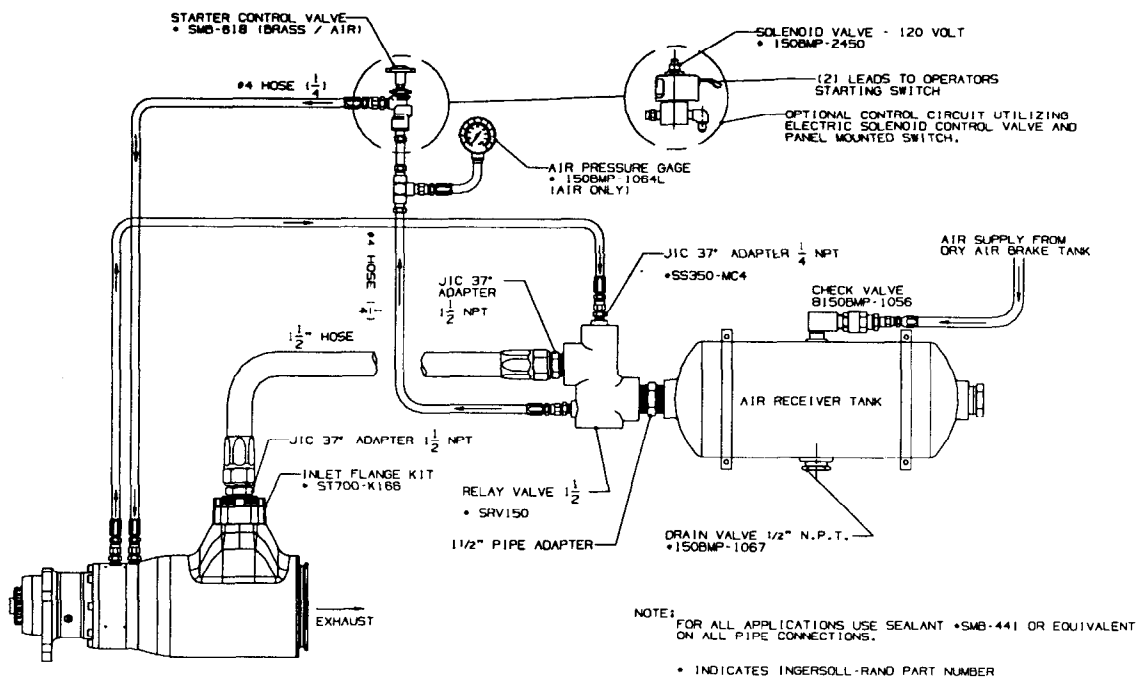
**Make certain the hose is connected to the "SUPPLY" side of the Starter Control Valve.**

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 (136 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

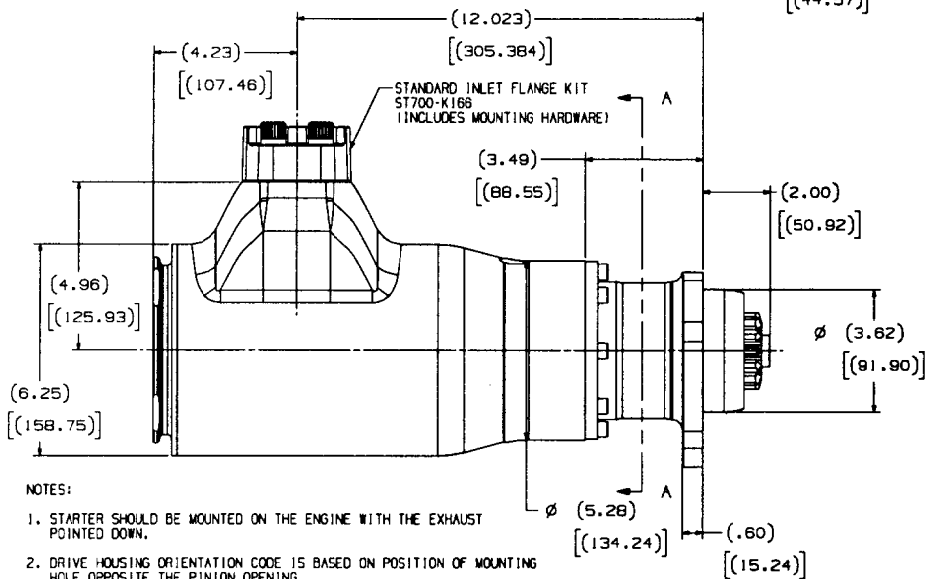
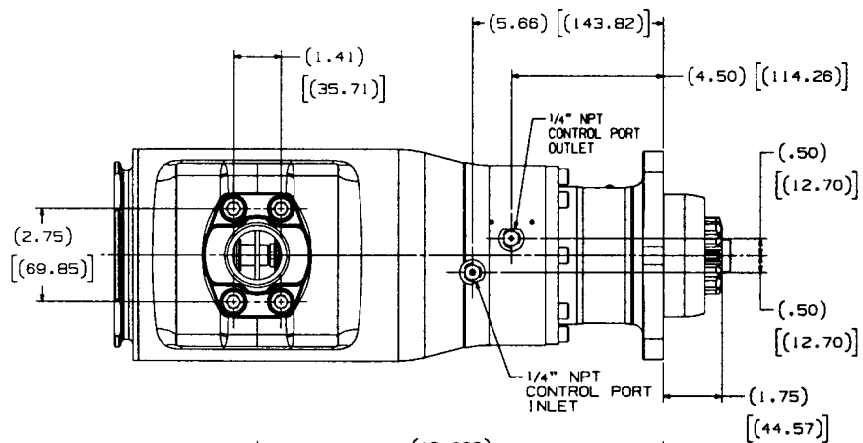


## PIPING DIAGRAM FOR A TYPICAL VEHICULAR INSTALLATION: PRE-ENGAGED



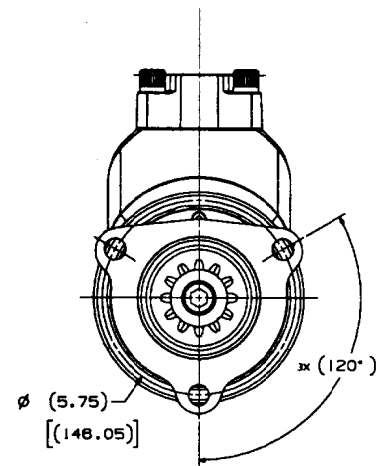
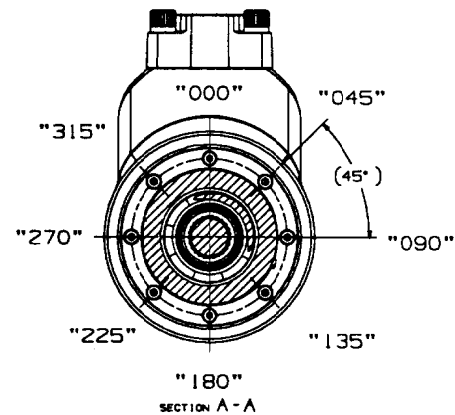
TPE\_1028

### ST600 PRE-ENGAGED MOUNTING DIMENSIONS



**NOTES:**

1. STARTER SHOULD BE MOUNTED ON THE ENGINE WITH THE EXHAUST POINTED DOWN.
2. DRIVE HOUSING ORIENTATION CODE IS BASED ON POSITION OF MOUNTING HOLE OPPOSITE THE PINTON OPENING.
3. PLEASE READ INSTRUCTIONS BEFORE ATTEMPTING TO REORIENT.
4. STARTER WEIGHT IS 39 LBS.
5. NOT TO BE USED WITH NATURAL GAS.

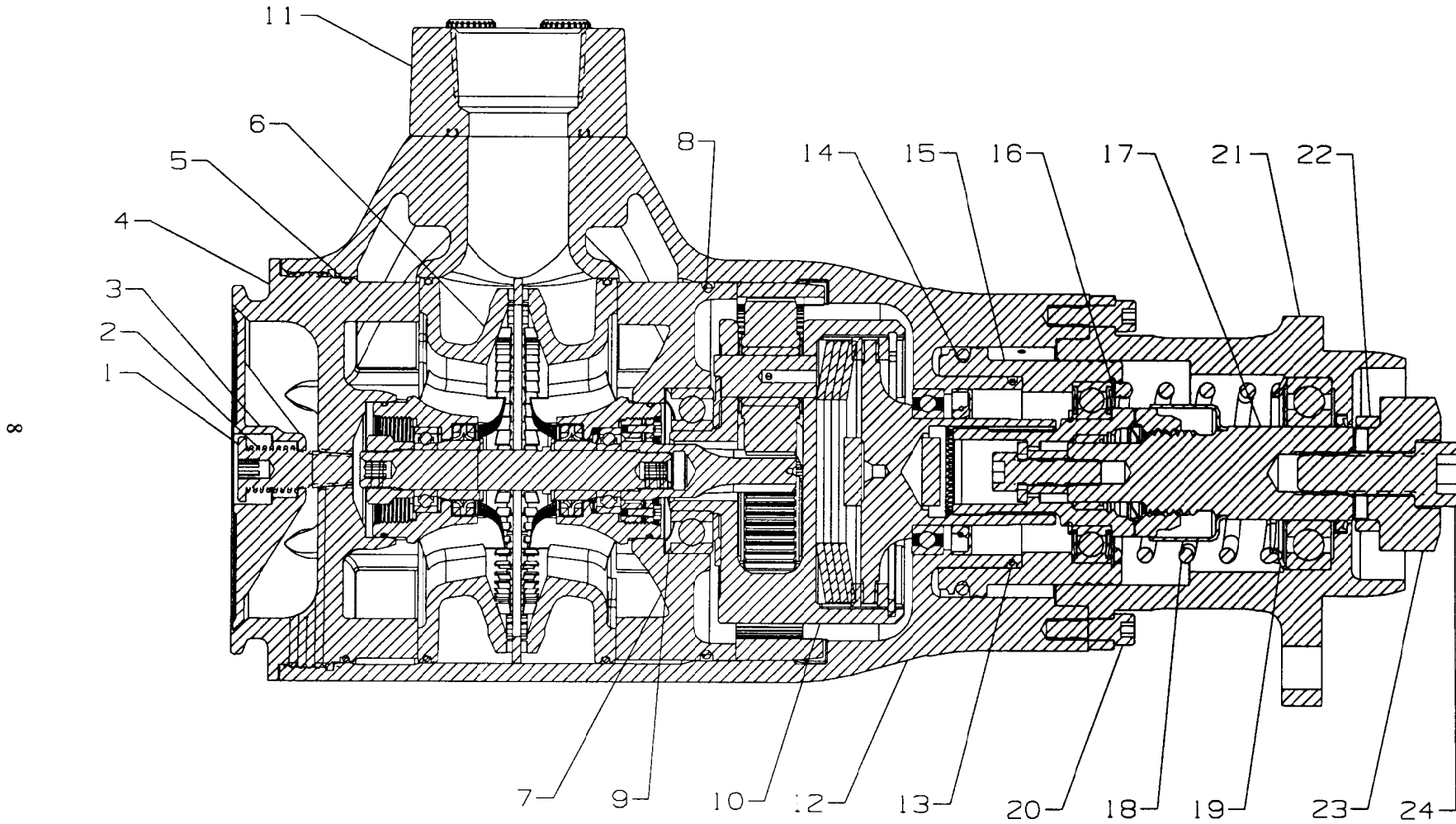


ORIENTATION OPTIONS
DRIVE HOUSING
Ø 45°

DUAL DIMENSIONS INCH MM

**TPE\_1027**

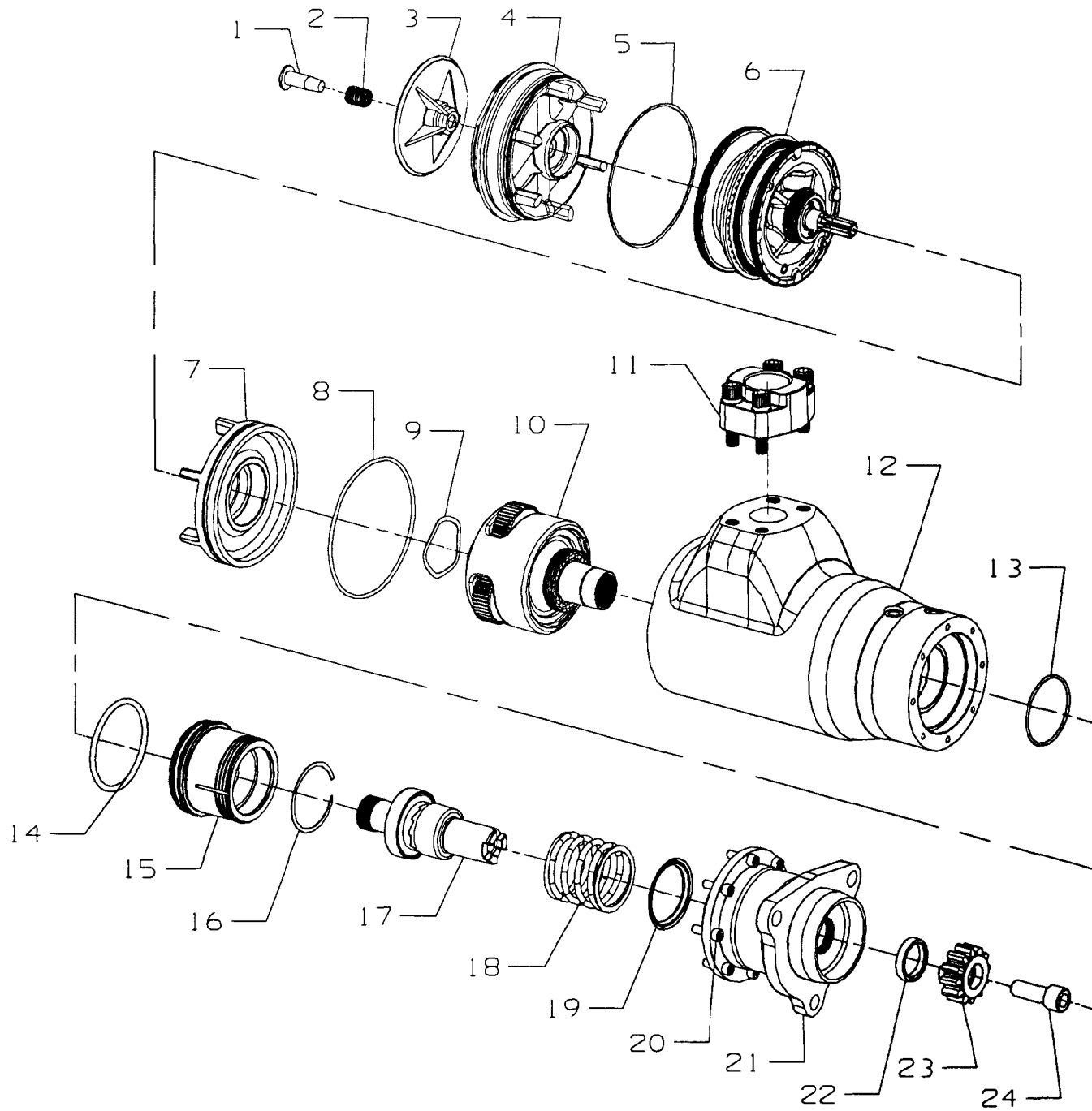
**PLACING STARTER IN SERVICE**



**MAINTENANCE SECTION**



MAINTENANCE SECTION



9

TPE\_1030



PART NUMBER FOR ORDERING 

PART NUMBER FOR ORDERING 

10

1	Screw .....	ST700-737	18	Spring .....	ST600-700
2	Spring .....	D10-275	19	Spring Seat .....	SS350-191
3	Deflector .....	ST700-735	20	Screw (8) .....	Y99-52
4	Exhaust Cap .....	ST600-562	21	Drive Housing Assembly .....	ST600-K300
5	O-Ring .....	ST700-67	22	Pinion Collar .....	ST600-175
6	Motor Assembly		23	Drive Pinion	
	for LH rotation models .....	ST650L-A53B		for ST650BP03L31, ST699BP03L31,	
	for RH rotation models .....	ST650R-A53B		ST650BP03R31 and ST699BP03R31 ...	ST600-13-31
7	Deflector .....	ST600-111		for ST650BP03L51, ST699BP03L51,	
8	O-Ring .....	Y325-253		ST650BP03R51 and ST699BP03R51 ...	ST600-13-51
9	Wave Spring .....	ST600-244		for ST650BP03L83 and ST650BP03R83	ST600-13-83
10	Gear Package Assembly .....	ST600B-APGR		for ST650BP03L91, ST699BP03L91,	
11	Flange Kit .....	ST700-K166		ST650BP03R91 and ST699BP03R91 ...	ST600-13-91
12	Motor Housing Assembly .....	ST600-A40		for ST650BP03L942, ST699BP03L942,	
13	O-Ring .....	SS350-151		ST650BP03R942 and ST699BP03R942 .	ST600-13-942
14	O-Ring .....	SS800-337	24	Screw	
15	Piston .....	ST600-703		for LH rotation models .....	ST600L-394
16	Retaining Ring .....	SS350-107		for RH rotation models .....	ST600R-394
17	Drive Package Assembly				
	for LH rotation models .....	ST600L-APDR			
	for RH rotation models .....	ST600R-APDR			

MAINTENANCE SECTION

## MAINTENANCE SECTION

### 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 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.

\*\* Registered trademark of Exxon Corp.

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).

### 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.**

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).

### NOTICE

**Transmission Fluid will drain and build-up on the Exhaust Cover. Handle Exhaust Cover with care.**

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).

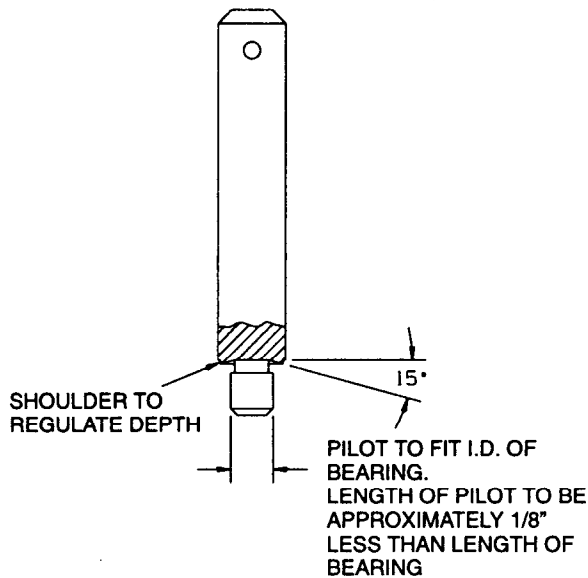
## MAINTENANCE SECTION

### 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.

#### Needle Bearing Inserting Tool



(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.

\*\* Registered trademark of Exxon Corp.

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.

#### 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.**

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

**After assembling the exhaust cover to the starter, add 20 ml of Dextron®\*\*II Automatic Transmission Fluid through the screw hole in the Exhaust Cover.**

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 100-110 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.**

## MAINTENANCE SECTION

### 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 (1) and check for blockage.
	Defective Control Valve or Relay Valve	Replace Control Valve or Relay Valve.
	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.
Loss of Power	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.
	Worn motor parts	Remove the motor from the Motor Housing (17) and disassemble the motor. Examine all parts and replace any that are worn or damaged.
	Lack of air to starter	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

#### NOTICE

**SAVE THESE INSTRUCTIONS. DO NOT DESTROY.**

## **NOTES**

## ***NOTES***

## **United States Office Locations**

### **For Order Entry, Order Status**

**Ingersoll–Rand  
Distribution Center**  
P.O. Box 618  
510 Hester Drive  
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Phone: (615) 672–0321  
Fax: (615) 672–0801

### **For Technical Support**

**Ingersoll–Rand**  
1725 U.S. Highway #1–N  
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Fax: (910) 692–7822

### **Web Site**

[www.airstarters.com](http://www.airstarters.com)

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