Turbine Powered Starters
Series ST700

Installation and Maintenance Information

EN Installation and Maintenance Information
ZH 安装和维护信息
JA 据付および保守の情報

Save These Instructions
Product Safety Information

Intended Use:
These 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 www.irtools.com.

Placing the Starter in Service

Installation

For maximum performance, read this manual prior to the installation or operation of Series ST700 Turbine-Powered Starters.

General Information

1. It is strongly recommended 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. Vehicle and engine vibration will soon 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 furnished Flange Mounting Kit is required for installation. All piping, hoses and valving must be clean prior to installation. Make sure that the starter inlet remains free of dirt and foreign material during installation.

3. In the actual mounting of a starter, it may be 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.

4. Engine design often demands that the starter be mounted 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 a single or double-end box wrench.

5. The efficiency of an Air 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 and/or motor housing cover to its desired position.

6. A leak in any of the connections in live air lines 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 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 Loctite® Pipe Sealant. After all connections have been made, check each joint with a soap bubble test. There must be no leaks in live air lines. The slightest leak will cause the system to lose pressure overnight. 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.

7. Whenever a hazardous gas is being used to operate the starter, there must be no leaks in inlet or exhaust piping or from any other starter joints. All discharges should be piped away to a safe area.

8. We recommend installation of a “glad hand” 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.

9. It is required that a strainer be installed in the inlet line for each starter. Ingersoll Rand offers 5 strainers:

ST900-267-64 for 4 inch lines,
ST900-267-48 for 3 inch lines and
ST900-267-32 and ST900-267-32F for 2 inch lines,

Orientation of the Starter

It is recommended that starters be ordered to proper orientation for your specific mounting to the required engine or for your specific installation. However, if the starter must be reoriented for installation, proceed as follows:

1. Refer to the dimension illustration on page EN5, EN6 and EN7 and note that the Drive Housing can be located in any one of sixteen radial positions relative to the Gear Case and the air inlet can be located in any one of four radial positions relative to the Drive 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. Separation of the Drive Housing from the Gear Case is not required. Reinstall the Drive Housing Cap Screws and tighten to 28 ft-lb (38 Nm) torque.

3. After the Drive Housing is properly oriented relative to the Gear Case, determine if the inlet port will be favorably located for hose installation. If either or both of these members must be reoriented, use an 8 mm hex-head wrench to remove the four motor housing cover cap screws, and rotate the motor housing and/or motor housing cover to its desired position.

Do not separate the Motor Housing from the Intermediate Gear case as gear lubrication oil will be lost.

Reinstall the motor housing cover cap screws and alternately tighten them to 60 ft-lb (81.4 Nm) torque in 20 ft-lb (27 Nm) increments.

Mounting the Starter

1. Study the appropriate piping diagrams on page 8 through 11 and install as indicated.

2. 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.

* Registered trademark of Loctite Corporation.
3. 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 pressured. Drain off any water that may have 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. For air installations, install the Starter Control Valve (SMB-618) 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 12V Solenoid Valve (150BMP-1051B) 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.

6. Attach Starter Instruction Label (TA-STR-100) to the control panel adjacent to the Starter Control Valve.

7. Mount the Air Pressure Gauge (150BMP-1064) on or adjacent to the control panel. It should be located where it is readily visible to the operator.

8. 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 (marked “SUP”) of the Starter Control Valve.

9. 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.

10. Attach the 1-1/2" air hose to the outlet side of the Relay Valve, and run the hose through the frame, etc. to its final position at the starter location.

11. 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.

12. 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.

13. Move the starter into position, and mount it on the flywheel housing. Tighten the mounting bolts to 100 ft-lb (136 Nm) torque.

14. For Pre-Engaged Models, install a 1/4" 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.

**NOTICE**

Inadvertent application of air pressure to the “OUT” port will result in Drive malfunction (Pinion will fail to retract). If this condition occurs, loosen Drive Housing Cap Screws (38) to vent Gear Case (28). Also, loosen Housing Plugs (10) and (11) to vent Motor.

15. Install a 1/4" hose line from the "OUT" port on the Starter Drive Housing to the small pipe tapped portion top of the Starter Relay Valve or Solenoid Valve.

16. If the exhaust is to be piped away, remove the standard Splash Deflector which is located at the rear of the Housing Exhaust Cover and replace the Assembly with the 1/4" N.P.T. pipe plug supplied with the starter.

17. Pressurize the complete starting system and check every connection with a soap bubble test. **There must be no leaks in live air lines or other connections.**

**Barring Over the Engine**

Occasionally, for setting injectors and/or for timing purposes, it may be desirable to bar over the engine in such a manner that any given piston can be stopped at any given location. This is very easily done with a Series ST700 Turbine Starter. Remove the Deflector Retaining Screw (5), the Deflector Return Spring (4) and the Splash Deflector (3). If piped-away exhaust is being used, remove piping so that you can gain access to the hole at the center of the Housing Exhaust Cover. Remove the 1/4" pipe plug.

**For Models with Inertia Drive:**

1. Manually engage pinion and insert a 1/4" hex wrench through the hole in the Housing Cover to engage the hex drive recess at the rear of the Motor Assembly.

2. Manually rotate the Motor Assembly until the engine is cranked to the desired position.

**For Models with Pre-Engaged Drive**

1. Disconnect the 1/4" hose at the “OUT” port on the Drive Housing, and plug the hole in the Drive Housing with a 1/4" pipe plug.

2. Engage the Drive Pinion with the flywheel by applying a minimum of 70 psig (4.8 bar/483 kPa) to the "IN" port on the Drive Housing.

3. Insert a 1/4" hex wrench through the hole in the Housing Exhaust Cover to engage the hex drive recess in the rear of the Motor Assembly.

4. Manually rotate the Motor Assembly until the engine is cranked to the desired position.
**Piping Diagrams**

**Pre-Engaged System (Series ST700 Shown)**

**Typical Vehicular Installation**

- Starter Control Valve ★ SMB - 618 (Brass)
- **Drive Housing Vent Plug ** ★ 1/8" N.P.T.
- 1 1/2" N.P.T. Inlet Flange Kit ST700 - K166
- **Relay Valve 1 1/2" ✔ SRV150**
- 1 1/2" Pipe
- **Drain Valve 1/2" N.P.T. ✔ 150BMP - 1067**
- **Check Valve 150BMP - 1056**
- **Air Supply from dry Air Brake Tank**
- **Exhaust**
- **Air Pressure Gage 150BMP - 1064L**
- **Solenoid Valve - 12 volt 150BMP - 1051B**
- "Optional Control Circuit Utilizing Electric Solenoid Control Valve and Panel Mounted Switch."

**Typical Stationary**

- **For gas operation, the relief valve outlet must be piped away to a safe location**
- **Relief valve set at 15 P.S.I. above regulator setting**
- **High Pressure Supply**
- **Pressure Regulator (Maximum setting not to exceed pressure rating shown on Starter Nameplate)**
- **Standard high pressure system air or gas. Use pressure regulator when supply pressure is over rating of starter**
- **Note: Use Sealant on all pipe connections. ✔ SMB - 441**

★ Ingersoll Rand Part Number

**Note:** 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.

(Dwg. TPA1282-3)
Piping Diagrams

Inertia Type System (Series ST700 Shown)

Typical Vehicular Installation

![Diagram of vehicular installation}

Note: Use Sealant on all pipe connections.

SMB - 441

Typical Stationary Installation

![Diagram of stationary installation]

Note: Use Sealant on all pipe connections.

SMB - 441

* * 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.

(Dwg. TPA1283-3)
Piping Diagrams

Pre-Engaged System (Series ST700 Shown)

Typical Installation with Engine Prelube System when Supply Pressure is over Rated Starter Pressure

* 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.

** Use Sealant on all pipe connections.

(Dwg. TPA1281-3)
Pipe Size
See Chart

Supply must be adequate to maintain desired operating pressures at the starters with starters running. (Not to exceed max. pressure shown on starter nameplate.)

ST700 series multiple starter piping schematic showing the control circuit.

**Note:**
Use Sealant on all pipe connections.

**SMB - 441**

**Ingersoll Rand Part Number**

**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.
Product Information

Intended Use:
Series ST700 Turbine Powered Starters are designed for air or gas operation in off-highway, marine and stationary applications.

How to order a Starter

- **MODEL CODING** -

  - Size Star	  
  - Percent Arc  
  - Gas Operation  
  - Gear Ratio: B=2.18-1  
  - Type Gear Case  
  - Type of Drive Housing  
  - Drive Housing Orientation Code  
  - Inlet  
  - Pinion Rotation  
  - Drive  
  - Type Mounting Flange  

  (Dwg. TPD1176)

- **MODEL CODING** -

  - Size Star	  
  - Percent Arc  
  - Gas Operation  
  - Gear Ratio: C=2.53-1  
  - Type Gear Case  
  - Type of Drive Housing  
  - Drive Housing Orientation Code  
  - Inlet  
  - Pinion Rotation  
  - Drive  
  - Type Mounting Flange  

  (Dwg. TPD1177)

- **MODEL CODING** -

  - Size Star	  
  - Percent Arc  
  - Gas Operation  
  - Gear Ratio: D=3.44-1  
  - Type Gear Case  
  - Type of Drive Housing  
  - Drive Housing Orientation Code  
  - Inlet  
  - Pinion Rotation  
  - Drive  
  - Type Mounting Flange  

  (Dwg. TPD1178)

For different models or special applications, contact your nearest Ingersoll Rand Distributor or SALES HEADQUARTERS, Engine Starting Systems, P.O. Box 1776, Liberty Corner, NJ 07938, Phone (908) 647 - 6000.
产品信息
用途:
此类空气启动器适用于往复式内燃机的启动。此类启动器应在正确安装到需要启动的内燃机上后，进行远程操作。
更多信息请参见内燃机空气启动器产品安全信息手册表45558624。
手册可从www.irtools.com下载。

使起动器处于使用状态
安装

为获得最大性能，请在安装或操作ST700系列涡轮电力起动器（Series ST700 Turbine-Powered Starters）之前阅读本手册。

一般信息
1. 强烈建议在受到振动的所有车载装置和固定发动机上，应使用适宜的软管而非刚性管连接至起动器。车辆和发动机振动会很快松动刚性管连接，而软管会缓冲此振动，从而使连接保持紧密。
2. 该起动器供在进口处的法兰装置之用。在安装时需要提供的法兰装置套件。在安装前，必须清洁所有管道、软管和装设阀门。在安装期间，请确保起动器进口没有污物和异物。
3. 在实际安装起动器的过程中，最好巳在接收器中连接软管，并使软管的起动器末端便于连接到起动器。
4. 通常，发动机设计要求起动器应安装在向下近四分之一处，而且其中两个装配螺栓孔易于触及，但是第三个孔却常常难以触及。要在安装前连接软管，最好巳在接收器中连接软管，并使软管的起动器末端便于连接到起动器。
5. 通过阀或旋塞排出气压。当储气罐仍处于增压状态时，切勿从箱上拔下塞子。

起动器的定向

建议起动器应该根据所需发动机的特殊装置或特殊设备进行正确定向。但是，如果起动器因安装而必须重新定向，可按照以下步骤操作:
1. 请参阅第 EN5、EN6 和 EN7页的尺寸图示，另请注意，箱顶部可位于与齿轮箱相对的16个径向位置中的任一处，并且空气进口阀可位于与齿轮箱相对的4个径向位置中的任一处。
2. 学习发动机安装要求，并确定与齿轮箱相对的传动箱的所需位置。如箱体必须重新定位，可卸下8个传动箱有头螺丝，然后将传动箱旋转至所需位置。不需要分开齿轮箱和传动箱。重新安装传动箱有头螺丝，并旋紧至 28英尺-磅（38牛米）扭矩。

产品安全信息
用途:
此类空气启动器应用于往复式内燃机的启动。此类启动器应在正确安装到需要启动的内燃机上后，进行远程操作。
更多信息请参见内燃机空气启动器产品安全信息手册表45558624。
手册可从www.irtools.com下载。
9. 要确定所需的 1-1/2” 进气软管的确切长度，可重负荷运行软管设备或直径相同的某些其他挠性软管（从储气罐的主启动阀到发动机的起动器位置）。

10. 将 1-1/2” 进气软管连接到主启动阀的出口侧，并使软管从机架等穿过起动器处的最终位置。

11. 在此，可在实际安装起动器之前或之后，确定将软管连接到起动器是否可行或实用。在多数情况下，可能需要在安装之前将软管连接到起动器。

12. 如果可能，请使用优质粘性齿轮润滑油充分润滑环形齿轮上的齿轮。这将有助于延长环形齿轮和起动器小齿轮的寿命。

13. 将起动器各就其位，然后将其安装在飞轮壳上。拧紧安装螺栓至 100 英寸-磅（136 牛米）扭矩。

14. 对于预先安装的型号，可从起动器控制阀或电磁阀的出料侧（标为“DEL”）到起动器传动箱的“IN”端口安装 1/4” 软管管线。

15. 从起动器传动箱的“OUT”端口到起动器上启动阀或电磁阀的小管道分接部分顶端安装 1/4” 软管管线。

16. 如果要排出废气，可卸下标准防溅导向板（位于外壳废气盖尾部），并更换随附起动器的 1/4” N.P.T. 管道塞子的配件。

17. 加压整个起动系统，并使用皂气泡测试检查各个连接。在活动空气管道或其他连接装置中一定不能出现泄漏状况。

### 发动机盘车

有时，为了设置喷油器和/或定时，可能需要以此方式（所提供的活塞可在任何给定地点停止）发动机盘车。这可通过 ST700 系列涡轮起动器轻易完成。

1. 手动安装小齿轮，并通过外壳盖中的孔插入 1/4” 六角扳手以在马达组件尾部安装六角传动凹槽。

2. 手动旋转马达组件直至发动机弯曲到所需位置。

#### 对于具有惯性传动装置的型号:

1. 在传动箱的“OUT”端口拔下 1/4”软管，并使用 1/4”管道塞子堵住传动箱中的孔。

2. 通过将最小 70 psig（4.8 巴/483 kPa）应用于传动箱的“IN”端口，使用飞轮安装传动小齿轮。

3. 通过外壳废气盖中的孔插入 1/4”六角扳手，以将六字传动槽安装到电动机配件尾部。

4. 手动旋转马达组件直至发动机运行到所需位置。
可以卸下传感器安装座组件中的 1/4”
壁堵头，安装法兰装置以检查起动器的供应。 
在重新安装堵头之前，要彻底清洁。 
并使用管路密封封胶（67 No SMB-441）或同类产品 
以防止泄漏。

标准进口法兰套件 
包括安装硬件（ST700-166）

1. 必须卸下防拨导向盘附件，才能接近 1/4”
转轴支架及防拨导向盘组件。
2. 在按下任何组件之前，起动器必须在适当的水平， 
以防从轴箱中倒流。
3. 在按下任何组件之前，可能会从空轴中挤出少量的油， 
（这是正常现象。）
4. 在重新装配之前，要清洁轴箱中的油。
并使用管路密封封胶（67 No SMB-441）或同类产品 
以防止泄漏。

- 型号编码 -

<table>
<thead>
<tr>
<th>型号编码</th>
<th>传动箱</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST7 50 G 0 0 0 R 31</td>
<td>0 N</td>
</tr>
</tbody>
</table>

直径 49.00
直径 16.00 ± 2.00

**注释：**
1. 应该使用气缸向下在发动机上安装起动器。
2. 这些型号不能用于起动器暴露在空气环境中的情况。
3. 该型号使用何种组件取决于发动机与发动机的安装方式。
4. 引发器前的启动器可由 67 SMB-441 介绍的启动器附件进行安装。
5. 请在安装启动器组件时阅读说明。
6. 起动器重量 = 68 磅（30.8 千克）
可以取下传动轴入口支架上的1/4"
管堵头，并安装齿轮箱以检查起动器的供应压力。
在重新安装管堵头之前，要清除螺纹。

起重机底座密封套
（如No. SMB-441或同类产品）
以防止泄露。

1. 必须卸下防滑导向板装配，
才能接近1/4"
传动支承孔或安装管路排气装置。
2. 在卸下六角
基之前，
起动器必须在适当的
水平，
以防从齿轮箱中漏油。
3. 在卸下六角
基时，
可能会从齿轮箱中漏出
少量的油。
(这是正常现象。)
4. 在重新装配之前，要清洁螺纹中的油，
并在用螺纹密封胶
（如No. SMB-441或同类产品）
以防止漏油。

用于内置排气装置的1/4"NPT
在使用内置排气装置时，
必须卸下防滑导向板装配，
并在气密接头孔中安装管堵头。
** 对于内置排气装置，必须是1/4"NPT
螺纹，在使用螺纹密封胶（如No. SMB-441）
或同类产品以防止泄露。
** 对于内置排气装置，
必须使用螺纹接头装配，
并使用连接到管路排气系统的气密软管替换气密接头，
使用螺纹密封胶（如No. SMB-441）或同类产品密封。

注意
1. 应该使气口向下在发动机上安装起动器。
2. 这些型号不能用于起动器暴露在空气露头中的情况。
3. 传动轴应与地面距离大于300mm以实现正确的安装位置。
4. 除非另行指定，否则根据提供的标准方向（OE）进行装运。
5. 请在尝试重新定位前阅读说明书。
6. 起动器重量=98 斤（444 千克）
管道布置图
预啮合安装的系统（显示 ST700 系列）

典型的车载安装

1/4”NPT 压力测量口。操作压力不超过在起动器标上所印的最大额定压力。

注意：
- 在所有管道连接处使用密封胶

** SMB - 441

典型的固定安装

1/4”NPT 压力测量口。操作压力不超过在起动器标上所印的最大额定压力。

注意：
- 在所有管道连接处使用密封胶

** SMB - 441

** 对于天然气操作，必须用管道排出起动器的主排气管。
- 要用管道连接传动机室，先卸下传动箱阀塞，然后用适当的接头接替。
- 管线必须在安全的位置排气，并且不得与任何其他排气管线相接。这些管线可能会对传动箱室产生回压。

(图: TPA1282-3)
管道布置图
惯性啮合系统（显示 ST700 系列）

典型的车载安装

画面中展示了管道布置图，详细描述了惯性啮合系统的安装和连接方式。

注意：
在所有管道连接处使用密封胶。
★ SMB - 441
★ Ingersoll Rand 部件编号

典型的固定安装

画面中展示了管道布置图，详细描述了惯性啮合系统的安装和连接方式。

注意：
在所有管道连接处使用密封胶。
★ SMB - 441
★ Ingersoll Rand 部件编号

(图. TPA1283-3)

**对于天然气操作，必须用管套安装起动器的排气管。**
要用管道连接转换阀，先断开转换箱的气管。
然后用适当的管套替代。
管套必须在安全的位置排放，并不碍与其他排气管或连接这些管套可能会对转换箱产生高压。
管道布置图

预装合安装的系统（显示 ST700 系列）

具有发动机预先润滑系统的典型安装时供应压力超过起动器压力的安装形式。

主启动阀 1½”

SRV150

JIC 37°接头 1/4”N.P.T.

空气压力表

150BMP - 1064L (仅空气)

油压感应阀

#4 号软管 (1/4”)

起动器控制阀

SMB-618 (钢/空气)

SMBG-618 (钢/气体)

1/4”N.P.T. 压力测量口。

操作压力不超过在起动器商标上所印的最大额定压力。

注意：

在所有管道连接处使用密封胶。

★ SMB - 441

** 对于天然气操作，必须用管路排出起动器的主排气管。

要拆管路连接储油箱，先卸下储油箱阀门，

然后用适当的管路替代。

管路必须在安全的位置排气，并且不得与任何其他排气管路相连。这些管路可能会对储油箱产生高压。

★ Ingersoll Rand 部件编号

(图. TPA1281-3)
管道布置图
典型多起动器装置

图. TPA1284-4
产品信息

用途：
ST700 系列涡轮电力起动器是为非公路车辆、船舶和固定装置中的空气或天然气操作而设计。

如何订购起动器

有关不同型号或特殊装置的信息，请就近联系 Ingersoll Rand 分销商或销售总部，Engine Starting Systems，P.O. Box 1776，Liberty Corner，NJ 07938，电话 (908) 647 - 6000。

(图纸 TPD1176)

(图纸 TPD1177)

(图纸 TPD1178)
製品に関する安全性

製品に関する安全性

これらのエアスターターは、往復内燃機関の始動に使用することを目的としています。これらのエアスターターは、始動させる必要のある往復内燃機関に正しく取り付けた後に、離れた場所から操作するように設計されています。

詳細は、「内燃機関用エアスターター製品安全情報説明書 45558624」を参照してください。
www.irools.com から説明書をダウンロードすることができます。

始動装置の供用
再組付け

最適の性能を得るために、シリーズ ST700 ターピン動力始動装置の再組付けまたは運転の前に本書を熟読してください。

一般情報

1. すべての車両への取り付けおよび操作に備えられた固定エンジンについて、始動装置に接続した管路を注意深く接続することを推奨します。製品の設計および構成を理解した上で、始動装置を正しく取り付けた後に、安全対策の検査を実施してください。

2. 本装置は、外気温度が -20°C 未満である場合、または高湿度（相対湿度 85% 以上）の条件下での使用を推奨します。潮湿による腐食を防ぐため、装置を保管する場所選びも重要です。

3. 始動装置の電気部品は、環境温度 -20°C から +10°C の範囲で動作を保証しています。温度がこれに外れた場合、始動装置の性能が低下することがあります。

4. 本装置は、中間変速装置ケーブルのantaged開けが保護されるように設計されています。取扱い中にケーブルを傷つけないよう注意が必要です。

5. 始動装置の回転方向は、エンジンの始動を容易にするための設計となっています。回転方向が逆である場合、エンジンの始動が困難になります。

6. 始動装置の供用と再組付けは、専門家に依頼することを推奨します。不適切な取り付けや操作は、安全対策を損なう可能性があります。

7. 始動装置の運転中にガスの漏れを確認するため、定期的に各部を点検することをお勧めします。ガスの濃度測定器を使用してガスの濃度を測定し、必要に応じて取付位置を調整し直すことが重要です。

8. システムの緊急再加圧用の「友好的握手」の再組付けを推奨します。「友好的握手」を清潔に、壊れやすい傷を取らないよう注意が必要です。

9. 各始動装置用の接触面にストレーナーを取り付けることが必要です。

Ingersoll Rand は 5 種類のストレーナーを提供します。
1-1/2 インチライン用 ST900-267-24
2 インチライン用 ST900-267-32 および ST900-267-32F
3 インチライン用 ST900-267-48
4 インチライン用 ST900-267-64

始動装置の向き

始動装置は、これを必要とするエンジン取り付けるお客様の特定の取り付け方法に合う正しい向きまたはお客様の特定の据付方法に合う正しい向きを注文されることが推奨されます。しかし、始動装置が再組付けの際に向きを変えた場合、以下のように進めてください。

1. EN5、EN6 および EN7 の各ページに記載されている寸法説明図を参照し、駆動部収納部が変速装置に対して放射状に位置する箇所の位置の中の 1 つに配置することができ、吸気口は、駆動部収納部に対して放射状の位置の 4 箇所の位置の中の 1 つに配置することができることを注意します。

2. エンジンの取り付け要求を検討し、変速装置に対する駆動部収納部の必要向きを決定します。駆動部収納部の向きを変える必要がある場合、駆動部収納部キャップの 8 本のネジを外し、駆動部収納部を変更した位置に回転させます。駆動部収納部キャップを 8 箇所の位置の中の 1 つに配置することができる。

3. 各始動装置用の吸気ラインにストレーナーを取り付けることが必要です。

Ingersoll Rand は 5 種類のストレーナーを提供します。
1-1/2 インチライン用 ST900-266-24
2 インチ管継手ネジ用 ST900-266-32
2 インチフランジ用 ST900-266-32F
3 インチフランジ用 ST900-266-48 および
4 インチライン用 ST900-266-64

備考

モーター収納部を分離させると潤滑油が無くなるので、分離させてください。

モーター収納部キャップの 4 本のネジを外しモーター収納部およびモーター収納カバーの両者またはどちらか一方を希望する位置に回転させます。

始動装置の取り付け

1. 8 ページから 11 ページに記載されている適切な関接図を検討して指示されているように取り付けます。

2. 始動装置取り付け用の空気受けタンクは、始動装置が推進される最大圧力以上の動作圧力定格を有する必要があります。

* Loctite Corporation の商標登録。
3. 始動装置を既に使用中の空気受けタンクに接続するときは、始動装置を取り付ける前に、タンク内の空気圧を徐々に減らして無くします。

警告
空気圧をバルブまたはコックを通して徐々に減らして無くします。タンク内にまだ圧力がある間にタンクから倉を抜くことをしないでください。

タクの底に溜まった水があれば排出します。

4. 1/1/2 インチショートニップルを使用して、配管図に示されているように空気受けタンクの端に [SRV150 始動装置リレーバルブ] を取り付けます。

5. 空気の取り入れに対しては、ダッシュパネル (車両再組立) または他の適切なパネル (固定再組立) に [始動装置制御バルブ (SMB-618)] を取り付けます。電気ソレノイド制御バルブおよびパネルに録付されている「L」フィードバック側に接続するよう確実にします。

6. 空気の取り入れに対しては、ダッシュパネル (車両再組立) または他の適切なパネル (固定再組立) に [始動装置制御バルブ (SMB-618)] を取り付けます。電気ソレノイド制御バルブおよびパネルに録付されている「L」フィードバック側に接続するよう確実にします。

7. [風圧計 (150BMP-1064)] を制御パネルまたはその周りに取り付けます。風圧計は、運転員が容易に見ることのできる場所に配置してください。

8. 始動装置制御バルブを始動装置駆動部に 1/4 インチホースで接続します。このラインに [風圧計] に至る短いフィーダーホースの付いたT字型分岐を取り付けます。ホースが始動装置制御バルブの供給側（「SUP」印されています）に接続されていることを確実にします。

9. 1/1/2 インチの空気ホースの必要な長さを決定するには、特別丈夫なホースまたは同径の柔軟な管類を受け側のリレーバルブからエンジン上の始動装置まで通じる線を追うと、その長さが適切であると確信することができます。

10. [風圧計 (150BMP-1064)] を制御パネルまたはその周りに取り付けて、風圧計は、運転員が容易に見ることのできる場所に配置してください。

11. 始動装置制御バルブをリレー部に 1/4 インチホースで接続します。このラインに [風圧計] に至る短いフィーダーホースの付いたT字型分岐を取り付けます。

12. 可能な場合、高品質のギアグリースの付いたリングギアの歯に大量にグリースを塗ります。こうすることにより、始動装置のピニオンの寿命を延ばすことができます。

13. 始動装置を所定の位置に固定し、フライホイール取納部上に取り付けます。取り付けボルトを 100 ft-lb (136 Nm) のトルクまで締め付けます。

14. 事前取り付け済みモディレに対する操作は、1/1/2 インチ ホースラインを始動装置制御バルブまたはレバーNPDバルブの供給側（「DEL」印されています）から始動装置用排気口の「SUP」入口に取り付けます。

備考
ホースが始動装置制御バルブの供給側（「SUP」印されています）に接続されていることを確認します。

重要点
空気圧を不用意に「OUT」出口に出すと、デラックス・パネルの吹き出し口に不可避の排気が発生し、安全を損なうおそれがあります。使用中や送気管または他の接続部に空気圧がある場合には、使用前に確認してください。

エンジンの閉じ込め
ときどき、注入管の設定およびタイミングの目的のために、またはそのどちらか一方のために、エンジンをどのような位置に設置しても、どのように設定されたことが望ましい場合があります。これは、[シリーズST700 タービン始動装置]で非常に容易に実施できます。

慣性駆動部付きモデルに対して
1. ハンドルをビニオンをもって、1/1/2インチ六角レンチを駆動部取納部に穴に挿入し、[モーター組立品]の背後で六角形の駆動部取納部はまるようにします。
2. エンジンが希望の位置までクラクーンで回転するまで [モーター組立品] を手動で回転させます。

事前取り付け済み駆動部を有するモデルに対して
1. [駆動部取納部]上の「OUT」出口にある1/4インチホースを外し、[駆動部取納部]の穴を用いて、ハンドルを20 psig (49 bar) の圧力で操作します。これにより、エンジンが期待の位置までクラクーンで回転するまで [モーター組立品] を手動で回転させます。
取り付け寸法

図面: TPA1277-5
配管図

事前取り付け済みシステム (表示されているシリーズ ST700)

典型的な車両取り付け

典型的な固定

備考: すべての配管接続に制御器を使用します。

** Ingersoll Rand 部品番号

(図面: TPA1282-3)
慣性タイプ システム (表示されているシリーズ ST700)

典型的な車両取り付け

- ソレノイドバルブ
- カウンタータイム
- 吸気パイプ
- 排気パイプ

典型的な固定取り付け

- ガス圧
- 高圧給気
- 防止装置

メカニカルデバイス

** 天然ガス使用の場合、始動装置のメイン排気は、配管で排出する必要があります。

- 銘板設置箇所
- 排気箇所

図面: TPA1283-3
配管図

事前取り付け済みシステム（表示されているシリーズ ST700）

供給力が定格始動圧力をを超えたときのエンジン事前潤滑システムとの典型的設定

**天然ガス運転をする場合** 始動圧のメイン排気は 配管で排出する必要があります。

動力圧関口に配管するためには、動力圧関を外側に適切な管路ラインに取り換えます。

管路は「安全な位置で通す」する必要があり、

動力圧関に逆の生を招くおそれのある他の排気管と

の相互接をしないようにする必要があります。

エンジン事前潤滑システムとの典型的設定

**天然ガス運をする場合** 始動圧のメイン排気は 配管で排出する必要があります。

運動圧関口に配管するために、

運動圧関を外側に適切な管路ラインに取り換えます。

管路は「安全な位置で通す」する必要があり、

動力圧関に逆の生を招くおそれのある他の排気管と

の相互接をしないようにする必要があります。

図面：TPA1281-3
一部の文字が見づらいです。
製品情報

製品の用途:
タービンを動力とするシリーズ ST700 始動装置は、オフハイウェイ、海洋および固定の各用途に於いて空気またはガスで運転するように設計されています。

始動装置の発注方法

<table>
<thead>
<tr>
<th>モデル</th>
<th>最大供給圧力PSIG/Kpa Max*</th>
<th>ビニオンデータ</th>
<th>敝数</th>
<th>D.P.</th>
<th>PD</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST750GBD03R31</td>
<td>ST750GBD03L32</td>
<td>150/1034</td>
<td>20BM-299-1</td>
<td>12/12</td>
<td>6/8</td>
<td>2.00&quot;</td>
</tr>
<tr>
<td>ST750GCDP03R25</td>
<td>ST750GCDP03L26</td>
<td>150/1034</td>
<td>20BM-299-3</td>
<td>12/12</td>
<td>6/8</td>
<td>2.00&quot;</td>
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<tr>
<td>ST789GBD03R31</td>
<td>ST789GBD03L32</td>
<td>90/621</td>
<td>20BM-299-1</td>
<td>12/12</td>
<td>6/8</td>
<td>2.00&quot;</td>
</tr>
</tbody>
</table>

発注するときに明記する必要があります。

別のモデルまたは特殊な用途については、最寄の Ingersoll Rand 販売店または SALES HEADQUARTERS, Engine Starting Systems, P.O. Box 1776, Liberty Corner, NJ 07938, 電話 (908) 647 - 6000 にご相談ください。

図面 TPD1176

図面 TPD1177

図面 TPD1178
Exploded Diagram, ST750 Turbine Powered Starter (Inertia)

(Dwg. TPA1272-2)
<table>
<thead>
<tr>
<th>Item</th>
<th>Part Description</th>
<th>Part Number</th>
<th>Item</th>
<th>Part Description</th>
<th>Part Number</th>
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<tbody>
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<td>Rear Drive Gear Bearing</td>
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<td>ST750 Turbine Powered Starter (Inertia)</td>
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<td>Gear Case Cover</td>
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<td>Exhaust Cover Seal</td>
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<td>Gear Case Cover O-Ring</td>
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<td>Drive Gear Shaft Seal</td>
<td>SS810-272</td>
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<td>3</td>
<td>Splash Deflector</td>
<td>ST700-735</td>
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<td>Drive Housing O-Ring</td>
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<td>for Models ST750GBDIO3R31 and ST799GBDIO3R31</td>
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<td>ST750R-A53</td>
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<td>for Models ST750GBDIO3L32 and ST799GBDIO3L32</td>
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<td>5</td>
<td>Deflector Retaining Screw</td>
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<td>7</td>
<td>Cap Screw Washer (4)</td>
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<td>Drive Housing Bearing</td>
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<td></td>
<td>Motor Housing Assembly</td>
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<td>8</td>
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<td></td>
<td>ST700-301</td>
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<td></td>
<td>Inlet Flange Kit (Includes Inlet Flange, Flange Mounting Bolts and Lock Washers)</td>
<td>ST700-K166</td>
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<td></td>
<td>Nameplate</td>
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<td>ST700-K167</td>
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<td>ST700-K10</td>
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<td>Tune-up Kit (for ST750 models with left hand rotation) includes illustrated parts 12, 14, 16, 16A, 17, 19, 20, 21, 22, 24 and 42</td>
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<tr>
<td>12</td>
<td>Motor Assembly</td>
<td></td>
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<td>Tune-up Kit (for ST750 models with right hand rotation) includes illustrated parts 14, 16, 16A, 17, 19, 20, 21, 22, 24 and 42</td>
<td>ST750L-TK3</td>
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<td>ST700-R-A53</td>
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* Not illustrated

† Indicates Tune-up Kit parts
## Parts List, Series ST700 Turbine Starter (Pre-Engaged) - Kits

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<td>Planet Gear Kit (includes illustrated parts 14, 19 [3], 20 [54], 21 [6] and 22 [3])</td>
<td>ST700-K10</td>
<td>*</td>
<td>Tune-up Kit (for ST799 models with left hand rotation) includes 12, 14, 16, 16A, 17, 19, 20, 21, 22, 24 and 66A</td>
<td>ST799R-TK5</td>
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<td>Tune-up Kit (includes illustrated parts 14, 15, 16, 16A, 17, 19, 20, 21, 22, 24 and 66A)</td>
<td>ST700-TK1</td>
<td>*</td>
<td>Tune-up Kit (for Pre-engaged drive models) includes illustrated parts 31, 41, 45, 47, 48, 55 and 60</td>
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<td>Tune-up Kit (for ST750 models with right hand rotation) includes illustrated parts 12, 14, 16, 16A, 17, 19, 20, 21, 22, 24 and 66A</td>
<td>ST750R-TK2</td>
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* Not illustrated
ST700K-350 Exhaust Kit (Available at extra cost)

Installation of Exhaust Kit

**NOTICE**

To aid in installation of ST700K-350 Exhaust Kit, refer to Drawings TPA1272-2 and TPA1273-2 in this manual.

**WARNING**

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.

1. Using an 8 mm hex-head wrench, remove Starter Assembly Cap Screws (6) and Cap Screw Washers (7).
2. Pull the Housing Exhaust Cover (1) from the Motor Housing (8). To dislodge the Housing Exhaust Cover, rotate it until it clears the Motor Housing. Using a plastic hammer, tap the ears alternately until the Housing Exhaust Cover can be removed from the Motor Housing.

**NOTICE**

If Exhaust Cover Seal (106) was removed or damaged, replace it with a new Seal.

3. Coat the Exhaust Cover Seal with O-ring lubricant and install in the groove in the Directional Housing Exhaust Cover (101).
4. Install Directional Housing Exhaust Cover on the rear of the Motor Housing in the desired orientation and using a plastic hammer, tap the Directional Housing Exhaust Cover until it seats.
5. Secure the Directional Housing Exhaust Cover on the rear of the Motor Housing using the Starter Assembly Cap Screws and Cap Screw Washers. Using an 8 mm hex-head wrench, tighten each Cap Screw a little at a time to a final torque of 55 ft-lb (74.5 Nm) in 20 ft-lb (27 Nm) increments.
7. Install Exhaust Adapter with Exhaust Adapter Seal down on Directional Housing Exhaust Cover. Align holes and secure Adapter with Cap Screws (102) and Lock Washers (103). Tighten each Cap Screw a little at a time to a final torque of 48 ft-lb (65 Nm torque) in 20 ft-lb (27 Nm) increments.

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<table>
<thead>
<tr>
<th>Item</th>
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<tr>
<td>101</td>
<td>Directional Housing Exhaust Cover</td>
<td>ST700-350</td>
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<tr>
<td>102</td>
<td>Capscrew (6)</td>
<td>ST700-703</td>
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<td>103</td>
<td>Lockwasher (6)</td>
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<td>104</td>
<td>Exhaust Adapter</td>
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<td>Exhaust Adapter Seal</td>
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<td>Exhaust Adapter Seal</td>
<td>ST700-352</td>
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<tr>
<td>*</td>
<td>Plug</td>
<td>R0H-377</td>
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* Not illustrated.
Maintenance

**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 ST700 Starter is disassembled for maintenance or repair, lubricate the starter as follows:

**For Models with Inertia Drive**

**NOTICE**
On models with inertia drive, do not lubricate the threaded area of the Drive Shaft as it could collect dirt and foreign material which will prevent efficient operation.

**For Models with Pre-Engaged Drive**
1. Lubricate the inside diameter of the Drive Shaft (57) 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 (40).
4. Roll the Piston Return Spring (59) in Ingersoll Rand No. 130 Grease.
5. Coat the outside of the Piston (54) with Ingersoll Rand No. 130 Grease.

**For All Models**
1. Lubricate all O-rings with O-ring lubricant.
2. Lubricate the Front Drive Gear (29) with 8 oz. (240 ml) of Ingersoll Rand No. 130 Grease.
3. Coat the Front Bearing Spacer (25) with gear lube before installing.
4. Add 175 ml (approximately 1/3 pint) of Dexron® II Automatic Transmission Fluid through the side plug hole in the Motor Housing (8).

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 copper-covered vice jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded and die cast 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 ST700 Turbine Starter. Never reuse old seals or O-rings.
5. Always mask adjacent parts on the Housing Exhaust Cover (1), Motor Housing (8), Intermediate Gear Case (13), Gear Case (28) and Drive Housing (38) so these members can be located in the same relative position when the Starter is reassembled.
6. Never wash the Inertia Drive in a solvent.
7. 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 Housing Exhaust Cover, Motor Assembly, and Motor Housing**
1. If replacing the Motor Assembly (12), remove both Housing Plugs (10) and drain the oil from the gearing before beginning disassembly of the Starter. Inspect the Magnetic Housing Plugs (10) for metal particles. Very fine metal particles are normal. Remove particles and reinstall plugs. Large particles or chips are an indication of a problem. Disassemble Gear Case (28) and inspect.
2. Using an 8 mm hex-head wrench, unscrew and remove the Starter Assembly Cap Screws (6) and Washers (7).
3. Pull the Housing Exhaust Cover (1) from the Motor Housing (8). To dislodge the Housing Exhaust Cover, rotate it until the ears clear the Motor Housing. Using a plastic hammer, tap the ears alternately until the Housing Exhaust Cover can be removed from the Motor Housing. Refer to Dwg. TPD1159.
4. Remove the Deflector Retaining Screw (5), Deflector Retaining Spring (4) and the Splash Deflector (3) from the Housing Exhaust Cover. Refer to Dwg. TPD1160.
5. Tap the Motor Housing with a plastic hammer to dislodge it from the Intermediate Gear Case (13). Refer to Dwg. TPD1162.

6. Grasp the rear of the Motor Assembly (12) and pull it from the rear of the Motor Housing. If the Motor Assembly is difficult to remove, lightly push the motor pinion which is on the front of the Motor Assembly toward the exhaust side of the Motor Housing in order to free the Motor Assembly. Refer to Dwg. TPD1161.

7. Tap the Intermediate Gear Case with a plastic hammer to dislodge it from the Gear Case (28). Refer to Dwg. TPD1164.

8. Position the Intermediate Gear Case on a bench in a copper-faced vise so that the Intermediate Pinion (26) is secured in the jaws of the vise. Tighten the vise only enough to hold the Intermediate Pinion securely.

9. Loosen the Intermediate Pinion Retaining Screw (27) 1-1/2 turns only. Do not remove.

10. Remove the Intermediate Gear Case Assembly from the vise and remove the Intermediate Pinion. Remove the Rear Gear Case O-ring (14) and Front Gear Case O-ring (15) from the Intermediate Gear Case.

11. Remove the Planet Gear Frame Assembly from the Intermediate Gear Case. Using a sleeve that contacts the outer race of the Front Gear Frame Bearing (17), press the Planet Gear Frame Shaft Seal (16) and the Front Gear Frame Bearing (17) from the front end and out of the rear of the Intermediate Gear Case. Refer to Dwg. TPD1166.

12. Using a bearing puller, remove the Rear Gear Frame Bearing (24) from the Planet Gear Frame (18) and remove the Gear Shaft Retaining Washer (23).

13. Remove the Planet Gear Shafts (22), Planet Gears (19), Planet Gear Bearings (20) and Bearing Spacers (21).

14. Using a bearing puller, remove the Front Bearing Spacer (25) and the Gear Shaft Retaining Washer (23) from the front of the Planet Gear Frame by pressing on the front of the Planet Gear Frame Shaft. Refer to Dwg. TPD1167.

**WARNING**

Remove the Gear Shaft Retaining Washer only if the Washer or Front Bearing Spacer is damaged.

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**WARNING**

If the Intermediate Gear Case is not supported on a bench and if the Intermediate Pinion Retaining Screw is completely removed, the Intermediate Gear Case and components could fall causing injury.

Tap the Intermediate Pinion lightly to back the Planet Gear Frame Assembly out of the Intermediate Gear Case. Refer to Dwg. TPD1169.
Disassembly of the Drive Housing

Inertia Models:
1. Remove the eight Drive Housing Cap Screws (40) and Lock Washers (41).
2. Tap the Drive Housing (38) with a plastic hammer to help dislodge it from the Gear Case Cover (32). Remove the Drive Housing (38) from the Starter Drive (36). Refer to Dwg. TPD1168.
3. Place the Drive Housing in an arbor press, bearing end up. Using a pressing bar remove the Drive Housing Bearing (39) the Drive Housing.
4. Using a screwdriver, displace the locking spring and remove the screw holding the Starter Drive (36) to the Drive Gear Shaft.
5. Slide the Starter Drive off the Drive Gear Shaft.
6. Remove the two Drive Gear Keys (37) from the Drive Gear Shaft. Refer to Dwg. TPD1171.
7. Remove the Gear Case Cover from the Gear Case.
8. Remove the Drive Housing G-ring (35) and the Gear Case Cover Seal (33) from the Gear Case Cover.
9. Pull the Drive Gear (30) out of the Gear Case.
10. Remove the Rear Drive Gear Bearing (31) and the Front Drive Gear Bearing (30) from the Drive Gear.

Pre-Engaged Models:
1. Grasp the Drive Pinion (63) in a copper-faced vise with the Starter supported on the workbench.
2. Remove the Drive Pinion Retaining Screw (61).
3. Remove the Starter from the vise.
4. Remove the Drive Pinion Washer (62) and the Drive Pinion.
5. Slide the Pinion Spring Sleeve (64) and the Pinion Spring (65) off the Drive Shaft.
6. Using an impact wrench with a 5/16” (8 mm) x 8” (203 mm) long hex inserted into the end of the Drive Shaft, unscrew the Drive Gear Screw (34).
7. Unscrew and remove the Drive Housing Cap Screws (38) and Lock Washers (39).
8. Tap the Drive Housing (40) with a plastic hammer to help dislodge it from the Gear Case (28).

Failure to follow this procedure could result in injury to personnel.
9. Place the Drive Housing in an arbor press, piston end up. Apply a load to the Piston (54) using the arbor press to compress the Piston Return Spring (59) before removing the Bulkhead Retainer (45). Do not use compressed air to load the Piston.
10. Using a screwdriver, remove the Bulkhead Retainer. Use off the arbor press.

CAUTION
Make sure the tension of the spring pushes the Bulkhead out of the Drive Housing before removing the Drive Housing from the arbor press.
11. Remove the Bulkhead (46) from the Piston.
12. Remove the Outer Bulkhead Ring (47) and the Inner Bulkhead Ring (48).
13. Slide the Drive Shaft (57) from the Drive Housing.
14. Pull the Piston Return Spring (59) off the Drive Shaft.

Do not remove the Front Drive Shaft Bearing (42) or the Drive Housing Seal (43) unless replacement is necessary and new parts are available. The Bearing and/or the Seal will always be damaged when removed from the Drive Housing.
15. Remove the Piston Ring (55) from the Piston.
16. Insert a large screwdriver blade through the Piston Seal (56) so that it rests on top of the Clutch Spring Cup (50). Pry the Seal out of the Piston.

NOTICE
This operation will damage the Piston Seal. Therefore, a replacement Piston Seal must be on hand.
17. Press the Clutch Spring Cup (50) down and remove the Clutch Spring Cup Retainer (49).
18. Remove the Clutch Spring Cup and Clutch Spring (51).
19. Remove the two Clutch Jaws (52).
20. Remove the Front Drive Gear Bearing (30), Drive Gear Cup (46), Drive Gear Lock Washer (35), Drive Gear Screw Ring (37) and Drive Gear Screw (34).
21. Using a screwdriver, remove the large Drive Shaft Bearing Retainer (53).
22. Press the Rear Drive Shaft Bearing and Drive Shaft (57) out of the Piston. If the Rear Drive Shaft Bearing needs to be replaced, proceed as follows:
   a. Using a small chisel, cut and remove the small drive shaft bearing retained in the Drive Shaft.
   b. Press the Rear Drive Shaft Bearing (58) off the Drive Shaft.
23. Place the Gear Case (28) on a workbench
24. Using retaining ring pliers and working through the access holes in the gear web, remove the Drive Gear Bearing Retainer (32). Refer to Dwg. TPD1170.
25. Pull the Drive Gear (29) out of the Gear Case.

**NOTICE**

Do not disassemble the Drive Gear and Clutch parts of Series ST700 Turbine-Powered Starters. If the Drive Shaft is defective, install a new or factory-rebuilt unit.

26. Using retaining ring pliers, remove the Drive Gear Shaft Bearing Retainer (33).

27. Remove the Rear Drive Gear Bearing (31) from the Drive Gear.

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**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 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 Gear case and Drive Housing Inertia Drive Models:**

**NOTICE**

On models with Inertia Drive, do not lubricate threaded area of the Drive Shaft as it could collect dirt and foreign material which will hinder efficient operation.

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26. Using retaining ring pliers, remove the Drive Gear Shaft Bearing Retainer (33).

27. Remove the Rear Drive Gear Bearing (31) from the Drive Gear.

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(Dwg. TPD1171)

**Gear Case**

1. Install the Rear Drive Gear Bearing (31) and Front Drive Gear Bearing (30) onto the Drive Gear (29).
2. Install the two Drive Gear Keys (37) into the drive gear shaft. Refer to Dwg. TPD1171.

3. Slide the Rear Drive Gear Bearing into the Gear Case.
4. Lubricate the Drive Gear with approximately 8 oz. (240 ml) of Ingersoll Rand No. 130 Grease.
5. Press the Drive Gear Shaft Seal (34) down into the Gear Case Cover (32) lip facing upward.
6. Install the Gear Case Cover O-ring (33) onto the Gear Case Cover.
7. Install the Gear Case Cover into the Gear Case.
8. Slide the Starter Drive (36) onto the drive gear shaft and tighten the Starter drive locating ring and screw securely.
9. Press the Drive Housing Bearing (39) into the Drive Housing (38) and lubricate with Ingersoll Rand No. 130 Grease. See Dwg. TPD786.
10. Install the Drive Housing O-ring (35) onto the Drive Housing.
11. Install the Drive Housing onto the Gear Case, aligning the punches.
12. Install the eight Drive Housing Cap Screws (40) and Drive Housing Cap Screw Lock Washers (41). Tighten to 28 ft-lb (38 Nm) torque. Refer to Dwg. TPD1168.
1. Place the Drive Gear Bearing Retainer over the rear end of the Drive Gear.
2. Using an arbor press, press the Rear Drive Gear Bearing (31) onto the rear end of the Drive Gear.
3. Using a plastic hammer, seat the Rear Drive Gear Bearing into the Gear Case by tapping the opposite end of the Drive Gear.
4. Using retaining ring pliers, install the Drive Gear Shaft Bearing Retainer (33).
5. Using retaining ring pliers and working through the access holes in the gear web, install the Drive Gear Bearing Retainer. Refer to Dwg. TPD1170.

**Assembly of the Gear case and Drive Housing Pre-Engaged Models:**

**Gear Case**

6. Lubricate the Drive Gear with approximately 8 oz. (240 ml) of Ingersoll Rand No. 130 Grease.
7. Press the Rear Drive Shaft Bearing (58) onto the Drive Shaft.
8. Slide the small bearing retainer convex side first, onto the Drive Shaft. Press it into position in accordance with the instructions packaged with the new Retainer.
9. Assemble the Drive Gear Screw (34), Drive Gear Lock Washer (35), Drive Gear Cup (36) and Drive Gear Screw O-ring (37).
10. Grasp the Drive Shaft (57) in a vise, external splined end down.
11. Insert the Clutch Spring (51) into the Drive Shaft.
12. Lubricate with Ingersoll Rand No. 130 Grease and install the Clutch Spring Cup Retainer (49).
13. Insert the Clutch Spring Cup (50) into the Drive Shaft.
14. Press the inserted parts into the Drive Shaft, and install the Clutch Spring Cup Retainer (49).

**NOTICE**

If it is necessary to replace the Drive Housing (40) and drive components, make sure that the Piston Seal (part number S5800-272) has been removed from the rear of the new Piston (54). The Piston Seal must be removed to prevent pressure build-up which will cause movement of the Planet Gear Frame Shaft Seal (16). If this condition occurs, the Piston cannot retract and the Drive Pinion (63) will remain in engagement with the flywheel, causing damage to the Starter drive train and/or Starter motor. To remove the Piston Seal, insert a screwdriver inside the lip of the Seal and pry it loose from the Piston.

15. Press the inserted parts into the Drive Shaft, and install the Clutch Spring Cup Retainer (49).
16. Assemble the Drive Gear Screw (34), Drive Gear Lock Washer (35), Drive Gear Cup (36) and Drive Gear Screw O-ring (37). Place assembled Drive Shaft Screw Unit into the Drive Shaft, screwhead down. Lubricate the inside diameter of the Drive Shaft with Ingersoll Rand No. 130 Grease.
17. Press the inserted parts into the Drive Shaft, and install the Clutch Spring Cup Retainer (49).
18. Using O-ring lubricant, lubricate the Piston O-ring (55) and install it in the groove of the Piston.
19. Position the Drive Housing in an arbor press, pinion-end down and install the Drive Housing Seal (43) into the Drive Housing. Using a pressing sleeve of the proper size; press the Seal into the Drive Housing so that the lip of the seal faces away from the Drive Pinion.
20. Using a sleeve that contacts the outer race of the Front Drive Shaft Bearing (42), press the Bearing into the Drive Housing until it seats. For “B” and “C” ratio models only, drop the Piston Return Spring Seat (60) on top of the Front Drive Shaft Bearing. (See illustration TPA1273-5 on page 16.)
21. Slide the Piston Return Spring (59) onto the Drive Shaft and snap it into the front of the Piston so that it is against the Large Drive Shaft Bearing Retainer (53).
22. Lubricate and insert the assembled Drive Shaft into the Drive Housing.
23. Using O-ring lubricant, lubricate and install the Outer Bulkhead O-ring (47) and the Inner Bulkhead O-ring (48) on the Bulkhead (45).
24. Slide the Bulkhead onto the Piston.
25. With the Drive Housing in the arbor press, press down on the rear face of the Piston.

**NOTICE**

Feel the underside of the Drive Housing to make sure the Drive Shaft passes through the Bearing.

26. Using a screwdriver, install the Bulkhead Retainer (45).

**NOTICE**

Make sure the Bulkhead Retainer is properly seated in the Motor Housing groove before easing off the arbor press. Failure to do so will allow improperly retained parts to separate when removed from the arbor press resulting in injury to personnel.

27. Remove the Drive Housing from the arbor press.
28. Using O-ring lubricant, lubricate and install the Drive Housing O-ring (41) in the groove of the Drive Housing.
29. Position the assembled Gear Case on a workbench. The assembled unit must be upright to accept the Drive Housing.
30. Carefully position the assembled Drive Housing (40) onto the Gear Case so as not to damage the Piston Seal. Align the punch marks of the Gear Case and Drive Housing.
31. Install the Drive Housing Cap Screw Lock Washers (39) and the Drive Housing Cap Screws (38) and tighten to 28 Ft-lb (38 Nm) torque.
32. Using an impact wrench with a 5/16” (8 mm) x 8” (203 mm) long hex inserted into the end of Drive Shaft, tighten the Drive Gear Screw (34) to 29 Ft-lb (39.3 Nm) torque.

(Dwg. TPD1168)

(Dwg. TPD1170)
33. Lubricate using **Ingersoll Rand** No. 11 Grease and slide the Pinion Spring (65) and the Pinion Spring Sleeve (64) over the Pinion end of the Drive Shaft.

34. Lubricate the Pinion end of the Drive Shaft with **Ingersoll Rand** No. 11 Grease and install the Drive Pinion (63).

35. Grasp the Drive Pinion in a leather-covered or copper-covered vise with the starter supported on a workbench.

36. Place the Drive Pinion Washer (62) onto Drive Pinion Retaining Screw (61).

### NOTICE

Models ending in R25, R31 and R51 have a left-hand thread; models ending in L26, L32 and L52 have a right-hand thread. Install the Drive Pinion Retaining Screw into the end of the Drive Shaft and tighten it to 80 ft-lb (108.5 Nm) torque for models with “B” and “C” gear ratios and to 125 ft-lb (169.5 Nm) torque for models with “D” gear ratio.

### Assembly of the Intermediate Gear Case, Motor Housing, Motor Assembly and Housing Exhaust Cover

1. Using a bearing pressing tool of the proper size, press the Front Gear Frame Bearing (17) into the rear of the Intermediate Gear Case (13). Place Spacer Ring (16A) on Bearing.

2. Using a sleeve which contacts the outer ring of the seal, press the Planet Gear Frame Shaft Seal (16) into the rear of the Intermediate Gear Case over the Front Gear Frame Bearing. Refer to Dwg. TPD1172-1.

### NOTICE

Make sure the flat side of the Seal is installed against the Bearing.

(Dwg. TPD1172-1)


4. Install one Gear Shaft Retaining Washer (23) on the front of the Planet Gear Frame (18). Press the Front Bearing Spacer (25) on the front shaft of the Planet Gear Frame to hold the Gear Shaft Retaining Washer snugly in position.

### NOTICE

Coat the Front Bearing Spacer with Gear Lube before installing it. Be careful not to gouge or scratch the Front Bearing Spacer during installation as this could result in leakage between the Planet Gear Frame and Gear Case.

5. Place Planet Gear Frame on a bench, shaft side down. Place the Planet Gear Bearing (20) inside of Planet Gear (19), Place Bearing Spacers (21) on top and bottom of Bearing and Gear. Slide the components into the slots in the side of the Planet Gear Frame. Align holes in Spacers and Bearing with holes in Planet Gear Frame and insert Planet Gear Shaft (22), integral keyed end down, through the Spacers and Bearing so that the larger portion of the keyed end of the Shaft contacts the Planet Gear Shaft Retaining Washer. Repeat the procedure for the two remaining Planet Gears and Components.

6. Install the other Planet Gear Shaft Retaining Washer over the shaft at the rear of the Planet Gear.

7. Using the proper size bearing inserting tool, press the Rear Gear Frame Bearing (24) on the shaft at the rear of the Planet Gear. Refer to Dwg. TPD1167.

8. Slide the Planet Gear Frame Assembly, coupling end first, into the rear of the Intermediate Gear Case (13), making sure that the Planet Gears mesh with the ring gear. Use care so as to not damage the seal. Refer to Dwg. TPD1173.

9. Install the Intermediate Pinion (26) making sure that the notches at the rear of the Pinion align with the notches and tangs in the shaft of the Planet Gear Frame.

10. Clean the threads of the Intermediate Pinion Retaining Screw (27) and apply 2-3 drops of Permabond HM118**** to the threads approximately 3 mm from the end of the Screw. Install Screw and tighten enough to hold assembly together.

11. For final tightening, position the Intermediate Gear Case so the Intermediate Pinion is secured in the jaws of a leather-covered or copper-faced vise. Tighten the Intermediate Pinion Retaining Screw to 90 ft-lb (122 Nm) torque. Refer to Dwg. TPD1204.

*** Registered trademark of Permabond Corporation.
12. Remove the Intermediate Gear Case from the vise and set it on a bench.

**NOTICE**

The Intermediate Gear Case will work in only one orientation. Align the punch marks on the Intermediate Gear Case and Gear Case and using a plastic hammer, tap the Intermediate Gear Case until it seats in the rear of the Gear Case. Make sure the Intermediate Pinion meshes with Drive Gear. Refer to Dwg. TPD1165.

13. 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 the geared end of the rotor toward the front. Refer to Dwg. TPD1161.

**NOTICE**

Turn the Intermediate Pinion so that the gear on the rotor meshes with the Planet Gears. Make sure that the rear of the Motor Assembly is installed flush with the rear of the Cylinder.

14. Align the punch marks on the Motor Housing with the punch marks on the Intermediate Gear Case and using a plastic hammer, tap the Motor Housing until it seats on the rear of the Intermediate Gear Case. Refer to Dwg. TPD1163.

**NOTICE**

When assembling the exhaust cover to the starter, add 15 ml of Dextron®II Automatic Transmission Fluid through the pipe plug hole in the Exhaust Cover.

15. Coat the Exhaust Cover Seal (2) with O-ring lubricant and install in the groove on the Housing Exhaust Cover.

16. Align the punch marks on the Housing Exhaust Cover with the punch marks on the Motor Housing and using a plastic hammer, tap the Housing Exhaust Cover until it seats.

17. Install the Housing Exhaust Cover on the rear of the Motor Housing using the Starter Assembly Cap Screws (6) and Cap Screw Washers (7). Use an 8 mm hex-head wrench to tighten each a little at a time to a final torque of 45 to 50 ft-lb (61 to 68 Nm). Refer to Dwg. TPD1183.

**NOTICE**

Coat the threads of the Deflector Retaining Screw with Ingersoll Rand SMB-441 Sealant.
Free speed specifications should be as follows:

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<th>MAXIMUM</th>
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<td>4600 rpm</td>
</tr>
<tr>
<td>&quot;C&quot; ratio</td>
<td>3660 rpm</td>
<td>4130 rpm</td>
</tr>
<tr>
<td>&quot;D&quot; ratio</td>
<td>2870 rpm</td>
<td>3100 rpm</td>
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</table>

13. **Exhaust Deflector Operation:** Install Starter on testing fixture. Apply low air pressure to motor and observe. Deflector must return to its normal position after operation of the Starter.

14. **Concentricity and Squareness of Shaft to Housing "D" Ratio Only:** Assemble indicator on shaft. Indicate pilot diameter. Check squareness of face at mounting surface. Pilot diameter must be concentric within 0.008 max. T.I.R. Mounting face must be square within 0.004 T.I.R. max.

15. **Drive Housing Leakage-P-Engaged Models Only:** Plug Drive Housing (40) "OUT" port and apply 50 psig (3.45 bar/345 kPa) to "IN" port to extend Drive Shaft (57). There should be no leakage.

16. **Test Pinion Engagement-P-Engaged Models Only:** Plug "OUT" port in Drive Housing (40). Apply 50 psig (3.45 bar/345 kPa) as needed. In its normal position, the distance from the mounting flange to the end of the Drive Shaft (57) should be 1-3/4". In its extended position, the distance from the mounting flange to the end of Drive Shaft should be 2-7/8". While the Drive Shaft is extended, push Drive Pinion (63) back on helical splined shaft. Rear face of Drive Pinion must move back 0.47" ± 0.035".

19. Install the bottom Housing Plug (10) and the Housing Plug Inlet Boss (11). Put the Starter on its side with the side plug hole upward. Add 175 ml (approximately 1/3 pint) of Dexron® II Automatic Transmission Fluid through the side plug hole in the Motor Housing (8).

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Do not overfill.

Install the side Housing Plug (10) and tighten all plugs to 5 to 10 ft-lb (6.8 to 13.6 Nm) torque.

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**Test and Inspection Procedure**

1. **Clutch Ratcheting:** Turn the Drive Shaft Pinion (63) by hand in the direction of Starter rotation. The clutch should ratchet smoothly with a slight clicking action.

2. **Motor and Gearing Freeness:** Turn the Drive Shaft Pinion (63) opposite the direction of Starter rotation. The Drive Shaft Pinion should turn by hand.

3. **Pinion Engagement:** Apply 50 psig (3.4 bar/245 kPa) pressure to the engagement “IN” Port. Drive Shaft Pinion (63) should move outward and air or gas should escape from the “OUT” Port. Plug the “OUT” Port and apply 150 psig (10.3 bar/1034 kPa) pressure to the “IN” Port. Check and make sure no air or gas is escaping. Measure the distance from the face of the Drive Shaft Pinion (63) to the face of the mounting flange. It should be 2-23/32” (69.0 + 2.0 mm) for models with “B” and “C” ratio gearing and 8-3/4” (222 + 2.0 mm) for models with “D” ratio gearing. Remove the pressure from the “IN” Port. Measure the distance from the face of the Drive Shaft Pinion to the face of the mounting flange. It should be 1-23/32” (43.0 + 2.0 mm) for models with “B” and “C” ratio gearing and 7-3/32” (180 + 2.0 mm) for models with “D” ratio gearing.

4. **Motor Action:** Secure Starter in a vise and apply 90 psig (6.2 bar/620 kPa) pressure using a 3/8” (9 mm) supply line to the inlet of the motor. Starter should run smoothly.

5. **Motor Seals:** Plug the exhaust and slowly apply 20 psig (1.38 bar/138 kPa) pressure to the inlet of the motor. Immerse the Starter for 30 seconds in a nonflammable, bubble-producing liquid. If the Starter is properly sealed, no bubbles will appear.

6. **Gear Case Seals:** Plug the exhaust and slowly apply 20 psig (1.38 bar/138 kPa) pressure to the inlet of the motor. Immerse the Starter for 30 seconds in a nonflammable, bubble-producing liquid. There should be no leakage in the housing joints in the Gear Case area or in the shaft seal in the Intermediate Gear System. If the Starter is properly sealed, no bubbles will appear.

7. **Confirm Motor Rotation:** Remove Housing Plug (10). Use a 1/4” hex drive to rotate the motor to verify proper motor adjustment. Intermediate Gearing output should rotate opposite the required starter rotation while observing from the pinion side. Replace Housing Plug.

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**NOTICE**

Use Ingersoll Rand SMB-441 Pipe Sealant on all plugs.
## Troubleshooting Guide

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable Cause</th>
<th>Solution</th>
</tr>
</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>
</tr>
<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 the blockage.</td>
</tr>
<tr>
<td></td>
<td>Blocked exhaust system</td>
<td>Remove Housing Exhaust Cover and check for blockage.</td>
</tr>
<tr>
<td></td>
<td>Defective Control Valve or Relay Valve</td>
<td>Replace Control Valve or Relay Valve.</td>
</tr>
<tr>
<td>Loss of Power</td>
<td>Low air pressure to Starter</td>
<td>Check air supply.</td>
</tr>
<tr>
<td></td>
<td>Restricted air supply line</td>
<td>Check for blockage or damage to air lines.</td>
</tr>
<tr>
<td></td>
<td>Relay Valve malfunctioning</td>
<td>Clean or replace lines or Relay Valve. Lubricate Relay Valve.</td>
</tr>
<tr>
<td></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>Damaged Motor Assembly</td>
<td>Replace Motor Assembly.</td>
</tr>
</tbody>
</table>

### For Models with Inertia Drive:

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive will not engage</td>
<td>Foreign material in Starter Drive</td>
<td>Remove obstruction.</td>
</tr>
<tr>
<td></td>
<td>Damaged or worn Drive parts</td>
<td>Check Drive components and replace if necessary.</td>
</tr>
</tbody>
</table>

### For Models with Pre-Engaged Drive:

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive will not engage</td>
<td>No pressure to Drive Housing port</td>
<td>Check air supply.</td>
</tr>
<tr>
<td></td>
<td>Internal Drive Housing ports blocked</td>
<td>Remove blockage.</td>
</tr>
<tr>
<td></td>
<td>Fluid in drive unit components</td>
<td>Remove fluid.</td>
</tr>
<tr>
<td></td>
<td>Damaged or worn Piston Assembly, O-rings or seals</td>
<td>Replace damaged or worn parts.</td>
</tr>
<tr>
<td></td>
<td>O-rings and seals dry</td>
<td>Re-lube O-rings and seals.</td>
</tr>
<tr>
<td>Motor runs, Pinion engages, but does not rotate flywheel</td>
<td>Damaged or broken drive train</td>
<td>Disassemble drive train and replace worn or damaged parts.</td>
</tr>
</tbody>
</table>

### Excessive butt engagement

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil blowing out of exhaust</td>
<td>Oil in air supply line</td>
<td>Inspect air line and remove source of oil.</td>
</tr>
<tr>
<td></td>
<td>Splash Deflector Retaining Screw or pipe plug missing</td>
<td>Install Splash Deflector Retaining Screw or pipe plug.</td>
</tr>
<tr>
<td></td>
<td>Worn or damaged rotor seals or static O-Rings</td>
<td>Replace static seals on outside of Motor or send Motor to Ingersoll Rand to be rebuilt.</td>
</tr>
</tbody>
</table>

### Oil leaking from Gear Case

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Worn or damaged O-Rings</td>
<td>Replace O-Rings.</td>
</tr>
<tr>
<td></td>
<td>Loose joints.</td>
<td>Make sure that joints fit properly and Starter Assembly Cap Screws are tightened to 60 ft-lb (81 Nm) torque. Make sure all seals and O-Rings fit and seal properly at their perimeters. If they do not, replace with new seals and O-Rings.</td>
</tr>
<tr>
<td></td>
<td>Excessive high-speed operation</td>
<td>Operate according to recommendations.</td>
</tr>
<tr>
<td></td>
<td>High number of start cycles</td>
<td>Replace worn components.</td>
</tr>
<tr>
<td></td>
<td>Loose or leaking Pipe Plugs</td>
<td>Tighten or replace Pipe plugs using Ingersoll Rand SMB-441 Pipe Sealant.</td>
</tr>
<tr>
<td></td>
<td>Splash Deflector Retaining Screw or pipe plug missing</td>
<td>Tighten Splash Deflector Retaining Screw or replace pipe plug.</td>
</tr>
</tbody>
</table>

### Air or gas leakage

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<tr>
<td></td>
<td>Loose Joints.</td>
<td>Make sure that joints fit properly and that Starter Assembly Cap Screws are tightened to 60 ft-lb (81 Nm) torque. 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.</td>
</tr>
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<td></td>
<td>Excessive high-speed operation</td>
<td>Operate according to recommendations.</td>
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<td>Loose or leaking Pipe Plugs</td>
<td>Tighten or replace pipe plugs.</td>
</tr>
<tr>
<td></td>
<td>Splash Deflector Retaining Screw or pipe plug missing</td>
<td>Tighten Splash Deflector Retaining Screw or replace pipe plug.</td>
</tr>
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</table>
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 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 Service center.

When the life of the Starters has expired, it is recommended that the Starters 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.