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 ingersollrandproducts.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. Separation of the Drive Housing from the Gear Case is not required. Reinstall the 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.

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.

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. It is required that a strainer be installed in the inlet line for each starter.

Ingersoll Rand offers 5 strainers:

- ST900-267-24 for 1-1/2 inch lines,
- ST900-267-32 and ST900-267-32F for 2 inch lines,
- ST900-267-48 for 3 inch lines and
- ST900-267-64 for 4 inch lines.

These 300 mesh strainers provide 50 micron filtration and offer significant protection against supply line contaminates which could damage the turbine components. Replacement elements are:

- ST900-266-24 for 1-1/2 inch,
- ST900-266-32 for 2 inch pipe thread,
- ST900-266-32F for 2 inch flange,
- ST900-266-48 for 3 inch flange and
- ST900-266-64 for 4 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 ENS, 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 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.
ST700 Inertia Mounting Dimensions

1. Mounting hole opposite the pinion opening here the sta
2. Splash Deflector (During Operation)
3. Standard Size Star Drive Housing (Motor Housing)
4. 1/4" Pipe Plug in Housing Inlet Boss (1.41")
5. Pipe Plug supplied with Starter.
6. Before removing the Hex. Plug the Starter should be installed on the engine with the exhaust pointed down.
7. Before reassembling the Starter, clean threads and apply Pipe Thread Sealant (IR No. SMB-441 or equivalent) to prevent oil leakage.
8. Standard orientation shown on 6/5/89 be shipped unless otherwise specified.

Notes:
1. Starters should be installed on the engine with the exhaust pointed down.
2. The exhaust is exposed to the transmission fluid.
3. Where the starter is exposed to the transmission fluid the exhaust must be 90° from the Gear Case.
4. Grease seal must be used and drive housing vent plug replaced with suitable hose which connects the transmission fluid to the vent plug.
5. Please read the instructions before attempting to change inlet orientation.
6. Standard weight = 68 lbs (30.8 Kg)

(Dwg. TPA1276-4)
1/4" Pipe Plug in Housing Inlet boss can be removed and Gage installed to check supply pressure to Starter. Before re-installing Plug, clean threads and apply Pipe Thread Sealant (IR No. SMB-441 or Equivalent) to prevent leakage.

For access to 1/4" Hex. Drive Sprocket Hole in Rotor Shaft, or when installing Piped Exhaust, the Splash Deflector Assembly must be removed. Before re-assembly make certain the Starter is reasonably level to prevent draining of oil from the Gear Case. (When the Deflector Screw is removed, a slight amount of oil may leak from hole; this is normal) before reassembly of the Splash Deflector, or when installing 1/4" Pipe Plug when using Piped Exhaust, clean all oil from the threads and apply Pipe Thread Sealant (IR No. SMB-441 or Equivalent) to prevent oil leakage.

4-# NPT for Piped Exhaust - when using Piped Exhaust replace Splash Deflector Assembly with Pipe Plug Supplied with Starter.

** For Natural Gas Operation, 4-# NPT Threads must be sealed. Use Pipe Thread Sealant (IR No. SMB-441) or equivalent to prevent gas leakage.

Notes:
1. Drive housing orientation code is based on position of control ports.
2. Starter orientation illustrated is "DG" if not specified when ordering orientation "OG" will be shipped.
3. Starter weight - 69 lbs (31.3 kg) without inlet flange.
4. When ordering Starter, include model number and orientation code number.
5. Information concerning models not listed should be requested from Ingersoll Rand Engine Starting Systems' marketing department.
6. Orientation code based on Starter Gear Case position as shown.
The Splash Deflector assembly must be removed for accessing the 1/4" hole Drive Flange or with installing a Pipe away exhaust. 
2. Before removing the Hex Plug, the Starter must be reasonably level to prevent draining the oil from the Gear Case.
3. When the Hex Plug is removed, rotate the Inlet in 4 positions. When changing Inlet Orientation, do not rotate Intermediate Gear Case. Intermediate Gear Case is timed with the offset Gear Case.
4. Before assembly, clean all oil from the threads and apply pipe thread sealant (IR No. SMB-441 or equivalent) to prevent oil leakage. **For Natural Gas Operation, 4" NPT threads must be sealed. Use Pipe Thread Sealant (IR No. SMB-441 or equivalent) to prevent gas leakage. **

**Notes:**
1. Starter should be installed on the engine with the exhaust pointed down.
2. These models are not approved for applications where the starter is exposed to the Transmission Fluid.
3. Drive Housing Orientation code is based on position of mounting hole opposite the Pinion Opening.
4. Standard Orientation shown (OE) be shipped unless otherwise specified.
5. Please read the instructions before attempting to reassemble.
6. Starter weight = 98 lbs (44.5 Kg).
Piping Diagrams

Pre-Engaged System (Series ST700 Shown)

Typical Vehicular Installation

Typical Stationary

* * 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)

### Piping Diagram for a Typical Vehicular Installation-Inertia

- (2) leads to operators starting switch.
- "Optional control circuit utilizing electric solenoid control valve and panel mounted switch."

**Diagram Components:**
- Starter control valve SMB-618 (Brass)
- Solenoid valve - 12 volt
- Air Pressure Gauge 150BMP-1064L
- JIC 37° adapter 1/4" N.P.T.
- Air supply from dry air brake tank
- Check valve 150BMP-1056
- Drain valve 1/2" N.P.T.
- Starter control valve SMBG-618 (Chrome/Gas)
- Air receiver tank
- Air pressure gauge 150BMP-1064L (Air Only)
- Pressure gauge 150BMP-1056 (Air Only)

**Diagram Notes:**
- Use sealant on all pipe connections.
- SMB-441
- SMB-618 (Brass/Air)
- SMBG-618 (Chrome/Gas)
- Ingersoll-Rand part number

### Piping Diagram for a Typical Stationary Installation-Inertia

- 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.
- Pressure regulator (maximum setting not to exceed pressure rating shown on starter nameplate)

**Diagram Components:**
- Starters control valve SMB-618 (Brass/Air)
- SMBG-618 (Chrome/Gas)
- Air receiver tank
- Air pressure gauge 150BMP-1064L (Air Only)

**Diagram Notes:**
- 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. 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 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.

** Note: Use Sealant on all pipe connections.

Note:

Relief valve set at 15 P.S.I. above regulator setting.

** 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.

** 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.

Note:

Use Sealant on all pipe connections.

** Ingersoll Rand Part Number

(Dwg. TPA1281-3)
Piping Diagrams

Typical Multiple Starter Installation

- 1/4" NPT pressure measuring port. Operating pressure not to exceed max. pressure rating stamped on starter nameplate.
- Inlet Flange Kit 1/4" NPT
- Relay Valve 1/4" NPT
- JIC 37° Adaptor 1/4" NPT

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

For natural gas operation, starter main exhaust must be piped away to a safe location and must not be interconnected with any other exhaust lines which might introduce a back pressure on the drive housing vent. 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. TPA1284-4)
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**

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**Supply Pressure PSIG/Kpa Max.***

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(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.
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, 应使用指定的软管而非刚性管来连接至起动器。车辆和发动机振动会很快松动刚性管连结, 而软管会缓冲此振动, 从而使连结保持紧固。
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, 最好已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, 而且虽然其中两个装配螺栓孔易于触及, 但第三个孔却常常难以触及。需要以下工具: 常用的棘轮扳手、套筒、万向接头、伸缩套筒和单头或双头套筒扳手。
5. 连接不当会大大削减气动起动器的效率。使用小于所建议尺寸的软管将会使进入马达中的压缩空气量减少, 而使用在排气管端口内的排放装置 (即渐缩管) 将会限制排气 (对导致性能降低的发动机造成反压力)。
6. 三通和弯头的数量以及供应管线的长度都应最小化。如果供应管线长达 15 英尺, 可使用 1-1/2"软管或管道; 如果供应管线超过 15 英尺, 可使用 2"软管或管道。
7. 连接气动管道中的任何连接装置出现泄漏状况都表明, 系统将会整夜排放并必须在第二天早上通过使用另一台车辆或压缩机来增压。使连接气泡紧密以避免不必要的费用和延迟。
8. 在整个系统的所有螺纹连接装置上, 使用 Ingersoll Rand No. SMB-441 Sealant, 非硬化的 No. 2 Permatex 或 Loctite® Pipe Sealant。
9. 在进行所有连接后, 可使用肥皂气泡测试检查每个接头。在整个系统中一定不能出现泄漏状况。稍有泄漏便会导致系统很快失压。务必从接收器的侧面或顶部运行空气供应管线, 切勿在底部或底部附近运行。空气中的水分聚集在接收器的底部, 便可能导致阀门损坏以致无法使用。定时打开箱底部的小龙头以排出水份。
10. 无论何时使用危险气体来操作起动器, 都必须确保进口或排出管道或任何其他起动器的接头处不会出现泄漏状况。应将所有排出物排放到安全地方。

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, 传动箱可位于与齿轮箱相对的 16 个径向位置中的任一处, 并且空压进口阀可位于与传动箱相对的 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定向。如果传动箱必须重新定位, 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。
3. 在传动箱正确定向 (相对于齿轮箱之后, 请确定进气口是否有利于软管安装。
4. 学习第 8 至 11 页的相应管道布置图, 并根据指示进行安装。起动器装置的空气接收箱必须具有工作压力 (等于或大于起动器将会操作的最大压力)。
5. 将起动器连接到已在使用的接收箱时, 可在安装起动器之前排除箱中的气压。

警    告
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。

安装起动器
1. 学习第 8 至 11 页的相应管道布置图, 并根据指示进行安装。
2. 起动器装置的空气接收箱必须具有工作压力 (等于或大于起动器将会操作的最大压力)。
3. 将起动器连接到已安装的接收箱时, 可在安装起动器之前排出箱中的气压。

确保连接到主启动阀的进口侧 (用字母“IN”表示), 并确保连接到侧线的出口侧 (用字母“SUP”表示)。

使用 ST900-267-24 (1-1/2"英寸管子) 和 ST900-267-32F (2 英寸管子)。该 300 网滤器具有 50 微米滤芯, 可有效保护空气管线免受污染 (这可能会损坏涡轮组件)。更换元件有: ST900-266-24 (1-1/2"英寸), ST900-266-32 (2 英寸管子), ST900-266-32F (2 英寸法兰), ST900-266-48 (3 英寸法兰) 和 ST900-266-64 (4 英寸法兰)。
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。旋紧安装螺栓至 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。

注意：不小心将气压应用到“OUT”端口将会导致传动发生故障（小齿轮将无法缩进）。如果发生此种情况，可旋松传动箱头螺丝（38）以通风齿轮箱（28）。另外，可旋松外壳塞子（10）和（11）以通风电动机。
15. 从起动器传动箱的“OUT”端口到起动器主启动阀或电磁阀的小通径分接部分顶端安装 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露状况。

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。
卸下导向板固定螺丝（5），导向板回位弹簧（4）和防溅导向板（3）。如果使用排出的废气，可拆卸管道以便可以使用外壳废气盖中央的孔。卸下 1/4”管道塞子。

对于具有惯性传动装置的型号：
1. 手动安装小齿轮，并通过外壳盖中的孔插入口 1/4” 六角扳手以在马达组件尾部安装六角传动凹槽。
2. 将传动组件直至发动机弯曲到所需位置。

对于预先安装的传动装置的型号
1. 在传动箱的“OUT”端口拔下 1/4”软管，并使用 1/4”管道塞子堵塞传动箱中的孔。
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。
可以卸下传动箱入口主要中的1/4"螺栓，且在安装前检查起动器的供应压力，在重新安装螺栓之前，要清洁螺栓，并使用螺纹润滑剂（如No. SMB-441 或同类产品）以防止损坏。

1. 必须卸下防导线导线装配，才能接近1/4"螺栓。使用特殊工具或在不使用螺栓的情况下，抽取螺栓。
2. 在拆下旧的螺栓后，起动器必须重新进行校验，以确保在启动过程中不会发生错误。
3. 在起动器安装过程中，可能会有从孔中滴出少量的油，这是正常现象。
4. 在重新装配之前，要清洁螺纹中的油，并使用螺纹润滑剂（如No. SMB-441 或同类产品）以防止污染。

### 型号编码

- **型号编码**
  - 4  @ 90° 16 @ 22 1/2°

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**注释：**
1. 应该使用气管将气缸连接至发动机的起动器。
2. 这些气管不能用于起动器暴露在低温环境中的情况。
3. 起动器的编码取决于气缸杆体的形状，安装位置。
4. 起动器的编码取决于气缸杆体的形状，安装位置。
5. 在尝试重新启动前请确认。
ST700-16

1. 必须卸下防导板斜板，才能接近 1/4’寸水管端头，并安装适当垫圈以防止超负荷的供应压力。
2. 在卸下斜板前，起动时必须在适当的水平，以防止落箱中漏油。
3. 在卸下斜板前，可能从无任何油量，这是正常现象。
4. 在重新装配之前，要清洗螺纹中的油，并在用螺纹密封胶（IR No: SMB-441 或同类产品）以防止漏油。

用于标准导板斜板的 1/4”NPT
1/4”NPT 导板斜板

注意
1. 试运行气口前在发动机上安装起动器。
2. 气液温度低于于起动器截止时设定的值，应重新设定的气液温度。
3. 起动器安装时，应安装起动器截止时设定的气液温度。
4. 起动器安装时，应在起动器截止时设定的气液温度。
5. 起动器安装时，应在起动器截止时设定的气液温度。
6. 起动器安装时，应在起动器截止时设定的气液温度。
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

** SMB - 618 (钢) **

(2) 连接到操作者起动开关的导线。

来自干燥空气箱的空气。

在所有管道连接处使用密封胶

** SMB - 441 **

JIC 37° 连接 1/4" N.P.T.

SS350 - MC

1½” N.P.T.

接头 1/2" N.P.T.

150BMP - 1067

** SMBG - 618 (钢/空气) **

#4 软管 (1/4"

JIC 37° 连接 1/4" N.P.T.

SS350 - MC

1½” N.P.T.

接头 1/2" N.P.T.

150BMP - 1056

** SMB - 441 **

#4 软管 (1/4"

JIC 37° 连接 1/4" N.P.T.

SS350 - MC

1½” N.P.T.

接头 1/2" N.P.T.

150BMP - 1056

** SMB - 441 **

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额定压力。

典型的压力表

** SMB - 618 (钢/空气) **

#4 软管 (1/4"

JIC 37° 连接 1/4" N.P.T.

SS350 - MC

1½” N.P.T.

接头 1/2" N.P.T.

150BMP - 1064

** SMB - 441 **

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额定压力。

注意：

在所有管道连接处使用密封胶

** SMB - 441 **

对于气体操作，必须从减压阀排放到安全地方

高压 供应

1. 减压阀

(最大设置不超过起动器商标上显示的额定压力) 标准高压系统空气或气体。使用减压阀供应的压力超过起动器的额定值

** Ingersoll Rand 部件编号 **

** 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箱，先卸下传动机箱塞，然后用适当的管线替代。传动机必须在安全的位置排气，并且不得与其他任何排气管线互连。这些管线可能会对传动机箱产生拉力。

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箱，先卸下传动机箱塞，然后用适当的管线替代。传动机必须在安全的位置排气。
管道布置图

惯性啮合系统（显示 ST700 系列）

注意：
在所有管道连接处使用密封胶。
★ SMB - 441

典型的车载安装

典型的固定安装

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)
具有发动机预先润滑系统的典型安装

1/4"N.P.T. 压力测量口。

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。
要用于连接的减压阀，先卸下减压阀盖，
然后用适当的螺纹替代。

注意：
在所有管道连接处使用密封胶。
* SMB - 441

** Ingersoll Rand 部件编号

(图. TPA1281:3)
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

产品信息

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。
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確に取付けた後、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タービ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. すべての車両の取り付けおよび機能に発生する固定エンジンについて、始動装置に配管を固定した接続を行うのではなく、規定の口部のホースを使用することを推奨します。車両およびエンジンの振動により固定した配管接続は直接接続が、ホースの場合は、振動と吸収、接続は強固のままです。

2. 2. 始動装置は、吸気口をフランジに取り付けるように設計されています。付属品の付いたフランジ取り付けキットを再組付けに必要です。すべての配管、ホースおよびバルブ類を再組付け前に清掃を必要としています。再組付けは正しい。始動装置の吸気口に塵埃のないことを確認してください。

3. 始動装置の実際の取り付けに於いては、ホースは前におろ吸気口での接続を流した後に、再組付けに取り付けるように手元に置いておくのが一番良い方法といえます。

4. エンジンの設計上、しばしば、始動装置が方形の非常近くに接し部屋に取り付けられ、取り付けボルト穴の中心は、容易に手が届きます。3つはしばしば手が届かないということが必要です。始動装置の再組付けは、本の工具が必要です。レギュラーラッチセット、ネジ、自転歯車、ホース伸長装置および製品またはポートのラックスレンチ。

5. [空気始動装置]の効率は、適切なT接続によって非常によくなわれます。推奨したり小型のホースが必要、モーターへ送る空気量を減少させ、吸気口に導入用の予防装置を使用する空気を引き込むマニホールドを制限し、性能を低下させます。T字型およびエンドハト型接続の数量および供給ライン長や漏れを抑えます。15フィート長までに供給ラインは1-1/2インチのホースまたは管を使用し、15フィート長を超える場合は、供給ラインには2-1/2インチのホースまたは管を使用します。

6. 空気を送っている送気管のどのどの接続部に漏れがあるという、このシステムが一層空気を流しているということであり、翌日の朝、別の車両もコンプレッサを使用して再生圧力を上げる必要があります。接続部から気泡がないように締め付ける、不要なコストや遅れの発生を避けます。システム全体のすべてのネジ接続は、Ingersoll Rand No. 5MB-441シーランクトフや非剝離型2 PermatexまたはLoctite® パイプ シールを推奨します。

すべての接続を終了した後に、各接合部をせん断部試験でチェックします。運転している送気管に漏れがないようにする必要があります。ほんの僅かで済むことも、一晩中、システムの圧力損失を引き起こします。常に給気管を受器の側面または上部から入口にし、決して底部またはその付近から入口することのないようにします。空気中の湿気は、受器の底で凝縮し、バルブの動作可能を引き起こすおそれのある損傷を招きます。ターゲットの表面をコンクリートの表面に、長時間に留めます。

7. 始動装置の運転に有害なガスを使用するときは、常に、吸気管または排気管、またはその他の始動装置の接合部から漏れがないようにする必要があります。すべての接続は、安全な場所に導出してください。

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」を清掃に、塵埃の無いように保持、損傷から保護するために、パイプ締によって閉まれた二番目の「友好的握手」をこれに合わせて取り付けるまたは「友好的握手」の保護ブレーキを使用することも可能です。

9. 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な場合、Ingersoll Randは5種類のストレーナーを提供します。

一般商品

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16箇所の位置のうちの一つに配置することができる。吸気口は、「駆動部収納部」に対して放射状に位置する4箇所の位置の1つに配置することに注意します。

2. エンジンの取り付け位置を検討し、「変速装置」に対する「駆動部収納部」の必要な向きを決定します。「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」のネジを外し、「駆動部収納部」を2本のネジで固定します。「変速装置」から「駆動部収納部」を分離させる必要はありません。「駆動部収納部」のネジを再度締めて38 lb-38 Nmのトルクで締付けます。

3. 「駆動部収納部」を「変速装置」に対して正しい向きにした後、吸気口がホースの再組付けに対し、好ましい位置に配置されてい るか確定します。これらの吸気口およびホースの片方がまたは両方の向きを変える必要がある場合、8 mm六角レンチを使用して、モーター収納カバーの4本のネジをはずしてモーター収納部およびモーター収納カバーの両方またはどちらか一方を希望する位置に回転させます。

備考

[モーター収納部]を[中間変速装置]ケースから分離させると潤滑油が無くなってしまうので、分離させてください。

モーター収納カバーキャップの4本のネジを元の穴に戻し、20 ft-lb(27 Nm)つつ増加させて、80 ft-lb(81.4 Nm)のトルクがかかるまで交互に締めて付けます。

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配管図を検討し、指示されているように取り付けてください。

2. 始動装置取り付け用の空気受けタンクは、始動装置が推奨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。
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じ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栓を抜くことはしないでください。

タン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[始動装置リレーバルブ]を取り付けます。

5. 先進の取り入れに対しては、ダッシャパネル(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取り付けられたレーバルブの吸気側に接続する事を確実にします。

6. 始動装置制御バルブに隣接する制御パネルに始動装置指示ラベル(TA-STR-100)を付けます。

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リレーバルブに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ードホースの付いたT字型分岐を取り付けます。

9. 1-1/2インチの空気ホースの必要とする正確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運ぶことを確実にします。

10. 始動装置制御バルブの排気側に1/4インチの空気ホースを取り付け、このホースをフレームなどを通って、始動装置の場所の最終位置まで運ぶことを確実にします。

11. この地点で、始動装置が実際に取り付けられる前または後に、ホースを始動装置に関連することが可能または実際的かつ、またはそうでないかを決定します。多くのケースでは、始動装置を取り付け前には、ホースを始動装置に関連することが必要である場合があります。

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。こうするとリングギアおよび始動装置のバイオニンの寿命を延ばすのに役立ちます。

13. 始動装置を所定の位置に移動し、フライホイールナッカ上に取り付けます。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ルに対しては、1/4インチホースラインを始動装置制御バルブまたはレーバルブの供給側にデリ(DEL)と記されていますから始動装置ドライプ収納部の「IN」入口に取り付けます。

備考

空気圧を不用意に「OUT」出口に出してはだれの誤動作(ピニオンが待避し損ないます)を招きます。この状態が生じた場合、ドライプ収納キャップのネジ(38)を緩めて(変速装置(28))に空気を排出します。また、[収納経路]と[モーター]に空気を排出します。
ST700 慣性取り付け寸法

図面. TPA1276-4
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

ガス運転の場合、開放バルブ弁弁は、配管によって安全な位置に離さざる必要があります。

高圧供給

圧力レギュレータ
(始動装置銃板に表示される
圧力が許容を超えない最大設定)
標準高圧システム空気またはガス
供給圧力が始動装置の設定圧力以上のとき、
圧力レギュレータを使用します。

\* Ingersoll Rand 部品番号

図面. TPA1262-3
配管図
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

（2）運転者に至ります
始動スイッチ

電気ソレノイド制御バルブ
およびパネル面上スイッチを使用する
オプションの制御回路

典型的な固定取り付け

ガス運転の場合、
開放バルブ排気口は、
配管によって安全な位置に
離れる必要があります。

高圧供給

圧力レギュレータ
（始動装置用に表示され
た圧力設定を越えない最大設定）

備考：
すべての配管接続に
封止剤を使用します。
★ SMB - 441
★ Ingersoll Rand 部品番号

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）

供給が定格始動圧力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

エンジン事前潤滑システムとの典型的設定

備考:
すべての配管排を
封止を使用します。
★ SMB - 441
★ Ingersoll Rand 部品番

図面: TPA1281-3
配管図
典型的な複式始動装置の再組付け

図面. TPA1284-4
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>数量</th>
<th>D.P.</th>
<th>D.</th>
<th>P.</th>
<th>D.</th>
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<td>12/12</td>
<td>6/8</td>
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<tr>
<td>ST750GBD03L32</td>
<td>150/1034</td>
<td>12/12</td>
<td>6/8</td>
<td>2.00°</td>
<td>20°</td>
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<tr>
<td>ST799GBD03R31</td>
<td>150/1034</td>
<td>12/12</td>
<td>6/8</td>
<td>2.00°</td>
<td>20°</td>
<td></td>
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</tr>
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</table>

- 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。

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)
- 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。

(図面. TPD1177)
- 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。

(図面. TPD1178)
Parts Information

Cross Section Diagram, ST700 Turbine Powered Starter

(Dwg. TPA1275-2)
Exploded Diagram, ST750 Turbine Powered Starter (Inertia)

(Dwg. TPA1272-2)
<table>
<thead>
<tr>
<th>Item</th>
<th>Part Description</th>
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<tr>
<td>1</td>
<td>Housing Exhaust Cover</td>
<td>ST700-562</td>
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<td>2</td>
<td>Exhaust Cover Seal</td>
<td>Y330-257</td>
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<tr>
<td>*</td>
<td>Exhaust Cover Plug</td>
<td>ST700-K37</td>
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<td>3</td>
<td>Splash Deflector</td>
<td>ST700-735</td>
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<td>4</td>
<td>Deflector Return Spring</td>
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<td>5</td>
<td>Deflector Retaining Screw</td>
<td>ST700-737</td>
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<tr>
<td>6</td>
<td>Starter Assembly Cap Screw</td>
<td>ST900-2574</td>
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<tr>
<td>7</td>
<td>Cap Screw Washer (4)</td>
<td>SS800-26</td>
</tr>
<tr>
<td>8</td>
<td>Motor Housing</td>
<td>ST700-40</td>
</tr>
<tr>
<td>10</td>
<td>Housing Plug (2)</td>
<td>CE110-29</td>
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<tr>
<td>11</td>
<td>Housing Plug Inlet Boss</td>
<td>ROH-377</td>
</tr>
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<td>*</td>
<td>Nameplate</td>
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<td>Nameplate Screw (4)</td>
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<td>ST700-67</td>
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<td>12A</td>
<td>Cylinder O-Ring Seal</td>
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<td>13</td>
<td>Intermediate Gear Case Assembly</td>
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<td>† 14</td>
<td>Rear Gear Case O-Ring</td>
<td>Y327-163</td>
</tr>
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<td>† 15</td>
<td>Front Gear case O-Ring</td>
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<td>† 16</td>
<td>Planet Gear Frame Shaft Seal</td>
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<tr>
<td>† 16A</td>
<td>Spacer Ring</td>
<td>ST700-323</td>
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<tr>
<td>† 17</td>
<td>Front Gear Frame Bearing</td>
<td>SS800-22</td>
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<td>18</td>
<td>Planet Gear Frame</td>
<td>ST700-108</td>
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<tr>
<td>† 19</td>
<td>Planet Gear (3)</td>
<td>ST700-10</td>
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<td>† 20</td>
<td>Planet Gear Needle Roller Bearing (3)</td>
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<td>*</td>
<td>Planet Gear Needle (18)</td>
<td>ST700-363-R</td>
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<td>† 21</td>
<td>Bearing Spacer (6)</td>
<td>ST700-364</td>
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<td>† 22</td>
<td>Planet Gear Shaft (3)</td>
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<td>23</td>
<td>Gear Shaft Retaining Washer (2)</td>
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<td>† 24</td>
<td>Rear Gear Frame Bearing</td>
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<td>Front Bearing Spacer</td>
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<td>Gear Case</td>
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<td>29</td>
<td>Drive Gear</td>
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<tr>
<td>† 30</td>
<td>Front Drive Gear Bearing</td>
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<th>Item</th>
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<tr>
<td>† 31</td>
<td>Rear Drive Gear Bearing</td>
<td>SS800-359</td>
</tr>
<tr>
<td>† 32</td>
<td>Gear Case Cover</td>
<td>SS810-678</td>
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<tr>
<td>† 33</td>
<td>Gear Case Cover O-Ring</td>
<td>SS800-244</td>
</tr>
<tr>
<td>† 34</td>
<td>Drive Gear Shaft Seal</td>
<td>SS810-272</td>
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<tr>
<td>† 35</td>
<td>Drive Housing O-Ring</td>
<td>SS800-152</td>
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<td>36</td>
<td>Starter Drive</td>
<td>20BM-610</td>
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<tr>
<td></td>
<td>for Models ST750GBDI03R31 and ST799GBDI03L32</td>
<td>20BM-299-3</td>
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<td>for Models ST750GBDI03L32 and ST799GBDI03L32</td>
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<td>Drive Gear Key (2)</td>
<td>ST700-3K3</td>
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<td>38</td>
<td>Drive Housing</td>
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<td>† 39</td>
<td>Drive Housing Bearing</td>
<td>SS600-363-13</td>
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<td>40</td>
<td>Drive Housing Cap Screw (8)</td>
<td>SS810-744</td>
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<td>41</td>
<td>Drive Housing Cap Screw Lock Washer (8)</td>
<td>TE223A-415</td>
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<tr>
<td>† 42</td>
<td>Inlet Flange Kit (Includes Inlet Flange, Flange Mounting Bolts and Lock Washers)</td>
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<td>43</td>
<td>Flange Mounting Hardware Kit (includes Flange Mounting Bolts and Lock Washers)</td>
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<td>*</td>
<td>Planet Gear Kit (includes illustrated parts 14, 19[3], 20[54], 21[6], and 22[3])</td>
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<td>*</td>
<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 42</td>
<td>ST750R-TK2</td>
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<tr>
<td>*</td>
<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>
<td>ST750L-TK3</td>
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<td>*</td>
<td>Tune-up Kit (for ST799 models with right hand rotation) includes illustrated parts 12, 14, 16, 16A, 17, 19, 20, 21, 22, 24 and 42</td>
<td>ST799R-TK4</td>
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<tr>
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<td>Tune-up Kit (for ST799 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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<td>Tune-up Kit (for Inertia Drive models includes illustrated parts 30, 31, 33, 34 35 and 39)</td>
<td>ST700I-TK6</td>
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* Not Illustrated
† Tune-up Kit Parts
# Parts List, Series ST700 Turbine Starter (Pre-Engaged)

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<th>Item</th>
<th>Part Description</th>
<th>Part Number</th>
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<td>1</td>
<td>Housing Exhaust Cover Assembly</td>
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<td>Splash Deflector</td>
<td>ST700-735</td>
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<td>Deflector Return Spring</td>
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<td>Starter Assembly Cap Screw (4)</td>
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<td>Motor Housing Assembly</td>
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<td>Drive Gear Screw O-ring</td>
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<td>Drive Housing O-ring for B &amp; C ratio</td>
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<td>Front Drive Shaft Bearing</td>
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<td>Outer Bulkhead O-ring</td>
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* Not illustrated
† Indicates Tune-up Kit parts
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<td>Clutch Jaw Kit</td>
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<td>58</td>
<td>Inlet Flange Kit (includes Inlet Flange, O-ring, Mounting Bolts and Lock, Washers)</td>
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<td>Seat (for all B and C ratio Models only)</td>
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* Not illustrated
† Indicates Tune-up Kit parts
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<th>Item</th>
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<td>17, 19, 20, 21, 22, 24 and 66A</td>
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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,</td>
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* Not illustrated
**ST700K-350 Exhaust Kit (Available at extra cost)**

![Diagram of exhaust kit components](image)

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<th>Item</th>
<th>Description</th>
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<tr>
<td>101</td>
<td>Directional Housing Exhaust Cover</td>
<td>ST700K-350</td>
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<tr>
<td>102</td>
<td>Capscrew (6)</td>
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<td>103</td>
<td>Lockwasher (6)</td>
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<td>104</td>
<td>Exhaust Adapter</td>
<td>ST700-351</td>
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<td>105</td>
<td>Exhaust Adapter Seal</td>
<td>Y327-46</td>
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<tr>
<td>106</td>
<td>Exhaust Cover Seal</td>
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<tr>
<td>107</td>
<td>Exhaust Cover Seal</td>
<td>ST700-352</td>
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<tr>
<td>*</td>
<td>Plug</td>
<td>R0H-377</td>
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</table>

* Not illustrated.

**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.
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.

**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.

**Registered trademark of Exxon Corporation.**
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.

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.

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.
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.

**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).

**Models ending in R25, R31 and R51 have a left-hand thread. Models ending in L26, L32 and L52 have a right-hand thread.**

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).

**WARNING**

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.

**NOTICE**

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.
11. Slide the Drive Gear Bearing (30) into the Drive Shaft.
10. Grasp the Drive Shaft (57) in a vise, external splined end down.
9. Assemble the Drive Gear Screw (34), Drive Gear Lock Washer (35), Drive Gear Cup (36) and Drive Gear Screw O-ring (37).
8. Slide the small bearing retainer convex side first, onto the Drive Shaft.
7. Press the Rear Drive Shaft Bearing (58) onto the Drive Shaft.
6. Lubricate the Drive Gear with approximately 8 oz. (240 ml) of No. 130 Grease.
5. Place the Drive Gear Bearing Retainer over the rear end of the Drive Gear.
4. Using retaining ring pliers, install the Drive Gear Shaft Bearing Retainer (33).
3. Using a plastic hammer, seat the Rear Drive Gear Bearing into the Gear Case by tapping the opposite end of the Drive Gear.
2. Using O-ring lubricant, lubricate and install the Drive Housing O-ring (41) in the groove of the Drive Housing.
1. 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).

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

**Gear Case**

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.
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.
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. 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.
11. Slide the Drive Gear Bearing (30) into the Drive Shaft.
12. Lubricate with Ingersoll Rand No. 130 Grease and install the Driving Clutch Jaw teeth facing up and Driven Clutch Jaw teeth facing down into the Drive Shaft.
13. Insert the Clutch Spring (51) into the Drive Shaft.
14. Insert the Clutch Spring Cup (50) into the Drive Shaft.
15. 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 5S800-272) 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.

16. Install the Piston (54) onto the Drive Shaft until the Rear Drive Shaft Bearing seats into the Piston.
17. Using a thin flat blade screwdriver to assist in this operation, coil the Large Drive Shaft Bearing Retainer (53) into the groove of the Piston to retain the outer race of the Drive Shaft Bearing.
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 (44) 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 towards 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

Ingersoll Rand No. 130 Grease
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.


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 another 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 Frame. 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.

**NOTICE**

Do not move or turn over the Planet Gear Frame until steps 6 and 7 have been completed. Movement of the Planet Gear Frame Assembly could dislodge assembled components, making it necessary to repeat Step 5.

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.

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**

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.

18. Install the Splash Deflector (3), Deflector Retaining Spring (4) and Deflector Retaining Screw (5) in the rear of the Housing Exhaust Cover. Refer to Dwg. TPD1160.

**NOTICE**

Coat the threads of the Deflector Retaining Screw with Ingersoll Rand SMB-441 Sealant.
Free Speed (All Models): Install the Starter on a testing fixture with proper containment system. Apply 90 psig (6.2 bar/620 kPa) to motor inlet. 

Free speed specifications should be as follows:

<table>
<thead>
<tr>
<th></th>
<th>MAXIMUM</th>
<th>MINIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>“B” ratio</td>
<td>4600 rpm</td>
<td>4500 rpm</td>
</tr>
<tr>
<td>“C” ratio</td>
<td>4130 rpm</td>
<td>3660 rpm</td>
</tr>
<tr>
<td>“D” ratio</td>
<td>3100 rpm</td>
<td>2870 rpm</td>
</tr>
</tbody>
</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 with shaft 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 the 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 (11) 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).

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.
# Troubleshooting Guide

<table>
<thead>
<tr>
<th>Troubleshooting Guide</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:**

| Drive will not engage | Foreign material in Starter Drive | Remove obstruction. |
|                      | Damaged or worn Drive parts | Check Drive components and replace if necessary. |

**For Models with Pre-Engaged Drive:**

| Drive will not engage | No pressure to Drive Housing port | Check air supply. |
|                      | Internal Drive unit components blocked | Remove blockage. |
|                      | Fluid in drive unit components | Remove fluid. |
|                      | Damaged or worn Piston Assembly, O-rings or seals | Replace damaged or worn parts. |
|                      | O-rings and seals dry | Re-lube O-rings and seals. |

| Motor runs, Pinion engages, but does not rotate flywheel | Damaged or broken drive train | Disassemble drive train and replace worn or damaged parts. |

| Excessive butt engagement | Damaged Drive Pinion or flywheel | Inspect Drive Pinion and flywheel and replace if necessary. |
|                          | Damaged Starter Drive or components | Inspect Drive components and replace worn or damaged parts. |
|                          | Low air pressure | Check air supply |
|                          | Wrong Drive Pinion | Replace with proper Drive Pinion. |

| Oil blowing out of exhaust | Oil in air supply line | Inspect air line and remove source of oil. |
|                           | Splash Deflector Retaining Screw or pipe plug missing | Install Splash Deflector Retaining Screw or pipe plug. |
|                           | Worn or damaged rotor seals or static O-Rings | Replace static seals on outside of Motor or send Motor to Ingersoll Rand to be rebuilt. |

| Oil leaking from Gear Case | Worn or damaged O-Rings | Replace O-Rings. |
|                          | Loose joints. | 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. |
|                          | Excessive high-speed operation | Operate according to recommendations. |
|                          | High number of start cycles | Replace worn components. |
|                          | Loose or leaking Pipe Plugs | Tighten or replace Pipe plugs using Ingersoll Rand SMB-441 Pipe Sealant. |
|                          | Splash Deflector Retaining Screw or pipe plug missing | Tighten Splash Deflector Retaining Screw or replace pipe plug. |

| Air or gas leakage | Loose Joints. | 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. |
|                   | Excessive high-speed operation | Operate according to recommendations. |
|                   | High number of start cycles | Replace worn components. |
|                   | Loose or leaking Pipe Plugs | Tighten or replace pipe plugs. |
|                   | Splash Deflector Retaining Screw loose or pipe plug missing | Tighten Splash Deflector Retaining Screw or replace pipe plug. |
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.

Manuels can be downloaded from ingersollrandproducts.com

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