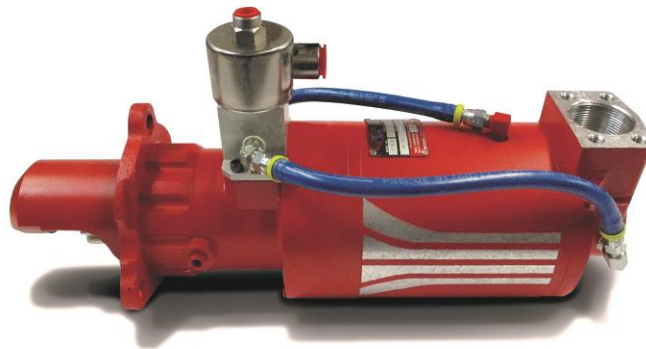


INSTALLATION AND OPERATING MANUAL



T6 *TURBO*TWISTER™**** **Engine Air Starter**



TABLE OF CONTENTS

Section	Subject	Page
1.0	General Information.....	1
2.0	Orientation of the Starter.....	2
3.0	Installing the Starter.....	3
4.0	Starter Operation.....	4
5.0	Performance Information.....	5
6.0	Warranty.....	5
7.0	Operator's Troubleshooting Guide.....	6

LIST OF ILLUSTRATIONS

Figure	Title	Page
1	T6 Air Starter Configuration.....	1
2	T6 Typical Installation.....	3
3	T6C Envelope Drawing.....	7
4	T6B Envelope Drawing.....	8
5	T6A Envelope Drawing.....	8
6	T6C Installation Diagram.....	9
7	T6B Installation Diagram.....	10
8	T6A Installation Diagram.....	11

1.0 GENERAL INFORMATION

This manual provides instructions for the installation and operation of the TDI **TURBOTWISTER**™ Model T6 engine air starters. If there are questions not answered by this manual, please contact your TDI **TURBOTWISTER**™ distributor for assistance.

The Model T6 is a turbine driven air starter with a pre-engage starter drive. It is well suited for starting engines up to 150 Liters (9150 CID). The Model T6 is designed for installation on engines which use a SAE 3 mounting pad.

The T6 starters are suited to operate within a wide range of inlet air pressures and ambient temperatures. The engine size and parasitic loading will determine the exact minimum pressure that will ensure reliable starting. A **TURBOFLOW** regulator P/N: 3-30327-001 (1 ½" NPT) installed within 10 feet of the starter can be used to adjust pressure to the starter.

The T6 starters are designed for operation with compressed air only. Small to moderate amounts of foreign matter or liquid in the air stream will normally not adversely affect T6 starters. As with all other TDI starter models, no lubrication is required in the supply air. The T6 series air starters are offered in the following configurations:

MODEL	DESCRIPTION
T6A	T6 starter with neither integral relay valve and solenoid.
T6B	T6 starter with integral relay valve, but no solenoid.
T6C Recommended	T6 starter with integral relay & solenoid valve. See Figure 1

All model T6 air starters are turbine driven starter motors. T6C is supplied as a fully integrated module that includes these features and/or components:

- Pre-engaged starter drive with one-way ratchet mechanism.
- Integral starter relay valve.
- Integral 24VDC solenoid valve.

Pre-Engaged Drive – The starter pinion gear is fully engaged into the engine ring gear before the starter motor runs (cranks the

engine). A minimum (pilot) air pressure of 40-45 psig is required to engage the starter pinion gear. A one-way ratchet mechanism provides maximum torque delivery and added protection of the starter (pinion) & engine (ring) gears.

Integral Relay Valve - T6B & T6C includes a main air relay valve and two external pilot air control lines. Upon receiving a pilot pressure, the integral relay valve opens to allow air flow to the starter turbine section.

Integral Solenoid Valve – T6C includes a robust electric, pilot-air solenoid w/manual over-ride feature for emergency starting. Upon receiving a voltage signal, the solenoid valve opens to allow air flow into the starter pre-engaged circuit to initiate pinion engagement.

In the event of emergencies or loss of control voltage, use the manual bypass feature on the solenoid to manually start the engine.

WARNING

DO NOT repeatedly use the manual bypass to defeat the engine's ECU control. Make necessary repairs as soon as possible to avoid repeated use of the bypass feature, as this may result in improper manual operation. The starter should never be used to "bar" or to "bump" the engine.

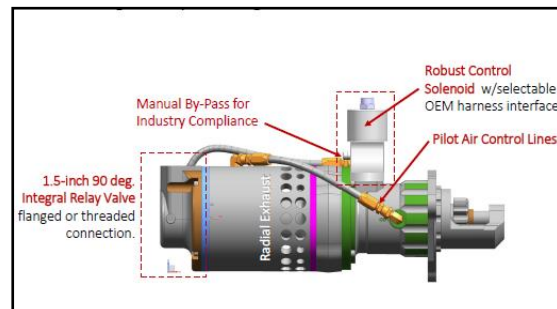


Figure 1. T6C Air Starter Configuration

The complete manual should be reviewed before installing your TDI **TURBOTWISTER**™ T6 starter.

1.1 WARNINGS, CAUTIONS, & NOTES

Throughout this manual, certain types of information will be highlighted for your attention:

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WARNING - used where injury to personnel or damage to the equipment is likely.

CAUTION - used where there is the possibility of damage to the equipment.

NOTE - used to point out special interest information.

1.2 INSTALLATION and SERVICE

The TDI **TURBOTWISTER**™ T6 starters provide distinct advantages of size and efficiency compared to electric motor, vane-type or other turbine-type air starters. It is important to properly install the starter to receive full benefit of these advantages.

A typical starting system will include the following components:

- T6 air starter installed on engine.
- Pressurized air supply (receiver/tank) connected to the air starter via adequately sized piping/hoses.
- A start signal from the engine control panel or manual control switch.
- A 100 mesh Y-strainer P/N: 52-93550-400.
- Manual isolation/ball valve.
- **TURBOFLOW** regulator P/N: 3-30327-001.

Repair technicians or service organizations without turbine starter experience should not attempt to repair this starter until they receive training from TDI, or its representatives.

Proper operation and repair of your TDI **TURBOTWISTER**™ T6 starter will assure continued reliable and superior performance for many years.

WARNING

The TDI TurboTwister™ T6 series starter must be installed and operated in accordance with the instructions given in this manual. Failure to properly install the starter or failure to operate it according to these instructions may result in damage to the starter, the engine, or cause personal injury.

CAUTION

The T6 does not have imbedded logic to prevent the starter from engaging into a running engine. Starter "lock out" must be provided in engine's control logic (ECU) and using proper operating procedures. The starter must never be engaged into a running or rotating engine.

NOTE

This starter is to be serviced only by authorized TDI distributors. Do not operate this starter unless it is properly installed on an engine.

2.0 ORIENTATION OF THE STARTER

If the factory orientation of the starter's pinion housing, gearbox assembly, or optional exhaust port does not fit your engine installation, the starter can be re-oriented.

2.1 MODEL T6 ORIENTATION

Determine the required orientation of the drive housing and turbine housing.

Note that the drive housing can be rotated to twelve different positions relative to the turbine housing.

CAUTION

All screw threads are treated at the factory with a fastener retention compound. Every screw and tapped hole must be cleaned and have Loctite 242 applied to the threads before being reinstalled.

2.1.1 Drive Housing Re-Orientation

Remove the twelve drive housing to gearbox housing socket head cap screws.

Rotate the drive housing to the desired position and reinstall the twelve screws. Apply Loctite 242 and torque the twelve socket head cap screws to **190 Lbs-In (21.46 Nm)**.

CAUTION

Ensure the O-ring on the drive housing remains in position and is not cut.

3.0 INSTALLING THE STARTER

A typical T6 installation is shown in Figure 2.

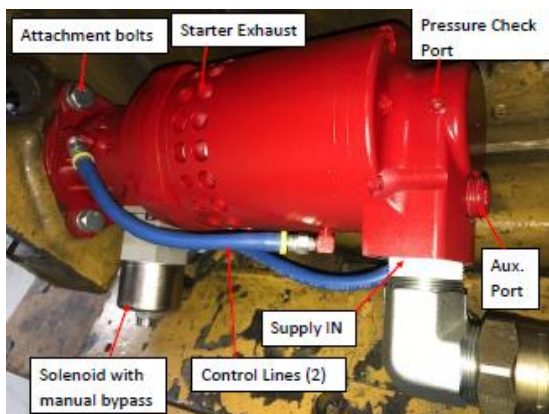


Figure 2. T6 Typical Installation

A turbine driven starter does not require separate lubrication in the supply air. If a vane-type starter motor is being replaced, TDI recommends all lubrication devices and lines be removed to minimize flow restrictions.

WARNING

If a fuel (pulse) lubricator is installed in the system, disconnect and plug the line to eliminate spraying diesel fuel into starter and on the engine.

Torque the 3 mounting screws according to engine manufacturer recommendation and tighten all fittings and connector hardware.

After installing the starter on the engine, connect the supply line from the air tank to the starter inlet port and connect wiring from engine ECU to starter control solenoid valve.

TDI recommends installing a quick disconnect for auxiliary pressurization of the air tank.

Turbine starters such as the T6 are sensitive to flow restrictions, care must be taken to use uniform hose or tubing and fittings for connection of the supply air line. Tees, elbows, and line length must be kept to a

minimum. TDI recommends hose or flex couplings be installed to eliminate strain on the supply air line.

In dirty environments, use of a 100 mesh Y-strainer P/N: 52-93550-004 is required.

CAUTION

Recheck all connections for tight fit to eliminate leakage.

Fill the air system tank and adjust the pressure regulator not to exceed the starter maximum pressure rating measure at the inlet pressure check port during starter operation.

To maximize starter longevity, the pressure regulator should be adjusted to the minimum pressure required to reliably start the engine. This can be accomplished by initiating 3-4 start sequences and adjusting the pressure between starts to identify the ideal pressure to achieve successful starting. The T6 Series starter is now ready to operate.

3.1 INLET PRESSURE CHECK PORT

A 1/8" NPT pressure check port is located on the starter inlet housing to be utilized for checking the dynamic supply pressure when the starter is operating.

To check the dynamic pressure, remove the 1/8" NPT plug and save for later use. Install a pressure gauge into this port to confirm dynamic pressure. Using Loctite Pipe Thread Sealant or equivalent, replace 1/8" NPT pipe plug after completion of pressure check.

3.2 PIPING SYSTEM

Only type approved metallic hose assemblies are approved in permanently pressurized compressed air lines of starters. Non-metallic hose assemblies are allowed only in cases when the piping system will be emptied after the starting procedure.

CAUTION

T6B and T6C configured with relay valve will always have pressure in the hose between the air tank and starter.

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Pipe unions must be type approved by GL. Downstream of the pressure regulator and a pressure relief valve is required to be provided in the system as well.

4.0 STARTER OPERATION

The maximum operating pressure limit noted on the starter's nameplate is the pressure measured at the starter inlet pressure check port.

CAUTION

IN NO CASE SHOULD INLET OPERATING PRESSURE EXCEED 150 PSIG (10 BAR).

WARNING

Do not operate the TDI TurboTwister T6 air starter with air pressure greater than the pressure rating on the nameplate. This pressure should be measured at the starter inlet while the starter is operating.

The static supply pressure will always be higher than the operating pressure. As a guideline, the maximum pressure limit (proof pressure) the T6 starter may be subjected to is 600 PSIG (41.37 BAR). System pressure that exceeds the maximum operating limit must use a pressure reducer device to ensure that the operating pressure limit to the T6 starter is maintained.

All appropriate local pressure codes and pressure limitations on other system components must be adhered to and supersede the guidelines given in this manual.

Follow the engine manufacturer's instructions for starting the engine.

WARNING

Do not engage the starter pinion while the engine is running.

If the starter fails to function properly when first operated, or its performance deteriorates with use, refer to the Operator's Trouble Shooting Guide, Section 6.0. If you cannot solve the problem, or repair is necessary, contact your local TDI **TURBOTWISTER**™ distributor.

TDI turbine starters share a common characteristic known as "coast-down". Once unloaded, turbines must coast to a stop from their unloaded or *free-speed*. Turbines behave differently in this respect, when compared to positive displacement devices, because the friction (drag) of rubbing, sealing surfaces quickly stops an unloaded machine. Less encumbered by drag, and typically decelerating from much higher operating speeds, turbines can take longer to stop.

When pre-engaged starters are used, a procedure specifying a 30-second delay between engine crank attempts would be sufficient to insure correct operation. This is common practice and such delays are typically programmed into fully automated starter control systems found on many packages. This "**30 Second Rule**" should also be strictly followed when using the starter in a "manual mode" or when performing routine maintenance tasks such as engine timing, inspections, valve adjustments, etc.

WARNING

Re-engaging pre-engaged turbine starters during coast-down can damage the starter pinion and the engine ring gear. Turbine air starters must **NEVER** be re-engaged during coast-down or before the starter comes to a complete stop.

The ECU or delay timer P/N: 2-28582 can be used to prevent coast down re-engagement.

To ensure correct starter operation, users may choose to incorporate an electronic or pneumatic control device to prevent accidental re-engagement during coast-down. In addition, operators and technicians should be educated about the effects of coast-down.

CAUTION

The grease used in the planetary system has a shelf life of 2 years. If the starter is **NOT** operated on the engine for 2 years after the starter is manufactured, the grease should be replaced prior to starter operation. The manufactured date is reflected in the starter serial number. (Ex: 1803-0312 has a manufactured date of March 2018).

5.0 T6 PERFORMANCE INFORMATION

Pressure PSI (bar)	Breakaway Torque ft-lb (Nm)	Speed @ Max HP RPM	Max Power HP (kW)	Flow SCFM (L/s)
40 (2.6)	102 (138)	1300	12 (9)	475 (807)
60 (4)	151 (205)	1500	19 (14)	647 (1099)
90 (6)	220 (298)	1600	32 (24)	923 (1568)
120 (8)	292 (396)	1700	43 (32)	1170 (1988)
150 (10)	340 (461)	1800	52 (39)	1424 (2419)

6.0 WARRANTY

Tech Development (TDI) warrants to the original user of the TDI *TURBOTWIN™* air starters to be free from defects in material and workmanship for a period of one year. The warranty period shall not extend beyond two years from the date the unit was manufactured. (i.e.: a unit with a manufactured date of March 2018 (SN: 1803-0312) will not be covered under warranty after March 2020). The conditions of this warranty are: **a)** TDI is notified within this period by return of such product to TDI or its authorized distributor, transportation prepaid by user; **b)** the starter has been installed according to TDI's specifications; **c)** the starter has not been misused, abused, or improperly maintained by user; **d)** the defect is not the result of normal wear and tear; **e)** the starter has been repaired with parts manufactured or authorized by TDI; and **f)** TDI installation and repair procedures as outlined in the appropriate manual were properly followed.

Tech Development will repair, or at its option, replace the unit during the warranty period at no charge to the customer, provided it is returned to TDI with the proper return procedure.

Tech Development makes no other warranty, and implied warranties including any warranty or merchantability or fitness for a particular purpose are hereby disclaimed.

This warranty constitutes the entire obligation of Tech Development relating to the sale and use of such product, and TDI's maximum liability is limited to the purchase price of such product at the date of purchase. In no event shall TDI be liable for incidental, indirect, consequential, or special damages of any nature arising from the sale or use of such engine starter product.

7.0 OPERATOR'S TROUBLESHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	SOLUTION
1. Air constantly flows through exhaust	A. Integral relay valve assembly not sealing properly.	A. Check for damaged sealing O-ring and repair valve assembly or damaged parts.
	B. Solenoid valve is not sealing allowing pressure to APP port of relay valve.	B. Check solenoid potential at the lead to ground should be 0. If not, fix ignition switch problem. Replace solenoid valve.
2. Starter engages but does not run	A. Valve assembly not operating properly	A. Check valve assembly for contamination. Repair valve assembly.
	B. Insufficient dynamic pressure	B. Install pressure gauge into pressure check port on inlet housing and confirm minimum pressure (30 psig) requirement to operate starter is applied to inlet valve assembly.
3. Starter does not run, small air flow from turbine exhaust.	A. Nozzle blockage.	A. Remove blockage or obstruction from nozzles.
4. Starter does not run. Normal air flow from exhaust.	A. Excessive bends in the supply line causing flow restriction.	A. Shorten length or straighten supply air line.
	B. Insufficient dynamic pressure	B. See 2B. above
5. Pinion does not engage	A. Air pressure is too low	A. Increase air pressure to above 40 psig.
	B. Control lines to starter ports reversed.	B. Check installation diagram and correct.
	C. Solenoid valve not operating or plugged.	C. Check wiring and solenoid operation. Correct wiring. Remove blockage, or replace solenoid valve as needed.
	D. Damaged pinion teeth.	D. Replace pinion or starter drive as necessary.
6. Starter runs but engine cranks slowly or not at all.	A. Air pressure too low	A. Increase air pressure until successful starting is achieved.
	B. Excessive back pressure.	B. Check exhaust and remove any blockage
	C. Nozzle blocked or damaged.	C. Remove blockage or replace damaged parts.
7. Starter continues to operate after start button is released.	A. Solenoid valve is not sealing correctly.	A. See 1B. above
	B. Relay valve is not sealing correctly.	B. See 1A. above
8. Air tank pressure decays after extended shut down.	A. Air connections are not tight.	A. Tighten loose fittings. Repair or replace damaged fittings.
	B. Damaged air lines: crushed, frayed, and kinked.	B. Replace damaged lines.
	C. Relay valve is not sealing correctly.	C. See 1B. above
	D. Solenoid valve is stuck open.	D. A. See 1C. above

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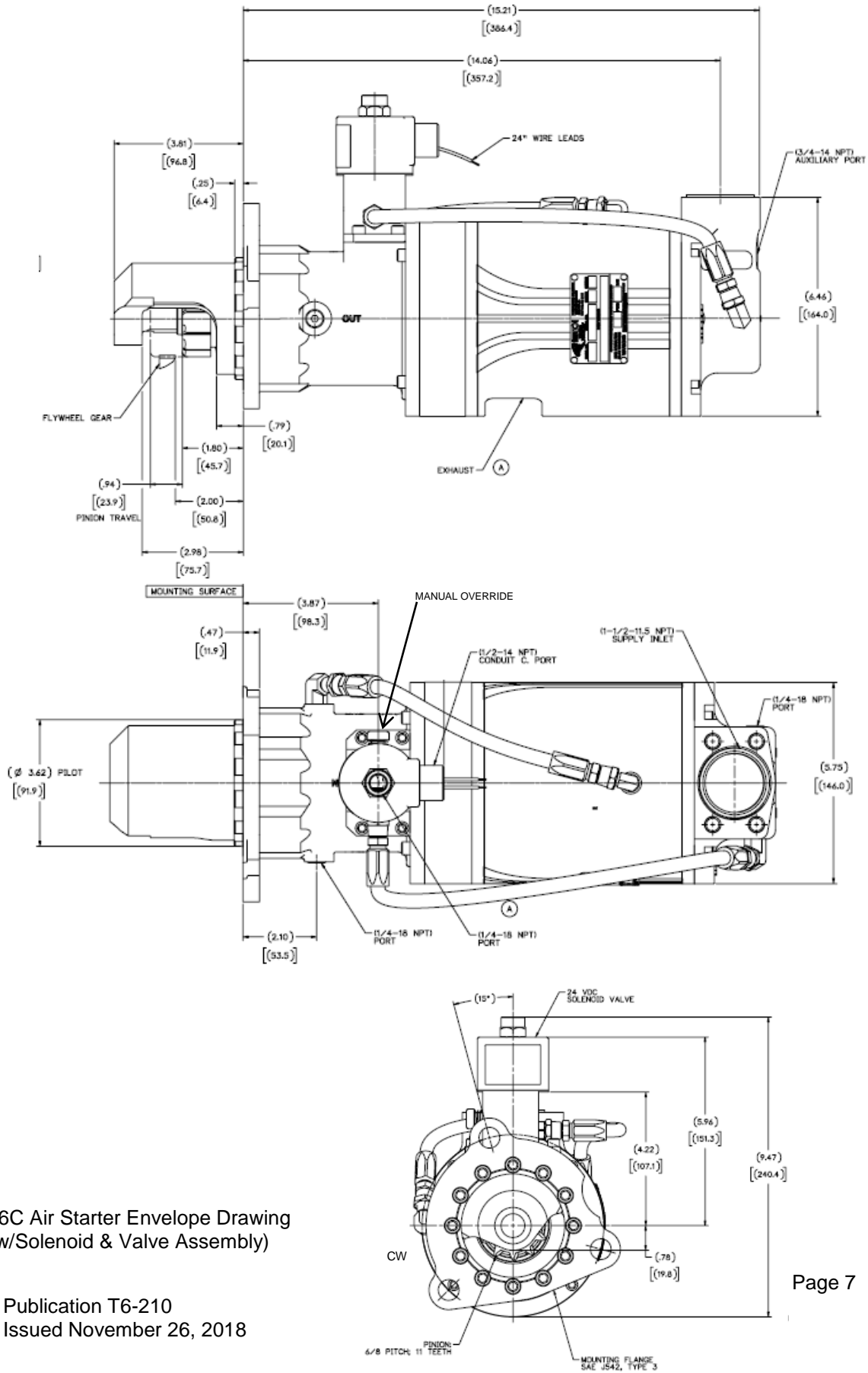


Figure 3. T6C Air Starter Envelope Drawing
(Starter w/Solenoid & Valve Assembly)

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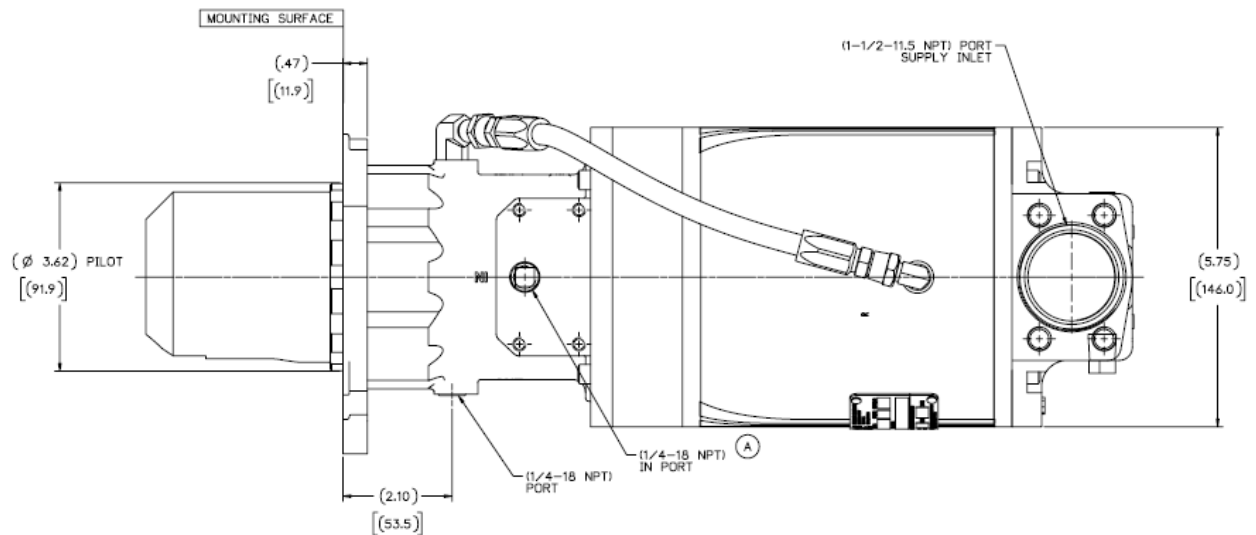


Figure 4. T6B Air Starter Envelope Drawing
(Starter w/Valve Assembly)

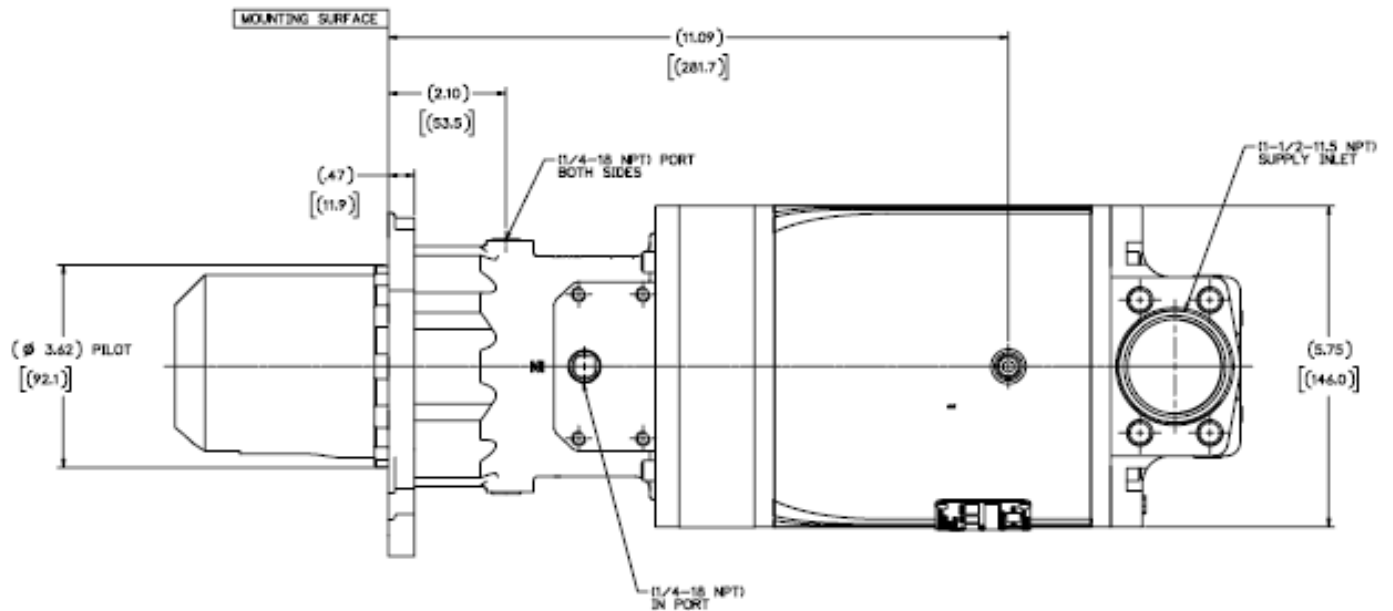


Figure 5. T6A Air Starter Envelope Drawing
(Starter Only)

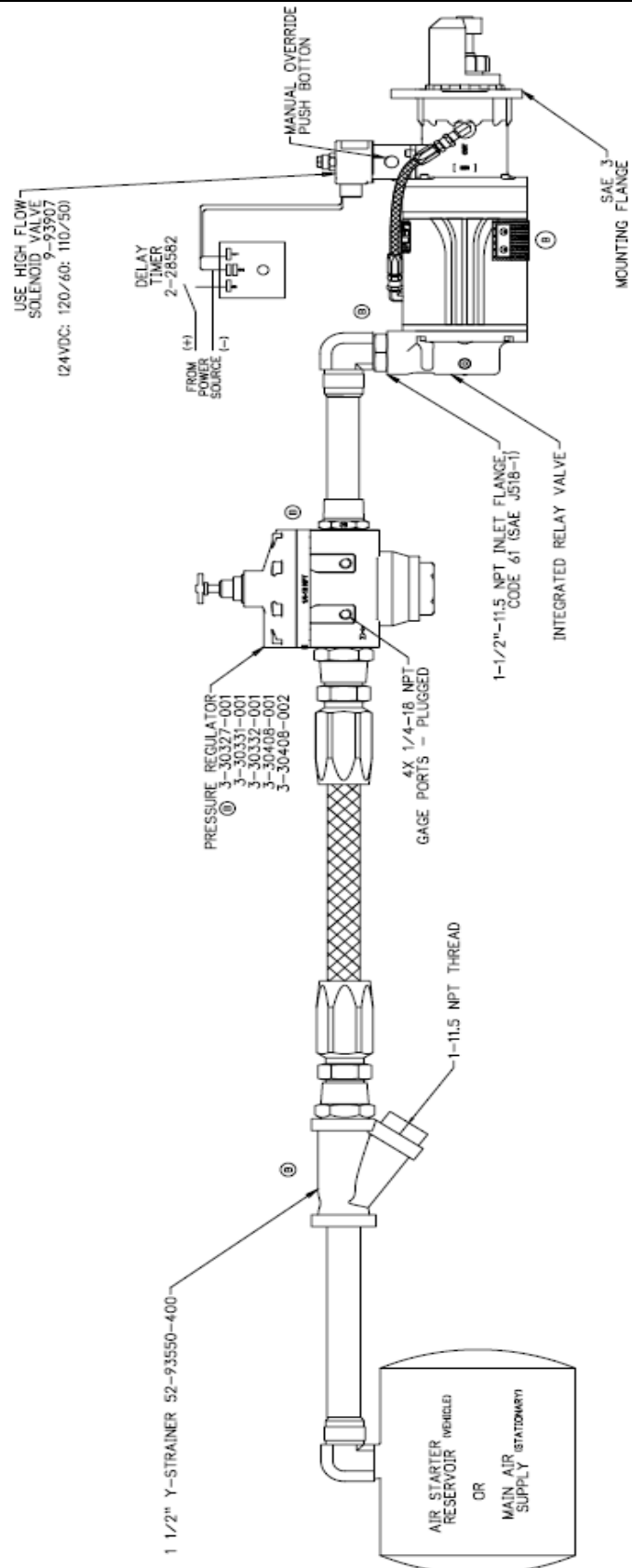


Figure 6. T6C Air Starter Installation Diagram

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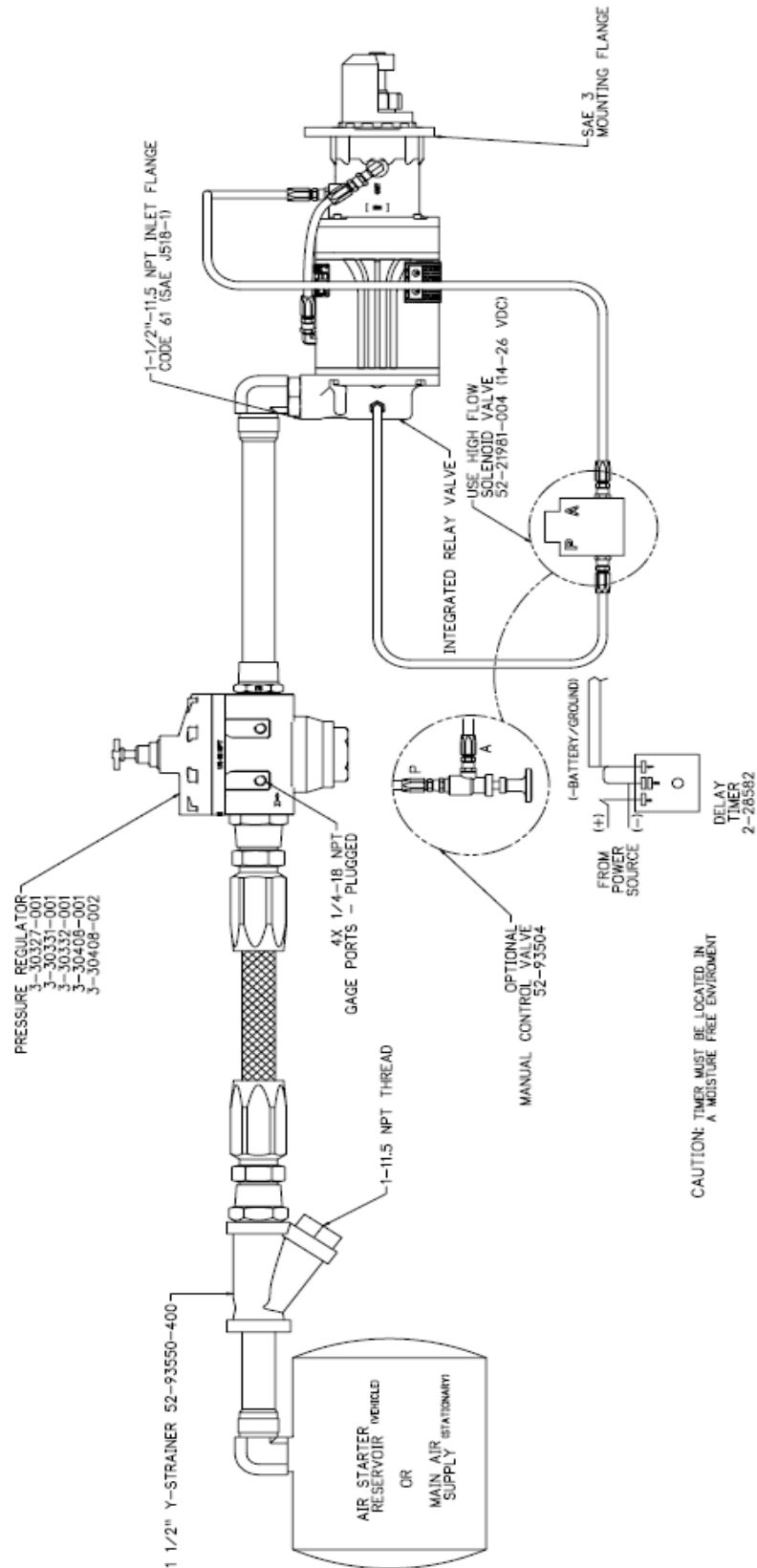


Figure 7. T6B Air Starter Installation Diagram

