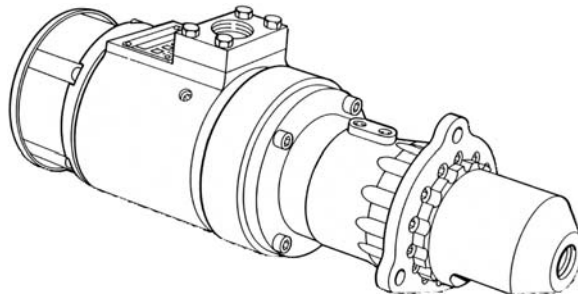


INSTALLATION AND OPERATING MANUAL



T50-P ***TURBOTWIN* Engine Air Starter**



TABLE OF CONTENTS

SECTION	SUBJECT	PAGE
1.0	General Information	1
1.1	Warnings, Cautions, & Notes.....	1
1.2	Installation and Service.....	1
2.0	Orientation of the Starter.....	1
2.1	Model T50P Orientation	1
2.1.1	Pinion Housing Re-Orientation	2
2.1.2	Exhaust Housing Orientation	2
3.0	Installing the Starter	2
3.1	Inlet Pressure Check Port.....	3
3.2	Exhaust Pressure Check Port.....	3
3.3	Piping System	3
3.4	Best Installation Practices.....	3
4.0	Starter Operation.....	4
4.1	Best Operating Practices	5
5.0	T50P Warranty	5
6.0	Operator's Troubleshooting Guide.....	6

ILLUSTRATIONS

FIGURE	TITLE	PAGE
1	T50-P Air Starter Envelope Drawing.....	7
2	T50-P Installation Diagram.....	8
	T50 Performance Curve – 10 nozzles (air).....	9
	T50 Performance Curve – 14 nozzles (air).....	9
	T50P Performance Curve – 10 nozzles (gas).....	10
	T50P Performance Curve – 14 nozzles (gas).....	10

1.0 GENERAL INFORMATION

This manual provides instructions for the installation and operation of the TDI **TURBOTWIN**[™] Model T50-P engine air starters. If there are questions not answered by this manual, please contact your TDI **TURBOTWIN**[™] distributor or dealer for assistance.

The Model T50-P is a turbine driven air starter with a pre-engage starter drive. It is well suited for starting diesel engines up to 70 Liters (4270 CID) or gasoline engines up to 98 Liters (5978 CID). The Model T50-P is designed for installation on engines which use a SAE 1, 2, or 3 mounting pad.

The T50 Series 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 pressure regulator installed within 10 feet of the starter can be used to adjust pressure to the starter.

The T50 Series starters are designed for operation with compressed air and natural gas effective serial number **0610-0994**. Small to moderate amounts of foreign matter or liquid in the air stream will normally not adversely affect T50 Series starters. As with all other TDI **TURBOTWIN**[™] models, no lubrication is required in the supply air.

You need to review the rest of this manual before installing your TDI **TURBOTWIN**[™] T50-P Series starter.

1.1 WARNINGS, CAUTIONS, & NOTES

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

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 **TURBOTWIN**[™] T50 Series 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. Repair technicians or service organizations without turbine starter experience should not attempt to repair this starter until they receive factory approved training from TDI, or its representatives. Proper operation and repair of your TDI **TURBOTWIN**[™] T50 Series starter will assure continued reliable and superior performance for many years.

WARNING

The TDI TurboTwin[™] T30 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.

NOTE

THIS STARTER IS TO BE SERVICED ONLY BY AUTHORIZED TDI TURBOTWIN[™] DISTRIBUTORS, DEALERS, AND REPAIR STATIONS. 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 T50-P ORIENTATION

A. Determine the required orientation of the pinion housing and gearbox housing.

B. Note that the pinion housing can be rotated to twelve different positions relative to the gearbox housing and the gearbox housing

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can be rotated to four positions relative to the inlet port.

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 Pinion Housing Re-Orientation

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

Rotate the pinion housing to the desired position and reinstall the twelve cap screws. 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.

2.1.2 Exhaust Housing Orientation

If this unit has an optional exhaust housing remove the four screws which connect the exhaust to the turbine assembly. Rotate the exhaust housing to the desired position relative to the inlet port.

Reinstall the four screws. **Torque to 190 Lbs.-In. (21.46 Nm)**

CAUTION

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

3.0 INSTALLING THE STARTER

Typical T50 Series installations are shown in Figure 2. The components illustrated may vary in shape, but there must at least be a start switch, air tank, and air piloted relay valve to correctly install and operate a T50 Series starter.

NOTE

Installing the air piloted relay valve on the starter is preferred in installations where the space is available.

TDI recommends mounting the air piloted relay valve no more than 3 meters (10 feet) from the starter's inlet port, and as close to the starter as possible. If the starter is being installed on a vehicle where the air tank is within 3 meters (10 feet) of the starter, then the relay valve may be mounted on the tank.

A turbine driven starter does not require lubrication in the supply air. Therefore, 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 on the engine.

Liberally grease the starter's pinion teeth with any multi-purpose high pressure/high temperature grease and then mount the T30 Series starter on the engine. Tighten all mounting hardware as appropriate.

After mounting the starter to the engine, attach the supply air line from the tank, the control air lines, and the solenoid to the ignition system and air piloted relay valve.

TDI recommends installation of a "Glad Hand" / quick disconnect for auxiliary pressurization of the air tank.

Because turbine starters such as the T50 Series 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.

Normally an air strainer is not required. In dirty environments, use of a #40 mesh Y-strainer is recommended.

WARNING

Recheck all connections for tight fit to eliminate leakage.

Fill the air system tank. The T50-P 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 housing, at the air inlet. This port is used to check the dynamic supply pressure (at the Motor when the Motor is operating). To check dynamic pressure, remove the 1/8" NPT pipe plug and save for later use. Install a pressure gauge to read at this port. Using Loctite Pipe Thread Sealant or equivalent, replace 1/8" NPT pipe plug upon completion of pressure check.

3.2 EXHAUST PRESSURE CHECK PORT

A 1/8" NPT pressure check port is located on the 90° exhaust adapter. This port is used to check back pressure caused by restriction in the exhaust piping. For optimum starter operation, the back pressure measured at the exhaust pressure check port should be 0 psig. In situations where the back pressure cannot be completely eliminated, the back pressure should not exceed 15 psig. To check back pressure, remove the 1/8" NPT pipe plug and save for later use. Install a pressure gauge to read the back pressure at this port. Using Loctite pipe thread sealant or equivalent, replace 1/8" NPT pipe plug upon completion of pressure check.

3.3 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 case the piping system will be emptied after the starting procedure.

Pipe unions must be type approved by GL. Downstream of the pressure regulator a pressure relief valve is to be provided.

3.4 BEST INSTALLATION PRACTICES

- Wear protective gloves and steel toe shoes when installing air starter.
- Follow engine manufacturer's torque requirements for all starter attachment screws.
- For new installations or where new piping or receiver tanks are installed, always purge the starter supply line of debris before installing or operating the air starter.
- Install and maintain a 40-mesh (400 micron) Y-strainer in the starter supply line to reduce the level of contamination entering air starter.
- To insure maximum performance and starter life, use the recommended starter inlet and exhaust piping sizes.
- Limit the number of elbows installed in starting system supply/exhaust lines and minimize to the extent possible, the length of these lines to prevent excessive flow losses and/or back pressure.
- Use a quick-opening starter relay valve to operate air starter, and install within 10 feet of the air starter inlet.
- To properly control the starter, use a control valve configured with 3 ports (IN, OUT, VENT). Use a 3-way valve only. Never use a 2-way or manual ball valve to operate a pre-engaged starter model or within the pre-engagement controls piping.)
- When a pressure regulator is required, locate this at a minimum distance of 10 feet away from the starter relay valve.
- Utilize pressure regulator(s) with flow characteristics that meet or exceed the selected air starter's flow requirements (Cu factor).
- Regulators located far from the starter may require sensing downstream

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- pressure closer to the starter inlet to deliver the desired dynamic pressure to the starter while operating.
- Do not use any mist or injection type lubricators/devices in supply line to a TDI air starter.
 - Where used in sub-freezing ambient temperatures, install air starter with inlet and exhaust in 6 o'clock position to allow drainage preventing freezing of trapped moisture in the starter inlet.

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. In order to check the starter inlet pressure, a 1/8" NPT pipe tap connection is provided on the housing. To attach a pressure gauge; refer to Figure 1.

CAUTION

IN NO CASE SHOULD INLET OPERATING PRESSURE EXCEED 8.3 BAR (120 PSIG).

WARNING

Do not operate the TDI TurboTwin T50 Series 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 T50 Series starter may be subjected to is 20.7 bar (300 PSIG). System pressure that exceeds the maximum operating limit must use a pressure reducer device to ensure that the operating pressure limit to the T50 Series 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 **TURBOTWIN**[™] distributor or dealer.

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 (piston rings or vanes) quickly stops an unloaded machine. Less encumbered by drag, and typically decelerating from much higher operating speeds, turbines can take longer to come to rest.

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.

4.1 BEST OPERATING PRACTICES

- To extend starter life, apply only the minimum pressure required, to successfully crank & start the engine.
- Never exceed starter maximum operating pressure identified on starter nameplate. This pressure can be best measured dynamically while starter is running.
- For longer starter life, operate (or design controls) to shut off supply pressure to the air starter immediately after a successful engine start.
- If engine fails to start or stalls, wait at least 15 seconds before attempting to re-start to allow the starter to coast to a complete stop.
- Never re-engage pinion into ring gear when starter is coasting down as this may damage the starter pinion gear and engine ring gear.

- Never engage starter while engine is operating as this may damage the starter, the pinion gear, and engine ring gear
-

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. Therefore, if the starter is NOT installed and 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: 0602-0567 has a manufactured date of February 2006).

5.0 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 from the date of installation. 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 July 1999 (SN: 9907-101) will not be covered under warranty after July 2001). The conditions of this warranty are: **a)** TDI is notified within this period by return of such product to TDI or its authorized distributor/dealer, 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.

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6.0 OPERATOR'S TROUBLESHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	SOLUTION
1. Air always flow through exhaust	A. Relay valve improperly installed.	A. Check typical installation diagram and correct.
	B. Relay valve not sealing properly.	B. Check for damaged sealing ring, replace relay valve or damaged parts.
	C. Solenoid is not sealing, pressure remains in APP port of relay valve.	C. Check solenoid potential at the lead to ground should be 0. If not, fix ignition switch problem.
2. Starter engages but does not run,	A. Bad relay valve	A. Replace relay valve.
3. Starter does not run, small air flow from turbine exhaust or drive housing.	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.	A. Shorten length or straighten supply air line.
5. Pinion does not engage	A. Air pressure is too low	A. Increase air pressure to 150 - 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 to 150-40 psig.
	B. Excessive back pressure.	B. Check Exhaust Closure Plate.
	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 1C. above
	B. Relay valve is not sealing correctly.	B. See 1B. 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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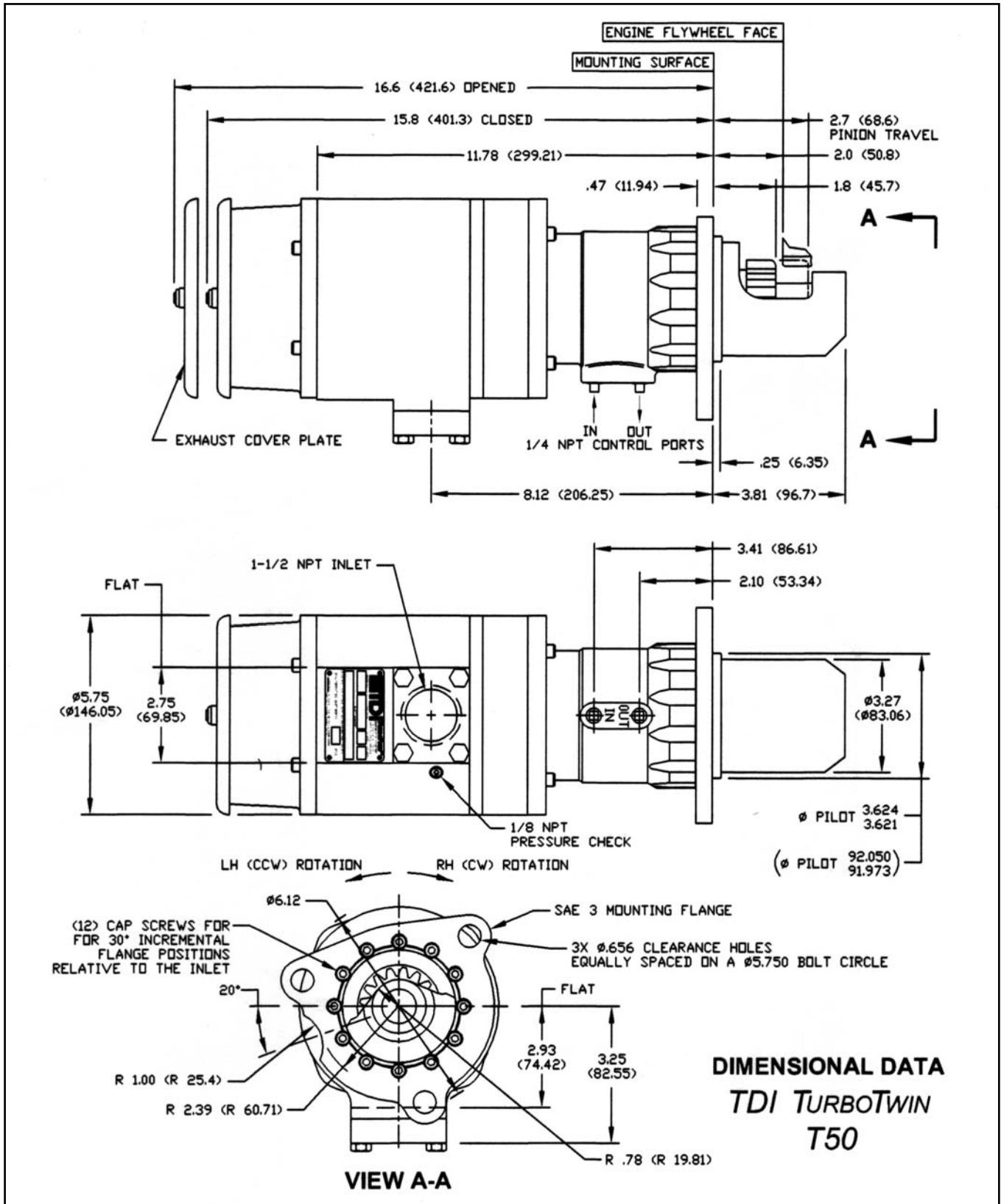


Figure 1. T50-P TURBOTWIN Air Starter Envelope Drawing

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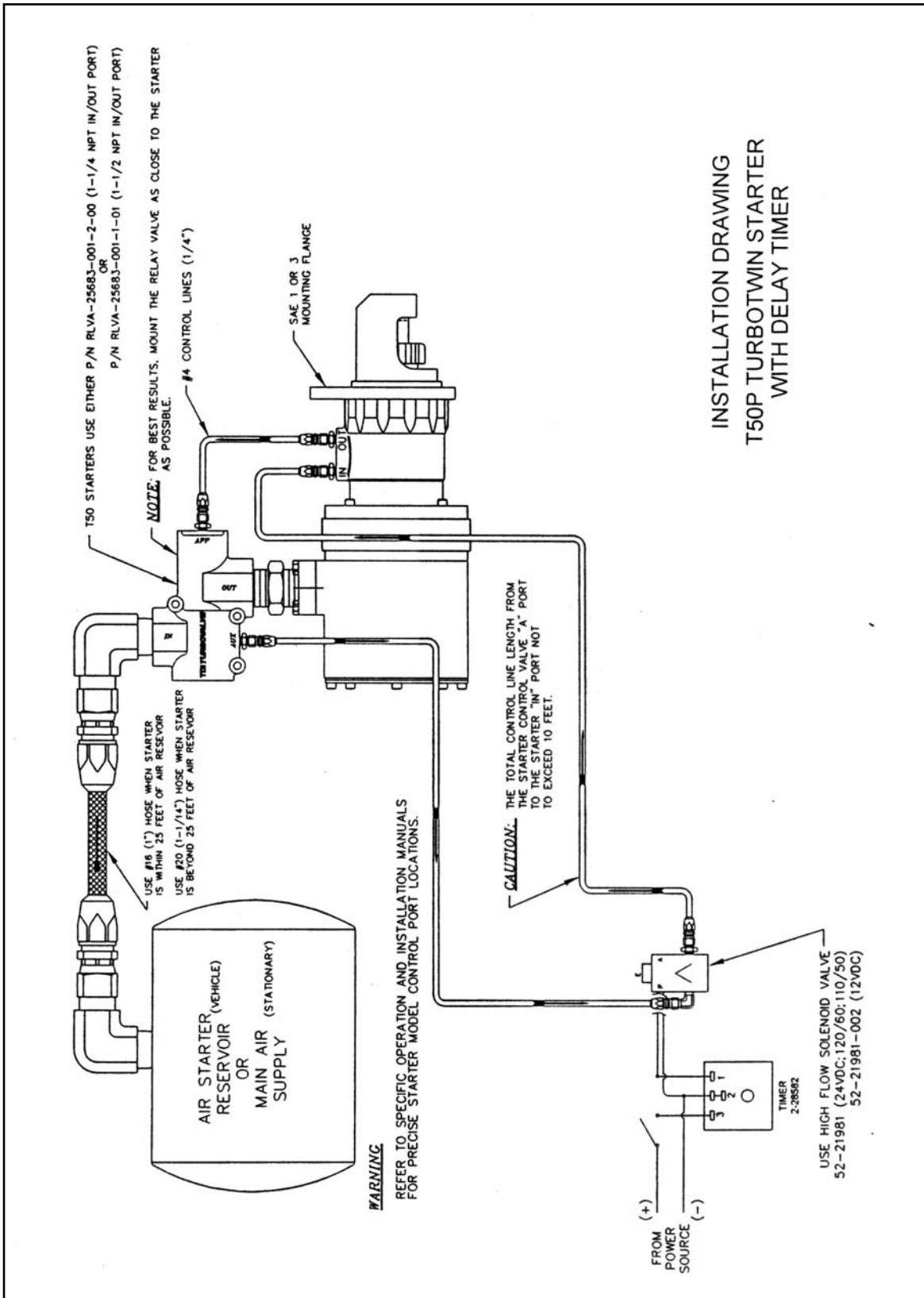
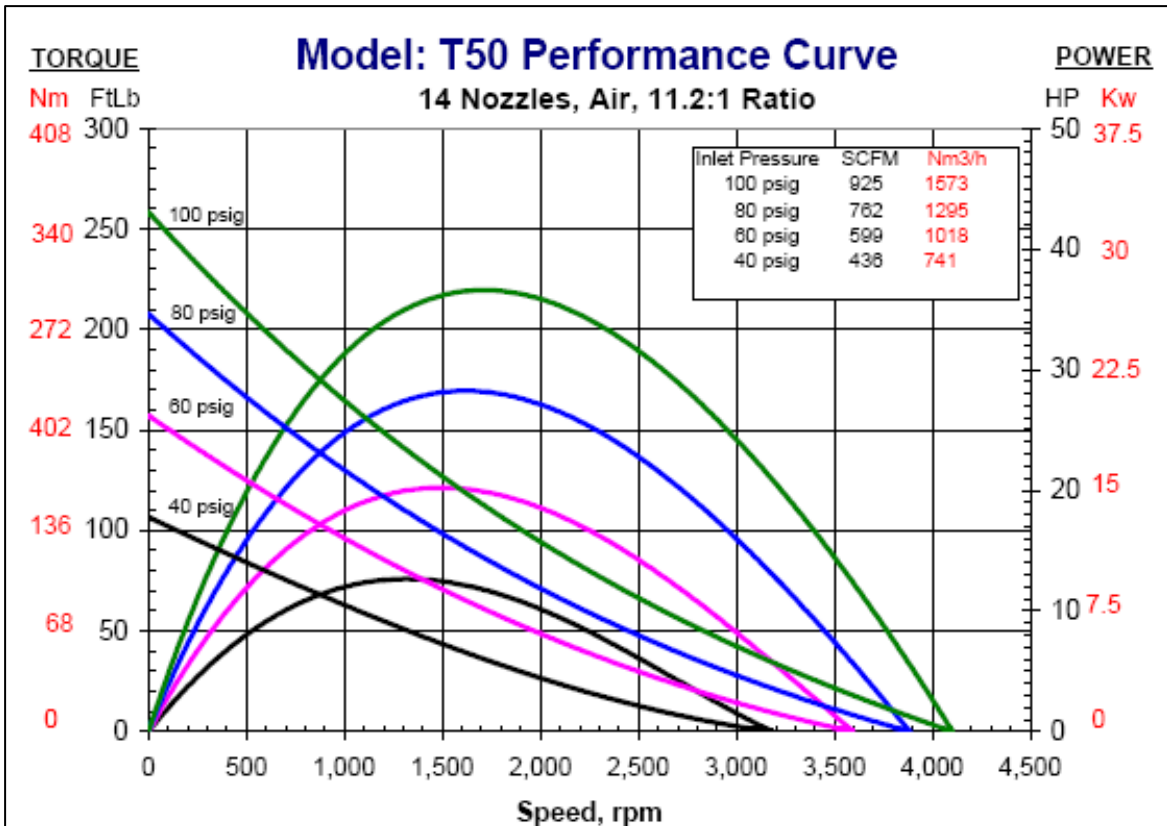
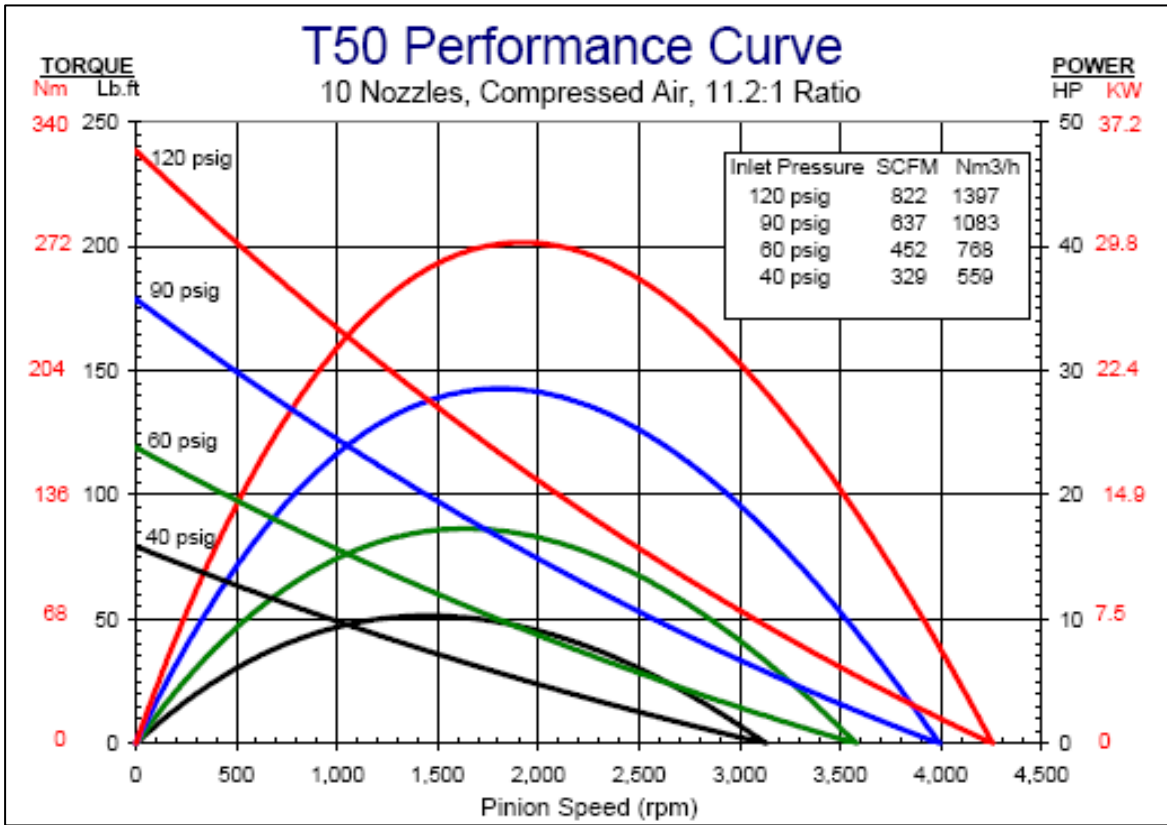


Figure 2. T50-P Installation Diagram



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