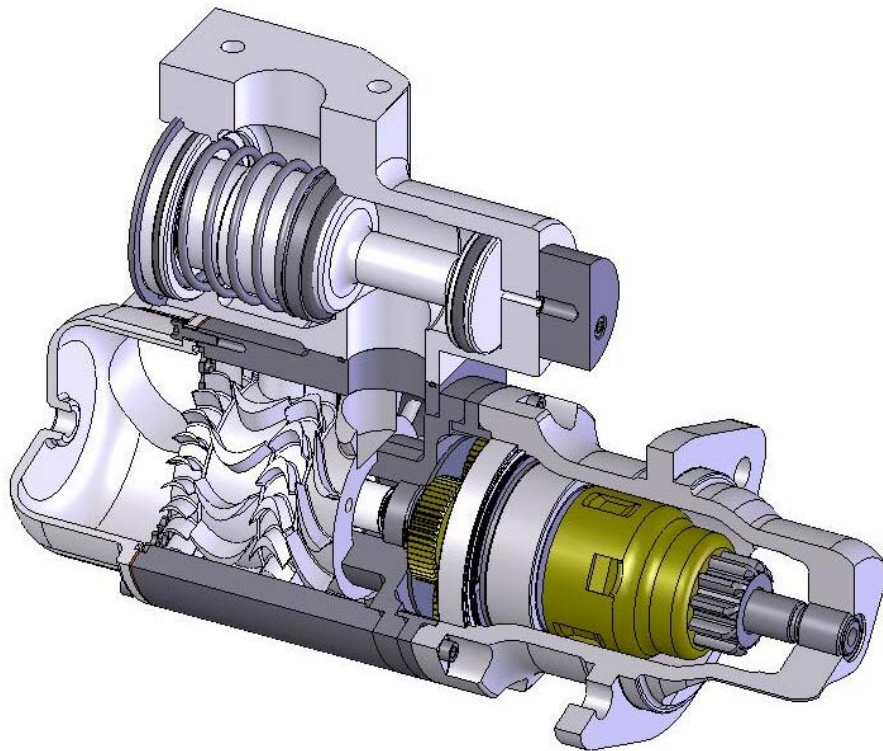


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Publication T20-719, Rev: 2  
Dated: April 15, 2014



# INSTALLATION AND OPERATING MANUAL



## MODEL: T20 ***TURBOTWIN*** Engine Air Starter

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## 1.0 GENERAL INFORMATION

This manual provides instructions for the installation and operation of the TDI TurboTwin™ Model T20 engine air starter. If there are questions not answered by this manual, please contact your TDI TurboTwin™ distributor or dealer for assistance.

The Model T20 is a turbine driven air starter with an inertia type drive. It is well suited for starting diesel engines up to 6 liters and gas engines up to 8 liters. The Model T20 is designed for installation on engines using a SAE 1, 2, 3, or 4 mounting flange. Additional flanges are available for special starter mounting requirements.

The T20 Series starters operate within a wide range of inlet gas pressures and ambient temperatures. The engine size and parasitic loading will determine the exact pressure to insure reliable starting. A pressure regulator installed within 10 feet of the starter can be used to adjust pressure to the starter.

T20 Series starters are designed for operation with compressed air or natural gas. Moderate amounts of foreign matter or liquid in the air stream will not adversely affect T20 Series starters. The T20 does not require lubrication in the supply gas.

This manual should be reviewed before installing your TDI TurboTwin™ T20 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 possible.

**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

TDI TurboTwin™ T20 Series starters provide 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 for full benefit of these advantages.

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™ T20 Series starter will ensure continued reliable and superior performance for many years.

### WARNING

The TDI TurboTwin™ T20 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.

## 1.3 PRODUCT IDENTIFICATION

The nameplate attached to starter housing identifies the following information:

- Model Designation - T20
- Part Number identifies number of nozzles, orientation, and pinion configuration.
- Serial Number (date manufactured code)
- Maximum Operating (Inlet) Supply Pressure
- Direction of Rotation

### NOTE

Direction of Rotation - either left hand LH (CCW) or right hand RH (CW) is designated from viewing pinion end of the starter.

### NOTE

Maximum Operating Pressure indicated on the nameplate can be verified at the pressure check port below starter inlet port, and set dynamically during starter operation.

### NOTE

The Proof Pressure shown on the nameplate indicates the maximum static pressure rating at which starter turbine housing will not burst.

## 2.0 ORIENTATION OF THE STARTER

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

### 2.1 MODEL T20 ORIENTATION

- Adjust the orientation of the mounting flange relative to the desired position of starter inlet. The optional exhaust adapters (deflector/elbow fitting) can also be oriented to the desired position.
- The starter mounting flange can be rotated to 8 different positions relative to the pinion housing. Additionally, the optional exhaust port can be rotated to 8 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 Starter Mounting Flange Orientation

Remove the 8 mounting flange to pinion housing screws and rotate flange to desired position.

Apply Loctite 242 to the screw threads and reinstall the 8 screws. Torque to 49 in-lbs.

#### 2.1.2 Exhaust Housing Orientation

If this unit has an optional exhaust elbow or deflector, remove 7 screws connecting the exhaust to the turbine assembly. Rotate the exhaust housing to the desired position relative to the inlet port.

Apply Loctite 242 to the screw threads and reinstall the 7 screws. Torque to 49 in-lbs.

## 2.2 SUPPLY & EXHAUST INSTALLATION

#### **WARNING**

Be sure to either bleed the pressurized air reservoir and/or safety the system such as closing all air/gas supply valves prior to installing starter or a new supply line.

The T20 supply line consists of a line from the air/gas supply source (via a pressure regulator when necessary) through filters and/or pneumatic/solenoid operated relay valves to the starter inlet.

The exhaust line consists of the line from the starter exhaust to a "safe" location. When the starter is operated using natural gas, the exhaust is typically plumbed away from the engine area.

Hard piping may be used on supply/exhaust lines. A section of flexible tubing (gas approved where required) is recommended, between starter inlet/exhaust outlets, to the hard piping. This can prevent leaks due to piping weight & vibration and aids field maintenance/replacement of the starter.

All pipe threaded joints should be sealed with Loctite Pipe Thread Sealant (TDI P/N 9-94085) or equivalent, for leak tight joints prior to final assembly. Be sure to tighten all joints to proper torque during final assembly.

The installation of the starter using natural gas is similar to the air installation except all fittings, piping, valves and regulators must be compatible with natural gas and gas industry regulations.

#### **WARNING**

When using natural (or combustible) supply gas (e.g. methane gas) must be piped to a safe location, routed, and terminated according to industry codes and local regulations.

#### **NOTE**

On low pressure applications, if the supply line is longer than 40 feet, piping size may need to be increased to minimize dynamic flow losses through piping. Similarly, exhaust piping length & diameter must not induce back pressure that will affect starter performance.

## 3.0 INSTALLING THE STARTER

The components may vary in shape, but there must be at least a start switch and air tank to correctly operate a T20 starter. A regulator should be installed in the starting system if the air pressure exceeds the maximum pressure rating of the starter. The regulator should be installed within 10 feet (3 meters) of the starter.



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A turbine driven starter does not require lubrication in the supply gas. If a vane-type starter motor is 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 chassis lube and then install the T20 Series starter on the engine. Tighten all mounting hardware as appropriate.

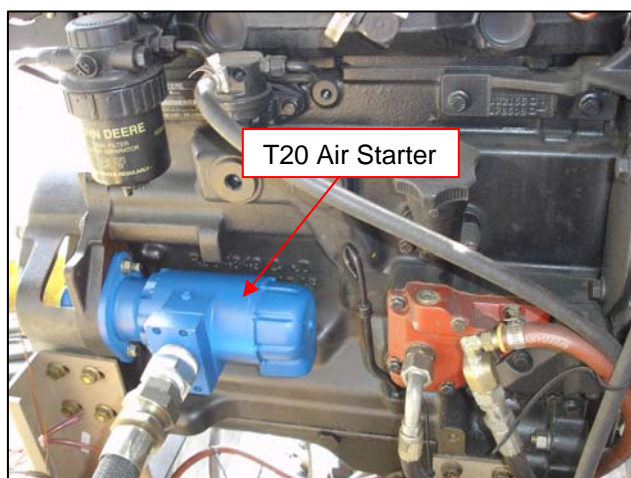
Normally a filter is not required in the supply line. However, in dirty environments, use of a #40 mesh Y-strainer P/N: 52-93550-100 is recommended.

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.

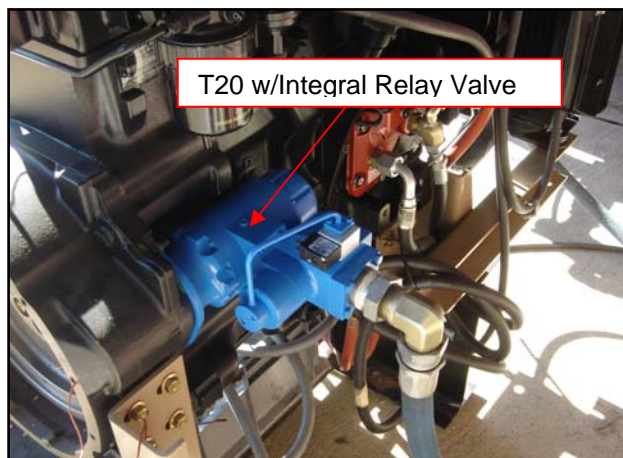
Pipe unions must be type approved by GL. Downstream of the pressure regulator a pressure relief valve is to be provided.

### **WARNING**

Recheck all connections for tight fit to eliminate gas leakage.



T20 installed on John Deere 4045 engine



T20 w/IRV installed on John Deere 4045 engine

### **CAUTION**

There is often weld slag, grindings, thread shavings, hardened compounds and other heavy debris in new package piping & at new site installations. At commissioning TDI recommends a purge or "blow-down" of supply lines to prevent damage to the starter. While the T20 is highly tolerant of moisture & fine contamination, starter life can be increased by use of a coarse #40 mesh strainer upstream in the supply line

### **3.1 INLET PRESSURE CHECK PORT**

A 1/8" NPT pressure check port is located on the Motor 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 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 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 operating pressure limit is that pressure measured at the starter inlet pressure check port during the crank cycle. To check the inlet pressure, a 1/8" NPT pipe tap connection is provided in the inlet housing for attaching a pressure gauge.

#### **CAUTION**

**IN NO CASE SHOULD INLET OPERATING PRESSURE EXCEED THE RATING IDENTIFIED ON STARTER NAMEPLATE.**

#### **WARNING**

Do not operate the TDI TurboTwin T20 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.

MODEL	# of NOZZLES	MAX PRESSURE
T20-02	2	150 PSIG
T20-04	4	60 PSIG
T20-06	6	40 PSIG
T20-12	12	20 PSIG

The static supply pressure will always be higher than the operating pressure. As a guideline, the maximum pressure limit (proof pressure) that the T20 Series starter may be subjected to is 600 psig (42 bar). System pressure that exceeds the maximum operating limit must use a pressure regulator to insure operating pressure limit to the T20 Series starter is not exceeded.

System pressure that exceeds the 600 psig (42 bar) limit must, in addition to a pressure reducer device, incorporate a pressure relief valve set below 600 psig (42 bar) in the supply air line.

**WARNING**

All appropriate local pressure codes and pressure limitations on other system components must be adhered to and supersedes 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<sup>™</sup> distributor or dealer.

**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: 0910-0567 has a manufactured date of October 2009).

#### 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

### **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: 9907-0101) 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 procedures.

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.

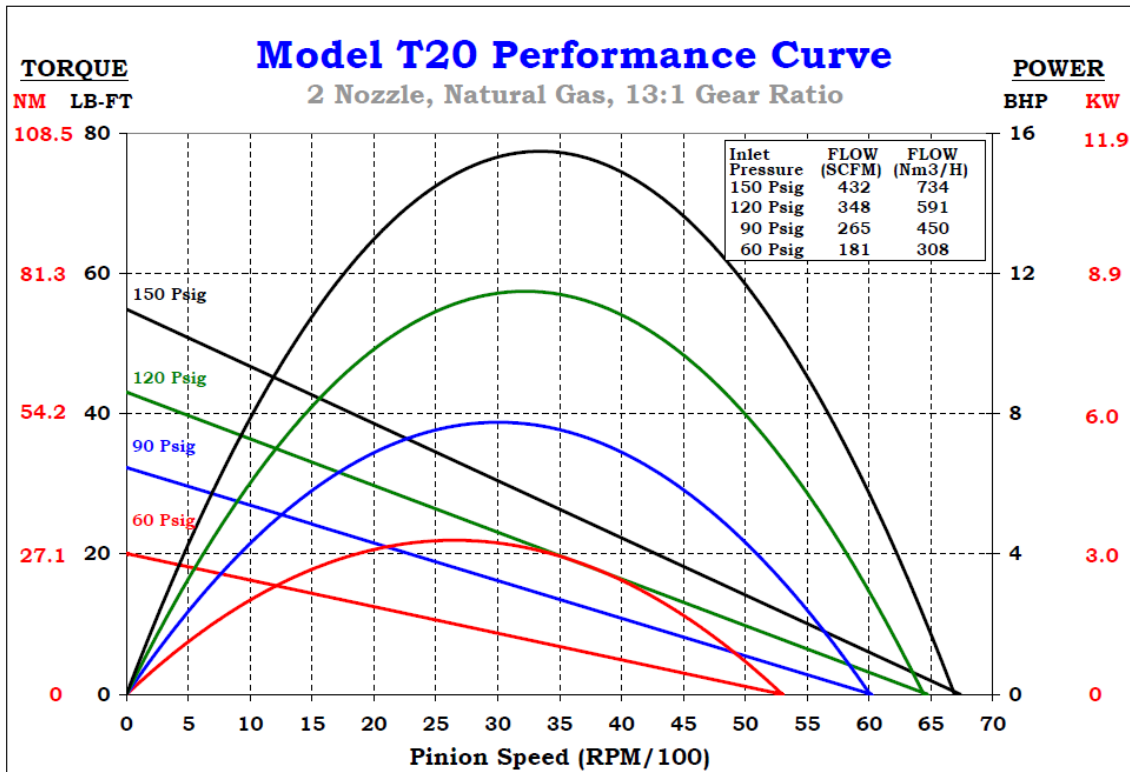
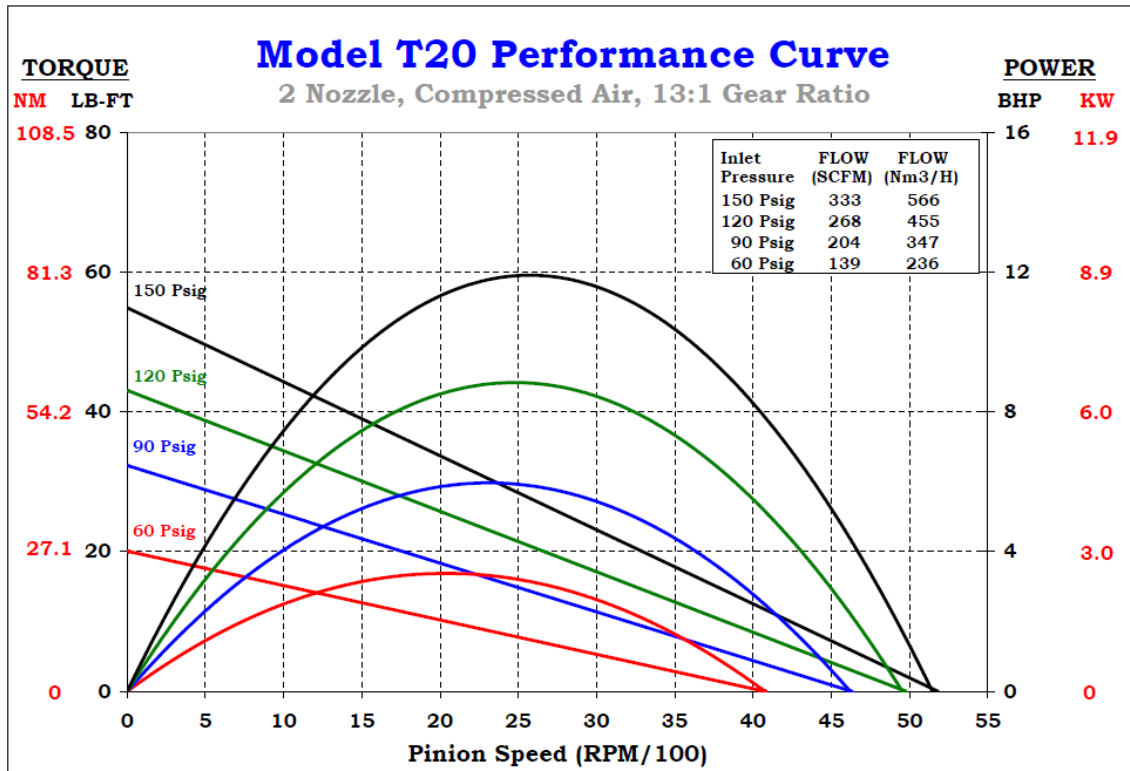


## 6.0 OPERATOR'S TROUBLESHOOTING GUIDE

TROUBLE	PROBABLE CAUSE	SOLUTION
1. Moderate amount of gas 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 o-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 starting switch problem.
2. Starter does not operate	A. Relay valve not functioning.	A. Check solenoid valve operation. Confirm pressure applied to relay valve APP port is 15 psig or higher.
3. Starter does not run. Small gas flow from turbine exhaust or drive housing.	A. Turbine nozzle blockage.	A. Remove blockage or obstruction from nozzles.
4. Starter does not run. Normal air flow from exhaust.	A. Excessive bends and/or fittings in the supply line.	A. Shorten length or straighten supply air line to increase air/gas flow to starter.
5. Pinion does not engage	A. Gas pressure is too low	A. Increase air pressure required for starter operation.
	B. Solenoid valve not operating or plugged.	B. Check wiring and solenoid operation. Check for correct voltage. Correct wiring, remove blockage, or replace solenoid valve as needed.
	C. Damaged pinion teeth.	C. Replace pinion or starter drive as necessary.
6. Starter runs, but engine cranks slowly or not at all.	A. Gas pressure too low	A. Increase air pressure required for starter operation.
	B. Excessive back pressure.	B. Check exhaust pressure and reduce if necessary.
	C. Worn or broken starter drive.	C. Replace starter drive.
	D. Turbine nozzle blocked or damaged.	D. 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 gas 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. See 1C above

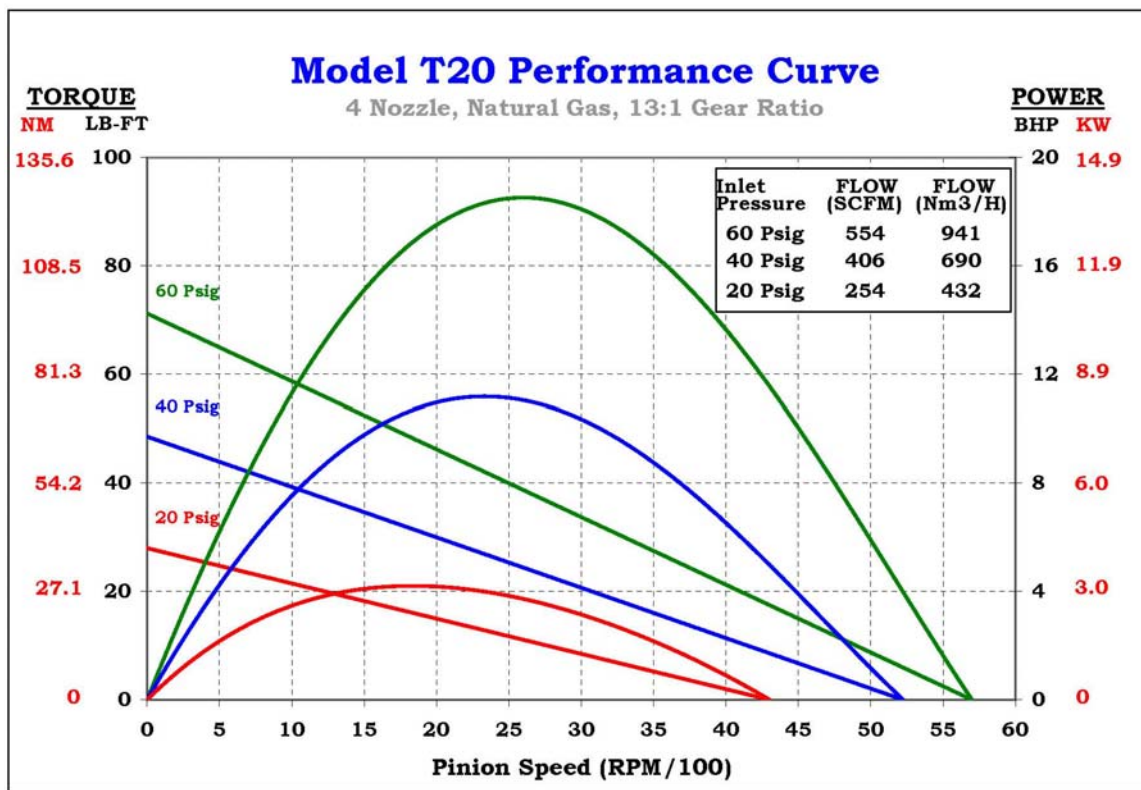
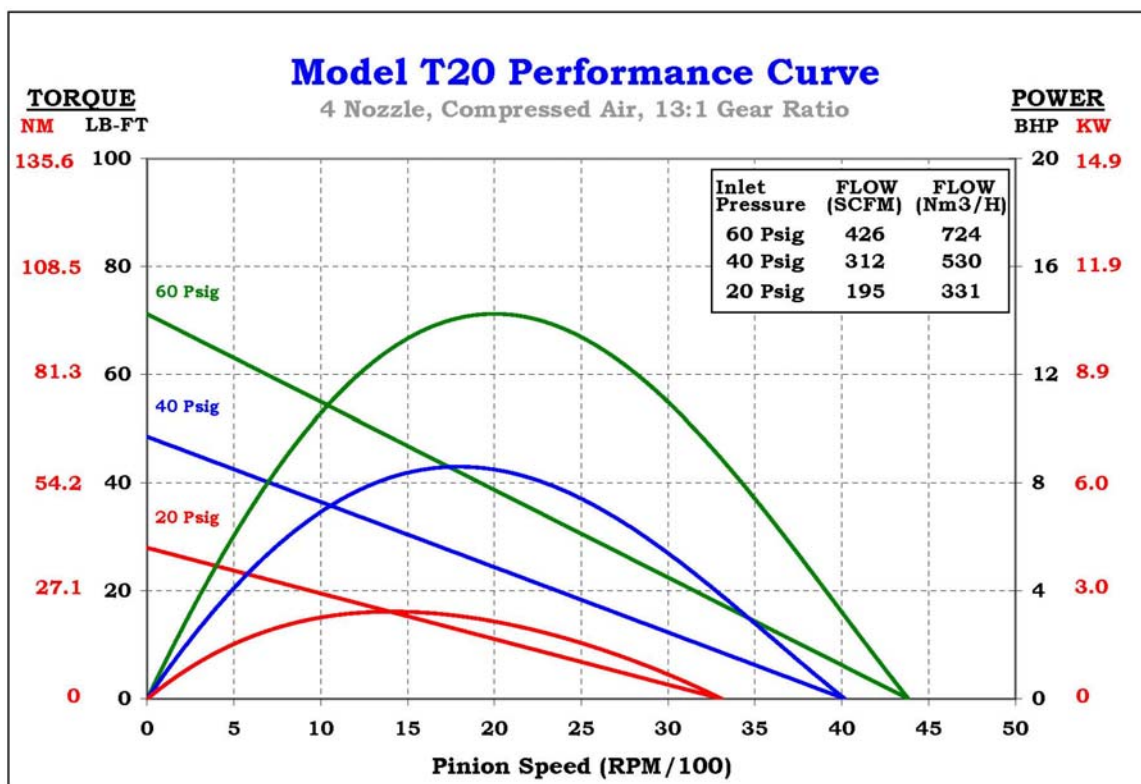
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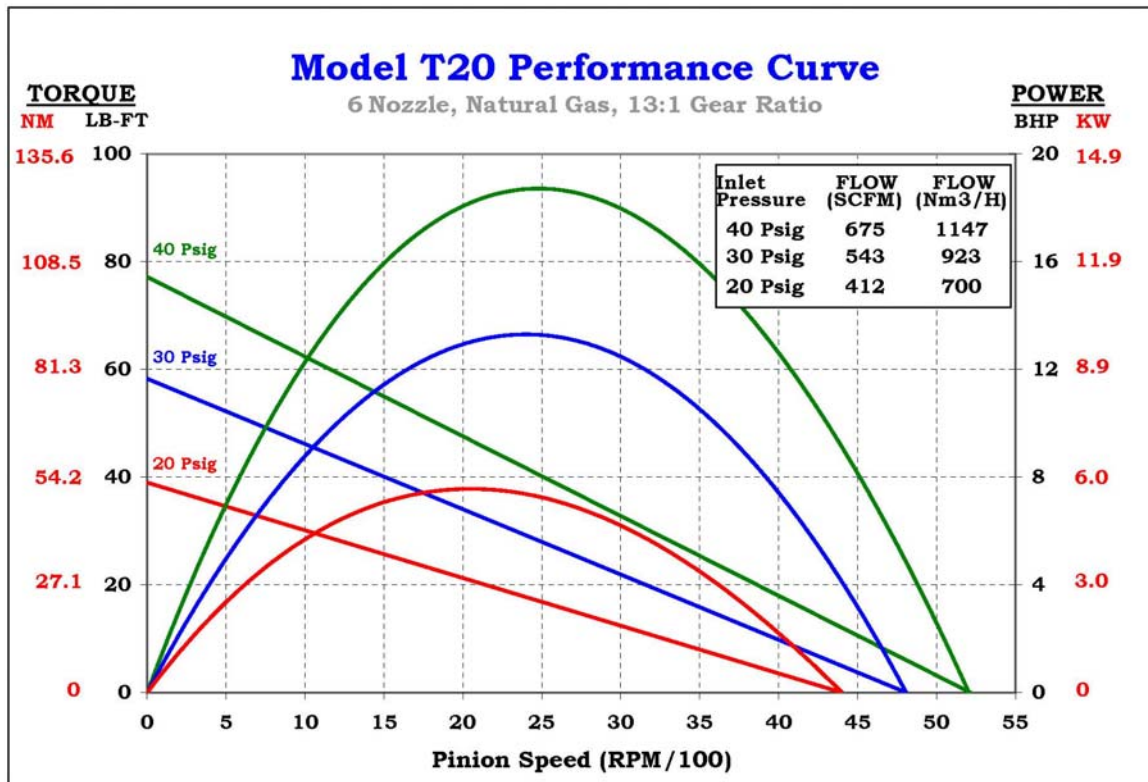
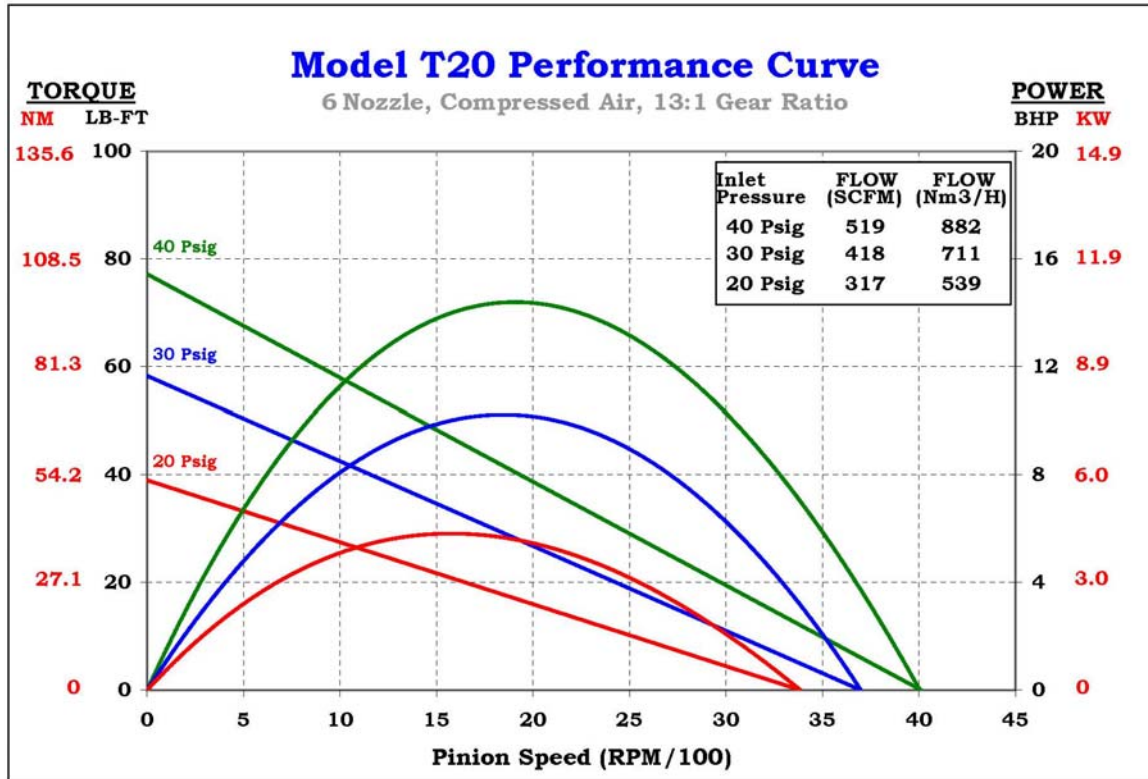
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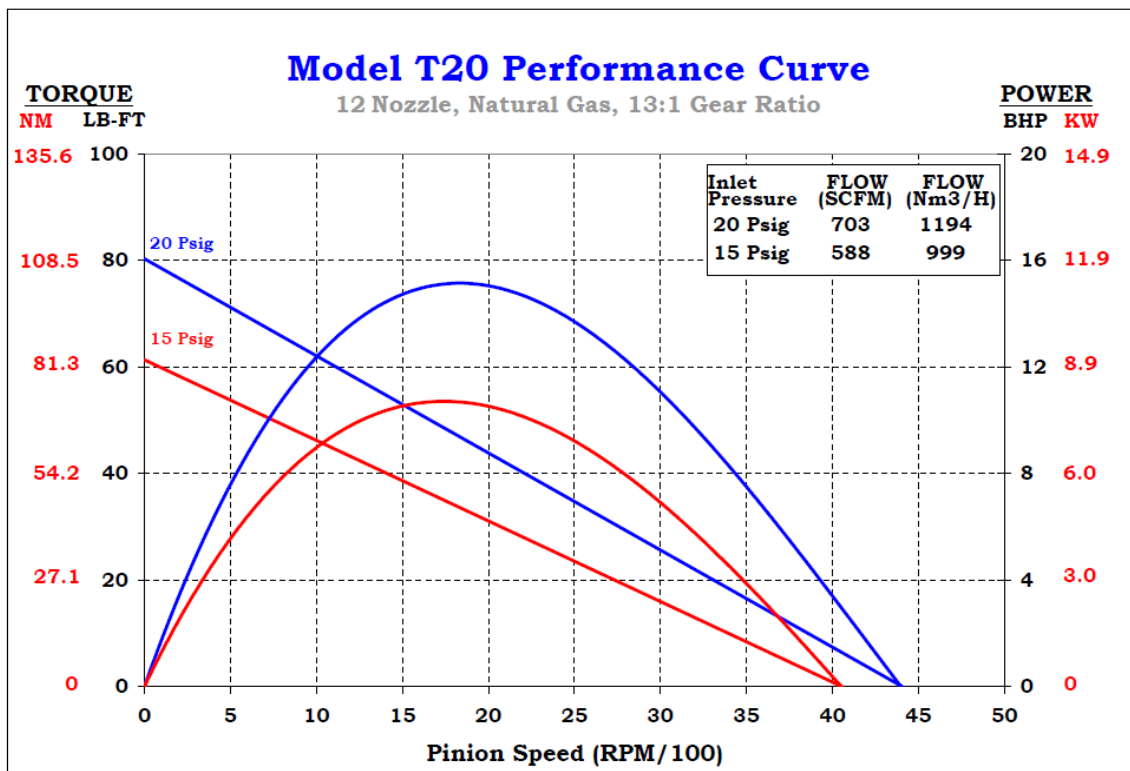
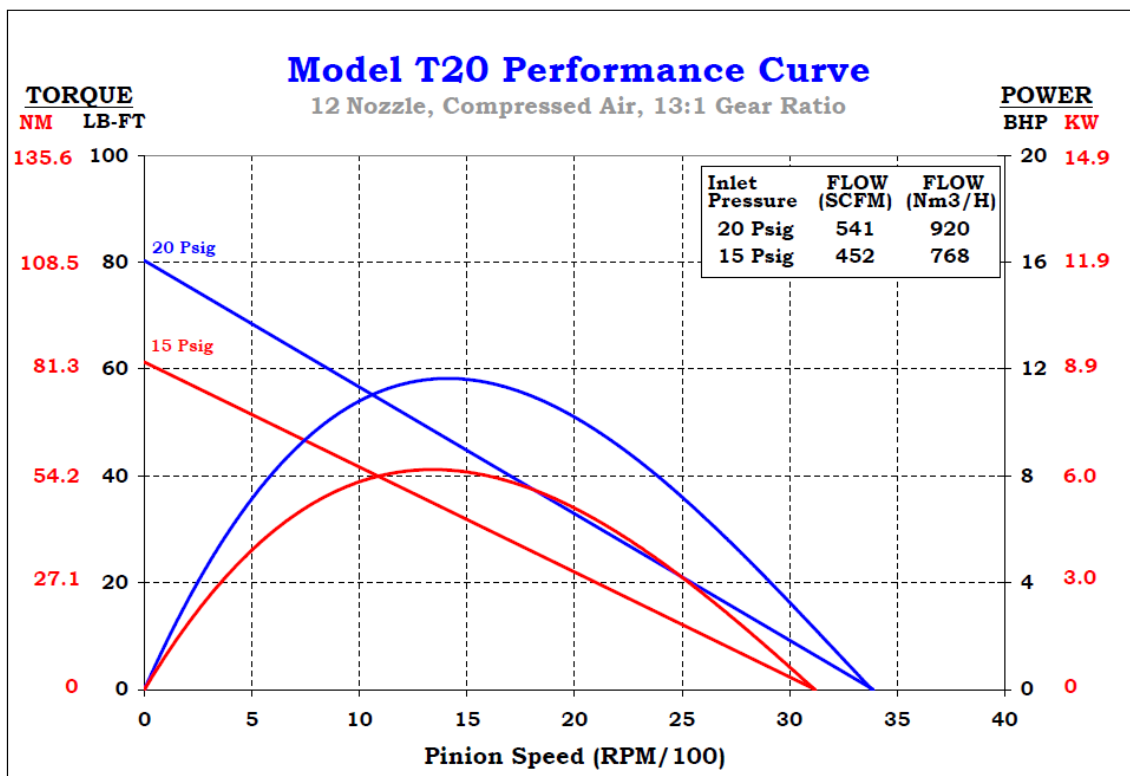
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# TDI TURBOTWIN™

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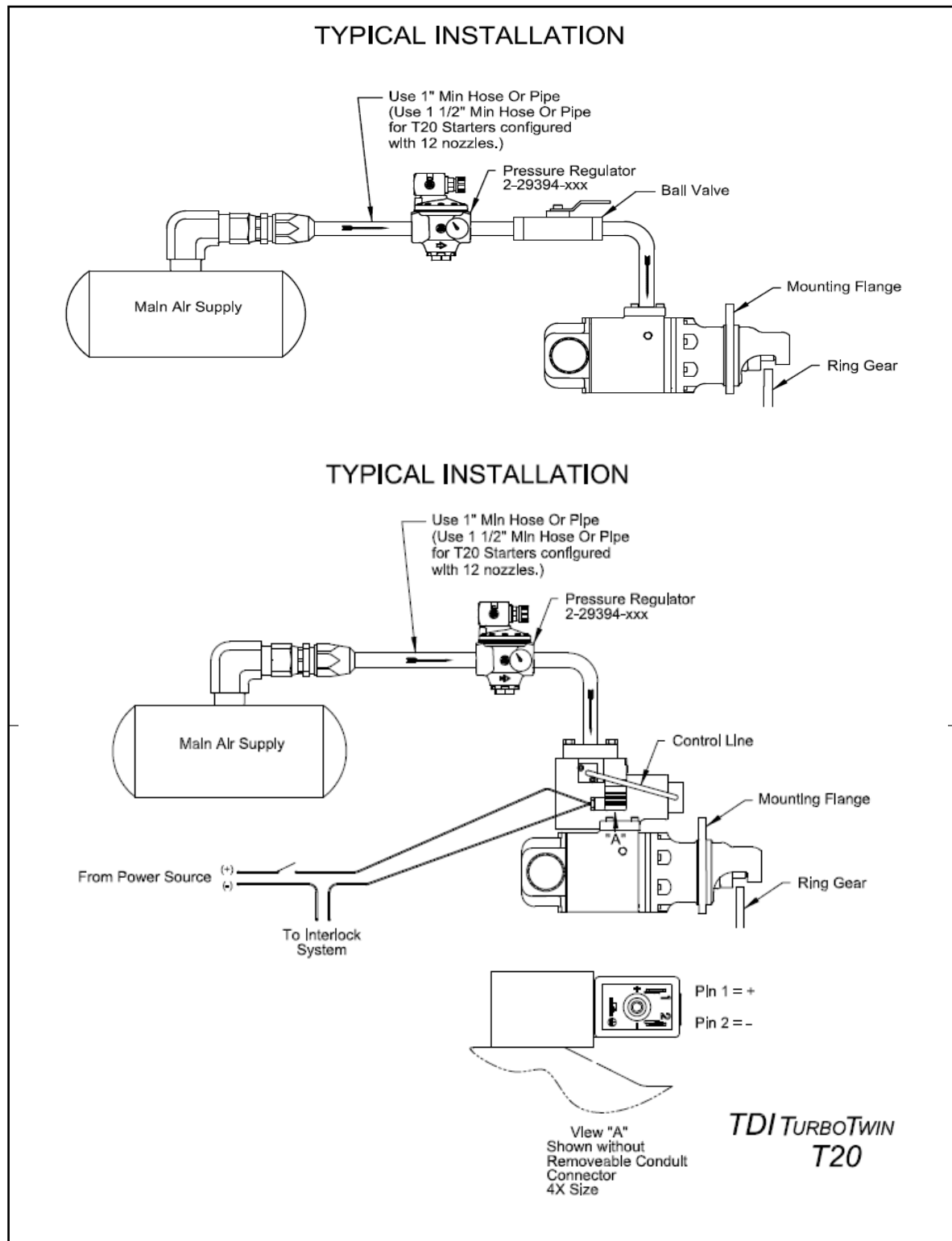
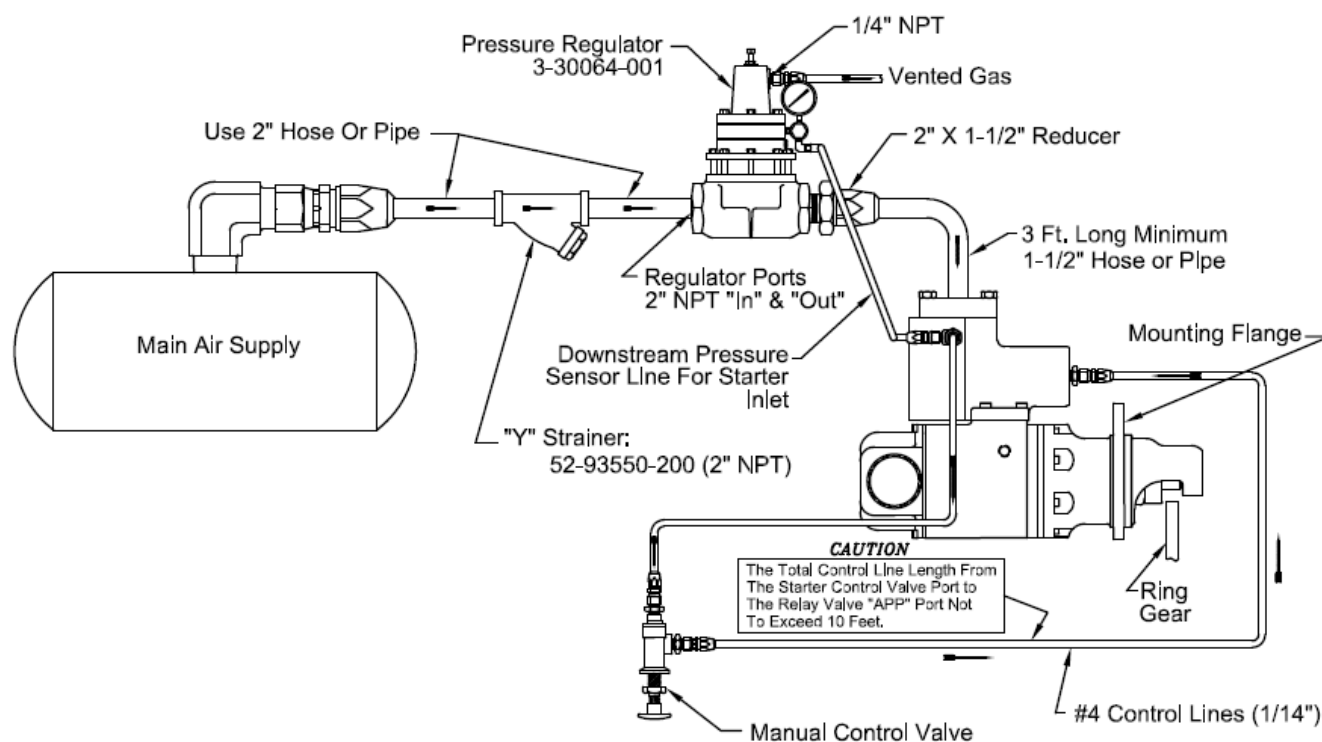


Figure 1. T20 Installation Diagrams (Compressed Air)

## TYPICAL INSTALLATION



**TDI TURBOTWIN**  
**T20**

Figure 2. T20 Installation Diagrams (Natural Gas)

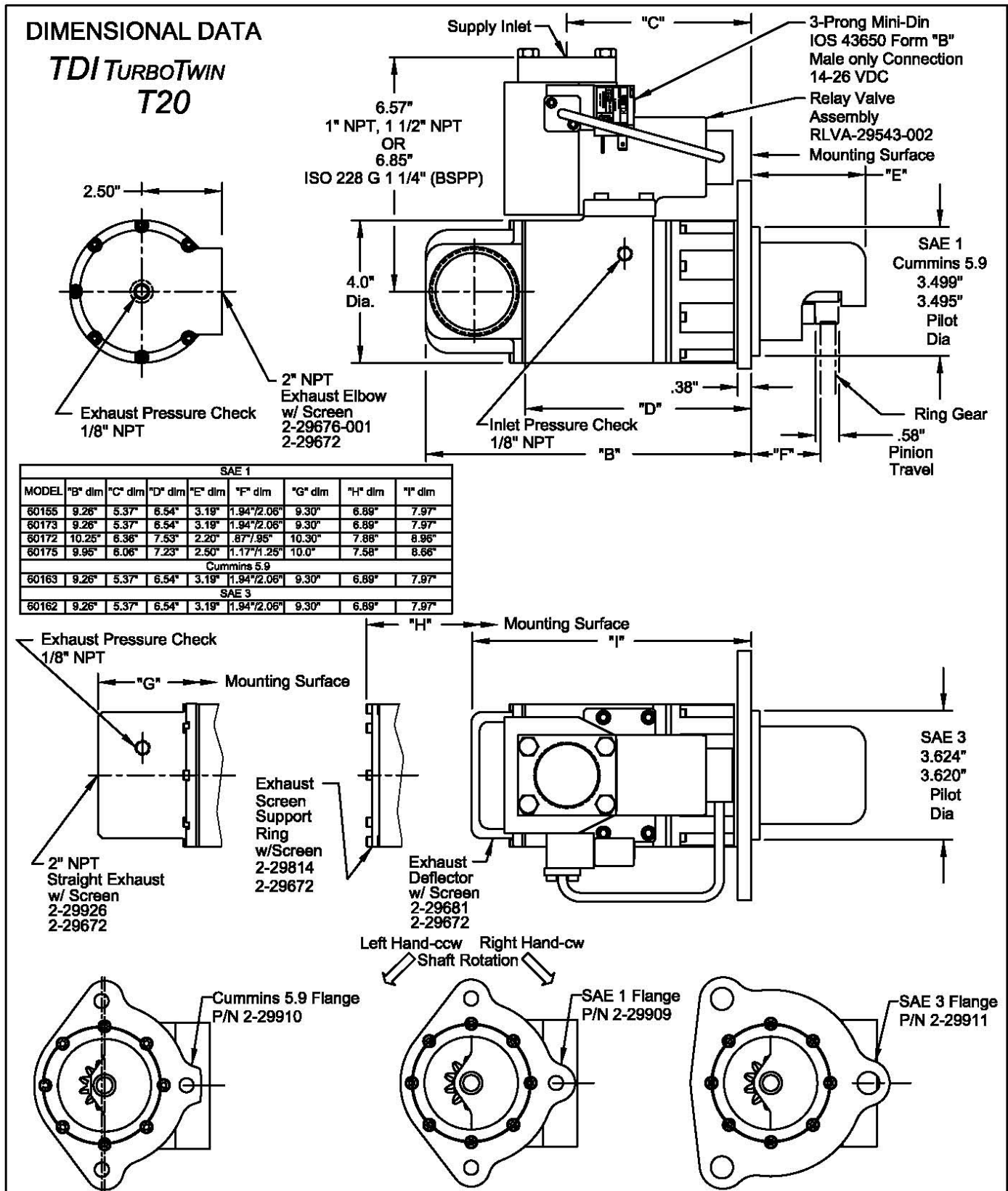


Figure 3. T20 Envelope Drawing (SAE 1, SAE 3 & Cummins 5.9 w/Solenoid Relay Valve)

# TDI TURBOTWIN™

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## DIMENSIONAL DATA

### TDI TURBOTWIN T20

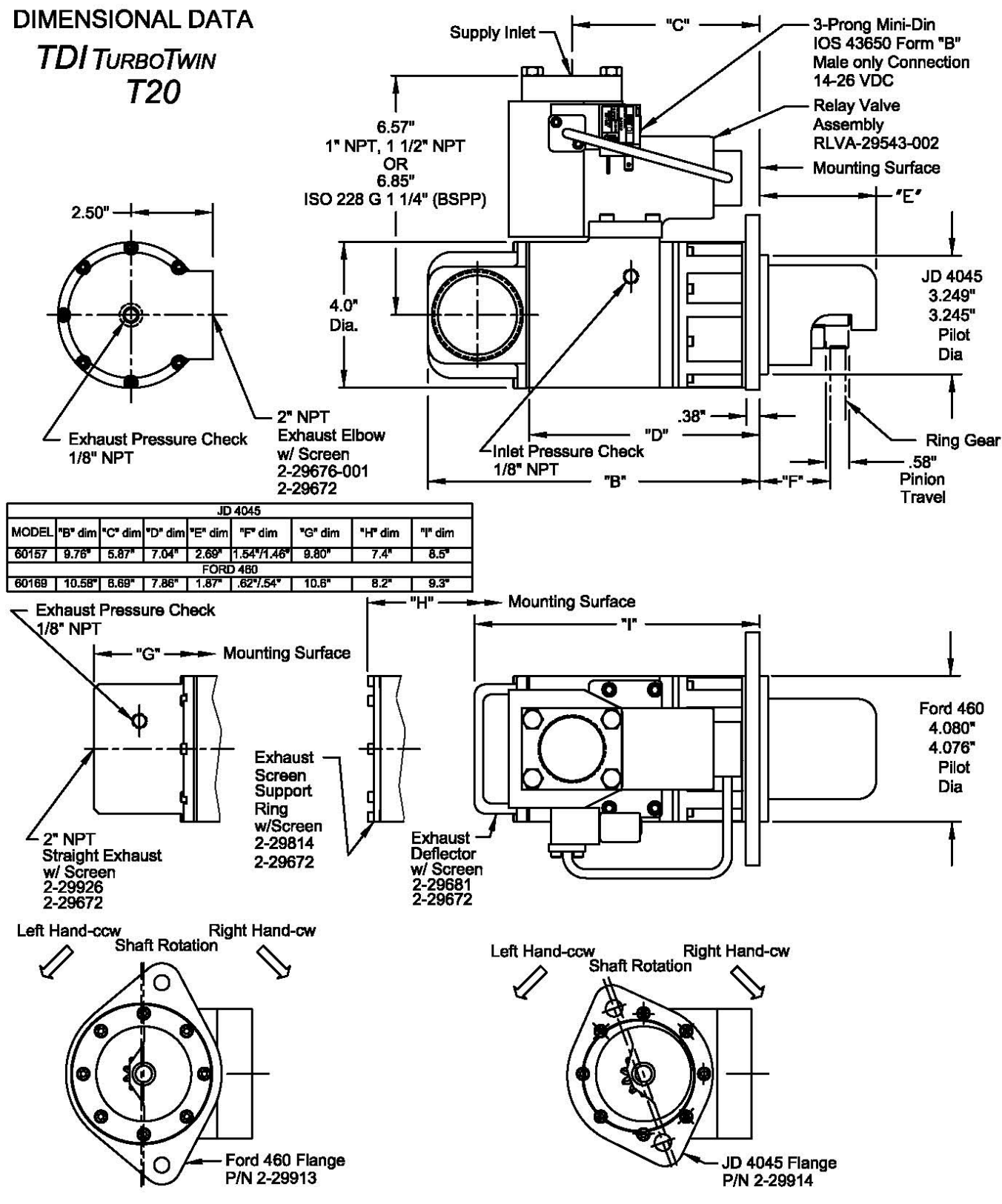


Figure 4. T20 Envelope Drawing (Ford 460 & John Deere 4045 w/Solenoid Relay Valve)

# TDI TURBOTWIN™

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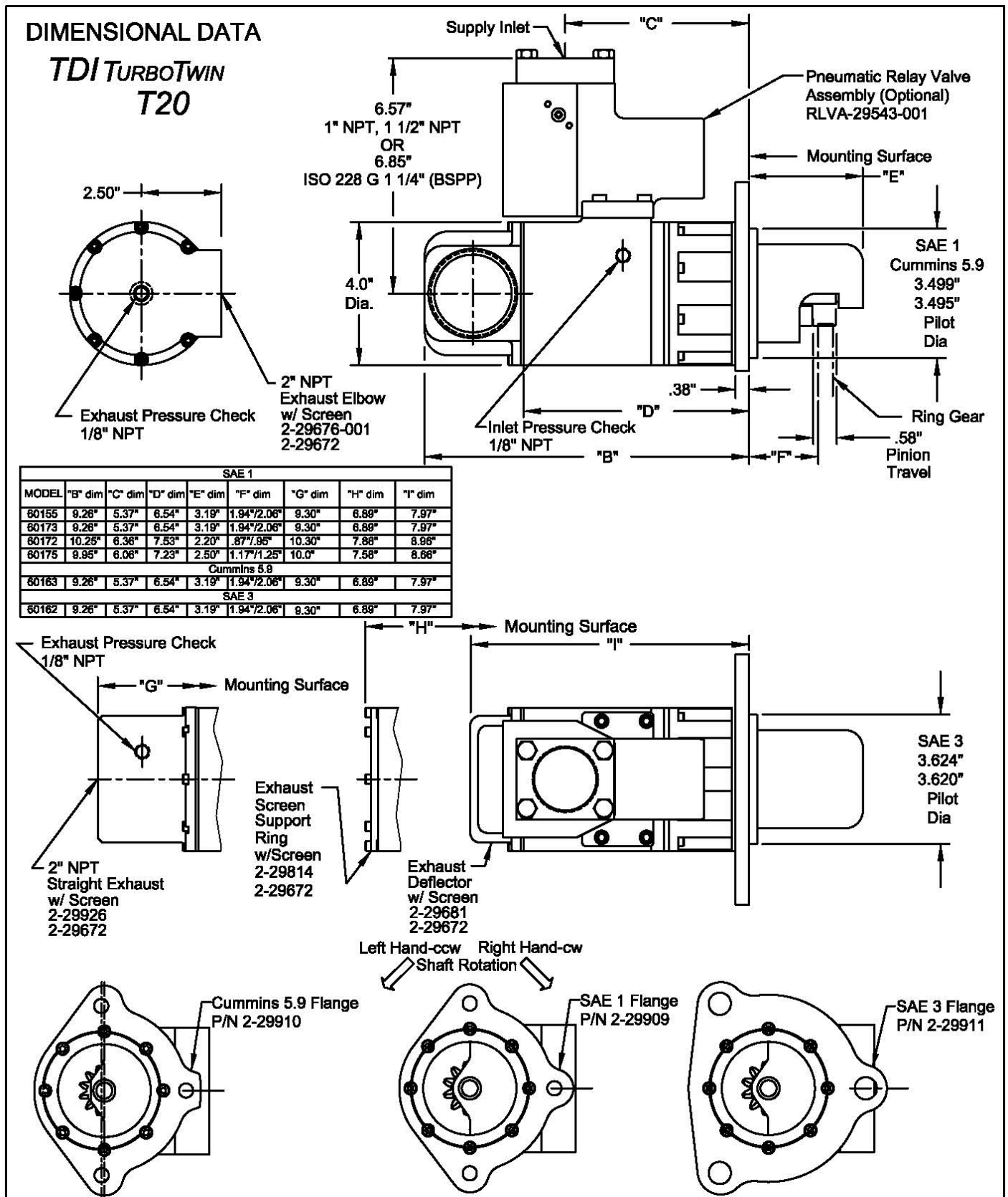


Figure 5. T20 Envelope Drawing (SAE 1, SAE 3 & Cummins 5.9 w/Pneumatic Relay Valve)



# TDI TURBOTWIN™

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## DIMENSIONAL DATA

### TDI TURBOTWIN T20

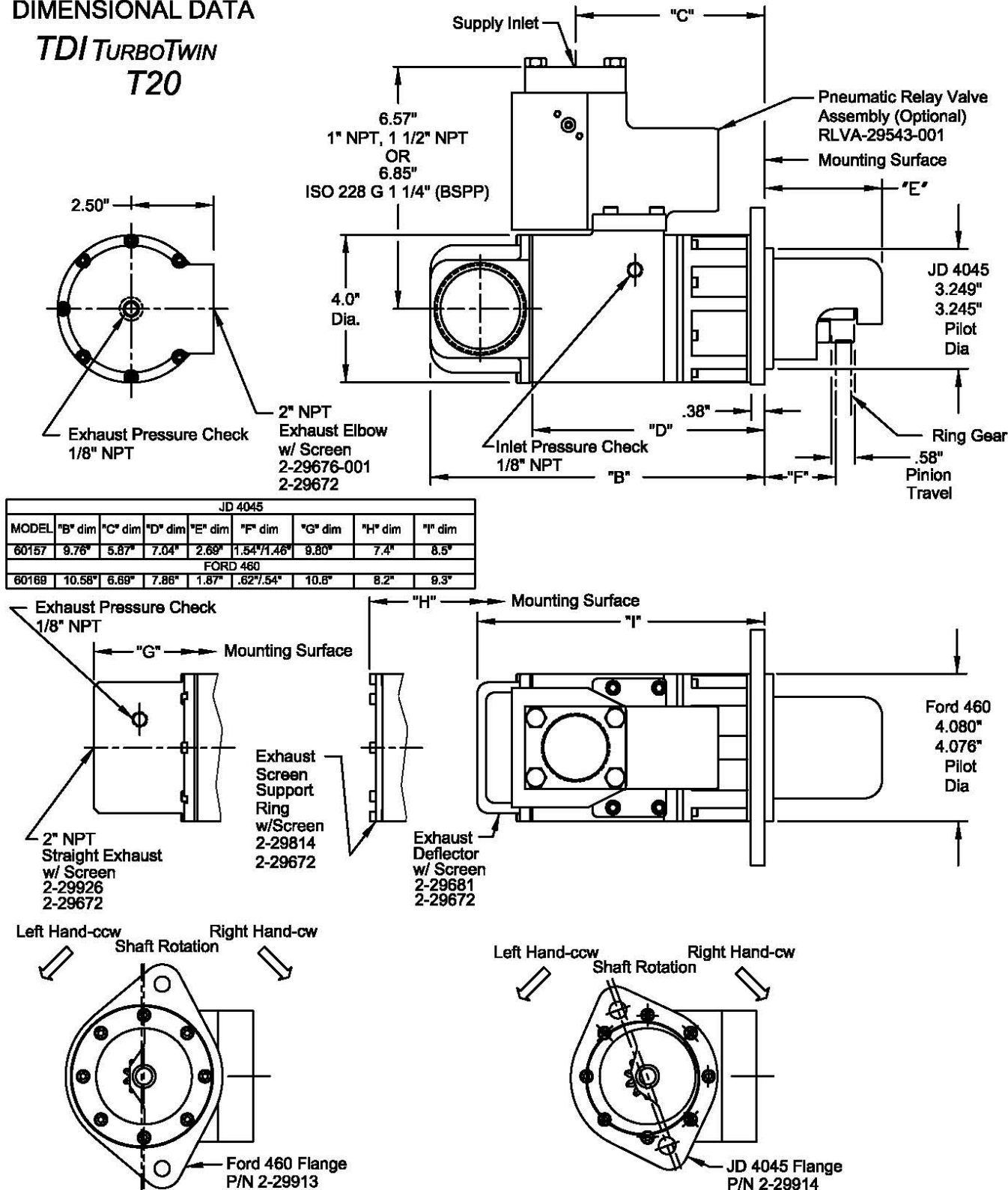


Figure 6. T20 Envelope Drawing (Ford 460 & John Deere 4045 w/Pneumatic Relay Valve)