

# INSTALLATION AND OPERATING MANUAL



## **TURBOTWIN™ Model: T100-MS** **Auxiliary Air Motors**

## TABLE OF CONTENTS

<b>SECTION</b>	<b>SUBJECT</b>	<b>PAGE</b>
<b>1.0</b>	<b>GENERAL INFORMATION.....</b>	<b>2</b>
1.1	DESCRIPTION & NEW FEATURES.....	2
1.2	BASIC OPERATION.....	2
1.3	PRODUCT IDENTIFICATION.....	3
1.4	MOTOR PERFORMANCE & OUTPUT.....	3
<b>2.0</b>	<b>INSTALLING THE MOTOR.....</b>	<b>5</b>
2.1	ORIENTATION & LUBRICATION.....	6
2.2	SUPPLY & EXHAUST LINE INSTALLATION.....	7
2.3	MOTOR CONTROLS.....	8
2.4	INLET PRESSURE CHECK PORT.....	8
2.5	MATCHING MOTOR OUTPUT TO LOAD.....	8
<b>3.0</b>	<b>MOTOR OPERATION.....</b>	<b>8</b>
<b>4.0</b>	<b>PREVENTIVE MAINTENANCE.....</b>	<b>9</b>
<b>5.0</b>	<b>TROUBLE SHOOTING GUIDE.....</b>	<b>10</b>
<b>6.0</b>	<b><i>TURBOTWIN</i> WARRANTY.....</b>	<b>11</b>

## 1.0 GENERAL INFORMATION

Instructions for installation, operation and maintenance of TDI **TURBOTWIN™ Model T100-MS Auxiliary Air Motors**. These are suitable for use on a variety of [Solar] applications including on Saturn, Centaur & Taurus machines. T100-MS Auxiliary Motors are used primarily for Wet Seal System Oil Pump drivers, or Pre-Post Lube Oil Pump drivers (as upgrades).

Review this manual before installing or operating **T100MS Model Air Motors**. Questions? Contact your Authorized TDI Distributor, OEM or TDI directly.

### WARNINGS, CAUTIONS AND NOTES

Certain types of information are highlighted in this manual for your attention:

**WARNINGS:** - used where NON-COMPLIANCE will likely result in injury to personnel or damage to the equipment.

**CAUTIONS:** - used where there is possibility of damage to the equipment.

**NOTES/IMPORTANT:** - used to point out special interest information or “optimum” use scenarios.

## 1.1 DESCRIPTION & NEW FEATURES

**T100-MS** Aux. Air Motors are extensively upgraded versions of previous T100M models. The “**S**” character (within in the new model nomenclature) designates the incorporation of many modifications and new product features including:

- Wet-sump (Splash) Oil Lubrication of planetary gear set & drive end bearings.
- Sealed (Vent-less) Gearbox w/Sight Glass for easy oil level maintenance.
- Higher (ABEC) Spec Turbine Bearings.
- Higher Spec Double-lip Shaft Seals.
- Nitride Treated planetary ring gear.
- Higher precision Dynamically Balanced Rotors.
- New Labyrinth-Type Primary Seal.
- Proprietary Gearbox Venting System
- Balanced Pressure Venting of aft seal/bearing

### NOTE

THIS MOTOR IS TO BE SERVICED ONLY BY AUTHORIZED TDI TURBOTWIN™ DISTRIBUTORS, DEALERS, AND REPAIR STATIONS. DO NOT OPERATE THIS MOTOR UNLESS IT IS PROPERLY ATTACHED TO AN ENGINE.

### NOTE

External dimensions of delete new T100-MS Motor Motors are near identical to previous T100-M Motor. **However, previous TDI Motor models cannot be economically upgraded** to incorporate the many additional features found in the newer models

- **TURBOTWIN** Upgrades can be easily installed, generally without inlet/exhaust piping changes.
- All **TURBOTWIN** Motors are designed for operation on either compressed air or on natural gas.
- **TURBOTWIN** materials are compatible with “sour” natural gas and marine environments.
- **TURBOTWIN** T100MS Motors are ATEX certified.
- As with all **TURBOTWIN** turbine Motors, mist or injection type lubrication of the air/gas supply is NOT required. (remove external lubricators).

### NOTE

Throughout this manual, the term “air” is used to designate the Motor drive medium. Unless other wise stated, “air” means either compressed air or natural gas.

## 1.2 BASIC OPERATION

**TURBOTWIN T100-MS** air Motors are simple two-stage turbine driven, gear reduced air Motors, with the following key differences vs. other types of Motors commonly used in similar (pump) applications:

- Unlike electric Motors, power output and operating speeds correspond (and vary widely) depending on the dynamic operating pressures supplied to the Motor inlet and the load imposed. (see performance data).
- Unlike vane-type or rotary screw-type (positive displacement) Motors, turbine type air Motors, if unloaded/under loaded will operate at much higher free-speeds.
- Turbine type Motors must be properly selected and regulated to operate efficiently, at a required loaded speed, rather than over a wide range of inlet supply pressures & speeds.

The basic operation of the Motor is as follows:  
 Pressurized air or natural gas enters the Motor through the inlet port. The compressed air expands through the two-stage turbine, which through a gearbox (speed reduction), results in shaft rotation (Motor output).

Upon completion of its cycle, turn off the air to the Motor immediately. Minimizing the time the Motor is operating, especially unloaded, maximizes Motor life

**IMPORTANT**

To attain maximum product life, it is important to properly match the Motor inlet supply pressure, power output and Motor speed to required load.

- Regulate (if necessary) Motor supply air pressure to the lowest possible setting required to drive the load (pump). No more.
- There are two pressure check ports on the Motors (at inlet & exhaust), that allow users to check the dynamic inlet supply pressure & exhaust (back) pressure applied to the Motor.
- Minimizing Motor exhaust back pressure will extend the life of air Motor. Back pressure should not exceed 15 psig. or may otherwise shorten the life of the Motors' rear seals & bearings.
- Dynamic pressures are measured with the Motor running, by taking readings at the aforementioned pressure check ports on the Motor housings.

**1.3 PRODUCT IDENTIFICATION**

The identification nameplate(s) attached to Motor housing should indicate the following information:

- Model designation
- P/Ns(OEM &/or aftermarket p/ns may be present on the Motor data tag(s).
- Serial Number (date of manufacture)
- Maximum Operating (Inlet) Supply Pressure
- Direction of Rotation

PART NUMBER IDENTIFICATION TABLE	
TDI Part Number	Solar Part Number
T103-60010-MSL-0-E0	1083842
T106-60010-MSL-1-40	1078365-400
T112-60010-MSL-1-40	1078365-500
T112-60010-MSR-1-40	1078365-600

**NOTE**

Direction of Rotation is either left hand (LH) rotation (CCW) or right hand (RH) rotation (CW) always viewed looking into the output (shaft) end of the air Motor.

**CAUTION**

Exceeding the *Maximum Operating Pressure* rating shown on Motor nameplate may result in damage to the Motor or damage to the driven equipment.

**NOTE**

*Maximum Operating Pressure* is indicated on the nameplate. This can (should) be measured at the pressure check port below Motor inlet port, and set dynamically (while the Motor is in operation) as described in Sec. 1.2.

**IMPORTANT**

*Optimum* (correct) *Operating Pressure* is not necessarily the dynamic Motor supply pressure recommended for *your* application. Motor supply pressure optimization, per application, has been proven to maximize the service life and reliability of the Motor(s) in most all applications. (See section 1.2)

**NOTE**

*Proof Pressure*, if shown on the nameplate, indicates the maximum static pressure rating at which Motor turbine Motor housing(s) will not burst in operation.

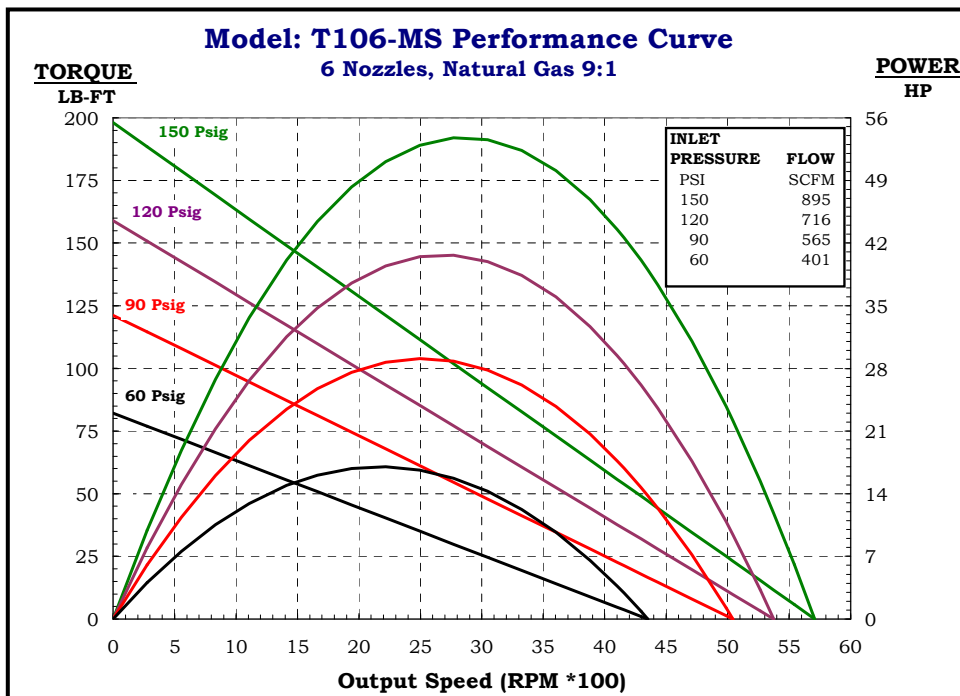
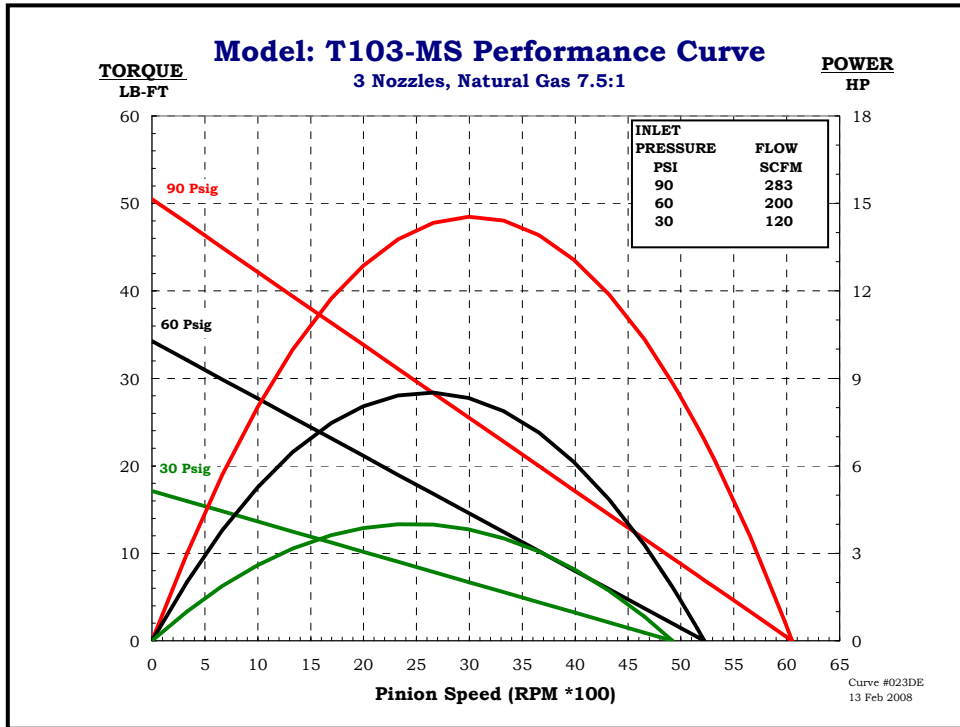
**1.4 MOTOR OUTPUT AND PERFORMANCE**

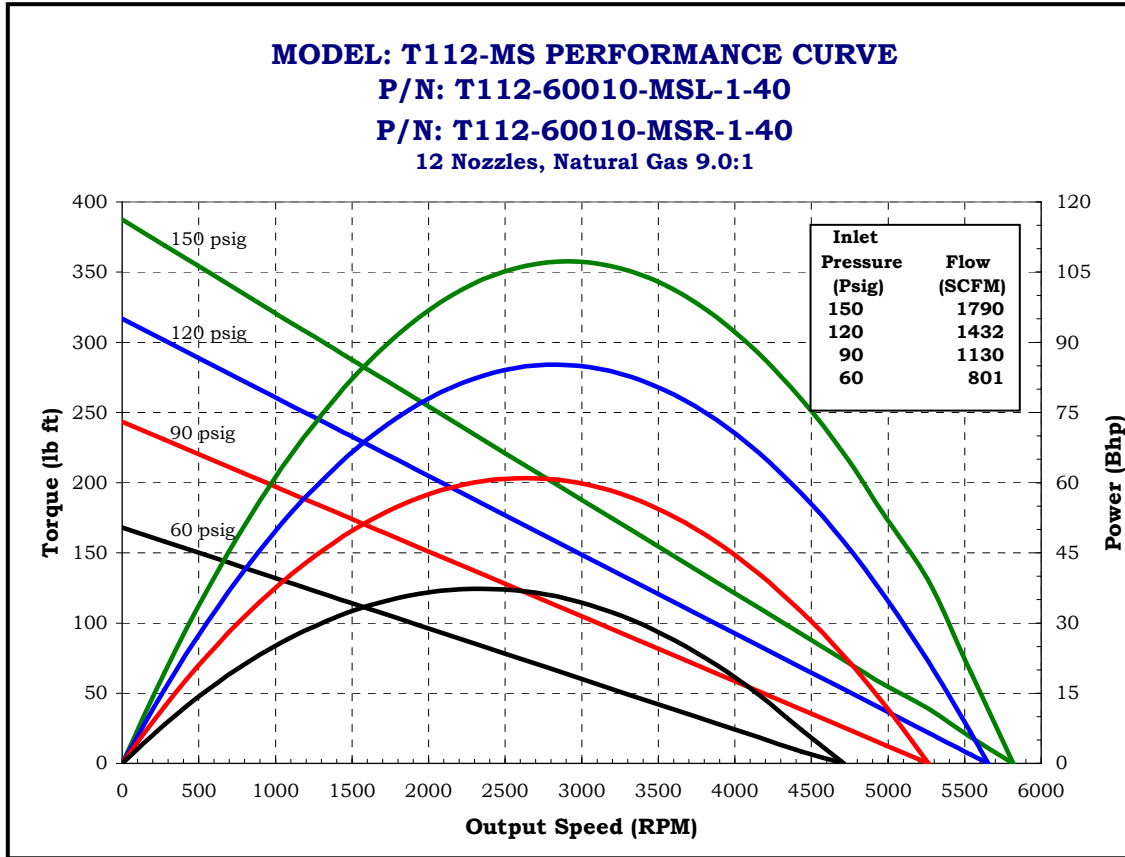
Please refer to specific Performance Graphs of the model being applied which illustrate:

- Motor Output (shaft HP/Torque) over range of *dynamic* supply pressures & speeds [0 RPM (stall) to maximum free speed] is indicated on the performance graphs of each model.
- Air Consumption Rates over range of *dynamic* supply pressures (consumption is constant at *dynamic* inlet pressures is also indicated in the tables on the performance graphs for each model. Consumption varies by pressure only, ...not by output speed.
- Motor consumption, output & operating speed may vary considerably on DIFFERENT drive mediums (e.g. air vs. methane gas). Supply pressure should adjusted accordingly.

- On methane gas, Motor produces significantly more HP at higher speeds. Inlet supply pressures may need to be reduced (regulated) accordingly, to prevent excessive Motor/pump speed (over speed).
- In all cases, indicated performance assumes

exhaust routed to atmospheric pressure, and combustible gasses used are piped to a safe location. Motor exhaust system piping should **minimize back pressure, not to exceed 15 psig.**





## 2.0 INSTALLING THE MOTOR

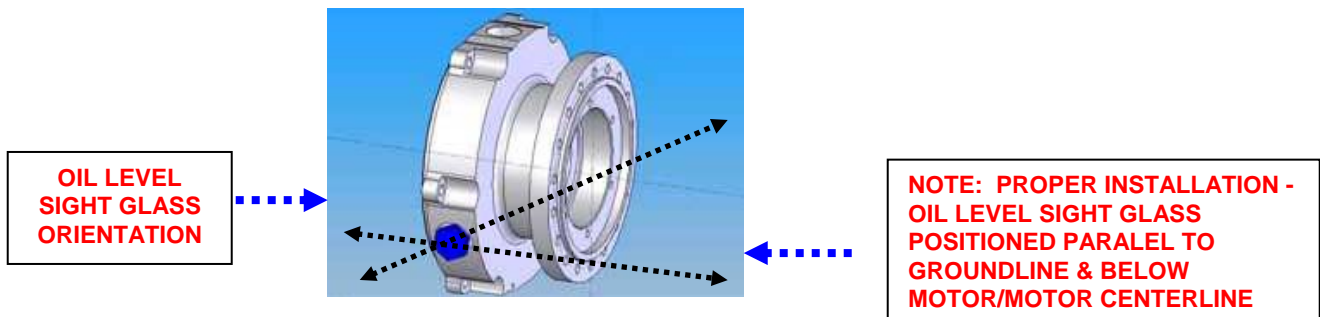
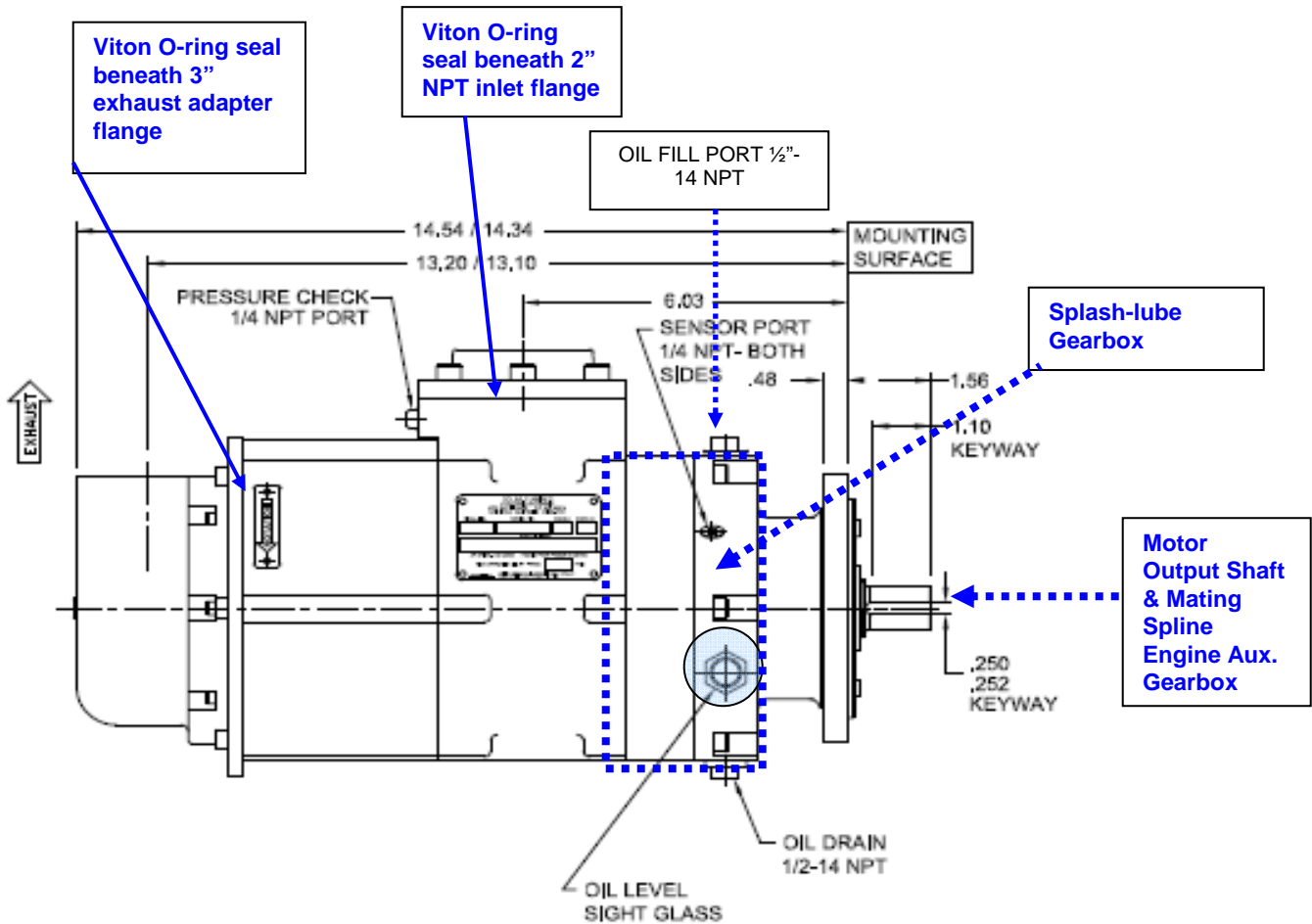
- TDI T100-MS Motors feature a turbine type air Motor that does not require lubrication in the supply air. **This is a separate consideration from the lubrication of the Motor gearbox, a discrete internal oil sump which requires oil maintenance (oil fills, checks & changes).**
- If a vane-type Motor is being replaced by a TDI turbine type Motor, TDI recommends removal of in-line/mist type lubricators to minimize their inherent flow restriction to the Motor and eliminate this maintenance item.

### CAUTION

All T100-MS/CS Motors should be installed with the inlet either straight down (6 o'clock or 180 degrees) or straight up (0 degrees or 12 o'clock). **In all cases, orientation of gearbox sight glass must be just below the Motor/Motor centerline**, to insure proper indication/maintenance of gearbox oil level (see section 2.1).

## 2.1 PROPER INSTALLATION, ORIENTATION & OIL LEVEL MAINTNENACE

**Motor/Motor Gearbox must be filled w/ (150ML) of Approved Oil Type\*\* & Level Maintained**



**\*\* Oil Type Recommended: Spec MIL-L-7808H, MIL-L-23699 (or equivalent synthetic grade turbine oil)**

**NOTE**

TDI recommends synthetic grade oil (turbine oil) is used in the Motor gearbox sump. Use of either improper synthetic or mineral based oils may compromise unit service life, void manufacturer's warranty, and will increase the frequency of maintenance intervals required.

**WARNING**

Do not operate this Motor unless gearbox has been filled to the proper oil level and maintained at this level.

**WARNING**

Do not operate this Motor unless it is properly connected to a load (see below).

**2.2 SUPPLY LINE & EXHAUST LINE 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 Motor or a new supply line.

**T100 TURBOTWIN T100-MS** Motors come standard with a 2" NPT female pipe thread adapter for the inlet connection port & various 3" exhaust adapters. Various flanged or threaded adapters may be utilized at these joints. Supplied adapters are sealed to the Motor housing with Viton O-rings (see section 2.1). Hard piping may be used on supply/exhaust lines. A sections of (gas approved) flexible tubing is recommended, between Motor inlets/outlets, to the hard piping... to prevent leaks or "wobble" out due to piping weight & vibration, and for ease of field maintenance/replacement of the Motor(s).

The supply line consists of the line from the air/gas supply source (via a pressure regulator when necessary) through filters, manual and/or automatic relay valves, to the Motor inlet.

The exhaust line consists of the line from the Motor exhaust to a "safe" location. Turbine exhaust (air) is typically plumbed away from the engine area.

Motor supply & exhaust lines and components should be dry-fitted for proper alignment /location, prior to final assembly.

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 after final assembly.

The installation of the Motor 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**

If the supply line is longer than 40 feet, the supply line piping size may need to be increased to 2" diameter, to minimize dynamic flow losses through piping and ensure specified output. Similarly, if exhaust piping is longer than 40 ft. in length, it may be necessary to increase its diameter from 3" to 4" to minimize Motor exhaust back pressure and insure specified output.

On higher HP (**T112-MS**) applications, valves or regulators on the supply side, having a **Cv of 40 or higher**, are recommended. This is a lesser concern for Motors having 6 or 3 nozzles (T106-MS & T103-MS). In all cases, care must be taken to insure all inlet supply line piping & components are capable of passing the required air flow needed to produce specified power levels (Motor output).

- See Motor performance chart for specific flow rates.

**WARNING**

Be sure that any/all piping &/or tubing used, meets applicable requirements and that no leaks are present following line installation or thereafter.

**CAUTION**

Although the light weight of these Motors is easily supported by their mounting flange designs, TDI recommends properly bracing all rigid piping attached to the Motors... to eliminate axial strain on Motor & Motor mounting flanges. High axial loads ("over-hung bending") will greatly reduce Motor life.

**CAUTION**

There is often weld slag, grindings, thread shavings, hardened compounds and other heavy debris in new



package piping & at new site installations. Therefore, at commissioning (before running Motors), TDI recommends a “blow-down” procedure to purge Motor supply lines of all hard debris that may otherwise damage the Motor severely. While **T100 TURBOTWIN** Motors are highly tolerant of contamination in the air/gas supply, Motor life can be greatly increased by using a coarse mesh strainer. At sites where dirty supply air/gas is present, use & maintenance of a #40 mesh Y-strainer, upstream of the Motors, is highly recommended.

**NOTE**

Expensive moisture abatement (air/gas drying) is not required, as this has no effect on the Motors.

**2.3 MOTOR CONTROLS**

A preferred Motor supply control valve is typically a pilot-operated type, which can be pneumatically or electrically actuated. The valve should be located relatively close to the Motor inlet, to prevent Motor over-running at the end of the cycle.

**CAUTION**

Proper supply pressure “matching” and over-speed control is highly recommended on all installations of Models T100MS (See section 2.5)

Do not use max supply pressure indications only, as a method to properly set the Motors’ supply pressure. A pressure regulator is required, where dynamic air/gas Motor supply pressure is great enough to exceed the Motor operating pressure (at the inlet port) **and/or where a “default” supply pressure (e.g. engine fuel gas pressure) would produce Motor output speeds beyond what is specified for the application.** (Result is over-speed, *not necessarily* an indicated over-pressure). **Both over-pressure & over-speed will reduce life of Motors/pumps & wastes supply air/gas (increases operating costs).**

**2.4 INLET PRESSURE CHECK PORT (checking dynamic operating pressures)**

A 1/4" NPT port is located on the Motor housing, under the air inlet. This port can be used to check the supply pressure at the Motor when the Motor is operating. To check dynamic pressure, remove the 1/4" 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 ¼" NPT pipe plug when done. This

pressure monitoring line/gauge may also be permanently installed. Alternately, a pressure transducer may be installed at the pressure check port and electrical lines routed to a digital display or panel at the operator's station.

**2.5 MATCHING MOTOR OUTPUT (SPEED) TO LOAD**

It is recommended that all T100-MS Motors be installed with a discrete Motor supply pressure regulator. A hand held tachometer should be used to double-check Motor output speeds. Motor supply pressure should be set at the *minimum pressure required* to insure the Motor runs the speed/load required by the application. Oil Pump discharge pressure may not indicate excessive motor speed, since an oil bypass (relief valve) may reduce this to a indicate a “normal” oil pressure reading.

Do not apply the maximum Motor supply pressure only by default, (such as default fuel gas pressure on the package). As indicators of Motor speed & output, this typically does not account for:

- Varying fuel gas pressures (on various turbine engine models)
- Varying oil pumps, oil types & loads.
- Varying site conditions (temperatures, etc...)
- Varying oil pressures (wet-seal oil pressure vs. lube oil pressures) & cycle times required.

**NOTE**

**Motor over-pressure** (even where Motor supply pressure minimally exceeds that needed for pump loads, may result in pumps turning faster than necessary of a.k.a. “over speed.” ***In this case simply reducing Motor supply pressure will correct this.*** This also reduces consumption and lowers supply air/gas costs.

**3.0 MOTOR OPERATION**

**WARNING**

Do not operate the TDI **TURBOTWIN** Motor at dynamic supply pressures greater than the pressure rating on the nameplate. This dynamic pressure is measured at the Motor inlet while the Motor is running.

- Static (non-flowing) supply pressure will always be higher than the operating (dynamic) pressure.
- The maximum pressure limit (proof pressure) that the TDI TURBOTWIN Motor housings may be subjected to is 600 PSIG (42 BAR).
- Where system static pressure may exceed the 600 PSIG (42 BAR) limit, in addition to pressure reducing device, a pressure relief valve (set below 600 PSIG [42 BAR], should be used.
- Where operating supply pressure exceeds Motors' maximum operating pressure ratings, or produces outputs above required by the application, a pressure reducing device (regulator) must be used.

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

**4.0 PREVENTIVE MAINTENANCE**

**IMPORTANT**

**All TURBOTWIN T100-MS/CS Motors use new oil-sump lubrication of the drive end (gearbox) which must be properly maintained.**

- **Severe Service \*\* & Required Field Maintenance Procedures**, to be performed as preventative maintenance include:
  - Utilize only oil types recommended by the manufacturer (TDI), in the Motor gearbox.
  - Properly orient the Motors as described herein, to insure proper oil levels can be easily checked & maintained in the Motor gearbox (See section 2.1)

<b>MAINTENANCE SCHEDULE</b>		
<b>INTERVAL</b>	<b>CHECKS</b>	<b>MAINTENANCE</b>
<b>2,000</b> operating hours (or quarterly)	<b>Check Oil Level,</b>	<b>Fill as necessary. Check oil condition; change oil as necessary, <u>OR</u> if using oil other than <u>recommended synthetic types</u></b>
<b>4,000</b> operating hours (or semi-annually)	<b>Check Oil Level</b>	<b>Fill as necessary. Check oil condition; change oil as necessary, <u>OR</u> if using oil other than <u>recommended synthetic types</u></b>
<b>8,000</b> operating hours (or annually)	<b>Check Oil Level</b>	<b>Change Oil (regardless of type being used)</b>

**\*\* Severe Service:** is where Motor(s) are cycled longer than one (1) hour continuously or wherever Motor(s) can/may become unloaded for periods longer than 30 seconds during cycle.

Repair technicians or un-authorized/un-trained service organizations, without TDI TurboTech certification, should not attempt to rebuild nor repair these products.

Proper maintenance, qualified maintenance repair of your TDI TURBOTWIN Motors & Motors will assure continued reliable and superior performance for many years.

**5.0 TROUBLESHOOTING CHART**

TROUBLE	PROBABLE CAUSE	SOLUTION
1. Motor does not run; small air flow from exhaust.	A. Y-Strainer or filter in supply line clogged.	A. Clean strainer.
	B. Nozzle blockage.	B. Remove blockage or obstruction from nozzles.
2. Motor does not run; (rotate) but normal air flow from exhaust.	D. Broken/damaged turbine rotor(s).	D. Replace all damaged parts.
	B. Broken gear train.	B. Repair or replace gear train.
	C. Seized Load (e.g. oil pump)	C. Repair or replace pump (or driven device)
3. Reduced Motor output power (will not carry load).	A. Motor inlet air pressure/flow insufficient to produce required Motor output.	A. Check dynamic operating pressure at Motor inlet. Increase air pressure in 10 PSIG (0.6 BAR) increments; DO NOT EXCEED OPERATING LIMIT.
	B. Damaged turbine nozzle.	B. Replace turbine nozzle.
	C. Inlet supply piping or components too small.	C. Check dynamic operating pressure at Motor inlet. Supply piping size (lengths/diameters) must match dynamic flow requirements.
	D. Pressure regulator orifice too small.	D. Check dynamic operating pressure at Motor inlet. Increase orifice size or replace pressure regulator to one that matches pressure/flow requirements.
	E. Inlet supply line valve (ball, gate, relay, plug) too small.	E. Check dynamic operating pressure at Motor inlet. Install valve that matches flow/pressure requirements for application.
	F. In line lubricator installed in supply line restricting flow.	F. Check dynamic operating pressure at Motor inlet. Remove lubricator.
	G. Control Valve or Regulator not fully open.	G. Check dynamic operating pressure at Motor inlet. Repair or replace control valve or regulator as needed.
	H. Excessive back pressure; exhaust restricted.	H. Check dynamic operating pressure at Motor exhaust port. Clean exhaust piping or increase size to length/diameter required for application.
	J. Wrong rotation Motor.	J. Check rotation (direction) Replace with Motor of proper rotation if necessary.
K. Wrong size Motor.	K. Check the Application Guide for the correct Motor.	
4. Motor & Pump turns too fast. Excessive oil pump output/pressure. OR Validate with a hand tachometer if necessary.	A. Motor Inlet air pressure too high.	A. Check dynamic operating pressure at Motor inlet. Decrease air pressure in 10 PSIG (0.6 BAR) increments. OR If there is a manual shut-off valve in the supply line, partially close it to restrict dynamic Motor supply pressure. OR Install a restriction orifice in the inlet supply line.
	B. Wrong size Motor.	B. Check Application Specifications for the correct Motor.

## 6.0 WARRANTY

### TDI TURBOTWIN ENGINE MOTOR 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 (6 month for remanufactured units) from the date of installation. The warranty period shall not extend beyond two years (12 months for factory remanufactured units) 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.