Publication: T3-790, Rev. 2
Issued: January 9, 2013

INSTALLATION AND OPERATING MANUAL

TURBOTWIN™ Model: T30-M Auxiliary Lube Pump Air Motors

AN09-484

From Tech Development
6800 Poe Ave. •Dayton OH 45414
Tel: (937) 898-9600 •Fax: (937) 898-8431
Website: www.tdi-turbotwin.com

TABLE OFCONTENTS

Publication: T3-790, Rev. 2
Issued: January 9, 2013

1.0 GENERAL INFORMATION

This manual contains Instructions for installation, operation and maintenance of TDI ***TURBOTWIN***™ **Model T30-M Air Motors** used as auxiliary drives for Pre & Post Lube Oil Pumps. These are supplied by OEMs and can also be obtained in the aftermarket as motor upgrades.

Review this manual before installing or operating **T30-M Air Motors.** For 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 wherein 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 cite special information for "optimum" use & care.

1.1 DESCRIPTION & ADVANTAGES

T30-M Air Motors are similar to the design used in T30 Air Starters. T30-M features various interfaces allowing the motors to be fitted with couplings or directly to different model mechanical (oil) pumps. T30-M Air Motors are superior to other types of drive motors in:

- **Durability-** Very tolerant of contamination (liquid or fine solids) in the air/gas supply.
- **Cost Effectiveness –** costly supply air/gas filtration, drying, lubrication are generally not required.
- **Efficiency -** Low air/gas consumption per unit of power produced.
- **Cooler Running –** greater expansion allows motor to run cooler on extended duty cycles.
- **Application Flexibility –** Variable operation (output power & RPM). Suitability for use at much lower air/gas supplies to 10 psig.
- **Ownership Cost -** Sealed bearings and gear train require no maintenance or external lubrication.
- **Ease of Compliance -** Exhaust is cleaner, since motor produces no (fugitive) oily mist emissions.

NOTE

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

- ***TURBOTWIN*** **T30-M Air Motors** are designed for operation on either compressed air or natural gas.
- ***TURBOTWIN*** **T30-M Air Motor** materials are compatible with "sour" natural gas and marine environments.
- ***TURBOTWIN*** **T30-M Air Motors** are ATEX certified (where indicated in certain OEM applications).
- ***TURBOTWIN*** **Air Motors** do NOT require mist-type or injection-type lubrication of the air/gas supply. These are not fitted on OEM applications and should be removed when upgrading from vane-type air motors.

NOTE

Throughout this manual, the term "air" designates the Motor drive medium. Unless otherwise stated, "air" means either compressed air or natural gas**. UNITS WITH INTEGRATED CONTROLS as SUPPLIED BY TDI, ARE NOT OPERABLE ON NATURAL GAS. OEM applications, may be supplied with gas compatible controls, and which meet various agency requirements as specified.**

1.2 BASIC OPERATION

NOTE

T30-M Air Motors are designed for intermittent duty cycles, **NOT** continuous duty cycles.

TURBOTWIN **T30-M Air Motors** are two-stage turbine driven, *gear reduced* air motors, with the following key differences vs. other types of motors commonly used in similar (pump) drive applications:

- *Unlike* electric Motors, power output and operating speed can vary greatly depending on the dynamic operating pressures supplied to the motor inlet and the loads imposed. (See performance data).
- *Unlike* vane-type (positive displacement) or electric motors, *turbine-type* air motors, if unloaded/under-loaded, will operate at much higher free-speeds (or over-speed).
- Turbine type motors should be properly *selected* and *regulated* to operate efficiently at a required load & speed… rather than over a

Publication: T3-790, Rev. 2
Issued January 9, 2013

wide range of inlet supply pressures, loads & speeds.

BASIC OPERATION:

Pressurized air or natural gas enters the motor through the inlet port. Air/gas expands through the two-stage turbine and is exhausted to atmosphere. The turbine drives through a gearbox (speed reduction) to the output shaft. Indicated motor output (torque, HP, RPM) is as measured at the shaft end.

Motor rotation is indicated "as viewed" on the shaft end of the motor; as either RH-CW (clockwise) & LH-CCW (counter-clockwise).

IMPORTANT

To attain maximum product life, it is important to properly match the Motor inlet supply pressure, power output and Motor speed to a specific 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.
- Motor exhaust *back pressure* exceeding 10 psig may reduce the life of the Motors' rear seals & bearings.
- *Dynamic pressures* are measured while Motor is running at indicated pressure check ports (inlet & exhaust) on the Motor housings.

1.3 PRODUCT IDENTIFICATION

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

- Model Designation - T30-M
- P/Ns (OEM &/or aftermarket p/ns) may be present on the Motor data tag(s).
- 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 output shaft end of the Motor.

CAUTION

Exceeding the *Maximum Operating Pressure* rating shown on Motor nameplate or continued operation above the *Recommended RPM Range* (speed) indicated may result in damage to the Motor or damage to the driven equipment (pump).

NOTE

Maximum Operating Pressure as indicated on the nameplate can be verified at the pressure check port below Motor inlet port, and set *dynamically* as described in Section 1.2.

IMPORTANT

DO NOT RUN UNLOADED or UNDERLOADED
Optimum (correct) *Operating Supply Pressure* is **not** necessarily the Motor supply pressure observed in *your* application or the Max rated Operating Pressure. Motor supply pressure optimization, per application, has been proven to maximize the service life and reliability of the Motor(s) in most applications.

NOTE

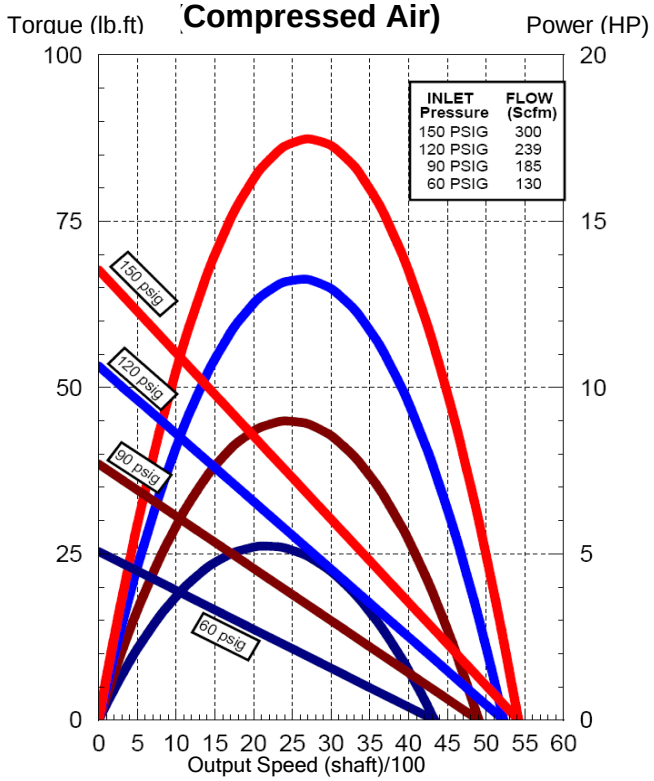
The *Proof Pressure* shown on the nameplate indicates the maximum static pressure rating at which Motor turbine Motor housing(s) will not burst in operation.

1.4 MOTOR OUTPUT AND PERFORMANCE

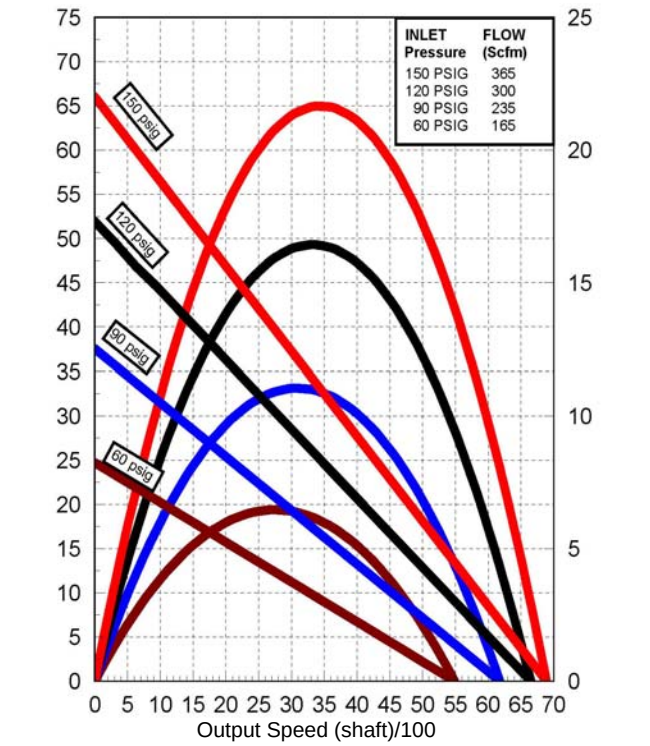
Please refer to Performance Graphs which illustrate:

- *Motor Output* (shaft HP/Torque) over a range of *dynamic* supply pressures & at speeds (RPM) from stall to maximum free speed is indicated on the performance graphs of each Motor model.
- *Air Consumption Rates* over a range of *dynamic* supply pressures (consumption is *constant* at a given *dynamic* inlet pressure) and is therefore cited in a separate table on the Performance Graphs for a Motor model.
- Operating speed varies by approximately +25% when motor is run on methane gas. Supply pressure should be adjusted accordingly to prevent excessive Motor/pump speed (over-speed) on gas.
- Performance assumes exhaust is to atmosphere or where Motor exhaust system piping **minimizes back pressure, to less than 10 psig.**

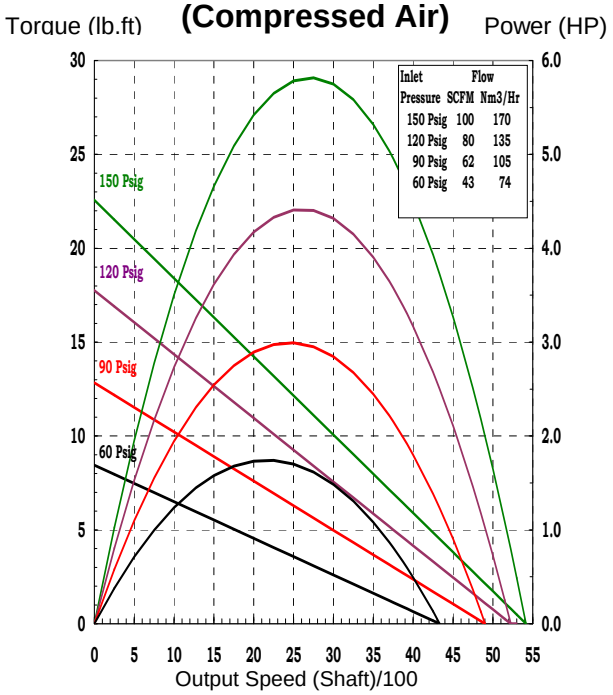
T303-M Performance Curve (Compressed Air)



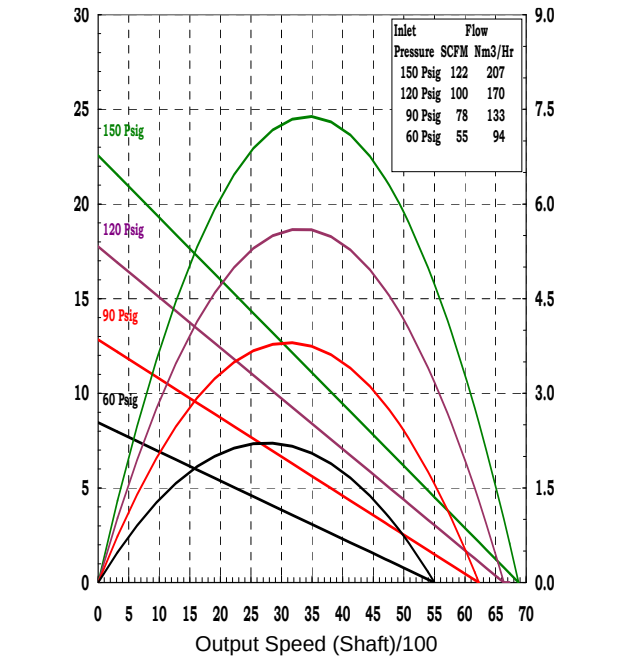
T303-M Performance Curve (Methane Gas)



T301-M Performance Curve (Compressed Air)



T301-M Performance Curve (Methane Gas)



T303-M Performance Curve

Publication: T3-790, Rev. 2
Issued January 9, 2013

2.0 INSTALLING THE MOTOR

- TDI T30-M Motors feature a turbine type air Motor that does not require lubrication in the supply air.
- If a vane-type Motor is being replaced by a TDI turbine type Motor, TDI recommends removal of in-line or mist type lubricators to minimize Motor supply flow restriction, eliminate oily exhaust residue and reduce maintenance.

2.1 PROPER INSTALLATION & SET-UP

WARNING

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

Motor & oil pump must be installed in a location that prevents unloaded or under-loaded operation.

T30-M Lube Pump Motor w/optional exhaust muffler

There are two main causes for the oil pump to become unloaded or under-loaded:

1) Cavitation - air in the oil suction line to the pump.

This can be prevented by insuring the oil supply (suction) line to the pump inlet, is below the oil sump level of the equipment/engine. This is referred to as a "flooded" location, as it insures oil will always be present at the pumps suction port. This is **VERY IMPORTANT** when up-fitting a TDI pump package that uses the T30-M motor, or installing a T30-M motor replacement on an existing oil pump. Take steps necessary to prevent accumulation of excessive air in the oil system. Utilize check valves and vent lines in accordance with equipment/engine manufacturer's guidelines.

2) Excessive Motor Output

Excessive Motor (Horsepower) results in pump over-speed. Excessive HP output will drive the mechanical oil pump to a speed higher than recommended (most are rated at 1200-1750 RPM for maximum life).

Oil pump over-speed does not always produce excessive or higher (indicated) oil pressures (on a panel or gauge) because most machines and/or oil pumps have a pressure bypass. Even pumps with a pressure bypass, if operated at excessive speed, may fail bearings and/or seals prematurely.

Adjusting T30-M Motor output is accomplished **simply by reducing** (or increasing if needed) the dynamic motor supply air/gas pressure. Matching the motor output speed *to the same optimum range* as that of the oil pump (1200-1750 RPM) will provide maximum T30-M Motor life

2.2 SUPPLY & 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.

The T30-M Motors come standard with a 1.0 inch NPT female pipe thread connection at the inlet. A 1.5 inch or 2.0" exhaust adapter is standard. Supplied adapters are sealed with Viton O-rings.

The Motor 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 (gas) 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 Motor inlet/exhaust outlets, to the hard piping. This can prevent leaks or "wobble" out due to piping weight & vibration and ease of field maintenance/replacement of

the Motor(s).
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

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 and ensure specified output. Similarly, exhaust piping length & diameter must not induce back pressure above 10 psig

On higher supply pressures, a regulator or manual valve may be used to limit dynamic operating and drive motor speed (RPM). **See Motor Performance Chart**

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

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 TDI recommends a purge or "blow-down" of Motor supply lines to prevent damage to the Motor. While **T30-M TURBOTWIN** Motors are highly tolerant of moisture & fine contamination, Motor life can be increased by use of a coarse #40 mesh strainer upstream in the motor supply line

NOTE

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

2.3 MOTOR CONTROLS

Preferred Motor supply control valve is a pilot-operated type, which is pneumatically or electrically actuated. A manual valve may also be used.

CAUTION

SET UP – Motor supply pressure "matching" will control motor speed and is recommended on all installations of the T30-M. **Do Not** use Motor's (data plate**)** Max Operating Pressure rating as the default supply pressure setting. (also See Section 2.5)

Motor supply pressure (flow restriction) or a pressure regulator **is required**:

- Where Motor supply pressure exceeds *dynamic* Motor operating pressure (measured at the inlet port while motor is running. (**Over-pressure)**.
- Where "default" Motor supply pressure (e.g. engine fuel gas pressure or starting pressure) produces Motor output speeds beyond what is specified for the application. (**Over-speed**).
- Where motor *over-speed*, occurs even when Motor is operated (dynamically) at a pressure below the Motor's Maximum Operating Max.

Over-pressure & Over-speed reduce life of Motor & driven equip (oil pump) & wastes supply air/gas (increases operating costs).

2.4 INLET PRESSURE CHECK PORT (checking dynamic operating pressures)

A 1/8" NPT 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.

This pressure monitoring 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

Publication: T3-790, Rev. 2
Issued January 9, 2013

at the operator's station.

2.5 MATCHING MOTOR OUTPUT (SPEED) TO LOAD – OIL PUMP/MOTOR LOCATION

It is recommended T30-M Motors be installed to operate at an RPM between 1200-1750 RPM.

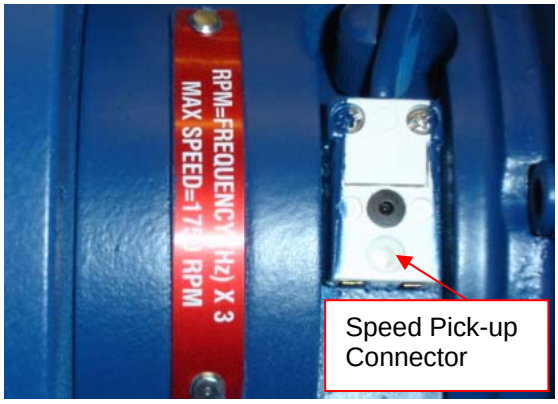
- ❖ Where possible, a hand held tachometer should be used to double-check Motor/pump output speeds.
- ❖ Motor supply pressure should be set at the *minimum pressure required* to insure the Motor runs the speed/load required by the pump application.
- ❖ Depending on where indicated/monitored, oil pressure may not indicate excessive motor speed since an oil bypass (relief valve) may reduce this to a indicate a "normal" oil pressure reading by the operator.
- ❖ Oil Pump discharge pressure (taken at the oil pump discharge port) is the best indicator of pump speed. Follow the pump manufacturer's recommendations.

Do not apply or select the maximum Motor supply pressure by default, (e.g. "same as" fuel gas pressure or starting air pressure on the package). Motor speed & output must account for:

- Varying starting or fuel gas pressures.
- Varying oil pump models, oil viscosity, oil temperatures (loads).
- Varying site conditions (temperatures, etc…).
- Varying oil pressure & cycle times required.

2.6 ADJUSTING MOTOR OUTPUT SPEED

- Set multi-meter to measure frequency (Hz).
- Connect the two multi-meter leads to the speed pick-up connector attached to the air motor.
- To identify the speed on the multi-meter, multiply the frequency times 3 as shown on the tag affixed to the air motor.
- Apply the supply pressure to the motor and slowly increase the pressure until the desired output speed is achieved. DO NOT EXCEED 1750 RPM.



NOTE
Motor over-speed: Where motor & pump output pressure or RPM, exceed that needed for an application: ***Reducing* Motor supply pressure;** or ***Increasing* size of oil pump supply/discharge lines,** will correct this condition.

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 Motor inlet while 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.

4.0 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.	A. Broken/damaged turbine rotor(s).	A. 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 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 Application Specification for 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 Specification for correct Motor.

Publication: T3-790, Rev. 2
Issued January 9, 2013

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.

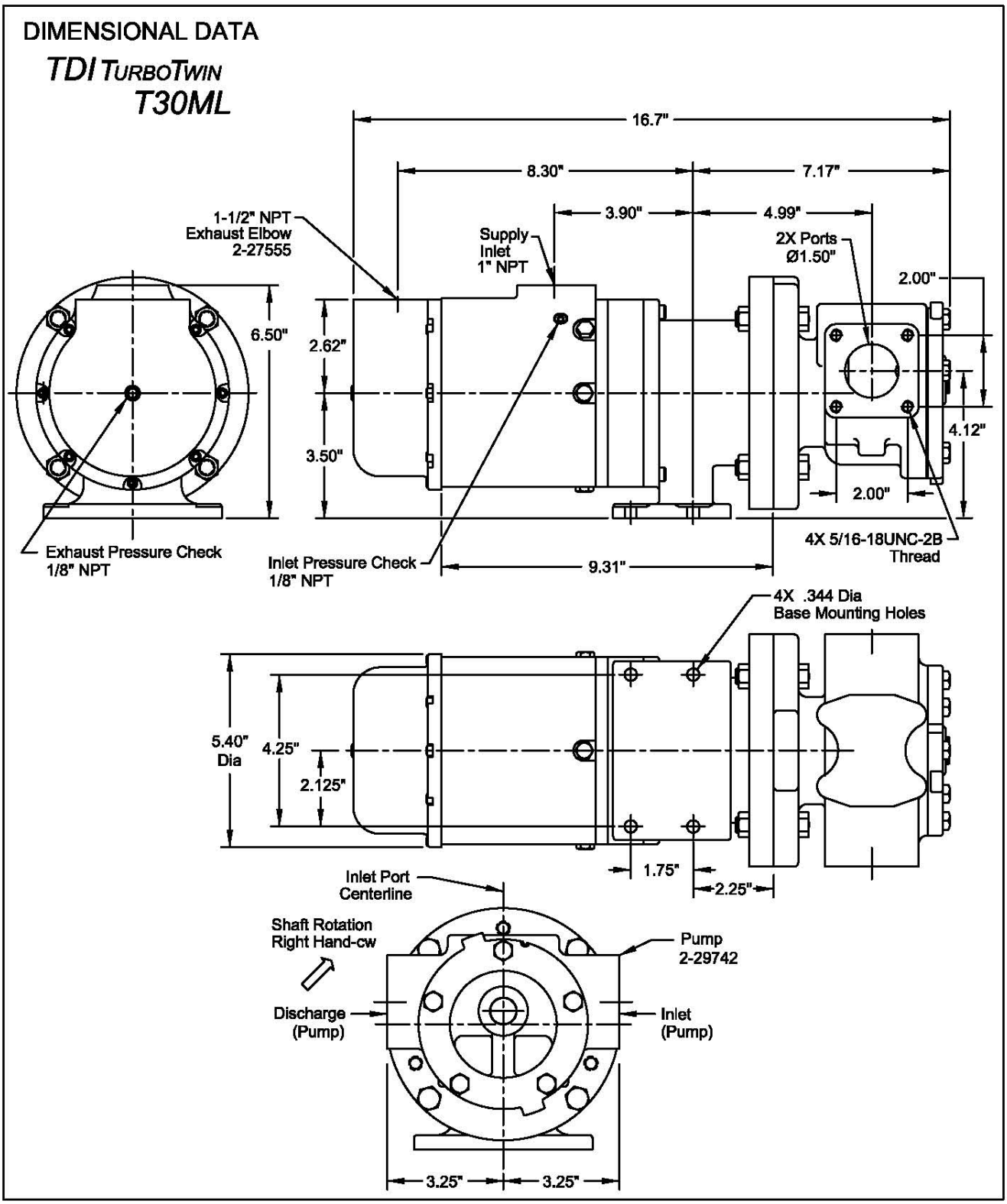


Figure 1. T30-M Lube Pump Motor

Publication: T3-790, Rev. 2
Issued January 9, 2013

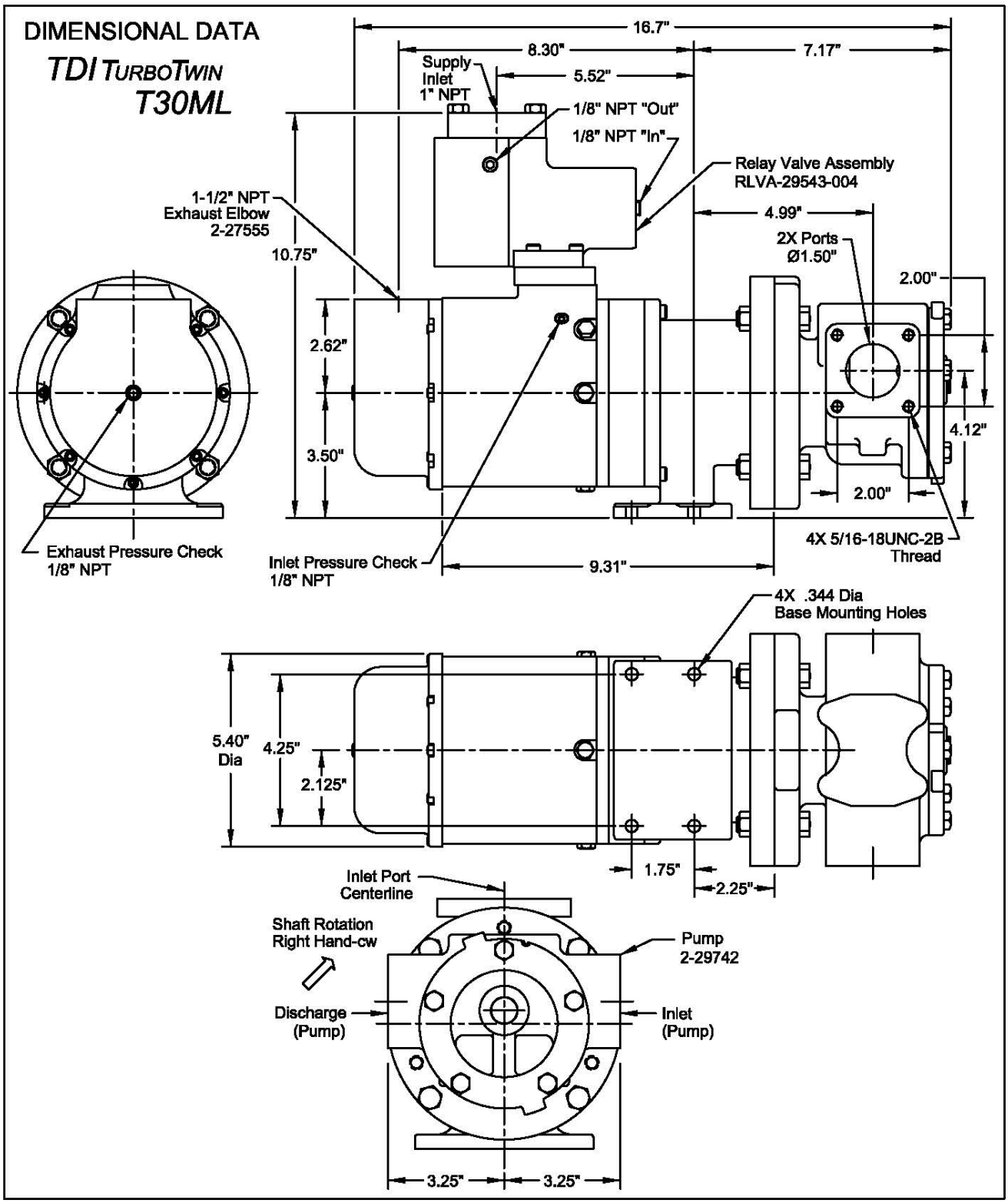


Figure 2. T30-M Lube Pump Motor w/Integral Relay Valve (Pneumatic)

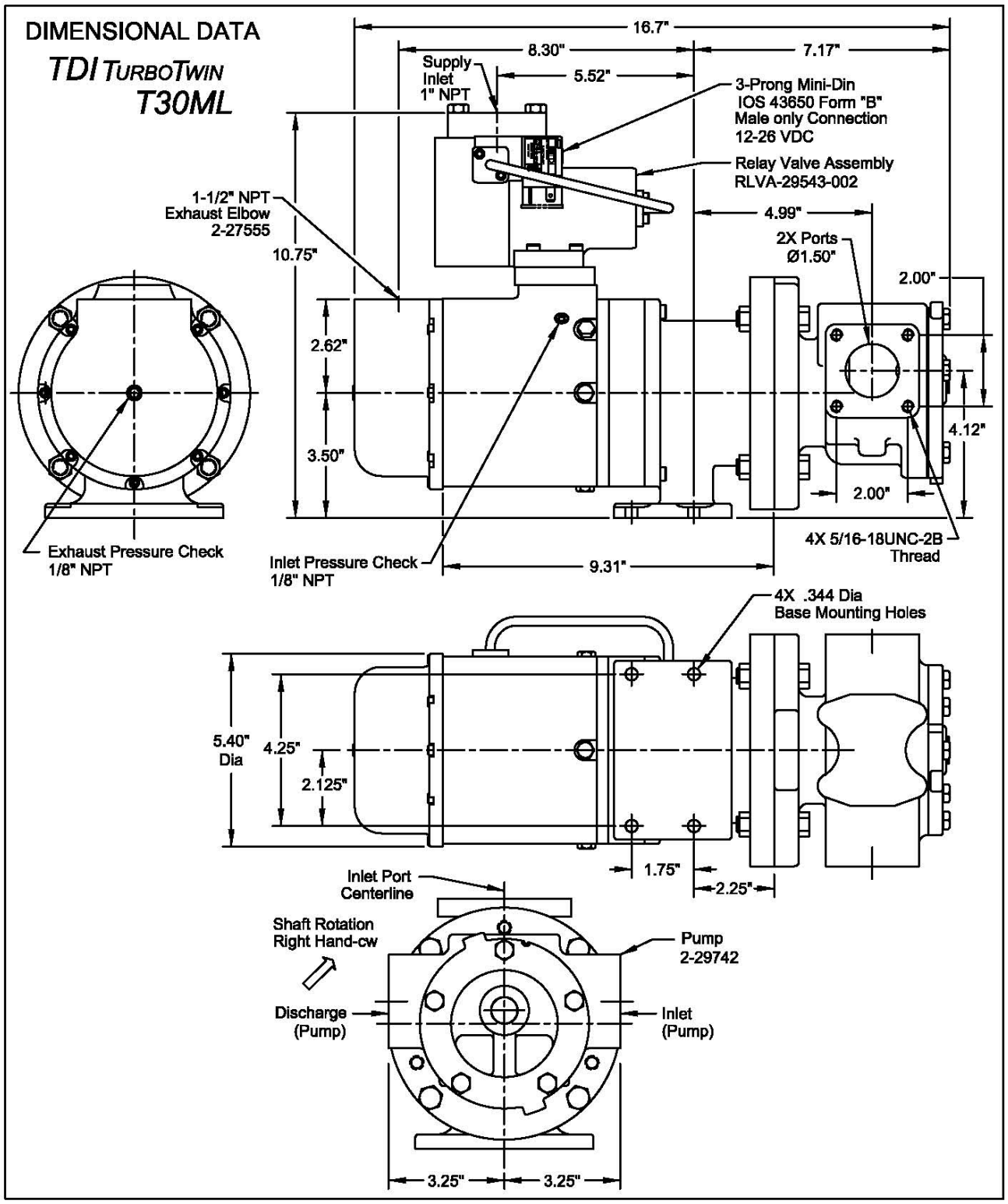


Figure 3. T30-M Lube Pump Motor w/Integral Relay Valve (Solenoid) for **Air Only Operation**

Publication: T3-790, Rev. 2
Issued January 9, 2013

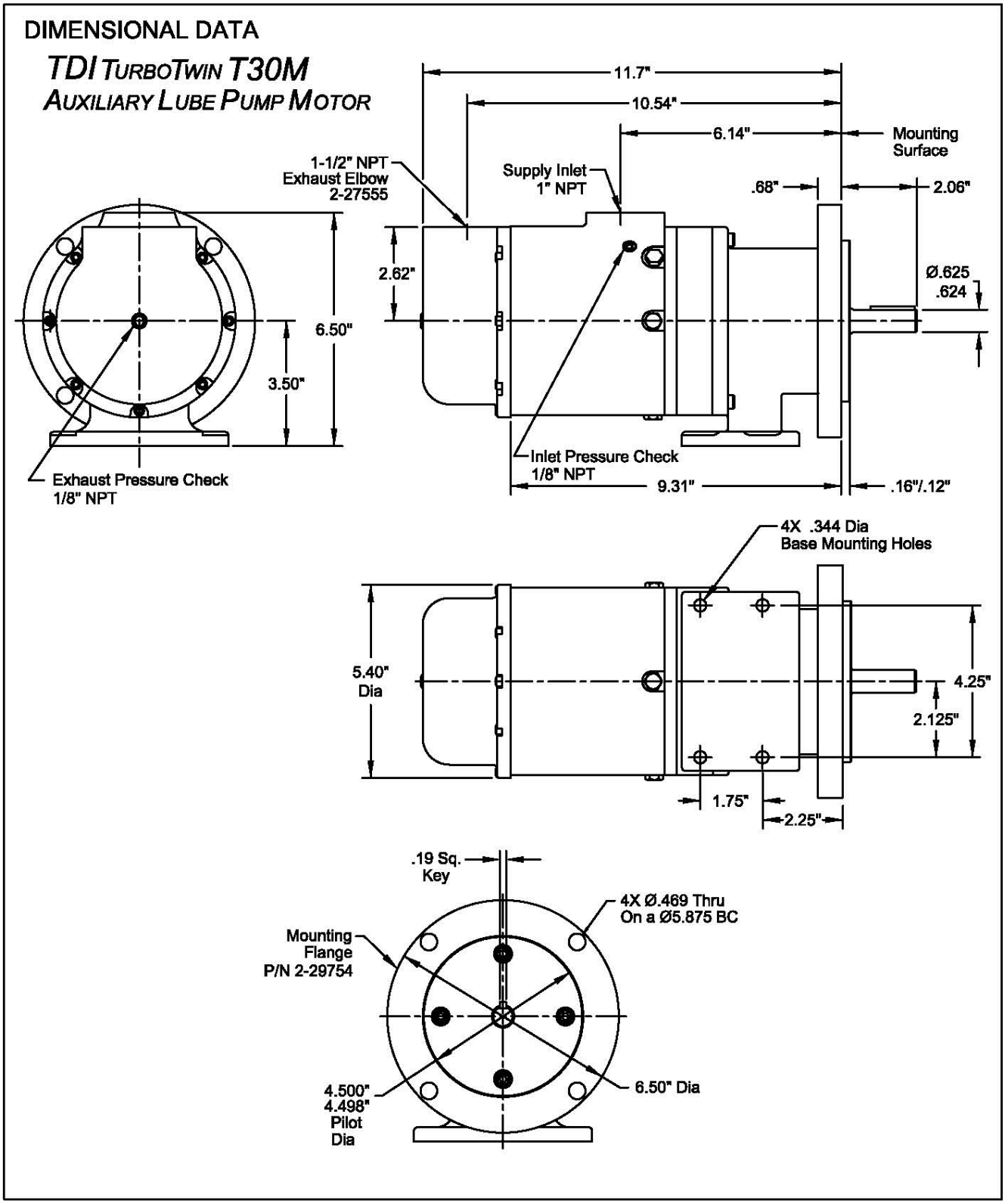


Figure 4. T30-M Lube Pump Motor w/Modified NEMA 56C Mounting Flange

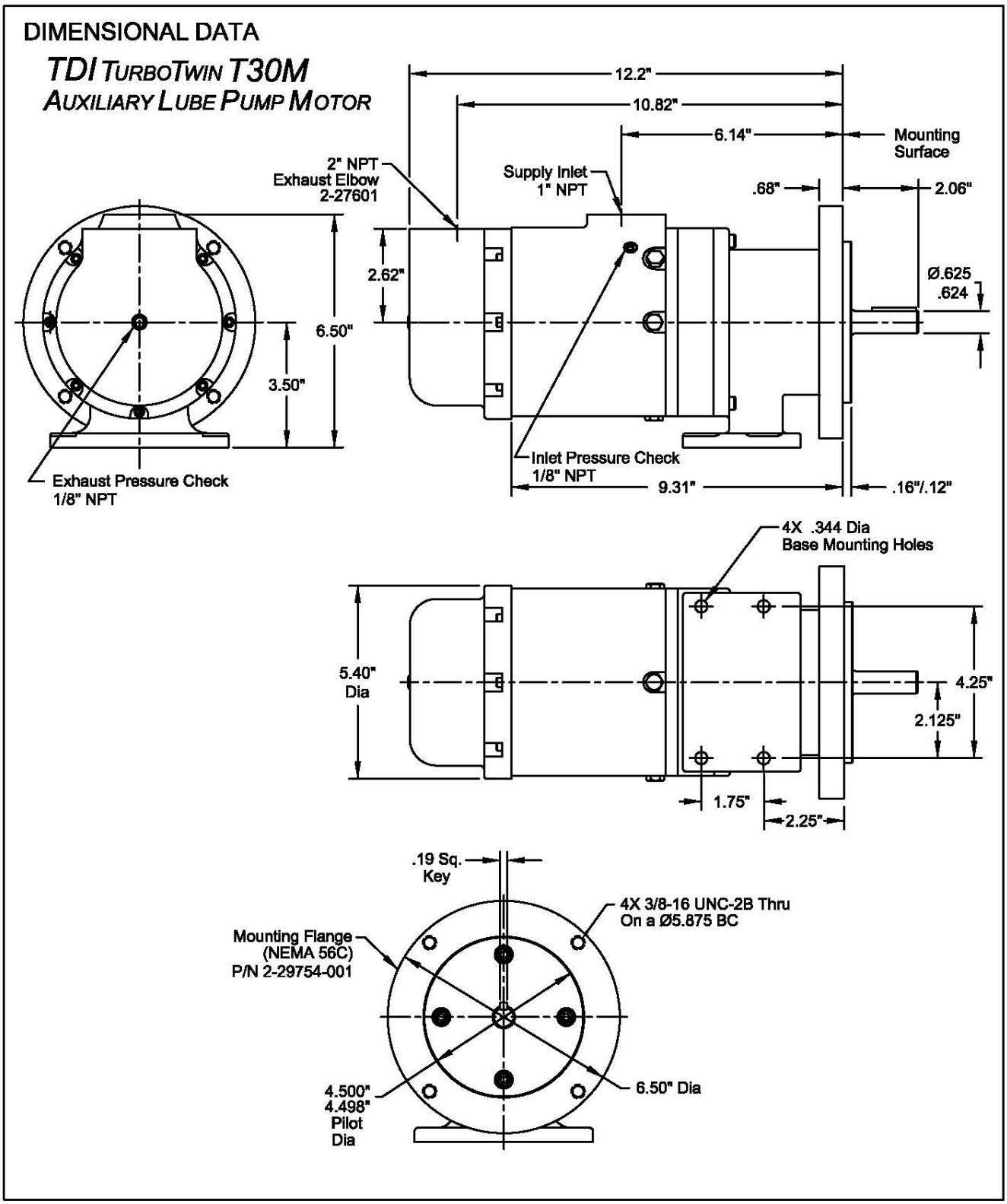


Figure 5. T30-M Lube Pump Motor w/NEMA 56C Mounting Flange

Publication: T3-790, Rev. 2
Issued January 9, 2013