



Cabin Pressurization Unit

Models:	15A7603-1000	15B7603-1000
15C7603-1000	15D7603-1000	15E7603-1000
15F7603-1000	15G7603-1000	15H7603-1000
15J7603-1000	15K7603-1000	



09/2007 – Rev. 09

REVISION	DATE	TEXT AFFECTED
03	12-23-03	Modified 9.7.2 Instrument Panel Components
04	05/2004	Modified 9.7.3 Electrical Components
05	01/2006	7.2.3 Modified Differential Pressure 7.4.1 Modified illustration 9.3.1 Modified illustration 9.7.2 Modified Illustration 9.7.2 Modified Parts List Appendix VIII Changed from Magnehelic to Capsuhelic
06	06/2006	Modified Appendix I
07	10/2006	9.7.2 Modified Parts List
08	01/2007	9.7.4 Modified Parts List
09	06/2007	Modified 9.7.1 Internal Parts, 9.7.2 Instrument Panel Components, and 9.7.4 Pipe Assembly

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This product can not be modified without the written approval of Tronair, Inc. Any modifications done without written approval voids all warranties and releases Tronair, Inc., its suppliers, distributors, employees, or financial institutions from any liability from consequences that may occur. Only Tronair OEM replacement parts shall be used.

1.0 PRODUCT INFORMATION

Cabin Pressurization Unit (CPU)

* Model 15X7603-1000 20 HP CE Compliant

Serial Number located on Nameplate.

Date of Manufacture located on Nameplate.

Location of Manufacture: **Tronair, Inc.**

1740 Eber Road
Holland, Ohio 43528 USA

* **X denotes Electrical Option. Reference Section 6.1.2 Full Load Amperage Table.**

1.1 FUNCTION

This Cabin Pressurization Unit is designed to provide a controllable air supply for the pressurization of aircraft cabin and cockpit areas for the purpose of cabin leakage testing, and/or outflow valve tests.

Adapter kits (sold separately) must be used to connect the Supply Hose from the CPU to the aircraft. (See Appendix VII for List of Adapter Kits)

This Cabin Pressurization Unit is to be operated only by qualified trained technicians.

This Operation and Service Manual is to be used only by qualified trained technicians.

1.2 LIST OF DRAWINGS

- Outline Dimensions
- Pneumatic Schematic
- Electrical Schematic
- Wiring Diagram

1.3 RELEVANT STANDARDS

- a. The CPU has been designed to comply with the following directives:
 - 89/392/EEC: Machinery Directive
 - 89/336/EEC: Electromagnetic Compatibility
- b. The following standards were used as guides to design the CPU:
 - EN 292-1:1991
 - EN 292-2:1991/1995
 - BS EN 418:1992
 - BS EN 954-1:1997
 - BS EN 983:1996
 - BS EN 1050:1997
 - BS EN 60204-1:1998
 - prEC 1915-1:1995

1.0 Product information continued on following page.

1.0 **PRODUCT INFORMATION** (continued)

1.4 **OVERVIEW**



FIGURE 1 – Front View



FIGURE 2 – Rear View

Item	Part Number	Description	Qty
1	Z-1675-02	Replacement, 25 ft External Hose Assembly	1
	N-1523	Coupling, Hose	1
	H-1666-02	Clamp, Band	2
	TF-1155*300	Hose, Supply CPU 2"	1
	N-1520	Coupling, Hose	1

2.0 SAFETY INFORMATION

2.1 ALARM AND WARNING SYSTEMS

This machine does not have any alarm or warning systems.

2.2 EXPLANATION OF WARNING AND DANGER SIGNS

Misuse of machine can cause personal injury and/or property damage.

Operation of the Cabin Pressurization Unit must be in accordance with this manual, and the airframe manufacturer's instructions



WARNING! Warning is used to indicate the presence of a hazard that **can cause severe personal injury, death, and/or substantial property damage** if the warning notice is ignored.



HAND ENTANGLEMENT/BELT DRIVE! This label warns of belt drive hazard inside cabinet **that can cause severe personal injury**.



ELECTRICAL SHOCK! Never touch electrical wires or components while electrical power is applied. Electrical wires can be sources of electrical shock.

Do not operate CPU with cabinet panels removed.

2.3 COMPONENT SAFETY FEATURES

- Overload and short circuit protection
- Pressure relief valve for blower protection set at 13.5 psi/0.9 bar
- Emergency Stop button located on control panel
- Separate Start and Stop buttons
- Caster brakes and swivel locks on all four corners

2.4 FUNCTIONAL SAFETY FEATURES

The pressure relief valve has been sized to bypass the full output of the blower. This feature provides operator and Cabin Pressurization Unit protection in the case where an operator may inadvertently start the machine with both the ball valve and the Airflow Control Valve closed.

Control circuit voltage is 115 VAC provided by the control circuit transformer.

2.5 FEATURES FOR OPERATOR SAFETY

In addition to the safety features listed above, the Cabin Pressurization Unit incorporates high attenuation industrial blower silencers for reduced noise levels.

2.5.1 Removable Guards

The front and rear removable guards provide access to the drive motor, belts, and blower. The fasteners for attaching these panels to the machine are captivated by O-rings.



WARNING!

DO NOT operate the machine with the guards removed

2.6 PERSONAL PROTECTIVE EQUIPMENT

Operators must use personal protective equipment in accordance with their employer's requirements.

The maximum sound level is 91 dB(a) at 3 foot (91.4 cm) distance from back of machine with unit operating at 12 psi (0.83 bar) system pressure and ball valve closed.

2.7 SAFETY GUIDELINES

Any uses other than those identified in section 1.1 of this manual are prohibited.

2.8 CONDITIONS FOR SAFE USE

Recommended Ambient Temperature Range = 32° to 90° F (0° to 32° C).

Do not operate outdoors while raining.

2.0 Safety information continued on following page.

2.0 SAFETY INFORMATION *(continued)***2.9 TECHNICAL EXPERTISE FOR****2.9.1 Installation**

The installation of this machine is to be completed by qualified electricians. See Section 6 for installation information.

2.9.2 Operation

This machine is to be used by skilled and trained aircraft technicians in accordance with this manual, and the airframe manufacturer's instructions. See Section 7 for Operation Instructions.

2.9.3 Maintenance

This machine is to be maintained by qualified maintenance personnel. See Section 9 for maintenance information.

2.10 ADDITIONAL SAFETY INFORMATION**WARNING!**

Always start the machine with the Airflow valve full open (counter-clockwise).

- **ALWAYS follow the airframe manufacturer's instructions when pressurizing an aircraft.**
- **NEVER open any aircraft door or access panel while there is any pressure within the cabin/cockpit.**
- **ALWAYS use applicable safety equipment required for aircraft pressurization tests.**

3.0 PACKAGING AND STORAGE**3.1 PACKAGING REQUIREMENTS**

Packaging for shipment should include a suitable pallet with surrounding crating to prevent damage to unit. The machine should be securely strapped to the pallet. Rings for this purpose are located at either end of the machine, on the bottom of the frame.

3.2 METHODS OF HANDLING

The Cabin Pressurization Unit can be rolled freely by hand. If required, the unit may be lifted, by a suitable fork truck, from any side provided that the forks extend thru to the side opposite the fork truck.

No provisions for lifting by overhead crane are provided.

3.3 STORAGE

The Cabin Pressurization Unit is suitable for either indoor or outdoor storage. While moisture sensitive components are sealed from falling rain, it is recommended that a soft tarp be used to cover the machine if stored outdoors.

3.4 STORAGE SPACE AND HANDLING FACILITIES

Minimum: 71 inches x 48 inches x 49 inches high (1,803 x 1,219 x 1,245 mm)

No specific handling facilities are required.

4.0 TRANSPORTATION**4.1 HANDLING POINTS**

- Rings are provided at either end of the machine for tie down points.
- The unit may be lifted by a fork truck from any side, provided the forks extend to the side opposite the fork truck.
- A handle is provided for manually rolling the machine.
- No other handling points are provided.

4.2 WEIGHT

1,100 lbs (500 kg)

5.0 ASSEMBLY

The Cabin Pressurization Unit is shipped complete and ready to use, however all fasteners and hose connections should be checked for tightness prior to use.

6.0 INSTALLATION

6.1 INSTALLATION REQUIREMENTS

6.1.1 Electrical Power Supply

The Cabin Pressurization Unit is supplied with a 50 ft (15.24 m) power cord of the proper current rating for this length cord, and the motor/voltage of the machine. The end user must select and connect the proper cord termination plug per all local and federal requirements.

The Cabin Pressurization Unit is supplied with proper overload and short circuit protection.

The facilities connection to be used for the Cabin Pressurization Unit must be equipped with a properly sized disconnect.

6.1.2 Full Load Amperage Table

Electrical Option	Voltage	Frequency	FLA	Phase
A	208 V~	60	59.3	3
B	230 V~	60	53.6	3
C	380 V~	60	31.8	3
D	460 V~	60	26.8	3
E	575 V~	60	21.4	3
F	200 V~	50	61.6	3
G	220 V~	50	51.9	3
H	380 V~	50	30	3
J	415 V~	50	29.1	3
K	440 V~	50	28.1	3

6.1.3 Motor Overload Protection

The CPU is equipped with a solid-state overload relay. The trip point of the relay is factory set to the proper current level. Adjustment is not recommended.

6.1.4 Shop Air Connection

Shop air must be supplied to the Cabin Pressurization Unit. The connection is located on the right end of the machine, as viewed from the operator station.

- Maximum pressure: 150 psi (10.3 bar)
- Connection size: ¼ NPT

6.1.5 Blower

Check the blower oil level using the external sight gauge. See Appendix VI for oil type and viscosity.

6.1.6 Relief Valve

The pressure relief valve is factory set at 13.5 psi (0.93 bar). **Do not adjust the pressure relief valve.**

6.2 PERSONNEL REQUIREMENTS (TECHNICAL EXPERTISE) FOR INSTALLATION

6.2.1 Electrical Connections

Electrical connections are to be made by a qualified electrician per all applicable codes and regulations.

6.2.2 Shop Air Connections

Shop air connections are to be made by qualified personnel per all applicable codes and regulations.

6.3 INSPECTION AND TESTING PROCEDURE ON INSTALLATION

6.3.1 Verify Rotation

After electrical connections to facilities supply is complete, open the ball valve, turn the airflow valve fully counter clockwise, and press the "Start" button. Verify air is blowing out of the ball valve. If not, switch any two power supply wires at the fuse block inside the electrical box on the machine.

7.0 OPERATION

7.1 OPERATING PARAMETERS

Due to the complexities, differences, and changes in aircraft pneumatic systems, no attempt has been made to relate to any specific aircraft. The customer must **always** follow the aircraft manufacturer's instructions regarding aircraft cabin pressurization procedures and pressure levels. It is mandatory that the operators read, and understand, this manual and the aircraft maintenance manual prior to using this equipment.

WARNING!

To prevent personal injury and/or damage to aircraft:



1. **ALWAYS** follow aircraft manual procedures for aircraft pressurization.
2. **NEVER** exceed specified aircraft pressure levels.
3. **Never** operation this CPU prior to reading this manual.
4. **Never** open any aircraft cabin door or access panel if there is any pressure in the cabin.
5. **ALWAYS** use applicable safety equipment required for aircraft pressurization tests.

7.1.1 General

This aircraft cabin pressurization unit (CPU) is a pneumatic device and as such follows the laws of compressible fluids. The operator should be aware of the following information.

Compressed Air

As air is compressed, a tremendous amount of energy is stored. This is similar to the energy stored in a coil spring when compressed. **Under no circumstances** are aircraft doors or access panels to be opened if there is any pressure at all in the aircraft above atmospheric pressure.

As an example, the force produced on a door two (2) feet (0.61 m) wide by five (5) feet (152.4 cm) high with only one (1) psig (0.7 bar) is equal to 1,440 lbs (20.3 kg).

ACFM versus SCFM

Air is a compressible fluid and is affected by pressure and temperature. Airflow measurements are normally corrected to "standard" temperature and pressure.

Uncorrected airflow measurements carry the unit ACFM (Actual Cubic Feet per Minute). Corrected airflow measurements carry the unit SCFM (Standard Cubic Feet per Minute). Reference *Appendix I*.

7.2 NUMERICAL VALUES AND LIMITS

7.2.1 General

Pressure Range:	0 – 13 psi (0 – 0.90 bar)
Flow Range:	0-275 SCFM
Relief Valve setting:	13.5 psi (0.93 bar)
Maximum permitted outlet air temperature:	300° F (150° C)
Motor:	3φ 20 hp (voltage optional)
Max Shop Air Supply Pressure:	150 psi (10.3 bar)
Maximum Noise Level:	84 dB(a) @ 10 ft (3.0 m) @ 0 psi (0 bar) 91 dB(a) @ 3 ft (0.9 m) @ 12 psi (0.83 bar)
Maximum Noise Level @ Operator Station:	83 dB(a) @ 0 psi 90 dB(a) @ 12 psi (0.83 bar) [measured with 55 dB(a) ambient conditions]

7.2.2 Dimensions

Overall:	70 x 48 x 49 in (180 x 122 x 125 cm)
Cabin Supply Hose:	2 in (5 cm) diameter x 25 ft (7.6 m) long
Cabin Sensor Feedback Hose:	1/4 in (0.6 cm) diameter x 30 ft (9.1 m) long
Door Seal Supply Hose:	1/4 in (0.6 cm) diameter x 30 ft (9.1 m) long

7.2.3 Instrumentation

Aircraft Cabin Data

Cabin pressure gauge:	0 – 15 psi (0 – 1.03 bar)
Rate of Climb:	0 – 4000 ft/min (0 – 2,032 cm/sec)

Airflow Measurement Data

System pressure gauge:	0 – 15 psi (0 – 1.03 bar)
Differential pressure:	0 – 20 inches (0 – 5 kPa) of water
Air Temperature:	30 – 300° F (0-150° C)

Regulated Shop Air

Pressure gauge:	0 – 30 psi (0 – 2.0 bar)
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7.0 OPERATION (continued)

7.3 FEATURES

7.3.1 Cabin Air Supply

The Cabin Pressurization Unit (CPU) uses a rotary blower driven by a 3-phase electric motor to provide a source of clean, low-pressure air.

As shown in the pneumatic system schematic, air is drawn through a dry element filter located outside of the cabinet by the rotary blower. After the air is discharged from the blower, it is either directed to the aircraft or returned to the atmosphere via the airflow control valve. A pressure relief valve is provided to protect the blower from a dead head start-up and is adjusted to open at 13.5 psig (0.95 bar).

7.3.2 Airflow Control Valve

The Airflow Control Valve is used to divert the output from the blower to atmosphere. With the Airflow Control Valve closed (turned fully clockwise), the full output from the blower is directed to the aircraft. Opening this valve allows regulation of cabin pressure.

The Airflow Control Valve is also used to control the rate of pressure increase in the cabin (rate of climb or descent). When beginning to pressurize the cabin, the Airflow Control Valve is fully open (counter clockwise). Closing the Airflow Control Valve directs progressively more air towards the cabin, thereby increasing the pressure inside the cabin. The faster the Airflow Control Valve is closed, the higher the rate of climb or descent.

7.3.3 Aircraft Cabin Instrumentation

Instruments are provided to measure the cabin pressure and rate of climb or descent inside the cabin. These instruments are provided, along with the Airflow Control Valve, within the Aircraft Cabin Data area on the instrument panel. Grouping these instruments together with the Airflow Control Valve provides easy operator monitoring of cabin conditions during the pressurization and testing process.

7.3.4 Airflow Measurement

The CPU is equipped with the instrumentation required to determine airflow into the cabin in terms of Standard Cubic Feet per Minute (SCFM). The airflow is determined by measuring the differential pressure caused by the flowing air over a known length within the CPU piping. This differential pressure is indicated on the Pressure Differential gauge located in the Airflow Measurement area of the instrument panel. Instruments are also provided in this area for system pressure, and airflow temperature. These two measurements are used to calculate SCFM from the indicated Pressure Differential.

7.3.5 Regulated Shop Air

The CPU is equipped with a regulator and pressure gauge for the purpose of supplying regulated air to the aircraft door/canopy seals.

These items are located in the Regulated Shop Air area on the instrument panel.

7.3.6 Power Controls

The Power Controls section on the instrument panel contains operators for "START", "STOP", and "EMERGENCY STOP" functions. A green light is also provided to indicate that the machine is running.

7.3.7 Additional Features

- External blower oil level indication
- External intake air filter
- Four (4) swiveling casters with brakes and swivel locks
- Hose hangers
- Lightweight removable maintenance panels with handles
- CE Marked (Machinery Directive)

7.0 Operation continued on following page.

- 7.0 OPERATION (continued)
- 7.4 INSTRUMENT PANEL
- 7.4.1 Instrument Panel



FIGURE 3 – Instrument Panel

7.4.2 Description of Controls

Regulated Shop Air

- Regulator – provides for regulation of shop air to aircraft door and canopy seals.

Power Controls

- OFF – Removes power from the drive motor
- ON – enables supply of power to the drive motor
- Green Pilot Light – illuminated when drive motor is running
- Emergency Stop - removes power from the drive motor

Aircraft Cabin Data

- Airflow Control Valve – Vents output from blower to atmosphere. Full counter clockwise rotation of handle opens valve completely. Full clockwise rotation of handle closes valve completely, forcing full output of blower into aircraft cabin.
- Cabin Pressure Gauge – indicates air pressure inside aircraft cabin.
- Rate of Climb – This is a Vertical Speed Indicator that displays the rate of climb or descent (rate of pressure change) inside the aircraft cabin in ft/min.

Airflow Measurement Data

- Pressure Differential – indicates the pressure drop across a known length of pipe within the CPU piping system in inches of water column.
- The reading from this gauge is used on the vertical axis on the curves contained in Appendix I.
- System Pressure – indicates the pressure within the CPU piping system. The reading from this gauge is used to identify the curves in Appendix I.
- Temperature – indicates the temperature of the airflow within the CPU piping. This reading is used to make the temperature correction to derive SCFM.

7.4.3 Connection Locations

1. Aircraft Cabin Supply Air
Supply hose connection with ball valve.
2. Aircraft Cabin Sensor Line
Feedback connection to aircraft.
3. Shop Air In
Connection to facilities compressed air supply.
4. Regulated Air (to aircraft)
Regulated air supply for aircraft door seals.

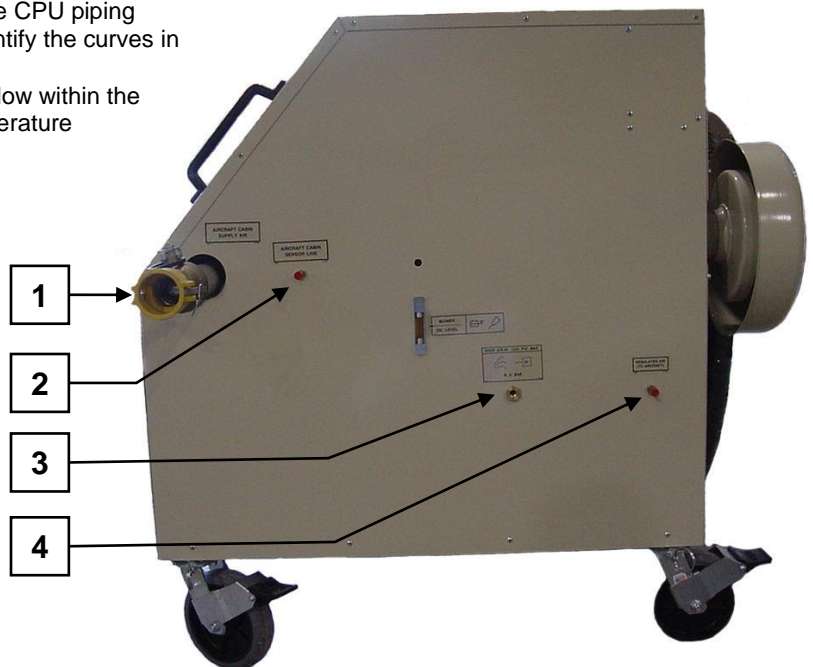


FIGURE 4 – Connection Locations

7.0 OPERATION (continued)

7.5 PREPARATION PRIOR TO FIRST USE

1. Verify correct blower oil level
2. Verify correct blower rotation prior to connecting any hoses to aircraft.
 - Open the ball valve
 - Quickly start, then stop, the CPU verifying that air is blowing out of the Aircraft Cabin Supply connection. If air is not blowing out, switch any two of the input power leads. **NOTE: This procedure must be completed by qualified technician(s).**
3. Visually inspect the machine for loose fasteners, shipping damage, loose internal air connections, etc. Repair any faults found.

7.6 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment must be used in accordance with employer's instructions, and local and federal regulations.

7.7 CHECKS PRIOR TO START UP

1. Verify correct blower oil level
2. Open Airflow valve by rotating handle fully counter clockwise.
3. Open regulator in "Regulated Shop Air" section by rotating knob fully counter-clockwise.
4. Close ball valve.
5. Verify that facilities compressed air supply is connected to "Shop Air In" connection.

7.8 START UP PROCEDURE

CAUTION!



To prevent personal injury and/or damage to aircraft:

- ALWAYS follow aircraft manual procedures for aircraft pressurization.
- NEVER exceed specified aircraft pressure levels.
- NEVER operate this CPU prior to reading this manual.
- NEVER open ANY aircraft cabin door or access panel if there is any pressure in the cabin.
- ALWAYS use applicable safety equipment required for aircraft pressurization tests.

1. Ensure that steps in 7.7 have been completed.
2. **Do not start CPU with both the airflow valve and the ball valve closed.**
3. Connect hoses from CPU to aircraft (Adapter kit required to connect cabin supply hose to aircraft is sold separately – See Appendix IV).

7.9 OPERATING PROCEDURES

7.9.1 Basic Operation

Follow aircraft manufacturer's instructions on cabin pressurization. See Appendix II & III for more detailed instructions.

Cabin Pressurization

1. Secure the aircraft per aircraft manufacturer's instructions.
2. Inflate door seals, using the regulator and gauge located in the "Regulated Shop Air" section, per aircraft manufacturer's instructions.

NOTE: The CPU does not need to be running for these controls to function.

3. Ensure that the Airflow Control Valve, located in the "Aircraft Cabin Data" section, is fully open (turned counter clockwise).
4. Press the "START" button.
5. Open the ball valve to allow air to begin entering the aircraft cabin.

NOTE: Do not exceed the rate of descent specified by the aircraft manufacturer.

6. Slowly rotate the handle on the Airflow Control Valve clockwise to begin increasing the pressure inside the aircraft cabin.



CAUTION!

Do not exceed the rate of descent specified by the aircraft manufacturer.

7. As the cabin pressure approaches the test pressure specified by the aircraft manufacturer, begin opening the Airflow Control Valve to slow down the rate of pressure increase.

7.9.1 Basic operation continued on following page.

7.9.1 Basic Operation (*continued*)

8. When the specified cabin test pressure has been reached, adjust the Airflow Control Valve as required to maintain the test pressure.

**CAUTION!**

Do not exceed the maximum cabin pressure specified by aircraft manufacturer.

9. Once the cabin pressure has been stabilized at the test pressure, write down the readings indicated on all of the gauges located in the "Airflow Measurement" section on the instrument panel. See Appendix II.
10. See Appendix I for instructions on how to determine leakage rate from the above measurements.

Cabin Depressurization**CAUTION!**

Follow aircraft manufacturer's instructions on cabin pressurization. See Appendix II & III for more detailed instructions.

1. With CPU still running, slowly open the Airflow Control Valve (turn counter-clockwise) to reduce the pressure inside the cabin.

**CAUTION!**

Do not exceed the rate of climb specified by the aircraft manufacturer.

2. After the Airflow Control Valve has reached its full open position, close the ball valve, and press the "STOP" button.
3. Any remaining pressure inside the cabin will bleed off naturally.

**CAUTION!**

NEVER open ANY aircraft cabin door or access panel if there is any pressure in the cabin.

7.9.2 General Plan

In general, aircraft cabin leakage testing should be done as follows:

- a. Using the CPU, establish actual aircraft leakage rate.
- b. Compare the leakage rate (SCFM) to the aircraft manufacturer's specification.
- c. Repair cabin leaks, starting with major leaks first. Use low-pressure air, 1 – 2 psi (0.07 – 0.14 bars).
- d. After repair, using the CPU again, determine the new leakage rate (SCFM) and compare to aircraft specification.
- e. Repeat steps c and d above until the cabin leakage rate meets or is less than that required by the aircraft manufacturer's specifications.

7.9.3 Test Methods

Two different test methods are generally specified by aircraft manufacturers to determine aircraft cabin leakage rates:

- a. Flow measurement method
- b. Pressure decay method

The following paragraphs explain each of the above methods.

**CAUTION!**

To prevent personal injury and/or damage to the aircraft, always follow the aircraft manufacturer's instructions for pressurizing aircraft.

a. Flow Measurement:

The flow measurement method measures the rate of air leakage from the aircraft cabin in SCFM.

The step-by-step test procedure for this test method is given in *Appendix II*.

b. Pressure Decay Method:

The pressure decay method determines cabin air leakage by timing the rate of climb de-pressurization from a set pressure. The time is normally measured in seconds. A stopwatch readable in 1/10 of a second may be used for this test.

The step-by-step test procedure for this test method is given in *Appendix III*.

7.9 OPERATING PROCEDURES (continued)

7.9.4 Aircraft Leakage

Aircraft cabins generally leak in the following areas:

- Door seals
- Outflow valves and valve gaskets
- Safety valves and valve gaskets
- Pneumatic air line connections
- Control cable seals in pressure bulkheads
- Electrical wiring bundles through pressure bulkheads
- Window seals
- Fuselage rivets and overlapping fuselage panels

7.9.5 Locating Aircraft Cabin Leaks

- a. It does not require high-pressure air to find leakage points in the aircraft cabin. Whenever possible, all leakage investigations should be performed at aircraft cabin pressures of between 1 and 2 psig (0.07 – 0.14 kgs/sq cm). In this way:
 1. Less heat build-up will occur during extended running.
 2. Lower CPU noise is generated, allowing audible leaks to be found.
 3. Lower power consumption by the CPU.
- b. Non-audible leaks can be found by spraying the aircraft exterior with a soap and water solution. Leaks are revealed by the bubbles generated and can be marked with a colored grease pencil for later correction.

7.10 STOPPING PROCEDURES

To stop the output of the CPU, press the “STOP” button.

An “EMERGENCY STOP” button is provided in addition to the “STOP” button.



CAUTION!

Stopping the CPU without shutting the ball valve may cause rapid depressurization of the aircraft.

7.11 EMERGENCY STOPPING PROCEDURES

7.11.1 If The Aircraft Is NOT Pressurized

1. Press the “EMERGENCY STOP” button.

7.11.2 If The Aircraft IS Pressurized

1. Shut the ball valve.
2. Press the “EMERGENCY STOP” button.

CAUTION!



Stopping the CPU without shutting the ball valve may cause rapid depressurization of the aircraft

8.0 TRAINING

8.1 TRAINING REQUIREMENTS

- CPU operators **MUST** be properly trained in all aspects of aircraft cabin pressurization tests.
- It is the employer’s responsibility to ensure that the operator is qualified to perform aircraft cabin pressurization and testing.
- This CPU Operation and Maintenance Manual does not provide qualified training to perform aircraft cabin pressurization and testing.

8.2 TRAINING PROGRAMS, MANUALS, METHODS, SUPERVISORS, AND OPERATORS

- Tronair does not provide training materials beyond the scope of this manual.
- It is the employer’s responsibility to provide any training requirements beyond the scope of this manual.

9.0 MAINTENANCE

9.1 DESCRIPTION OF EQUIPMENT

- Blower – Roots positive displacement rotary blower. See Appendix VI for blower manufacturer maintenance manual.
- Motor – 3 phase electric motor – 20 Hp. See Appendix VII for motor manufacturer maintenance data.
- Air Filter – Dry element inlet air filter
- Blower Drive – Dual V-belt
- Airflow control valve – Brass gate valve
- Pressure Differential sensor - Meriam Instruments Accutube
- Pressure Differential measurement – Dwyer Instruments capsuhelic pressure differential gauge (inches of water column)

9.2 DESCRIPTION OF CONTROL SYSTEM

- The momentary “ON” button energizes the coil on the motor contactor, sending input voltage to the motor windings starting the machine. A set of auxiliary contacts creates a latching circuit holding the contactor “in”.
- The momentary “OFF” button uses redundant N.C. contacts to break the latching circuit, eliminating voltage to the motor contactor coil, thereby stopping the machine.
- The “EMERGENCY STOP” button is the same as the “OFF” button, except that the operator is a maintained twist to release type.
- The Airflow control valve is a gate valve used to vent blower output to atmosphere.
- The ball valve opens or closes the air output from the machine

9.3 LAYOUT OF CONTROL PANEL

9.3.1 Front of Panel



FIGURE 5 – Front Panel

9.4 DESCRIPTION OF POWER SUPPLY AND WIRING CIRCUITS

- See **Figure 9 – Wiring Diagram**

9.5 DESCRIPTION OF MECHANICAL AND ELECTRICAL PROTECTION SYSTEMS

9.5.1 Mechanical

- The blower and gauges are protected against over-pressurization by a pressure relief valve set at 13.5 psi (0.95 bar).
- **DO NOT adjust the pressure relief valve.**
- The CPU enclosure complies with EN 953 Guards, fixed and removable.

9.5.2 Electrical

- The CPU electrical system includes short circuit protection on the facilities power circuit, and the control circuit transformer primary and secondary windings.
- The CPU electrical system includes solid state motor overload protection.
- All electrical system components are CE Marked.
- The electrical system is designed per EN 60294-1:1998

- 9.0 MAINTENANCE (continued)
- 9.6 ENGINEERING DRAWINGS AND WIRING DIAGRAMS
- 9.6.1 Outline Dimensions

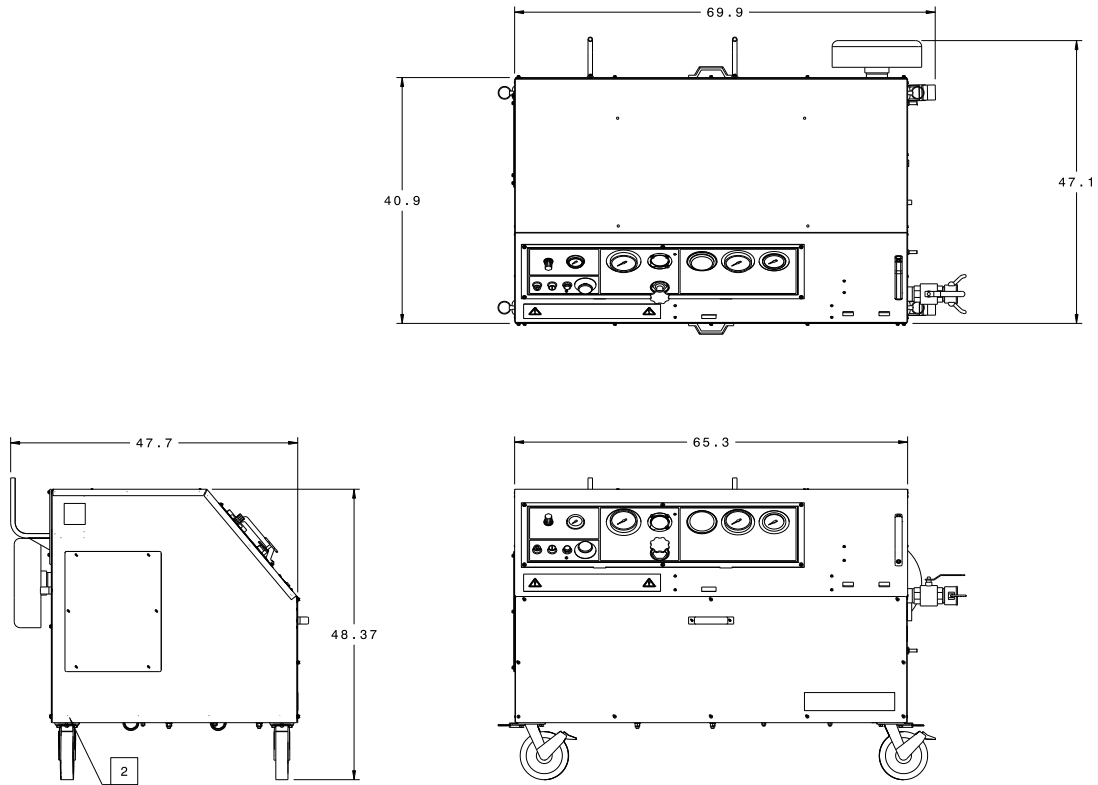


FIGURE 6 – Outline Dimensions

9.6.2 Pneumatic Schematic

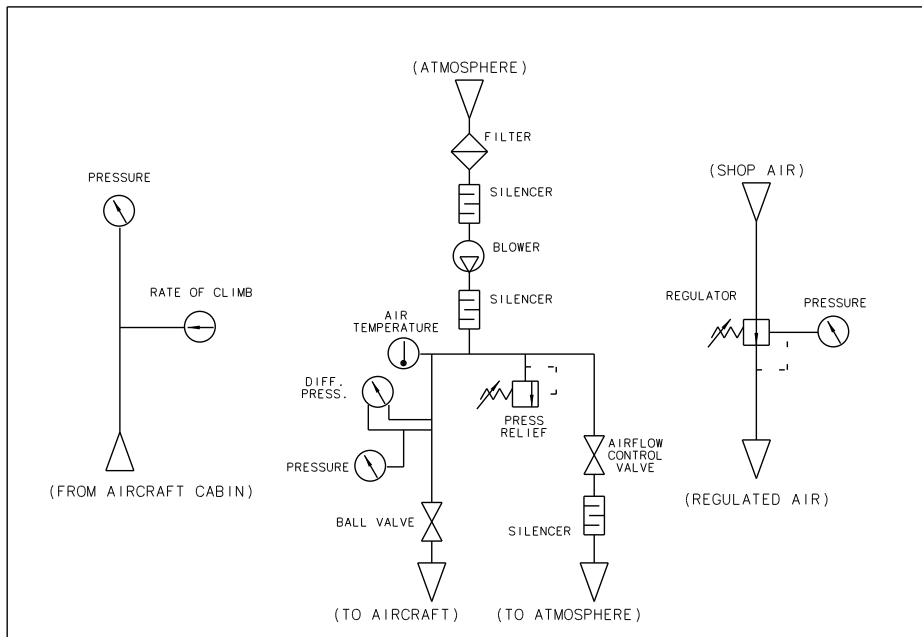
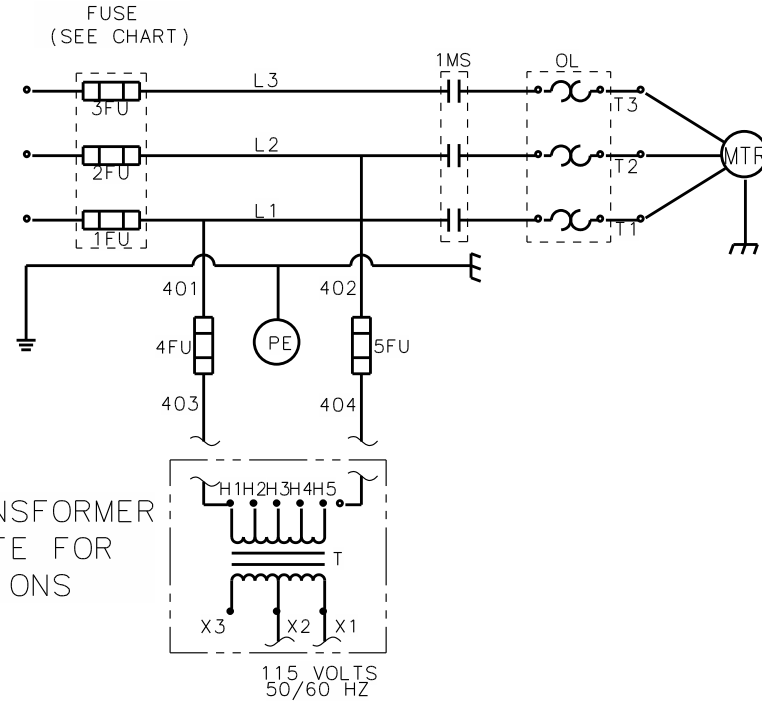


FIGURE 7 – Pneumatic Schematic

9.6 Engineering drawings and wiring diagrams continued on following page.

9.6 ENGINEERING DRAWINGS AND WIRING DIAGRAMS (continued)
 9.6.3 Electrical Schematic

VOLTS/ HERTZ	FUSE AMPS
208 / 60	80
230 / 60	70
380 / 60	40
460 / 60	35
575 / 60	30
200 / 50	80
220 / 50	70
380 / 50	40
415 / 50	40
440 / 50	40



SEE TRANSFORMER
 NAMEPLATE FOR
 CONNECTIONS

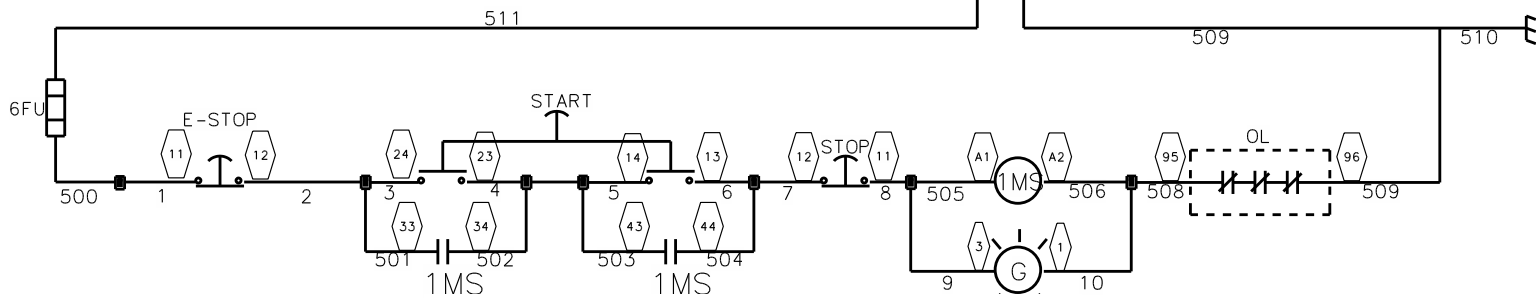


FIGURE 8 – Electrical Schematic

9.6 Engineering Drawings and Wiring Diagrams (continued)
 9.6.4 Wiring Diagram

CONTROL WIRES-ELECTRICAL PANEL					
A.W.G./PART #	WIRE #	COLOR	TERMINAL BLOCK LOCATION	TERMINATION LOCATION	OPERATOR PANEL TERM. BLOCK LOCATION
#14	1	BLACK	101		201 (E-STOP BTN TERM #11)
#14/EC-1252-01	500	RED	102	JUMPER FROM FUSE	
#14	2	BLACK	103		203 (E-STOP BTN TERM #12)
		2-POLE JMPR	104	103-104 TO 105-106	
#14	3	BLACK	105		205 (START BTN TERM. #13)
#14/EC-1252-01	501	RED	106	AUX. CONTACT #24	
#14	4	BLACK	107		207 (START BTN TERM. #14)
#14/EC-1252-01	502	RED	108	AUX. CONTACT #23	
#14	5	BLACK	109	(JUMPER 107-108 TO 109-110)	209 (START BTN TERM. #23)
#14/EC-1252-01	503	RED	110	AUX. CONTACT #14	
#14	6	BLACK	111		211 (START BTN TERM. #24)
#14/EC-1252-01	504	RED	112	AUX. CONTACT #13	
#14	7	BLACK	113		213 (STOP BTN TERM #11)
			114	111-112 TO 113-114	
#14	8	BLACK	115		215 (STOP BTN TERM #12)
#14/EC-1252-01	505	RED	116	STARTER COIL #A1	
		3-POLE JMPR	117		
			118	115-116 TO 117-118 TO 119-120	
#14	9	BLACK	119		219 (PILOT LIGHT TERM #1)
			120		
#14	10	BLACK	121		221 (PILOT LIGHT TERM #3)
#14/EC-1252-01	506	RED	122	STARTER COIL #A2	
#14	11	BLACK	123		223 (PILOT LIGHT TERM #3)
#14	507	GRN/YEL	GROUNDING BLOCK TO GROUNDING BLOCK (PART OF CONTROL CABLE)		
#14/EC-1252-01	508	RED	JUMPER FROM A2 TO 95 ON O.L.		
#14/EC-1256-01	509	LT. BLUE	NEUTRAL FROM 96 TO X1		
#14/EC-1572-01	510	GRN/YEL	FROM X1 TO GROUNDING BLOCK		
#14/EC-1252-01	511	RED	FROM X2 TO FUSE BLOCK		

CONTROL WIRES-OPERATOR INTERFACE			
A.W.G./PART #	WIRE #	COLOR	DEVICE TERMINAL
#14	1	BLACK	E-STOP BTN TERM. #11
#14	2	BLACK	E-STOP BTN TERM. #12
#14	3	BLACK	START BTN TERM. #24
#14	4	BLACK	START BTN TERM. #23
#14	5	BLACK	START BTN TERM. #14
#14	6	BLACK	START BTN TERM. #13
#14	7	BLACK	STOP BTN TERM. #12
#14	8	BLACK	STOP BTN TERM. #11
#14	9	BLACK	PILOT LIGHT TERM. #3
#14	10	BLACK	PILOT LIGHT TERM. #1
#14	11	BLACK	
#14	12	GRN/YEL	GROUND STUD

FIGURE 9 – Wiring Diagram

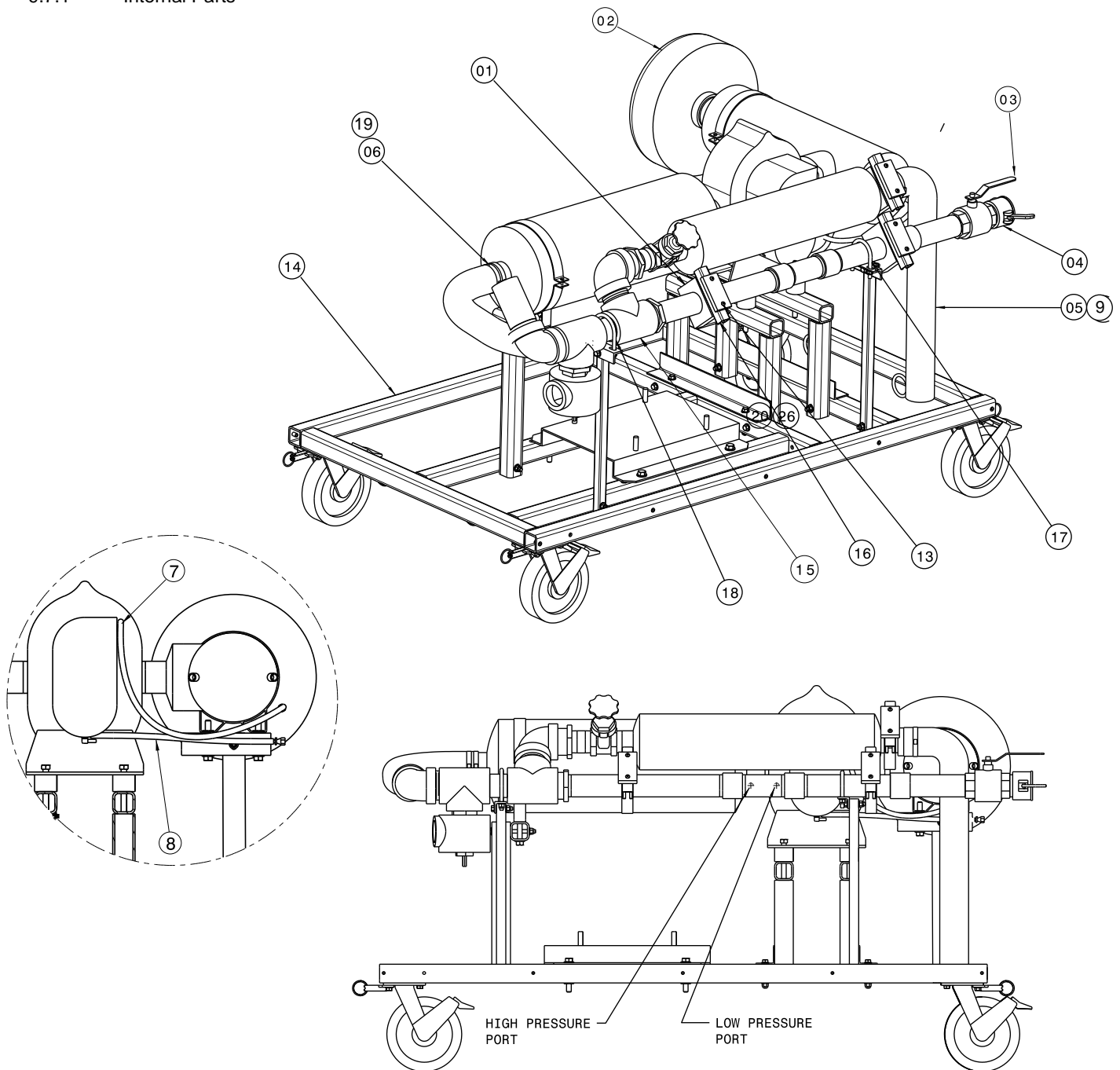
9.0 Maintenance continued on following page

9.0 MAINTENANCE (continued)

9.7 PARTS LISTS

When ordering replacement parts/kits, please specify model, serial number and color of your unit.*

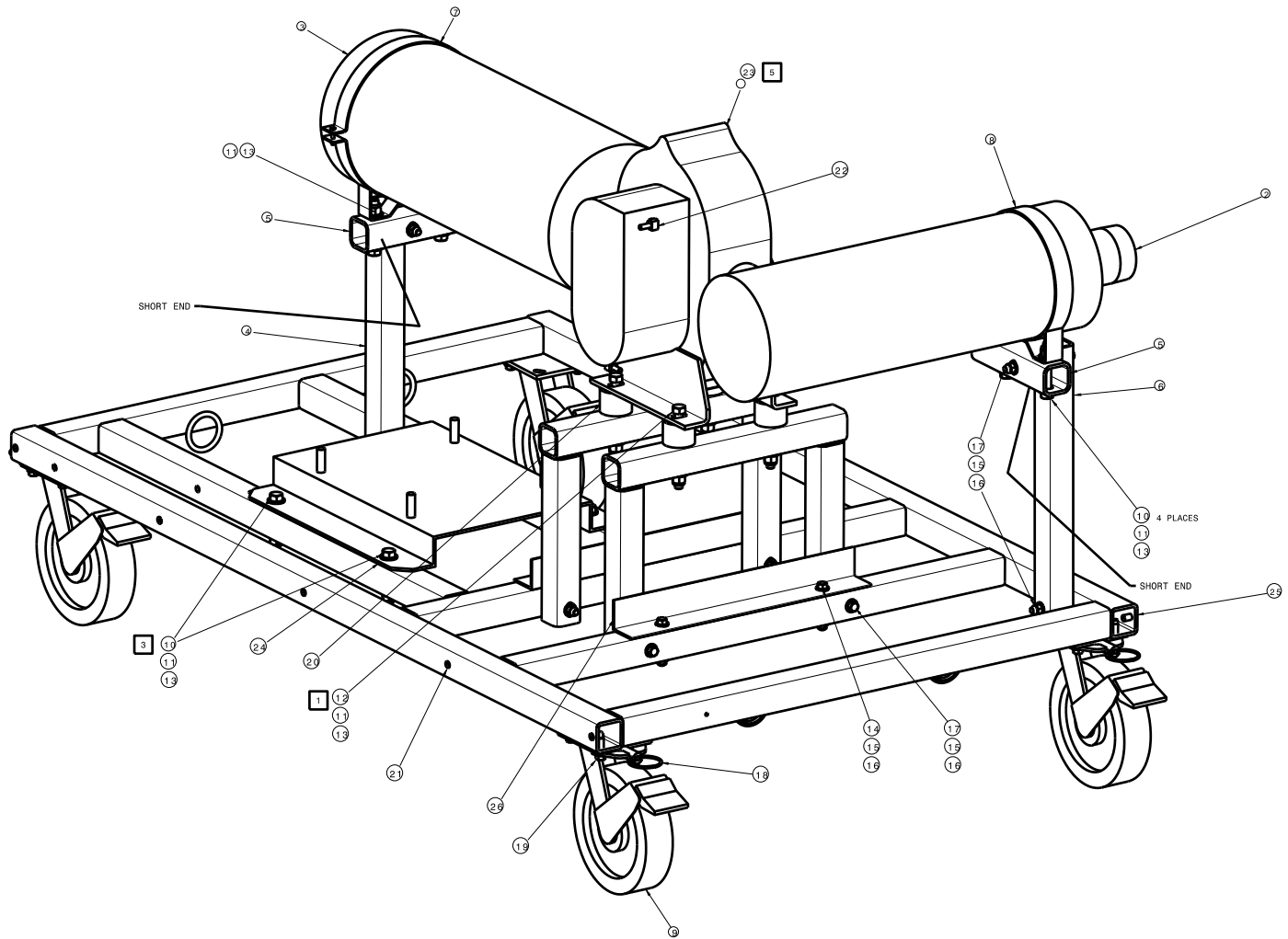
9.7.1 Internal Parts



9.7.1 Internal Parts (continued)

Item	Part Number	Description	Qty
1	H-2495	Clamp, Pipe (2 inch)	3
2	H-1402-01	Filter, Inlet Cover	1
	H-1439	Element, Replacement Filter	1
3	H-2666-08	Valve, Ball	1
4	N-1521	Coupling, Hose	1
5	TF-1113*032.0	Hose, Flexible	1
6	H-1426-14	Clamp, Hose (3.25" I.D. maximum)	4
7	TF-1047-01*28.0	Hose, 1/4" Push-on	1
8	TF-1047-01*19.0	Hose, 1/4" Gray	1
9	G-1351-19	Rivet, Steel (Blind)	1
13	G-1476-105004	Screw, 25-20 Soc But Hd Cap	6
14	Z-4726	Assembly, Internal CPU-300	1
15	Z-4650	Assembly, Pipe	1
16	Z-5458-01	Weldment, Mounting Rail	3
17	G-1009-26	U-Bolt	1
18	G-1009-27	U-Bolt	1
19	TR-2210	Tube, Silencer	1

9.7.1 Internal Parts (continued)

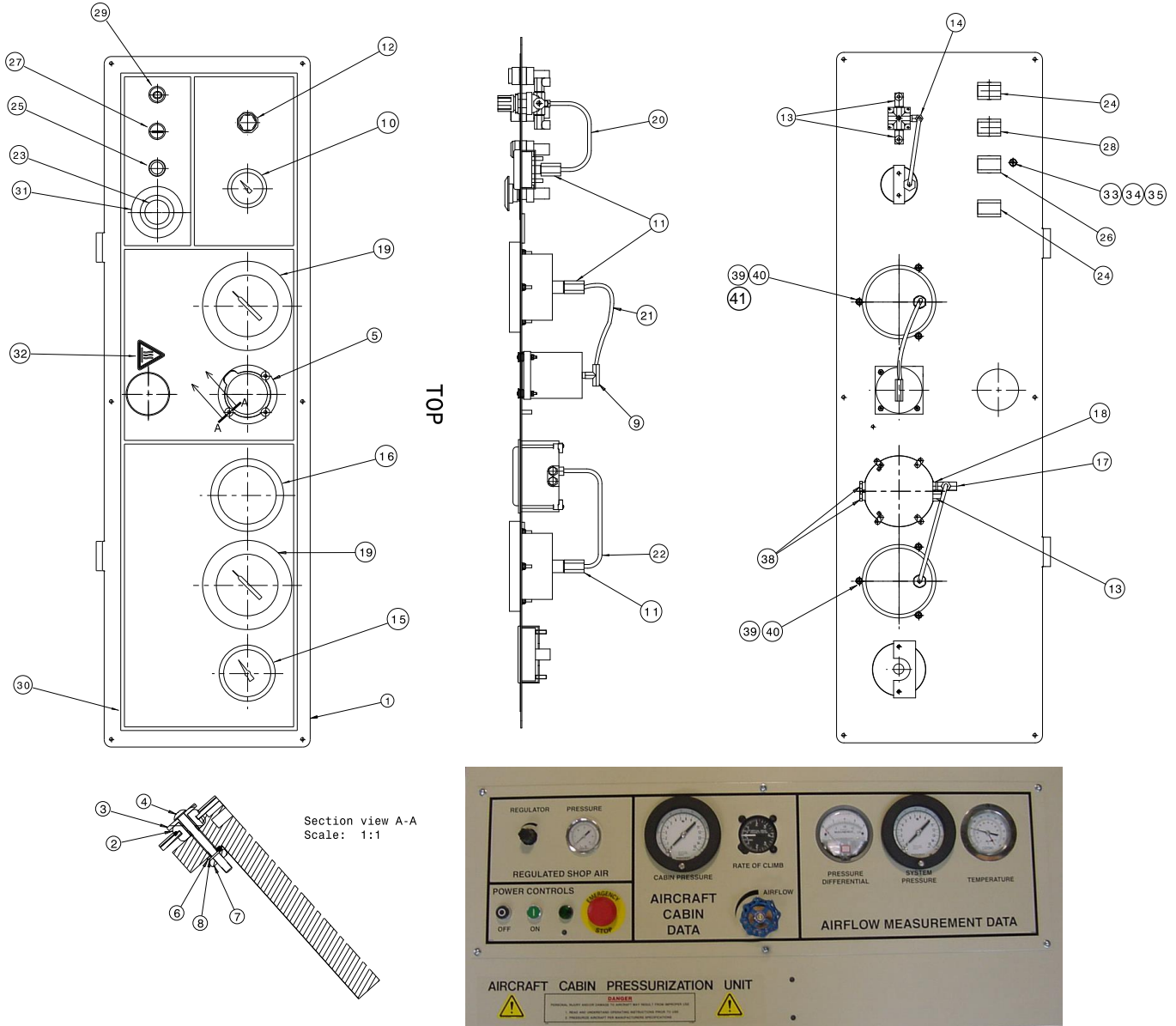


Item	Part Number	Description	Qty
1	H-1400-08	Blower, Roots 53 Frame	1
2	H-2365-00	Silencer, Intake	1
3	H-2364-00	Silencer, Exhaust	1
4	TS-1882-01	Tube, Exhaust Silencer Post	1
5	TS-1780-01	Tube, Silencer Mount	2
6	TS-1880-01	Tube, Intake Silencer Post	1
7	H-2377-00	Mount, Silencer Modified	1
8	H-2376-00	Mount, Silencer Modified	1
9	U-1085	Caster, Swivel	4
10	G-1100-109532	Bolt, Hex Head, Grade 5, 0.5-20 x 3.25" long	8
11	G-1250-1090N	Flatwasher, 0.5 Narrow	20
12	G-1100-109550	Bolt, Hex Head, Grade 5, 0.5-20 x 5" long	4
13	G-1202-1095	Stopnut, 0.5-20 Elastic	12
14	G-1100-107526	Bolt, Hex Head, Grade 5, 0.375-24 x 2.75" long	4
15	G-1250-1070N	Flatwasher, 0.375 Narrow	24
16	G-1202-1075	Stopnut, 0.375-20 Elastic	12
17	G-1100-107546	Bolt, Hex Head, Grade 5, 0.375-24 x 4.75" long	8
18	U-1087	Lock, Swivel	4

9.7.1 Internal Parts (continued)

Item	Part Number	Description	Qty
19	G-1180-107006	Bolt, Hex Head, Self-Tap, 0.375-16 x 1.25" long	10
20	R-2076	Spacer, Blower	4
21	G-1440-1050-S	Nutsert, Thickwall, 0.25-20	10
22	N-2410-02	Elbow, Male Pipe to Hose Barb	2
23	V-1219	Label, Rotation	1
24	H-1392-08	Base, Motor	1
25	Z-4625-01	Weldment, Frame	1
26	Z-5120-01	Weldment, Blower Mount	2

9.7 PARTS LISTS (continued)
 9.7.2 Instrument Panel Components

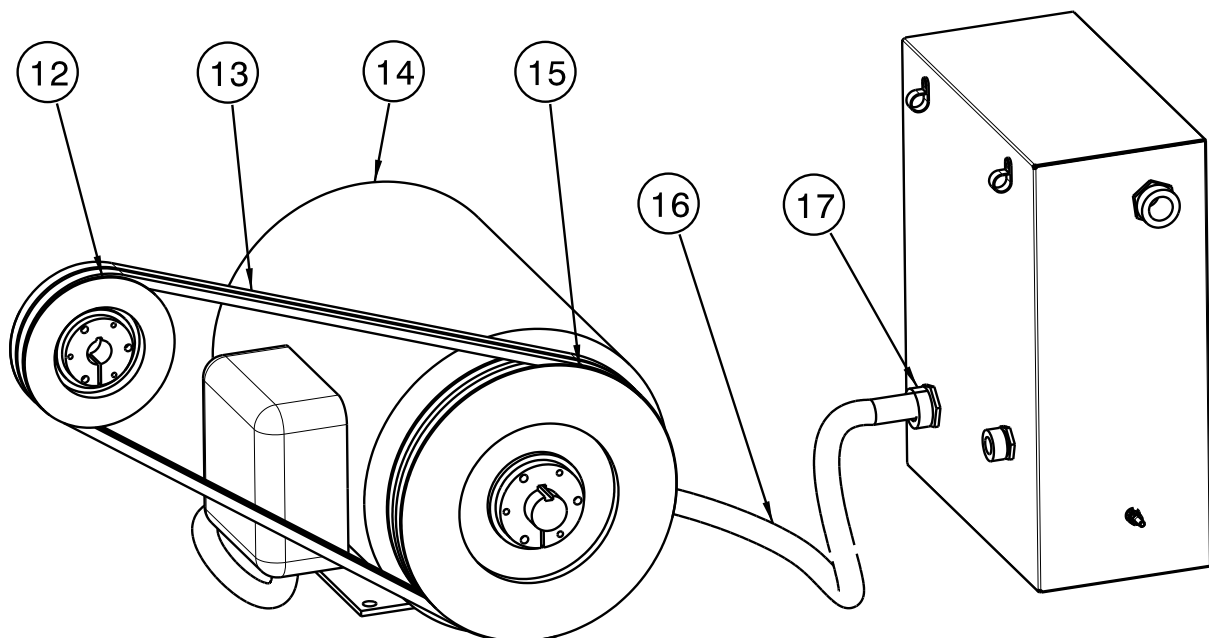
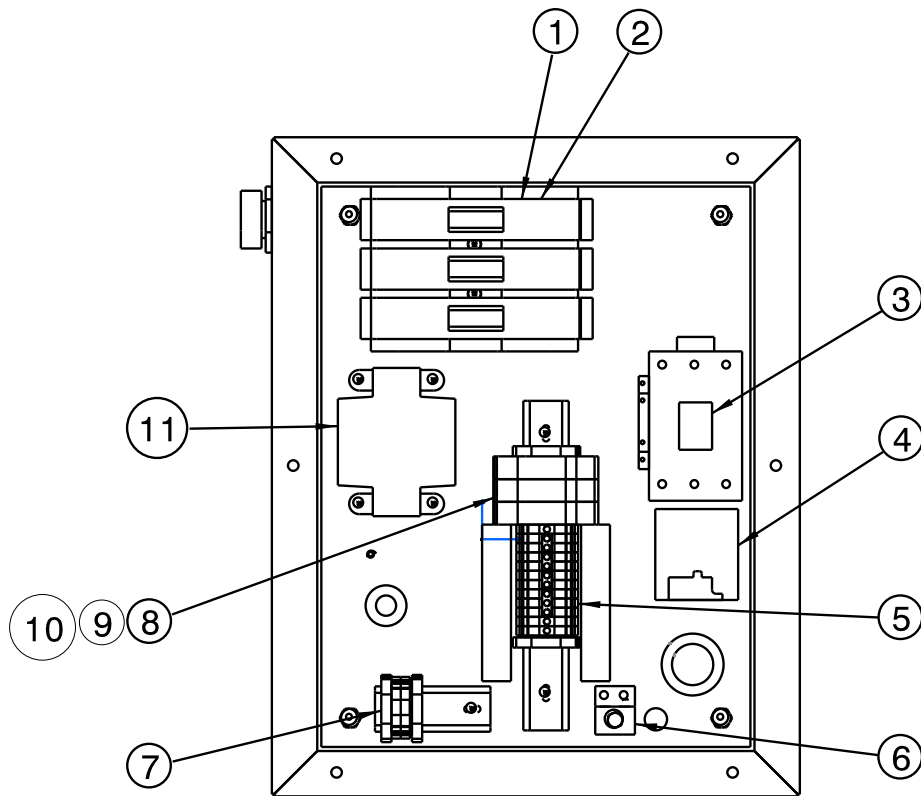


Item	Part Number	Description	Qty
1	S-1828-01	Panel, Operator	1
2	H-1484-01	Grommet, Vibrations	3
3	H-1487	Spacer, Grommet	3
4	G-1476-101012	Screw, #6-32 Soc But Hd Cap	3
5	H-1396	Gauge, Vertical Speed	1
6	G-1250-1010N	Flatwasher, #6 Narrow	3
7	G-1200-1010	Nut, Hex #6-32	3
8	G-1251-1010R	Lockwasher, #6 Regular	3
9	N-2448-03	Tee, Swivel Male Pipe/Tube	1
10	H-2657	Gauge, Pressure, 0-60 psi (0-4 bar)	1
11	N-2776-02	Connector, Swivel Female Pipe/Tube	3
12	H-1397	Regulator	1

9.7.2 Instrument Panel Components (continued)

Item	Part Number	Description	Qty
13	N-2777-02	Elbow, Male Pipe/Tubing	3
14	N-2777-01	Elbow, NPT/Tube	1
15	H-2656	Thermometer, Panel Mount	1
16	H-2890-01	Gauge, Capsuhelic	1
17	N-2778-02	Swivel, Male Run Tee	1
18	N-2200-03-B	Elbow, Street	1
19	H-1394	Gauge, Pressure, 0-15 psi (0-1.03 bar)	2
20	TF-1153*012.00	Hose	1
21	TF-1012*008.00	Hose	1
22	TF-1153*18.00	Tube	1
23	EC-1948	Pushbutton, Emergency Stop	1
24	EC-1946-MX01	Block, IEC Contact	2
25	EC-1945-01	Indicator, IEC Pilot Light	1
26	EC-11951-MN5G	Block, IEC Pilot Light Contact	1
27	EC-1953-MF306	Pushbutton, IEC On	1
28	EC-1946-MX20	Block, IEC Contact	1
29	EC-1953-ME205	Pushbutton, IEC Stop	1
30	V-1865-00	Label, CPU-300 Controls	1
31	EC-1950-02	Plate, Emergency Stop Legend	1
32	V-1721	Label, ISO Burn Hazard/Hot Surface	1
33	G-1200-1050	Nut, Hex 0.25-20	1
34	G-1251-1050R	Lockwasher, 0.25 I D	1
35	EC-1180-23	Terminal, Ring 0.25 Hole 18-14 AWG	1
36	EC-1610-07*72.0	Cable, Control (14 AWG)	1
37	INS-1622	Wiring Diagram 20 hp CPU	1
38	N-2206-03	Plug, Hex Head	2
39	G-1250-1030N	Flatwasher, #10 Narrow	6
40	G-1202-1035	ESN, #10 32	6
41	G-1156-103506	Screw, Machine #10 32 x 3/4	6

9.7 PARTS LISTS (continued)
 9.7.3 Electrical Components



9.7.3 Electrical Components (continued)

PARTS LIST

Item	60 Hz Applications					Description	Qty
	208	230	380	460	575		
1	EC-1556-02	EC-1556-01	EC-1557-28	EC-1557-27	EC-1557-26	Fuse, Class J	3
2	N/A	N/A	EC-1602-03	EC-1602-03	EC-1602-02	Reducer, Fuse	3
3	EC-1587	EC-1587	EC-1586	EC-1586	EC-1586	Contact, IEC Motor	1
4	EC-1525	EC-1525	EC-1589	EC-1589	EC-1589	Relay, IEC Overload	1
5	EC-1515-02	EC-1515-02	EC-1515-02	EC-1515-02	EC-1515-02	Terminal Block IEC	12
6	EC-1532-02	EC-1532-02	EC-1532-02	EC-1532-02	EC-1532-02	Lug, Ground	2
7	EC-19588	EC-1958	EC-1958	EC-1958	EC-1958	Terminal Block, Ground	2
8	EC-1541-01	EC-1541-01	EC-1541-01	EC-1541-01	EC-1541-01	Fuseholder, Modular	3
9	EC-1542-22	EC-1542-22	EC-1542-22	EC-1542-22	EC-1542-22	Fuse, LPP-CC Low Peak	1
10	EC-1542-11	EC-1542-11	EC-1542-11	EC-1542-11	EC-1542-11	Fuse, CPP-CC Low Peak	2
11	EC-1804-02	EC-1804-02	EC-1804-02	EC-1804-02	EC-1804-02	Transformer	1
12	H-2370	H-2370	H-2370	H-2370	H-2370	Pulley, V-Belt	1
13	H-2378	H-2378	H-2378	H-2378	H-2378	V-Belt	2
14	EC-1480-17	EC-1480-17	EC-1480-16	EC-1480-17	EC-1480-18	Motor, 20 HP	1
15	H-2371	H-2371	H-2371	H-2371	H-2371	Pulley, V-Belt	1
16	EC-1227-02*72.0	EC-1227-02*72.0	EC-1171-02*72.0	EC-1171-01*72.0	EC-1171-01*72.0	Cable, Power	1
17	EC-1175-21-A	EC-1175-21-A	EC-1175-20-A	EC-1175-19-A	EC-1175-19-A	Connector, Cable	2
Not Shown	EC-1227-02*0600	EC-1227-02*0600	EC-1171-01*0600	EC-1171-01*0600	EC-1171-01*0600	Cable, Power	1

9.7.3 Electrical components continued on following page.

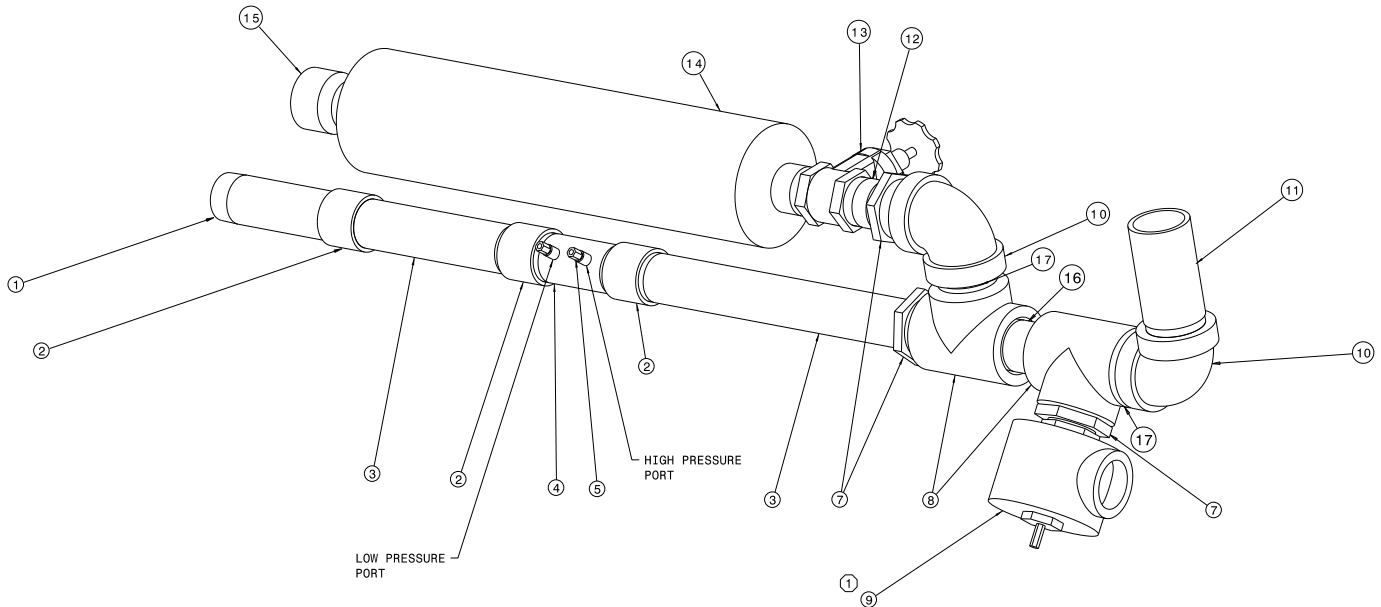
9.7.3 Electrical Components (continued)

PARTS LIST

Item	50 Hz Applications					Description	Qty
	208	230	380	460	575		
1	EC-1556-02	EC-1556-01	EC-1557-28	EC-1557-28	EC-1557-28	Fuse, Class J	3
2	N/A	N/A	EC-1602-03	EC-1602-03	EC-1602-02	Reducer, Fuse	3
3	EC-1587	EC-1587	EC-1586	EC-1586	EC-1586	Contact, IEC Motor	1
4	EC-1525	EC-1525	EC-1589	EC-1589	EC-1589	Relay, IEC Overload	1
5	EC-1515-02	EC-1515-02	EC-1515-02	EC-1515-02	EC-1515-02	Terminal Block IEC	12
6	EC-1532-02	EC-1532-02	EC-1532-02	EC-1532-02	EC-1532-02	Lug, Ground	2
7	EC-1528	EC-1528	EC-1528	EC-1528	EC-1528	Terminal Block, Ground	2
8	EC-1541-01	EC-1541-01	EC-1541-01	EC-1541-01	EC-1541-01	Fuseholder, Modular	3
9	EC-1542-22	EC-1542-22	EC-1542-22	EC-1542-22	EC-1542-22	Fuse, LPP-CC Low Peak	1
10	EC-1542-11	EC-1542-11	EC-1542-11	EC-1542-11	EC-1542-11	Fuse, CPP-CC Low Peak	2
11	EC-1804-02	EC-1804-02	EC-1804-02	EC-1804-02	EC-1804-02	Transformer	1
12	H-2409	H-2409	H-2409	H-2409	H-2409	Pulley, V-Belt	1
13	H-2410	H-2410	H-2410	H-2410	H-2410	V-Belt	2
14	EC-1480-17	EC-1480-19	EC-1480-19	EC-1480-17	EC-1480-17	Motor, 20 HP	1
15	H-2408	H-2408	H-2408	H-2408	H-2408	Pulley, V-Belt	1
16	EC-1227-02*72.0	EC-1227-02*72.0	EC-1171-02*72.0	EC-1171-02*72.0	EC-1171-02*72.0	Cable, Power	1
17	EC-1175-21-A	EC-1175-21-A	EC-1175-20-A	EC-1175-19-A	EC-1175-19-A	Connector, Cable	2
Not Shown	EC-1227-02*0600	EC-1227-02*0600	EC-1171-01*0600	EC-1171-02*0600	EC-1171-02*0600	Cable, Power	1

9.7 PARTS LISTS (continued)

9.7.4 Pipe Assembly



Item	Part Number	Description	Qty
1	N-2695	Nipple, Painted Black Pipe, 2" NPT x 8" long	1
2	N-1019	Coupling, 2" NPT	3
3	N-2236-09-47	Nipple, Black Pipe	2
4	H-1408	Sensor, Inline	1
5	N-2274-01	Connector, Male	2
7	N-2696-28	Bushing, Reducer Pipe	3
8	N-2207-18-S	Tee, Female Pipe 2 ½	2
9	H-2597-01	Valve, Pressure Relief, 13 ½	1
10	N-1031	Elbow, 90°	2
11	TR-1716	Tube, Temperature	1
12	N-2236-09-30	Nipple, Black Pipe	1
13	H-1407	Valve, By-Pass	1
14	H-2595-00	Silencer, Absorptive	1
15	N-2733	Coupling, Pipe Modified	1
16	N-2236-10-32	Nipple, Black Pipe	1
17	N-2236-10-29	Nipple, Black Pipe	2

9.0 MAINTENANCE (continued)

9.8 RECOMMENDED SPARE PARTS

PART NUMBER	DESCRIPTION
H-1439	Replacement Filter Element
H-2378	V-Belt for 60 HZ applications (2 req'd)
H-2410	V-Belt for 50 HZ applications (2 req'd)
EC-1542-11	Fuse, Control Transformer Primary Side (2 per machine)
EC-1542-22	Fuse, Control Transformer Secondary Side (1 per machine)

POWER FUSES AS NEEDED (3 per machine)		
PART NUMBER	DESCRIPTION	APPLICATION
EC-1556-02	Fuse	208V/60HZ
EC-1556-01	Fuse	230V/60HZ
EC-1557-28	Fuse	380V/60HZ
EC-1557-27	Fuse	460V/60HZ
EC-1557-26	Fuse	575V/60HZ
EC-1556-02	Fuse	200V/50HZ
EC-1556-01	Fuse	220V/50HZ
EC-1557-28	Fuse	380V/50HZ
EC-1557-28	Fuse	415V/50HZ
EC-1557-28	Fuse	440V/50HZ

9.9 INSPECTION POINTS

- Blower oil level – each use
- Drive belt tension – after first use, then semi-annually thereafter
 - The proper tension is the minimum required to drive the load. Tighten the belts by adjusting the motor base until the belts feel alive and springy when struck with the hand. Ensure that the pulleys remain in alignment, both axially and in parallel, while adjusting.
- Vertical Speed Indicator zeroing – each use
- Instrument Calibration – verify last calibration is within previous 12 months
 - Instruments are to be calibrated annually

9.10 SCHEDULED MAINTENANCE

9.10.1 Instrumentation

All instruments should be calibrated annually to maintain accuracy of machine

9.10.2 Blower Lubrication

- Initial oil change – 6 months or 100 hours
- Regular oil change – every 1,000 hours maximum
- Bearing lubrication per Appendix VI
- See Appendix VI for detailed Blower maintenance data.

9.10.3 Drive Belt Tension

- Adjust as required
 - The proper tension is the minimum required to drive the load. Tighten the belts by adjusting the motor base until the belts feel alive and springy when struck with the hand. Ensure that the pulleys remain in alignment, both axially and in parallel, while adjusting.

9.10.4 Caster Lubrication

- Grease all lube points on casters annually

9.10 SCHEDULED MAINTENANCE *(continued)*

9.10.5 Motor

- Periodically inspect the motor for excessive dirt, friction or vibration. Dust may be blown from an inaccessible location using compressed air. Keep the ventilation openings clear to allow free passage of air. Make sure the drain holes in the motor are kept open. Grease or oil can be wiped by using a petroleum solvent.
- See Appendix VII for additional maintenance data.

9.10.6 Intake Air Filter

- Clean periodically and replace annually.

9.11 TECHNICAL SPECIFICATIONS

- Blower: Roots RAI-53
- Motor: 20 Hp 3 phase open drip proof foot-mount
- V-belts: B section Gripnotch
- Control Circuit Voltage: 24 VAC
- Solid state motor overload protection

VOLT/AMP/FUSE SIZE TABLE
(Fuses must be UL Class J dual element time delay)

ELECTRICAL OPTION	VOLTAGE	FREQUENCY	FLA	FUSE SIZE	PHASE
A	208 V~	60	59.3	80 A	3
B	230 V~	60	53.6	70 A	3
C	380 V~	60	31.8	40 A	3
D	460 V~	60	26.8	35 A	3
E	575 V~	60	21.4	30 A	3
F	200 V~	50	61.6	80 A	3
G	220 V~	50	51.9	70 A	3
H	380 V~	50	30	40 A	3
J	415 V~	50	29.1	40 A	3
K	440 V~	50	28.1	40 A	3

9.12 MAINTENANCE PERSONNEL REQUIREMENTS

Maintenance personnel should have a basic knowledge of mechanical, electrical, and pneumatic systems.

9.0 MAINTENANCE (continued)
 9.13 TROUBLESHOOTING GUIDE

PROBLEM	PROBABLE CAUSE	REMEDY
Cannot build required cabin air pressure – Flow HIGH – CPU Pressure LOWER	Excessive cabin leakage	Assure all aircraft inspection panels in place.
		Assure door seal inflated.
		Assure aircraft cabin air controls are properly set. Check outflow and safety valves.
Cannot build required cabin air pressure – Flow LOWER – CPU Pressure HIGH	Back pressure loss in aircraft system	Assure aircraft cabin air controls are set properly.
		Common on aircraft where CPU air enters upstream of aircraft mass air flow valve. Re-plumb downstream of aircraft mass air flow valve.
Low CPU output pressure and/or flow	Loose belts	Tighten belt/Replace belts (Reference Section 9.8)
	Dirty inlet filter	Replace filter (Reference Section 9.8)
	Low power	Check for facility blown fuse, loose wire. (Reference Section 9.8)
No CPU output (Motor not running)	No inlet power	Check facility
	Overload relay tripped	Power switch in OFF position, allow unit to cool, reset overload relay and restart unit
	Failed motor	Replace motor (Reference Section 9.7)
No CPU output (Motor running)	Blocked inlet	Inspect inlet silencer/filter for blockage and correct
	Leakage between unit and aircraft	Leak check hose connections and over all hose
	Drive belts failed	Inspect and tighten or replace
	Failed blower	Refer to Appendix VI – Blower Maintenance

10.0 PROVISION OF SPARES**10.1 SPARE PARTS CAN BE OBTAINED FROM THE MANUFACTURER**

TRONAIR, Inc.
1 Air Cargo Pkwy East
Swanton, Ohio 43558 USA

Telephone: (419) 866-6301 or 800-426-6301
Fax: (419) 867-0634
E-mail: sales@tronair.com
Website: www.tronair.com

10.2 RECOMMENDED LEVEL OF SPARE PARTS TO BE HELD

Part Number	Description	Qty. Held
• H-1439	Replacement Filter Element	1 on hand
• H-2378 or H-2410	V-Belt	2 on hand
• EC-1542-11	Fuse, Control Transformer Primary Side	4 on hand
• EC-1542-22	Fuse, Control Transformer Secondary Side	2 on hand
• Power Fuses as Needed		6 on hand

11.0 IN-SERVICE SUPPORT

Contact Tronair for Technical Services and information.

12.0 GUARANTEES/LIMITATION OF LIABILITY

Tronair products are warranted to be free of manufacturing or material defects for a period of one year after shipment to the original customer. This is solely limited to the repair or replacement of defective components. This warranty does not cover the following items:

- Parts required for normal maintenance
- Parts covered by a component manufacturers warranty
- Replacement parts have a 90-day warranty from date of shipment

If you have a problem that may require service, contact Tronair immediately. Do not attempt to repair or disassemble a product without first contacting Tronair, any action may affect warranty coverage. When you contact Tronair be prepared to provide the following information:

- Product Model Number
- Product Serial Number
- Description of the problem

If warranty coverage is approved, either replacement parts will be sent or the product will have to be returned to Tronair for repairs. If the product is to be returned, a Return Material Authorization (RMA) number will be issued for reference purposes on any shipping documents. Failure to obtain a RMA in advance of returning an item will result in a service fee. A decision on the extent of warranty coverage on returned products is reserved pending inspection at Tronair. Any shipments to Tronair must be shipped freight prepaid. Freight costs on shipments to customers will be paid by Tronair on any warranty claims only. Any unauthorized modification of the Tronair products or use of the Tronair products in violation of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied.

The obligations of Tronair expressly stated herein are in lieu of all other warranties or conditions expressed or implied. **Any unauthorized modification of the Tronair products or use of the Tronair products in violations of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied and Tronair disclaims any and all liability for injury (WITHOUT LIMITATION and including DEATH), loss or damage arising from or relating to such misuse.**

13.0 APPENDICES

APPENDIX I	Leakage Air Flow Determination and SCFM Procedure
APPENDIX II	Flow Measurement Test Procedure
APPENDIX III	Pressure Decay Test Procedure
APPENDIX IV	Aircraft Adapter Kits (Partial Listing)
APPENDIX V	Declaration Of Conformity
APPENDIX VI	Blower Maintenance Data
APPENDIX VII	Motor Maintenance Data
APPENDIX VIII	Air Flow Gauge (Magnehelic) Calibration And Maintenance Data
APPENDIX IX	Pressure Gauge Calibration Data



APPENDIX I

Leakage Air Flow Determination And SCFM Correction Procedure

This procedure is used to determine aircraft SCFM (standard cubic feet per minute) leakage from data read from the cabin pressurization unit gauges.

APPENDIX I

LEAKAGE AIR FLOW DETERMINATION AND SCFM CORRECTION PROCEDURE

This procedure is used to determine aircraft SCFM (Standard cubic feet per minute) leakage from data read from the cabin pressurization unit gauges.

Tronair provides an on-line CPU calculator to quickly and accurately provide flow in SCFM. The calculator is located at www.tronair.com under the Technical Support pull down menu. The following curves and procedures may also be used for calculation.

Curve #1 Pressure Compensated Flow at 70° F (21.1° C):

This curve is an expanded curve for reference only and allows the operator to determine aircraft leakage rates to the maximum "Air Leakage" gauge reading of 20.0 inches (5 kPa) water (differential pressure), assuming a line air temperature of 70° F.

Curve #2 Pressure Compensated Flow at 70° F (21.1° C):

This curve is used to determine aircraft leakage rate where the CPU unit pressure gauge (Group 2) is reading between 3 and 7 psi (0.21 and 0.48 bars), assuming a line air temperature of 70° F (21.1° C).

Curve #3 Pressure Compensated Flow at 70° F (21.1° C):

This curve is used to determine aircraft leakage rate where the CPU unit pressure gauge (Group 2) is reading between 7 and 13 psi (0.48 and 0.9 bars), assuming a line air temperature of 70° F (21.1° C).

Curve #4 Temperature Correction:

This curve is used to provide a temperature correction multiplication factor that is used to convert the flow found using Curves 1, 2, or 3 to SCFM.

CFM DETERMINATION

Convert the reading (inches of WG) obtained from the air leakage gauge (Group 1) to CFM air flow by using Curves 2 or 3.

1. Determine which curve to use, curve 2 or 3, based on the level of CPU pressure.
2. Find inches of WG. value on the vertical scale.
3. Move horizontally across graph to the appropriate CPU pressure curve.
 - a. CPU pressure Group 2 pressure is used to calculate leakage flow and not aircraft cabin pressure.
 - b. Interpolate if the CPU pressure falls between the pressure lines provided.
4. At the intersection of inches of WG and the CPU pressure curve, move downward on the graph and read air flow (CFM) from the horizontal scale.

NOTE: This value is the leakage air flow assuming an air flow temperature of 70° F (21.1° C).

Leakage Air Flow Determination And SCFM Correction Procedure continued on following page.

SCFM DETERMINATION

Correct the air flow value (CFM) obtained in CFM Determination section on previous page by multiplying this value by the temperature correction factor obtained from Curve 4. The result is leakage air flow corrected to standard conditions; SCFM (standard conditions are 14.696 psi (1.013 bars) and 60° F (15.6° C)).

1. Find the air flow temperature value read from the temperature gauge (Group 2) on the vertical scale of Curve 4.
2. Move horizontally across the graph to the temperature correction curve.
3. At the intersection of temperature and the temperature correction curve, move downward on the graph and read the Temperature Correction Multiplication Factor.
4. Multiply the air flow value obtained in CFM Determination section, Step 4 by this temperature correction factor. Leakage air flow is now in SCFM terms.

CFM multiplied by Temperature correction Factor = SCFM

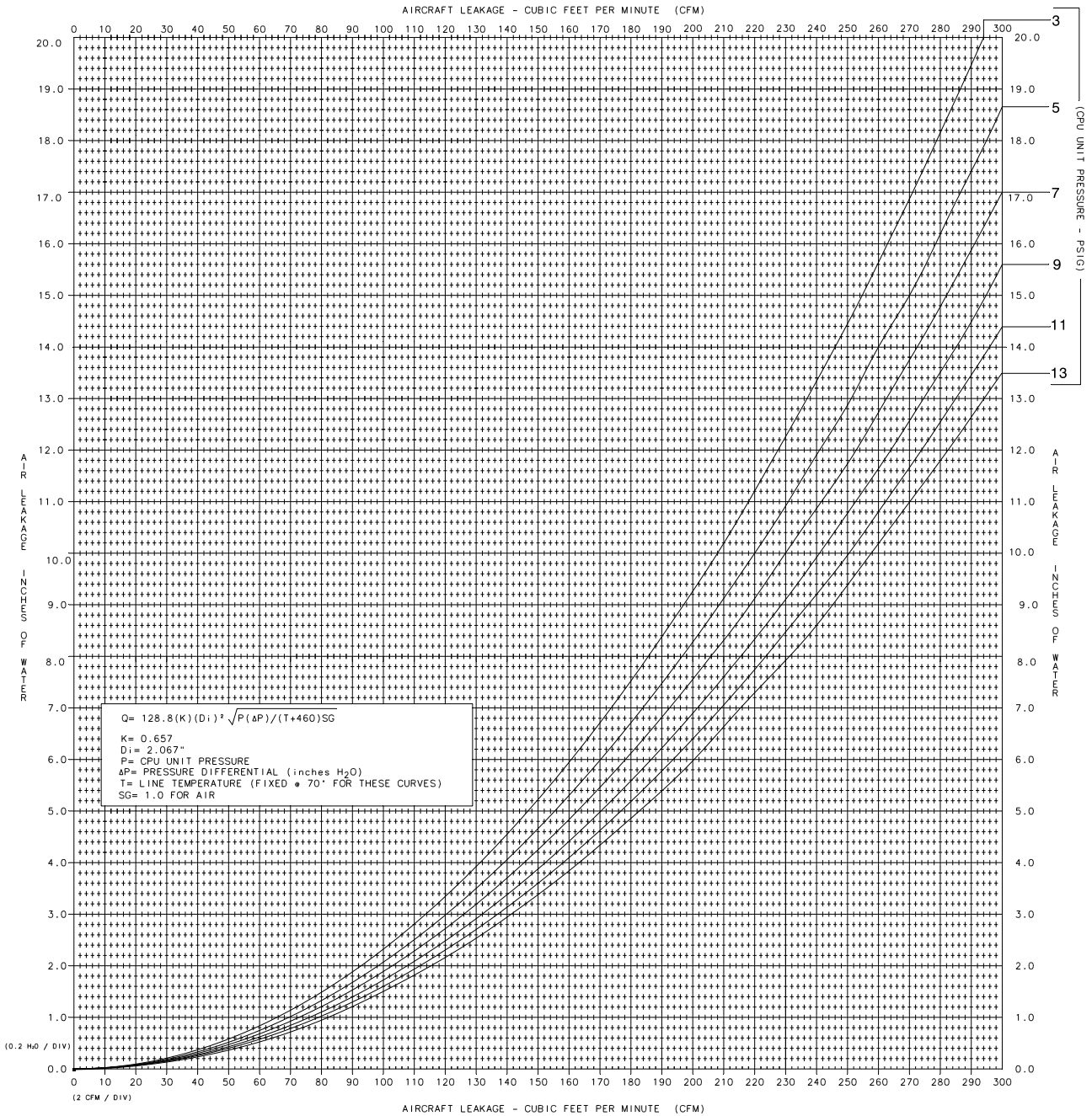
ACFM DETERMINATION

If required by aircraft manufacturer test specifications, the leakage flow rate can be expressed in ACFM. Determine SCFM using the above process, then convert SCFM to ACFM by using the following formula:

$$ACFM = SCFM \left(\frac{LineTemp + 460}{520} \right) \left(\frac{14.696}{CPU Pressure + 14.696} \right)$$

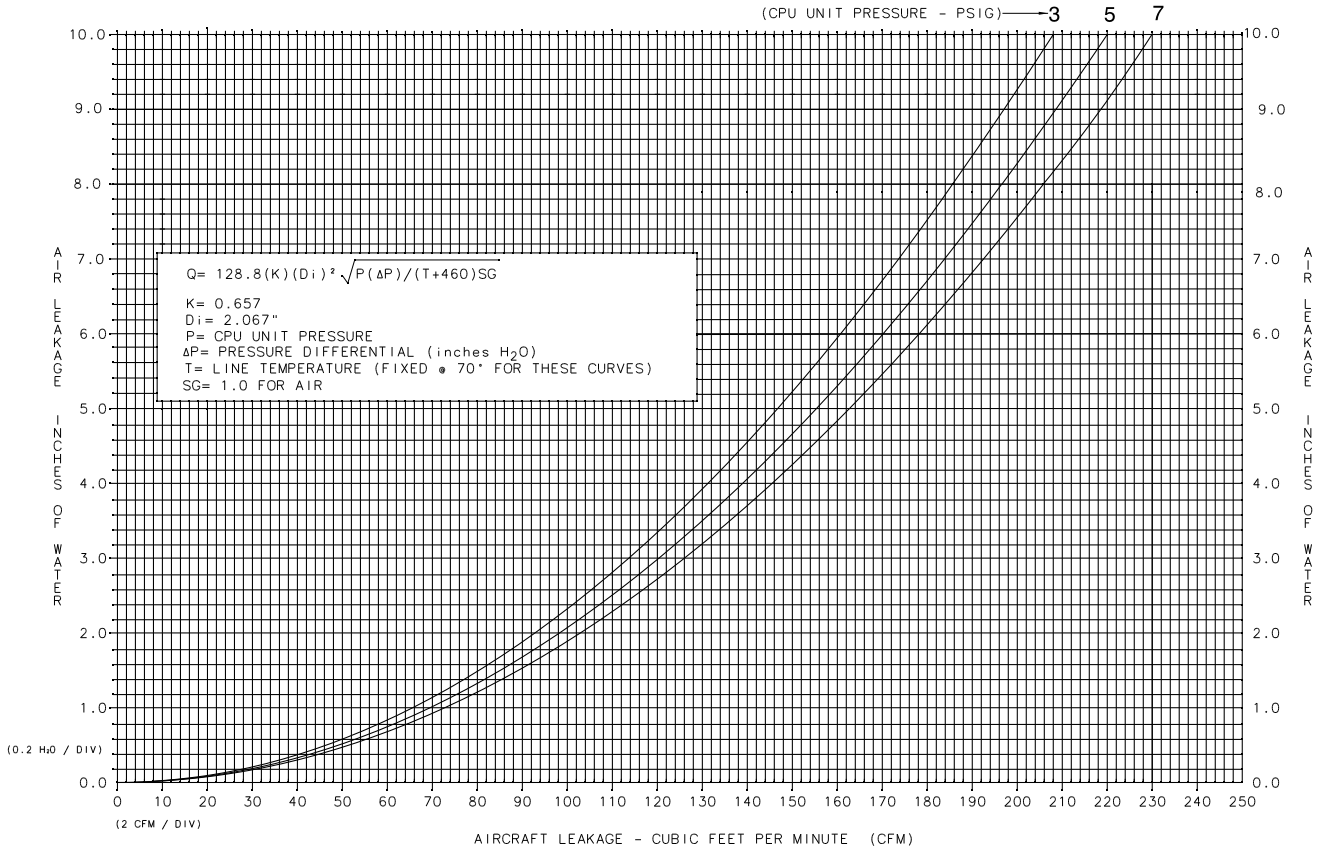
CURVE #1 PRESSURE COMPENSATED FLOW @ 70°: INCHES OF H₂O vs. LEAKAGE

Reference full size drawing included with this manual.

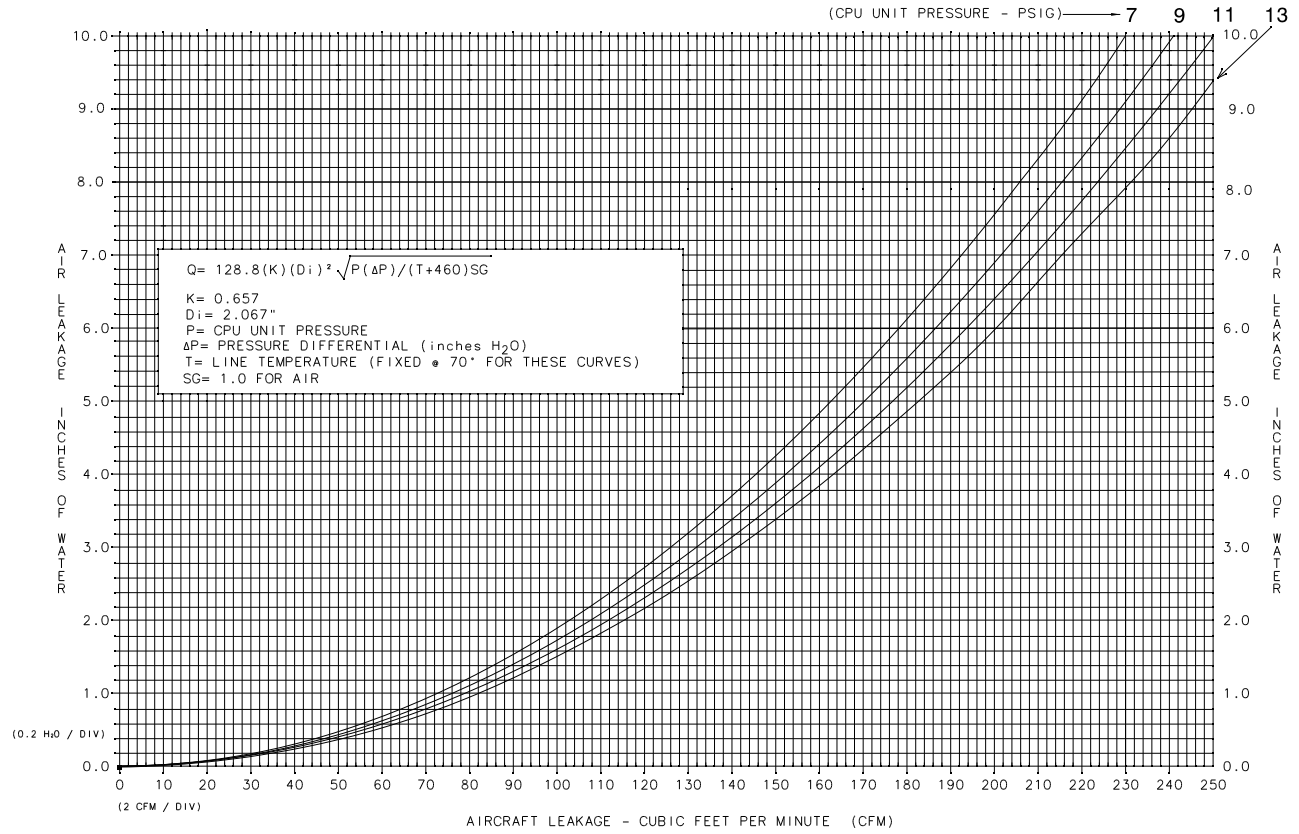


CURVE #2 PRESSURE COMPENSATED FLOW @ 70° F: INCHES OF H₂O vs. LEAKAGE

Reference full size drawing included with this manual.



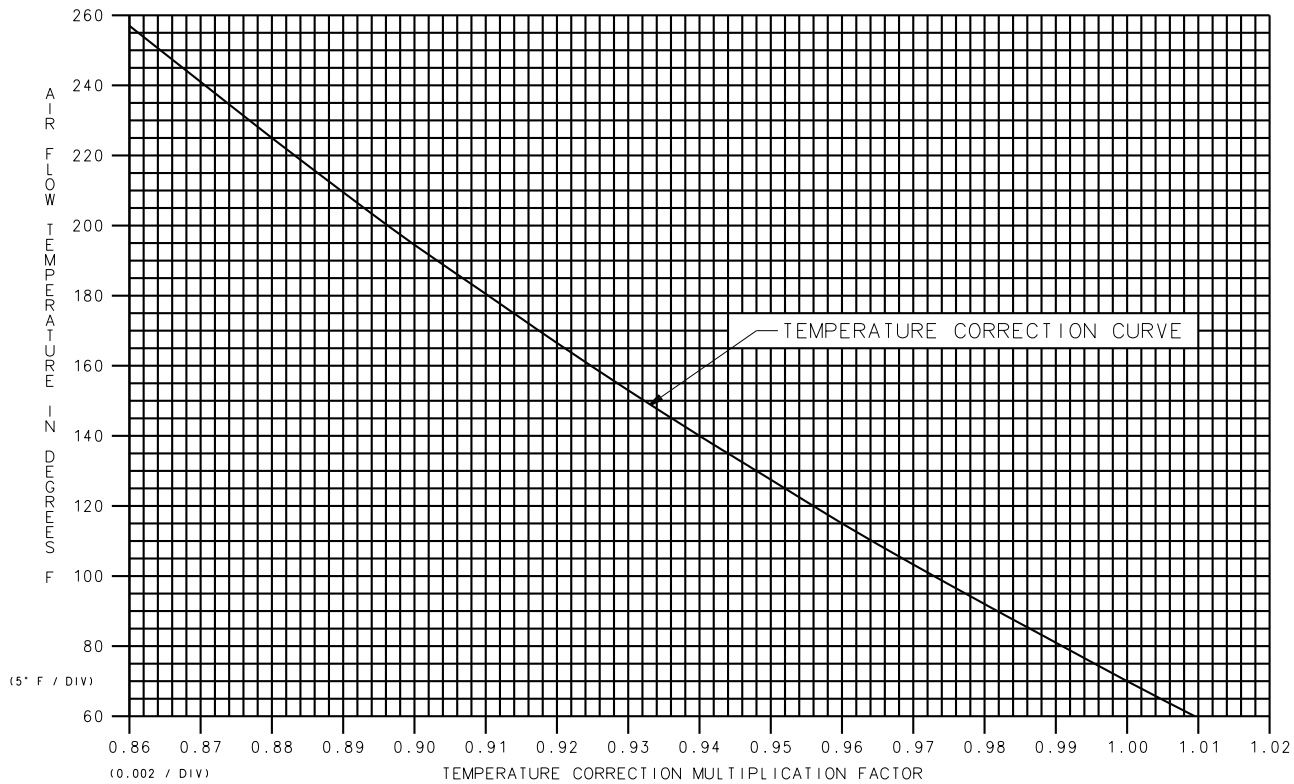
CURVE #3 PRESSURE COMPENSATED FLOW @ 70° F: INCHES OF H₂O vs. LEAKAGE



(0.2 H₂O / DIV)

(2 CFM / DIV)

CURVE #4 TEMPERATURE CORRECTION - DESIGN FLOW TEMP = 7





APPENDIX II

Flow Measurement Test Procedure

This test procedure should be used when the aircraft manufacturer requires cabin air leakage be measured in terms of air flow; SCFM (standard cubic feet per minute).

APPENDIX II

FLOW MEASUREMENT TEST PROCEDURE

This test procedure should be used when the aircraft manufacturer requires cabin air leakage be measured in terms of air flow; SCFM (standard cubic feet per minute).

DANGER!



To prevent personal injury and/or damage to the aircraft:

1. ALWAYS follow the aircraft manufacturer's instructions for pressurizing aircraft.
2. NEVER operate this CPU prior to reading the CPU operation and service manual.

1. Determine the aircraft pressurization limits and leakage rates from the aircraft manufacturer's manual. A handy form for recording this data is provided at the end of this procedure.
2. Connect the air supply hose to the aircraft with the appropriate Adapter.
3. Connect the sensor hose to the aircraft.

CAUTION!



To obtain true aircraft cabin feedback data and prevent over pressurizing the aircraft cabin:

1. All connections must be tight and free of leaks.
2. Aircraft connection port must be unobstructed and connected directly to the cabin and/or cockpit area.

4. If required, connect the regulated shop air hose to the aircraft in order to pressurize door seals, etc.

NOTE: It is suggested that prior to each use, the regulator be adjusted to its minimum setting and re-set as required.

5. Set aircraft cabin pressurization controls in the cockpit in accordance with the aircraft manufacturer's instructions for ground pressurization testing using external air source.
6. Secure all aircraft windows, access panels, and doors as if preparing the aircraft for take off.



CAUTION!

To prevent personal injury, attach warning tags to all door handles.

7. Close the CPU aircraft cabin air supply valve.
8. Fully open the CPU air control valve (full counter-clockwise position).
9. Turn power "ON" to CPU.
10. Slowly open the aircraft cabin air supply valve.
 - a. The CPU rate of climb gauge will start reading (on most aircraft) showing air is going into the aircraft.
 - b. The rate of climb gauge indicates an INCREASE in pressure when the needle moves in the down direction; (counter-clockwise).
 - c. Check and correct any leaks in the air supply hose connections between CPU and aircraft as these will contribute to the aircraft leakage rate and give erroneous readings.
11. Increase aircraft cabin pressure, read off the CPU panel (Group 1), by turning the CPU air control valve clockwise. The cabin rate of climb gauge will respond directly with the turning of this valve.



WARNING!

- Damage to the aircraft instrumentation is possible.
- Do not exceed aircraft manufacturer's rate of climb specification.

12. As the aircraft cabin pressure approaches the required level, gradually back-off the CPU cabin air control valve so that at the required pressure level, the rate of climb reads zero (0).

NOTE: If the leakage rate is too high, the required pressure may not be attainable. At this point, record the data stated in Step 13 below.

13. Maintaining the CPU rate of climb at zero, ♦ record the following data:
 - a. Aircraft cabin pressure (psig)
 - b. Air leakage rate, inch (WG)
 - c. CPU pressure (psig)
 - d. CPU air temperature (° F)

♦ See form at end of Appendix II.

Flow Measurement Test Procedure continued on following page.

14. After the data has been recorded, reduce the aircraft cabin pressure to zero (0) using the CPU aircraft cabin air control valve. Turn the valve counter-clockwise while maintaining an acceptable rate of descent on the rate of climb gauge.

NOTE: The rate of climb gauge shows a DECREASE in cabin pressure when the needle moves in the up direction; clockwise.



WARNING!

- **Damage to the aircraft instrumentation is possible.**
- **Do NOT exceed aircraft manufacturer's rate of descent specification.**

15. If there is still pressure in the aircraft after the aircraft cabin air control valve is in the full counter-clockwise position, close the aircraft cabin air supply valve and shut off the CPU.

The remaining aircraft cabin pressure will bleed off naturally. Opening the aircraft cabin supply valve slightly will increase the bleed off rate, however, do not exceed rate-of-descent limits.

16. Ensure ALL cabin pressure is bled off.

DANGER!



Under possibility of bodily injury, do not open cabin door until:

1. "Tapped" cabin feed back pressure gauge reads zero (0),
2. Disconnected air supply hose from cabin pressurization unit is checked to assure no air is coming from aircraft,
3. Slowly unlatch cabin door.

17. See Appendix I for leakage data correction to SCFM.

DATA SHEET: FLOW TEST METHOD

Aircraft :	Notes:
Aircraft Registration No:	
Pressures:	
• Not to exceed _____psig	
• Safety Valve Operation _____psig	
• Leakage Test _____psig	
Rate of Climb (not to exceed):	
Ascent _____ft/min	
Descent _____ft/min	
Cabin Leakage Limit:	
• Test Data	
- Flow Rate _____ in. of water	
- System Pressure ♦ _____psig	
- Unit Air Supply Temp _____ ° F	
• From Curves #2 & #3	
in. of water = _____ACFM	
• From Curve #4	
Temp. Factor x (____ACFM) = _____SCFM	
♦ Record and calculate using System Pressure, not aircraft cabin pressure	
Tested By: _____ Date: _____	
Repair Station Cert. No: _____	



APPENDIX III

Pressure Decay Test Procedure

This test procedure should be used when the aircraft manufacturer requires cabin air leakage be measured in terms of pressure decay during a period of time; seconds.

APPENDIX III PRESSURE DECAY TEST PROCEDURE

This test procedure should be used when the aircraft manufacturer requires cabin air leakage be measured in terms of pressure decay during a period of time; seconds.

DANGER!



To prevent personal injury and/or damage to the aircraft:

- **Always follow the aircraft manufacturer's instructions for pressurizing aircraft.**
- **Never operate this cpu prior to reading the cpu operation and service manual.**

The pressure decay method determines cabin air leakage by timing the rate of cabin depressurization from a set pressure. The time is normally measured in seconds. A stopwatch readable in 1/10 of a second may be used for this test.

1. Determine the aircraft pressurization limits and leakage rates from the aircraft manufacturer's manual. A form for recording this data is provided at the end of this procedure.
2. Connect the air supply hose to the aircraft with the appropriate Adapter.
3. Connect the sensor hose to the aircraft.

CAUTION!



To obtain true aircraft cabin feedback data and prevent over-pressurizing the aircraft cabin:

1. **All connections must be tight and free of leaks.**
2. **Aircraft connection port must be unobstructed and connected directly to the cabin and/or cockpit area.**

4. If required, connect the regulated shop air hose to the aircraft in order to pressurize door seals, etc.

NOTE: It is suggested that prior to each use, the regulator be adjusted to its minimum setting and reset as required.

5. Set aircraft cabin pressurization controls in the cockpit in accordance with the aircraft manufacturer's instructions for ground pressurization testing using an external air source.
6. Secure all aircraft windows, access panels, and doors as if preparing the aircraft for takeoff.



CAUTION!

To prevent personal injury, attach warning tags to all door handles: "DO NOT OPEN".

7. Close the CPU aircraft cabin air supply valve.
8. Fully open the CPU air control valve (full counter-clockwise position).
9. Turn power "ON" to CPU.
10. Slowly open the aircraft cabin air supply valve.
 - a. The CPU rate of climb gauge will start reading (on most aircraft) showing air is going into the aircraft.
 - b. The rate of climb gauge indicates an INCREASE in pressure when the needle moves in the down direction (counter-clockwise).
 - c. Check and correct any leaks in the air supply hose connections between CPU and aircraft as these will contribute to the aircraft leakage rate and give erroneous readings.
11. Increase aircraft cabin pressure, read off the CPU panel, by turning the CPU air control valve clockwise. The cabin rate of climb gauge will respond directly with the turning of this valve.



WARNING!

- **Damage to the aircraft instrumentation is possible.**
- **Do NOT exceed aircraft manufacturer's rate of climb specification.**

12. As the aircraft cabin pressure approaches the required level, gradually open the Airflow Control Valve so that at the required pressure level, the rate of climb reads zero (0).
13. With the rate of climb gauges stabilized at zero (0), the following tasks must be performed in rapid succession:
 - a. Close the aircraft cabin air supply valve.
 - b. Start the stop watch.
 - c. Shut off the CPU.
 - d. Record the elapsed time rate between the two specified pressure levels.

Pressure Decay Test Procedure continued on following page.

14. After the data has been obtained, bleed off the aircraft cabin pressure to zero (0).

- NOTES:**
1. *If the bleed off rate is low, open the supply valve slightly to increase bleed off rate, however, do not exceed rate of descent limits.*
 2. *The rate of climb gauge shows DECREASE in cabin pressure when the needle moves in the UP direction, (clockwise).*

15. Ensure all cabin pressure is bled off.

DANGER!



Under possibility of bodily injury, do not open cabin door until:

1. Tapped cabin feed back pressure gauge reads zero (0).
2. Disconnected air supply hose from cabin pressurization unit is checked to assure no air is coming from aircraft.
3. Slowly unlatch cabin door.

DATA SHEET: PRESSURE DECAY METHOD

Aircraft :	Notes
Aircraft Registration No:	
Pressures:	
<ul style="list-style-type: none"> • Not to exceed _____psig • Safety Valve Operation _____psig • Leakage Test: <li style="padding-left: 20px;">Initial Pressure _____psig <li style="padding-left: 20px;">Final Pressure _____psig 	
Rate of Climb (not to exceed):	
<ul style="list-style-type: none"> • Ascent _____ft/min • Descent _____ft/min 	
Cabin Pressure Decay:	
<ul style="list-style-type: none"> • Specification Time Limit _____sec • Actual Time _____sec 	
Tested By: _____ Date: _____	
Repair Station Cert. No: _____	
AIRCRAFT CABIN PRESSURE, NOT CPU SYSTEM PRESSURE	



APPENDIX IV

CPU Adapters

APPENDIX IV CPU ADAPTERS

The following CPU aircraft Adapters are available from Tronair. If you cannot find the specific Adapter you require, please contact Tronair sales.

ADAPTER KIT NUMBER	AIRCRAFT
K-1285	Beech King Air
K-1286	Lear 21, 25, 36, 36
K-2601	Cessna Citation I, II, V, S/II & Ultra
◆ K-1288	Cessna Citation III, VI, VII, X
K-1358	Citation I & II (Threaded)
K-1359	Cessna 421, 425, 441 & Lear 45
K-1360	Lear 55 & Embraer 120
K-1381	Piper PA-31T Cheyenne
K-1456	Beech Duke
K-1491	Cessna 337
K-2610	Raytheon Hawker
K-1622	Falcon 10, 20, 50, 100, 200, 900
K-1623	Aero Commander
K-1660	MU-2 & Beech Jet (Diamond)
K-1661	Lear 24
K-1943	Beech Starship
◆◆K-2182	Lear 55 (Prior To S/N 124), Lear 60
K-2403	Sabre 65
K-2418	Westwind/Astra
K-2453	Pilatus PC-12
K-3317	SJ 30-2
K-2081	Piaggio P-180

- ◆ Citation III must use the kit only; deflector for temperature dissipation.
- ◆◆ A/C must have LearJet part number S419057-8 duct.



APPENDIX V

Declaration of Conformity



DECLARATION of CONFORMITY

The design, development and manufacture is in accordance with European Community guidelines

CABIN PRESSURIZATION UNIT

Relevant provisions complied with by the machinery:

2006/42/EC

89/336/EEC

Relevant standards complied with by the machinery:

EN ISO 12100-1

BS EN 418:1992

BS EN 954-1:1997

BS EN 983:1996

BS EN 1050:1997

BS EN 60204-1:1998

prEC 1915-1:1995

Identification of person empowered to sign on behalf of the Manufacturer:

A handwritten signature in black ink that reads "Patrick Finch". The signature is written in a cursive style and is positioned above a horizontal line.

Quality Assurance Representative



APPENDIX VI

Blower Maintenance Data

Universal RAI®, URAI-DSL, URAI-G and Metric Series

Contents

Information Summary	1	Inspection & Maintenance.	11
Safety Precautions.	3	Figures.	12-15
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Operation.	9	Basic Connection & Drive Shaft Information.	25-27
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Do These Things To Get The Most From Your ROOTS® blower

- Check shipment for damage. If found, file claim with carrier and notify ROOTS.
- Unpack shipment carefully, and check contents against Packing List. Notify ROOTS if a shortage appears.
- Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.**
- Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- In event of trouble during installation or operation, do not attempt repairs of ROOTS furnished equipment. Notify ROOTS, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void ROOTS warranty.
- Units out of warranty may be repaired or adjusted by the owner. Good inspection and maintenance practices should reduce the need for repairs.

NOTE: Information in this manual is correct as of the date of publication. ROOTS reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest ROOTS Office, dial our Customer Service Hot Line toll free; 1 877 363 ROOT(S) (7668) or direct 281-966-4700.



ROOTS® products are sold subject to the current General Terms of Sale, GTS-5001 and Warranty Policy WP-5020. Copies are available upon request.

**Contact your local ROOTS Office
or ROOTS Customer Service
Hot Line 1-877-363-ROOT(S) (7668) or
direct 281-966-4700.**

Safety Precautions

It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream. **CAUTION: Never cover the blower inlet with your hand or other part of body.**
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting ROOTS.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

Operating Limitations

A ROOTS blower or exhauster must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for various models & sizes of blowers & exhausters. These limits apply to all units of normal construction, when operated under standard atmospheric conditions. Be sure to arrange connections or taps for instruments, thermometers and pressure or vacuum gauges at or near the inlet and discharge connections of the unit. These, along with a tachometer, will enable periodic checks of operating conditions.

PRESSURE – The pressure rise, between inlet and discharge, must not exceed the figure listed for the specific unit frame size concerned. Also, in any system where the unit inlet is at a positive pressure above atmosphere a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded without first consulting the ROOTS. Never should the maximum allowable differential pressure be exceeded.

On vacuum service, with the discharge to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

TEMPERATURE – Blower & exhauster frame sizes are approved only for installations where the following temperature limitations can be maintained in service:

- Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the unit. This is not outdoor temperature unless the unit is installed outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature.
- The average of the inlet and discharge temperature must not exceed 250°F. (121°C).
- The ambient temperature of the space the blower/motor is installed in should not be higher than 120°F (48.8°C).

SPEED – These blowers & exhausters may be operated at speeds up to the maximum listed for the various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

Special Note: The listed maximum allowable temperature rise for any particular blower & exhauster may occur well before its maximum pressure or vacuum rating is reached. This may occur at high altitude, low vacuum or at very low speed. The units' operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

Installation

ROOTS blowers & exhausters are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of internal protection is considered to be one year under average conditions, if shipping plugs & seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to ensure corrosion protection.

- Coat internals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
- Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- Seal inlet, discharge, and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- Protect units from excessive vibration during storage.
- Rotate shaft three or four revolutions every two weeks.
- Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed unit design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected operating temperatures, and that the unit be located so that routine checking and servicing can be performed conveniently. Proper care in locating driver and accessory equipment must also be considered.

Supervision of the installation by a ROOTS Service Engineer is not usually required for these units. Workmen with experience in installing light to medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Unit mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

Bare-shaft Units: Two methods are used to handle a unit without base. One is to use lifting lugs bolted into the top of the unit headplates. Test them first for tightness and frac-

tures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If lifting lugs are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain on the extended drive shaft.

Packaged Units: When the unit is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the unit casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the lifting lugs in the top of the unit headplates.

Before starting the installation, remove plugs, covers or seals from unit inlet and discharge connections and inspect the interior completely for foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with an appropriate solvent. Turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Cover the flanges until ready to connect piping.

Mounting

Care will pay dividends when arranging the unit mounting. This is especially true when the unit is a "bare-shaft" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces the least satisfactory results. It definitely causes the most problems in leveling and alignment and may result in a "Soft Foot" condition. Correct soft foot before operation to avoid unnecessary loading on the casing and bearings. Direct use of building structural framing members is not recommended.

For blowers without a base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided. The plate should be at least 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the unit is mounted. It should have properly sized studs or tapped holes located to match the unit foot drilling. Proper use of a high quality machinist's level is necessary for adequate installation.

With the mounting plate in place and leveled, set the unit on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers turn freely. If the unit is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the unit shaft. Best unit arrangement is directly bolted to the mounting plate while the driver is on shims of at least 1/8 inch (3mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Aligning

When unit and driver are factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory

installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the leveled and shimmed base is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the unit shaft by hand. It should turn freely at all points. Loosen the unit foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if unit is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the unit, consider how piping arrangements are dictated by the unit design and assembly. Drive shaft rotation must be established accordingly and is indicated by an arrow near the shaft.

Typical arrangement on vertical units has the drive shaft at the top with counterclockwise rotation and discharge to the left. Horizontal units are typically arranged with the drive shaft at the left with counterclockwise rotation and discharge down. See Figure 4 for other various unit arrangements and possible conversions.

When a unit is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the unit. Refer to Table 1 for allowable speeds of various unit sizes.

A flexible type coupling should always be used to connect the driver and unit shafts.

When direct coupling a motor or engine to a blower you must insure there is sufficient gap between the coupling halves and the element to prevent thrust loading the blower bearings. When a motor, engine or blower is operated the shafts may expand axially. If the coupling is installed in such a manner that there is not enough room for expansion the blower shaft can be forced back into the blower and cause the impeller to contact the gear end headplate resulting in damage to the blower. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end-play exists. Coupling manufacturer's recommendations for maximum misalignment, although acceptable for the coupling, are normally too large to achieve smooth operation and maximum life of the blower.

The following requirements of a good installation are recommended. When selecting a coupling to be fitted to the blower shaft ROOTS recommends a taper lock style coupling to insure proper contact with the blower shaft. If the coupling must have a straight bore the coupling halves must be fitted to the two shafts with a line to line thru .001" interference fit. Coupling halves must be warmed up per coupling manufacturer's recommendations. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around

the coupling.

When a unit is BELT DRIVEN, the proper selection of sheave diameters will result in the required unit speed. When selecting a sheave to be fitted to the blower shaft ROOTS recommends a taper lock style sheave to insure proper contact with the blower shaft. This flexibility can lead to operating temperature problems caused by unit speed being too low. Make sure the drive speed selected is within the allowable range for the specific unit size, as specified under Table 1.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the unit shaft. **The driver should be mounted on the inlet side of a vertical unit (horizontal piping) and on the side nearest to the shaft on a horizontal unit. SEE PAGE 6 - Acceptable Blower Drive Arrangement Options.** The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

CAUTION: Drive couplings and sheaves (pulleys) should have an interference fit to the shaft of the blower (set screw types of attachment generally do not provide reliable service.) It is recommended that the drive coupling or sheave used have a taper lock style bushing which is properly sized to provide the correct interference fit required. Drive couplings, that require heating to fit on the blower shaft, should be installed per coupling manufacturer recommendations. A drive coupling or sheave should not be forced on to the shaft of the blower as this could affect internal clearances resulting in damage to the blower.

Engine drive applications often require special consideration to drive coupling selection to avoid harmful torsional vibrations. These vibrations may lead to blower damage if not dampened adequately. It is often necessary to install a fly-wheel and/or a torsionally soft elastic element coupling based on the engine manufacturer recommendations.

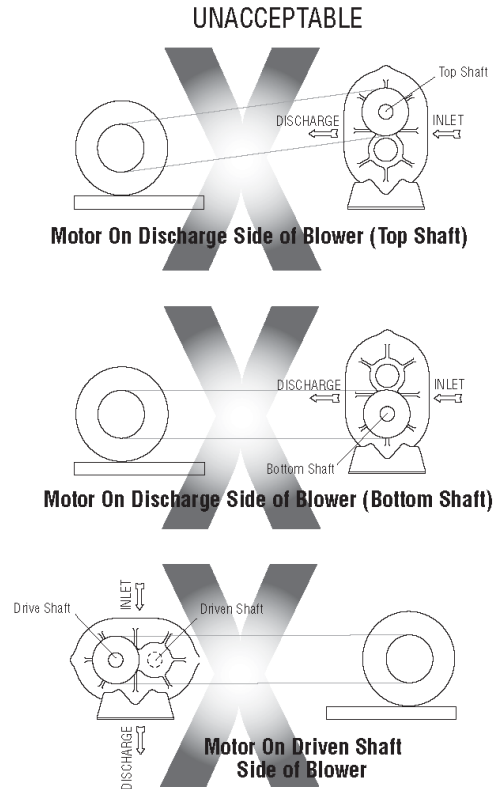
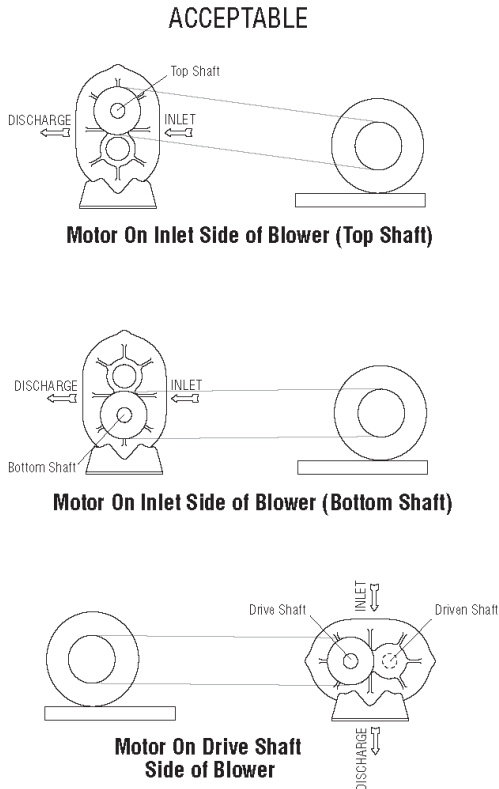
The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that 2/3 of the total movement is available in the direction away from the unit, and mount the assembly so that the face of the sheave is accurately in line with the unit sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the unit is operating under load. Excessive tightening can lead to early bearing concerns or shaft breakage.

Before operating the drive under power to check initial belt tension, first remove covers from the unit connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being drawn into the unit while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under **LUBRICATION**.

Piping

Before connecting piping, remove any remaining anti-rust compound from unit connections. Clean pipe should be no

Acceptable Blower Drive Arrangement Options



smaller than unit connections. In addition, make sure it is free of scale, cuttings, weld beads, or foreign material of any kind. To further guard against damage to the unit, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours of operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the unit may cause serious damage.

Pipe flanges or male threads must meet the unit connections accurately and squarely. DO NOT attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the unit casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the unit to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 3 represents an installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or other restrictions. When a shut-off valve can not be avoided, make sure a full size vacuum relief is installed nearest the unit inlet. This will protect against unit overload caused by accidental closing of the shut-off valve.

Need for an inlet silencer will depend on unit speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is recommended, especially in dusty

or sandy locations. A discharge silencer is also normally suggested, even though Whispair units operate at generally lower noise levels than conventional rotary blowers. Specific recommendations on silencing can be obtained from your local ROOTS distributor.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the unit under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on unit operating conditions. The back-pressure regulator shown in Figure 3 is useful mainly when volume demands vary while the unit operates at constant output. If demand is constant, but somewhat lower than the unit output, excess may be blown off through the manual unloading valve.

In multiple unit installations where two or more units operate with a common header, use of check valves is mandatory. These should be of a direct acting or free swinging type, with one valve located in each line between the unit and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle unit.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment.

DO NOT operate the unit at this time unless it has been lubricated per instructions.

Technical Supplement for URAI® Gas Blowers

Technical Supplement for 32, 33, 36, 42, 45, 47, 53, 56, 59, 65, 68, 615 Universal RAI-G blowers

ROOTS Universal RAI-G rotary positive gas blowers are a design extension of the basic Universal RAI blower model. URAI-G blower uses (4) mechanical seals in place of the standard inboard lip seals to minimize gas leakage into the atmosphere. The seal vent chambers are plugged. These units are intended for gases which are compatible with cast iron case material, steel shafts, 300/400 series stainless steel and carbon seal components, viton o-rings and the oil/grease lubricants. If there are any questions regarding application or operation of this gas blower, please contact factory.

Precaution: URAI-G blowers: Care must be used when opening the head plate seal vent chamber plugs (43) as some gas will escape—if it is a pressure system, or the atmospheric air will leak in—if the system is under vacuum. There is a possibility of some gas leakage through the mechanical seals. This leakage on the gear end will escape through the gear box vent, and on the drive end, through the grease release fittings. If the gas leakage is undesirable, each seal chamber must be purged with an inert gas through one purge gas hole (43) per seal. There are two plugged purge gas holes(1/8 NPT) provided per seal. The

purge gas pressure must be maintained one psi above the discharge gas pressure. Also, there exists a possibility of gear end oil and drive end grease leakage into the gas stream.

The lubricants selected must be compatible with the gas.

URAI GAS Blower Oil and Grease Specifications

The specified oil should be ROOTS synthetic P/N 813-106- of the proper viscosity.

When servicing drive end bearings of a Gas blower, use the specified NLGI #2 premium grade aluminum complex* grease, ROOTS P/N T20019001, with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

*ROOTS Synthetic Oil & Grease is superior in performance to petroleum based products. It has high oxidation stability, excellent corrosion protection, extremely high film strength and low coefficient of friction. Typical oil change intervals are increased 2-3 times over petroleum based lubricants. Also, ROOTS Synthetic Oil is 100% compatible with petroleum based oils. Simply drain the oil in the blower and refill the reservoirs with ROOTS Synthetic Oil to maintain optimum performance of your ROOTS blower.

Lubrication

For Units with a Grease Lubricated Drive End

A simple but very effective lubrication system is employed on the drive shaft end bearings. Hydraulic pressure relief fittings are provided to vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

When servicing drive end bearings of Non Gas blower, use the specified NLGI #2 premium grade microgel grease with 250°F (121°C) service temperature and moisture resistance and good mechanical stability. ROOTS specifies Shell Darina EP NLGI Grade 2. Product Code 71522.

URAI GAS Blower Oil and Grease Specifications

The specified oil should be ROOTS synthetic P/N 813-106- of the proper viscosity.

When servicing drive end bearings of a Gas blower, use the specified NLGI #2 premium grade aluminum complex* grease, ROOTS P/N T20019001, with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

NOTE: Lithium based greases are not compatible with the ROOTS Synthetic grease used when assembling a Gas blower or the non-soap base grease used when assembling a standard URAI blower. Lithium based grease is not approved for any ROOTS blowers.

Using a pressure gun, slowly force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting. The use of an electric or pneumatic grease gun could force the grease in too rapidly and thus invert the seals and should not be used.

After a long shutdown, it is recommended that the grease fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using a hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and unusual circumstances.

For Units with Splash Lubrication on Both Ends

Bearings and oil seals are lubricated by the action of the timing gears or oil slingers which dip into the main oil sumps causing oil to splash directly on gears and into bearings and seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Seals located inboard of the bearings in each headplate effectively retain oil within the sumps. Any small leakage that may occur should the seals wear passes into a cavity in each vented headplate

and is drained downward.

Oil sumps on each end of the blower are filled by removing top vent plugs, Item (25), and filling until oil reaches the middle of the oil level sight gauge, Item (45 or 53), or the overflow plug (see pages 14 and 15).

Initial filling of the sumps should be accomplished with the blower not operating, in order to obtain the correct oil level. Approximate oil quantities required for blowers of the various models and configurations are listed in Table 3. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. *ROOTS synthetic oil (ROOTS P/N 813-106-) is highly recommended. ROOTS does not recommend automotive type lubricants, as they are not formulated with the properties mentioned above.

The oil level should not fall below the middle of the site gauge or overflow plug on URAI (ref. pages 14 & 15) when the blower is idle. It may rise or fall on the gauge during operation, to an extent depending somewhat on oil temperature and blower speed.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of oil level and necessary addition of lubricant should be sufficient. During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not necessary unless the blower is operated in a very dusty location.

Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 180°F (82°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 210-216°F (99°C - 102°C) will produce life expectancy of 1/4 or 500 hours. Therefore, it is considered normal to have oil change periods of 500 hours with petroleum based oils.

Normal life expectancy of ROOTS™ Synthetic Oil is about 4000 to 8000 hours with an oil temperature of about 180°F (82°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 210-216°F (99°C - 102°C) will produce life expectancy of 1/4 or 1000 to 2000 hours.

NOTE: To estimate oil temperature, multiply the discharge temperature of the blower by 0.80. Example: if the discharge air temperature of the blower is 200° F, it is estimated that the oil temperature is 160° F.

*ROOTS™ Synthetic Oil & Grease is superior in performance to petroleum based products. It has high oxidation stability, excellent corrosion protection, extremely high film strength and low coefficient of friction. Typical oil change intervals are increased 2-3 times over petroleum based lubricants. Also, ROOTS™ Synthetic Oil is 100% compatible with petroleum based oils. Simply drain the oil in the blower and refill the reservoirs with ROOTS™ Synthetic Oil to maintain optimum performance of your ROOTS™ blower.

Operation

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure check list as a guide, but consider any other special conditions in the installation.

- Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen as described under INSTALLATION is strongly recommended.
- Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- Ensure oil levels in the main oil sumps are correct.
- Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- Bump blower a few revolutions with driver to check that direction of rotation agrees with arrow near blower shaft, and that both coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions. The following procedure is suggested to cover this initial operation test period.

- a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.
- b. After blower comes to a complete stop, repeat above, but let blower run 2 or 3 minutes. Check for noises, such as knocking sounds.
- c. After blower comes to a complete stop, operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and headplate surfaces for development of hot spots such as burned paint, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually

close the discharge unloading valve to apply working pressure. At this point it is recommended that a pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual, shut down and investigate conditions in the piping system. Refer to the TROUBLESHOOTING CHECKLIST for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under INSTALLATION. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading or vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the TROUBLESHOOTING CHECKLIST.

Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, see chart below for an appropriate assessment guide for rotary lobe blowers rigidly mounted on stiff foundations.

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

As shown on the chart below, the level of all pass vibration will determine the need to measure discrete frequency vibration levels and the action required.

All Pass Vibration (in/sec)	Discrete Frequency Vibration (in/sec)	Action
0.45 or less	N/R	Acceptable
Greater than 0.45 but 1.0 or less	0.45 or less @ any frequency	Acceptable
	Greater than 0.45 @ any frequency	Investigate
Greater than 1.0	Less than 1.0	Investigate
	Greater than 1.0	Investigate

Troubleshooting Checklist

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance
	2	Wrong rotation	Compare actual rotation with Figure 1 Change driver if wrong
	3	Obstruction in piping	Check piping, valves, silencer to assure open flow path
Low capacity	4	Speed too low	See item 1, If belt drive, check for slippage and readjust tension
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with Published performance
	6	Obstruction in piping	See item 3
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance
	9	Excessive pressure rise	See Item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment
	11	Scale, sludge, rust or product build up	Clean blower appropriately
Damage to bearings or gears	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade
	14	Excessive pressure rise	See Item 5
	15	Coupling misalignment	Check carefully. Realign if questionable
	16	Excessive belt tension	Readjust for correct tension
Vibration	17	Misalignment	See Item 15
	18	Impellers rubbing	See Item 10
	19	Worn bearings/gears	Check gear backlash and condition of bearings, and replace as indicated
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance
	21	Driver or blower loose	Tighten mounting bolts securely
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance
Driver stops, or will not start	24	Casing strain	Re-work piping alignment to remove excess strain
	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth
	26	Scale, sludge, rust or product build-up	Clean blower appropriately
Excessive breather	27	Broken seal	Replace seals
Blow-by or excessive oil leakage to vent area	28	Defective O-ring	Replace seals and O-ring
Excessive oil leakage in vent area	29	Defective/plugged breather	Replace breather and monitor oil leakage
	30	Oil level too high	Check sump levels in gear and drive headplates.
	31	Oil type or viscosity incorrect	Check oil to insure it meets recommendations. Drain then fill with clean oil of recommended grade.
	32	Blower running hot	Recommended oil temperature can be found on page 6 of this manual. The blower must be operated within the conditions of this manual

Inspection & Maintenance: Universal RAI® series blowers

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention there after may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for

any reason. Some oil seal leakage may occur since an oil film under the lip is required for proper operation. Periodically leaked oil should be wiped off from surfaces. Minor seal leakage should not be considered as indicating seal replacement.

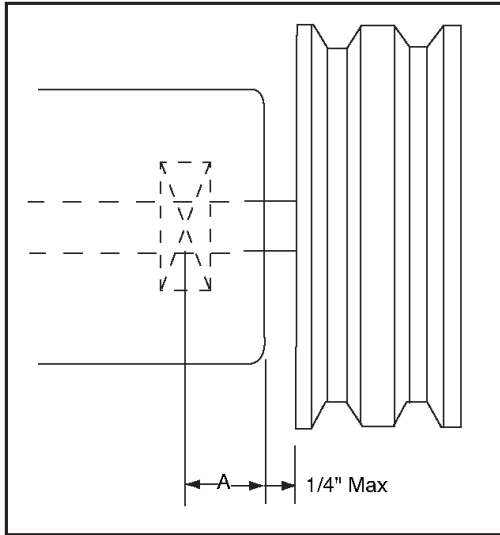
Timing gear wear, when correct lubrication is maintained, should be negligible. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance, backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interference or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely. Foreign materials in the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to an authorized ROOTS distributor.

Warranty failures should not be repaired at all, unless specific approval has been obtained through ROOTS before starting work. Unauthorized disassembly within the warranty period may void the warranty.

Figure 2 - Allowable Overhung Loads for V-Belt Drives Universal RAI®/URAI®-J Units



$$\text{Belt Pull lbs} = \frac{252100 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

$$\text{Shaft Load (lb.in)} = \text{Belt Pull} \cdot \left(A + \frac{1}{4} + \frac{\text{Sheave Width}}{2} \right)$$

Frame Size	Dimension "A"	Max Allowable Shaft Load (lb-in.)	Min Sheave Diameter
22, 24	0.61	150	4.00
32, 33, 36	0.80	400	5.00
42, 45, 47	1.02	650	5.00
53, 56, 59	1.13	1,325	6.00
65, 68, 615	1.36	2,250	8.00
76, 711, 718	1.16	2,300	9.50

NOTE:
 Arc of sheave belt contact on the smaller sheave not to be less than 170°
 Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.
 ROOTS recommends the use of two or more 3V, 5V or 8V belts and sheaves.

Acceptable Blower Drive Arrangement Options

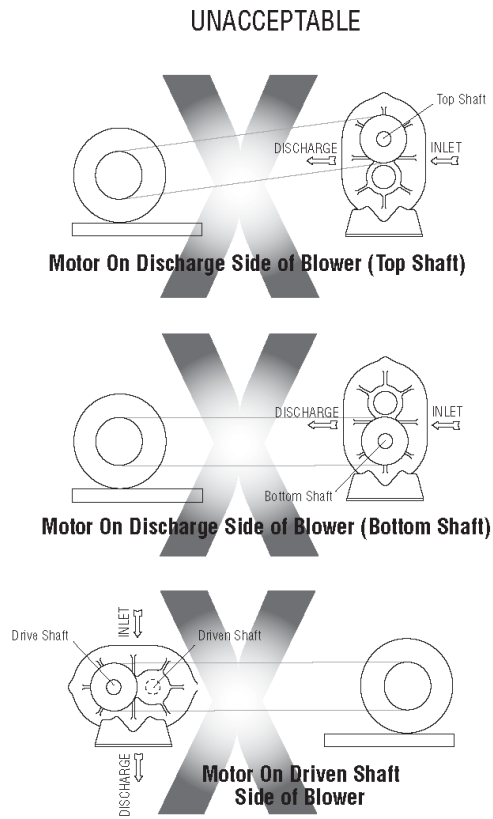
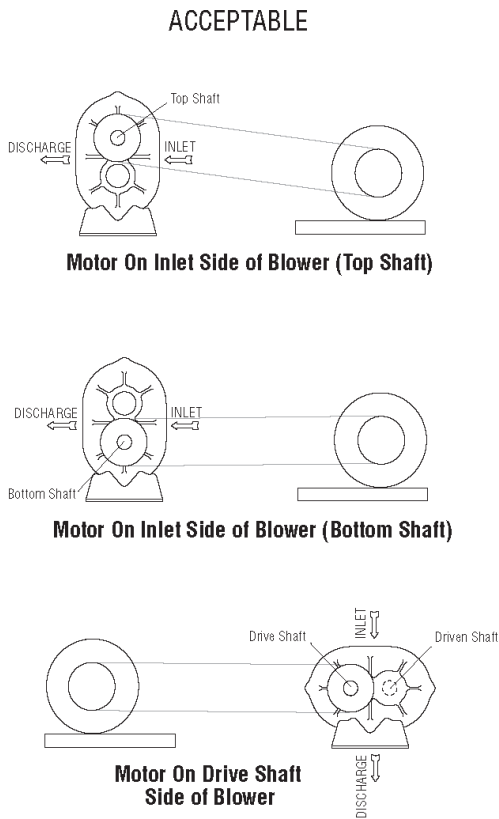
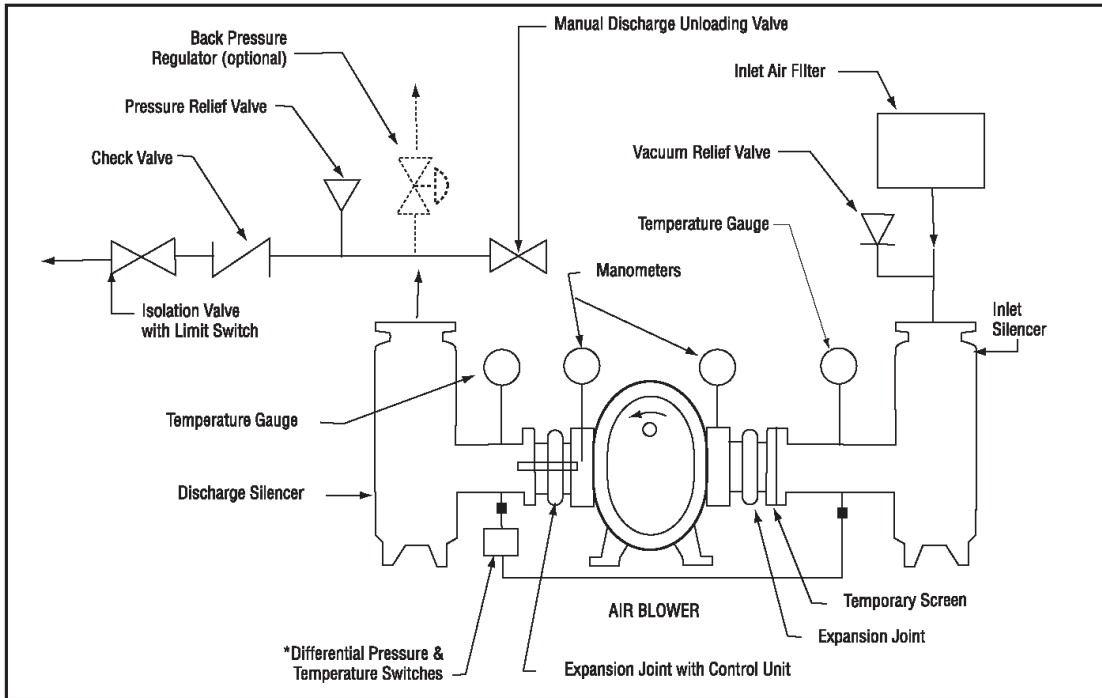
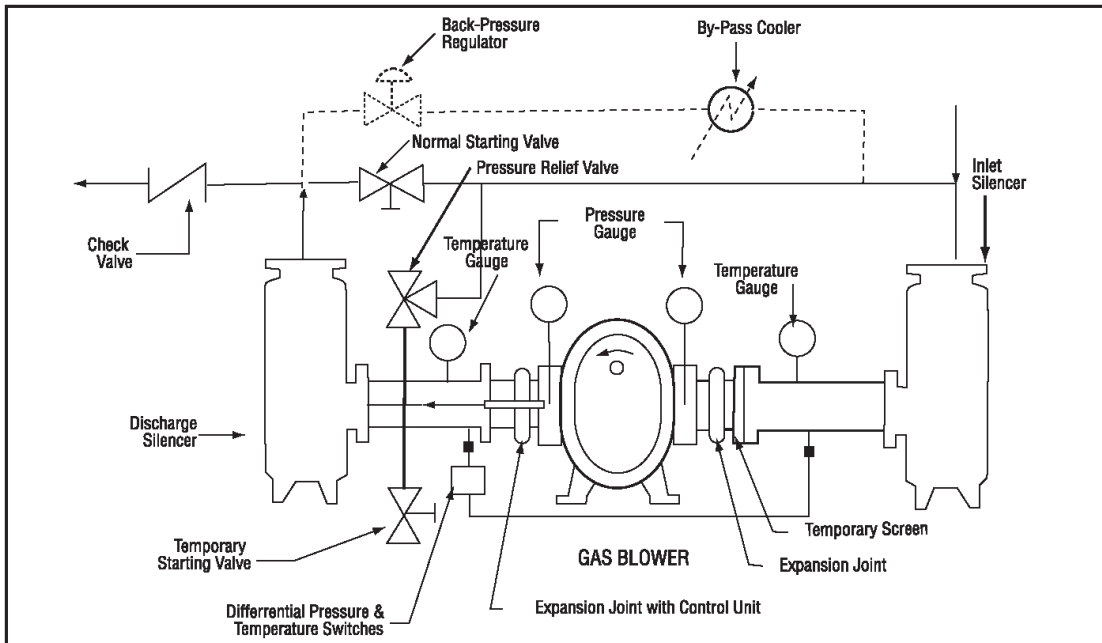


Figure 3a - Air Blower Installation with Accessories



Above are suggested locations for available accessories.

Figure 3b -Gas Blower Installation with Accessories



Above are suggested locations for available accessories.

Figure 4

Blower Orientation Conversion

Model	Reversible Rotation	Whispair™ Design
Universal RAI	yes	no
URAI-J Whispair™	no	yes
URAI-G	yes	no

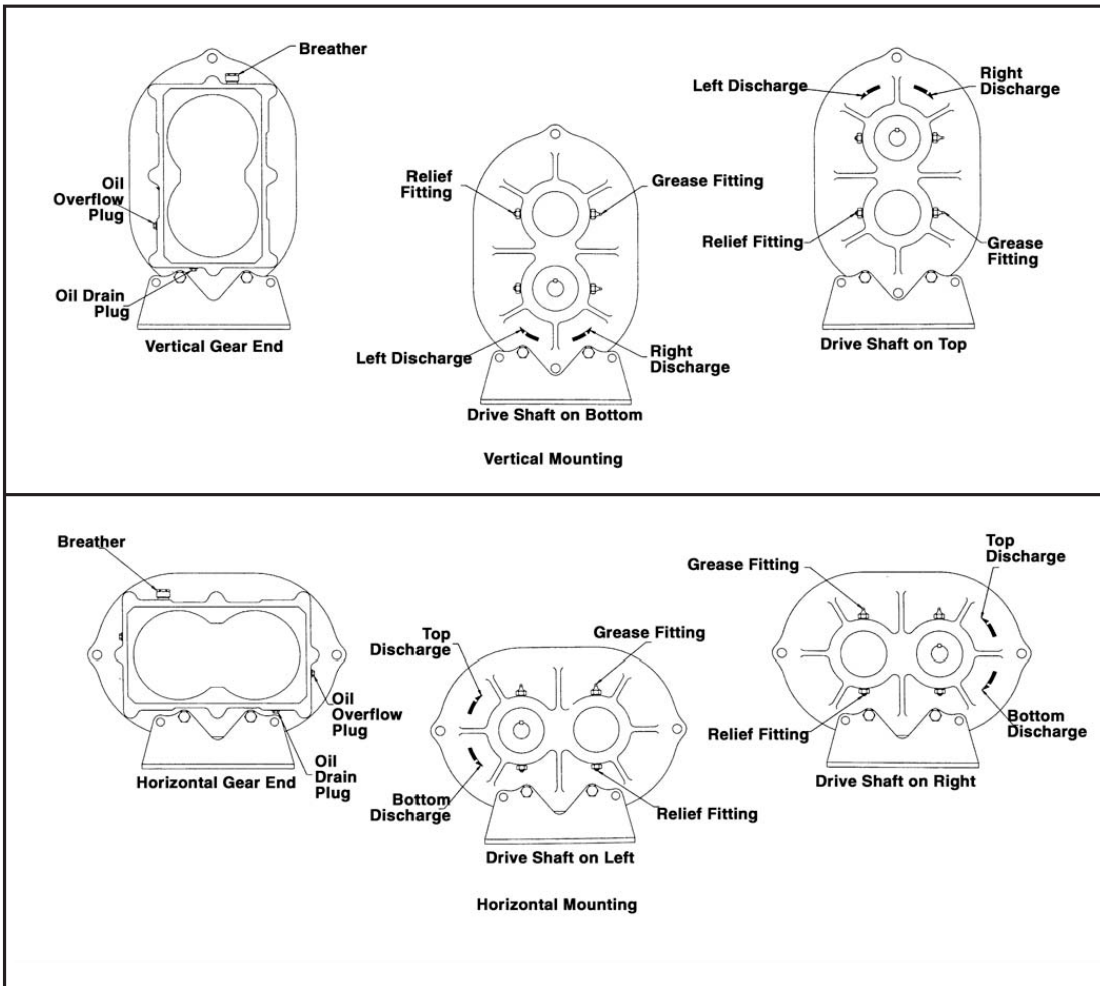
Special Note: WHISPAIR™ models are designed to operate with only one shaft rotation direction to take full advantage of the Whispair feature. Therefore, a WHISPAIR™ blower may be operated in the following combinations.

- CCW Rotation: Bottom Shaft; Right side discharge or a Left Shaft; Bottom discharge
- CCW Rotation: Top Shaft; Left side discharge or a Right Shaft; Top discharge

or

- CW Rotation: Bottom Shaft; Left side discharge or a Right Shaft Bottom discharge
- CW Rotation: Top Shaft; Right side discharge or a Left Shaft Top discharge

Blower Orientation and Lubrication Points: Grease Lubricated Drive End
Universal RAI series & URAI-G gas blowers



Drive End Breather Orientation for U-RAI series - DSL with Oil Lube

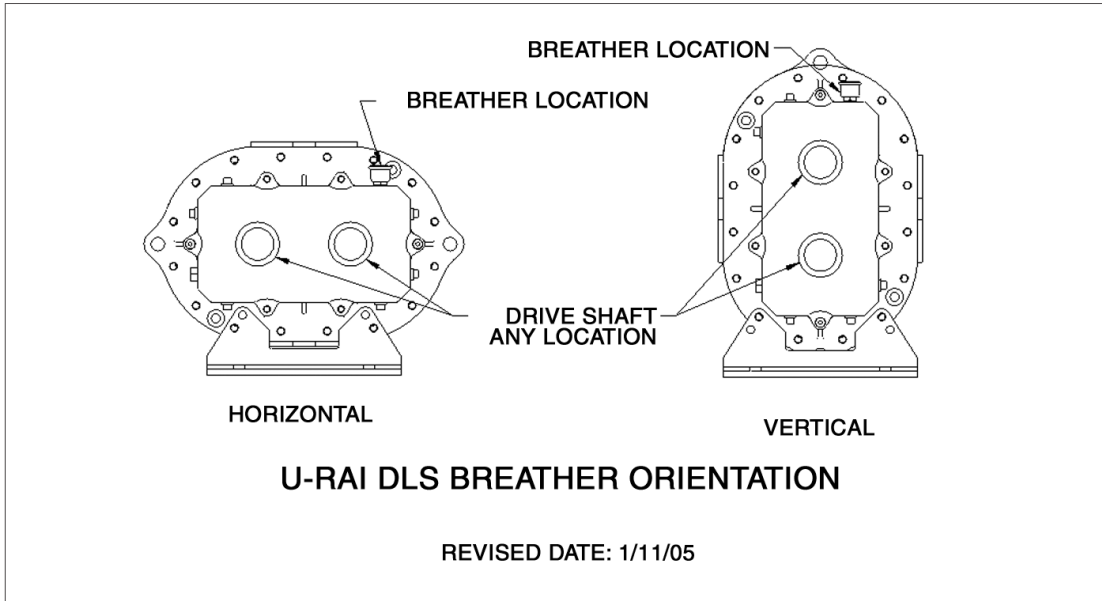


Table 1 - Universal RAI series, Universal URAI-DSI & URAI-G gas blower, Maximum Allowable Operating Conditions

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
22	2.5	5275	225 (125)	12 (827)	15 (500)
24	2.5	5275	210 (117)	7 (483)	15 (500)
32	3.5	3600	240 (133)	15 (1034)	16 (539)
33	3.5	3600	225 (125)	12 (827)	15 (500)
36	3.5	3600	225 (125)	7 (483)	15 (500)
42	4.0	3600	240 (133)	15 (1034)	16 (539)
45	4.0	3600	225 (125)	10 (690)	16 (539)
47	4.0	3600	225 (125)	7 (483)	15 (500)
53	5.0	2850	225 (125)	15 (1034)	16 (539)
56	5.0	2850	225 (125)	13 (896)	16 (539)
59	5.0	2850	225 (125)	7 (483)	15 (500)
65	6.0	2350	250 (130)	15 (1034)	16 (539)
68	6.0	2350	240 (133)	14 (965)	16 (539)
615	6.0	2350	130 (72)	7 (483)	14 (472)
76	7.0	2050	250 (139)	15 (1034)	16 (539)
711	7.0	2050	225 (125)	10 (690)	16 (539)
718	7.0	2050	130 (72)	6 (414)	12 (405)

Table 2 - Recommended Oil Grades

Ambient Temperature °F (°C)	ISO Viscosity No.
Above 90° (32°)	320
32° to 90° (0° to 32°)	220
0° to 32° (-18° to 0°)	150
Below 0° (-18°)	100

URAI GAS Blower Oil and Grease Specifications

The specified oil should be ROOTS synthetic P/N 813-106- of the proper viscosity.

Table 3 - Approximate Oil Sump Capacities

These capacities are provided to assist in stocking the correct amount of oil. Exact sump capacities may differ slightly. See "Lubrication" section for proper filling instructions.

UNIVERSAL RAI, URAI-J, URAI-G

Frame Size	Gear End Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
32	8.5 (.25)	16.0 (.47)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)
76	32.3 (.96)	59.5 (1.76)
711	32.3 (.96)	59.5 (1.76)
718	32.3 (.96)	59.5 (1.76)

UNIVERSAL URAI series-DSL Splash Lubricated Drive End

Note that the gear end sump capacity is provided on the adjacent table.

Frame Size	Drive End Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
32	4.0 (.12)	6.5 (.19)
33	4.0 (.12)	6.5 (.19)
36	4.0 (.12)	6.5 (.19)
42	5.5 (.16)	10.8 (.32)
45	5.5 (.16)	10.8 (.32)
47	5.5 (.16)	10.8 (.32)
53	7.5 (.22)	14.8 (.44)
56	7.5 (.22)	14.8 (.44)
59	7.5 (.22)	14.8 (.44)
65	16 (0.47)	31 (0.91)
68	16 (0.47)	31 (0.91)
615	16 (0.47)	31 (0.91)

See page 14 and 15 for illustration of vertical and horizontal configurations.

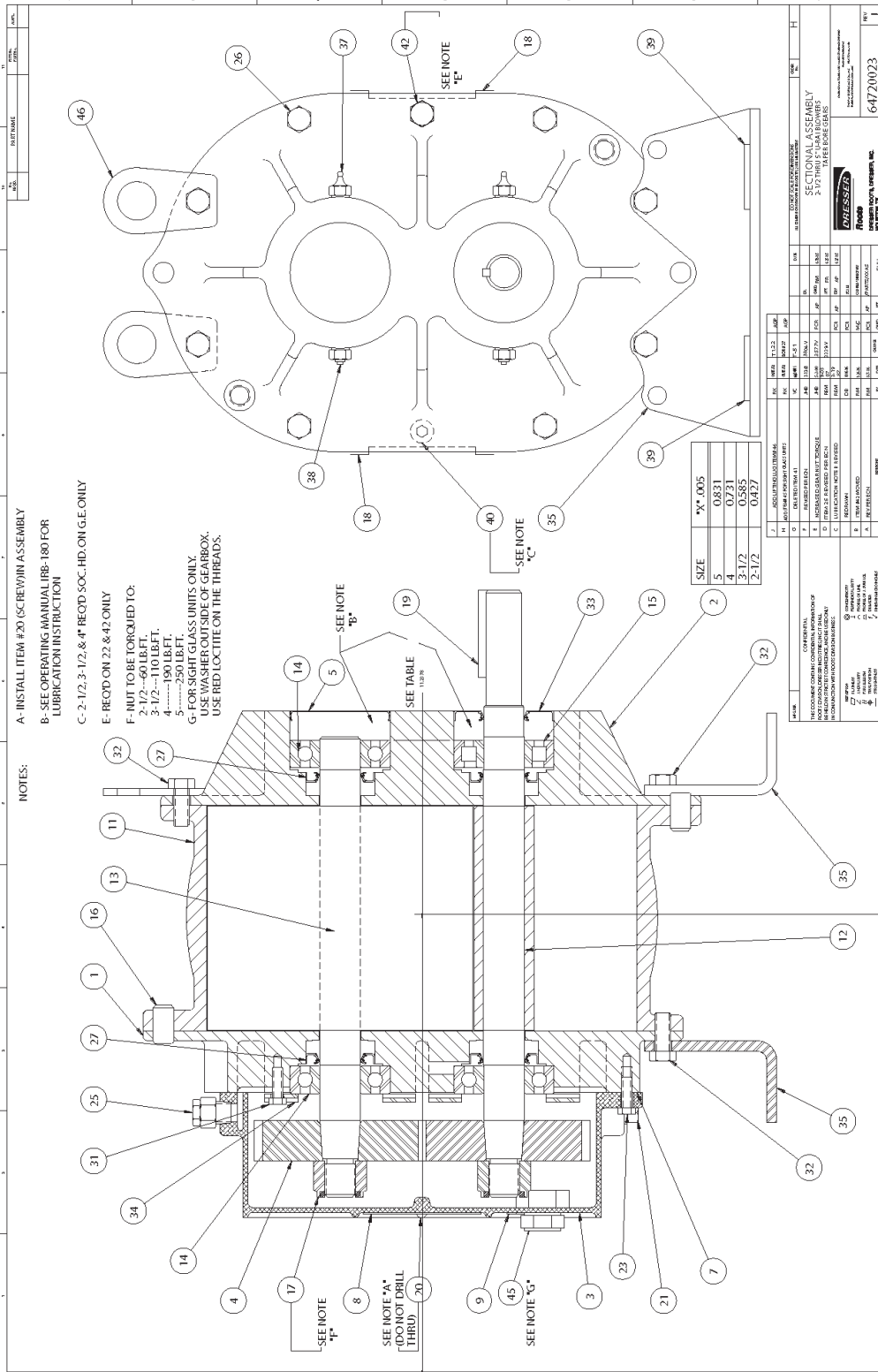
Table 4 - Universal URAI series with Grease Lubricated Drive End: Specified Bearing Greasing Intervals

Speed In RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1

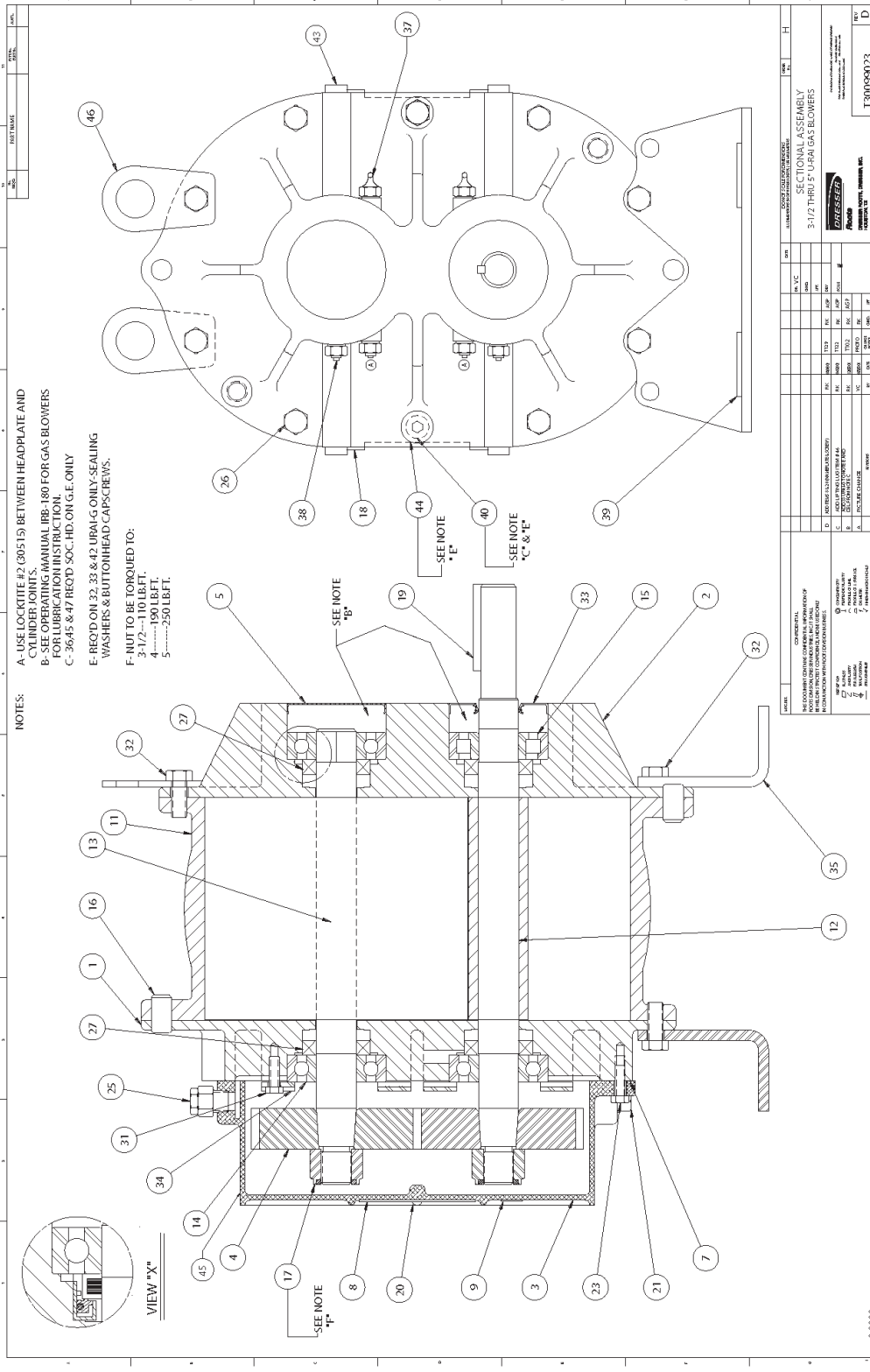
The specified grease for servicing drive end bearings of a Gas blower, use a NLGI #2 premium grade aluminum complex* grease, ROOTS P/N T20019001 with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

When servicing drive end bearings of Non Gas blower, use a NLGI #2 premium grade microgel grease with 250°F (121°C) service temperature and moisture resistance and good mechanical stability. ROOTS specifies Shell Darina EP NLGI Grade 2. Product Code 71522.

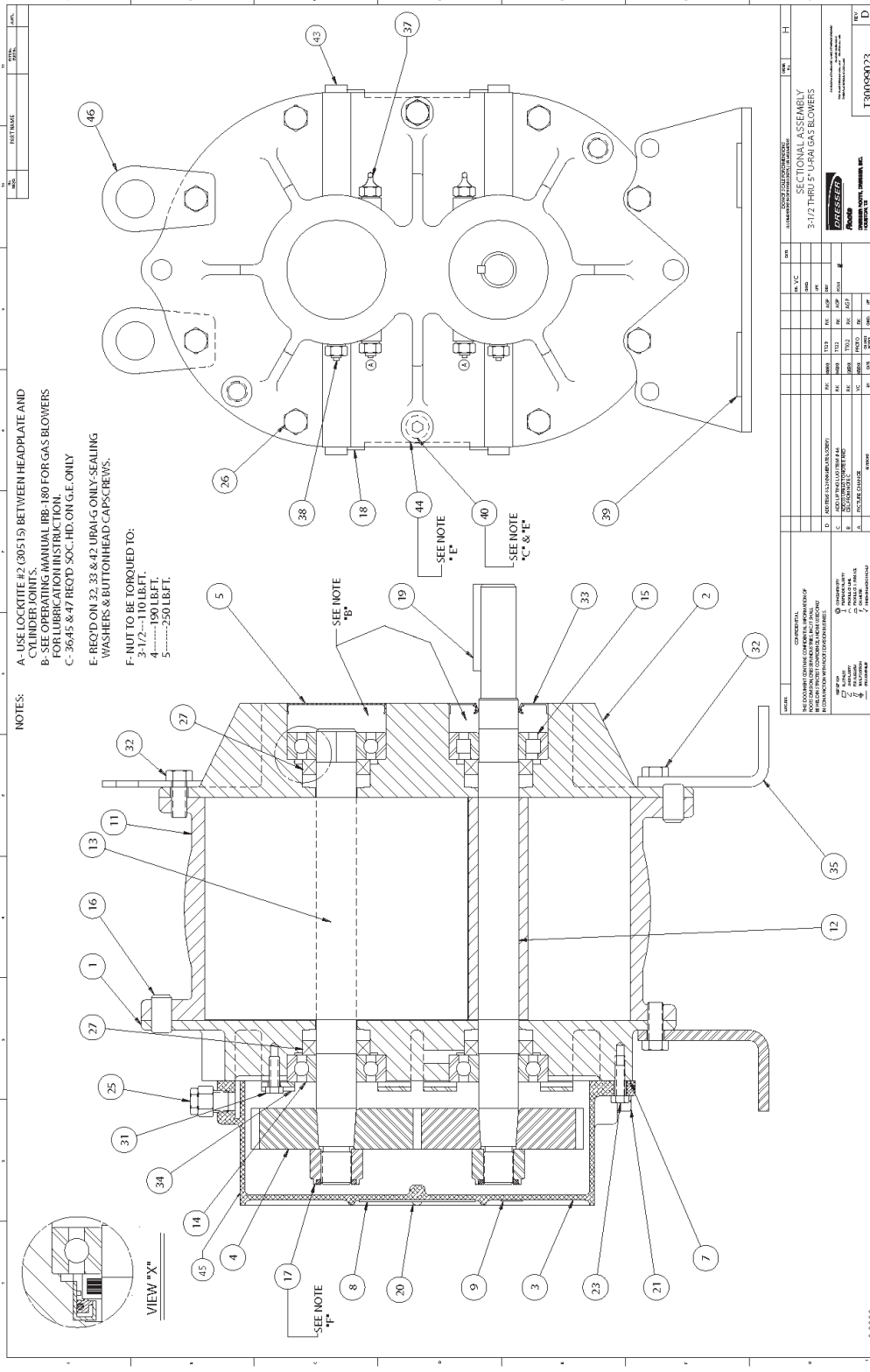
NOTE: Lithium based greases are not compatible with the ROOTS Synthetic grease used when assembling a Gas blower or the non-soap base grease used when assembling a standard URAI blower. Lithium based grease is not approved for any ROOTS blowers.



Assembly of UNIVERSAL RAI Series, Air Blowers, 2-1/2" Through 5" Gear Diameter



Assembly of UNIVERSAL RAI-G Series Gas Blowers, 3-1/2" Through 5" Gear Diameter



Assembly of UNIVERSAL RAI-G Series Gas Blowers, 3-1/2" Through 5" Gear Diameter

Universal RAI Series Blowers Parts List
2-1/2" – 5" Gear Diameter
 (Refer to drawing #64720023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
31	Screw, Hex, Nylock	4
32	Screw, Hex	6
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2

*Quantities vary by blower.

Universal RAI Series Blowers Parts List
6" & 7" Gear Diameter
 (Refer to drawing #64792023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex Nylock	8
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
29	Washer, Spring Wavy	2
31	Screw, Hex, Nylock	4
32	Screw, Hex	10
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4

*Quantities vary by blower.

Universal RAI-DSL Series Blowers Parts List
3-1/2" – 5" Gear Diameter
 (Refer to drawing #T30356023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
7	Gasket, Gear Box, DE Cover	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
31	Screw, Hex, Nylock	4
32	Screw, Hex	6
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2
48	DE Oil Slinger Set Screw	4
50	Drive End Cover	1
52	Drive End Oil Slinger	2
53	Oil Sight Glass	2

*Quantities vary by blower.

Universal RAI®-DSL Series Blowers Parts List 6" Gear Diameter
 (Refer to drawing #T30382023)

Item #	Part Name	Qty.	Item #	Part Name	Qty.
1	Headplate Gear End	1	21	Plug, Pipe	3
2	Headplate Drive End	1	23	Screw Hex Nylock	8
3	Gearbox	1	25	Breather (Plug Vent)	1
4	Timing Gears	2	26	Screw, Hex	*
7	Gasket, Gear Box	1	27	Seal, Lip Bearing	4
11	Cylinder	1	31	Screw, Hex, Nylock	4
12	Impeller & Shaft Drive	1	32	Screw, Hex	10
13	Impeller & Shaft Driven	1	33	Seal Lip-Drive	1
14	Bearing, Ball	3	34	Clamp Plate	2
15	Bearing, Roller	1	35	Foot	2
16	Pin, Dowel	4	39	Washer Mounting	4
17	Gear Nut	2	48	DE Oil Slinger Set Screw	4
19	Key	1	50	Drive End Cover	1
			52	Drive End Oil Slinger	2

*Quantities vary by blower.

Universal RAI Series Gas Blowers Parts List
3-1/2" & 5" Gear Diameter
 (Refer to drawing #T30099023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	8
25	Breather (Plug Vent)	1
26	Screw, Hex	14*
27	Seal, Bearing	4
31	Screw, Hex	4
32	Screw, Hex	4
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2

*Quantities vary by blower.

Universal RAI Series Gas Blowers Parts List
6" Gear Diameter
 (Refer to drawing #T3011023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
7*	Gasket DE Cover	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex Nylock	8
25	Breather (Plug Vent)	1
26	Screw, Hex	14**
27	Seal, Bearing	4
31	Screw, Hex	4
32	Screw, Hex	10
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2
43	Plug	8
53	Oil Sight Glass	2

*DE cover gasket is not the same as the gasket used on the GE. You must specify the gasket required when ordering.
 **Quantities vary by blower.

Specified Lubricants

ROOTS Synthetic Oil: ISO-VG-220 Grade

	Part Number
Quart	813-106-001
Gallon	813-106-002
Case (12 qts)	813-106-008

ROOTS Synthetic Oil: ISO-VG-320 Grade

	Part Number
Quart	813-106-004
Gallon	813-106-005
Case (12 qts)	813-106-007

ROOTS Synthetic Grease: NLGI #2

	Part Number
14.5 oz. Tube	T200019-001
5 Gallon Pail	T200019-003
Case (30 tubes)	T200019-002

Basic Connection & Drive Shaft Information

UNIVERSAL RAI (URAI) AIR BLOWERS

URAI AIR BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
65102020	22	1" NPT	0.625"	32
65103020	24	2" NPT	0.625"	43
71048020	32	1.25" NPT	0.750"	69
65105020	33	2" NPT	0.750"	74
65106020	36	2.5" NPT	0.750"	102
65108020	42	1.5" NPT	0.875"	88
65109020	45	2.5" NPT	0.875"	109
65110020	47	3" NPT	0.875"	128
65112020	53	2.5" NPT	1.125"	143
65113020	56	4" NPT	1.125"	170
65114020	59	4" NPT	1.125"	204
65116020	65	3" NPT	1.375"	245
65117020	68	5" NPT	1.375"	285
65118020	615	6" Flange	1.375"	425
65120020	76	4" NPT	1.562"	400
65121020	711	6" Flange	1.562"	530
65122020	718	8" Flange	1.562"	650

Refer to Specification Sheet S-12K84

URAI-DSL AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
T30378020	32	1.25" NPT	0.750"	72
T30379020	33	2" NPT	0.750"	77
T30380020	36	2.5" NPT	0.750"	105
T30352020	42	1.5" NPT	0.875"	92
T30353020	45	2.5" NPT	0.875"	113
T30354020	47	3" NPT	0.875"	132
T30359020	53	2.5" NPT	1.125"	148
T30360020	56	4" NPT	1.125"	175
T30361020	59	4" NPT	1.125"	209
T30384020	65	3" NPT	1.375"	250
T30385020	68	5" NPT	1.375"	290
T30386020	615	6" Flange	1.375"	430

Refer to Specification Sheet S-27S03

Universal RAI air blowers include detachable mounting feet which permit vertical or horizontal installation. The units are center timed for rotation in either direction. The bearings on the URAI are grease lubricated on the drive end and splash lubricated on the gear end. The URAI-DSL is splash lubricated on BOTH ends.

UNIVERSAL RAI (URAI) GAS BLOWERS

URAI-G™ GAS BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
710480G0	32	1.25" NPT	0.750"	69
651050G0	33	2" NPT	0.750"	74
651060G0	36	2.5" NPT	0.750"	102
651080G0	42	1.5" NPT	0.875"	88
651090G0	45	2.5" NPT	0.875"	109
651100G0	47	3" NPT	0.875"	128
651120G0	53	2.5" NPT	1.125"	143
651130G0	56	4" NPT	1.125"	170
651140G0	59	4" NPT	1.125"	204
651160G0	65	3" NPT	1.375"	245
651170G0	68	5" NPT	1.375"	285
651180G0	615	6" NPT	1.375"	425

Refer to Specification Sheet S-60A01

Universal RAI-G™ gas blowers include detachable mounting feet which permit vertical or horizontal installation. **Feet are different for vertical and horizontal mounting.**

The units are center timed for rotation in either direction. The bearings on the Universal RAI-GTM are grease lubricated on the drive end and splash lubricated on the gear end. ROOTS Synthetic lubricant is recommended.

Basic Connection & Drive Shaft Information

UNIVERSAL RAI (URAI-J) WHISPAIR AIR BLOWERS

URAI-J WHISPAIR AIR BLOWERS (with Grease Lubed Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
74065020	33J	2" NPT	0.750"	84
74086020	36J	2.5" NPT	0.750	112
74066020	45J	2.5" NPT	0.875"	119
74087020	47J	3" NPT	0.875	138
74067020	56J	4" NPT	1.125"	180

Refer to Specification Sheet S-33A93

URAI-J-DSL WHISPAIR AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
T30417020	33J	2" NPT	0.750"	87
T30418020	36J	2.5" NPT	0.750	115
T30410020	45J	2.5" NPT	0.875"	122
T30412020	47J	3" NPT	0.875	141
T30415020	56J	4" NPT	1.125"	185

Refer to Specification Sheet S-30S03

URAI-J METRIC WHISPAIR AIR BLOWERS (with Grease Lubed Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
TBD	33J	2" BSP	19 mm	84
740860M0	36J	2.5" BSP	19 mm	112
TBD	45J	2.5" BSP	24 mm	119
TBD	47J	3" BSP	24 mm	138
TBD	56J	4" BSP	28 mm	180

URAI-J-DSL METRIC WHISPAIR AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
TBD	33J	2" BSP	19 mm	87
T304660M0	36J	2.5" BSP	19 mm	115
TBD	45J	2.5" BSP	24 mm	122
T304550M0	47J	3" BSP	24 mm	141
TBD	56J	4" BSP	28 mm	185

Universal RAI-J air blowers incorporate the patented Whispair™ design in addition to the same features as the original URAI blowers. The URAI-J's are center timed, however the Whispair™ benefits can only be realized when the jet is located in the discharge position.

Basic Connection & Drive Shaft Information

UNIVERSAL RAI METRIC (URAI-M) AIR BLOWERS

NOTE: METRIC URAI product has metric shaft diameter and connection sizes

URAI-METRIC AIR BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
651020M0	22	1" BSP	16 mm	32
651030M0	24	2" BSP	16 mm	43
710480M0	32	1 1/4" BSP	19 mm	69
651050M0	33	2" BSP	19 mm	74
651060M0	36	2 1/2" BSP	19 mm	102
651080M0	42	1 1/2" BSP	24 mm	88
651090M0	45	2 1/2" BSP	24 mm	109
651100M0	47	3" BSP	24 mm	128
651120M0	53	2 1/2" BSP	28 mm	143
651130M0	56	4" BSP	28 mm	170
651140M0	59	4" BSP	28 mm	204
T30392060	65	3" BSP	32 mm	245
T30394060	68	5" BSP	32 mm	285
T30390060	615	150 NP10	32 mm	425
T30396060	76	4" BSP	38 mm	400
T30398060	711	150 NP10	38 mm	530
T30400060	718	200 NP10	38 mm	650

URAI-DSL-METRIC AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
T30463060	32	1 1/4" BSP	19 mm	72
T30464060	33	2" BSP	19 mm	77
T30465060	36	2 1/2" BSP	19 mm	105
T30451060	42	1 1/2" BSP	24 mm	92
T30452060	45	2 1/2" BSP	24 mm	113
T30453060	47	3" BSP	24 mm	132
T30459060	53	2 1/2" BSP	28 mm	148
T30460060	56	4" BSP	28 mm	175
T30461060	59	4" BSP	28 mm	209
T30472060	65	3" BSP	32 mm	250
T30473060	68	5" BSP	32 mm	290
T30474060	615	150 NP 10	32 mm	430

Universal RAI air blowers include detachable mounting feet which permit vertical or horizontal installation. The units are center timed for rotation in either direction. The bearings on the URAI are grease lubricated on the drive end and splash lubricated on the gear end. The URAI-DSL is splash lubricated on BOTH ends.

CUSTOMER SERVICE

Dresser Roots

16240 Port Northwest Drive
Houston, TX 77041
Toll Free Hot Line: 1-877-363-ROOT(S) (7668)
Direct Line: 832-590-2600
Toll Free Fax: 1-877-357-7238
Direct Fax: 832-590-2325

**Roots Factory Service
& Repair Centers**

**Dresser Roots – Houston Service Center
Dresser Roots Factory Service & Repair Center**

11611B Tanner Rd.
Houston, TX 77041
Ph: 713-896-4810
Fax: 713-896-4927

**Dresser Roots – Connersville Service Center
Dresser Roots Factory Service & Repair Center**

801 West Mount Street
Connersville, IN 47331
Ph: 765-827-9200
Fax: 765-827-9266

**Dresser Roots – United Kingdom Service Center
Dresser Roots Factory Service & Repair Center**

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Turnbridge, Huddersfield
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Ph: +44 (0) 1484 422 222
Aftermarket Direct Line: +44 (0) 1484 487 669
Aftermarket email: graeme.wadsworth@dresser.co.uk
Aftermarket Fax: +44 (0) 1484 487 657

**Dresser Roots – Mexico Service Center
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ISRB-2002 rev.0106
(formerly IOM-180-205)

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England HD1 6RB
Ph: +44 (0) 1484-422222
Fx: +44 (0) 1484-422668

website: www.rootsblower.com • US email: ROOTS@dresser.com • UK email: DMD_ROOTS@dresser.co.uk



APPENDIX VII

Motor Maintenance Data

Carefully read and fully understand this Owner's Manual prior to installation, operation and maintenance of your motor.

1. SAFETY DEPENDS ON YOU

Lincoln motors are designed and manufactured with safety in mind. However, your overall safety can be increased by properly installing, operating and maintaining the motor. Read and observe all instructions, warnings and specific safety precautions included in this manual and **THINK BEFORE YOU ACT!**

2. RECEIVING AND INSPECTION

Check packing list and inspect motor to make certain no damage has occurred in shipment. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

Turn the motor shaft by hand to be certain that it rotates freely. Be careful not to cut yourself on the shaft keyway; it is razor sharp!

Check the nameplate for conformance with power supply and control equipment requirements.

3. HANDLING

⚠ WARNING	
	<p>FALLING EQUIPMENT can injure.</p> <ul style="list-style-type: none"> ● Lift only with equipment of adequate lifting capacity. ● If so equipped, use lift ring(s) on the motor to lift ONLY the motor and accessories mounted by Lincoln.

In case of assemblies on a common base, the motor lift ring(s) **CANNOT** be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

4. STORAGE

Motor stock areas should be clean, dry, vibration free and have a relatively constant ambient temperature. For added bearing protection while the motor is in storage, turn the motor shaft every six months.

A motor stored on equipment and component equipment prior to installation should be kept dry and protected from the weather. If the equipment is exposed to the atmosphere, cover the motor with a waterproof cover. Motors should be stored in the horizontal position with drains operable and positioned in the lowest point. **CAUTION:** Do not completely surround the motor with the protective covering. The bottom area should be open at all times.

Windings should be checked with a megohm-meter (Megger) at the time equipment is put in storage. Upon removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Note the sensitivity of properly connected megohm-meters can deliver erroneous values. Be sure to carefully follow the megohm-meter's operating instructions when making measurements.

All external motor parts subject to corrosion, such as the shaft and other machined surfaces, must be protected by applying a corrosion-resistant coating.

5. INSTALLATION

For maximum motor life, locate the motor in a clean, dry, well ventilated place easily accessible for inspecting, cleaning and lubricating. The temperature of the surrounding air should not exceed 104°F (40°C) except for motors with nameplates indicating a higher allowable maximum ambient temperature.

⚠ WARNING	
	<p>MOVING PARTS can injure.</p> <ul style="list-style-type: none"> ● BEFORE starting motor, be sure shaft key is captive. ● Consider application and provide guarding to protect personnel.

5.1 INSTALLATION – MECHANICAL

Base

Mount the motor on a firm foundation or base sufficiently rigid to prevent excessive vibration. On foot-mounted motors, use appropriately sized bolts through all four mounting holes. For frames which have six or eight mounting holes, use the two closest the drive shaft and two on the end opposite the drive shaft (one on each side of the frame). If necessary, properly shim the motor to prevent undue stress on the motor frame and to precision align the unit.

Position

Standard motors may be mounted in any position. The radial and thrust load capacity of the motor's bearing system provides for this feature.

Drains

All motors have drain holes located in the end brackets. As standard, drains are in place for the horizontal with feet down mounting position. Other positions may require either rotation of the end brackets or drilling additional holes to attain proper drainage. Be sure existing drain or vent holes do not permit contaminant entry when motor is mounted in the other positions.

Additional drain holes exist near the bearing cartridge in both end brackets of 284T thru 449T steel frame motors. The drain holes are closed with a plastic plug. When the motor is vertically mounted, the plug located in the lower end bracket must be removed. To access the plug on blower end, simply remove the shroud; on some models, it is also necessary to take off the blower.

Drive – Power Transmission

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Do not drive the unit on the shaft as this will damage the bearings. Coat the shaft lightly with heavy oil before installing pulley.

Belt Drive: Align the pulleys so that the belt(s) will run true. Consult the belt manufacturer's catalog for recommended tension. Properly tension the belt; excessive tension will cause premature bearing failure. If possible, the lower side of the belt should be the driving side. On multiple belt installations be sure all belts are matched for length.


Chain Drive: Mount the sprocket on the shaft as close to the shaft shoulder as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is essential. Secure the motor and driven unit rigidly to the base. Shimms may be needed to achieve proper alignment.

Excessive motor vibration may result if the full length of the motor shaft key is not completely engaged by the coupling or sheave. For these situations, adjustment of the key length is required.

5.2 INSTALLATION – ELECTRICAL

⚠ **WARNING**



ELECTRIC SHOCK can kill.

- Disconnect input power supply before installing or servicing motor.
- Motor lead connections can short and cause damage or injury if not well secured and insulated.

Use washers, lock washers and the largest bolt size which will pass through the motor lead terminals in making connections.

Insulate the connection, equal to or better than the insulation on the supply conductors.

Properly ground the motor — see GROUNDING.

Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate.

Proper branch circuit supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

Short circuit current fuses or breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor.

Each of these should be properly sized and installed per the National Electrical Code and local codes.

Properly ground the motor – See GROUNDING.

Terminal Box

Remove the appropriate knockout. For terminal boxes without a knockout, either a threaded power-conduit entry hole is provided or the installer is responsible for supplying a correctly sized hole.

The majority of terminal boxes can be rotated in place to allow power lead entry from the 3, 6, 9 or 12 o'clock direction.

Motor Connection

All single speed and two-speed Lincoln motors are capable of across-the-line or autotransformer starting. Reference the lead connection diagram located on the nameplate or inside of the terminal box cover.

Single speed motors have reduced voltage start capability per the following chart.

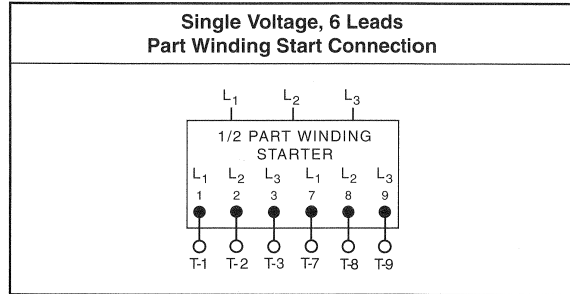
Number of Motor Leads	Number of Rated Voltages	Lead Numbers	YDS	PWS
3	Single	1-3	No	No
6	Single	1-3, 7-9	No	Yes
	Dual	1-6	Yes ⁽¹⁾	No
9	Dual	1-9	No	No
12	Single	1-12	Yes	Yes
	Dual	1-12	Yes	No ⁽²⁾

(1) YDS capability on lower voltage only.

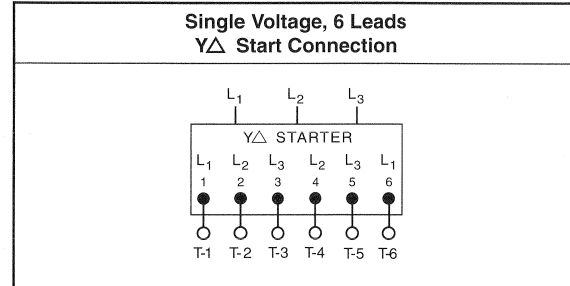
(2) PWS capability on lower voltage only, 1200 RPM, 324T-365T steel frame motors with Model Number efficiency letters of "S" or "H".

Contact Customer Service at 1-800-668-6748 (phone), 1-888-536-6867 (fax) or mailbox@lincolnmotors.com (e-mail) for a copy of across-the-line and other reduced voltage start connection diagrams.

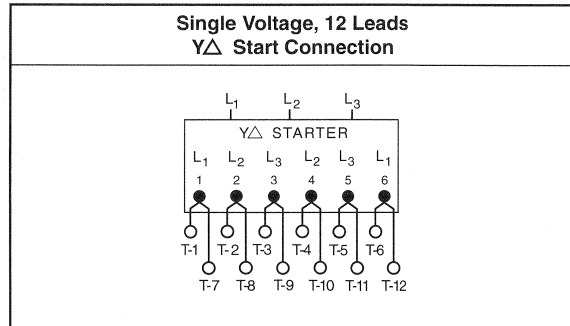
Connection Diagram 1



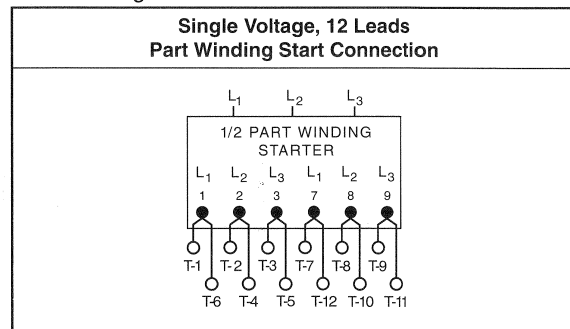
Connection Diagram 2



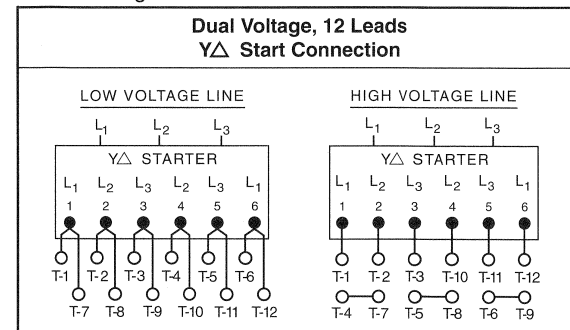
Connection Diagram 3



Connection Diagram 4



Connection Diagram 5



Space Heater (option)

Leads for space heaters are identified as H1 and H2. Heater voltage and watts are marked on the motor nameplate and should be checked prior to connection to power source.

Thermostat (option)

Leads for thermostats (normally closed, automatic reset contacts) are identified as P1 and P2. Connect these to a relay or signaling device. Motor line current cannot be handled by the thermostat.

Table 1 — Thermostat Contact Ratings

Voltage (60 Hz)	110V	220V
Max. Cont. Current (amps)	3.0	1.5
Min. Cont. Current (amps)	0.2	0.1

Thermistor (option)


Leads for thermistors are identified as P3 and P4. Thermistors require connection to Texas Instruments® Control Module Model 32AA or its equivalent for proper operation. This item may be purchased from Lincoln - see LC100 catalog.

Brake (option)

Carefully read and fully understand the instructions supplied by the brake manufacturer (see inside of brake housing or separately enclosed sheet). Contact the brake manufacturer for additional information.

GROUNDING

⚠ WARNING



ELECTRIC SHOCK can kill.


- **Connect the motor frame to a good earth ground per the National Electrical Code and local codes to limit the potential to ground in the event of contact between live electrical parts and the metal exterior.**

Lincoln motors may be electrically connected to earth ground using a terminal box mounting screw or a separate grounding screw when provided. Both are accessible inside the mounted terminal box. When a bronze mounting screw is supplied, always use it as the grounding point. In making the ground connection, the installer should make certain that there is a good electrical connection between the grounding lead and the motor.

6. OPERATION


Three phase squirrel cage induction motors will operate successfully, but not necessarily in accordance with nameplate ratings, at voltages 10 percent above or below nameplated value at the design frequency.

⚠ WARNING



MOVING PARTS can injure.

- **Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury.**
- **Keep away from moving parts.**



ELECTRIC SHOCK can kill.


- **Do not operate with covers removed.**
- **Do not touch electrically live parts.**

After checking that the shaft key is secure, operate the motor free of load and check the direction of rotation. If the motor rotates in the wrong direction, interchange any two supply leads.

Couple the motor to its load and operate it for a minimum of one hour. During this period, check for any unusual noise or thermal conditions. Check the actual operating current to be sure that the nameplate current times service factor is not exceeded for steady continuous loads.

7. MAINTENANCE

⚠ WARNING



ELECTRIC SHOCK can kill.

- **Internal parts of the motor may be at line potential even when it is not rotating.**
- **Disconnect all input power to the drive and motor before performing any maintenance.**

Lincoln motors have been designed and manufactured with long motor life expectancy and trouble-free operation in mind.

Periodically inspect the motor for excessive dirt, friction or vibration. Dust may be blown from an inaccessible location using compressed air. Keep the ventilation openings clear to allow free passage of air. Make sure the drain holes in the motors are kept open and the shaft slinger is positioned against the end bracket. Grease or oil can be wiped by using a petroleum solvent.

Overheating of the bearings caused by excessive friction is usually caused by one of the following factors:

1. Bent shaft.
2. Excessive belt tension.
3. Excessive end or side thrust from the gearing, flexible coupling, etc.
4. Poor alignment.

Damaging vibrations can be caused by loose motor mountings, motor misalignment resulting from the settling or distortion of the foundation, or it may be transmitted from the driven machine. Vibration may also be caused by excessive belt or chain tension.

BEARING SYSTEM

Lincoln motors have a high quality, premium design bearing system. Bearing sizes and enclosures are identified on most motor nameplates. The majority are double-shielded, deep-groove ball bearings. Double-sealed ball bearings are used on some motors in frames 56 and 143T thru 145T. A drive-end cylindrical roller bearing is standard on Crusher Duty motors, frames 405T and larger.

Lubrication instructions and/or grease specifications provided on the motor supersede the following information.

In general, the motor's bearing system has sufficient grease to last indefinitely under normal service conditions. For severe or extreme service conditions, it is advisable to add one-quarter ounce of grease to each bearing per the schedule listed in Table 2. Use a good quality, moisture-resistant, polyurea-based grease such as Chevron SRI #2. Lithium based greases are not compatible with polyurea-based greases; mixing the two types may result in the loss of lubrication.

Motors designed for low ambient applications have bearings with special low temperature grease. Use Beacon 325 lithium based grease or equivalent per the appropriate interval in Table 2.

Motors designed for high ambient applications have bearings with special high temperature grease. Use Dow Corning DC44 silicone grease or equivalent per the interval in Table 2 under "Extreme".

Severe Service: Operating horizontally, 24 hours per day, vibration, dirty, dusty, high humidity, weather exposure, or ambient temperatures from 104-130°F (40-55°C).

Extreme Service: Operating vertically, heavy vibration or shock, heavy duty cycle, very dirty or ambient temperatures from 130-150°F (55-65°C).

Table 2 : Bearing Lubrication Intervals

Motor Syn Speed	Motor Horsepower	Service Conditions	
		Severe	Extreme
BALL BEARINGS			
1800 RPM and slower	1/4 to 7-1/2 HP	2 years	6 months
	10 to 40 HP	1 year	3 months
	50 HP and up	6 months	3 months
above 1800 RPM	all sizes	3 months	3 months
ROLLER BEARINGS			
all speeds	all sizes	3 months	3 months

When adding lubricant, keep all dirt out of the area. Wipe the fitting completely clean and use clean grease dispensing equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

If the motor is equipped with a relief port or tube, make certain it is open and free of caked or hardened grease. Before replacing relief plugs, allow excess grease or pressure to vent by running the motor for several minutes after lubrication.

⚠ CAUTION

- LUBRICANT SHOULD BE ADDED AT A STEADY MODERATE PRESSURE. IF ADDED UNDER HEAVY PRESSURE BEARING SHIELD(S) MAY COLLAPSE.
- DO NOT OVER GREASE.

PARTS

All parts should be ordered from Authorized Motor Warranty Stations. Call your Lincoln Motors Sales Office for location and phone number. A "Service Directory" listing all Authorized Motor Warranty Stations by geographic location is available; request Bulletin SD-6. These shops stock GENUINE Lincoln replacement parts and have factory trained personnel to service your motor.

8. WHO TO CALL

For the location and phone number of the Lincoln Motors District Sales Office nearest you, check your local Yellow Pages or call 1-800-MOTOR-4-U (1-800-668-6748) or visit our web site at # www.lincolnmotors.com.

9. WARRANTY

Lincoln Motors, the Seller, warrants all new *standard* motors and accessories thereof against defects in workmanship and material provided the equipment has been properly cared for and operated under normal conditions. All warranty periods begin on the date of shipment to the original purchaser. Warranty periods for **low voltage (< 600 V)** motors are defined in the following chart. The warranty period for **medium voltage (> 600 V)** motors is one year on sine-wave power. Contact Lincoln for warranty period on PWM power.

Model Number Prefix	Efficiency Code(s)	Frame Sizes	Warranty Period	
			Sine-Wave Power	PWM Power
AA, AF, AN	S, P, B	143T-286T	5 Yrs	2 Yrs*
CF, SD	M	143T-215T	2 Yrs	1 Yr
CF, CN, CS, CP	E, H, P, B	143T-449T	5 Yrs	2 Yrs*
		182U-449U	5 Yrs	2 Yrs*
C5, C6	H, P	M504-689	3 Yrs	Contact Lincoln #
MD, SE	S	284T-445T	5 Yrs	1 Yr
RC, RJ, SC	H	56-145T	5 Yrs	2 Yrs*
RD, RF	S	56-56H	5 Yrs	2 Yrs*
REW, SEW	S	56-256T	1 Yr	1 Yr
SD, SF	S, H, P, B	143T-449T	5 Yrs	2 Yrs*
Field Kits and Accessories			5 Yrs	

* Applies to motors with a service factor of 1.15 or higher. Motors with a 1.0 service factor have a 1 year warranty on PWM power.

If the Buyer gives the Seller written notice of any defects in equipment within any period of the warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided the Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to accessories or equipment, either expressed or arising by option of law or trade usage or otherwise implied, including with limitation the warranty of merchantability, all such warranties being waived by the Buyer.



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- indicates change since last printing.



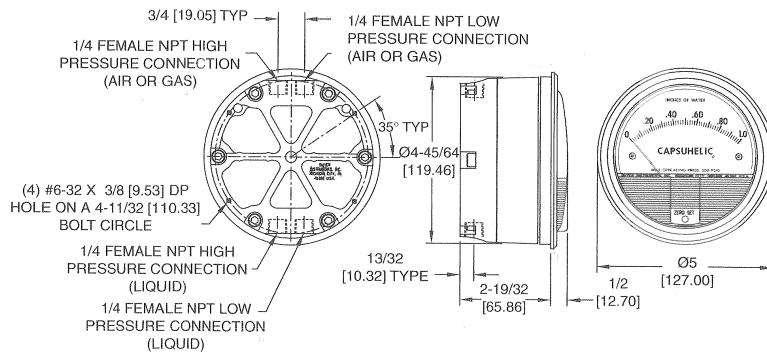
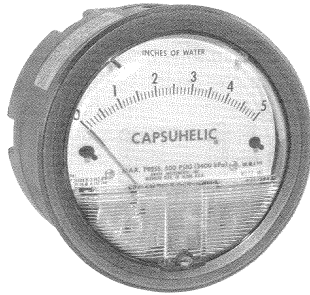
APPENDIX VIII

Air Flow Gauge (Capsuhelic) Calibration & Maintenance Data



Series 4000 Capsuhelic® Differential Pressure Gage

Specifications - Installation and Operating Instructions



CAUTION: Use of a line filter (Dwyer model A-391 or equivalent) is recommended to prevent entry of liquid borne particles into gage. Dwyer Instruments cannot assume responsibility for failure of gages due to clogging of internal passages.

NOTE: DO NOT use with hydrogen gas. Toxic and/or explosive gas may form due to reaction with rare earth magnet.

CAPSUHELIC® INSTALLATION

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 200°F. Sensing lines may be run any necessary distance. For example, 250 foot lines will not affect accuracy but will damp the reading slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult factory for means of providing additional damping.

2. All standard models are calibrated for use with the diaphragm and scale in a vertical position. Special factory calibration is necessary for operation in an inclined or horizontal position. The exceptions are ranges under 5 in. w.c., (or metric equivalents) which can only be calibrated for vertical operation.

SPECIFICATIONS

Service: Aluminum Case: Air and compatible gases and oil based liquids. Brass Case: Air and compatible gases and water based liquids.

Wetted Materials: Consult factory.

Housing: Die cast aluminum with impregnated hard coating, standard. Optional forged brass housing is required for water or water based fluids. Special material diaphragms available, contact factory.

Accuracy: ±3% of full scale at 70°F (21.1°C). (±2% on 4000S models, ±4% on 4200, 4210, 4215, 4220, 4300, 4400, and 4500).

Pressure Limits: -20" Hg to 500 psig. (-0.677 bar to 34.4 bar).

Temperature Limits: 20 to 200°F. (-6.67 to 93.3°C).

Size: 4" (101.6 mm) diameter dial face.

Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.

Process Connections: 1/4" female NPT high and low pressure taps, duplicated -one pair top for air and gas, and one pair bottom for liquids.

Weight: 3 lb, 3 oz (1.45 kg) aluminum case;
7 lb, 13 oz (3.54 kg) brass case.

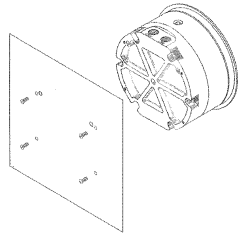
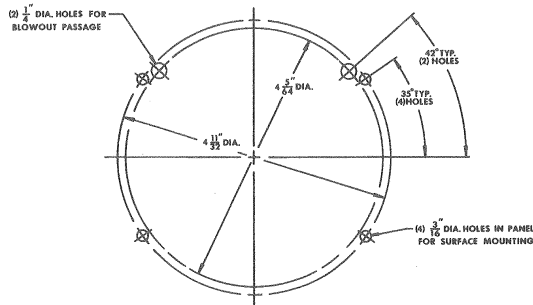
Standard Accessories: Two 1/4" NPT plugs for duplicate pressure taps, four flush mounting adapters with screws and four surface mounting screws.

DWYER INSTRUMENTS, INC.
P.O. Box 373 • Michigan City, IN 46361, U.S.A.

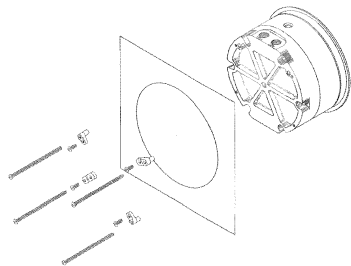
Phone: 219/879-8000
Fax: 219/872-9057

www.dwyer-inst.com
e-mail: info@dwyer-inst.com

3. Surface Mounting



Locate 4 mounting holes, 35° from horizontal centerline on a 4-11/32" dia. circle. Use No. 6-32 machine screws of appropriate length. Be sure to drill 1/4" holes for blowout protection as shown in the diagram.



4. Flush Mounting

Provide a 4-13/16" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with mounting lugs firmly secured in place.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

CAUTION

Note location of blowout or vent holes in the surface mounting diagram. Do not block these holes as their function is to vent overpressure failure out the back of the gage rather than blowing off the front cover.

Important Notes:

Two pairs of high and low pressure taps are provided, one pair on the top and a duplicate pair on the bottom. These fittings may be utilized according to the type of service for which the gage will be used. For gas or vapor service the gage should be connected from the pressure source to the top pressure fittings so that any accumulation of condensate may be drained or bled out the bottom fittings. For liquid service the pressure source should be connected to the bottom taps so that any trapped gas may be vented out the top fittings. Optional bleed fittings may be obtained to replace the standard 1/4 NPT plugs for installations requiring frequent draining or venting of the gage. Note that the unused pair of pressure taps must be plugged in order for the gage to operate. For straight pressure or vacuum applications where only one of a pair of high and low pressure taps are being utilized, the other tap must be open to atmosphere.

For portable use or temporary installation use 1/4 male NPT to male flare fitting and connect to pressure source with high pressure hose or tubing with flare nut connectors. For permanent installation 1/4" OD copper or stainless steel tubing is recommended.

Proper installation of fittings and plugs is important. Sparingly apply pipe thread sealant to threads. Excessive amounts can fall into pressure passages and cause blockage. We recommend Loctite® 69-31 Hydraulic Sealant. Install using torque wrench. Tighten only to 20 ft/lbs. Over-tightening can damage case.

CAPSULELIC® MAINTENANCE

Note: Capsuhelic® differential pressure gages are high precision instruments assembled and calibrated in a modern factory. If trained instrument mechanics are not available, we recommend that any instruments requiring repair be returned to the factory.

1. No lubrication or periodic servicing is required. If the interior is protected from dust, dirt, corrosive gases and fluids, years of trouble free service may be expected.

2. For service requiring a high degree of continued accuracy, periodic calibration checks are recommended. Send back to the factory for re-calibration.



APPENDIX IX

Pressure Gauge Calibration Data



APPENDIX X

Instrument Certification Notice



Instrument Certification Notice

The gauge Certificates of Calibration supplied for the gauge(s) on this unit contain the calibration data for the actual instrument calibrated, along with the calibration date of the **STANDARD** used to perform the calibration check.

The due date for re-calibration of the instrument should be based upon the date the instrument was placed in service in your facility. Re-calibration should be done on a periodic basis as dictated by the end user's quality system or other overriding requirements.

Note that Tronair, Inc. does not supply certificates of calibration on flow meters or pyrometers unless requested at the time of placed order. These instruments are considered reference indicators only and are not critical to the test(s) being performed on the aircraft.