

OMEGA* User's Guide



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WT-2000 Thermal Wind Tunnel



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WT-2000 Thermal Wind Tunnel



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Section 1 - Introduction

1.1 Description

The new Thermal Wind Tunnel Model WT-2000 is designed to produce variable flow rates inside a rectangular 17 by 3 ¼" cross sectional area test chamber. The Wind Tunnel has an electronic control unit where it controls the four compact, high power density fans. Velocity can be controlled via simple push button user input, or by the Free PC based software control via USB cable for optimum performance.

The Thermal Wind Tunnel is recommended for the testing of circuit boards and heat sinks, as well as other temperature related products. The four fans can be controlled independently, in groups of two, or all together to produce a wide range of different air flows.

OMEGA offers a complete line of temperature sensing equipment including thermocouple and RTD probes and their corresponding panel and bench top meters as well air velocity meters such as hot wire anemometers.

Figure 1 and 2 – Illustrate the important components of the wind tunnel as well as its overall dimensions (1.2, 1.3). Figure 3 – Shows the front and side view of the Electronic Control Box (2.1). Figure 4 – Shows the rear panel of the Electronic Control Box (2.1).

1.2 Unpacking

Remove the packing list and verify that you have received all equipment. If you have any questions a bout the shipment, please call Customer Service Department at **1-800-622-2378** or **203-359-1660**. We can also be reached on the Internet at **omega.com**, e-mail: **info@omega.com**. When you receive the shipment, inspect the container and equipment for any signs of damage. Note any evidence of rough handling in transit and immediately report any damage to the shipping agent.

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

Items included with your WT-2000 Package:

- 1. Wind Tunnel
- 2. Electronic Control Box
- Power Cord
- 4. PC Interface Control Software
- USB Cable for PC Interface
- 6. Fan Control Cable
- 7. Package of Compression Fittings with PTFE Compression Ferrules
- 8. Package of Port Hole Caps
- 9. Operator's Manual

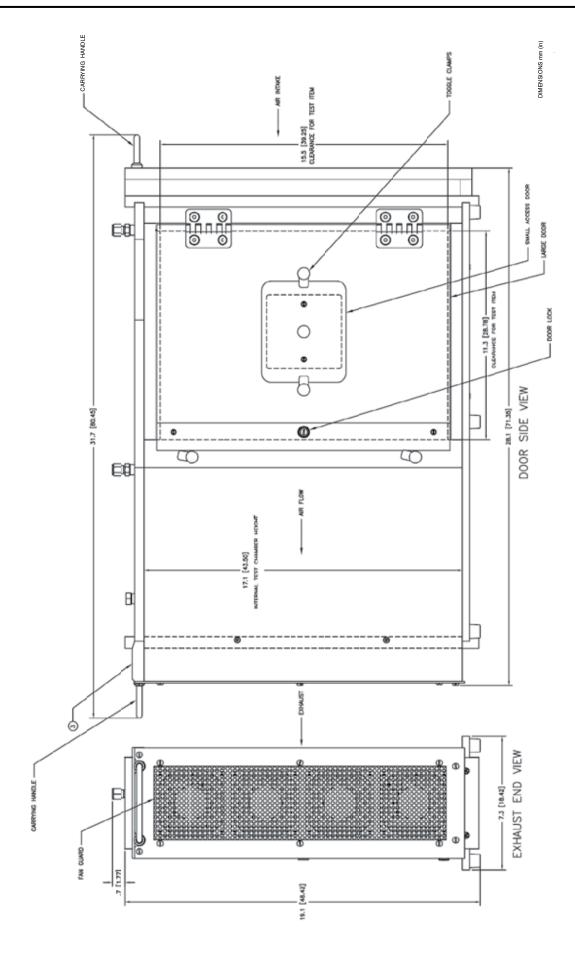


Figure 1. Wind Tunnel Door Side and Exhaust End Views

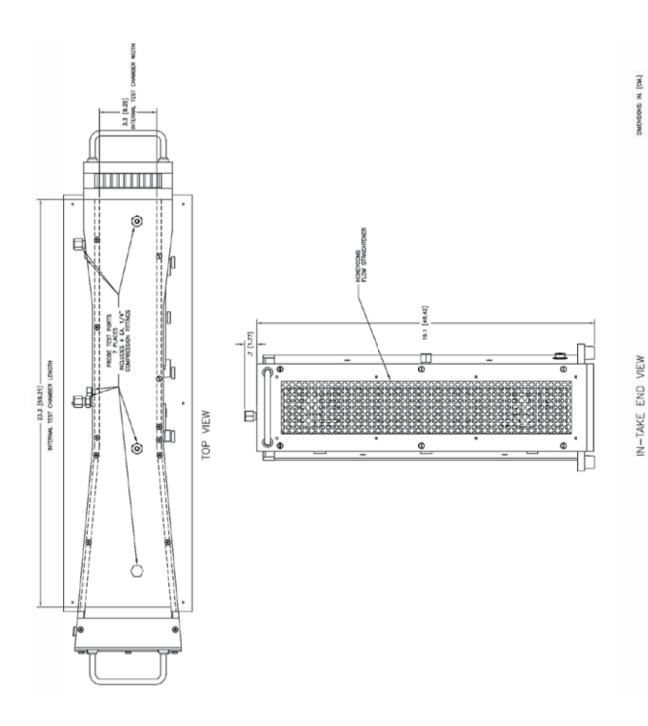


Figure 2. Wind Tunnel Top and In-take End Views

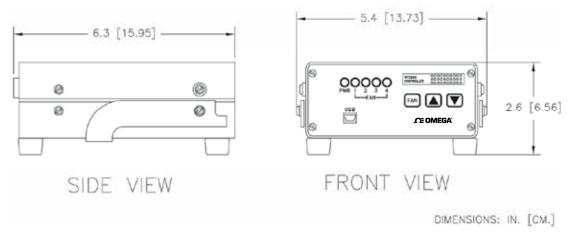


Figure 3. Electrical Control Box Front and Side Views



Figure 4. Electrical Control Box Rear Panel

Section 2 - Operation

2.1 Setting Up the Wind Tunnel - Precautions

A wind tunnel's performance can be severely diminished if not used properly. Please follow the following tips:

- Do not use the wind tunnel in rooms with less than 1800 cubic feet. The air flow creates currents that undermine the wind tunnel's accuracy.
- Place the wind tunnel on a flat and level surface.
- Avoid locating the intake and exhaust toward open windows, door ways or corridors where people are walking. The effect of air current changes across the intake has a severe affect on the flow rate changing in the wind tunnel.
- There should be at least 1.5 m (5 feet) clear space in front of and behind the wind tunnel. No obstacles, moving objects, or open doors or windows.
- Locate the exhaust towards the largest open area of the room to minimize room air currents. The higher the flow rate, the more chance of creating currents.
- The air flow rate of the wind tunnel depends on the air temperature and barometric pressure. Adjust it accordingly. See Section 6.2 for Hot Wire Anemometer correction factors.
- This instrument should only be used for its intended purpose in accordance to the instruction manual.

2.2 Placing a Unit Under Test (UUT) in the Wind Tunnel

- Ensure that the Electronic Control unit is off before opening the wind tunnel door or access panel.
- Loosen the screws that secure the slides by turning them counterclockwise to allow them to move freely.
- Secure the UUT by using the clips or slots in the slides. Secure the slides by turning the screws clockwise. Ensure that the UUT is as close as possible to the center of the slide assembly of the wind tunnel. Keep in mind that even the smooth inner walls of the wind tunnel may introduce some turbulence in the flow of air.

2.3 Operating the Wind Tunnel

Before operating the wind tunnel, please follow all the precautions stated in the previous sections and then proceed as follows:

- 1- Make sure the power switch in the back of the electronic control unit is off, then connect the cable from the DC Fans on the Wind Tunnel to the back of the Electrical Control box labeled 'Fan Control'.
- 2- Connect the AC input of the Control unit to a line voltage (90 to 264 VAC @ 50/60 Hz) with the Power cord provided. Please refer to the accessory table for power cords for other countries.
- 3- Turn on the Power switch in the back. The power LED indicator on the front of the control box will turn on.
- 4- The four fan LEDs show which fan velocity is going to be modified using the up and down arrows. Once a fan velocity has been set using the arrow keys it will maintain the same velocity, even if the FAN button is pushed to control a different fan or combination of fans. Pushing the FAN button cycles through the possible selections: Fan1 only, Fan2 only, Fan3 only, Fan4 only, Fan1&Fan3, Fan2&Fan4, Fan2&Fan3, Fan1&Fan4, or all 4 Fans. For optimum performance use the supplied PC Interface Software to control the fans. See Section 2.4 for details.
- 5- To change the fan speed, use the arrow up and arrow down keys. They may be pressed and released for small adjustments, or held for larger adjustments.

2.4 PC Interface (Optional)

2.4.1 Introduction

After following the steps in the previous section for Operating the Wind Tunnel, you can optionally connect the USB Cable from a PC with the Omega Wind Tunnel Control Software to the Wind Tunnel Electrical Control Box. This simple software allows for quick, precise open loop control of the DC Fan velocities. Connecting the USB cable to the electrical control Box will "lockout" the front panel buttons on the Electrical control box. The user can verify that the front panel is "locked out" when the 4 Fan LEDs are extinguished.

In order to use the PC Interface, you must install the software from the CD-ROM provided with your order of the WT-2000.

2.4.2 System Requirements

Your PC should meet the following minimum requirements:

- Pentium Class or higher processor
- Hard Drive Space: 30 MB
- Ram: 256 MB
- 1 Available USB Port
- 1 CD-ROM Drive

2.4.3 Software Installation

Insert the WT-2000 User Software CD that was included with your unit into the CD-ROM drive on your PC. Your system should begin the installation process automatically. If it does not automatically start, open my computer and double click on the D: Drive (or the drive in which the User Software CD is located). Then double click the Setup.exe installation file.



Figure 5. Welcome Screen

This Welcome Screen should be visible on your computer screen. Click the "Next >" button to continue installing the program.



Figure 6. License Agreement Screen

Please read the license agreement and you must select "Agree" to continue installing your program. After making your selection, click the "Next >" button. The setup wizard will now install the software.

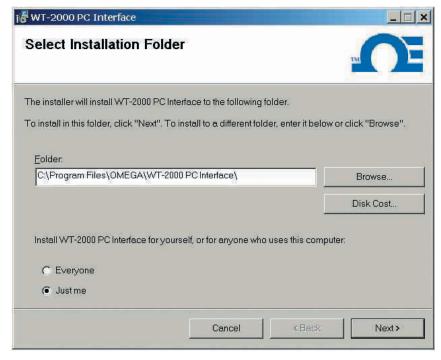


Figure 7. Select Installation Folder Screen

From this screen you can select the folder were you want the program files installed on your PC. The default setting will install the software in your "Program Folders" under the folder structure "Program Folders\Omega\WT-2000." You may optionally install the software for just the "Current user" windows account or for "Anyone who uses this computer." Click the "Next>" button to continue installing the program.

2-4

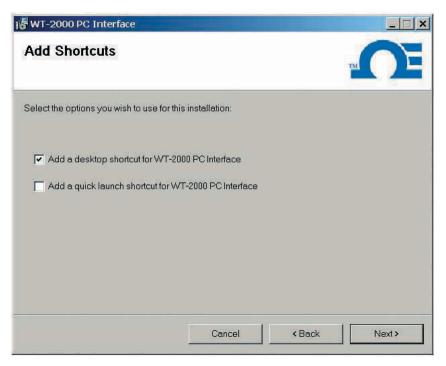


Figure 8. Add Desktop Icon and Quick Launch Icon Screen

From this screen you can optionally add an Icon for the WT-2000 User Software to your Windows desktop and/or quick launch toolbar.

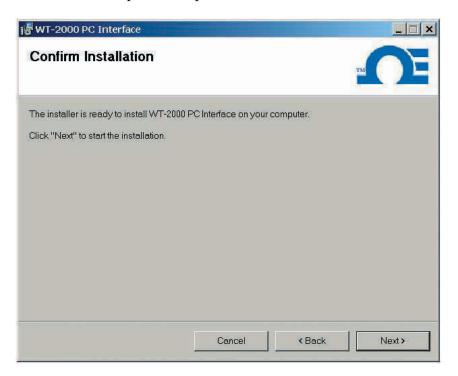


Figure 9. Confirm Installation Screen

Click the "Next >" button to confirm installation settings.

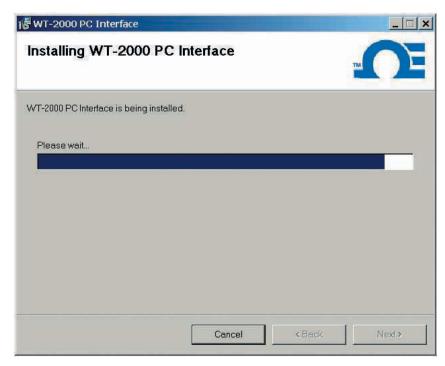


Figure 10. Software Installation Screen

A progress bar indicates installation progress.

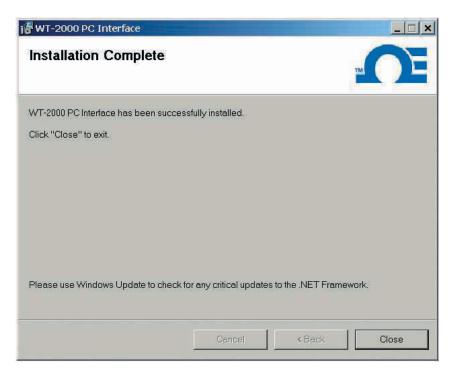


Figure 11. Software Installation Complete Screen

Congratulations! You have finished installing the WT-2000 User Software on your computer. To close the finished setup program, click the "Close" button.

2.4.4 USB Driver Installation

To install the USB software drivers that are required for your WT-2000 Controller to work properly please follow these procedures.



You need to have the User Software CD that was supplied with your WT-2000 Wind Tunnel and Controller loaded into the CD-ROM drive of your PC.

- 1. Make sure the WT-2000 Controller power switch is in the off position before connecting it to the computer using the USB cable.
- 2. Connect the WT-2000 Controller by connecting the supplied USB cable between an unused USB port and the WT-2000 Controller.
- 3. Turn the power switch on the back of the WT-2000 Controller to the on " \mid " position.
- 4. You should see a notice box that indicates that you computer has "Found New Hardware."



Figure 12. Found New Hardware Notice Box

5. Your computer will then launch the Found New Hardware Wizard. Follow the instructions indicated on the Wizard boxes and the additional instructions noted in this manual.



After completing the Found New Hardware Wizard, your system will ask that you repeat this process. This is normal. You should repeat the steps outlined here twice. After the second driver is installed you should then get the "New Hardware Ready for Use" notification.



Figure 13. Welcome to the Found New Hardware Wizard Screen

From this box you should check the "No, not this time" button. Then click the "Next >" button to continue with the driver installation process.

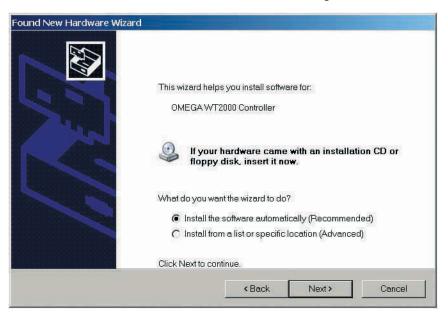


Figure 14. Install Software Automatically Screen

Next, check the "Install the software automatically" button. Then click the "Next >" button to continue.

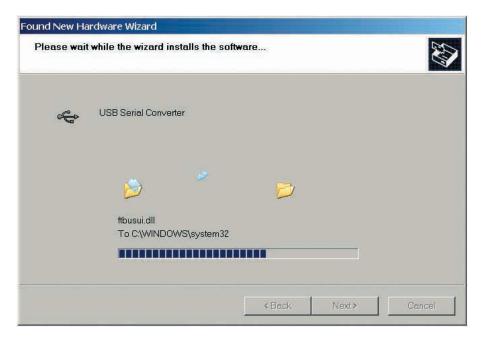




Figure 15. Completing the Found New Hardware Wizard Screen

This screen will be displayed to indicate that the software drivers have been installed. You should click the "Finish" button to complete the process.

2.5 WT-2000 PC Interface Program

2.5.1 Launch Program

To launch the WT-2000 PC Interface program on your PC, begin by accessing the "Programs" list under your "Start" menu. Next, scroll through the list of program folders to find the "Omega" folder. Inside that folder click on the "WT-2000 PC Interface" program link. (Additionally, if you selected the appropriate options during installation, there should also be a WT-2000 PC Interface Icon on the Desktop and/or in the Quick Launch toolbar that you can click to start the program.)

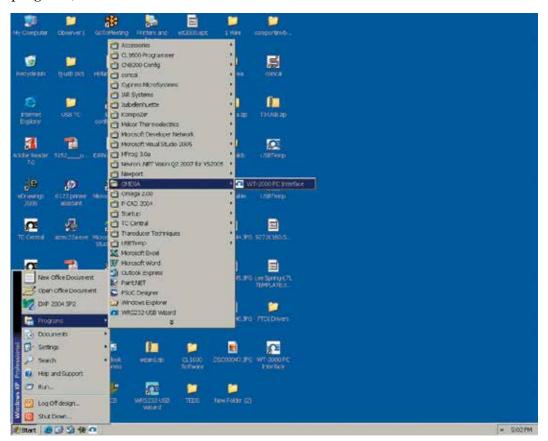


Figure 16. Start Button/Launch Program Screen

2.5.2 Connecting to the WT-2000 Controller

Ensure that the line cord, fan control cable and USB cable are connected to the WT-2000 Controller as specified in sections 2.3 and 2.4.1.

The available Com ports will load when the program is started. To refresh this list, Click "File" on the menu bar and click "Refresh COM Ports." Select the COM Port which has been assigned to the WT-2000 Controller, and click Connect. The rest of the controls will become accessible after a proper connection has been established.

2-10

2.5.3 Using the Program to Control the Wind Tunnel

There are two distinct ways to control the wind tunnel using the WT-2000 PC interface:

- 1) On the left of the window are the single fan controls. The user can enter a value between 0% and 100% by either typing a value in the text box, using the mouse to click the up or down buttons on the program, or by using the up and down arrows on the keyboard. When typing in a value, the user must press "Enter," "Return," or "Tab" on the keyboard to update the value and move to the next control; or use the mouse to navigate to another control.
- 2) On the right, there are fan selection boxes and group preset buttons. To use them, check off the fans for which you want to control, and use the preset buttons to change the velocity for each selected fan. The new velocities will be reflected in the Single Controls on the left side of the page, and fine tuning can be completed in the Single Controls box.



The value in the control represents a linear percentage of fan velocity within the reliable operation of the fan. The values are NOT a true percent of fan velocity, because the fans do not operate reliably below a certain threshold. Both the Controller alone and the Software interface establish the 1% value as slightly above that threshold so that the fans are always running within their reliable operation range.

Section 3 - Sensing

3.1 Ports

The WT-2000 Wind tunnel has been built with the ability to accommodate for a wide variety of sensors, including temperature sensing devices (such as thermocouples, RTDs, and thermistors), and air velocity sensors (such as hot wire anemometers). There are several ports that can be used to allow for sensors to be inserted into the wind tunnel for measurement during operation. Compression fittings and port hole caps have been included for insertion into desired ports.

3.2 Notes

There are many factors to consider while sensing temperature and flow inside the wind tunnel. Please consider the following points:

- Open ports may dramatically affect air flow. Please seal measurement ports and close the door tightly to ensure proper flow.
- Air flow will change with the size and shape of the unit under test.
- Avoid the use of large temperature sensing probes on small devices. They may act as heat sinks; especially with high air velocity. It is suggested to use surface mounted types of temperature sensors for better accuracy.
- Avoid damage to the Honeycomb flow straightener.
- When using the compression fittings for holding probes in place, use the Teflon ferrule inserts to hold the probe by hand tightening the compression fitting. Do not use tools or wrenches.

4 Calibration

Section 4 - Calibration

4.1 Hot Wire Anemometer Calibration

The wind tunnel produces a highly uniform flow and is therefore capable of calibrating hot wire anemometers. It is recommended to use one calibrated probe as a standard and place the probe to be calibrated in close proximity but not in opposition to airflow. The probes should be of the same type for the best results. See section 6.2 for hot wire anemometer correction factors.

Section 5 - RS232 Communication

5.1 Introduction

The Wind Tunnel controller has the ability for RS 232 communication through a USB port. There is a USB to Serial RS 232 communication chip within the controller that allows for a PC with the proper drivers installed to recognize the WT-2000 controller as a serial RS 232 device connected through a COM Port. This allows for the simplicity of RS 232 communication and the convenience of using any open USB port.

5.2 Serial Communication Parameters



Note that both the WT-2000 Controller and the computer must be communicating with the same serial communications parameters to establish a working communication link.

The serial communications parameters should be as follows:

Baud Rate: 9600

Data Bits: 8
Parity: None
Stop Bits: 1

Flow Control: None

5.3 Commands

Valid commands are in the following format:

1) ENQ [CR/LF] - a command that causes the controller to return with the following message:

WT-2000

xxxxxx where xxxxxx is the firmware version number.

2) PWM *fan#* *vel* [CR/LF]

where *fan#* is a value between 0 and 3; each number representing one of the 4 fans to control. Fan 0 is the highest fan in the assembly and Fan 3 is the fan closest to the base of the wind tunnel.

vel is a value between 0 and 2400. The fans will not start reliably below a value of 300, so they should never be issued a command that would have them run at a value greater than 0 but less than 300.

The controller will echo back the command in the following format:

PWM *fan#* = *vel* to confirm that the message was received.

If the message was attempting to force a parameter out of range, the controller will send a message to show what the value was actually changed to (typically the highest or lowest value depending upon which direction the outgoing message was out of range). The controller may send back BAD COMMAND if it receives an invalid message. Note, only the RS232 protocol is supported by the USB serial port. A standard USB cable with one "A" connector end on the PC side end and a "mini B" connector end on the controller side should be used.

[CR/LF] - Every transmission must be terminated with a carriage return [CR] character. The line feed [LF] character is optional. This can usually be accomplished by pressing the enter or return key.

Section 6 - Specifications

6.1 Specifications

Test Chamber: 17 x 3.25" Cross Section

Flow Rates: 0 to 5 m/s (1000 FPM)

Speed: 3800 RPM

DC Fan Motor: 12 Vdc @ 0.47A ea. (5.6W ea.)
Noise: 61 dBA from 1 meter away

Power Input: 90-264 Vac @ 47-63Hz

Fuse: 2A Fast Acting 5x20mm Cartridge Type

Operating Temperature: 5 to 45°C (41 to 113°F)

Operating Relative Humidity: Less than 80% RH without condensation

Size:

Wind Tunnel: 80.5 L x 18.4 W x 48.4 cm H

(31.7 L x 7.3 W x 19.1" H)

Electrical Control Box: 16 L x 13.8 W x 6.7 cm H

 $(6 \frac{1}{4} L \times 4 \frac{7}{16} W \times 2 \frac{1}{16} \text{" H})$

Weight:

Wind Tunnel: 12.48 kg (27.5 lb)

Electrical Control Box: 0.9 kg (2 lb)



All specifications measurements taken at an ambient room temperature of 70°F (22.2°C) with less than 80% relative humidity and 29.92 inches of Hg barometric pressure.

6.2 Hot Wire Anemometer Correction Factors

When using Hot Wire Anemometers in conditions that are other than the standard condition - 29.92 inches of Hg and 70°F (22.2°C), correction factors must be used. The correction factor equation for K1 is as follows.

 $K1 = (29.92/P) \times (460 + T)/530$; where

P = the Barometric pressure in inches of Hg

T =the ambient temperature in $^{\circ}F$.

There is a second correction factor which is a function of the air probe geometry (K2).

6-1

Table 1 lists K2 for different Hot Wire Anemometer probes offered by Omega Engineering. So the actual air velocity is as follows:

Actual Velocity (FPM) = Measured average value over one minute time interval (FPM) \times K1 \times K2.

Model No.	Description	Half Velocity	Full Velocity
 FMA-904	Hot Wire 0 -2000 FPM	1.04	1.00
FMA-905	Hot Wire 0 -5000 FPM	1.00	1.00
 HHF42	Hot Wire 40-3940 FPM	1.04	1.00

Table 1 - K2 Correction Factor

Example: An FMA-904 Hot Wire anemometer is being used in the Wind Tunnel at half velocity (~500 FPM). The measured environmental conditions are:

Barometric Pressure = 27.88 inches of Hg

Ambient Temperature = 80° F

The FMA measures 442 FPM. Calculate the actual air speed:

Actual Air speed (FPM) = Measured average value over one minute time interval (FPM) \times K1 \times K2.

 $K1 = (29.92/P) \times (460 + T)/530$

 $K1 = (29.92/27.88) \times (460 + 80)/530$

K1 = 1.093

From Table 1, K2 for FMA-904 @ Half Velocity is 1.04.

Actual Air speed = 502 FPM

Section 7 - Troubleshooting 7.1 Troubleshooting

Problem	Solution		
Scraping noise from area of fan	Check for obstructions, Realign position of the fans		
The wind tunnel is not on- LED power indicator is not on	 Make sure the motor controller is plugged into a live outlet. Make sure the ON/OFF switch on the electrical control box is in the "ON" position Check the fuse in the electrical control box controller-if blown replace with same type and rating. 		
The wind tunnel is not on – fan does not turn	 Be sure the fan control cable is connected to both the wind tunnel and the electrical control box. Check for Fan obstructions Press the FAN key until all 4 fans' LEDs are lit indicating control of all 4 fans. Press and hold the UP arrow key to ramp up the fans in order to confirm that all 4 fans are working properly. 		
Electrical Control Box keys are inoperative, but the LED power indicator is lit	 Disconnect the USB cable from the computer and the Electrical Control Box to unlock the keypad. Cycle Electrical Control Box Power by switching the ON/OFF switch into the OFF position and then turning back ON to reset the Control Box. 		

7-1

Section 8 - Maintenance

8.1 - Maintenance

The following points should be adhered to for a maintenance-free operation of the wind tunnel.

- Make sure the wind tunnel is operating in a relatively dirt-free room that is at least 1,800 cubic feet.
- If the fan blades, guards, or honeycomb flow straightener should get dirty for any reason, they can be cleaned very easily using a mild soap or detergent. Do not use any solvents.
- Use only light touch to clean the honeycomb flow straightener. Do not use excessive pressure, as this will damage it.

Spare Parts and Replacement Parts

Description	Omega Part Number
Compression Fittings (1/4")	SSLK-14-14
Compression Fittings (1/2")	SSLK-12-12
Reducer (1/2 to 1/4")	RB-12-14-SS
Honeycomb Flow Straightener	WTT-0014
Thumb Screws	WT-0060
USB Cable	UWTC-0006
Fan Control Cable	WIT-0063
Power cord (USA, Mexico, Canada)	POWER CORD-MOLDED
Power cord (Denmark)	POWER CORD-DM
Power Cord (Continental Europe)	POWER CORD-E-10A
Power cord (Italy and Ireland)	POWER CORD-IT
Power cord (United Kingdom)	POWER CORD-UK
Power cord for all countries (Stripped Ends) 250VAC max	POWER CORD-SE



NOTES:

WT-2000 Thermal Wind Tunnel



NOTES:

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one** (1) **year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

- 1. Purchase Order number under which the product was PURCHASED,
- 2. Model and serial number of the product under warranty, and
- 3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

- 1. Purchase Order number to cover the COST of the repair,
- 2. Model and serial number of the product, and
- 3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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TEMPERATURE

☑ Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies

Wire: Thermocouple, RTD & Thermistor

☑ Calibrators & Ice Point References

Recorders, Controllers & Process Monitors

Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

☑ Transducers & Strain Gages

☑ Load Cells & Pressure Gages

Displacement Transducers

☑ Instrumentation & Accessories

FLOW/LEVEL

☑ Rotameters, Gas Mass Flowmeters & Flow Computers

Air Velocity Indicators

☑ Turbine/Paddlewheel Systems

☑ Totalizers & Batch Controllers

pH/CONDUCTIVITY

Benchtop/Laboratory Meters

☑ Controllers, Calibrators, Simulators & Pumps

☑ Industrial pH & Conductivity Equipment

DATA ACQUISITION

Communications-Based Acquisition Systems

☑ Data Logging Systems

Wireless Sensors, Transmitters, & Receivers

☑ Signal Conditioners

☑ Data Acquisition Software

HEATERS

Heating Cable

☑ Cartridge & Strip Heaters

☑ Immersion & Band Heaters

Flexible Heaters

Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

Metering & Control Instrumentation

☑ Refractometers

Pumps & Tubing

Air, Soil & Water Monitors

☑ Industrial Water & Wastewater Treatment