User's Guide

OMEGA®

An OMEGA Technologies Company

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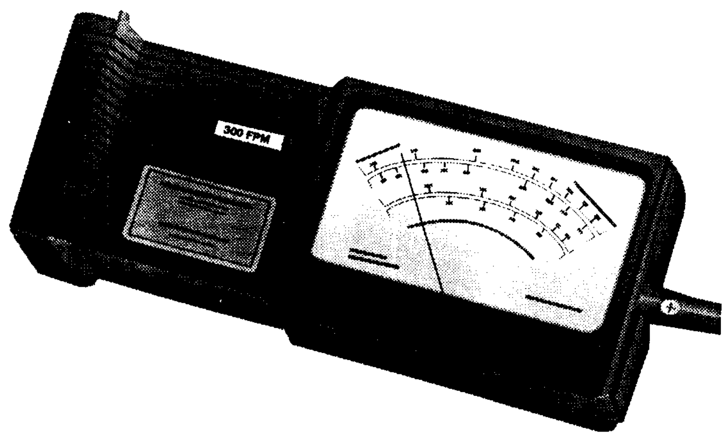

HHF600 SERIES
Air Velocity Meters

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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

Unpacking Instructions

Remove the Packing List and verify that you have received all equipment, including the following (quantities in parentheses):

- Combination Air Velocity/Temperature* Probe with integral cable
- Handheld Analog Readout
- Static Pressure Adaptor*
- NiCad Battery and Charger
- Carrying Case

*For Temperature and Pressure Models

If you have any questions about the shipment, please call the OMEGA Customer Service Department.

When you receive the shipment, inspect the container and equipment for signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

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

1.1 General Description

The HHF600 Series Portable Air Velocity Meter is a lightweight, versatile instrument that can be used anywhere to measure air velocity, temperature, and air static pressure. The meter and probe weigh less than 3 pounds (1.3 Kg). Applications include hood velocity, clean rooms, OSHA compliance, ventilation ducts and outlets, heating and air-conditioning, wind tunnels, product development, air-flow research, mass-flow measurement in ducts, and high temperature measurements in stacks and hot gas flows.

The HHF600 Series meter is a rugged, portable instrument intended for the rigors of field use. The meter, probe and cable, battery charger, and pressure attachment (where applicable), are all enclosed in the handy carrying case for transporting to the field. The meter has a taut-band movement and can withstand a five foot drop in the field. The large sensor is the most rugged of its kind and is resistant to dirt, contamination, and breakage. It is easily cleanable by using water or alcohol and a small artist's brush.

HT models can be operated in stacks or hot gas flows up to 425°F, or 218°C. This maximum temperature should not be exceeded. Since the sensor is glass coated, stacks with hydrofluoric acid should be avoided.

1.2 Available Models

Model	Velocity	Temperature	Pressure
HHF610	0-300 FPM 0-1250 FPM 0-2500 FPM	–	0-3 in. H_2O
HHF615	0-300 FPM 0-1250 FPM 0-6000 FPM	−40° to 250°F	–
HHF615 M	0-1.5 m/sec 0-6 m/sec. 0-30 m/sec.	−40° to 125°C	–
HHF615 HT	0-300 FPM 0-1250 FPM 0-6000 FPM	0 to 425°F	–
HHF615 MHT	0-1.5 m/sec. 0-6 m/sec. 0-30 m/sec.	0 to 218°C	–
HHF616	0-300 FPM 0-6000 FPM	−40° to 250°F	0-5 in. H_2O
HHF616 M	0-1.5 m/sec. 0-30 m/sec.	·40° to 125°C	0-120 mm H_2O
HHF617	0-300 FPM 0-2500 FPM 0-12,000 FPM	–	0-5 in. H_2O
HHF617 M	0-1.5 m/sec. 0-10 m/sec. 0-60 m/sec.	–	0-120 mm H_2O
HHF618	0-100 FPM 0-300 FPM 0-1250 FPM 0-6000 FPM	–	–
HHF619	0-300 FPM 0-1250 FPM 0-6000 FPM	–	0-5 in. H_2O
HHF619 M	0-1.5 m/sec 0-6 m/sec. 0-30 m/sec.	–	0-120 mm H_2O

HT Option: High Temperature Operation, to 425°F, includes special 304SS probe with 15 ft. cable.

1.3 Principle of Operation

The air velocity probe has two sensors: a velocity sensor and a temperature sensor. The velocity sensor is a self-heated platinum resistance temperature detector (RTD). The bridge circuit continuously maintains the velocity sensor at a constant temperature differential above ambient (approximately 30°F). The velocity sensor measures the cooling effect of the air as it passes over it. The temperature sensor compensates for changes in ambient temperature. Note: Temperature compensation can only be done at OMEGA Engineering and is a proprietary process.

Since the heat is carried away by the molecules in the air, the sensor measures air mass velocity, referenced to "standard" conditions of 25°C and 760 mm of mercury. For most applications, standard velocity is the desired quantity. For "actual" velocity, the standard velocity is simply multiplied by the air density relation described in Section 4, Calculating Actual Velocity.

The voltage/velocity curve is a non-linear function, with ever increasing sensitivity as velocity decreases. This non-linear response is a major advantage because it provides a tremendous rangeability of 2000:1 with one meter (5 to 12,000 FPM) and excellent low-speed sensitivity.

Both the velocity and temperature sensors are rugged, glass-coated platinum RTD's. The unexcelled stability and reproducibility of RTD's has made them the standard of NBS. The velocity sensor is rugged and large; it is not a fragile hot wire. It is breakage resistant, insensitive to dirt, and easily cleaned with an artist's brush and water or alcohol.

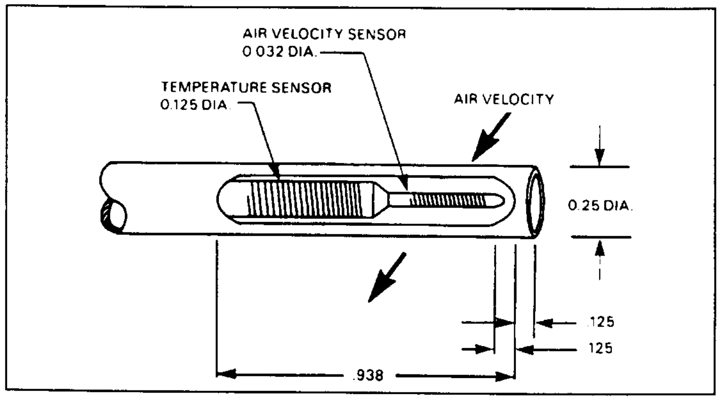

Figure 1-1. Dimensions (Inches)

Notes

2 Preparation for Use

2.1 Cleaning the Probe

To prepare the probe, loosen the compression fitting on the probe shield and pull the shield down (retract), exposing the probe sensor. Then tighten the fitting. Look at the air velocity sensor (the sensor with the small 0.032 inch diameter). It if is visibly dirty, clean it with water or alcohol (ethanol) and an artist's brush until it appears clean again. Even though the sensor is rugged and breakage-resistant, avoid touching it with any solid object and use a light touch in cleaning it. The probe is insensitive to small amounts of contamination or dirt, so a little contamination or discoloration will not cause accuracy errors. The temperature sensor is generally insensitive to contamination and dirt.

2.2 Using the Probe

For most measurements in open air (external flows), the 13 inch long probe is sufficiently long. If the probe cannot reach the flow, (such as ceiling ventilation diffusers), remove the probe shield, reverse it, reinsert over the probe and cable, and tighten the compression fitting. The resulting probe is 20 inches long and reaches most remote locations.

For measurements in ducts, pipes, or other internal flows, the probe shield is removed and a 0.25 inch compression tube fitting x 1/4" NPT, or other suitable bulkhead fitting, is inserted over the probe and screwed into the duct. Nylon or Teflon ferrules are desirable so that the probe can be traversed easily over the cross section of the duct to get the total mass flow rate. The circumferential scribe marks on the probe, 1 inch apart, aid in traversing. After traversing, the probe can be permanently located at the average velocity point in the duct, and the compression fitting tightened. Figure 2-1 shows the best velocity measurement points in circular and rectangular ducts or stacks.

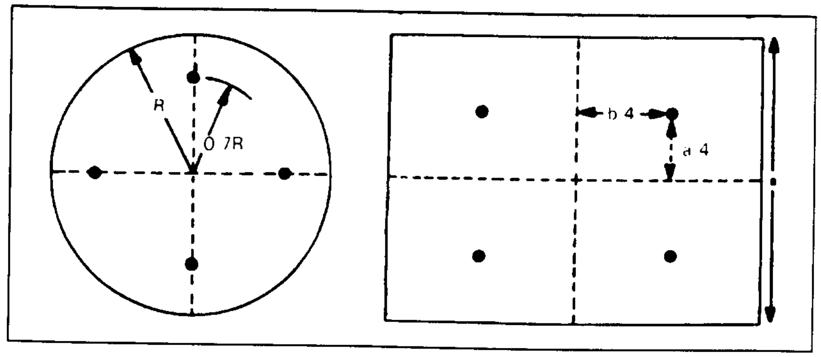

Figure 2-1. Recommended Points for Velocity Measurements in Circular and Rectangular Ducts

3 Operation

3.1 Controls on Front Panel

Operation of the HHF600 Series is straightforward. All controls on the front panel are clearly designated as to their function.

3.2 Measuring Air Velocity

1. Turn main switch to "BATTERY TEST" to check the condition of batteries. Recharge if necessary.
2. See Section 2 for a discussion of the probe shield, probe lengths, and recommended velocity measurement points in ducts and stacks.
3. Insert the probe into the flow so the flow field covers the entire tip of the probe at least 1.25 inches, and preferably at least 2 inches from the end. Rotate the probe so that the flow goes perpendicularly through the flow "window". The axial line scribed on the probe should face upstream and be perpendicular to the flow. The probe measures air speed accurately when the velocity vector is anywhere within a solid cone with a 20 degree half angle relative to the normal to the velocity probe.
4. Turn the main switch to the highest (first) air velocity scale. Then turn the switch clockwise to the lowest range covering the maximum velocity anticipated. The meter is now measuring air velocity. If "actual" velocity is desired, use the procedure in Section 4, Calculating Actual Velocity. Allow approximately three minutes for temperature equilibrium.
5. If long-term measurements of several hours are being made, battery recharging may be necessary.

3.3 Measuring Temperature

1. Turn the main switch to "BATTERY TEST" to check the condition of batteries. Recharge if necessary.
2. See Section 2 for a discussion of the probe shield and probe lengths.

3. Insert the probe into the flow so that the flow field or gas co the 0.125 inch diameter temperature sensor. It is desirable the entire tip of the probe is "wetted" at least 1.25 inches, a preferably 2 inches, from the end. Although the meter is designed for temperature measurement in air and gasses, it also be used in non-corrosive liquids, such as water, over the specified temperature range.

4. Turn the main switch to the temperature scale. The meter is n measuring temperature.

5. When switching from a velocity scale or battery check to the temperature scale, about 60 seconds are required for the temperature sensor to attain the correct reading.

6. Since the temperature measurement mode requires minimal electrical current, the batteries should last a long time between charging. Nevertheless, it is prudent to make a periodic check "BATTERY TEST".

3.4 Measuring Static Pressure

1. Turn the main switch to "BATTERY TEST" to check the condition the batteries. Recharge if necessary.

2. Withdraw the probe shield all the way, or remove altogether. Meters with an air static pressure scale have a static pressure attachment in the carrying case. The attachment is a 0.75 inch diameter x 2 inch long anodized aluminum fixture with gaske inlet and outlet flanges. Insert the pressure attachment over the of the probe until it bottoms out. Rotate until the radial scribe l on the bottom of the attachment is oriented with the axial scribe line on the probe, and tighten the nylon thumb screw.

3. Drill a 0.25 to 0.31 inch diameter hole in the duct or pipe. Sta pressure can only be made in ducts with low positive or negativ static pressures relative to ambient 0-3 or 0-5 inches of water maximum. Do not use in high pressure installations.

4. Place the flange over the duct hole and hold firmly in place with the probe parallel to the duct wall, so that the gasket effects a good seal. If the pressure in the duct is positive (+), or higher than ambient, the flange with the "+" sign should be placed ove the hold. If the pressure in the duct is negative (-), or lower than ambient, the flange with the "-" sign should be placed over the hole.

The probe measures the static pressure differential between the duct and ambient by measuring the flow through the orifice in the pressure attachment. For this reason, the static pressure scale is calibrated for air static pressure. With the proper positive and negative orientation given above, the flow always impinges the velocity sensor one way. The meter is now measuring air static pressure.

5. If long-term measurements of several hours are being made, periodically check the batteries on "BATTERY TEST".

3.5 Measuring Total Air Flow in Ducts, Pipes, Hoods, and Stacks

This section describes the methods prescribed in the National Standards of the Associated Air Balance Council.

3.5.1 Determining Total Flow Rates

The total flow rate Q (SCFM) is determined by the following relationship:

$Q = \overline{V}A$

where:

$\overline{V}$ = average of velocities in SFPM (MPS) and

A = cross-sectional area of the the duct or pipe in ft^2 (m^2)

Whenever practical, traverses with the probe should be located at least 7½ duct diameters downstream from air flow disturbance or change in direction, such as an elbow. The traverse should also be 2½ diameters upstream from such disturbances. Variations from these requirements should be noted.

3.5.2 Equal Area Traversing Method

The "Equal Area Method" is recommended for most duct flow measurement applications. Traversing in round ducts with diameters of 6 inches or less should be made as shown in Figure 3-1. The traverse should consist of a total of 12 readings taken along two diameters at 90° to each other and at centers of equal areas. Traversing in round ducts with a diameter larger than 6 inches should be made as shown in Figure 3-2. In this case, the traverse should consist of a total of 20 readings along two diameters at 90° to each other, at centers of equal areas.

For rectangular ducts, the following procedure should be used:

1. At least 16, but not more than 64, readings should be taken at centers of equal areas.
2. If less than 64 readings are taken, the traverse points should not be over 6 inches center-to-center.
3. If 64 readings are taken, the traverse points may be over 6 inches center-to-center.

TUBE MARKINGS FROM WALL		
1	" Dia. × 0.043 =	"
2	" Dia. × 0.146 =	"
3	" Dia. × 0.296 =	"
4	" Dia. × 0.704 =	"
5	" Dia. × 0.854 =	"
6	" Dia. × 0.957 =	"

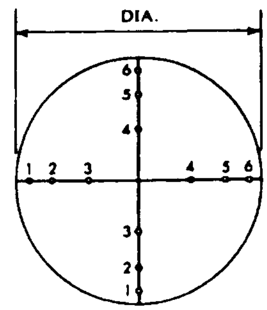

Figure 3-1. Equal Area Traverse for Round Ducts, 6 Inch Diameter or Less

TUBE MARKINGS FROM WALL		
1	" Dia. × 0.026 =	"
2	" Dia. × 0.082 =	"
3	" Dia. × 0.146 =	"
4	" Dia. × 0.226 =	"
5	" Dia. × 0.342 =	"
6	" Dia. × 0.658 =	"
7	" Dia. × 0.774 =	"
8	" Dia. × 0.854 =	"
9	" Dia. × 0.918 =	"
10	" Dia. × 0.974 =	"

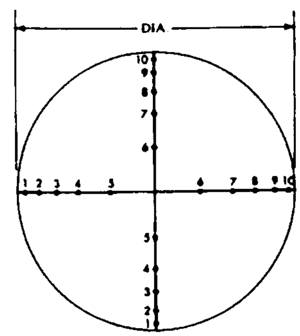

Figure 3-2. Equal Area Traverse for Round Ducts Larger than 6-inch Diameter

3.5.3 Log-Linear Traversal Method

The "Log-Linear Method" provides high accuracy (±3%) in flow totalization by considering the effect of friction along the walls of a duct. In the case of round ducts, the three-diameter, six-point method, as shown in Figure 3-3, is the preferred traverse. If the three-diameter method cannot be used (because of inaccessibility), then the two-diameter method shown in Figure 3-4, is acceptable. This method consists of two sets of ten readings, 90° apart.

	TUBE MARKINGS FROM WALL
1	" Dia. × 0.032 "
2	" Dia. × 0.135 "
3	" Dia. × 0.321 "
4	" Dia. × 0.679 "
5	" Dia. × 0.865 "
6	" Dia. × 0.968 "

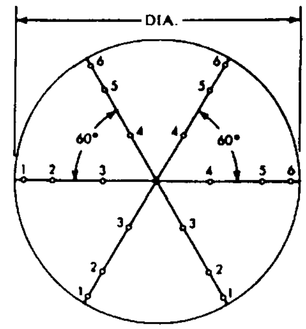

Figure 3-3. Log-Linear Traverse for Round Ducts, 3-Diameter Approach

	TUBE MARKINGS FROM WALL
1	" Dia. × 0.019 "
2	" Dia. × 0.077 "
3	" Dia. × 0.153 "
4	" Dia. × 0.217 "
5	" Dia. × 0.361 "
6	" Dia. × 0.639 "
7	" Dia. × 0.783 "
8	" Dia. × 0.847 "
9	" Dia. × 0.923 "
10	" Dia. × 0.981 "

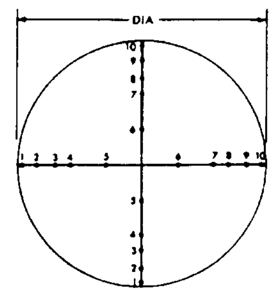

Figure 3-4. Log-Linear Traverse for Round Ducts, 2-Diameter Approach

In the case of rectangular ducts, the following procedure should be followed:

1. The minimum number of readings should be 25.
2. The points where the readings are to be taken should be located at the intersection of the traverse lines as shown in Table 3-1.

Table 3-1 indicates that any rectangular duct dimension that is less than 30 inches requires five traverse lines on that side. Thus, a 28 inch by 20 inch duct will require 25 readings, because each side would have five traverse lines. A 32 inch x 20 inch duct will require 30 readings (6 traverse lines on the 32 inch side and 5 on the 20 inch side). A 38 inch x 20 inch duct will require 35 readings (7 traverse lines on the 38 inch side and 5 on the 20 inch side). Figure 3-5 gives an example of a 25-point traverse in a rectangular duct.

NOTE: The above example is for a duct with both sides less than 30". A duct 32" x 20" would require 30 points (5 x 6 = 30).

TABLE 3-1
Log-Linear Traverse for Rectangular Ducts

DUCT SIDE DIMENSION	NUMBER OF TRAVERSE LINES
Less than 30 inches	5
Over 30 inches and less than 36 inches	6
Over 36 inches	7

TABLE 3-2
Location of Traverse Points

NO. OF TRAVERSE LINES	POSITION RELATIVE TO INNER WALL DIMENSIONS
5	0.074 0.288 0.500 0.712 0.926
6	0.061 0.235 0.437 0.563 0.765 0.939
7	0.053 0.203 0.366 0.500 0.634 0.797 0.947

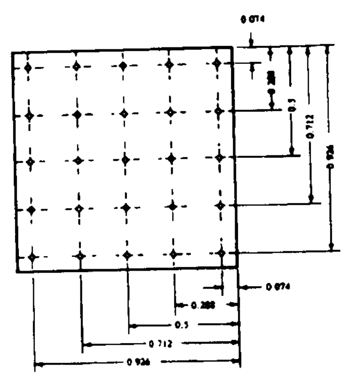

Figure 3-5. Example of a 25-Point Log-Linear Traverse for Rectangular Ducts

4 Calculating Actual Velocity

As discussed in Section 1.3, the HHF600 probe measures the "standard" velocity, or the mass velocity or air referenced to 25°C and 760 mm of mercury. The units of measurement are standard feet per minute (SFPM) or standard meters per second (sm/s). Since they directly measure mass velocity, HHF600 meters are ideal for measurement of air mass flow in ducts or in external flows. In these cases, no correction is needed.

In cases where the "actual" velocity of the air at the actual temperature and pressure at the time of measurement is desired, a single correction is required. In this case, the velocity is in units of feet per minute (FPM) or meters per second (m/s). The required correction factor is given in the following equation:

$$v = v_s \left(\frac{\rho_s}{\rho}\right) = v_s \left(\frac{P_s}{P}\right)\left(\frac{T}{T_s}\right)$$

where:

v = "actual" velocity at conditions of ρ, P, and T,

v_S = "standard" velocity referenced to standard conditions of ρ_S, P_S, and T_S,

ρ = air mass density at actual conditions, g/cc,

ρ_S = air mass density at standard conditions, = 1.189×10^{-3} g/cc,

T = air temperature at actual condition, °K,

T_S = standard air temperature = 25°C = 298°K,

P = air pressure at actual conditions, mm of mercury,

P_S = standard air pressure = 760 mm of mercury.

Example Calculation

The Model HHF615 shows a reading of 800 SFPM on the 0-1250 FPM scale. The air temperature, as measured on the -40° to 250°F temperature scale, is 120°F (49°C). The flow field is open to the atmosphere, and the barometric pressure is 800 mm mercury. From Equation (1), the actual velocity, V, is calculated as:

$$v = 800\left(\frac{760}{800}\right)\left(\frac{49 + 273}{298}\right) = 821 \text{ FPM.}$$

Notes

5 Maintenance

5.1 Calibration

If the probe or meter have been damaged, or you simply want to recalibrate, please call the Customer Service Department. Having OMEGA Engineering do your calibration will prove to be the most cost-effective alternative.

5.2 Removal of Rear Panel of Meter

To gain access to the electronics circuit board of the meter, remove the single screw on the rear panel. After removal, use the hex end of the screw to pull outward on the screw hole. Simultaneously push downward on the panel with your thumb or screwdriver in the detent in the top of the panel.

5.3 Breakage or Damage of Probe

The shielded design of the probe protects the temperature and velocity sensors from damage. If the sensors are broken or damaged, the probe, meter, and pressure attachment must be returned to OMEGA. A new probe will be installed and recalibrated with your meter. Since the zero and span for each meter scale is set up on the circuits inside the meter, the probe, meter and pressure attachment must accompany the probe in shipment back to OMEGA.

5.4 Battery Maintenance

Ni-Cad batteries, used with reasonable care, will provide many hours of dependable service. To insure the Ni-Cad battery life:

1. Be sure to set the "115-230 Vac" switch on the charger for the proper line voltage.
2. Avoid sustained overcharging heat. This is caused by overheating the batteries to a point where they get hot and slowly begin to destroy cell chemistry. Avoid overcharging.

3. Cell reversal takes place when one of the cells in the battery "strip" is completely discharged. The remaining cells then force a current through the discharged cell, causing it to reverse, destroying cell chemistry. Avoid this by keeping an eye on the "BATT-OK" range and noting if discharging proceeds at a a rapid rate.

4. "Memory" is a condition resulting from consistently discharging the battery pack to 10% of its full capacity and then being recharged. "Memory" can be reversed with a series of full charge/discharge cycles. The battery pack will normally improve with each cycle. It is a good idea to periodically run the battery pack down and then recharge fully before your next scheduled re-use. If the meter will not operate in the "BATT-OK" range, and the batteries are found to be at fault, order a new Ni-Cad battery pack from OMEGA. To install, remove the back panel, unsolder the leads to the two old batteries, and solder in the new batteries.

NOTE: Typical battery charge time should not exceed 14 to 16 hours with the main switch in the off position.

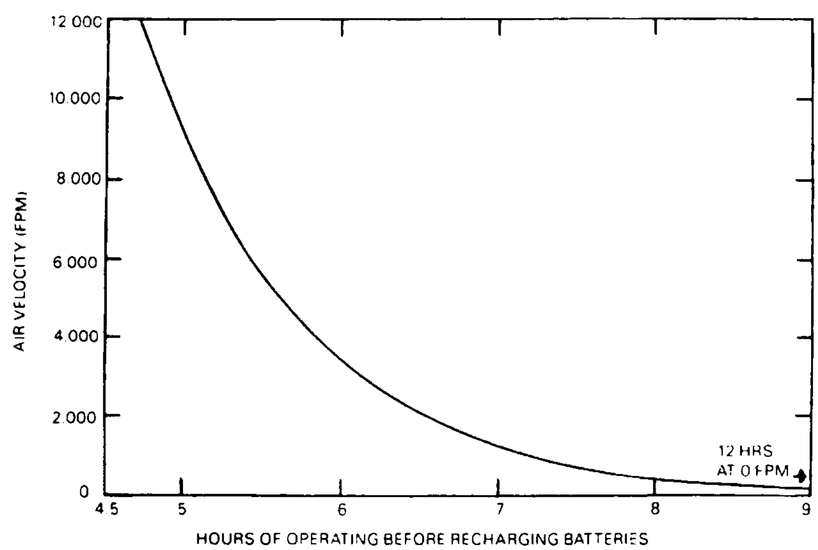

Figure 5-1. Typical Battery Life

5.5 Troubleshooting

Typical problems and solutions are given in this section. If other problems arise, or if the suggested action does not solve the problem, contact the Customer Service Department.

Problem	Possible Cause	Action
Velocity or pressure measurement seems low	Probe not oriented properly	Orient probe with respect to flow
	Batteries low	Recharge batteries
	Probe dirty	Clean probe with water or ethanol and an artist's brush
Velocity or pressure measurement is erratic or fluctuating	Very turbulent flow	Try to find less turbulent area to measure velocity
	Probe tip is broken	Return probe and meter for repair or replacement of probe and recalibration
	IC1 (integrated circuit) is defective	Replace with same type IC or return for repair
	Probe is not secured to a solid base	Secure probe to a non-vibrating solid mount
Meter needle pegs plus or minus	Probe not plugged into meter	Plug in probe
	Probe tip is broken	Return probe and meter for repair or replacement of probe and recalibration
	IC1 is defective	Replace with same type IC or return for repair
	Q1 (transistor) is shorted	Replace with same type transistor or return for repair

Troubleshooting (continued)

Problem	Possible Cause	Action
Batteries won't charge ("BATT OK" indicates low)	Battery charger defective	To determine if battery charger is operating, switch to "BATTERY TEST" position; note position of needle with charger unplugged. Needle should rise slightly when charger is in, indicating batteries are charging. If a DVM is available,charger output at plug tip should be 15 Vac ±.5V. If not, replace with a new battery charger.
	Battery charger is set to wrong line voltage	Move switch to correct voltage range
	Batteries defective (not charging or holding charge)	Replace with new Ni-Cad Battery Pack
Meter needle won't zero	Mechanical zero off	Adjust mechanical zero, with power off
	Out of calibration	Return probe and meter for recalibration
	Probe tip is broken	Return probe and meter for repair or replacement and recalibration
Meter needle won't hold zero when case position is changed	Meter movement out of balance	Return for balancing
Temperature scale no longer accurate	Improper operation measurement	Review manual for temperature measurement
	IC2 defective	Replace with same type IC or return for repair
	Out of calibration	Return probe and meter for calibration

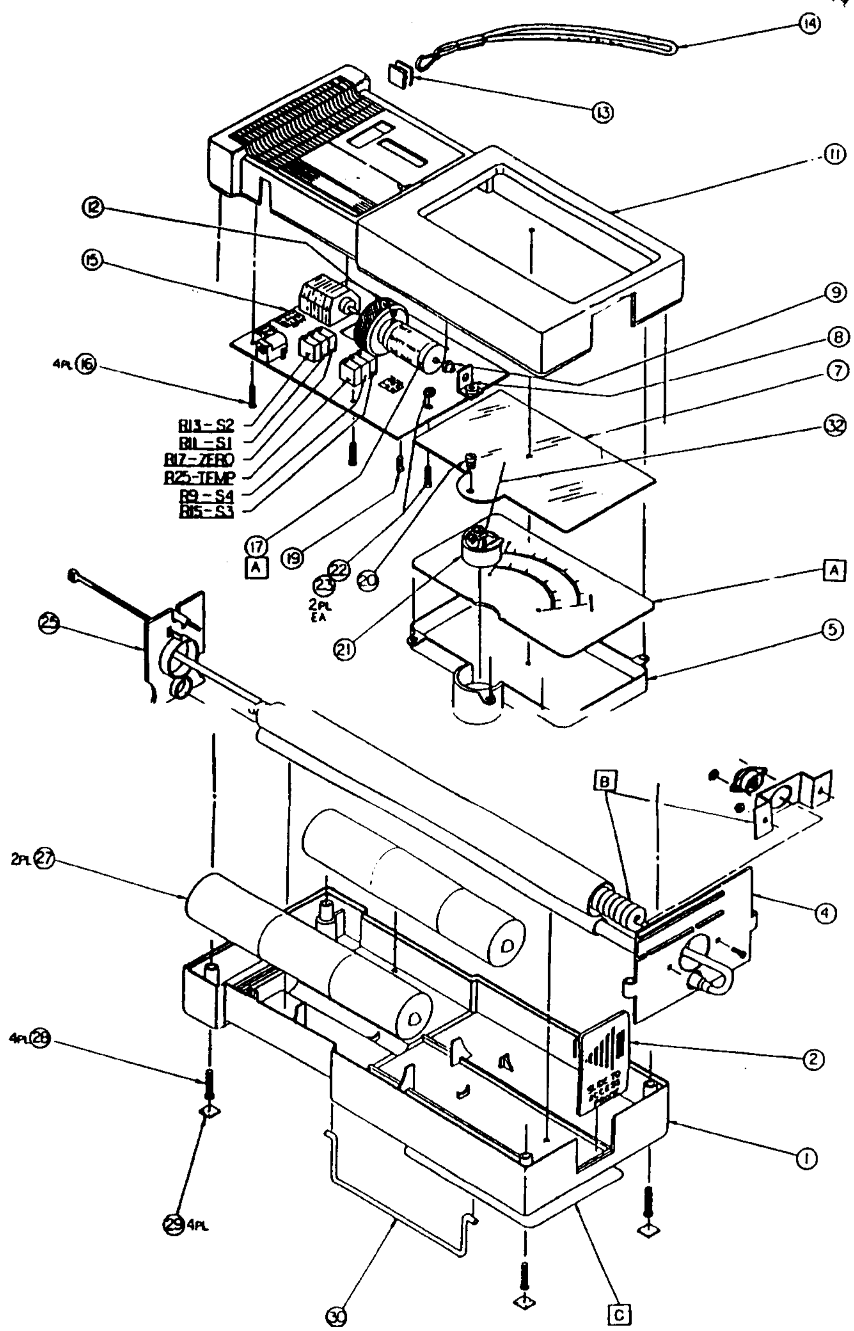

Figure 5-2. Component Layout

5.6 Parts List

Item #	Description	Part No.
1	Bottom Enclosure	6102-057
2	Sliding Door	6102-058
4	Probe Entrance Plate	6102-059
5	Meter Movement Enclosure	6102-061
7	Scale Cover	6102-078
8	Knob Anchor	6102-028
9	Knob Bushing	6102-029
11	Top Enclosure	6102-056
12	Set Screw	
13	Strap Boss	6302-027
14	Strap, 8-1/2-BRN	
15	New PCB-FAB	6103-012
16	Pan Hd Phil Screw	
17	Knurled Knob	6102-030
19	Pan Hd Phil Screw	
20	Zero Adjust	
21	Meter Movement	
22	Pan Hd Phil. Screw	
23	Kep Nut	
25	Internal Tube Support	6102-060
27	Batteries	6302-011
28	Pan Hd. Phil. Screw	
29	Feet, Rubber	6102-077
30	Meter Bail	6102-027
32	Needle	
A	Scale Label Assembly	
B	Cable Assembly	

6 Specifications

Velocity Accuracy:	±2% of full scale over -20° to 60°C and 5 to 30 psia ±4% of full scale over -55° to -20°C and 60°C to 125°C ±4% of full scale over 1 to 5 psia and 30 to 100 psia ±4% of full scale for HT models over 100°C to 218°C
Temperature Accuracy:	±1% of full scale
Pressure Accuracy:	±2% of full scale over 20° to 40 °C
Repeatability:	±0.2% of full scale for velocity and temperature
Response Time:	Probe: 10 msec Meter readout: 500 msec
Probe Temperature:	-55° to 125°C standard; -55° to 218°C for HT models
Front Panel:	Ranges and battery test switch; mechanical zero; zero and span controls inside meter
Readout:	12 cm, taut-band analog meter; self-shielding; 0 to 50°C operating range; -20 to 70°C storage range; 12.7 cm W x 17.8 cm H x 5.7 cm D (5" W x 7" H x 2" D)
Probe:	Ceramic, platinum, and epoxy sensor, glass-coated, chrome-plated brass probe; 0.25 inch diameter probe, 13 inches long; markings every inch along axis; probe shield extends length to 20 inches. HT models have 316 stainless steel probe and glass-coated ceramic or platinum sensor.
Probe Cable:	Four wire; 8 ft. length; 15 ft. length for HT models
Power Required:	Two Ni-Cad rechargeable batteries; charger operates on 115/230 Vac, at 50/60 Hz power; operates up to 8 hours between charges at 1250 FPM, 6 hours at 6000 FPM, and 5 hours at 12,000 FPM.
Weight:	1.25 Kg (2.75 lb.)

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 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 should malfunction, 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 being 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 which wear are not warranted, including but 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 it 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.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

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. P.O. 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. P.O. number to cover the COST of the repair,
2. Model and serial number of 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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- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
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- Infrared Pyrometers

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- Transducers & Strain Gauges
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
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pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
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- Metering & Control Instrumentation
- Refractometers
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- Industrial Water & Wastewater Treatment
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