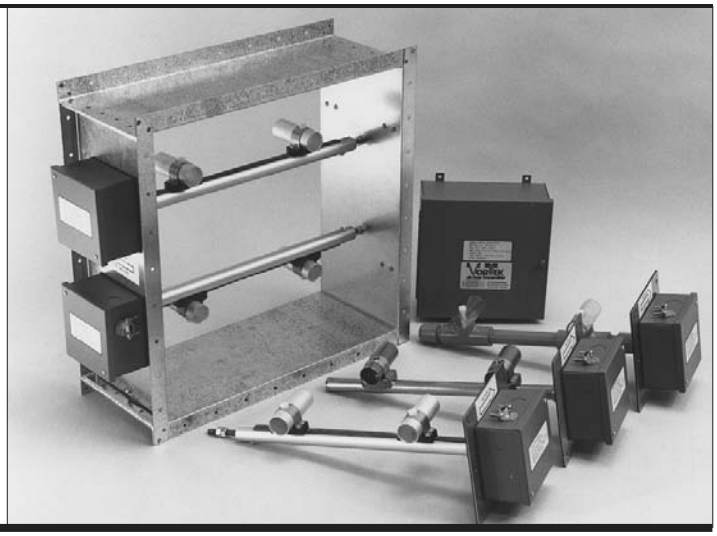
VorTek VT5000

VORTEX FLOW TECHNOLOGY MEASUREMENT

US PATENT # 4,770,035

Electronic airflow measurement device designed specifically for the reliable measurement of air-flow in ducts over a wide range of operating conditions.

- **Unique patented sensing principle**
- **Linear velocity averaging**
- **Insertion probes**
- **AC power**
- **Duct case optional**
- **Wide range of operation**
- **Stable, drift-free operation**
- **Internal diagnostics**
- **Jumper selectable output**



General Description

The **VorTek 5000** airflow measuring device consists of multi-sensor probes which are inserted in the ductwork where airflow is to be measured and transmitted. Individual sensors on the probes provide pulse type electronic output signals which are directly proportional and linear to the airflow velocity. These digital signals are totalized in the companion transmitter and converted to an industry standard, 4-20mA output. (1.5 VDC or 2-10 VDC are also selectable by jumper).

Probe and sensor quantities are selected on the basis of duct size to provide an accurate and repeatable instantaneous airflow traverse. Sensors also incorporate integral shrouds for the reduction of turbulence at the sensing points. Cables are provided for the connection of individual probes to the transmitter, eliminating the need for complex field terminations.

The **VorTek** transmitter operates on industry standard 24 VAC power with less than 8 VA power consumption. Transmitter output is fully isolated to prevent ground loop problems in the receiving instrument.

An integral calibration standard is provided in the transmitter to allow for the calibration of the unit in the field. Diagnostic functions are provided to allow for on-line zero and sensor checking.

Application

Tek-Air's **VorTek 5000** airflow measuring device is designed for use in applications where the reliable and accurate measurement of airflow in ducts is required over a wide range of operation. Common applications include VAV fan synchronization, clean room control, filter monitoring, and laboratory pressurization.

VorTek Sensing

Velocity measurement is accomplished by Tek-Air's unique, patented **VorTek** sensors. **VorTek** sensors utilize an industry proven vortex shedding phenomena to measure the true airflow velocity independent of changes in temperature, density and humidity, which effect pitot and thermal airflow measurement systems.

The requirements for accuracy and reliability have focused attention on the limitations of conventional, pneumatic type pitot arrays. Aware of these limitations and the limitations of electronic thermal airflow transmitters, Tek-Air developed and patented the **VorTek** Sensing System.

VorTek Sensing: How It Works

The vortex shedding phenomena can be witnessed all around us in everyday life. Swirling vortices, or eddy currents are generated whenever air or liquids flow around an obstruction in their flow path. Common examples are the eddy currents which develop behind rocks in a stream, and the fluttering of a flag behind a flag pole. The flag and the flag pole provide the most visual example of how vortex shedding works. The flag pole (see fig. 1) presents an obstruction in the path of the airflow, which is the wind. As wind passes around the flag pole, vortices (eddies) are created in the wake of the pole.

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VorTek Airflow Measurement Device VT5000

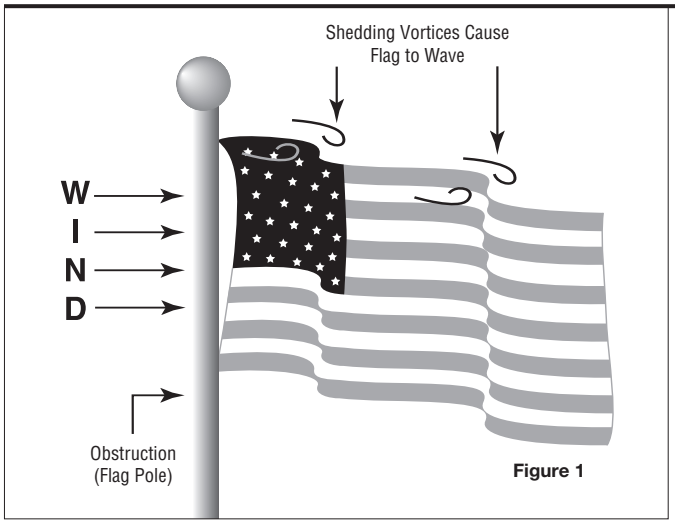

Figure 1

These vortices, in accordance with the laws of nature, are developed and shed in an alternating manner, from one side of the flag pole to the other. The evidence of the shedding of vortices is in the waving of the flag itself.

The conditions required to create stable and repeatable vortex shedding were determined in the early 1900's by T. von Karmen; hence stable vortices are termed "Karmen vortices". Tek-Air's unique **VorTek** sensors generate stable, repeatable Karmen vortices over a wide range of operation.

VorTek sensors (see fig. 2) operate in the following manner. Airflow in the duct enters the directional shroud which helps direct any airflow. Airflow then passes around the trapezoidal shedder, creating alternating high and low pressure vortices. A trapezoid is used because it is the most effective shaped obstruction for creating strong alternating vortices and "pulses". Sensing ports on opposite sides of the shedder relay these pressure pulses via tubing to pulse detectors which output a digital signal to the electronics. The electronics convert these digital pulses to analog output signals.

Features and Advantages of the VorTek Airflow Measuring Device

The **VorTek** airflow measuring device offers many advantages over conventional analog devices such as pitot arrays with velocity pressure transmitters and thermal techniques. Unlike these analog measurement techniques, **VorTek** sensors provide digital pulse outputs at a frequency which is linear to the airflow velocity. Velocity averaging becomes a simple matter of totalizing pulses from individual sensors to effect an instantaneous duct traverse.

Unique Sensor

The **VorTek** device utilizes a sensing technique called vortex shedding to measure airflow velocity. Sensors provide true linear outputs, true velocity (not pressure) averaging, and insensitivity to dirt and dust. Benefits include high flow turndowns, drift free operation, shock resistance, insensitivity to normal temperature, pressure, and humidity variations, plus the ability to calibrate over the entire range of operations.

Wide Range of Operation

VorTek 5000 sensors operate over the range of 400 to 7000 feet per minute. Because the sensor's signals are linear, the electronic transmitter can be calibrated to operate over this entire range, unlike velocity pressure transmitters, which must be replaced if major range changes are needed. The digital frequency output from the **VorTek** sensors is directly proportional to the velocity of the air flowing in the vicinity of a sensor. This inherent linearity simplifies the averaging and totalizing process, reducing the amount of complicated electronic circuitry required. It also provides for uniform accuracy over the entire range of instrument operation.

True Velocity Averaging

Unlike pitot arrays which average nonlinear velocity pressure signals pneumatically, the **VorTek** transmitter averages true velocity as recommended in the ASHRAE guide.

Modular Electronics

Each **VorTek** airflow transmitter incorporates modular electronics. All units, regardless of the application or options, utilize the combination of two or three circuit boards. Simple plug-in program modules are used to configure the transmitters for a particular application.

Diagnostic Features

To simplify setup, calibration, and troubleshooting, several diagnostic features are provided. These include the ability to check transmitter zero on-line, check sensor performance, and calibrate electronics with the internal frequency standard.

Multiple Applications

Airflow measurement and control for: Semiconductor labs, R & D Facilities, Labs and Hospitals, and Process Manufacturing.

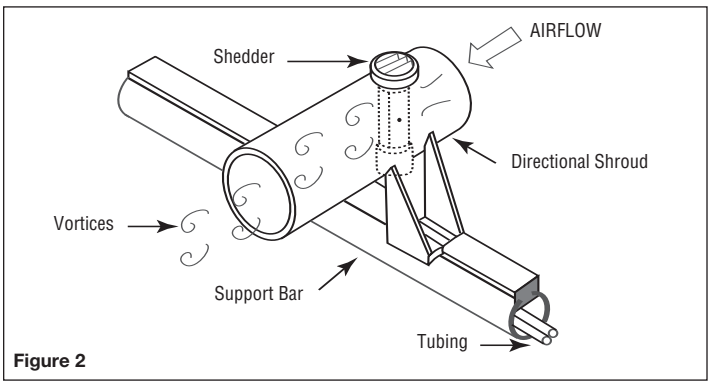

Figure 2

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VorTek Airflow Measurement Device VT5000

Specifications

Sensors

Accuracy*	+/- 2.0% reading
Interchangeability	+/- 0.5%
Temperature Limits	
304 Stainless Steel	-20°F to 200°F
High Temp. S.S.	-20°F to 320°F
Aluminum	-20°F to 140°F
CPVC	-20°F to 140°F
Velocity Range**	400 to 7000 fpm
Humidity Limits	non-condensing
Construction	Aluminum, CPVC, 304 S.S., 316 S.S.

* The accuracy specified is representative of controlled test conditions. The installed accuracy typically observed is subject to actual upstream and downstream conditions, and the accuracy of the field instruments used for verification which is typically +/- 5% of reading or better.

** The recommended minimum velocity range for control applications is 450 fpm.

Electronics

Accuracy	+/- 0.5% full scale
Range (adjustable)**	400 to 7000 fpm
Input	1 to 16 sensors
Output	4-20mA standard (1-5V & 2-10 VDC optional)
Power	24 VAC +/- 20%, 8 VA, 50/60 HZ, 15-35 VDC
Load Limits	650 ohms max.
Internal Frequency	122 Hz
Temperature Range	25° F 10 125° F
Temperature Error	< +/- 0.5% over 25° F to 125° F
Humidity Limits	Non-condensing
Enclosure	Equivalent to NEMA 1 Optional NEMA 4
Cables	10' standard (longer available)

VorTek Minimum Installation Requirements

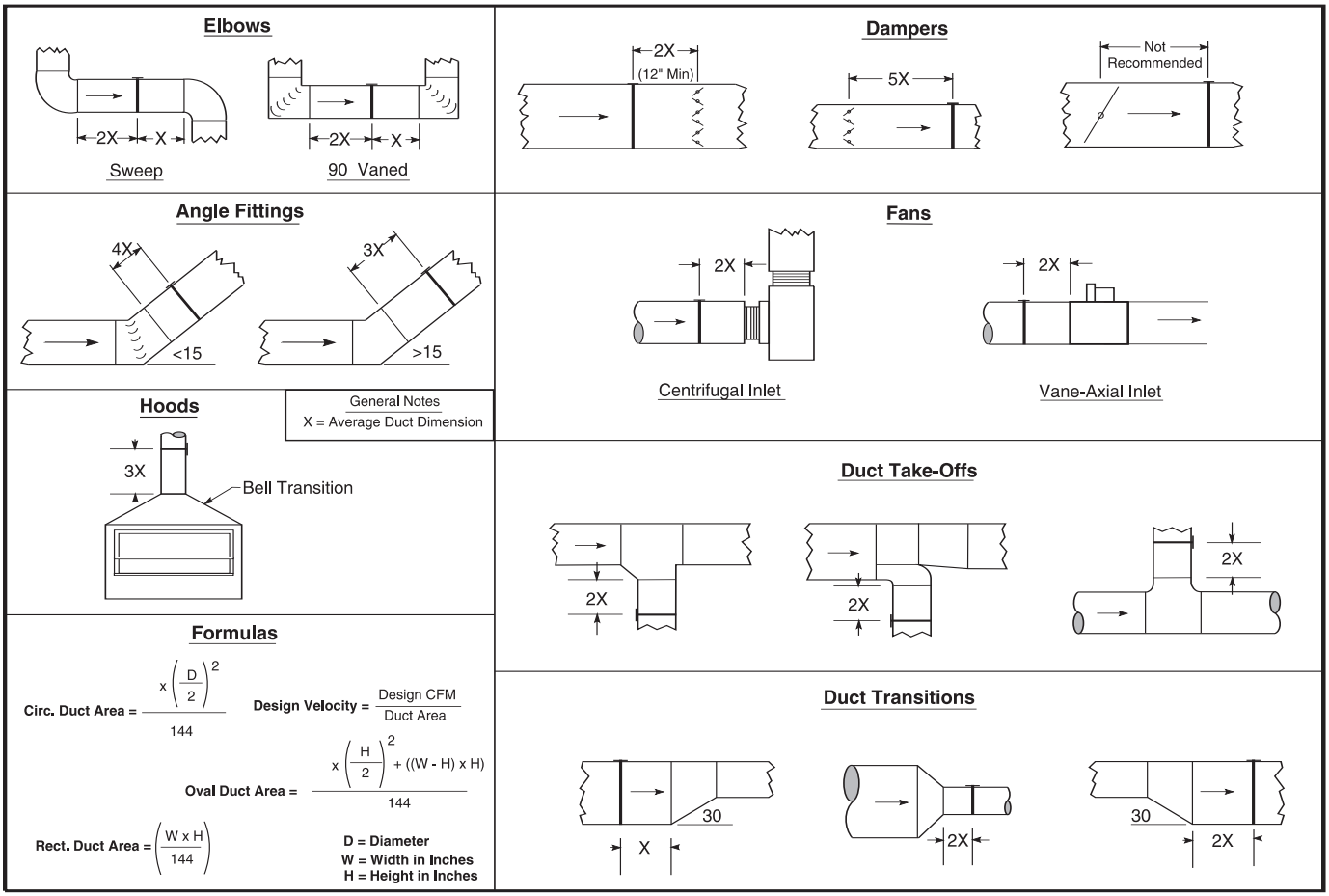

Figure 3

NOTE: At minimum requirements, optimum accuracy should not be expected.
Optimum installation for any flow device is 8 diameter upstream, 3 diameter downstream of any turbulence.

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Installation Guide

More than any other factor, the performance of the **VorTek** Airflow Transmitter is greatly effected by the installation of the sensing probes. Conditions which produce turbulent or stratified airflow must be anticipated in the placement of sensing probes.

Turbulence should be minimized by adhering to the minimum installation requirements shown in figure 3. (See note on fig.3) Stratification should be anticipated. Probes should be located so that they traverse across the area of greatest stratification in the duct.

Sensor Fouling: Fumes, dry dust, dirt, and particulate will not present a plugging problem with **VorTek** sensors. Extremely wet or sticky particles (like tablet or candy coating processes) may cause buildup that would require occasional cleaning. (see Optional)

Materials of Construction

Standard: Aluminum bars, galvanized steel mounting plates, ABS plastic shedder bars, aluminum shrouds, and NEMA 1 equivalent enclosure.

CPVC: CPVC plastic bars, 304 S.S. mounting plate, ABS plastic shedder bars, and CPVC shrouds.

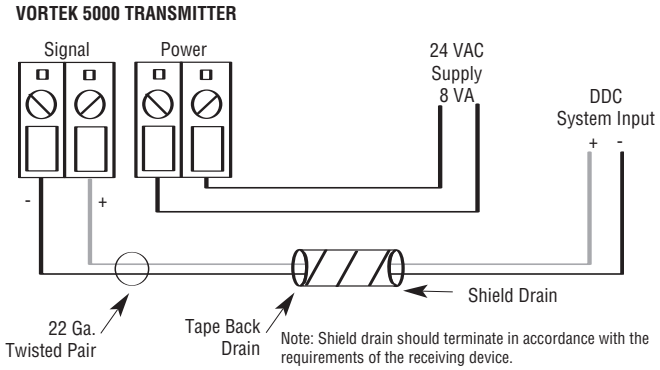
Stainless Steel, Low Temperature: 304 S.S. bars and shrouds. 303 S.S. shedders are available where required. Urethane sensor tubing inside bars is used where service temperature will not exceed 200° F.

Stainless Steel, High Temperature: Same as low temperature, except the sensor tubing inside the bars is 304 S.S., allowing service temperatures of up to 320° F.

NOTE: Maximum length on S.S. high temperature bars is 36 inches.

Optional: NEMA 4 enclosure, sensor purge.

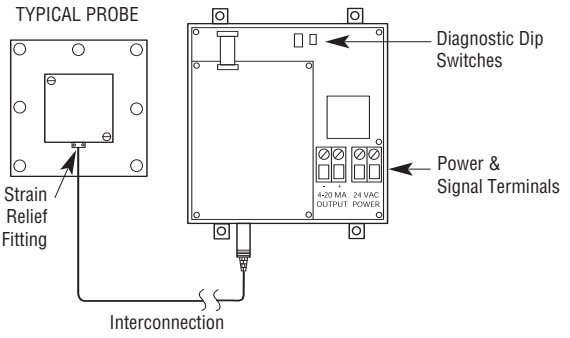
Wiring



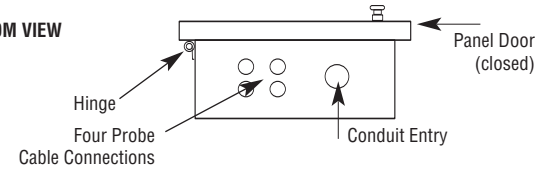
Dimensions (NEMA1)

NOTES:
1. Mount transmitter on vertical surface, wall, duct, etc.
2. Transmitter is designed for indoor mounting only (NEMA 4 optional).
3. Probe cable can be plugged into any input connector on transmitter.
4. Power and signal can be run separately if desired.
5. Isolate from cold surfaces to prevent condensation in humid environments.

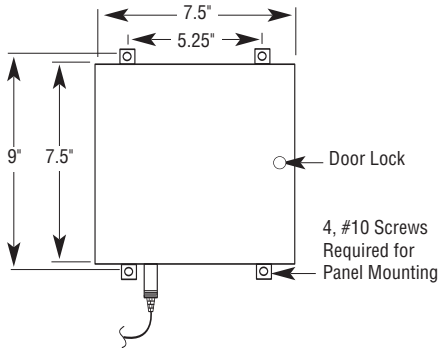
INTERIOR VIEW



BOTTOM VIEW



FRONT VIEW



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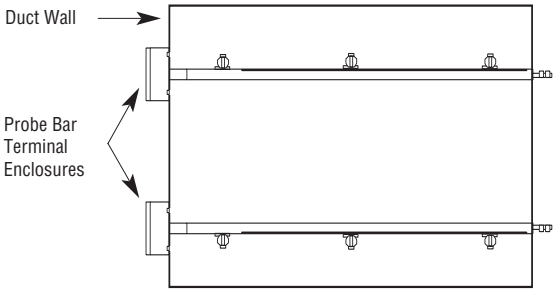
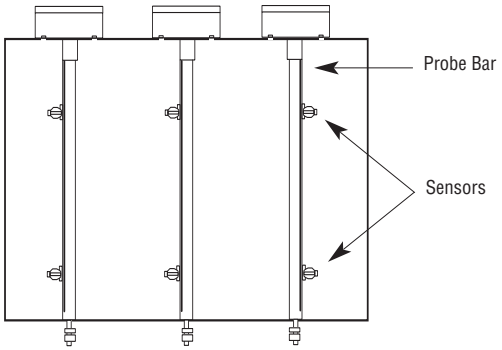
Probe Configurations

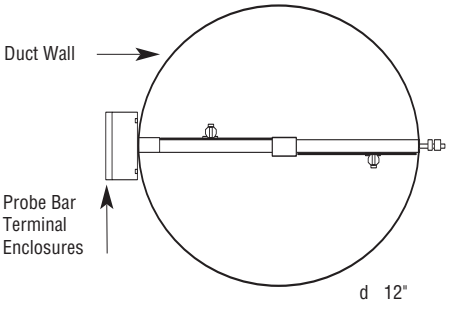


2 x 3

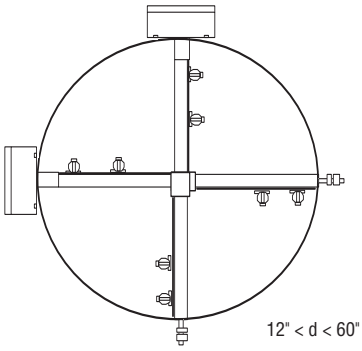


3 x 2

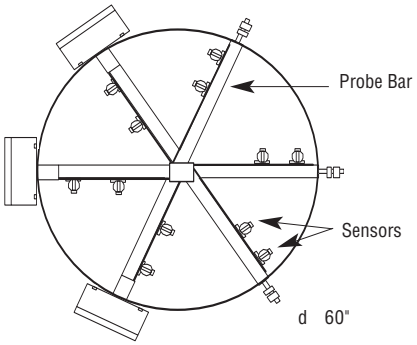
Rectangular



1 x 2

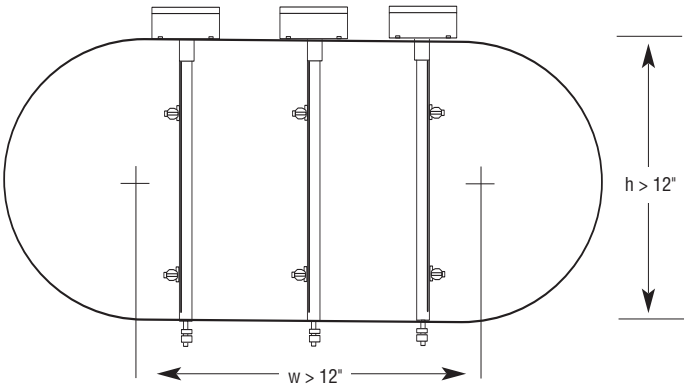


2 x 4



3 x 4

Circular



3 x 2

Oval
(additional oval configurations available - consult factory)

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VorTek 5000 Model Codes

T - VT5 ☐ ☐ 0- ☐ X ☐ - ☐ ☐ - ☐☐ / OPTIONS

BASIC MODEL DESIGNATION
Transmitter, Probes, One Manuel
4-20mA Output, 10 ft. Cable

DUCT SHAPE
1 - Circular
2 - Rectangular
3 - Oval

PROBE / SENSOR MATERIAL
1 - Aluminum & ABS
2 - CPVC & ABS
3 - 304 S.S.
4 - High Temp. S.S. (max. 350° F)

BAR QUANTITY
1, 2, 3, or 4 (see schedule)

SENSORS PER BAR
1, 2, 3, 4, or 6 (see schedule)

TRANSMITTER ENCLOSURE
1 - Standard, NEMA 1 equivalent
2 - NEMA 4
3 - Standard, NEMA 1 equivalent with display
4 - NEMA 4 with display

PROBE ELECTRONICS
1 - Standard, NEMA 1 equivalent
2 - NEMA 4

BAR LENGTH
(in inches, max. 72")

OPTIONAL
V1 - 1-5 VDC output
V2 - 2-10 VDC output
P - Sensor purge
INS1 - Duct has 1" internal insulation (see note 3)
INS2 - Duct has 2" internal insulation (see note 3)
C25 - 25 ft. cable
C50 - 50 ft. cable
C75 - 75 ft. cable
C100 - 100 ft. cable

Note: Order must include the following information to be processed:
1. Minimum and maximum design cfm
2. Duct size (rectangular and oval)
3. Insulated ducts: width & height should be outside dimensions

Guide Specifications

Provide as indicated on the accompanying plans, electronic airflow traverse probes and transmitters for the purpose of continuously monitoring duct airflow volume.

The airflow measurement system shall consist of single or multiple probes with velocity measuring sensors. Each sensor shall utilize the principle of vortex shedding for the measurement of airflow velocity. Sensors shall be immune to the effects of changing temperature, humidity, and static pressure. Primary sensor output shall be linear and shall not drift over time. Sensors shall not be effected by the presence of dirt or dust in the air stream.

Probe and sensor quantities shall be determined by the manufacturer but shall adhere to the following criteria as a minimum. Duct area less than 1 sq. ft., 1 per 0.3 sq. ft.; less than 3 sq. ft., 1 per 0.75 sq. ft.; less than 8 sq. ft., 1 per sq. ft.; less than 32 sq. ft., 1 per 2 sq. ft.; above 32 sq. ft., use 16 sensors. Sensors and probes shall be arranged to effect an equal area traverse.

Each insertion probe shall be provided with a gasketed duct mounting plate and threaded end support. Each airflow measurement probe shall be pre-connected to the companion transmitter through a manufacturer supplied flexible conduit.

All specifications are subject to change without notice.

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