Vortek

AIRFLOW TRANSMITTER

SERIES VT-5000 & VT-7000
INSTALLATION, OPERATION
& MAINTENANCE MANUAL

RELEASE 2.1
APRIL 2005
PROTECTED BY US PATENT 4,770,035

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FOREWORD

This manual is designed to provide the user with the information required to install, wire, configure, calibrate, operate, maintain, and trouble shoot VorTek Air Flow Transmitters. It is important that this manual be read in its entirety prior to installation and commissioning of VorTek.

While we would like to think that this manual is complete in content and clear in instruction, there may be questions that we haven't anticipated. If you have questions that you would prefer to direct to a live person, we encourage your calls. Technical assistance is available from the service department, at 203-791-1400 from 8:30 AM to 5:00 PM ET.

Tek-Air also offers a variety of service and maintenance packages to keep the equipment at peak performance. For further details contact the Service Department at the above phone number.

WARRANTY

Tek-Air Systems Inc. warrants that the products it manufactures, under normal use and service as described in the Operation and Instruction manual, is free from defects in workmanship and material for a period of thirty-six months from the date of shipment to the customer. This limited warranty is subject to the following conditions:

With respect to any repair services rendered, Tek-Air warrants that the parts repaired or replaced will be in good working condition, under normal use, for the period of the original warranty, or for 90 days from date of shipment to the customer if the original warranty period has expired.

This warranty is based on the return of the product to Tek-Air's factory and does not include field repairs. Periodic maintenance required, as outlined in the Operation and Instruction manual, is the responsibility of the user.

Unless specifically authorized by Tek-Air in writing, no warranty is made with respect to, and no liability is assumed in connection with, any goods which are incorporated into other products or equipment by the Buyer.

The foregoing is in lieu of all other warranties and is subject to the conditions and limitations stated herein. No other expressed or implied warranty of fitness for particular purpose or merchantability is made.

The exclusive remedy of the user or purchaser, and the limit of the liability of Tek-Air or any other seller for any and all losses, injuries, or damage resulting from the use of this product shall be the return of the product and the refund of the purchase price, or, at the option of Tek-Air or any other seller, the repair or replacement of the product. In no event shall Tek-Air or any other seller be liable for any incidental or consequential damages.

Products manufactured by other manufacturers but supplied by Tek-Air carry the original manufacturers warranty.

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1.0 OPERATION

1.1 General Description

The Tek-Air VorTek[tm] airflow measurement system consists of one or more duct insertion probes and an electronic transmitter. The VorTek measurement system is capable of measuring airflow volume in ducts of all sizes and shapes, as well as fan inlet bells.

VorTek insertion probes have multiple velocity sensors located along their length. Each sensor measures airflow velocity using a unique, patented (4,770,035) application of the digital velocity sensing technique using the principles of vortex shedding.

Vortex shedding is the generation of eddy currents created by an obstruction in an air stream. Airflow through each VorTek sensor creates a succession of eddy currents which are then sensed as pressure pulses. The frequency at which these pulses are generated, is directly proportional to the velocity of airflow around the sensor.

In large ducts, the profile of the air velocity across a duct is often uneven due to the bends and transitions in the ductwork. In-line devices such as dampers, elbows, and transitions also create disturbances in the flow profile. To compensate for these varying velocity profiles, multiple VorTek sensors are utilized within a duct. The frequency outputs of individual sensors are averaged to obtain the average duct velocity.

The VorTek transmitter totalizes the frequency signals from the individual sensors to perform true velocity averaging. From this average, an electronic signal (4-20mA) is generated for direct input to a customer’s control system.

The VorTek transmitter provides several beneficial features to the user, including adjustable damping, on-line zero check, on-line calibration, sensor diagnostics, and optional digital indication. This manual will cover the operation, installation, startup, and calibration of the VorTek probes and transmitter.

1.2 Specifications

Sensors and Probes

Sensor Type: Vortex shedding
Velocity Range: 350 to 9500 FPM
Probe bar Length: 8" to 72"
Probe bar Configuration: Rectangular, Round, Oval, Fan Inlet
Materials of Construction; Standard:
- Mounting Plate: Galvanized steel
- Probe bar: Extruded aluminum
- Sensor Assembly: Aluminum and ABS
- Miscellaneous: EPDM finishing strip

Materials of Construction; Fume hood:
- Mounting Plate: Stainless steel
- Probe bar: CPVC
- Sensor Assembly: CPVC and ABS

Materials of Construction; Stainless steel: (High Temp.)
- Mounting Plate: Stainless steel
- Probe bar: Stainless steel
- Sensor Assembly: Stainless steel

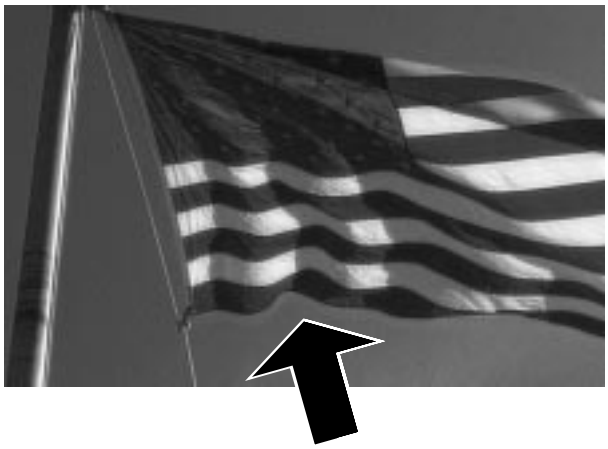
Probe bar Support: Mounting Flange Plate and Threaded Rod w/nuts
Sensors Per Probe: 1 to 6 per Bar
Number of Probe bars per Transmitter: 1 to 4 (16 sensors maximum)
Operational Temperature: -20 to 200°F, (160°F for CPVC)
320°F maximum for high temperature
Weight: Function of probe configuration

Transmitter Electronics

Input: One to Sixteen sensors
Output: 4-20mA, fully isolated; 1-5VDC ; 2-10 VDC
Load Capability: 650 ohms
Voltage: 20-28VAC, 60 Hz
Power: 8 VA, .33 amps at 24 VAC
Probe bar Connections: Plug-in cable, Plenum Rated,10 ft. provided (longer available as a special option)
Calibration: Adjustable from 0 to 7000 for ducts; 0 to 9000 for inlets
Operational Temperature: 0 to 140°F
Frequency Conversion Error: less than ±0.25% FS (8 sensors)
Temperature Error: less than ±0.5% over 25 to 125°F
Signal Damping: 2 or 4 seconds, selectable
Setup & Diagnostic Controls: Zero check, sensor check, Internal Cali bration Standard: 122 Hz
Dimensions: 7.5" x 7.5" x 3.5" (WxHxD)
Weight: 5 lbs
Mounting: Surface mount for wall, duct, or panel

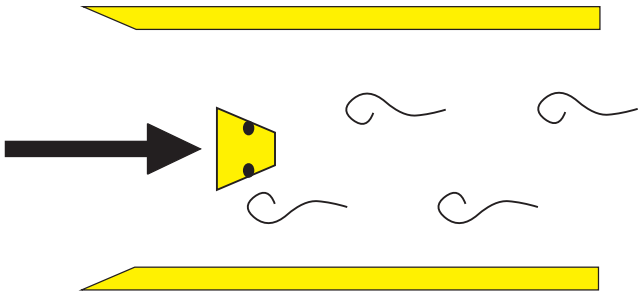
1.3 Operation of VorTek^{tm} Sensors

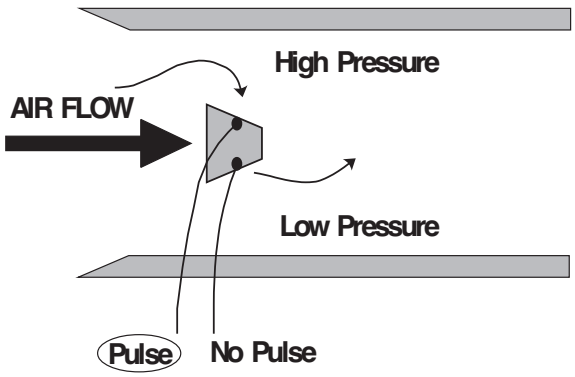
The VorTek Sensing system measures air velocity by a physical principle called vortex shedding. The vortex shedding phenomena can be witnessed all around us in everyday life. Swirling vortices, or eddy currents, are generated whenever air or liquids flow around an obstruction in their flow path. Common examples are the eddy currents which develop behind rocks in a stream, and in 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.

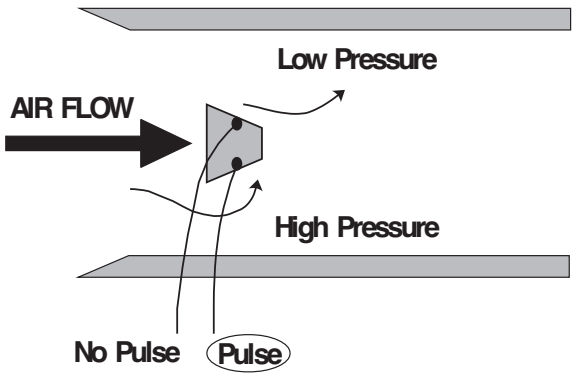


The flag pole presents an obstruction in the path of the airflow, which is the wind. As the wind passes around the flag pole, vortices (eddies) are created in the wake of the pole. These vortices, in accordance with the laws of nature, are developed and shed in an alternating manner, from one side of the flag pole to the other. The evidence of the shedding of vortices is in the waving of the flag itself.

Tek-Air's unique VorTek flow sensors use a trapezoidal shaped obstruction placed in a small tube section to generate stable vortices over a wide range of low velocities. Pressure sensors sense the passing of individual eddies. Multiple VorTek sensors are mounted on probe supports to provide ample coverage of the duct cross section.







1.4 Transmitter Operation

The enclosure located on the external end of each duct probe bar is the probe electronics housing. It contains the electronics which sense the vortices generated by the VorTek probes. At the bottom of the enclosure is the electronic connector required to connect each duct probe to the transmitter. A ten foot long connecting cable is provided for each duct probe for this purpose.

The VorTek transmitter is capable of accepting inputs from as many as four probe bars from one measuring station, each with a maximum of four VorTek sensors each. Up to six sensors may be located on a single probe support bar but the total number of sensors can not exceed 16.

In the simplest sense, the transmitter electronics can be considered a pulse frequency-to-analog converter. The transmitter receives electronic pulses from each of the VorTek sensors. As every pulse represents the same increment of velocity, the pulses need only be summed together and integrated over time to determine velocity. Additional circuitry converts the total pulses per second into analog, 4-20mA signal which is proportional to either CFM or FPM.

The VorTek transmitter consists of a minimum of two circuit boards: the Amplifier board and the mother board. The amplifier board performs the required signal conditioning on up to eight VorTek sensor inputs. Either one or two amplifier boards are provided depending on the number of probe bars used at the station.

The mother board accepts the conditioned pulses from the amplifier board(s), sums them, integrates them, and converts them into a 4-20mA output signal. The mother board also provides the power supply, calibration adjustments, internal calibration standard, and circuitry to drive the optional digital display.

A “PROGRAM MODULE” is installed on the mother board and programs the unit for the correct number of sensors required for the specific configuration. This module “plugs-in” and can be changed easily for an alternate configuration if required.

Because airflow is inherently turbulent, it tends to produce fluctuating electronic output signals if not damped when high turbulence is present. Also, some commercial direct digital temperature control systems update control outputs only on changing input signals. The rapid input changes caused by airflow turbulence can cause these types of systems to effectively overload and crash. To allow the user to select the damping to meet his application, the transmitter includes a switch-selectable damping constant of either 2 or 4 seconds.

1.5 Options

Many users prefer to have a digital display as a part of the transmitter. This type of display is available as an option with the VorTek transmitter. A 3-1/2 digit display is available allowing a display of 0 to 1999 in either CFM or FPM, which is specified by the customer at the time of purchase. Multipliers of either x10 or x100 can be used to display up to 200,000 CFM.

2.0 INSTALLATION

The VorTek measurement system consists of two basic elements: the probes and the transmitter. The VorTek probe bars are inserted into the duct and measure the velocity of the air moving through the duct. The VorTek transmitter, which is mounted in close proximity to the probes, converts the electronic pulses generated by the probes into an electronic signal compatible with most DDC control systems.

The following details are provided on the mounting and installation of the VorTek transmitter and flow probes. Please read this data carefully and install the equipment in strict accordance with the instructions provided. Should you have any questions, contact Tek-Air directly.

2.1 Probe Mounting and Location

2.1.1 Duct- Mounted Probes

(refer to drawings on pages A-2 thru A-4 of Appendix A)

General- VorTek probe bars are designed for installation in ducts, regardless of the duct size. Usually, the larger the duct, the more sensing points are required to provide an accurate measurement of airflow volume. In a typical application, multiple probe support bars are directly inserted in the duct. Each probe bar has multiple VorTek sensors for measurement of the air velocity in the area of the duct it serves.

Turbulent Airflow- Probe design allows for installation in ductwork without the requirement for special air straighteners. However, care should be taken to avoid installation within close proximity to:

- Balancing dampers
- Modulating opposed blade dampers
- Non-airfoil type, parallel-blade dampers
- Elbows
- Transitions
- Humidifiers
- Coils

Refer to the drawing “Minimum Installation Requirements”, Appendix A, page A-1 for the minimum acceptable installation criteria for specific applications. If more space is available, probe bars should be located so that they have two thirds of the straight duct length upstream of the probe bars. Keep in mind that locations other than those specified as minimums often have areas with very high turbu-

lence and reverse flow. Accurate airflow measurement is impossible in these locations.

Direction of Flow- VorTek airflow probe bars must be mounted so airflow direction corresponds to the direction indicated by the flow arrow on the duct mounting flange. Failure to mount the units properly will result in an erroneous or no flow output. Probes can be mounted in any plane, vertical, or horizontal without effecting the measurement quality. Sensors must be mounted straight in the airflow stream.

Temperature- VorTek probes are designed for use in normal HVAC applications. Continuous operation with temperatures over 200 degrees with standard materials of construction is not recommended. Fume hood exhaust sensors with CPVC construction have a limit of 180°. Close proximity to steam humidifiers and coils is not recommended. Should a steam valve leak when air is not flowing, temperatures in excess of the recommended maximum can occur. Moisture can also cause incorrect readings.

Airborne Contaminants- Normal dirt and dust associated with air conditioning applications will not effect sensor performance. The presence of agglomerating or sticky particles can cause performance problems and should be avoided. Should this occur, the probe bars can be removed for cleaning (see Appendix C).

Inspection- Carefully unpack and inspect the probes. If probes have been bent or broken in shipment, advise Tek-Air immediately.

Installation- Probes are mounted across the duct and attach to the duct on both sides. A 3 3/4" diameter hole should be located on the side of the duct where the probe will be inserted. A 5/16" diameter hole is required in the duct wall on the opposite side of the duct for probes longer than 12".

A sensor probe mounting plate is provided with a neoprene gasket and does not require the application of special sealants. The flange plate should also not be insulated to allow for easy removal if ever desired. See Diagram, Appenidix A, Page A-2.

Large ducts need multiple Probe Bars so flow can be averaged. The bars should be spaced out on the same “plane” of the duct so the sensors are located to pick up the flow. Refer to the A_1, A_2, A_3, A_4 (as required) dimensions on submittal schedule.

2.1.2 Fan Inlet- Mounted Probes

(refer to drawings on pages A-5 thru A-10 in Appendix A)

General- The VT-7000 Series Vortek Fan Inlet Probes are in pairs of bars for each inlet. For single-inlet fans, one pair is provided. For double-inlet fans, two pairs are provided. One Transmitter serves all bars in the one or two-pair set. On bars sized for fan inlet diameters of 24" I.D. or less, the bar electronics are mounted in an enclosure which mounts separately from the bars and is permanently connected to the bars via flexible non-metallic conduit. On bars sized for fan inlet diameters greater than 24" I.D., the bar electronics are housed in enclo-

sures which are mounted in the center of each bar. In both cases the bar electronics connect to the Transmitter via prefab cables, which are factory-connected to the bar electronics enclosures.

Direction of Flow- The probes must be positioned so that they face into the airflow: the Safety Cables on the ends of the bars leading out of the fan inlet bell, and the mounting brackets facing back into the fan inlet bell. On bars for fan inlets over 24" I.D., the bar electronics controller has an airflow direction label affixed to it for your convenience.

Mounting the Probe Bars- Hold the bars in place as shown in the drawing (choose the drawing that matches the fan type which you are working with). Make sure the bars are positioned as described above. Mark, on the inlet bell surface, the mounting hole locations of the brackets on the ends of the bars. Remove the bars from the inlet and drill pilot holes for #14 self-tapping screws where you marked them.

Remove the brackets from the ends of the bars (be careful not to lose the bolts, nuts and Safety Cables). Screw the brackets to the inlet bell surface using thread locking compound and #14 self-tapping screws.

Re-attach the bars to the installed mounting brackets, being careful to face the bars in the correct direction, and to re-attach the Safety Cables as they were before. Tighten the NyLok nuts on the bar mounting bolts sufficiently to prevent loosening of the nuts through vibration. Note: If a screw, nut, or bolt is stripped, replace it with the same type fastener. If a drilled pilot hole is stripped, DRILL ANOTHER HOLE and move the probe according.

DO NOT USE STRIPPED HOLES OR FASTENERS AS DAMAGE TO THE PROBES AND FAN CAN RESULT FROM PROBES COMING LOOSE AND BEING DRAWN INTO THE FAN WHEEL!

Stretch the Safety Cables outward from the bars towards the outside of the fan, leaving no slack in the cable. The eyelet on the end of the cable must be screwed to a sturdy, metallic surface such as the bell, fan casing, or bearing support. Mark where you intend to srew the eyelets, and drill #14 self-tapping screw pilot holes. Using thread locking compound and #14 self-tapping screws, screw the eyelets down, tighening the screws sufficiently to prevent loosening due to vibration, but DO NOT STRIP THEM!

Run the cables out to where the Transmitter will be mounted, leaving sufficient slack to allow easy plugging and unplugging of the cables into the transmitter receptacles.

2.2 Transmitter Mounting and Location

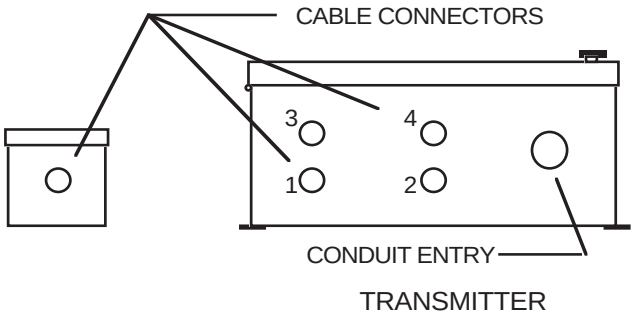
General- The transmitter is typically located in close proximity to the duct insertion probe bars and transmits a 4-20mA signal over long distances to the customers control system.

Transmitter Location- The VorTek transmitter is small and designed for mount-

ing either on the duct or on a wall, column, or other support close to the point of measurement. The transmitter housing is a general purpose enclosure and is therefore not designed for mounting outdoors or in areas requiring explosion-proof classification. For outdoor use, a Nema 4 enclosure can be purchased as an option. For installation in explosion-proof areas contact factory. Areas where the temperatures are expected to exceed 125° F for extended periods of time are to be avoided.

2.3 Probe and Transmitter Connection

Probe Connection- Ten foot connecting cables are provided for each insertion probe. This cable has a shielded 8 pin connector from the probe electronics enclosure and is plugged into either connector on the bottom of the transmitter.



Probe Cable Connection Points
Figure 1

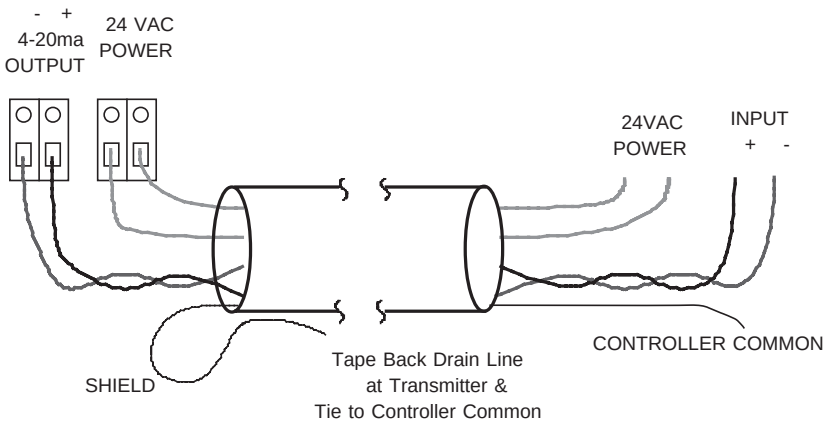
Probes should be plugged in to the transmitter in numeric sequence (ie. 1, 2, 3, 4). If one probe is used it should be plugged into connector 1. If three probes are used they should be plugged into connectors 1, 2, and 3. It is not important however which probe is plugged in to a particular connector. After connectors have been plugged in it is advisable to anchor them with tie wraps.

2.4 Transmitter Wiring

Terminations- Inside the transmitter on the bottom right are two pairs of terminals. The left most pair are the signal output terminals. (See Fig. 3) The right most are for 24VAC Power input. Transmitter power is 24 Volts AC, 8VA maximum current. Power may fluctuate ±20% without effect.

Signal and power wiring can be run in a common shielded cable or separately. If run separately, signal cable should be shielded. In either case, shields should be tied to the input device (controller) common and taped back on the other end. (See Fig. 2) Typically, shields are terminated at the controller.

Output Signal- Transmitter output is 4-20mA and is capable of driving up to 650 ohms of load. Control equipment which accepts voltage inputs can be accommodated with internal jumpers that will generate a 1-5VDC output or a 2-10 VDC output. SEE DRAWING ON NEXT PAGE.



Transmitter Power and Signal Wiring
Figure 2

3.0 STARTUP ADJUSTMENTS

3.1 General Description

The VorTek airflow transmitter has several modes of operation which are determined by setting the four position DIP (Dual Inline Package) switch located on the upper right corner of the mother board. This switch is utilized for adjusting the damping, transmitter zero check, and quick calibration check.In addition to this switch, potentiometers are available for adjusting Transmitter Zero, Full Scale, Frequency Offset, and digital indicator output. See Figure 3 below.

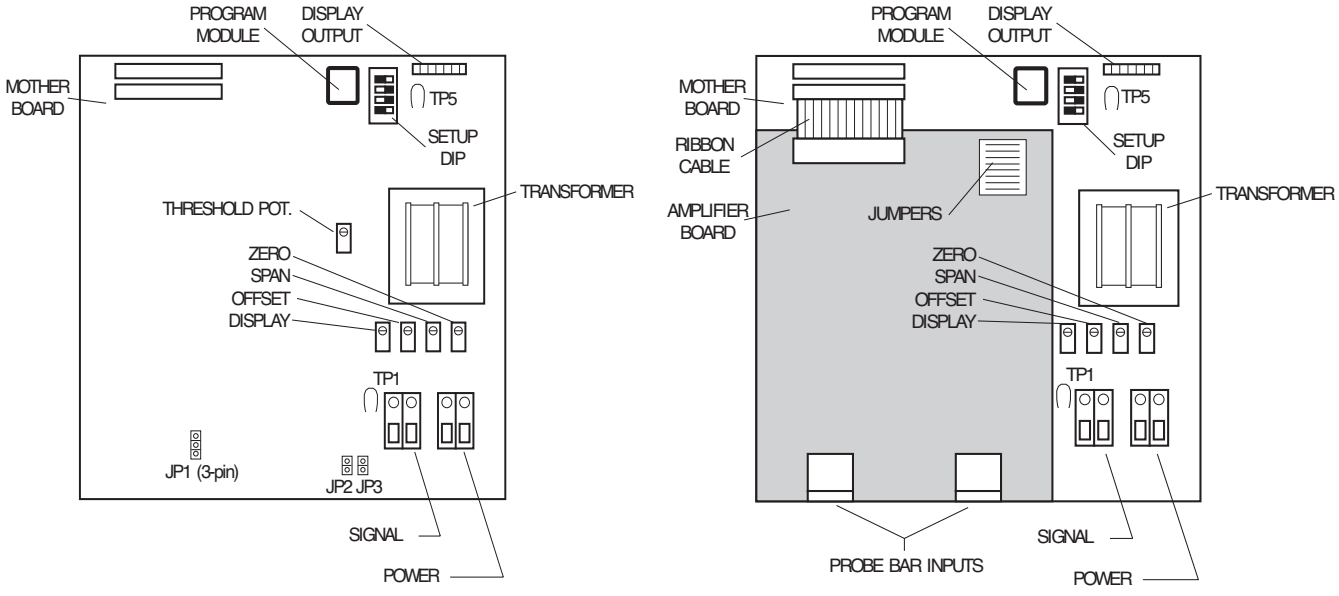


Figure 3 - Vortek Mother Board, (left); VorTek mother board showing Amplifier board installed (right).

Transmitter output checks can be made by connecting a voltmeter set for DC milliamps, in series as follows;

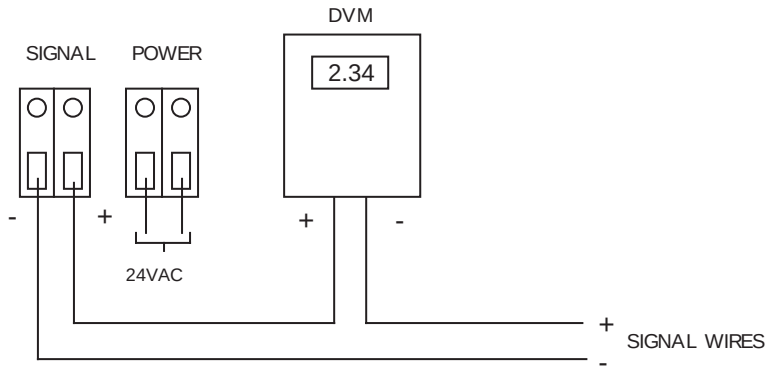


Figure 4

3.2 Normal Operation

In order for the transmitter to function properly as a flow measurement device the DIP switch must be set as follows;

DIP 1	On or Off
DIP 2	On
DIP 3	On
DIP 4	Off

3.3 Damping Adjustment

Damping can be set by using DIP switch number 1. With switch one in the “on” position minor damping is in effect. With switch one in the “off” position the normal damping is doubled.

3.4 Zero Check

Transmitter zero output (4-20mA) can be simulated by setting DIP switches 2, 3, and 4 as follows, and removing the probe connectors from the bottom of the transmitter;

DIP 1	On or Off
DIP 2	Off
DIP 3	Off
DIP 4	Off

With the voltmeter set for milliamps and connected in series (See fig. 4) with the 4-20mA output, the zero-flow output can be adjusted by utilizing the zero calibration potentiometer. At these settings the meter should read 4mA. Reinstall the probe connectors when complete. Remember to return DIP switches to normal operation or continue on to Quick Calibration Check.

3.5 Quick Calibration Check

Transmitter calibration can be checked quickly by setting DIP switches 2, 3, and 4 as follows, and then removing the probe connectors from the bottom of the transmitter;

DIP 1 On or Off
DIP 2 Off
DIP 3 Off
DIP 4 On

The proper output of the transmitter can be established by making the following calculation. Full scale Hz data can be obtained from the transmitter label on the front door;

Expected mA= [16*(122/Full Scale Frequency Hz)]+4

If the value observed does not agree with the value expected, ±0.5% full scale, then the transmitter may require recalibration. The use of this internal frequency standard for calibration of full scale values is possible but will not be as accurate as calibration using a frequency generator set at full scale Hz.

3.6 Threshold Adjustment

The threshold adjustment is normally made on a calibration bench. However, the threshold can be set empirically in the field by following the procedure in section 4.2. The threshold adjustment serves to limit the lower operating limit of the transmitter to increase sensitivity at low flow conditions.

Threshold is factory set at a point equivalent to 350 FPM. Below this level the threshold circuit forces the output to go to 4.0 ma. Lowering the threshold below 350 increases chances that the transmitter may show flow when none is present if a high ambient noise condition is present.

The threshold should only be adjusted if the transmitter indicates flow when in fact there is none present. Before adjusting, check to see that zero is properly adjusted. Then, with no flow in the duct, turn the threshold adjustment clockwise until the transmitter indicates 4 ma.

4.0 CALIBRATION & MAINTENANCE

4.1 Field Calibration

The VorTek transmitter comes calibrated for the CFM or FPM specified by the customer. The calibration factor is established as a function of the type of VorTek sensor utilized in the construction of the probe bars. These calibration factors are established by test and represent flow conditions expected when normal Minimum Installation Requirements are observed. (See Appendix A, page A-1)

When these conditions are not present and duct turbulence is a problem, corrections may be required to match flow transmitter output to readings observed by traverse. In these cases transmitter span can be adjusted to read the desired output. Adjustment of transmitter span will not effect transmitter zero.

For best results, a traverse should be done with the airflow at a fixed CFM. This can be done by: Fixing the output to the damper/valve which throttles the air in that duct, or by removing the output to the valve/damper, and keeping all doors closed in the area that is affected by this airflow.

The CFM reading can then be compared to the transmitter output. A milliamp meter should be connected in series with the output signal wires. (refer to figure 4 on page 11). The reading will fall between 4 and 20 mA. Use the formula below to convert the mA value to the equivalent CFM. The transmitter Full Scale CFM can be found on the transmitter enclosure.

Current Transmitter CFM Value = [Full Scale CFM/16]*(milliamp reading - 4)

If the transmitter CFM reads differently than the traverse, then an adjustment can be made. If there is a front end system receiving the control signal. A multiplication constant should be added to the scaling formula to agree with a balancer reading. If this is not possible, the transmitter itself can be adjusted. First calculate the corresponding milliamp value which matches the traversed CFM with this formula:

New desired mA value = [(traversed CFM/Transmitter Full Scale CFM)* 16]+4

Turn the span potentiometer (see figure 3) clockwise to increase the mA signal, counter clockwise to decrease the signal, until the desired mA signal is output.

4.2 Bench Calibration

Full transmitter calibration is normally calibrated at a bench, although it is possible to bring the bench calibration instruments to the transmitter in the field. Connect a digital voltmeter to the transmitter as shown in figure 4. A frequency generator is required and can be used in conjunction with a Multi-meter. The full procedure is as follows.

Set Zero- Set switches 2, 3, and 4 to “OFF”. Adjust the “ZERO” potentiometer until 4.00 mA is read on the digital voltmeter.

Set Full Scale- (see figure 5, next page) Set switches 2, 3, and 4 off. Connect the negative lead of the frequency generator to TP 1 on the mother board (next to the wire connectors). Connect the positive lead to TP 5. Set the generator to the full scale Hertz indicated on the label fixed to the transmitter enclosure. Set the frequency generator to *sinusoidal* wave and the output voltage to the minimum level. Adjust the span potentiometer until the output reads 20.0 mA. Turn the span potentiometer clockwise to increase the mA signal, counter clockwise to decrease the signal.

Set Optional Display- With the above connections and settings in place from the previous step, adjust the “DVM” potentiometer to read the appropriate scale display value. As the maximum display is 1999, a multiplier of x10 or x100 may have to be utilized to get the total CFM display.

Threshold Adjustment- With the above connections and settings in place from the previous step, set the frequency generator to approximately 60 Hz. Turn the “THRES” potentiometer clockwise until the transmitter output switches to 4 ma. Then, slowly turn the “THRES” adjustment counter clockwise until the output switches back to a reading other than 4 mA. Threshold is now set.

Return To Service- Return switches 2 and 3 to the “ON” position prior to returning the unit to service.

4.3 Offset Adjustment

The tag on the transmitter enclosure may have two separate values for frequency; Full scale Hz and Span Hz. If this is the case, the transmitter was factory calibrated with an offset. To set the offset, follow the set up procedure in 4.2 first. Next turn the offset potentiometer (see figure 5) counter clockwise all the way. Now input the span frequency to the transmitter, and adjust the span potentiometer until the output is 20.0 mA. Next input the Full Scale frequency. The mA output will go up. Turn the offset potentiometer clockwise until the output is 20.0 mA again. The adjustment is complete.

4.4 Calibration Check

1. Follow the setup instructions shown in section 4.2 (in the “Set full scale” section) of the manual.

2. The check should include 3 points: 1/2 full scale frequency, 3/4 full scale frequency, and the full scale frequency. Input these frequencies using the method in “Set full scale”. The transmitter output will be 12 mA, 16 mA, and 20 mA respectively.

3. If the calibration does not match the above, recalibration will be required. The calibration should match the entire range of operation. If it agrees at the maximum frequency but not in the center, there may be a problem with the way the unit is configured. It is likely that jumper JP 1 is not set properly. It should be in the down position if full scale frequency is greater than 600 Hz.

4.5 Wave form check with an oscilloscope

Voltage Input - See figure 5, below. Set up the oscilloscope to read wave forms clearly on the screen. To check the power input, set the scope to read 24VAC. Touch the negative test lead to either screw in the power wire connector **(A)**, and the positive lead to the other screw. The screen should read 60Hz.

Connect the negative lead to the test point 1 (TP1) **(B)** on the mother board. Connect the positive lead to one of the exposed metal jumpers **(C)** on the amplifier board. A clean, square wave should appear, and the numerical frequency value should not bounce more the 20% for a good signal. Check each of the thin metal jumpers and read the values. The average frequencies of the jumpers should be fairly close in value. If there are two amplifier boards on top of the mother board, the top amplifier board must be removed.

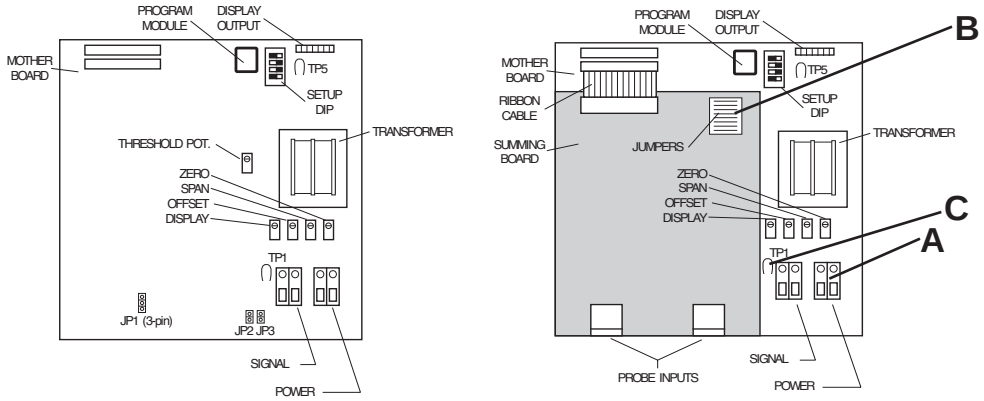
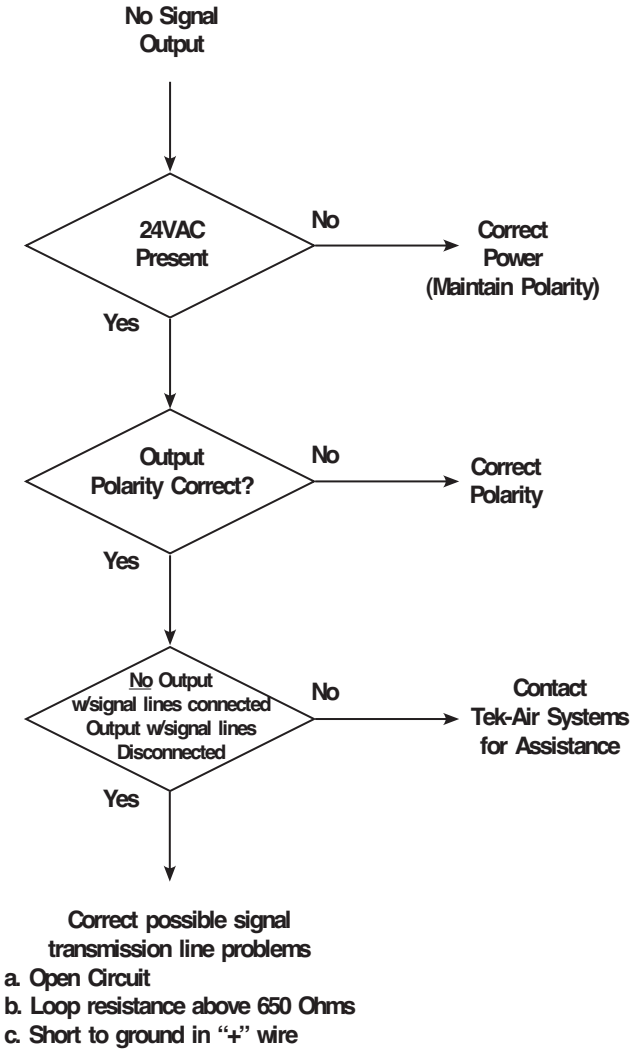
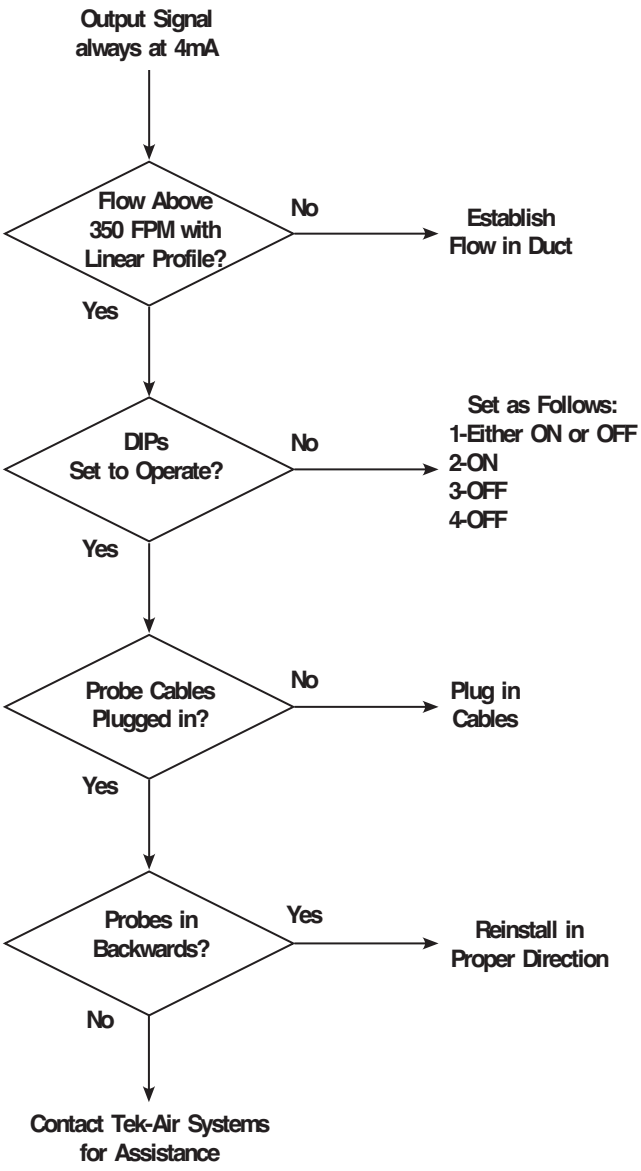


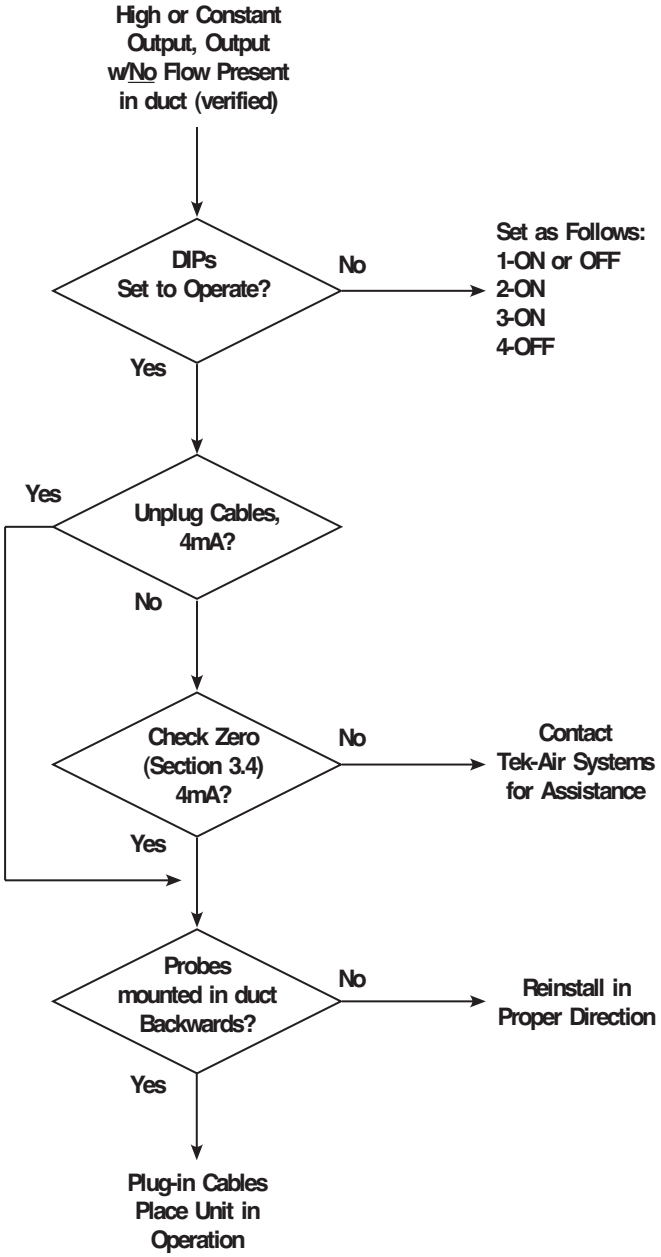
Figure 5 - Vortek Mother Board, (left); VorTek mother board showing summing board (right).

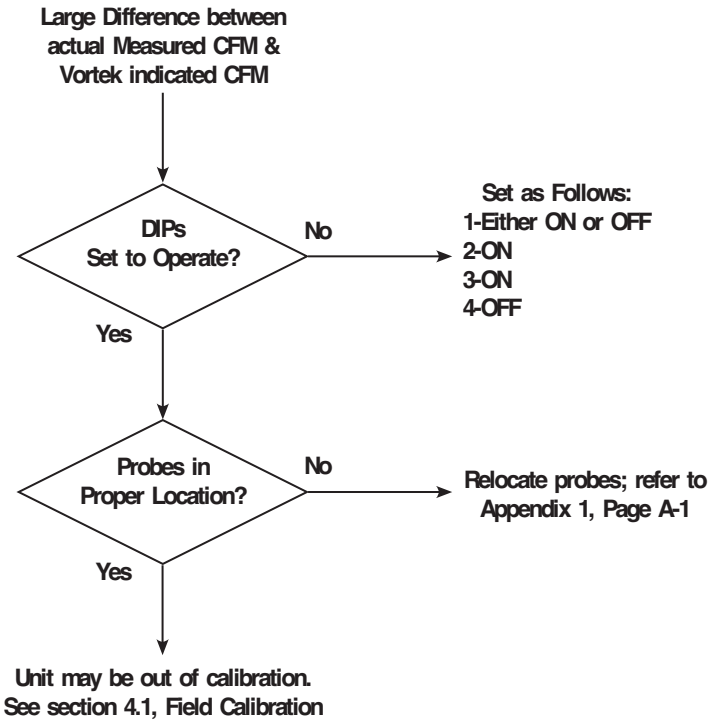
4.6 Trouble Shooting

The following flow charts are designed to aid in trouble shooting the transmitter and flow sensors should problems be experienced in commissioning the airflow measurement system.

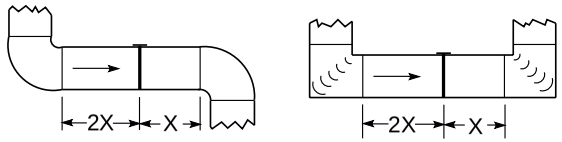





High or Constant Output, Output w/No Flow Present in duct (verified)
DIPs Set to Operate?
No
Set as Follows: 1-ON or OFF 2-ON 3-ON 4-OFF
Yes
Yes
Unplug Cables, 4mA?
No
Check Zero (Section 3.4) 4mA?
No
Contact Tek-Air Systems for Assistance
Yes
Probes mounted in duct Backwards?
No
Reinstall in Proper Direction
Yes
Plug-in Cables Place Unit in Operation

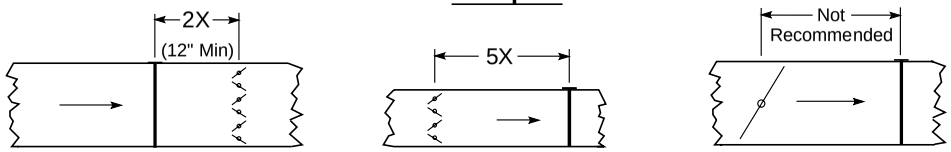

Large Difference between actual Measured CFM & Vortek indicated CFM
DIPs Set to Operate?
No
Set as Follows: 1-Either ON or OFF 2-ON 3-ON 4-OFF
Yes
Probes in Proper Location?
No
Relocate probes; refer to Appendix 1, Page A-1
Yes
Unit may be out of calibration. See section 4.1, Field Calibration

Elbows

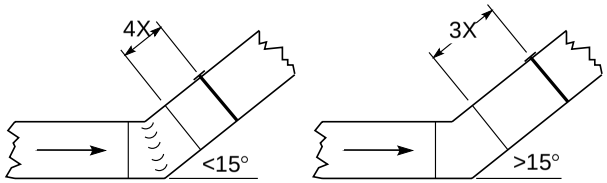


Sweep — 90° Vaned

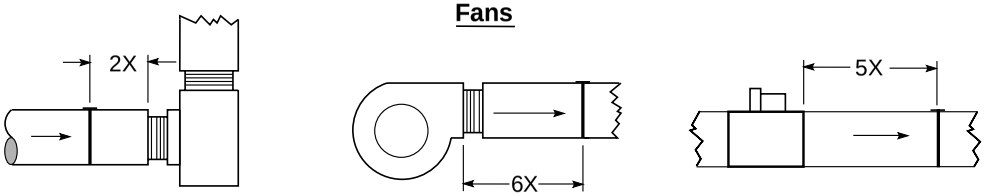
Dampers



Angle Fittings

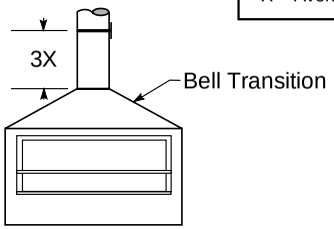


Fans



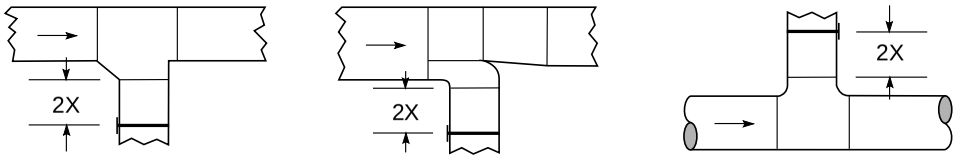
Centrifugal Inlet — Centrifugal Discharge — Vane-Axial Discharge

Hoods



General Notes
X = Average Duct Dimension

Duct Take-Offs



Formulas

D = Diameter **W = Width in Inches** **H = Height in Inches**

$$\text{Circ. Duct Area} = \frac{\pi \times \left(\frac{D}{2}\right)^2}{144}$$

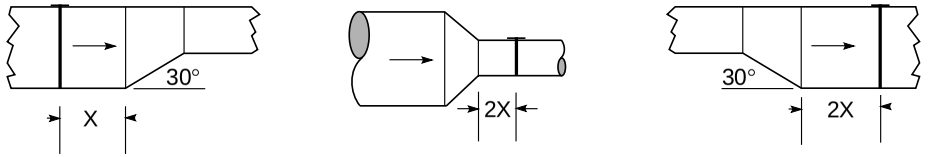
$$\text{Rect. Duct Area} = \left(\frac{W \times H}{144}\right)$$

$$\text{Oval Duct Area} = \frac{\pi \times \left(\frac{H}{2}\right)^2 + ((W - H) \times H)}{144}$$

$$\text{Design Velocity} = \frac{\text{Design CFM}}{\text{Duct Area}}$$

$$\text{Probe Velocity Pressure} = \left(\frac{\text{Duct Velocity}}{3020}\right)^2$$

Duct Transitions



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Engineering Department
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Danbury, CT 06810
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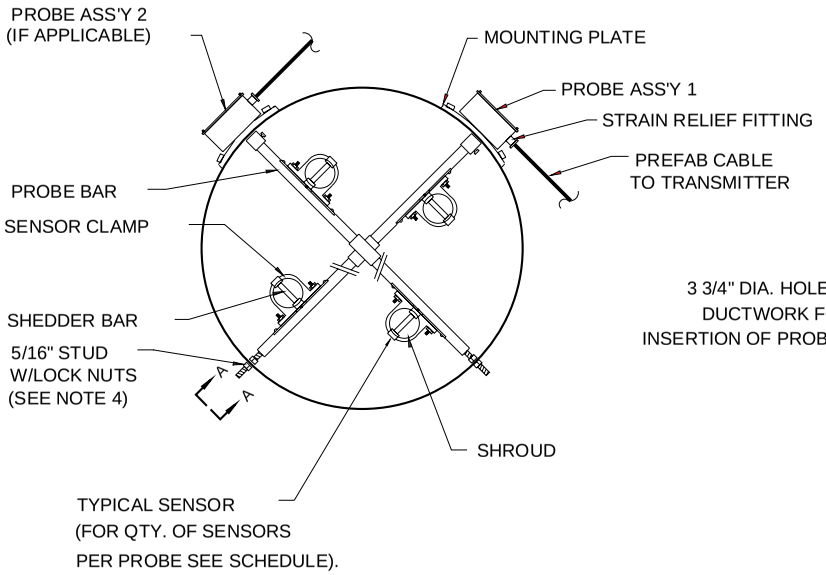
(203) 798-6534 Fax

VorTek
Airflow Measuring Probes

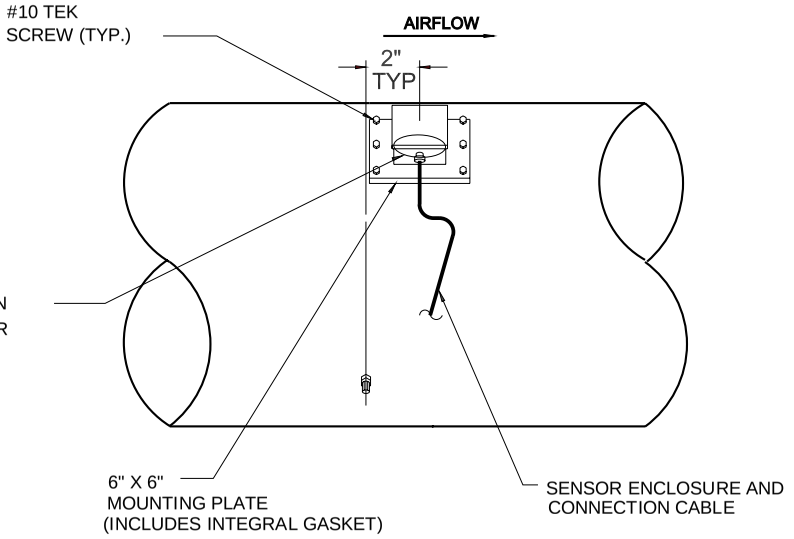
Minimum Installation Requirements
& Formulas

Revision Letter: A	Dwg. No:
Revision Date: 4/21/97	Drawn By: GV
Filename: VT-MIN.CDR	

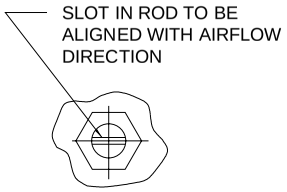
DUCT CROSS SECTION



INSERTION SIDE



Selection of Materials For Construction			
☐	☐	☐	☐
Aluminum & ABS	CPVC & ABS	304 St Steel	High Temp. St. Steel



SECTION A-A
PROBE ALIGNMENT SLOT
REQ'D FOR ALL BARS

NOTES:

1. INSTALL IN ACCORDANCE WITH AIRFLOW DIRECTION INDICATOR.
2. FOR QTY. OF PROBES & SENSORS PER PROBE SEE SCHEDULE.
3. FOR SINGLE BAR UNITS USE PROBE ASS'Y 1 ONLY. FOR UNITS WITH TWO BARS USE PROBE ASS'Y 1 & 2.
4. FOR DUCT DIAMETERS OF 14" OR LESS PROBE IS CAPPED WITH NO STUDS OR NUTS PROVIDED. IN THIS CASE, NO (5/16") HOLE SHOULD BE DRILLED.

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Engineering Department
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(203) 791-1400 Phone
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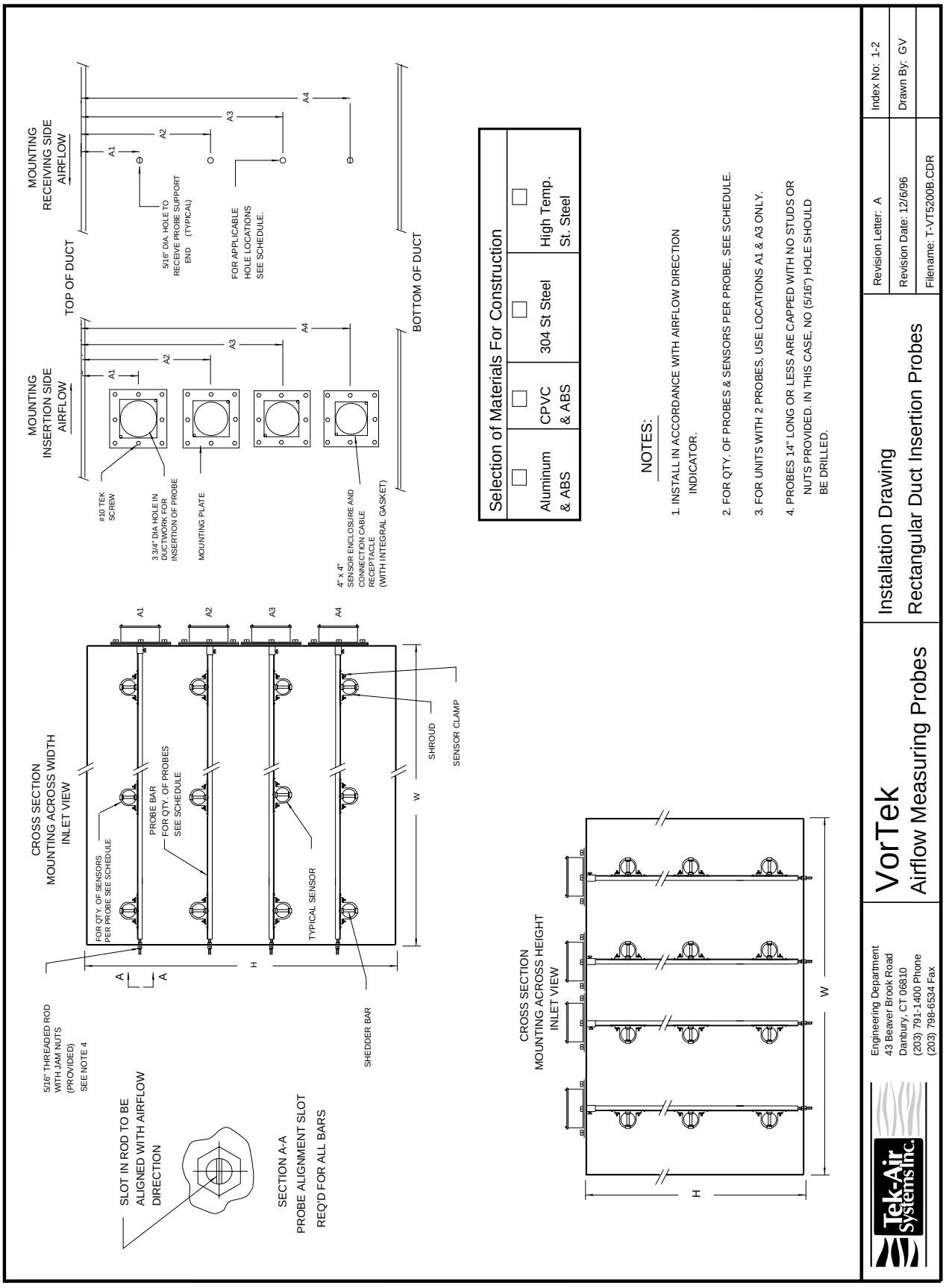
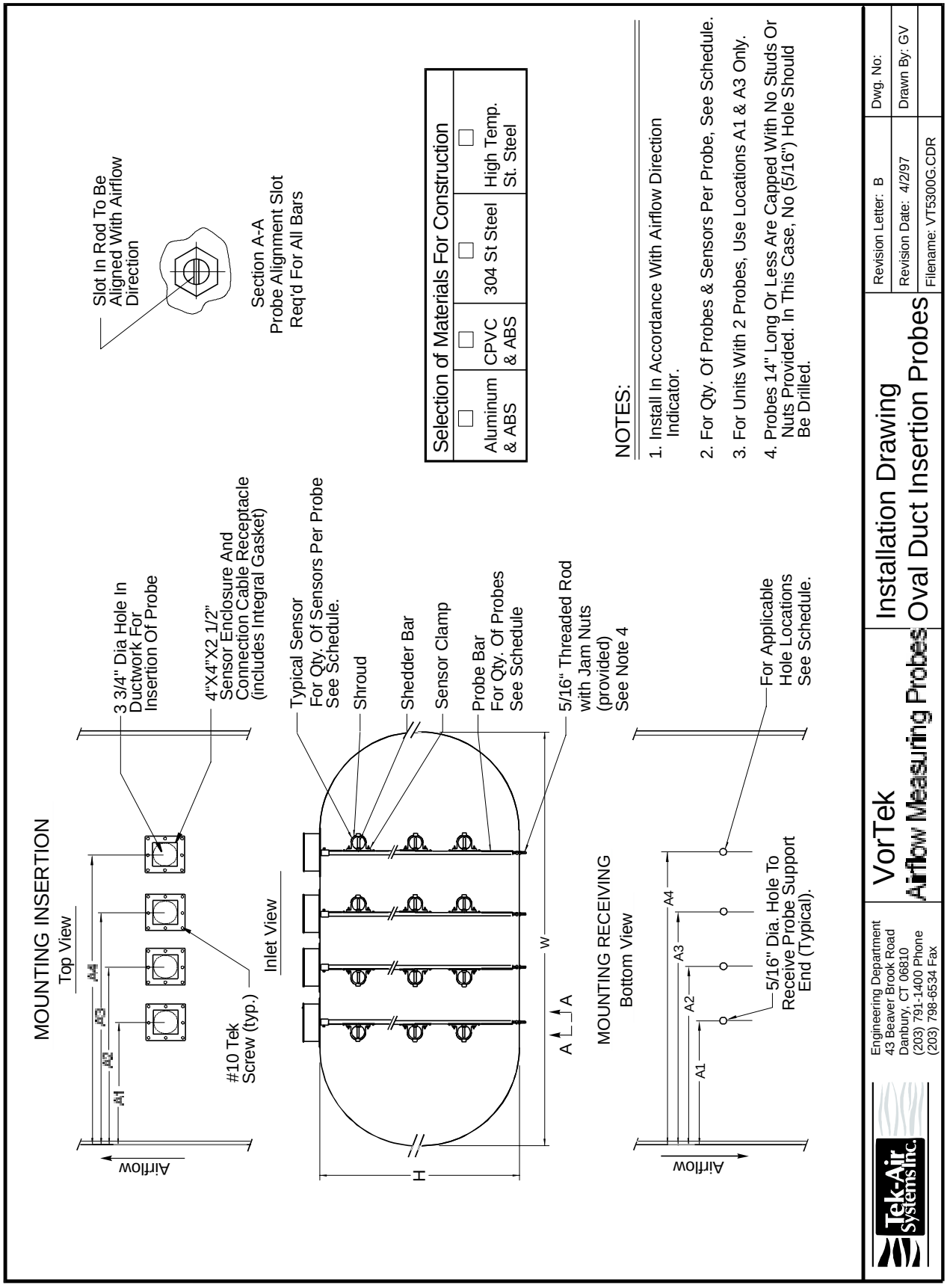
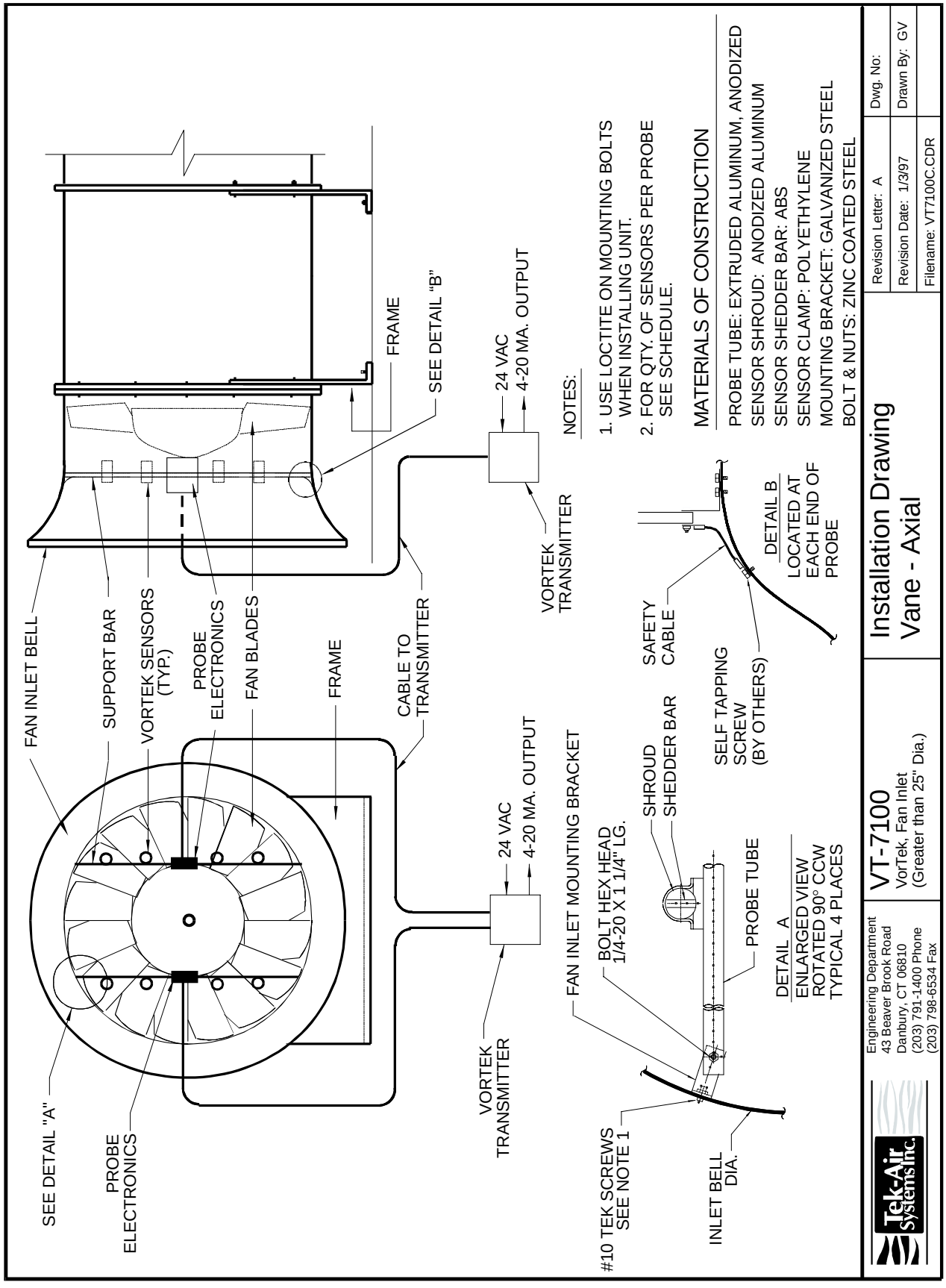
VorTek
Airflow Measuring Probes

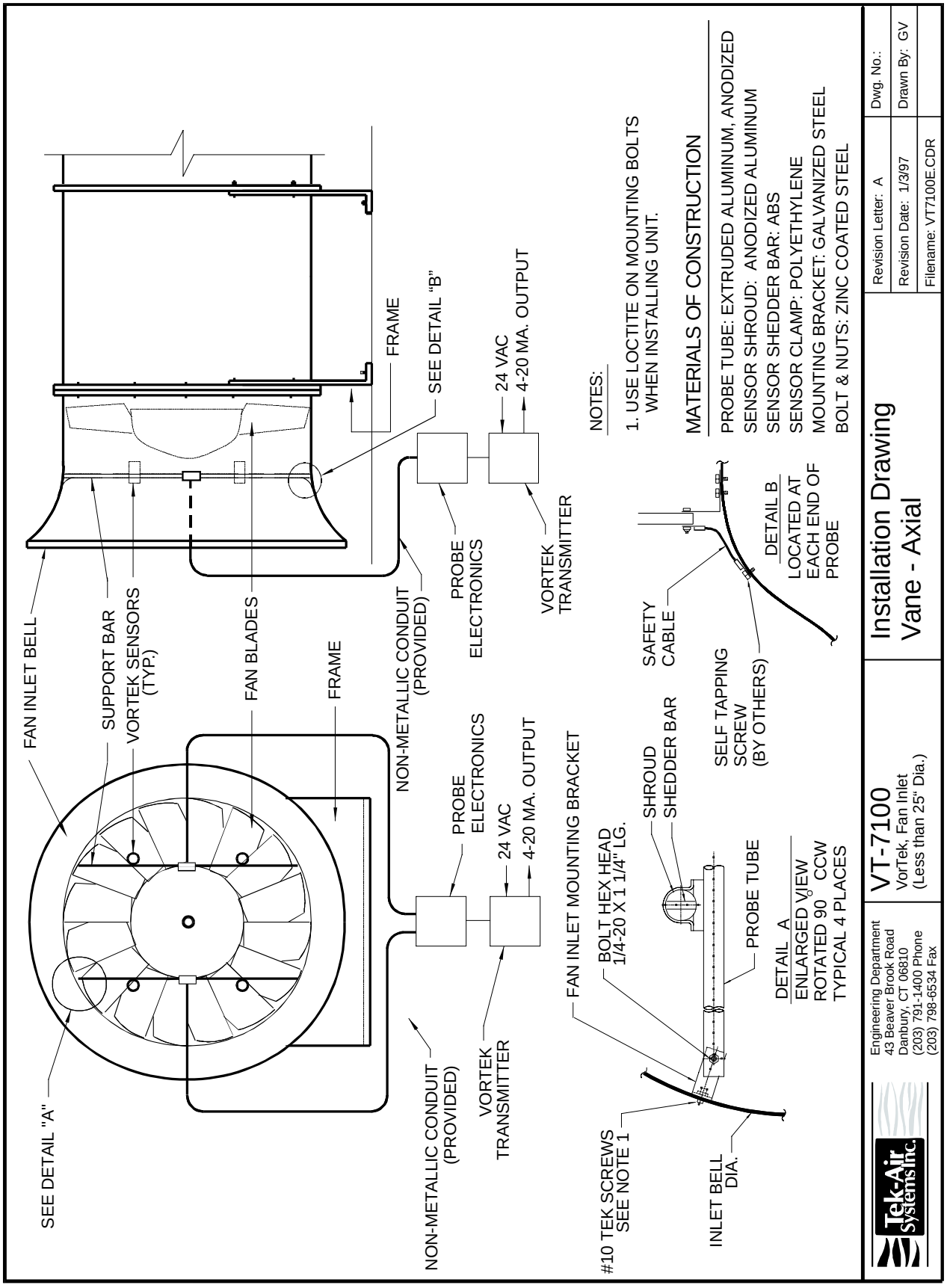
Installation Drawing
Circular Duct Insertion Probes

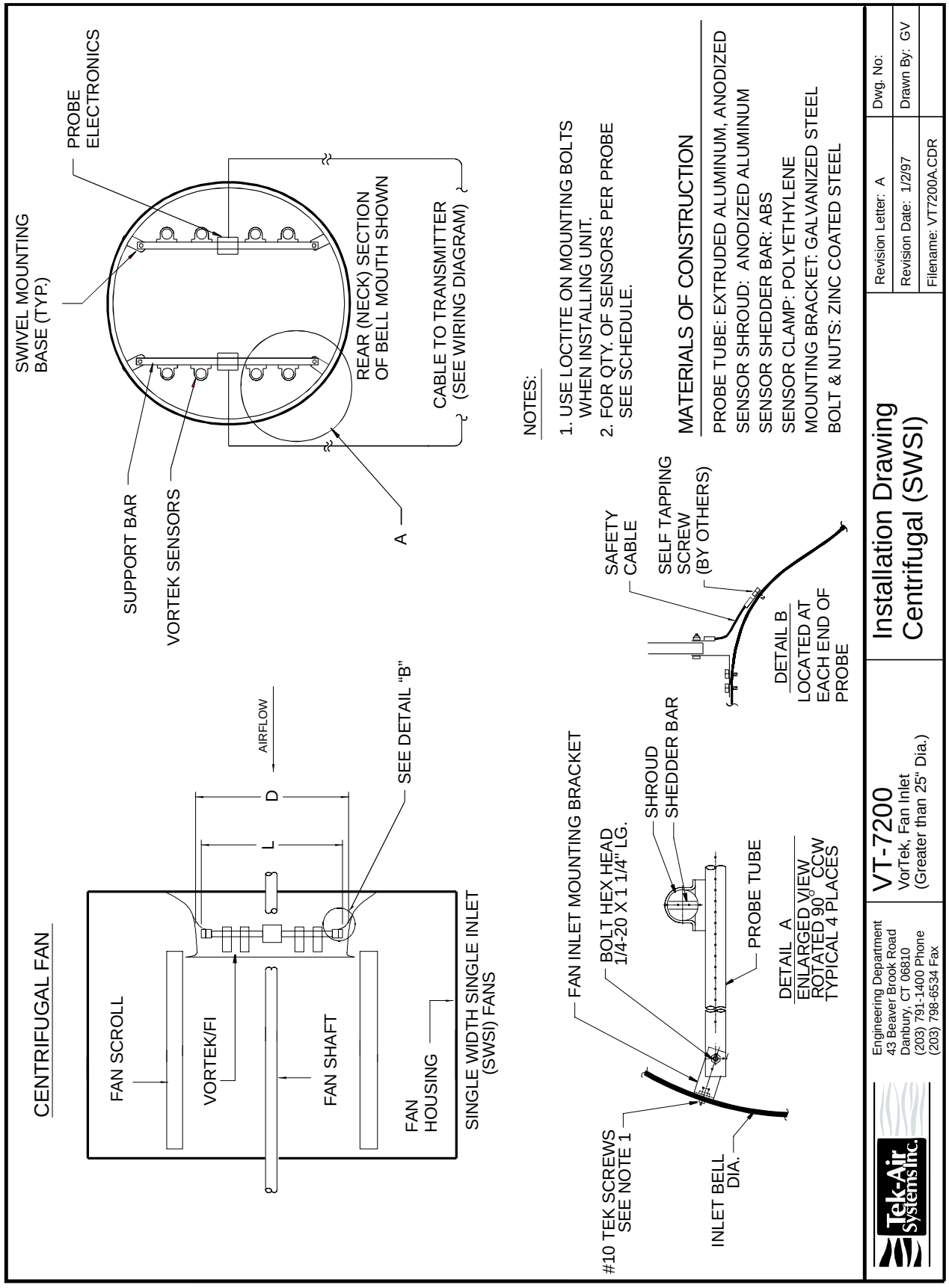
Revision Letter: A	Index No: 1-1
Revision Date: 12/11/96	Drawn By: GV
Filename: T-VT5100A.CDR	

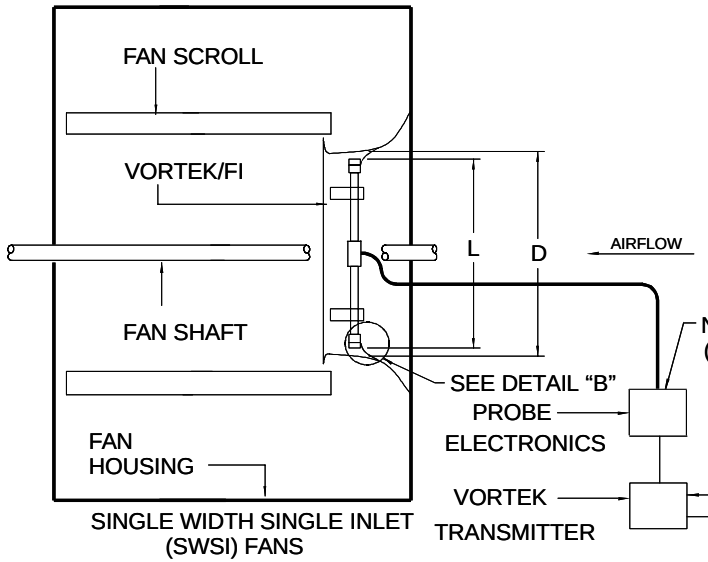

MOUNTING RECEIVING SIDE AIRFLOW
TOP OF DUCT
A1
A2
A3
A4
5/16" DIA. HOLE TO RECEIVE PROBE SUPPORT END (TYPICAL)
FOR APPLICABLE HOLE LOCATIONS SEE SCHEDULE.
BOTTOM OF DUCT
MOUNTING INSERTION SIDE AIRFLOW
#10 TEK SCREW
3.3/4" DIA HOLE IN DUCTWORK FOR INSERTION OF PROBE
MOUNTING PLATE
4" X 4" SENSOR ENCLOSURE AND CONNECTION CABLE RECEPTACLE (WITH INTEGRAL GASKET)
Selection of Materials For Construction
Aluminum & ABS
CPVC & ABS
304 St Steel
High Temp. St. Steel
NOTES:
1. INSTALL IN ACCORDANCE WITH AIRFLOW DIRECTION INDICATOR.
2. FOR QTY. OF PROBES & SENSORS PER PROBE, SEE SCHEDULE.
3. FOR UNITS WITH 2 PROBES, USE LOCATIONS A1 & A3 ONLY.
4. PROBES 14" LONG OR LESS ARE CAPPED WITH NO STUDS OR NUTS PROVIDED. IN THIS CASE, NO (5/16") HOLE SHOULD BE DRILLED.
CROSS SECTION MOUNTING ACROSS WIDTH INLET VIEW
FOR QTY. OF SENSORS PER PROBE SEE SCHEDULE
PROBE BAR FOR QTY. OF PROBES SEE SCHEDULE
TYPICAL SENSOR
SHROUD
SENSOR CLAMP
SHEDDER BAR
5/16" THREADED ROD WITH JAM NUTS (PROVIDED) SEE NOTE 4
SLOT IN ROD TO BE ALIGNED WITH AIRFLOW DIRECTION
SECTION A-A
PROBE ALIGNMENT SLOT REQ'D FOR ALL BARS
CROSS SECTION MOUNTING ACROSS HEIGHT INLET VIEW
H
W
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VorTek
Airflow Measuring Probes
Installation Drawing
Rectangular Duct Insertion Probes
Revision Letter: A
Revision Date: 12/6/96
Filename: T-VT5200B.CDR
Index No: 1-2
Drawn By: GV

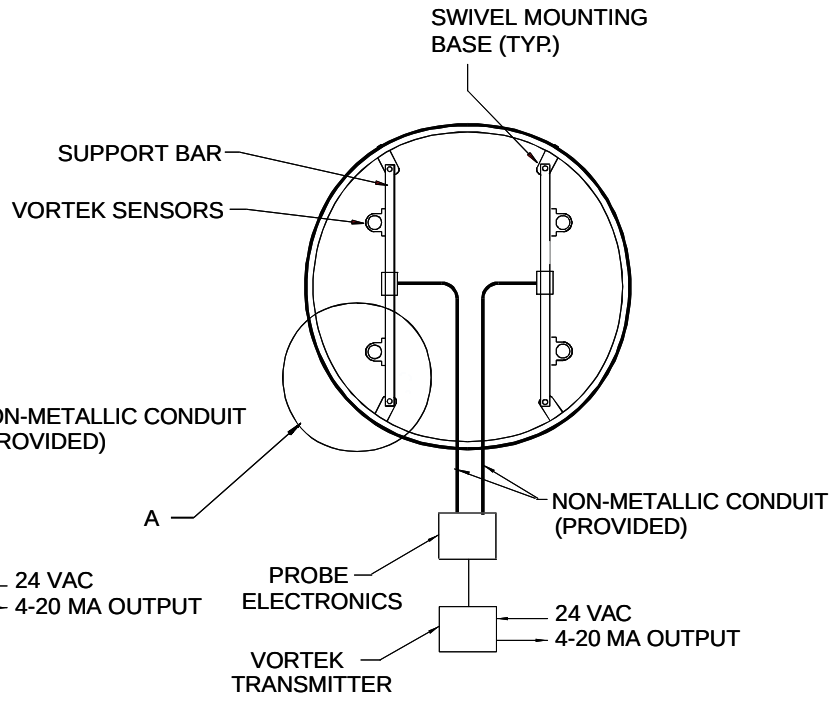

MOUNTING INSERTION
Top View
Airflow
A1
A2
A3
A4
3 3/4" Dia Hole In Ductwork For Insertion Of Probe
4"X4"X2 1/2" Sensor Enclosure And Connection Cable Receptacle (includes Integral Gasket)
#10 Tek Screw (typ.)
Inlet View
Typical Sensor For Qty. Of Sensors Per Probe See Schedule.
Shroud
Shedder Bar
Sensor Clamp
Probe Bar For Qty. Of Probes See Schedule
5/16" Threaded Rod with Jam Nuts (provided) See Note 4
H
W
A
A
Slot In Rod To Be Aligned With Airflow Direction
Section A-A
Probe Alignment Slot Req'd For All Bars
Selection of Materials For Construction
Aluminum & ABS
CPVC & ABS
304 St Steel
High Temp. St. Steel
NOTES:
1. Install In Accordance With Airflow Direction Indicator.
2. For Qty. Of Probes & Sensors Per Probe, See Schedule.
3. For Units With 2 Probes, Use Locations A1 & A3 Only.
4. Probes 14" Long Or Less Are Capped With No Studs Or Nuts Provided. In This Case, No (5/16") Hole Should Be Drilled.
MOUNTING RECEIVING
Bottom View
Airflow
A1
A2
A3
A4
5/16" Dia. Hole To Receive Probe Support End (Typical).
For Applicable Hole Locations See Schedule.
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VorTek
Airflow Measuring Probes
Installation Drawing
Oval Duct Insertion Probes
Revision Letter: B
Revision Date: 4/2/97
Filename: VT5300G.CDR
Dwg. No:
Drawn By: GV

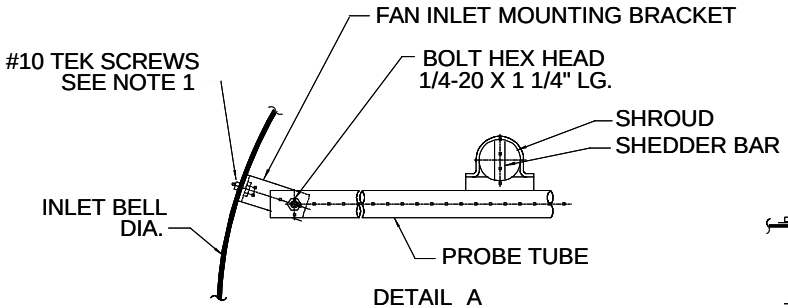

FAN INLET BELL
SUPPORT BAR
VORTEK SENSORS (TYP.)
PROBE ELECTRONICS
FAN BLADES
FRAME
CABLE TO TRANSMITTER
VORTEK TRANSMITTER
24 VAC
4-20 MA. OUTPUT
SEE DETAIL "B"
FRAME
SEE DETAIL "A"
PROBE ELECTRONICS
INLET BELL DIA.
#10 TEK SCREWS SEE NOTE 1
FAN INLET MOUNTING BRACKET
BOLT HEX HEAD 1/4-20 X 1 1/4" LG.
SHROUD SHEDDER BAR
PROBE TUBE
SELF TAPPING SCREW (BY OTHERS)
SAFETY CABLE
DETAIL A
ENLARGED VIEW ROTATED 90° CCW TYPICAL 4 PLACES
DETAIL B
LOCATED AT EACH END OF PROBE
NOTES:
1. USE LOCTITE ON MOUNTING BOLTS WHEN INSTALLING UNIT.
2. FOR QTY. OF SENSORS PER PROBE SEE SCHEDULE.
MATERIALS OF CONSTRUCTION
PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VT-7100
VorTek, Fan Inlet
(Greater than 25" Dia.)
Installation Drawing
Vane - Axial
Revision Letter: A
Revision Date: 1/3/97
Filename: VT7100C.CDR
Dwg. No:
Drawn By: GV

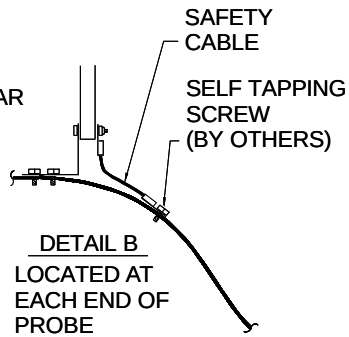

FAN INLET BELL
SUPPORT BAR
VORTEK SENSORS (TYP.)
FAN BLADES
FRAME
NON-METALLIC CONDUIT (PROVIDED)
PROBE ELECTRONICS
VORTEK TRANSMITTER
SEE DETAIL "A"
NON-METALLIC CONDUIT (PROVIDED)
VORTEK TRANSMITTER
FRAME
SEE DETAIL "B"
24 VAC
4-20 MA. OUTPUT
PROBE ELECTRONICS
24 VAC
4-20 MA. OUTPUT
FAN INLET MOUNTING BRACKET
#10 TEK SCREWS SEE NOTE 1
BOLT HEX HEAD 1/4-20 X 1 1/4" LG.
SHROUD
SHEDDER BAR
PROBE TUBE
INLET BELL DIA.
SELF TAPPING SCREW (BY OTHERS)
SAFETY CABLE
DETAIL A
ENLARGED VIEW
ROTATED 90° CCW
TYPICAL 4 PLACES
DETAIL B
LOCATED AT EACH END OF PROBE
NOTES:
1. USE LOCTITE ON MOUNTING BOLTS WHEN INSTALLING UNIT.
MATERIALS OF CONSTRUCTION
PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VT-7100
VorTek, Fan Inlet
(Less than 25" Dia.)
Installation Drawing
Vane - Axial
Revision Letter: A
Revision Date: 1/3/97
Filename: VT7100E.CDR
Dwg. No.:
Drawn By: GV


PROBE ELECTRONICS
SWIVEL MOUNTING BASE (TYP.)
REAR (NECK) SECTION OF BELL MOUTH SHOWN
CABLE TO TRANSMITTER (SEE WIRING DIAGRAM)
SUPPORT BAR
VORTEK SENSORS
A
NOTES:
1. USE LOCTITE ON MOUNTING BOLTS WHEN INSTALLING UNIT.
2. FOR QTY. OF SENSORS PER PROBE SEE SCHEDULE.
MATERIALS OF CONSTRUCTION
PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL
CENTRIFUGAL FAN
FAN SCROLL
VORTEK/FI
FAN SHAFT
FAN HOUSING
SINGLE WIDTH SINGLE INLET (SWSI) FANS
AIRFLOW
D
L
SEE DETAIL "B"
SAFETY CABLE
SELF TAPPING SCREW (BY OTHERS)
DETAIL B
LOCATED AT EACH END OF PROBE
FAN INLET MOUNTING BRACKET
BOLT HEX HEAD 1/4-20 X 1 1/4" LG.
SHROUD
SHEDDER BAR
PROBE TUBE
#10 TEK SCREWS SEE NOTE 1
INLET BELL DIA.
DETAIL A
ENLARGED VIEW
ROTATED 90° CCW
TYPICAL 4 PLACES
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VT-7200
VorTek, Fan Inlet
(Greater than 25" Dia.)
Installation Drawing
Centrifugal (SWSI)
Revision Letter: A
Revision Date: 1/2/97
Filename: VT7200A.CDR
Dwg. No:
Drawn By: GV









NOTES:

1. USE LOCTITE ON MOUNTING BOLTS WHEN INSTALLING UNIT.

MATERIALS OF CONSTRUCTION

PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL

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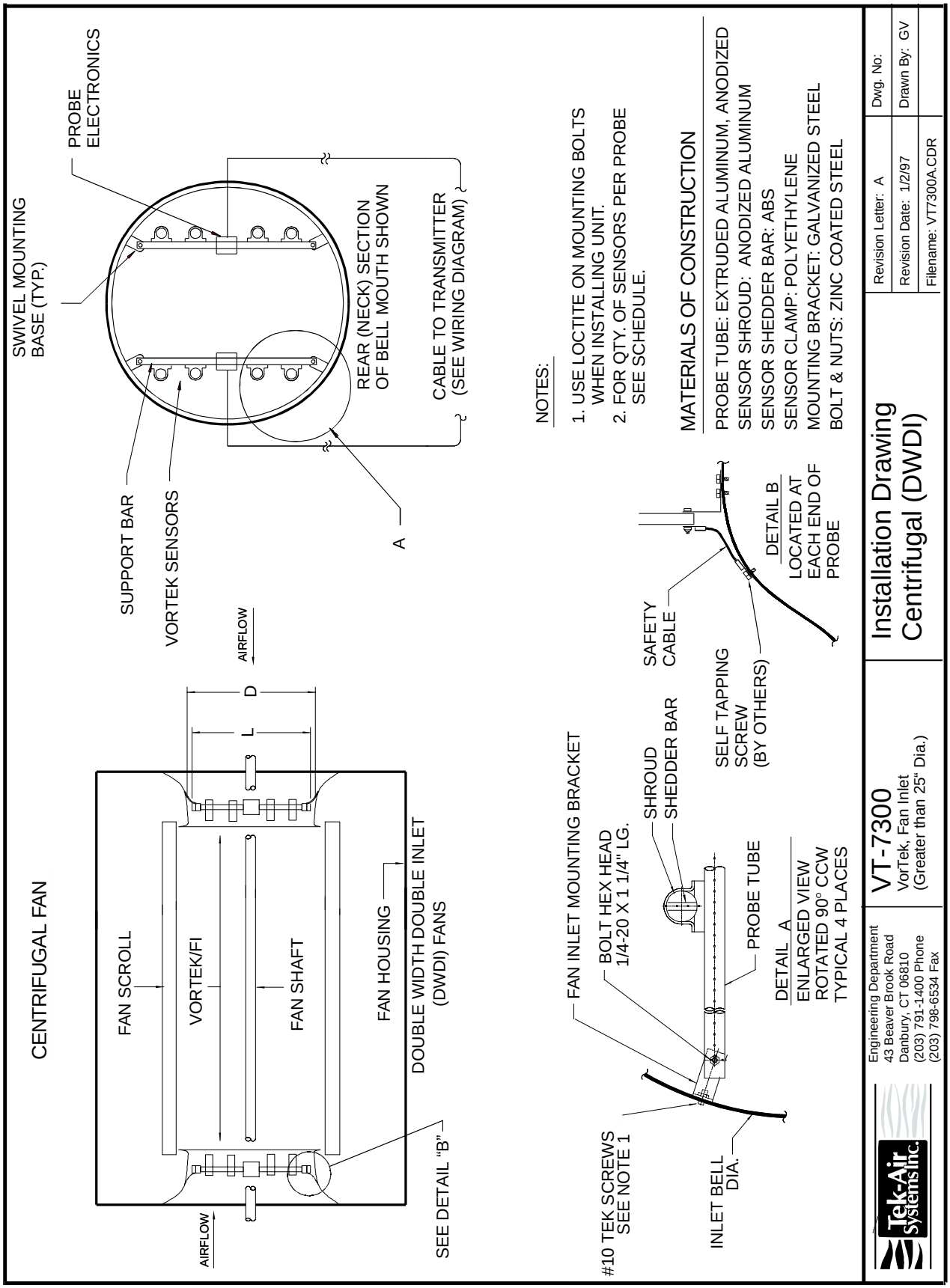
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax

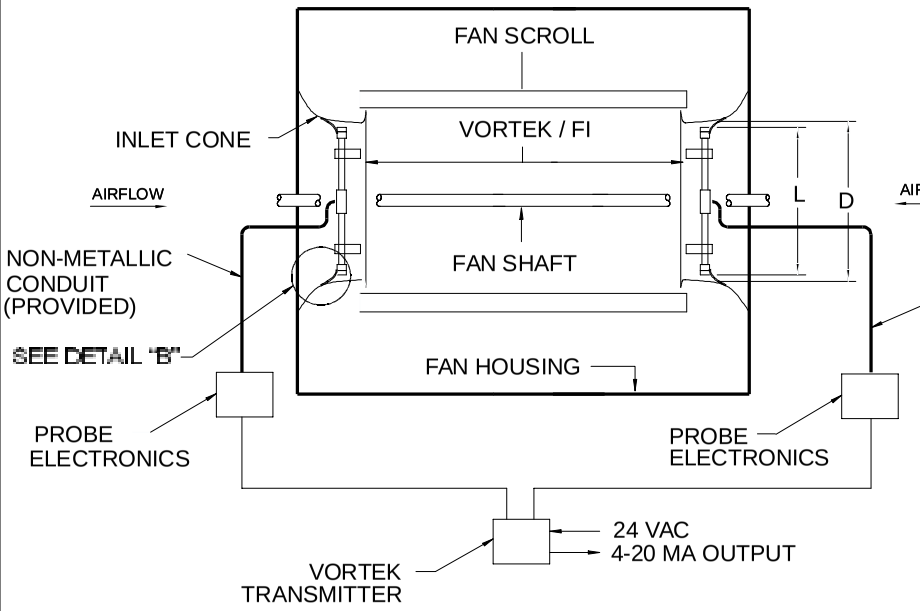
VT-7200
VorTek, Fan Inlet
(Less than 25" Dia.)

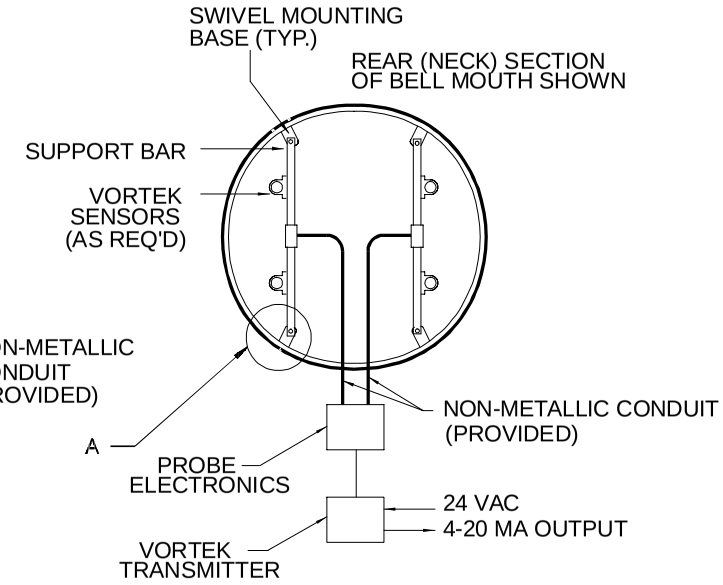
Installation Drawing
Centrifugal (SWSI)

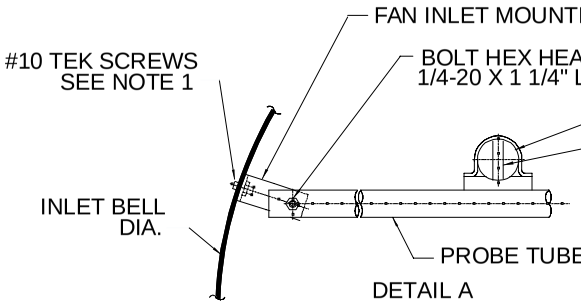
Revision Letter: A	Dwg. No.
Revision Date: 1/3/97	Drawn By: GV
Filename: VT7200E.CDR	


CENTRIFUGAL FAN
FAN SCROLL
VORTEK/FI
FAN SHAFT
FAN HOUSING
DOUBLE WIDTH DOUBLE INLET
(DWDI) FANS
SEE DETAIL "B"
AIRFLOW
D
L
AIRFLOW
SWIVEL MOUNTING
BASE (TYP.)
PROBE
ELECTRONICS
SUPPORT BAR
VORTEK SENSORS
REAR (NECK) SECTION
OF BELL MOUTH SHOWN
CABLE TO TRANSMITTER
(SEE WIRING DIAGRAM)
A
NOTES:
1. USE LOCTITE ON MOUNTING BOLTS
WHEN INSTALLING UNIT.
2. FOR QTY. OF SENSORS PER PROBE
SEE SCHEDULE.
MATERIALS OF CONSTRUCTION
PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL
FAN INLET MOUNTING BRACKET
BOLT HEX HEAD
1/4-20 X 1 1/4" LG.
SHROUD
SHEDDER BAR
SELF TAPPING
SCREW
(BY OTHERS)
SAFETY
CABLE
DETAIL B
LOCATED AT
EACH END OF
PROBE
#10 TEK SCREWS
SEE NOTE 1
PROBE TUBE
INLET BELL
DIA.
DETAIL A
ENLARGED VIEW
ROTATED 90° CCW
TYPICAL 4 PLACES
Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax
VT-7300
VorTek, Fan Inlet
(Greater than 25" Dia.)
Installation Drawing
Centrifugal (DWDI)
Revision Letter: A
Revision Date: 1/2/97
Filename: VT7300A.CDR
Dwg. No:
Drawn By: GV

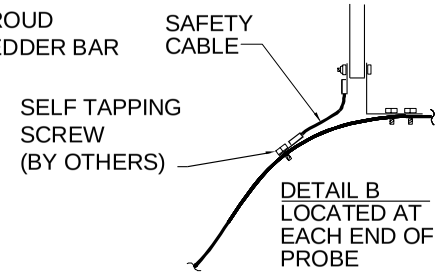
CENTRIFUGAL FAN







DETAIL A
ENLARGED VIEW
ROTATED 90° CCW
TYPICAL 4 PLACES



DETAIL B
LOCATED AT
EACH END OF
PROBE

NOTES:

1. USE LOCTITE ON MOUNTING BOLTS WHEN INSTALLING UNIT.

MATERIALS OF CONSTRUCTION

PROBE TUBE: EXTRUDED ALUMINUM, ANODIZED
SENSOR SHROUD: ANODIZED ALUMINUM
SENSOR SHEDDER BAR: ABS
SENSOR CLAMP: POLYETHYLENE
MOUNTING BRACKET: GALVANIZED STEEL
BOLT & NUTS: ZINC COATED STEEL

Tek-Air Systems Inc.
Engineering Department
43 Beaver Brook Road
Danbury, CT 06810
(203) 791-1400 Phone
(203) 798-6534 Fax

VT-7300
VorTek, Fan Inlet
(Less than 25" Dia.)

Installation Drawing
Centrifugal (DWDI)

Revision Letter: A	Dwg. No:
Revision Date: 1/2/97	Drawn By: GV
Filename: VT7300D.CDR	

Proper procedure for the cleaning of VorTek Airflow Measuring Probes

The Tek-Air Systems, Inc. VorTek Airflow Measuring Probe is a very versatile flow measuring station that is used in many types of applications. Some of these applications include use in harsh environments such as pharmaceutical pill coating areas, dirty exhaust systems, etc. In some instances the VorTek flow stations may become fouled and require some careful cleaning to insure their long-term operation. These cleaning tips and concerns are detailed below:

1) The VorTek probe(s) must first be carefully removed from the ductwork noting the orientation of the sensors.

a) VorTek VT-2000 (Small Duct) - The transmitter is attached to the probe bar with flexible hose which can not be disassembled and must be removed as a complete unit.

b) VorTek S (Standard) - The probe bar(s) may be disconnected from the transmitter simply by pulling off the connector from the microphone board, and undoing the romex connection on the enclosure.

2) The probes then can be evaluated as to the extent of fouling buildup and the composition of the buildup.

a) Buildup of the non-hardening type, such as dust and fiber collection, can be simply blown off using compressed air.

Note: EXTREME CAUTION MUST BE USED WHEN CLEANING WITH COMPRESSED AIR. THIS INCLUDES MAKING SURE THAT THE FULL PRESSURE OF THE AIR (NOT TO EXCEED 20 PSI) IS NEVER DIRECTLY AIMED IN THE BACK OF THE SENSOR IN THE SMALL SENSOR TUBES AS THIS CAN DAMAGE THE PROBE.

b) Buildup including both the hardening and non-hardening type can be cleaned by first removing as much as possible with compressed air. The remaining buildup may be removed with combinations of alcohol, compressed air, and possibly the use of a lint free cloth. When “wiping” with a cloth, caution must be taken so as not to push any fouling agent into the sensing tubes located at the back of the sensors. If these holes are plugged to any extent, improper readings will be observed.

Water is not usually recommended for cleaning VorTek probes due to the fact that the sensor tubes may become entrained with fluid and block the sensor.

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