KURZ
INSTRUMENTS INC.

Model 430DC/435DC DC-Powered Air Velocity Transducer User's Guide

October 1989

Unit Description Sheet

Complete Model Number: _____

Serial Number: _____

Kurz Order Number: _____

Customer P. O. Number: _____

Gas Calibration:

- ☐ Air
- ☐ Other (specify): _____

Calibration Reference Temperature:

- ☐ Standard (25° C, 77° F)
- ☐ Other (specify): _____

Calibration Reference Pressure:

- ☐ Standard (760 mm Hg, 29.92 in Hg)
- ☐ Other (specify): _____

Velocity Range:

- ☐ 0-100 SFPM 0-1.5 SMPS
- ☐ 0-300 SFPM 0-6 SMPS
- ☐ 0-1,250 SFPM 0-15 SMPS
- ☐ 0-2,500 SFPM 0-30 SMPS
- ☐ 0-6,000 SFPM 0-60 SMPS
- ☐ 0-12,000 SFPM
- ☐ Other (specify): _____

Engineering Units:

- ☐ SFPM
- ☐ SCFM/ft^2
- ☐ lbs mass/min/ft^2
- ☐ SCFM
- ☐ lbs/min
- ☐ SMPS
- ☐ Other (specify): _____

Line or Duct Size (for SCFM and lbs/min only): _____

Power Supply Input:

- ☐ Standard (18-24 Vdc)
- ☐ Other (specify): _____

Output Signal:

- ☐ Standard (linear 0-5 Vdc)
- ☐ Isolated 4-20 mA
- ☐ Non-Isolated 4-20 mA
- ☐ Other (specify): _____

Probe & Sensor:

- ☐ Custom Probe Length (specify): _____
- ☐ Custom Probe Cable Length (specify): _____
- ☐ Teflon-Coated Sensor
- ☐ Epoxy-Coated Sensor
- ☐ Other: _____

High Temperature Applications:

- ☐ HT Rated to 250° C

Electronics Enclosures:

- ☐ 437 Board Included in One-PiecePackage
- ☐ None - Unmounted 437 Circuit Board
- ☐ 437 Board Mounted in NEMA 1 Enclosure
- ☐ 437 Board Mounted in Rack-Module, 1.4"
- ☐ 437 Board Mounted in Rack-Module, 2.8"
- ☐ 19" Rack Chassis with Guides
- ☐ Bench Enclosure for 19" Rack Chassis

Power Supply:

- ☐ 191 - 2.4 Amp 115 VAC 50/60 Hz Power Supply
- ☐ 191 - 4.8 Amp 115 VAC 50/60 Hz Power Supply
- ☐ 191 - 12 Amp 115 VAC 50/60 Hz Power Supply
- ☐ Rack Mounted 191 115 VAC 50/60 Hz Power Supply
- ☐ 220VAC 50 Hz Operation of 191 Power Supply Above

Displays:

- ☐ Multi-Channel LCD Display

Alarm:

- ☐ Model 111 Dual Alarm Board

Totalizers:

- ☐ Totalizer
- ☐ Resettable Totalizer

Safety Circuit

- ☐ Sensor Safety Circuit

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Warranty Statement

The Kurz Model 430DC and Model 435DC DC-Powered Air Velocity Transducers are warranted to be free from defects in material or workmanship for one year from the date of shipment from the factory. Kurz's obligation is limited to repairing, or at its option, replacing products and components that, on verification, prove to be defective. Warranty work will be performed at the factory in Monterey, California. Kurz shall not be liable for installation charges, for expenses of buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. Kurz extends this warranty only upon proper use and/or installation of the product in the application for which it is intended and does not cover products that have been serviced or modified by any person or entity other than Kurz Instruments Incorporated and its authorized service technicians. This warranty does not cover damaged sensors, units that have been subjected to unusual physical or electrical stress, or upon which the original identifications marks have been removed or altered.

Transportation charges for material shipped to the factory for warranty repair are to be paid for by the shipper. Kurz will return items repaired or replaced under warranty prepaid. No items shall be returned for warranty repair without prior authorization from Kurz. Call Kurz Instruments service department at (408) 646-5911 to obtain a return authorization number.

This warranty contains the entire obligation of Kurz Instruments Incorporated. No other warranties, expressed, implied, or statutory are given.

Special Precautions for Installation with Hazardous Gases

We at Kurz have done everything reasonable to ensure the safety of users of Kurz equipment. Even so, we are aware that special situations can arise that can result in an unsafe condition if hazardous gases are involved.

It is the responsibility of the user to properly install the product and especially to check for leakage in the extended plumbing and to properly seal conduit fittings, etc., according to the relevent codes.

An example is the installation of a Model 555 insertion mass flow meter in which the Model 455 probe is inserted into the ball valve retractor assembly. It is the responsibility of the user to ensure that the assembly does not leak upon initial installation and to perform rountine maintenance (such as replacing the seals, etc.) on a regular basis and to verify the safety of the entire installation.

Table of Contents

Figures

About This Book

This book contains five sections and an appendix, each of which is briefly described below. The book also contains a Unit Description Sheet and a Quick Set-Up Guide. The book is not designed to be read cover to cover; rather, it is designed to present information to the 430DC and 435DC user in as accessible a manner as possible.

Organization

Unit Description Sheet

This sheet is found in the front of the book, immediately following the title page. It contains important identifying information about your 430DC or 435DC DC-Powered Air Velocity Transducer, including model number, serial number, Kurz order number, and customer purchase order number. It also lists any options you ordered with your transducer. Check the options listed against your original order and against the actual contents of the shipping carton. Report any discrepancies immediately to Kurz Instruments Incorporated at (408) 646-5911.

Quick Set-Up Guide

The Quick Set-Up Guide is a chart summarizing much of the information presented in the rest of the manual. You can use the chart to refresh your memory after you read the relevant sections of the manual. Or, if you feel that you do not need the more detailed information presented in the rest of the manual, you can attempt to install your 430DC or 435DC referring only to the Quick Set-Up chart. Kurz Instruments does **not**, however, recommend the latter approach.

Section 1: Product Overview

This section introduces you to the purpose, principles of operation, and features of the 430DC and 435DC transducers. You can safely skip this section if you are already familiar with that information.

Section 2: Installation

Section 2 explains, in necessarily general terms, how to install your transducer. This section explains how to determine the correct location for installation, as well as how to perform the physical installation in pipes and flat or round ductwork. You should read thoroughly the parts of this section that apply to your installation before you install the 430DC or 435DC. **You may also want to read Section 5, "Testing," before you install the transducer.**

Section 3: Operation and Maintenance

This section explains how to calculate actual velocities from the standard velocities reported by the 430DC or 435DC, how to recalibrate the unit, and how and when to clean the sensor. Refer to this section as needed.

Section 4: Options

This section lists and explains most of the options available with the transducer. Contact Kurz Instruments for a complete, up-to-date list of available options.

Section 5: Testing

This section explains some of the tests you can perform on the 430DC and 435DC to determine whether or not it is operating properly. Although each transducer is thoroughly tested before it leaves the factory, you may want to run the tests described in Section 5 to make sure that the unit has not been damaged in transit. Whether or not you do so depends largely on your judgment of the complexity of your installation: If installation and possible later removal are relatively easy, it probably makes more sense to go ahead and install the unit without extensive preinstallation testing. If your installation is a difficult one, and removing the unit later for testing would be more time consuming than the testing procedures themselves, you should probably test before you install.

Appendix A: Component Layout and Schematic Drawings

The appendix contains detailed component layout drawings and circuit diagrams of the various components of the 430DC and 435DC. This information is not needed by most users in routine operation of the unit. It is provided as an aid to those users who want to perform more detailed maintenance and testing operations than those described in sections 3 and 5.

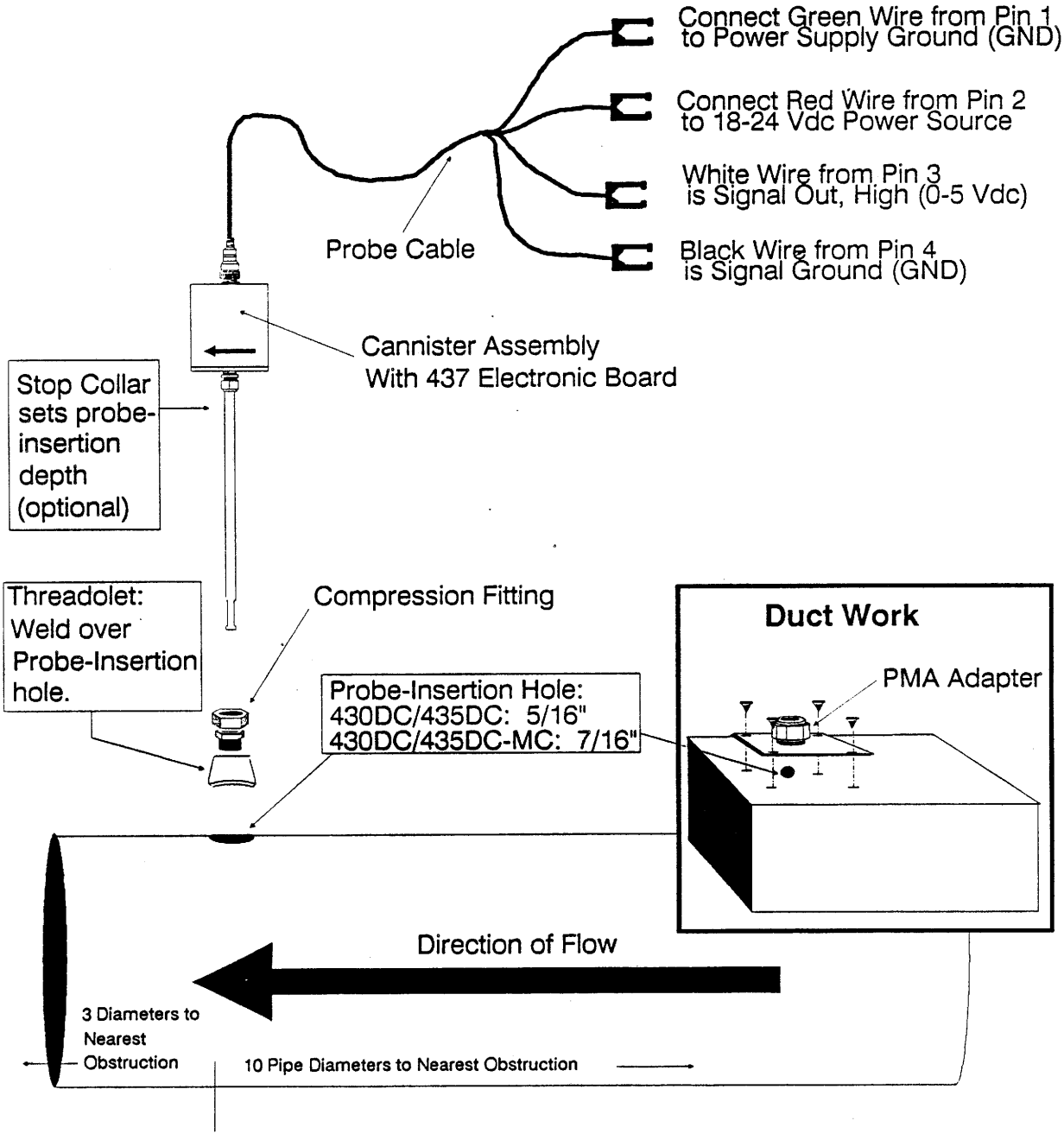
About the Art in This Book

The computer-generated art in the main sections of this book is intended to illustrate particular points under discussion. It includes only as much detail as is relevant to the discussion at hand. No attempt has been made to accurately scale these drawings or to include details not under discussion in the text that precedes and follows each drawing. If you need more detailed and precise visual information, refer to Appendix A, which contains reproductions of actual engineering drawings.

Quick Set-Up Guide

The quick set-up chart below summarizes much of the information presented in this manual. It does not, however, contain all the information you may need for safe and satisfactory installation of your 430DC or 435DC. Kurz Instruments recommends that you read applicable sections of the manual before attempting installation.

Important Note: Do NOT Place Cannister Next to Hot Ducts or Stacks, Ambient Temperature Must Be 50° C or Less.



Section 1: Product Overview

This section contains a general description of the DC-Powered Air Velocity Transducers. It explains how the transducers work and lists their features and specifications.

1.1 Description

The 430DC, 430DC-MC, 435DC, and 435DC-MC DC-Powered Air Velocity Transducers are rugged, very low maintenance instruments ideally suited to monitoring relatively clean air or gas flows in small ducts, pipes, or similar enclosed channels.

The four models are distinguished by the following characterisitics:

430DC: Outputs a non-linear 0-5 Vdc signal representing flow velocity; uses Duraflo sensor

430DC-MC: Outputs a non-linear 0-5 Vdc signal representing flow velocity; uses mini MetalClad sensor

435DC: Outputs a linear 0-5 Vdc signal representing flow velocity; uses Duraflo sensor

430DC-MC: Outputs a linear 0-5 Vdc signal representing flow velocity; uses mini MetalClad sensor

These models will be referred to generically as the 430DC and 435DC except when specific features of 430DC-MC or 435DC-MC are being discussed.

The 430DC and 435DC can be used stand-alone or integrated into a wide range of OEM instruments and systems. Some of the applications include:

- heating, ventilating, and air conditioning (HVAC) systems
- laminar flow ceilings, bench hoods, and duct monitoring systems in semiconductor manufacturing facilities
- airborne engine test systems (to monitor gas turbine bleed air)
- air control systems in hospitals and other medical facilities

The 430DC and 435DC are best used in commercial applications where the flow to be measured is not heavily laden with particulate contamination and the temperature of the air or gas flow does not exceed 125° C.

The 430DC-MC and 435DC-MC, with the mini Metal Clad sensors, can be used in applications where the air flow does contain particulates. In all other respects excepting the construction of the sensor, the 430DC/435DC and 430DC/435DC-MC are identical. For extremely hot, dirty, or corrosive industrial environments, Kurz recommends the even more robust 455 Industrial Air Velocity Transducer.

The 430DC and 435DC are best suited for monitoring velocity in lines from a minimum of four inches in diameter up to approximately 24 inches in diameter (or in ducts up to 24 inches across in their smaller dimension). With optional custom probe lengths, these transducers can be used in lines up to 48 inches in diameter, although Kurz generally and strongly recommends a multi-point, multi-sensor EVA system for large diameter lines.

The 430DC and 435DC consist of the following basic components:

- Duraflo™ (430DC and 435DC) or mini MetalClad™ (430DC-MC and 435DC-MC) sensor mounted in a protective window at one end of the probe support

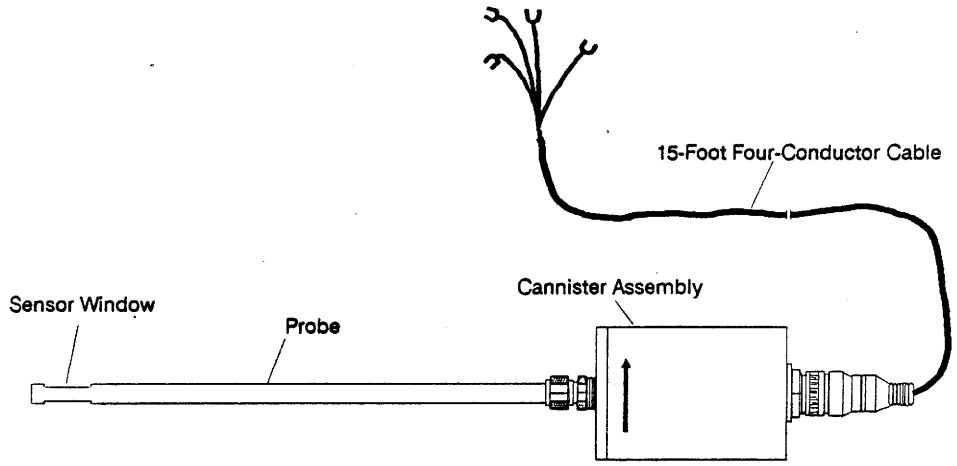
  NOTE: The sensor shipped with your transducer was specifically matched to your unit's electronics during factory calibration. Sensors are **not** interchangeable between different units.

- 12-inch long, 1/4-inch diameter 316 stainless steel probe support (Nonstandard lengths from 3 to 48 inches are optionally available.)

- 437 Electronics Board housed in rugged, weather-resistant enameled aluminum cannister assembly at the end of the probe. (The 437 board can be unmounted, mounted in a NEMA 1 or NEMA 4 enclosure, or mounted in a rack module – refer to Section 4, "Options.")

Figure 1-1 shows the basic components of the 430DC and 435DC.

Figure 1-1. *430DC/435DC Basic Components*

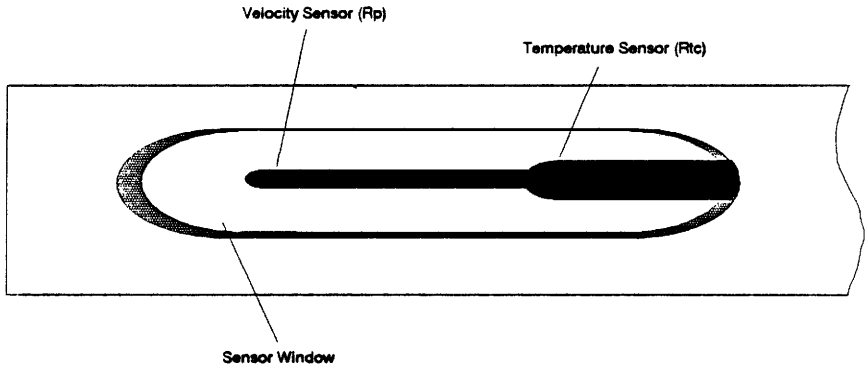


Important Note: The cannister assembly should NOT be placed close to a hot duct or stack. Provide enough clearance between the duct or stack and the cannister assembly so that the ambient temperature at the cannister is not above 50° C.

1.2 How the Sensor Works

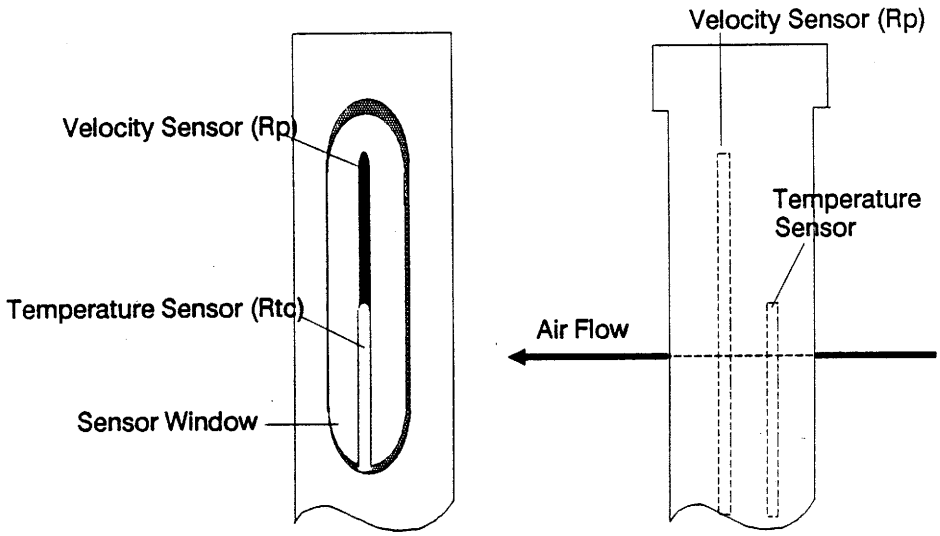
Although different in their construction, the Duraflo sensor of the 430DC and 435DC and the mini MetalClad sensor of the 430DC-MC and 435DC-MC work in the same way. Each of these sensors is in fact two sensors in one: a temperature sensor and a velocity sensor. The Duraflo sensor consist of reference-grade platinum windings wound around a ceramic mandrel and enclosed in a single glass sheath. The temperature sensor (R_{tc}) is located at the base of the sensor. The velocity sensor (R_p) is located at the tip of the sensor. Figure 1-2 shows a close-up view of the Duraflo sensor within its protective sensor window.

Figure 1-2. *Duraflo Sensor*



The mini MetalClad dual-sting sensor in the 430DC-MC and 435DC-MC consists of reference-grade platinum windings wound around two ceramic mandrels enclosed in two stainless steel sheaths. The temperature sensor (R_{tc}) is the shorter of the mini MetalClad's two sensor elements. The velocity sensor (R_p) is the longer of the two elements. Figure 1-3 shows a close-up view of the mini MetalClad sensor within its protective sensor window.

Figure 1-3. *Mini MetalClad Sensor: Two Views*



The temperature sensor senses the ambient temperature of the air flow. The velocity sensor is then heated to approximately 75° to 100° F **above** the ambient temperature and is maintained at the same level of temperature differential (overheat) above the ambient temperature regardless of changes in ambient temperature or air velocity.

CAUTION: The transducer sensor's standard rating is for nonexplosive gases. An optional safety temperature limiting option is available. Contact Kurz Instruments for more information on using the 430DC or 435DC (and 430DC-MC or 435DC-MC) sensor in explosive gas flows.

Because the temperature sensor compensates for fluctuations in ambient temperature, the amount of electrical power needed to maintain the velocity sensor's overheat is affected only by the flow of air or other gases over the sensor: The greater the velocity of the flow, the greater its cooling effect on the sensor and the greater the electrical power needed to maintain the sensor's overheat. It is this power or current draw that is measured by the 430DC and 435DC.

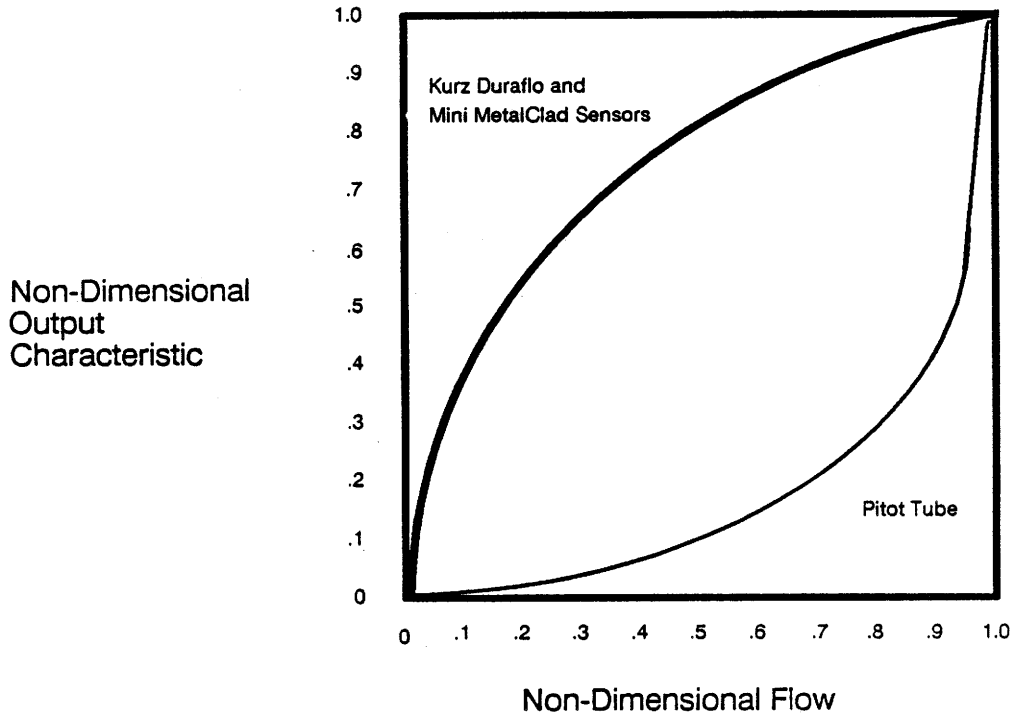
The sensor is directly measuring mass flow (i.e., the number of molecules carrying heat away from the velocity sensor), and is calibrated in **standard** units, which are referenced to a temperature of 25° C and atmospheric pressure of 760 mm Hg. In other words, air at 25° C and 760 mm Hg, flowing at 100 feet per minute (FPM) will produce a reading of 100 **standard** feet per minute (SFPM)[1]. A 100 FPM flow at a different temperature or pressure produces a reading in SFPM that accurately compensates for the temperature or pressure differential.

The temperature and velocity sensors form two legs of a balanced Wheatstone bridge. The bridge circuitry itself is contained on the 437 electronics board in the cannister assembly at the end of the probe support. The temperature sensor leg (R_{tc}) is input to the positive side of an operational amplifier as a reference. The bridge is activated through an offset differential of the two legs. The sensor is heated with current through the R_p winding. Resistance increases until it balances with the minus input of the operational amplifier, which drives a power transistor to provide bridge current.

The signal received from the sensor is nonlinear in that the amount of power needed to maintain the velocity sensor's overheat is not directly proportionate to the velocity of the airflow. Instead, the power-consumption curve is fairly steep at low flow rates and relatively flatter at higher rates of flow. Figure 1-4 shows the Duraflo and mini MetalClad sensor's output curve as flow increases. Figure 1-4 also shows the corresponding curve for a pitot-tube type sensor. Note the greatly superior sensitivity of the Duraflo and mini MetalClad sensors at low flow rates.

1 Standard calibration for these transducers is in SFPM. Other engineering units are also available – refer to Section 4, "Options".

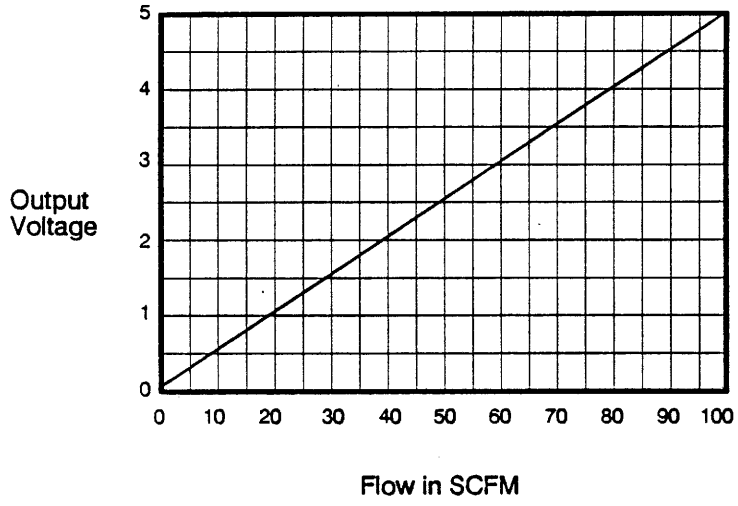
Figure 1-4. *Sensor Output vs Flow*



Zero and span circuitry on the 437 electronics board converts the signal from the sensor to a non-linear 0-5 Vdc signal that has approximately the same curve as shown above. This non-linear 0-5 Vdc signal is output from the 430DC unless the non-isolated 4-20mA option (-I) was ordered. If this option was ordered, the 430DC outputs a non-linear 4-20mA signal.

However, the 437 board in the 435DC and 435DC-MC contains an additional linearizer circuit that converts the nonlinear voltage into a linear voltage that is directly proportionate to flow velocity: 0 Vdc indicates no flow, 5 Vdc indicates maximum measurable flow, and 2.5 Vdc indicates a flow exactly half of the maximum measurable flow, as shown in Figure 1-5.

Figure 1-5. *Linearized 0-5 Vdc Output of the 435DC and 435DC-MC*



The 437 board will convert this linear output voltage to an 4-20 mA output if the 435DC was ordered with the non-isolated option (-I).

1.3 Features and Specifications

Some of the outstanding features of the 430DC and 435DC are summarized below:

Rugged Construction

The Duraflo and mini MetalClad sensor is exceptionally durable in normal use. It is resistant to both dirt and corrosion; unlike pitot-tube and orifice-plate sensors, its performance is not significantly degraded by operation in a dirty atmosphere.

Unsurpassed Accuracy

The Duraflo and MetalClad sensor windings are Resistor Temperature Detector (RTD)-type windings of reference-grade platinum 385.

Automatic Temperature and Pressure Compensation

The 430DC and 4355DC directly measure mass velocity. No computations are necessary to compensate for temperature and pressure changes.

Excellent Low-Speed Sensitivity

Unlike pitot-tube and orifice-plate sensors, the 430DC and 435DC can accurately measure flows down to 20 SFPM.

Convenient 0-5 Vdc Output

The 430DC outputs a non-linear 0-5 Vdc signal. The 435DC outputs a linear 0-5 Vdc signal. This output signal is convenient for digital panel meters, voltmeters, chart recorders, and computers. Other outputs are optionally available.

NBS-Traceable Calibration

Every 430DC and 435DC is factory-calibrated in a National Bureau of Standards (NBS) traceable wind tunnel. Packaged with your transducer is a Calibration Certificate showing output voltage vs air velocity. The factory calibration is for air at 25° C and 760 mm Hg. Calibration for other gases, temperatures, and pressures is available at an additional charge.

The specifications of the 430DC and 435DC are given in Table 1-1. All specifications apply to all models except where noted.

Table 1-1. *430DC and 435DC Specifications*

Sensor Construction:	Reference-grade 385 platinum RTD-type windings around a high-purity ceramic core, sheathed in glass (430DC and 435DC) or stainless steel (430DC-MC and 435DC-MC)
Accuracy:	+/- 2% of full scale (non-linear - 430) +/- 3% of full scale (linear - 435)
Repeatability:	+/- 0.25%
Response Time:	1 second
Calibration:	Factory calibrated in NBS-traceable wind tunnel for air at 25° C and 760 mm Hg. Includes Calibration Certificate showing output voltage vs air velocity for 11 data points, including zero flow.
Sensor Operating Temperature Range:	0° C to +125° C standard HT rated sensor optionally available for temperatures from 0° C to +250° C **NOTE:** The electronic components on the 437 board are rated only to 70° C. Specify a remote-mounted enclosure for the electronics or longer probe if the portion of the probe **outside** the pipe or duct to be monitored will be exposed to temperatures higher than 50° C. (See Section 2.5.3 for information on high-temperature installations.)

Table 1-1 (continued)

Probe Construction:	430DC/435DC: 316 stainless steel, epoxy, and glass wetted parts 430DC-MC/435DC-MC: 316 stainless steel and epoxy wetted parts
Probe Dimensions:	430DC/435DC: 1/4" outside diameter; 12" length standard; lengths from 3" to 48" optionally available 430DC/435DC-MC: 3/8" outside diameter; 12" length standard; lengths from 3" to 48" optionally available
Electronics Hookup:	A 15-foot four-conductor cable is supplied to connect the transducer to the 18-24 Vdc input and 0-5Vdc output.
Electronics Board Enclosure:	2.75" X 4.75" X 1.13" enameled aluminum cannister. (Refer to Section 4 for information on optional configurations.)
Output:	430DC and 430DC-MC: Non-linear 0-5 Vdc standard 435DC and 435DC-MC: Linear 0-5 Vdc standard Non-isolated 4-20 mA outputs optionally available on the 437 electronics board. Isolated 4-20 mA output available with optional electronics board. See Section 4 for further information. For other nonstandard outputs, consult factory.

End of Section 1

Section 2: Installation

This section explains how to install your Model 430DC or 435DC DC-Powered Air Velocity Transducer. The instructions given in this section are necessarily general in nature; every installation is unique. If you need further assistance with your installation, contact your local Kurz representative, or contact Kurz Instruments, Inc. at (408) 646-5911.

2.1 Checking the Contents of the Shipping Carton

Open the shipping carton and remove the protective foam packaging material that covers the 430DC or 435DC and any options shipped with it. Check to see that the shipping carton contains everything you ordered.

Make sure the NBS traceable calibration certificate is included. Verify that the line size (if applicable) and pipe schedule shown on the calibration certificate are correct.

2.1.1 430DC/435DC Without Options

If you ordered your transducer without any options, the contents of the shipping carton should be as shown in Figure 1-1, "430DC/435DC Basic Components."

If the contents of the shipping carton are correct, proceed with the installation. (If you prefer to test the unit before you install it, refer now to Section 5, "Testing.")

2.1.2 430DC/435DC with Options

Any options you ordered should be specified on the Unit Description Sheet at the front of this manual. Available options are listed, described, and (where applicable) pictured in Section 4, "Options". If the options specified on the Unit Description Sheet do not match the options you ordered or the options actually shipped, contact Kurz immediately.

If you ordered your transducer with the 437 electronics board in a NEMA enclosure, check inside this unit and remove any desiccant or other packaging material you find there.