DESCRIPTION

The FE-1500-FX airflow measurement station consists of single or multiple airflow elements, factory mounted and pre-piped in a casing designed for flanged connection to the ductwork. The station also incorporates an airflow straightening section using honeycomb having a ½ inch opening by 3 inch depth. Standard materials consist of a G90 galvanized casing, 6063-T5 anodized aluminum flow sensors, and 3003 aluminum airflow straightener.

The FE-1500-FX airflow measurement station has been developed for use in duct systems having a highly turbulent condition at the point of measurement. The airflow averaging element, utilized in the FE-1500-FX, is a head type device, which generates a differential (velocity) pressure signal similar to the orifice, venturi, and other head producing primary elements. The FE-1500-FX is constructed so that strategically located sensing ports (based on duct size) continually sample the total and static pressures, when inserted normal to flow. The total pressures sensed by the upstream ports are continually averaged within the element in an isolated chamber. The static sensing ports (located where the influence of the velocity head is zero) are averaged in a second isolation chamber. Multiple elements are manifolded together for connection to a differential measurement device (gauge, transmitter, etc.) for flow measurement and indication purposes.

Features

- Low signal-to-noise ratio
- Multiple total and static pressure sensing ports along the length of the element
- Factory mounted and pre-piped in a flanged duct section (casing)
- Honeycomb airflow straightening section
- ±2% accuracy throughout the velocity ranges of 100 fpm and over
- Standard construction includes a galvanized casing, 6063-T5 anodized aluminum flow sensors, and 3003 aluminum airflow straightener
- Available in optional corrosive or high temperature resistance materials including Type 304L and 316L stainless steel, Hastaloy, Type 1 PVC, and phenolic and polyurethane enamel coatings
- Standard airflow stations can be operated (in air) continuously in temperatures up to 350°F or intermittently in temperatures up to 400°F
- All airflow stations can be operated in humidity ranges of 0 to 100%
- Standard airflow stations have good salt air resistance and are suitable for most HVAC applications
FE-1500-FX Technical Specifications

1. Accuracy
   Within 2% of actual flow when installed in accordance with published recommendations

2. Operating Velocity Range
   100 to 10,000 fpm

3. Material
   **Elements**
   - 6063-T5 anodized aluminum (standard)
   - Type 316L stainless steel (optional)
   - Hastaloy (optional)
   - Type 1 PVC (optional)
   **Casings**
   - 16 ga G90 galvanized steel (standard)
   - Type 304L stainless steel (optional)
   - Type 316L stainless steel (optional)
   - Hastaloy (optional)
   **Coatings**
   - Heresite VRL 500 phenolic coating (optional)
   - Imron 333 polyurethane enamel (optional)
   **Air Straightner**
   - 3003 aluminum (standard)
   - Type 304L stainless steel, bonded (optional)
   - Type 316L stainless steel, welded (optional)
   **Note**
   Other corrosive resistant materials are available. Consult factory for further information.

4. Temperature
   **Galvanized Casing, Aluminum Elements, and Aluminum Air Straightner**
   - 350°F continuous operation and 400°F intermittent operation (in air)
   **Stainless Steel Elements and Casing**
   - Type 304L-900°F continuous or intermittent operation (in air)
   - Type 316L-1600°F continuous or intermittent operation (in air)
   **Stainless Steel Air Straightner**
   - Type 304L-350°F continuous operation and 400°F intermittent operation (in air)
   - Type 316L-800°F continuous or intermittent operation (in air)
   **Hastaloy Casings and Elements**
   - 900°F continuous or intermittent operation (in air)
   **PVC Elements**
   - 120°F continuous operation and 170°F intermittent operation (in air)
   **Heresite Phenolic Coating**
   - 150°F continuous operation and 3200°F intermittent operation (in air)
   **Imron Polyurethane Enamel**
   - 200°F continuous operation and 300°F intermittent operation (in air)
   **Note**
   Corrosive resistant element maximum operating temperatures vary greatly with the concentration of the media in the process stream. Consult factory for further information.

5. Humidity
   **All Airflow Stations**
   0 to 100% non condensing

6. Corrosion Resistance
   **Galvanized Casings**
   Widely used for most air handling systems; not recommended for corrosive atmospheres
   **Aluminum Elements and Air Straightner**
   Good salt, air, and mild acid gas resistance; excellent solvent and aromatic hydrocarbon resistance
   **Stainless Steel Elements, Casings and Air Straightner**
   Good for sulfates, phosphates and other salts, as well as reducing acids such as sulphurous and phosphoric
   **Hastaloy Elements and Casings**
   Excellent resistance to strong oxidizers such as ferric and cupric chlorides, chlorine, formic and acetic acids, acetic anhydride, and salts.
   **PVC Elements**
   Excellent acid and alkalis resistance
   **Heresite Phenolic Coating**
   Excellent resistance to acids and salt air. Good resistance to alkalis and solvent.
   **Imron Polyurethane Enamel**
   Excellent resistance to acids, alkalis, salts, weather, and humidity. Very good resistance to solvents.

7. Instrument Connections
   **Aluminum Elements**
   - ¼” compression, suitable for use with thermoplastic or copper tubing; thermoplastic tubing requires the use of tubing inserts, which are supplied with the fittings
   **Stainless Steel and Hastaloy Elements**
   - 1/8-27 Female NPT
   **PVC Elements**
   - 1/8-27 Female NPT

Paragon Controls Incorporated

Revision Level 000
FE-1500-FX Casing Construction

Circular Stations

Standard circular airflow measuring stations include a 16 gage galvanized casing with attached 90° connecting flanges as listed below:

<table>
<thead>
<tr>
<th>Station Size</th>
<th>Flange Thickness</th>
<th>Flange Size</th>
<th>Casing Length “L”</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” – 15”</td>
<td>0.064”</td>
<td>1”</td>
<td>8”</td>
</tr>
<tr>
<td>16” – 44”</td>
<td>0.064”</td>
<td>1½”</td>
<td>8”</td>
</tr>
<tr>
<td>45” – 72”</td>
<td>0.188”</td>
<td>1½”</td>
<td>10”</td>
</tr>
<tr>
<td>73” &amp; Over</td>
<td>0.188”</td>
<td>2”</td>
<td>12”</td>
</tr>
</tbody>
</table>

Rectangular Stations

Standard rectangular airflow measuring stations include a 16 gage galvanized casing, 8 inches long, with formed integral 90° connecting flanges as listed below:

<table>
<thead>
<tr>
<th>Station Size</th>
<th>Flange Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>8” – 72”</td>
<td>1½”</td>
</tr>
<tr>
<td>73” &amp; Over</td>
<td>2”</td>
</tr>
</tbody>
</table>

Oval Stations

Standard oval airflow measuring stations include a 18 gage galvanized casing, 8 inches long between beads with 1 inch connecting sleeve on each end (10 inch overall length). Actual O.D. dimensions are ¼ inch less than specified duct I.D. dimensions.

<table>
<thead>
<tr>
<th>Station Width</th>
<th>Flange Thickness</th>
<th>Flange Size</th>
<th>Casing Length “L”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 48”</td>
<td>0.064”</td>
<td>1½”</td>
<td>8”</td>
</tr>
<tr>
<td>Over 48”</td>
<td>0.188”</td>
<td>1½”</td>
<td>10”</td>
</tr>
</tbody>
</table>
FE-1500-FX Dimensions

Circular Stations

Rectangular Stations
FE-1500-FX Dimensions (Continued)

**Oval Stations**

TOTAL PRESSURE (T.P.) TAKEOFF

0.250" RADIUS BEADED EDGE (TYP)

STATIC PRESSURE (S.P.) TAKEOFF

FLOW

AIR STRAIGHTENER

2D FLOW

3D FLOW

CENTRIFUGAL FANS

DUCT TAKE-OFFS

EXHAUST TO ATMOSPHERE

OPPOSED BLADE DAMPERS

TRANSITIONS

15° MAX

30 DEGREE MAXIMUM TRANSITION ANGLE

Notes:

- Round Ducts:
  
  \[ D = \text{Duct diameter} \]

- Rectangular Ducts:
  
  \[ D = \sqrt{\frac{4HW}{\pi}} \quad H = \text{Height} \quad W = \text{Width} \]

FE-1500-FX Minimum Installation requirements

The elements may be installed in any duct configuration. However, the accuracy of the installation is dependent on the flow conditions in the duct. The minimum installation requirements for the elements based upon a uniform velocity profile approaching the duct disturbance for flow rates less than 2,500 fpm are shown below. Add one duct diameter to the installation requirements shown below for each additional flow rate of 1,000 fpm. These are not ideal locations. It is always best to locate the elements as far as possible from all duct disturbances, with upstream disturbances being the most critical consideration.
FE-1500-FX Resistance to Airflow

![Graph showing the relationship between pressure drop (inches water column) and velocity (fpm).]

FE-1500-FX Ordering Information

FE-1500-  
- - - x - - - FX-  

- Air Straightener  
  1 = 3003 aluminum (standard)  
  2 = Type 304L stainless steel  
  3 = Type 316L stainless steel

- Insulation Thickness (inches)  
  Indicates insulation thickness for an internally insulated duct (if applicable)  
  0 = No Insulation

- Configuration  
  R = Rectangular  
  C = Circular  
  O = Oval

- Duct Height (inches) – Rectangular and Oval  
  0 = Circular

- Duct Width or Diameter (inches) – Element Length

- Protective Coatings  
  0 = No Coating  
  1 = Heresite VRL 500 phenolic coating  
  2 = Imron 333 polyurethane enamel

- Element Material  
  A = 6063-T5 anodized aluminum (standard)  
  S = Type 316L stainless steel  
  P = Type 1 PVC  
  H = Hastaloy

- Casing Material  
  1 = 16 ga G90 galvanized steel (standard)  
  2 = Type 304L stainless steel  
  3 = Type 316L stainless steel  
  4 = Hastaloy (optional)
FE-1500-FX Specification Guide

Airflow Measurement Stations

1. Provide where indicated and/or scheduled airflow traverse elements capable of continuously monitoring the fan or duct air volumes they serve.

2. Each element shall be designed and built to comply with, and provide results in accordance with, accepted practice for duct system traversing as defined in the ASHRAE Handbook of Fundamentals, AMCA publication #203, as well as the Industrial Ventilation Handbook. The number of sensing ports on each element, and the quantity of elements utilized at each installation, shall comply with ASHRAE Standard #111 for equal area duct traversing.

3. Each element shall be of a dual integral chambered design. Each airflow measuring element shall contain multiple total and static pressure sensing ports placed along the leading edge of the cylinder. The static pressure chamber shall incorporate dual offset static taps on opposing sides of the averaging chamber, so as to be insensitive to flow angle variations of as much as ± 20 degrees in the approaching air stream.

4. The airflow traverse elements shall be capable of producing steady, non-pulsating signals of true total and static pressure, with an accuracy of 2% of actual flow for operating velocities as low as 180 feet per minute (fpm). Signal amplifying sensors requiring flow correction (K factors) or field calibration are not acceptable.

5. The airflow traverse elements shall not induce a measurable pressure drop, greater than 0.18 inch at 4,000 fpm. The units shall have a self-generated sound rating of less than NC40 and the sound level within the duct shall not be amplified, nor shall additional sound be generated.

6. The probes shall be mounted in an eight inch deep, 16 gauge galvanized steel casing with 90 degree undrilled flanges, fabricated to the duct size, and shall contain multiple airflow traverse elements interconnected as herein before described.

7. Where primary flow elements are located outside of the manufacturer’s published installation guidelines the manufacturer shall be consulted, and approve of any special configurations, such as air equalizers and/or additional and strategically placed measuring points, as may be required.

8. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be sized to facilitate matching connecting ductwork.

Installation Considerations

1. Primary flow elements shall be installed in strict accordance with the manufacture’s published requirements and with ASME guidelines effecting non-standard approach conditions. These elements serve as the primary signals for the airflow systems; it shall be the responsibility of the contractor to verify correct installation to assure that accurate primary signals are obtained.

2. An identification label shall be placed on each unit casing listing model number, size, area, and specified airflow capacity.

Manufacturer

1. Airflow measurement stations shall be Paragon Controls Inc. Model FE-1500-FX or equal as approved by the Engineer.

2. Naming of a manufacturer does not automatically constitute acceptance of this standard product nor waive the responsibility of the manufacturer to comply totally with all requirements of the proceeding specification.
## Engineering Reference Table

### VELOCITY VERSUS VELOCITY PRESSURE

<table>
<thead>
<tr>
<th>V = VELOCITY IN FEET PER MINUTE</th>
<th>P_V = VELOCITY PRESSURE IN INCHES H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 0.0020 620 0.0240</td>
<td>1060 0.0701 1500 0.1403</td>
</tr>
<tr>
<td>190 0.0023 630 0.0247</td>
<td>1070 0.0714 1510 0.1422</td>
</tr>
<tr>
<td>200 0.0025 640 0.0255</td>
<td>1080 0.0727 1520 0.1440</td>
</tr>
<tr>
<td>210 0.0027 650 0.0263</td>
<td>1090 0.0741 1530 0.1459</td>
</tr>
<tr>
<td>220 0.0030 660 0.0272</td>
<td>1100 0.0754 1540 0.1479</td>
</tr>
<tr>
<td>230 0.0033 670 0.0280</td>
<td>1110 0.0768 1550 0.1498</td>
</tr>
<tr>
<td>240 0.0036 680 0.0288</td>
<td>1120 0.0782 1560 0.1517</td>
</tr>
<tr>
<td>250 0.0039 690 0.0297</td>
<td>1130 0.0796 1570 0.1537</td>
</tr>
<tr>
<td>260 0.0042 700 0.0305</td>
<td>1140 0.0810 1580 0.1556</td>
</tr>
<tr>
<td>270 0.0045 710 0.0314</td>
<td>1150 0.0825 1590 0.1576</td>
</tr>
<tr>
<td>280 0.0049 720 0.0323</td>
<td>1160 0.0839 1600 0.1596</td>
</tr>
<tr>
<td>290 0.0052 730 0.0332</td>
<td>1170 0.0853 1610 0.1616</td>
</tr>
<tr>
<td>300 0.0056 740 0.0341</td>
<td>1180 0.0868 1620 0.1636</td>
</tr>
<tr>
<td>310 0.0060 750 0.0351</td>
<td>1190 0.0883 1630 0.1656</td>
</tr>
<tr>
<td>320 0.0064 760 0.0360</td>
<td>1200 0.0898 1640 0.1677</td>
</tr>
<tr>
<td>330 0.0068 770 0.0370</td>
<td>1210 0.0913 1650 0.1697</td>
</tr>
<tr>
<td>340 0.0072 780 0.0379</td>
<td>1220 0.0928 1660 0.1718</td>
</tr>
<tr>
<td>350 0.0076 790 0.0388</td>
<td>1230 0.0943 1670 0.1739</td>
</tr>
<tr>
<td>360 0.0081 800 0.0399</td>
<td>1240 0.0959 1680 0.1760</td>
</tr>
<tr>
<td>370 0.0085 810 0.0409</td>
<td>1250 0.0974 1690 0.1781</td>
</tr>
<tr>
<td>380 0.0090 820 0.0419</td>
<td>1260 0.0990 1700 0.1802</td>
</tr>
<tr>
<td>390 0.0095 830 0.0429</td>
<td>1270 0.1006 1710 0.1823</td>
</tr>
<tr>
<td>400 0.0100 840 0.0440</td>
<td>1280 0.1021 1720 0.1844</td>
</tr>
<tr>
<td>410 0.0105 850 0.0450</td>
<td>1290 0.1037 1730 0.1866</td>
</tr>
<tr>
<td>420 0.0110 860 0.0461</td>
<td>1300 0.1054 1740 0.1888</td>
</tr>
<tr>
<td>430 0.0115 870 0.0472</td>
<td>1310 0.1070 1750 0.1909</td>
</tr>
<tr>
<td>440 0.0120 880 0.0483</td>
<td>1320 0.1086 1760 0.1931</td>
</tr>
<tr>
<td>450 0.0126 890 0.0494</td>
<td>1330 0.1103 1770 0.1953</td>
</tr>
<tr>
<td>460 0.0132 900 0.0505</td>
<td>1340 0.1119 1780 0.1975</td>
</tr>
<tr>
<td>470 0.0138 910 0.0516</td>
<td>1350 0.1136 1790 0.1998</td>
</tr>
<tr>
<td>480 0.0144 920 0.0528</td>
<td>1360 0.1153 1800 0.2020</td>
</tr>
<tr>
<td>490 0.0150 930 0.0539</td>
<td>1370 0.1170 1810 0.2042</td>
</tr>
<tr>
<td>500 0.0156 940 0.0551</td>
<td>1380 0.1187 1820 0.2065</td>
</tr>
<tr>
<td>510 0.0162 950 0.0563</td>
<td>1390 0.1205 1830 0.2088</td>
</tr>
<tr>
<td>520 0.0169 960 0.0575</td>
<td>1400 0.1222 1840 0.2111</td>
</tr>
<tr>
<td>530 0.0175 970 0.0587</td>
<td>1410 0.1239 1850 0.2134</td>
</tr>
<tr>
<td>540 0.0182 980 0.0599</td>
<td>1420 0.1257 1860 0.2157</td>
</tr>
<tr>
<td>550 0.0189 990 0.0611</td>
<td>1430 0.1275 1870 0.2180</td>
</tr>
<tr>
<td>560 0.0196 1000 0.0623</td>
<td>1440 0.1293 1880 0.2203</td>
</tr>
<tr>
<td>570 0.0203 1010 0.0636</td>
<td>1450 0.1311 1890 0.2227</td>
</tr>
<tr>
<td>580 0.0210 1020 0.0649</td>
<td>1460 0.1329 1900 0.2251</td>
</tr>
<tr>
<td>590 0.0217 1030 0.0661</td>
<td>1470 0.1347 1910 0.2277</td>
</tr>
<tr>
<td>600 0.0224 1040 0.0674</td>
<td>1480 0.1366 1920 0.2299</td>
</tr>
<tr>
<td>610 0.0232 1050 0.0687</td>
<td>1490 0.1384 1930 0.2322</td>
</tr>
</tbody>
</table>

Above \( P_V \) Values Are Based On Standard Air Density Of 0.075 lbm/ft³ Which Is Air At 68°F, 50% Relative Humidity, And 29.92" Hg. The equation for converting air volume (Q) into velocity (V) and velocity pressure (P_V) is:

\[
V = \frac{Q}{A} \quad P_V = \left(\frac{V}{C}\right)^2 \times \rho
\]

Where:

- \( V \) = Velocity, in fpm
- \( Q \) = Flow, in cfm
- \( A \) = Area, in ft²
- \( C \) = Density of air, in lb/ft³
- \( P_V \) = Velocity pressure, in inches H₂O

\[
\rho = \frac{1096.7}{C} \quad \frac{3}{2} \cdot \frac{V}{C} = 2.5 \cdot \frac{V}{C}
\]

### Notes:

- **QV** (Q Value)
- **A** (Area, in ft²)
- **V** (Velocity, in fpm)
- **C** (Density of air, in lb/ft³)
- **PV** (Pressure Value)

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**Revision Level 000**

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Revision Level 000