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Thermal Sensor Location (Sensor Density)

(AFM-3)

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Thermal sensor location (or sensor density) can be determined in several ways. Each has their basis in engineering fundamentals.

One common method is to divide the duct into equal areas and then sum the centerline velocities of each area and then average these values. Several manufacturers have assigned their own recommended unit areas. Often the size of unit areas are decreased for smaller ducts and increased for larger ducts. AMCA (Standard 610-93 for testing air flow stations) does not recommend a unit area but permits the manufacturer to select their own and then report an accuracy. In our opinion the equal area technique does not accurately represent both field caused non-uniform upstream velocities as well as boundary layer values (the retardation of the flow at duct walls)

Two other methods suggest relocating the sensors based on unequal areas. One method (Log Techbychef), which forms the basis for several International standards, suggests many sensor locations representing not only the mainstream velocities but also the distribution near the walls (a logarithmic distribution). The mainstream velocities can be represented by a polynomial velocity distribution.

We believe that each probe should include

- a center sensor which represents the area that is most easily predictable and
- two additional sensors near the extremities of the probes in areas that are most difficult to predict.

Accordingly we recommend the following locations

1. One sensor at the centerline of the probe representing about 80% of the average flow
2. Two sensors located near the outer portions of the probe-- each sensor representing about 10% of the average flow. If the duct is insulated on the interior surface the insulation thickness should be

included in the 10%. These outer two sensor locations will represent the most unpredictable flow in the duct system

To more accurately represent the actual air flow contours the transmitter can individually field calibrate each sensor to reflect actual field velocities.

Sources

Fan Engineering Howden Buffalo Ninth Edition (1999)
AMCA Standard 610 – 93
ASHRAE Fundamentals
Various manufacturers catalogues