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Assembly Instructions

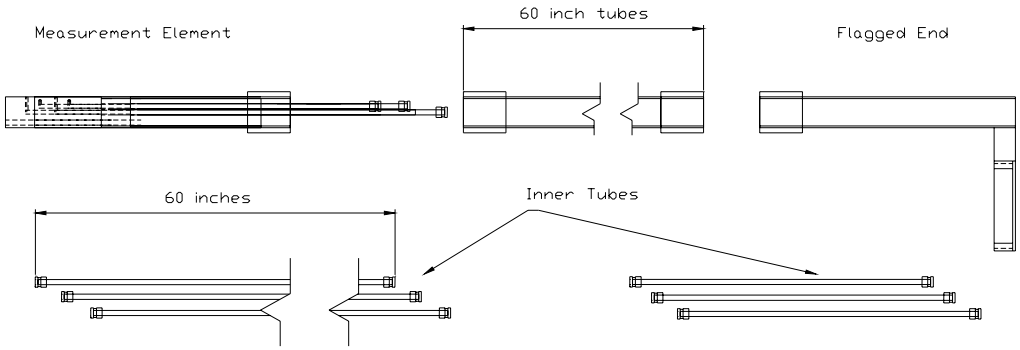
Item No.	Quantity	Description
(1)	1	Thermocouple and lead with length of 17 feet, 8 inches
(2)	9	¼ inch O.D., length 60 inch, tubes with compression fittings attached to one end of each tube
(3)	1	1-½ inch O.D. Front Piece or measurement element, with three ¼ inch tubes, with compression fittings at the end of the small tubes. This piece has three pressure sensing holes and a pipe coupling.
(4)	3	1-½ inch O.D. Connection Pipes, length 60 inches, with pipe couplings at each end of each one
(5)	1	1-½ inch O.D. end piece, with a 6 inch flag attached at one end; other end lipped with a threaded pipe coupling
(6)	1	Angular Protractor, with flanged base

Assembly of Equipment

The first step in using the probe is to determine the necessary length required for the testing. This is a probe that has the capability of being used at 7 feet, 12 feet, or at 17 feet of traversable length. As is shown in Figure 1, the order of the pieces has the measurement element, with pre-welded inner tubes, the three 60 inch extensions with nine corresponding inner tubes, and the end flagged piece with three 12 " inner tubes. Also, the protractor fits into the machined grooves on the flag. The compression fittings for the ¼ inch tubes should be attached to one end of all of the ¼ inch tubes for easier assembly.

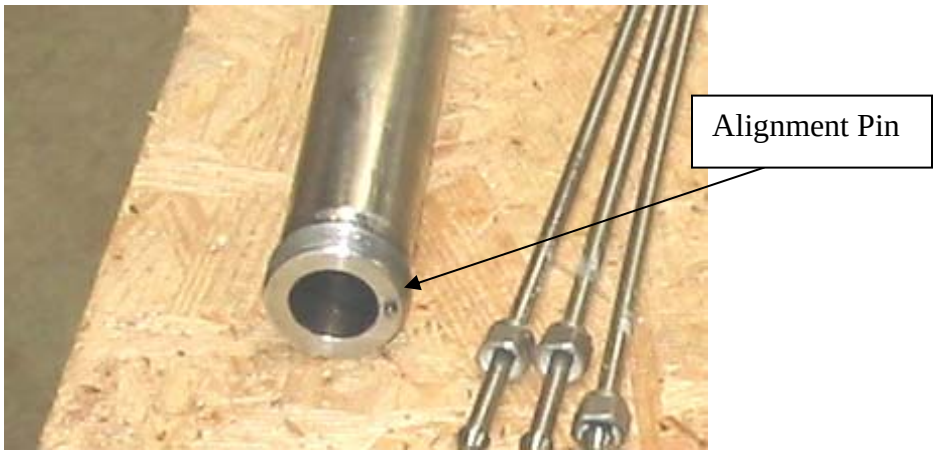
Note: The last sixty inch outer section must be used in all combinations of the probe. Therefore the assembly of the probe in the 7-foot configuration would be as follows, 1-4-5; or 12-foot configuration, 1-3-4-5.

Figure 1



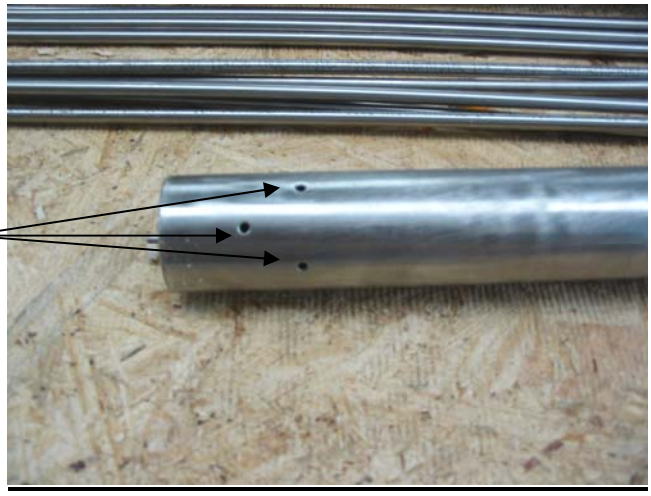
Begin assembly by laying the necessary pieces down on the ground in their corresponding order. The coupling pieces are labeled with scribe marks on either end as 1-5. Pull the end of the thermocouple lead through all the other extension pieces of the probe to be used, to ensure the thermocouple reaches the required length of the probe. Make sure that the outer tubing is arranged in order so that one pegged end of one tube is facing a holed end from another tube. This will ensure that the probe is aligned properly.

The process for assembling the inner tubes is fairly simple. You will notice that the tubes have a ferrule attached at one end that holds a nut facing the end, and the other end having a compression fitting assembly attached. To assemble one continuous inner tube, one would simply align two tubes that are to be attached together, fit the ferruled end of one of the tubes into the open end of a compression fitting on the other tube, and tighten the nut until it will not turn any more unless applied with excessive force.



The final process for assembly is to attach the outer tubes together using the attached tube couplings. First, thread the couplings of the two tubes, lining up the peg from the end of one pipe into the hole on the opposite pipe using the markings on the tube to ensure the correct sequence. Once the couplings are partially threaded it will be possible to seat the alignment pin correctly. After this is accomplished, use the coupling to screw the two ends together, tightening the coupling with a pipe wrench until it is snugly attached. There should be no play between the couplings at this point. This process is repeated for all couplings.

Finally, attach the angular protractor into the grooves on the flag, and assembly is complete.



To check for proper assembly, make certain that the impact holes line up with the flag on the opposite end. If they are not, the outer tubes are in the wrong order and this can result in a false null reading.

Procedure for Using a Fecheimer Probe for Air Flow Measurement

Necessary Equipment

Item	Quantity	Description
(1)	1	Fecheimer Probe of sufficient length
(2)	2	10” Incline Manometers. (1) manometer will be connected across the differential pressure transmitter for local pressure measurement. The second manometer will be used to record velocity head measurements off the probe.
(3)	1	Sufficient length of triple and double strand flexible tubing to use with incline manometers.
(4)	2	U-tube manometers (60” and 24”). One U-tube is to be used for static pressure measurement. The second U-tube will be a “null” balance to help position the probe directly into the airflow stream.
(5)	1	Temperature measurement assembly including: one (1) type “K” chrome-alumel thermocouple of sufficient length integrated into the probe, one (1) type “K” lead wire of sufficient length, and one (1) digital thermometer.
(6)	1	One pair of hot gloves
(7)	1	One protractor to be used with the probe

Assembly of the Test Equipment

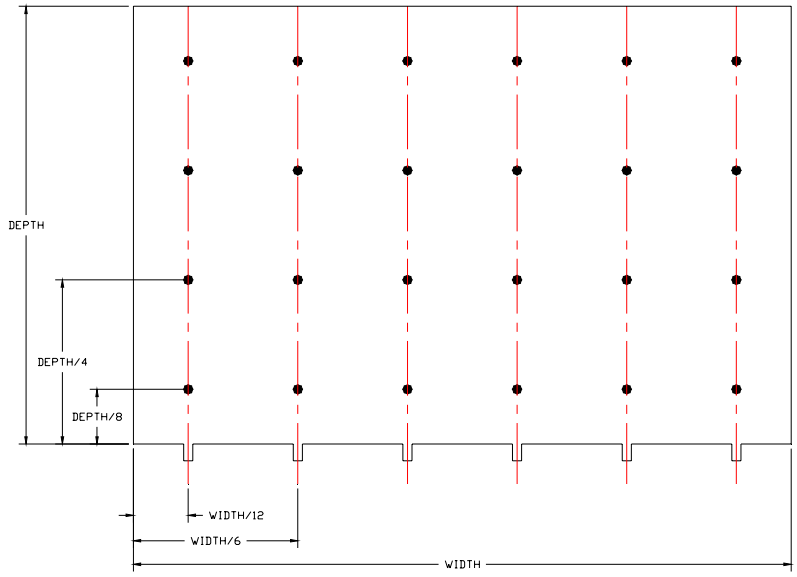
The first step is to setup the incline and U-tube manometers, taking special care to ensure that all valves are open, the inclines “leveled”, and everything properly “zeroed”. Connect one incline manometer across the differential pressure transmitter using the double strand of tubing. The “high” side of the transmitter should correspond with the “high” side of the manometer. When valving the incline “in”, it may be necessary to pinch both sides of the tubing and release them simultaneously so that the manometer oil is not blown out.

The triple strand of heavy wall, flexible tubing should then be connected to the remaining incline and Fecheimer probe. Taking the end of the strand labeled for connection to the manometer, attach the tubing labeled No. 1 to the "high" side of the manometer, No. 2 to the "low" side, and No. 3 to one side of the 60" slack tube manometer. The other end of the triple strand should be connected to the probe. Tubing labeled No. 1 should be connected to the longest stainless steel tube. Tubing labeled No. 2 and No. 3 should be connected to the remaining SS sensing lines (Note: It does not matter which is which, as both are low pressure sensing taps).

Connect the double strand of tubing that is "T-d" off of the triple strand to the 24-inch U-tube manometer. This is the "null" balance U-tube. Once again, it does not matter which side is connected where. (See Figure 3 on the following page.)

Traverse points on the probe are to be marked according to PTC 38 for rectangular ducts if possible. For airflow measurement, we typically try to achieve a minimum of at least one traverse point for every 1 - 2 ft² of duct area. Once this is complete, the probe is ready for use. (See Figure 2 below.)

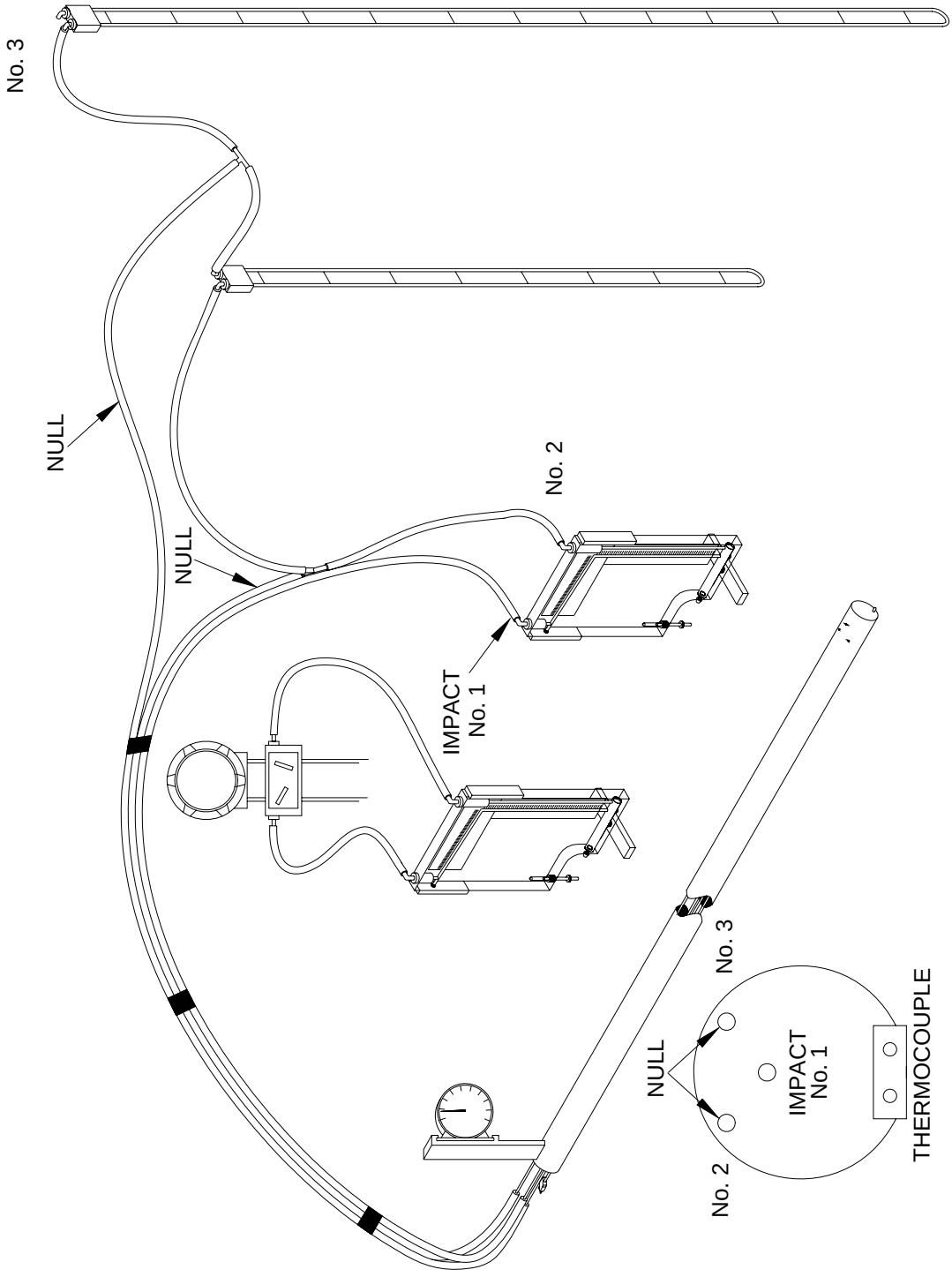
Figure 2



NOTE: IT IS IMPORTANT TO HAVE A SUFFICIENT NUMBER OF SAMPLING POINTS FOR REPRESENTATIVE MEASUREMENTS. THE DIMENSIONS ON THE SKETCH ABOVE MAY VARY DEPENDING ON THE NUMBER OF TEST TAPS REQUIRED DUE TO SIZE OF DUCT BEING TESTED.

TEST TAP AND SAMPLING POINT LOCATION
LAY-OUT FOR RECTANGULAR DUCTS

Figure 3


No. 3
NULL
No. 2
NULL
IMPACT
No. 1
No. 3
NULL
IMPACT
No. 1
THERMOCOUPLE
No. 2

The first step in testing is to establish steady state conditions for the unit. All soot blowing should be completed prior to commencement of the test. The unit will need to remain steady for the duration of the test.

Insert the probe into the duct and position it on the mark providing the deepest depth. It may be necessary to "pinch" both the "high" and "low" pressure tubing leading to the manometer when inserting or removing the probe from a test port. Extremely high static pressures can cause the oil to be blown out if one is not careful. By starting at the deepest mark, the probe has some time to cool as it is worked out of the duct and is generally easier to handle when moving between ports.

Once the probe is positioned at the first mark, rotate the probe slowly until the "null" U-tube is balanced. This balance is usually no more than 15 - 20° off the centerline of the duct. Take care to make sure that the impact hole, "high" pressure hole, is positioned into the flow as the probe is inserted. An erroneous "null" balance can be achieved with the probe head turned directly away from the flow.

Once the "null" position is established and held, record the velocity head reading off of incline, the temperature from the digital thermometer, the angle of the probe with relation to the duct, and the static pressure off of the slack tube "U-tube" manometer. Move to the next point. Once all points for the test port have been recorded, it is necessary to move to the next port.

Calculations

$$\text{Density } (\delta) = \frac{460 + 70°\text{F}}{460 + °\text{F}} \times \frac{\text{Bp} + \frac{\text{Sp}}{13.6}}{29.92\text{" Hg}} \times 0.075 \text{ Lbs./ft}^3$$

$$\text{Velocity} = 1096 \frac{\text{Avg}\sqrt{\text{Cvh}}}{\sqrt{\delta}} \times \text{Probe K} \qquad \text{Avg}\sqrt{\text{Cvh}} = \frac{\sum_{vh=1}^{n} \sqrt{\text{vh}} \cos^2 \theta}{\text{n}}$$

$$\text{Volumetric Flow (Q)} = \text{velocity (Fpm)} \times \text{duct cross - -sect. area (ft}^2\text{)}$$

$$\text{Mass Flow (W)} = \text{Q} \times 60 \text{ min/hour} \times \text{Density}$$

$$\text{Device "K factor"} = \frac{\text{Mass Flow (W)}}{\sqrt{\text{Density}} \times \sqrt{\text{Transmitte r } \Delta\text{P}}}$$