Directional Probes
2 - Dimensional Probes

FOR MEASURING TOTAL AND STATIC PRESSURES, YAW ANGLE AND TOTAL TEMPERATURE

Directional probes are used to measure total and static pressure, yaw and pitch angle, and total temperature. Some United Sensor probes indicate all five quantities.

United Sensor two-dimensional probes, indicating flow direction only in a plane perpendicular to the probe axis, have three measuring holes. The center hole indicates pressure P1, and the two side holes indicate pressures P2 and P3. Preferably the probe is rotated until P2 = P3; the flow direction is established as 0° yaw angle and within the probe's limitations P1 indicates total pressure.

Because the pressure P2 or P3 is highly sensitive to Mach Number and to small variations in construction, etc., cylindrical (YA) and cobra (CA or CT) probes are not recommended for indicating static pressure. To indicate static pressure as well as total pressure and yaw angle, prism (YC) and wedge (W) probes were developed. These are individually calibrated. Typical calibrations are shown in Fig. 4. Both the prism and wedge probes can be supplied with a thermocouple to read total temperature, designated as YCT and WT, respectively.

A typical installation with manometers is shown in Fig. 1 for a static pressure indicating probe such as the YC or W. For a YA or CA probe the choke and static pressure manometer showing P1 – P23 could be omitted. The choke (USC-8261-3) is not essential, but speeds up the readings considerably. It provides a high resistance bleed across the differential P2 – P3, tapped at the center so that the center tap indicates $\frac{P2 + P3}{2}$.

This average pressure changes only slowly with yaw angle, so P2 and P3 do not need to be exactly equal when the pressures are observed, and the probe can be effectively balanced more quickly. As Fig. 2 shows, the probe sensitivity is such that a yaw angle error of 1° corresponds to a differential P2 – P3 amounting to 5% of Pt – Ps; and if no chokes were used, but static pressure taken to be P2 or P3, the static pressure error would be 2-1/2% of Pt – Ps. With the use of the choke, the static pressure error at 1° yaw is negligible (Fig. 3).

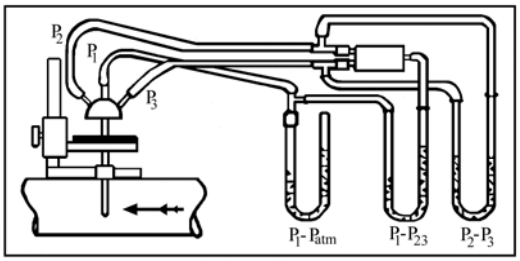

Fig. 1. Typical manometer connections for YC or W probes.

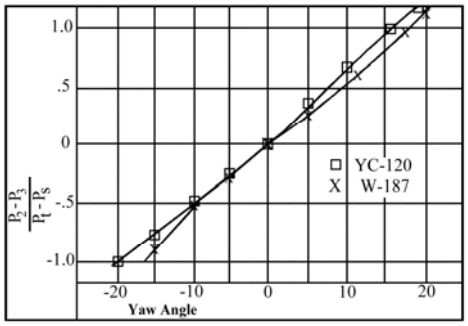

Fig. 2. Yaw angle sensitivity of YC and W probes.

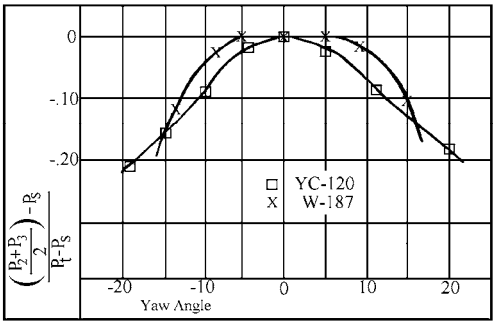

Fig. 3. Average static pressure $\frac{P2 + P3}{2}$ of YC and W probes vs. yaw angle.

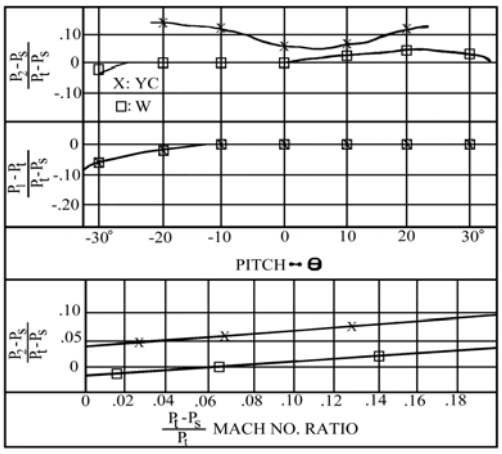

Fig. 4. Typical calibration of W and YC probes vs. Mach Number and pitch angle.

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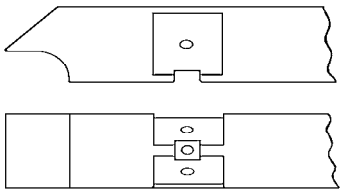
Standard Specifications:

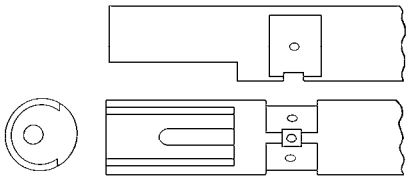
YC: Three-hole, prism shaped measuring section. Measures total and static pressure and yaw angle. Insensitive to pitch angle up to 20°. Furnished with individual calibration curve. Usable up to Mach 0.7. Tip extends 2 diameters beyond holes. Typical calibration shown in Fig. 4.

Standard diameters are 1/8", 5/32", 3/16", 1/4", 3/8"



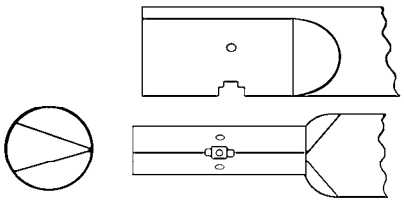
YCT: Same as YC, except includes thermocouple inside the head to measure total temperature.

Standard diameters are 5/32", 3/16", 1/4", 3/8"



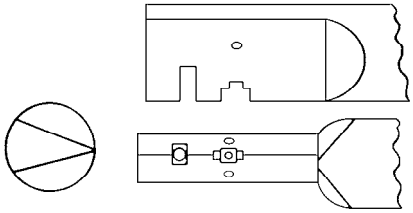
W: Three-hole, wedge shaped measuring section. Measures total and static pressure and yaw angle. Insensitive to pitch angle up to 30°. Furnished with individual calibration curves. Typical calibration shown in Fig. 4. Tip extends 1 diameter beyond hole. Usable up to Mach 0.7.

Standard diameters are 3/16", 1/4", 3/8"



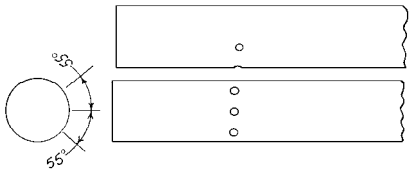
WT: Same as W, also includes thermocouple inside the head to measure total temperature with separate inlet and outlet holes.

Standard diameters are 3/16", 1/4", 3/8"



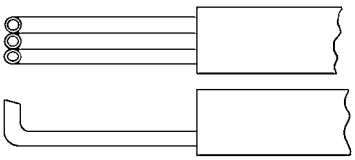
YA: Three-hole, cylindrical. For use where only total pressure and yaw angles are to be measured. Not suitable for static pressure or pitch angles over 5°. Usable up to Mach 0.7. Tip extends 2 diameters beyond holes.

Standard diameters are 1/8", 3/16", 1/4", 3/8"

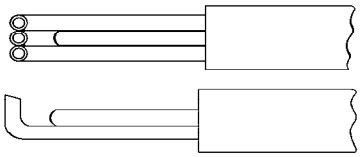


CA: Three tubes. For use where only total pressure and yaw angles are to be measured. Usable up to Mach 0.7. Not suitable for static pressure or pitch angles over 5°. More accurate for boundary layer traverses than type YA.

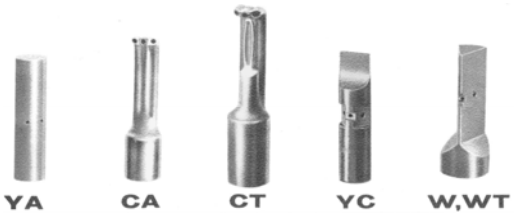
Standard diameters are 1/8", 5/32", 3/16", 1/4", 3/8"



CT: Three tubes like CA, plus thermocouple to measure total temperature, yaw angle, and total pressure. Same application as type CA.



Standard diameters are 5/32", 3/16", 1/4", 3/8"



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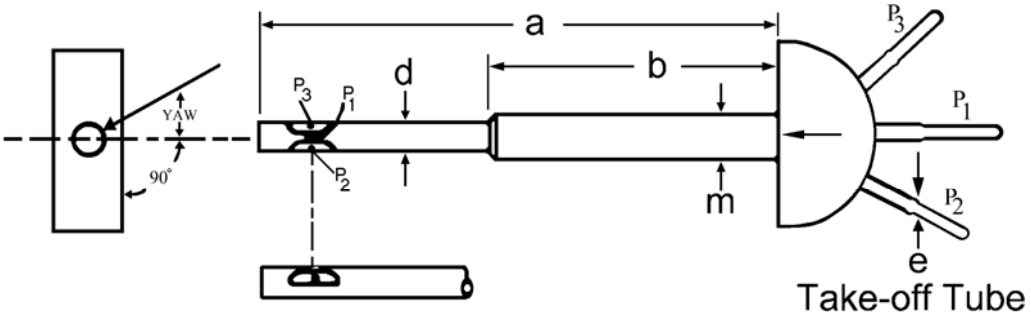
Ordering Information



Typical Example: CT-125-24-F-22-CD-K-Plug

CT: Sensing Head Type *
125: d = .125" – Sensing Head Diameter (inches) **
24: a = 24" – Overall Length (inches)
F: m = 1/4" – Reinforcement Tubing Diameter ***

D	E	F	H	J	L
1/16"	3/16"	1/4"	5/16"	3/8"	1/2"

22: b = 22" – Reinforcement Tubing Length (inches) ***
CD: e = 5/32" – Swaged down to 1/8" – Take-off Tube Diameter

A	C	D	E	F
1/16"	1/8"	5/32"	3/16"	1/4"

Thermocouple Type:
K: Chromel – Alumel
J: Iron – Constantan
T: Copper – Constantan
E: Chromel – Constantan
For types CT, WT, YCT probes only, omit on others.
Plug: Plug termination is standard. Jacks or Lead-wire are available.

* See standard specifications for standard sensing head types.
** Give desired dimensions as decimals, e.g. .125" diameter = 125 in part number.
*** Omit if reinforcement tubing is not required.

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