

Kiel Probes

General Information

Aerodynamic Properties

Kiel probes are used to measure total pressure in a fluid stream where the direction of flow is unknown or varies with operating conditions. Their correction factor is 0 when used within the ranges outlined below.

Mach Number Range

True total pressure is indicated up to a Mach Number of 1.0. There is a slight drop in yaw insensitive range above Mach Number 0.3. This decrease averages about 4% for all types at a Mach Number of 1.0.

Reynolds Number Range

The probes are insensitive to Reynolds Number except at extremely low velocities for Pitot-Static probes. For air this limiting velocity is about 4 ft/sec for the smallest size Kiel probes listed.

Time Constant

Time constant depends on the complete installation, probe, pressure lines, and manometer. With 1/8" connecting hose up to 20 ft. long and a liquid manometer of 1/4" ID, the Type B probe will reach equilibrium reading in approximately 15 seconds. Using this time "t" as a standard the other time constants for average stem lengths will be:

Type	Constant
A	2.4 t
C, D, H	.04 t
E, F	.02 t

Turbulence Errors

Turbulence errors are negligible, especially since the probe is yaw insensitive. Very High turbulence may cut down the yaw and pitch insensitive ranges however.

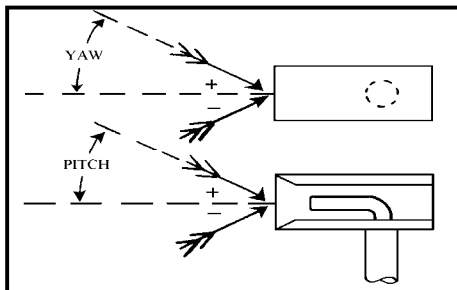


Figure 1. Flow Angles

Yaw and Pitch Angle Range

The outstanding advantage of Kiel probes compared with other total pressure probes is complete insensitivity to direction of flow within certain limits. Their yaw and pitch characteristics are generally the same although stem interference on some designs will change one from the other. Fig. 1 shows these flow angles and Fig. 2 is a typical calibration curve of a Type A probe. It can be seen that the correction factor equals 0 up to the limits of the yaw range and then drops very sharply. The range is arbitrarily defined as the point where the error equals 1% of velocity pressure.

Symbols used in these figures are:

Pt: Total Pressure

Ps: Static Pressure

Ptp: Indicated Total Pressure

The yaw and pitch range for all types listed below at a Mach Number of .25 are:

Type	Yaw Range	Pitch Range
A	±52°	±47° - 40°
B	±48°	±45°
C	±54°	±49°
D	±54°	±49°
E	±63°	±58°
F	±67°	±61°
R	±54°	±49°

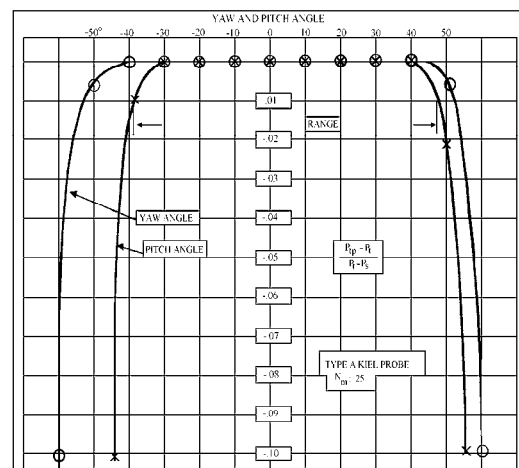


Figure 2. Typical Calibration Curve of a Type A Probe

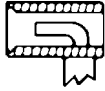
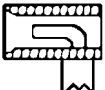


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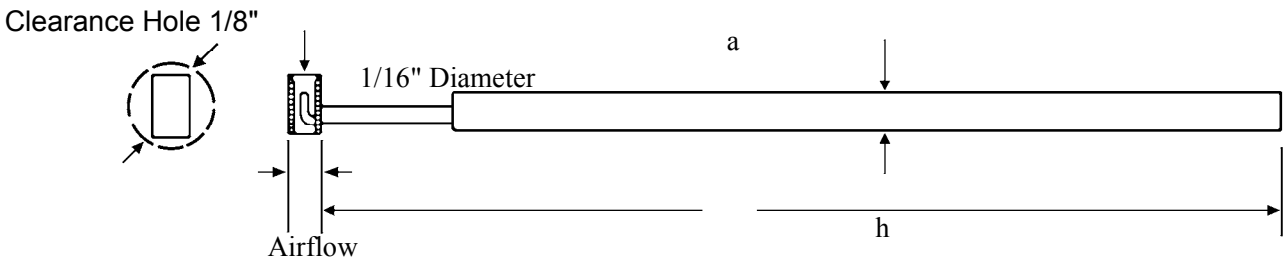
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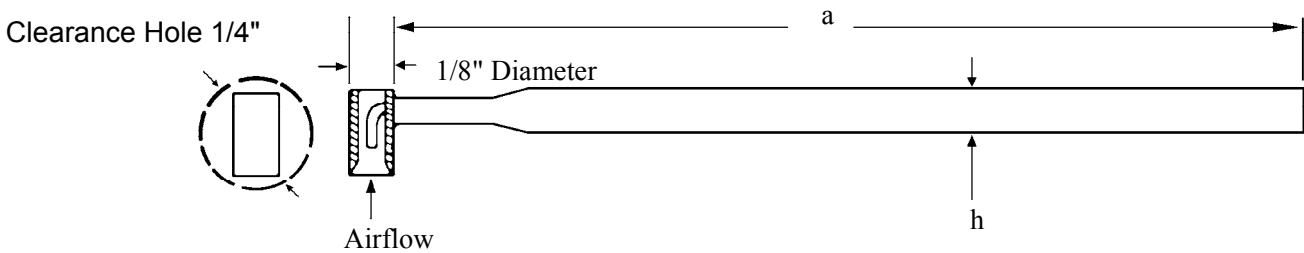
SELECT FROM THESE KIEL MODELS / SPECIFICATIONS

Ordering Part Number	Sensing Head Description	Probe Diameter r h	Probe Length a	Yaw Range **	Pitch Range **	Time † Constant (Sec.)
KAA-"a"	1/16" Dia. Miniature Type KA 	1/16"	Standard Probe Lengths are 6" 8" 12" 24"	± 52°	+ 47° - 40°	36
KAC-"a"		1/8"				
KBA-"a"	1/8" Dia. Standard Type KB 	1/16"		± 48°	± 45°	15
KBC-"a"		1/8"				
KBC-"a"-W						

Type KA:



Type KB:



** "Range" is defined as the point at which error equals 1% of velocity pressure.

† See qualifications under "Time Constant", front page.


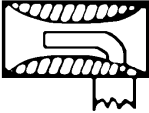


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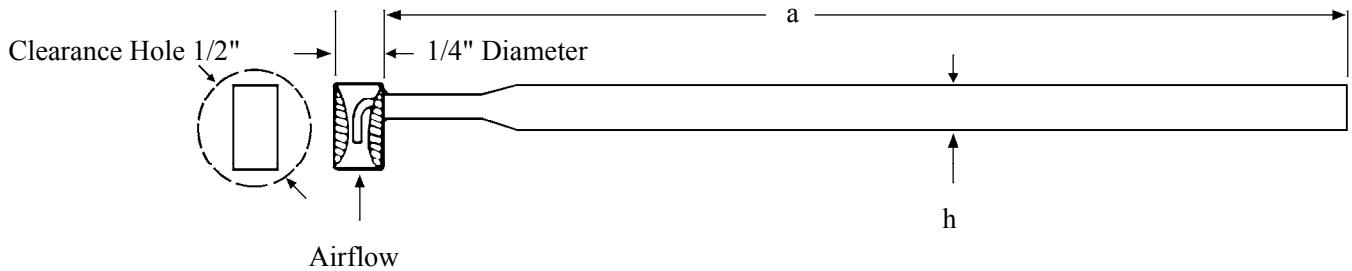
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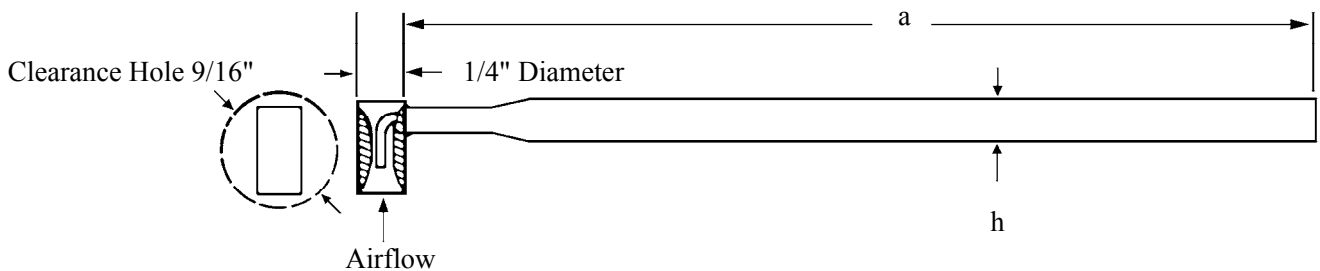
SELECT FROM THESE KIEL MODELS / SPECIFICATIONS

Ordering Part Number	Sensing Head Description	Probe Diameter r h	Probe Length a	Yaw Range **	Pitch Range **	Time † Constant (Sec.)	
KCC-"a"	1/4" Dia. Venturi Type KC 	1/8"	Standard Probe Lengths are 6" 8" 12" 24"	± 54°	± 49°	0.6	
KCE-"a"		3/16"					
KCF-"a"		1/4"					
KCF-"a"-W							
KDC-"a"	1/4" Dia. Venturi Type KD 	1/8"		± 54°	± 49°		0.6
KDE-"a"		3/16"					
KDF-"a"-W		1/4"					

Type KC:



Type KD:



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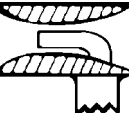
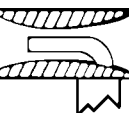


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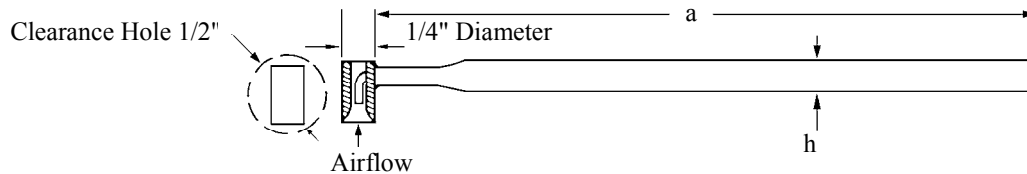
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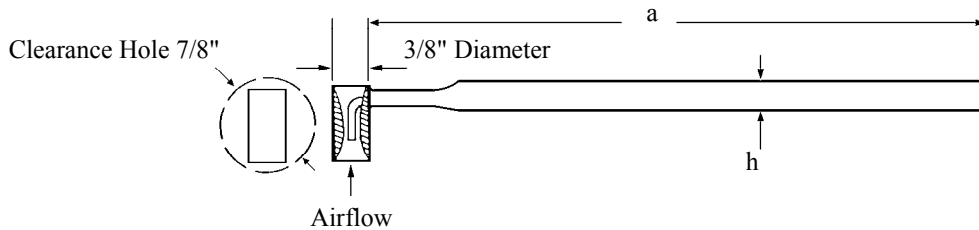
SELECT FROM THESE KIEL MODELS / SPECIFICATIONS

Ordering Part Number	Sensing Head Description	Probe Diameter r h	Probe Length a	Yaw Range **	Pitch Range **	Time † Constant (Sec.)
KRC-"a"	1/4" Dia. High-Range Type KR 	1/8"	Standard Probe Lengths are 6" 8" 12" 24"	± 54°	± 49°	0.6
KRF-"a"		1/4"				
KEC-"a"	3/8" Dia. Venturi Type KE 	1/8"		± 63°	± 58°	0.3
KEE-"a"-W		3/16"				
KEF-"a"		1/4"				
KFF-"a"	3/4" Dia. Venturi Type KF 	1/4"		± 67°	± 61°	0.3

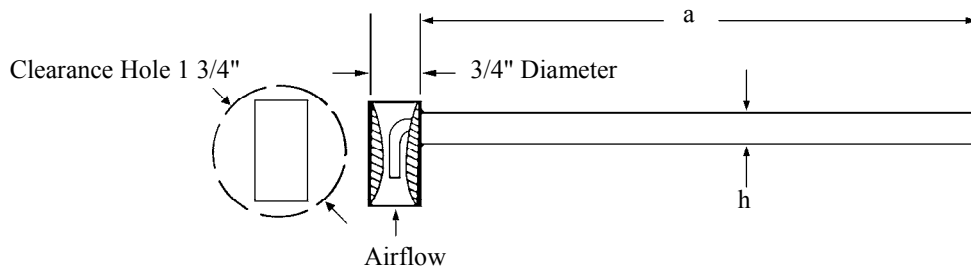
Type KR:



Type KE:



Type KF:



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Boundary Effects

Boundary effects are small as in all total pressure probes. However, in steep total pressure gradients as near solid boundaries or in “trough” behind guide vanes a shift in the effective center of the probe occurs, so the total pressure measured corresponds to the streamline 0.5d away from the geometrical center of the head in the direction of the higher total pressure as shown in Fig. 3.

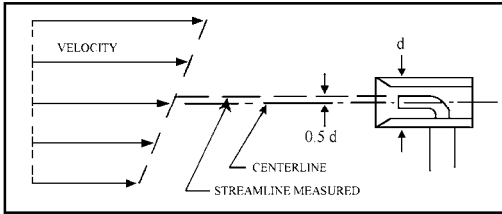


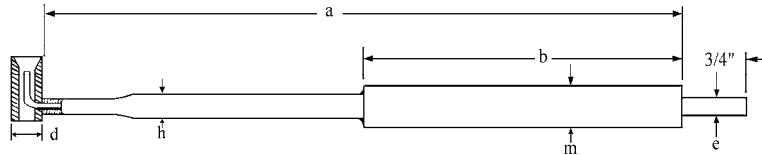
Figure 3. Shift in Effective Probe Center

Installation

These probes are usually installed through holes large enough to pass the head as listed on the Kiel Specification pages. See each individual type for the minimum size.

Special construction including other material, designs to customer’s specifications, special take-offs, and mounting adapters quoted as requested.

Ordering Information



Typical Example: KBC-12-F-10-C-W

- K: Class = K (Kiel) All stainless steel construction
- B: d = See chart and table – Type A, B, C, D, E, F, R
- C: h = 1/8" - see chart for range in each type

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

- 12: a = 12" - Overall length - inches
- F: m = 1/4" - Reinforcing tube diameter (Omit if no reinforcing required)

C	D	E	F	H	J	L	M	N
1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"

- 10: b = Reinforcing tube length – inches (Omit if no reinforcing required)
- C: e = 1/8" - Take-off diameter (Omit if take-off is same size as stem; i.e.

“h”)

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

- W: Welded for use up to 2,000°F

High temperature braze for use up to 1,500°F, use N in place of W.

Omit if Welded or Microbraz is not required. Standard Braze is Silver soldered for use up to 900°F.



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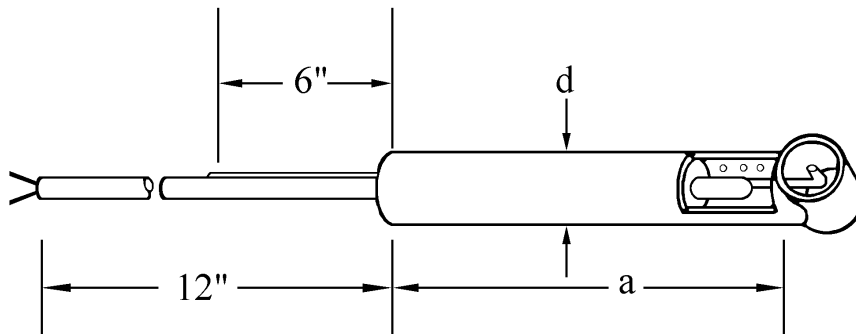
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Kiel Temperature Probes

Combination Pressure/ Temperature Probes

KT: Special purpose Kiel-Temperature Probe measures total pressure and temperature in one unit. The Kiel Head is insensitive to pitch and yaw angles of flow up to +/- 45°. Thermocouple has grounded junction with bleed holes. Exposed and ungrounded junctions are available. Thermocouple accessories and pressure connectors are also available upon request. Please consult United Sensor.

Ordering Information



Typical Example: KT-8-K-12-C

KT: Type KT
8: a = 8" – Probe Length
K: Thermocouple Wire Calibration
K: Chromel – Alumel
J: Iron – Constantan
T: Copper – Constantan
E: Chromel – Constantan

12: 12" - Leadwire Length
C: d = 1/8" – Probe Diameter

C	E	F
1/8"	3/16"	1/4"



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