STEP I. Determine general Accutube mounting style required.

STEP II. Determine if pressure and temperature ratings of selected Accutube are adequate for the application. If not, check alternative Accutube styles*.

STEP III. Determine if Accutube material iscompatible with application. If not, check material of alternative models for compatibility*.

STEP IV. Determine if model selected is available in required line size. If not, check alternative models for line size availability.

STEP V. Calculate differential pressure (D.P) generated by selected Accutube under flowing conditions at the maximum anticipated flow rate (see equations below). A precise computer-generated calculation will be supplied with your order or upon request.

STEP VI. Determine if D.P. at maximum flow rate is within maximum allowable limitations (see below). If not, determine if a double mounted probe of the same diameter will meet the maximum D.P. requirement**. If double mount probe is insufficient, consider a larger diameter probe.

STEP VII. Determine if natural frequency vibration exists in the anticipated range of flow rates (see vibration calculation procedure below). If vibration occurs within the anticipated flow range, check the double mounted Accutube of the same probe diameter. If vibration is still a problem, check larger probe diameters that meet steps I through VI***.

STEP VIII. Configure Accutube model number using Meriam Instrument general catalog pages 21 through 29.

*If standard P & T ratings or materials are insufficient, consult factory for specials.
** Double-mounted Accutubes generated the same D.P. as single-mounted Accutubes of the same probe meter.
***Continuous operation within the calculated vibration range may result in probe failure.

Differential Pressure Calculations (Step V)

The following equations approximate the differential pressure generated by an Accutube in gas, liquid or steam service. The flow coefficient K in the equations is obtained from Table 2 below. For sizing, be sure to use the maximum anticipated flow rate in the equations. Precise sizing and selection calculations are available from Meriam, our representatives or software provided at your request.

Liquid

$$D.P. = \frac{GPM^2 \times S_F}{K^2 \times D^4 \times 32.14}$$

Gas

$$D.P. = \frac{SCFM^2 \times Ss\,(T + 460)}{K^2 \times D^4 \times P \times 16590.}$$

Steam or Gas

$$D.P. = \frac{PPH^2}{K^2 \times D^4 \times \square \times 128900}$$

D = I.D. of Pipe (Inches) K = Flow Coefficient (See Table 2) □ = Flow Density (# / Ft^3) Ss = Specific gravity @ 60 F & 14.7 PSIA
DP = Inches H_2O P = Line Pressure (PSIA) S_F = Specific gravity @ flow conditions T = Flow temp. (F)

TABLE 2: "K" FLOW COEFFIECINTS

PROBE	**NOMINAL LINE SIZE (inches)**													
DIA.	½"	¾"	1"	1.25"	1.50"	2"	2.50"	3"	3.50"	4"	5"	6"	8"	10"
Inline	.407	.455	.514	.584	.601	.657	.688	.701						
3/8"			.517	.583	.580	.638	.617	.665	.661	.672	.671	.706	.665	.696
½"						.557	.598	.645	.630	.656	.656	.662	.673	.682
	NOMINAL LINE SIZE (inches)													
	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	60"
¾"	.706	.686	.676	.683	.698	.688	.689	.686	.789	.720	.757	.697		
1"	.647	.678	.681	.677	.665	.691	.678	.705	.708	.664	.663	.672	.673	.685
23/8"					.603	.618	.628	.634	.645	.671	.652	.668	.733	.670

Maximum Allowable Differential Pressure Check (Step VI)

Find the maximum allowable D.P. for the Accutube under consideration from Table 3 below or Table 4 at right. If the maximum allowable D.P. is greater than the D.P. calculated in STEP V, the selected Accutube probe will withstand the stress imposed by the flowing fluid.

NOTE: Consult factory for steam applications generating less than 10” w.c. at normal flow.

TABLE 3: INLINE ACCUTUBES

LINE SIZE, INCHES	MAXIMUM ALLOWABLE DIFFERENTIAL PRESSURE (inH2O)			
		10A		11A
½		74		270
¾		70		73
1		73		115
1 1/4		75		98
1 1/2		75		75
2		75		73
21/2		77		80
3		75		64

TABLE 4: INSERTION AND WET TAP ACCUTUBES

MAXIMUM ALLOWABLE DIFFERENTIAL PRESSURE, (in H2O)										
LINE SIZE	Single Mount Probe Dia.					Double Mount Probe Dia.				
INCHES	3/8'	1/2"	3/4"	1"	2 3/8"	3/8"	1/2"	3/4"	1	2 3/8
1	1200									
1 1/4	833									
1 1/2	668									
2	459	1064					4256			
2 1/2	338	713					2852			
3	237	510				671	2040			
3 1/2	186	400				544	1600			
4	150	328				449	1312			
5	101	230				316	920			
6	72	163	270	465		234	652	845	1860	
8	44	100	164	289		147	400	535	1156	
10	29	66	107	192		98	264	362	768	
12			77	140				265	560	
14			65	117	487			223	468	
16			50	90	392			174	360	
18			40	72	329			140	288	
20			32	59	277			115	236	
22			26	54	252			96	215	
24			22	41	171			81	164	684
26			19	38	158			70	151	631
28			16	35	147			60	141	586
30			14	27	117			53	108	468
32			13	25	110			47	101	439
34			12	23	103			42	95	413
36			9	18	84			37	72	336
42			6	13	65			28	52	260
48					50				40	200
60					32				27	160
72					23				19	115

Vibration Calculations (Step VII)

Natural frequency or resonant vibration can inhibit Accutube performance. Checks are to be made during sizing. The checks will guide you to the proper probe with resonant vibration range outside the anticipated operating flow range. Vibration checks are not necessary for inline Accutube applications. In this case, maximum allowable differential pressure becomes the limiting factor before destructive vibration occurs. VIBRATION CHECKS MUST BE MADE FOR ALL OTHER ACCUTUBE APPLICATIONS.

Natural frequency vibration is caused by a force created as vortices are shed by the Accutube probe. At a critical point (which is a function of probe geometry, probe material and velocity of the flowing fluid) a destructive natural frequency vibration is created which can lead to probe failure.

To an extent, we can adjust the point at which destructive vibration occurs by using various Accutube probe diameters or by improving the probe's resistance to vibration by using a second mounting support. Ideally, the destructive vibration range should be above the maximum anticipated flow rate. This removes the vibration concern from the flow application. An Accutube can alos be used if the vibration range is well below the anticipated operating flow range. The process flow rate can pass through the vibration range but should not be allowed to flow within the vibration range continuously.

The equations below will give a flow rate range which must be avoided when selecting an Accutube. The calculated flow range is representative of the point of natural frequency vibration for the probe and a $\pm$ 20% safety factor. If operated continuously within the calculated range, probe failure may result.

AVOID VELOCITY RANGE OF…

$$\text{Vel}_{\text{lower limit}} = \frac{525.7 \times M \times Pr \times DIA}{L^2} \quad \text{TO} \quad \text{VEL}_{\text{upper limit}} = \frac{7879.0 \times M \times Pr \times DIA}{L^2}$$

where:

Vel = fluid velocity, feet per second
Pr = probe factor, see TABLE 5 below
M = mounting factor
DIA = probe diameter, inches
L = unsupported probe length, inches, see TABLE 6 below

M = 3.52 for single mount (20T, 22L, 24D, 33T, 37L)
M = 15.4 for double mount (21T, 23L, 25D)

TALBE 5: Probe Factor

PROBE DIAMETER	Pr
3/8”	0.185
½”	0.269
¾”	0.372
1”	0.552
2 3/8”	1.300

TABLE 6: Unsupported Probe Length

SINGLE MOUNT SERIES	DOUBLE MOUNT SERIES	PROBE DIA.	FLANGE RATING	SINGLE MOUNT L, INCHES	DOUBLE MOUNT L, INCHES
20T	21T	3/8"	N/A	I.D. = Wall + 1.25	O.D. + 2.19
20T	21T	¾"	N/A	I.D. = Wall + 1.56	O.D. + 2.81
22L	23L	½"	N/A	I.D. = Wall + 1.50	O.D. + 2.75
22L	23L	1"	N/A	I.D. = Wall + 1.94	O.D. + 3.56
24D	25D	½"	150#	I.D. = Wall + 3.62	O.D. + 4.87
24D	25D	1"	150#	I.D. = Wall + 3.62	O.D. + 5.24
24D	25D	2 3/8"	150#	I.D. = Wall + 4.50	O.D. + 6.25
33T		ALL	N/A	CONSULT FACTORY	NA
37L		ALL	N/A	CONSULT FACTORY	NA

The upper and lower limit velocities calculated define the destructive vibration range. Convert velocity into Gallons per Minute (GPM), Actual Cubic Feet per Minute (ACFM) or Standard Cubic Feet per Minute (SCFM) using the equations shown on the right. Then compare the calculated vibration range to your anticipated operating flow range and refer to the bottom of this page for interpretation of your results.

$$GPM = Vel \times I.D.^2 \times 2.448$$
$$ACFM = Vel \times I.D.^2 \times 0.3272$$
$$SCFM = ACFM \times 35.37 \times P/T$$
$$PPH = ACFM \times \boldsymbol{P} \times 60$$

Where: GPM = Gallons Per Minute
ACFM = Actual Cubic Feet per Minute at flowing conditions
SCFM = Standard Cubic Feet per Minute at 14.7 PSI and 60°F
PPH = Pounds Per Hour
Vel = Velocity, feet per second
I.D. = pipe Inside Diameter, inches
P = inlet Pressure, PSIA
T = inlet Temperature, °R (°R = 460 + °F)
P = density, pounds per cubic foot

COMPARISON OF VIBRATION RANGE TO OPERATING FLOW RATE RANGE

A. Vibration range greater than operating flow range…Accutube selection is OK.

B. Vibration range is within operating flow range…Rerun vibration check using double mount, larger probe diameter or both as necessary.

- If check is OK, then the new Accutube selection is OK. Re-check requirements of STEP 1 through VI.
- If vibration range is still within 70% of the minimum operating flow, try a smaller probe and see "C" at right.

C. Vibration range less than 30% of minimum operating flow range…Accutube selection is OK provided: (1) flow rate is not allowed to remain within calculated vibration range. (2) requirements of STEP I through VI are satisfied.