MERIAM

LAMINAR FLOW ELEMENT

INSTRUCTION MANUAL

U OF M DEARBORN

Technical Note 2A
INSTRUMENT DIVISION

MERIAM LAMINAR FLOW ELEMENT MODEL 50MC2

● The Meriam Laminar Flow Element is a flow measuring instrument indicating volume flow by producing an easily determined differential pressure. It has a linear response between flow and differential making a flow range of 100 to 1 possible. Its accuracy at low flows is determined only by the limitations on reading the differential pressure. The Meriam Laminar Flow Element is inherently accurate and reproducible after initial calibration. While it is a precision instrument, it features complete freedom of installation as it is unaffected by either upstream or downstream flow considerations except for a few very severe applications as noted below.

FUNDAMENTALS OF LAMINAR FLOW

In 1883, Osborne Reynolds published a series of papers describing his experiments on "circumstances whether the motion of water shall be direct or sinuous and of the law of resistance in parallel channels." This classic experiment consisted of injecting dye into water flowing in glass tubes.

Fluid Flow Patterns

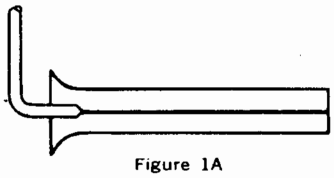


Figure 1A

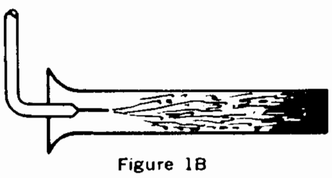


Figure 1B

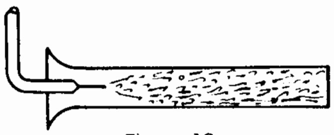


Figure 1C

When the flow rate was low enough, the dye line remained as a thread moving straight down the tube and parallel to the walls without disintegrating, (Figure 1 A). If the flow rate was increased past a certain point, the dye line broke up filling the tube, (Figure 1 B). When observed with the aid of an electric spark, the flow pattern on breaking could be seen to turn into distinct curls and eddys, (Figure 1 C). In Figure 1 A, if the dye thread is moved from top to bottom of the tube, the velocity will be found to vary, with the fluid at the center of the tube moving faster than at the edges. Since it is moving parallel to the walls of the tube, but at different rates, the fluid is said to move in layers, or lamina, and the flow is called laminar. When the dye line breaks up in eddys, the flow is called turbulent.

A great number of fluid flow phenomena depend on whether the flow is laminar or turbulent. Reynolds found that this characteristic was primarily dependent on the pipe diameter and the fluid viscosity, density, and velocity. They may be combined mathematically to produce the equation:

$$N_R = \frac{VD\rho}{\mu} \qquad \text{(Eq. 1)}$$

Where:

N_R = Reynolds Number
V = Average fluid velocity
D = Inside pipe diameter
ρ = Density of flowing fluid
μ = Absolute viscosity

If consistent units are used, the results are dimensionless. This means that whether the numbers are based on the English or metric system, the numerical value of the Reynolds number will be identical. His results showed that when the Reynolds number is below 2,000, the flow is laminar. The important difference between laminar and turbulent flow is that in laminar flow, the pressure drop varies linearly with the flow rate. In turbulent flow, the pressure drop varies as the square of the flow rate.

The Meriam Laminar Flow Element operates on the principles of capillary flow derived independently by Hagen and Poiseuille near the middle of the nineteenth century. Stated as an equation the pressure drop during laminar flow is:

$$\Delta P = \frac{AQ\mu L}{D^4} \qquad \text{(Eq. 2)}$$

If entrance and exit effects are included in the overall pressure drop as they are in the Meriam Laminar Flow Element, an additional term involving Q^2 is added.

$$\Delta P = \frac{AQ\mu L}{D^4} + \frac{B\rho Q^2}{D^4} \qquad \text{(Eq. 3)}$$

Where:

ΔP = Differential pressure
A = Constant
B = Constant
Q = Volume flow
μ = Absolute viscosity
L = Capillary length
D = Capillary diameter
ρ = Density of flowing fluid

The constant "B" is customarily a small fraction of "A", and by making "L" suitably long, the effect of the "B" term can be minimized to any desired degree. Note that the density does not appear in the first term in the equation and thus does not materially affect the equation. This equation applies only to capillary flow.

Most flows encountered in engineering work are turbulent, the small cost of increased pressure drop more than offset by the saving in piping costs. This being true, the Meriam Laminar Flow Element must produce laminar flow from turbulent flow. Referring to the Reynolds number equation, (Eq. 1) it is seen that the only free terms are the fluid velocity "V" and the tube diameter "D", since for a given fluid, viscosity and density will be fixed. What the Meriam Laminar Flow Element does then is to channel the flow through myriad parallel ducts which keeps the velocity about the same as in the pipe, while reducing the duct dimension sufficiently to produce laminar flow. The heart of the Meriam Laminar Flow Element that does this job is called the "matrix."

Matrix Section

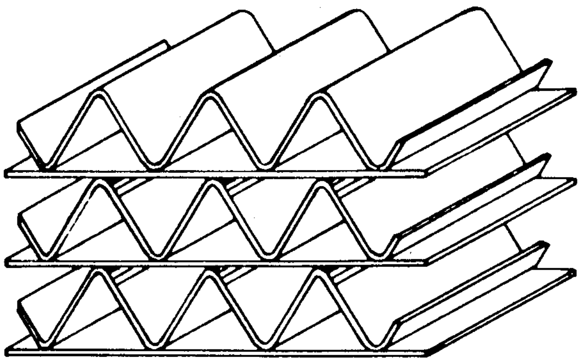


Figure 2

Figure 2 represents an end view of a matrix. The dimensions of the triangular passages are only a few thousandths of an inch, while the length of the passage is normally a few inches.

As the fluid flows down these passageways the friction created causes a pressure drop which is determined by measuring the pressure difference between the inlet and outlet of the matrix. (See Figure 4A, Page 4.) This pressure drop is related to the flow by Equation 3.

The Meriam matrix, made of type 303 stainless steel, is formed into a mechanically rigid unit which assures geometric integrity. This is mandatory to achieve permanent calibration. Laminar flow elements made of such materials as bundles of spaghetti, glass wool, felt pads, and flat plates have been tried, but on cleaning or disturbance, they often shift calibration due to changing dimensions in the flow passageways.

The Meriam Laminar Flow Element due to its unique construction is a single mechanical structure that cannot change calibration with cleaning or proper handling.

EFFECT OF TEMPERATURE

The Meriam Laminar Flow Element is not significantly affected directly by temperature. However, its flow relationship depends directly on viscosity which is affected by temperature. Gas viscosity, contrary to liquids, increases with temperature. For air, an increase of 10° Fahrenheit will increase the differential pressure 1.5 percent for the same *volume* flow. If the flow is to be measured in terms of weight, or standard cubic feet, then as the temperature changes, the flow will be affected first by the viscosity effect, and second by the density effect. For pure gases, or gas mixtures on which viscosity data are available, accurate corrections can be made.

EFFECT OF PRESSURE

As noted, density does not enter into the Laminar Flow Element flow equations except as a second order effect. The effect of pressure on viscosity is small, so, except at elevated pressures it can be neglected. As with temperature though, where weight or standard cubic foot measurements are desired the effect of pressure on density must be taken into account.

There is one other consideration of pressure that must be kept in mind. For gases, the density changes in proportion to the absolute pressure. Reynolds numbers change in direct proportion to the density of the flowing fluid and the laminar equations apply only when the Reynolds number is below 2,000. For example, assume a gas is at 15 PSIA and for a given flow the Reynolds number is 600. Then if the pressure is increased 5 times to 75 PSIA, for the same volume flow the Reynolds number will be 3,000 and the laminar equations will no longer apply.

It should be pointed out that while the laminar calibration will no longer apply, a calibration made at the new flowing conditions would be fully useable and reproducible. The linear relationship between flow and pressure drop, however, would not apply.

Most Laminar Flow Elements when carefully calibrated do not display a perfectly linear relationship between flow and differential. This can be accounted for in part by the squared term in Equation 3 which also contains a density term. For small changes in pressure, the effect is negligible, but when the use of the Laminar Flow Element is at pressures considerably higher than the calibration pressure, the increase in density multiplies the coefficient of the squared term which increases the curvature.

Other effects are also introduced as the pressure rises and they operate in a manner not entirely understood or predictable. The result is that at the present time The Meriam Instrument Company does not recommend using the Laminar Flow Element at pressures above 20 PSIG unless calibrated at the desired flowing pressure.

A test program is in progress to determine the nature of these phenomena and the relationships involved.

EFFECT OF PULSATIONS

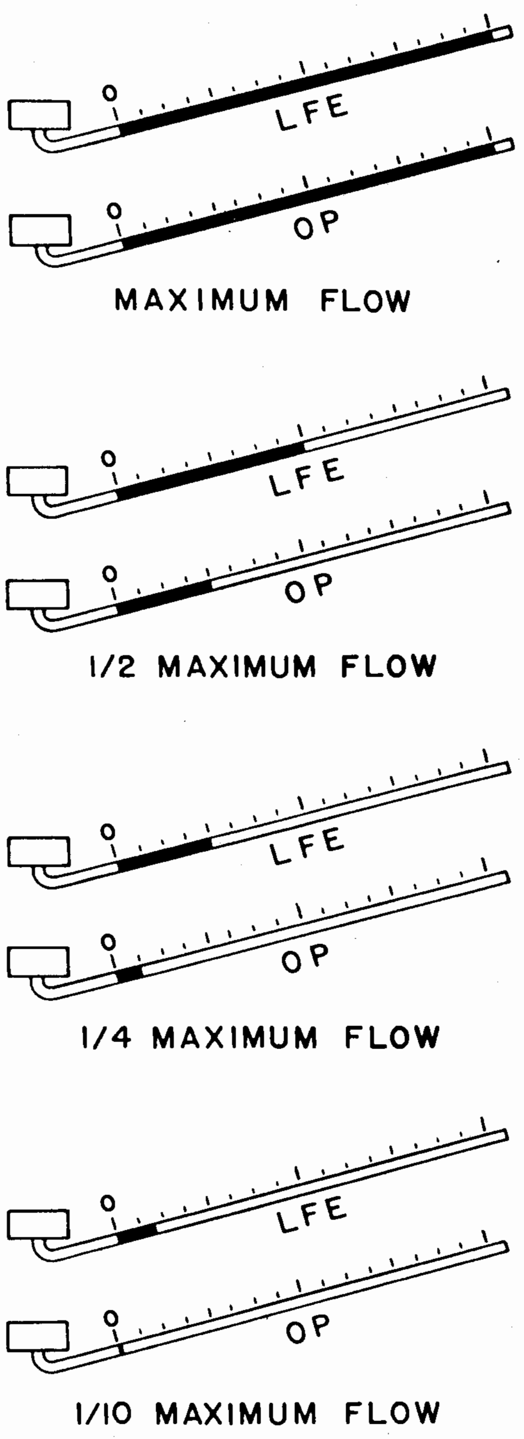
The Meriam Laminar Flow Element is particularly well adapted to the measurement of pulsating flows for two reasons. First, it gives a linear relationship between flow and differential pressure, which means that the arithmatic average of pressure differential will give the average flow. This does not happen with an orifice plate or nozzle. Second, the Meriam Laminar Flow Element introduces a strong damping action on the system which tends to smooth pulsations out.

For strongly pulsating flows, it is necessary that the differential pressure taps be equipped with viscous pulsation dampers. This is because the pulsations by themselves can affect the reading of the differential pressure instrument due to resonance or "tuning" effects. Meriam Laminar Flow Elements for such use are supplied with viscous pulsation dampers in the differential pressure taps to minimize this effect.

RANGE

The Meriam Laminar Flow Element has a useable range of 100 to 1 when coupled with a suitable secondary element. By comparison a nozzle or orifice plate has a generally acceptable range of 3 to 1 or 4 to 1. This means that if a given Meriam Laminar Flow Element and orifice plate produce the same differential pressure at a certain maximum flow, then at one-half flow, the Laminar Flow Element will produce one-half of the maximum differential pressure while the orifice plate will produce one-fourth of the maximum flow. At one-tenth flow, the Laminar Flow Element will still produce ten percent of the full scale reading, but the orifice plate will produce only one percent. See Figure 3.

Manometer Reading of Orifice Plate & Laminar Flow Element At Noted Flows



L F E - LAMINAR FLOW ELEMENT

O P - ORIFICE PLATE

Figure 3

In addition, orifice coefficients become unreliable at low flows adding to the uncertainty of measurement. There is no such problem in the Laminar Flow Element. The low range accuracy is limited only by the readibility and accuracy of the pressure sensing instrument. The importance of this is that one Laminar Flow Element will cover a flow range that would otherwise require three or four orifice plates or nozzles.

CALIBRATION AND ACCURACY

All Meriam Laminar Flow Elements are calibrated unless ordered otherwise. Ambient air is used as the flowing fluid. Calibration is within plus or minus 0.5% of The Meriam Instrument Company flow standards. The National Bureau of Standards will accept Meriam Laminar Flow Elements for calibration, if desired.

MERIAM LAMINAR FLOW ELEMENT — GENERAL FEATURES

The Meriam Laminar Flow Element is a complete primary flow measuring element.

Figure 4 A represents the general structural elements of a Laminar Flow Element. It consists of a metal housing with inlet and outlet connections, pressure taps and a metering section of "matrix" material. Upstream and downstream are flow straighteners which are made of the same matrix material as the metering section, only shorter. As the name implies, they tend to straighten the flow out.

Frequently the flow straighteners are replaced with piezometer rings, (Fig. 4 B). The piezometer ring is simply a ring with a series of holes that pick up the

General Construction of a Laminar Flow Element

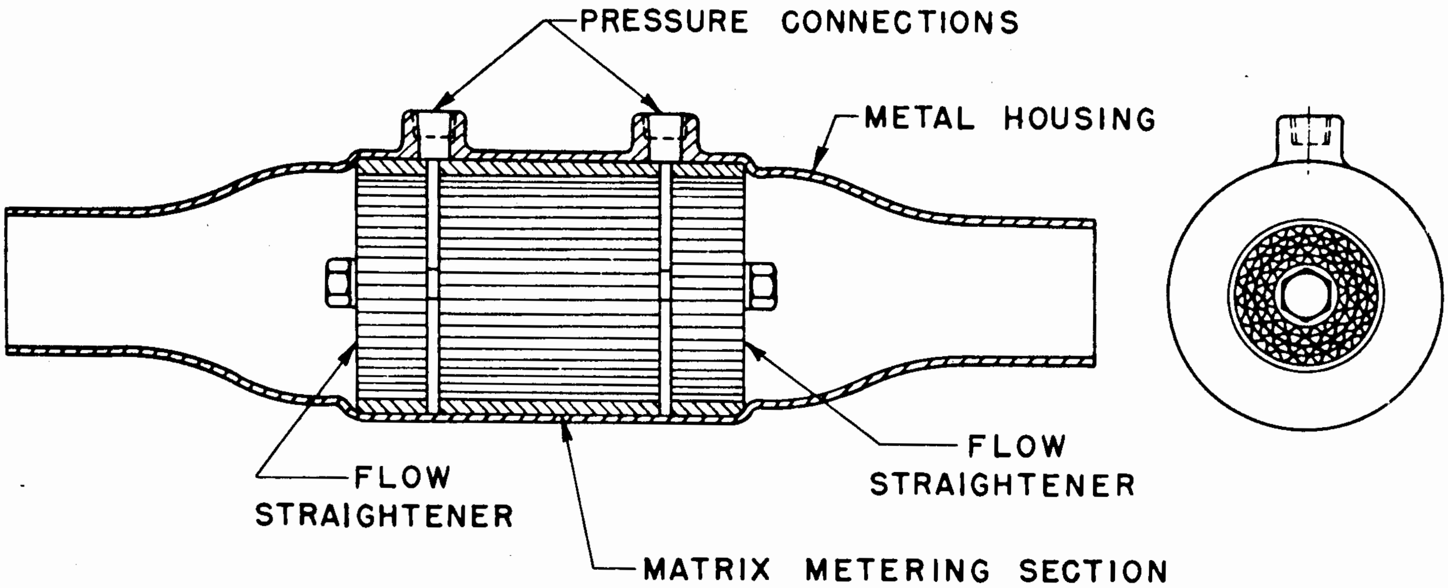


Figure 4A

It should be kept in mind that the accuracy of the Meriam Laminar Flow Element is *not* based on the percentage of full scale as is customary in most instruments. Its accuracy is maintained over the full range of use as a percentage of the scale reading. Practical considerations of the secondary element are the limiting ones as far as metering accuracy at low ranges is concerned.

A graph of flow versus differential is provided with each calibrated laminar flow element and, unless otherwise ordered is based on a flowing temperature of 70° Fahrenheit. In addition temperature and pressure correction factor graphs are supplied. Graphs in any units with any required correction factors can be supplied, provided that the necessary conversion factors are available.

pressure around the housing and channel it to the pressure tap. This averages out any pressure variations around the "matrix" without adding any pressure drop.

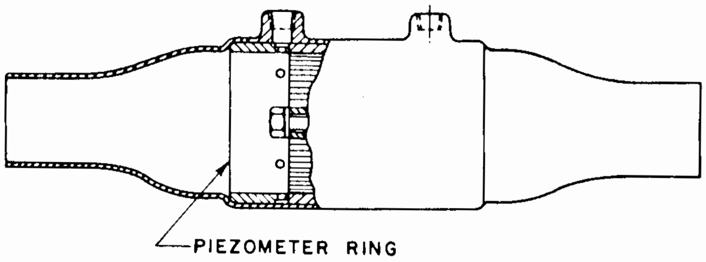


Figure 4B

DIFFERENTIAL PRESSURE and PRESSURE DROP

The differential pressure in a Laminar Flow Element is normally restricted to a maximum of 10″ of water, with usual differentials of 2″ to 8″. There is no pressure recovery in a Laminar Flow Element matrix. Flow straighteners, filters, and inlet and outlet geometries increase the total pressure drop and must be taken into consideration when over-all pressure drop considerations are critical.

INSTALLATION

The Meriam Laminar Flow Element may be directly coupled into any system without regard to upstream or downstream disturbances. It is a complete metering section and in comparing costs with an orifice plate, should be compared on that basis. The orifice plate requires flanges, a smooth and long enough upstream and downstream run of pipe (usually a total of 30 to 40 pipe diameters) and the requisite space for installation.

When used for engine test work, the usual practice is to couple the Laminar Flow Element directly to the carburetor inlet by means of a short piece of hose. In spite of the severe pulsations, this procedure usually works very well. However, in some cases, it has been found necessary to incorporate a volume chamber between the Laminar Flow Element and carburetor. Reasons for this are not clear and there is no general method of predicting just when a volume chamber is necessary. The effect is caused by the nature of the engine pulsations and there is some indication that the difficulty is in the differential pressure readings rather than the Laminar Flow Element itself.

The metered fluid must be clean and the use of a filter is recommended. When used for engine test work, if there is any possibility of backfire, a trap or filter should be installed to keep carbon deposits out of the matrix. Carbon deposits are extremely difficult to remove and yet will change the calibration.

Depending on the type of element, coupling is effected with standard pipe, flanges, or flexible rubber hoses.

Pressure tap connections are usually supplied with hose nipples for the attachment of flexible rubber or Tygon tubing between the element and the measuring instrument. Copper tubing, plastic tubing, and pipe are also used.

OPERATION

Operation of the Meriam Laminar Flow Element is straightforward. The fluid passing through the metering system creates a pressure differential which is measured on an inclined manometer or other differential pressure sensing instrument. The differential pressure is recorded and the calibration chart supplied with the meter consulted. The chart usually plots volume flow versus differential pressure, but can be provided in any units. In some cases, the scale of the differential sensing instrument is calibrated directly in flow units.

For precision work, the observed reading must be multiplied by a temperature correction factor. Whether or not a pressure factor is required depends on the type of flow units desired. Temperature correction, and where needed, pressure correction charts are supplied with complete instructions in the instruction manual that accompanies every Meriam Laminar Flow Element.

MAINTENANCE AND CLEANING

When used on clean fluids, the Meriam Laminar Flow Element requires very little maintenance or cleaning. Care must be exercised in handling the matrix as the metal is soft and the edges easily bent. Cleaning is required when an abnormally high differential is observed for a relatively modest flow rate. Usually a solvent rinse is all that is required. Detailed instructions are provided with each Laminar Flow Element.

USE AND APPLICATION

Meriam Laminar Flow Elements are used principally to meter the flow of low pressure gases. They have found wide application in measuring air flow to internal combustion engines where severe pulsations are a problem. They are used to measure supercharged air and refrigerated air (-40°F.) to engines as well as hot (800°F.) exhaust gases from engines. They are used as master air flow standards in industry. They make particularly good standards where volume flow rather than weight flow is of interest as they are relatively unaffected by pressure changes. Examples of such applications are the air flow from fans, air motors, valves, and filters. Leakage rates from airplane cabins, home windows and storm windows have also been measured with Meriam Laminar Flow Elements.

They are used to measure low pressure natural gas flows.

Leak rates and very low flow rates are conveniently and accurately measured by single capillary elements.

Special fabrications have been made with the matrix metering sections installed in automobile air cleaner shrouds to meter actual air consumption of the test vehicle while on the road.

The variety of applications is limitless and we are glad to tailor fabrication for special requirements.

ACCESSORIES

For atmospheric air inlet applications, a filter can be provided as an accessory and is recommended.

A useful aid to the quick computation of flow is the Meriam Laminar Flow Element circular slide rule. This precision made plastic slide rule will calculate weight or SCFM (Standard Cubic Feet Per Minute) flows directly for air. Actual Cubic Feet Per Minute for air, or flow rates for other gases can be determined by following instructions provided with the rule.

When the Laminar Flow Element is made for hose connections The Meriam Instrument Company can supply the necessary hoses and clamps to attach the instrument to any size pipe. Necessary pressure tap tubing, hose fittings and clamps are also available.

DIFFERENTIAL PRESSURE INSTRUMENTATION

Although the Meriam Laminar Flow Element will work with any pressure sensing secondary element, the high accuracy, low cost and trouble free, inclined tube liquid manometer is recommended. The Meriam Instrument Company makes several models ranging from the very accurate 34FB2 micromanometer through the 40HE35 inclined gauge to the durable and inexpensive 40GC4 draft gauge.

The 34FB2 micromanometer is available in a 10″ or 20″ range, uses treated water as the indicating fluid and reads to 0.001″.

The 40HA10 is a precision inclined manometer with a scale length of 48″. Various vertical ranges are available from 4″ to 16″. It uses treated water as the indicating fluid and is supplied with a precision bore glass tube.

The versatile 40HE35 inclined tube manometer is the choice of most users of the Meriam Laminar Flow Element. It combines the features of good accuracy and readability with modest cost. The 50″ scale length is usually chosen with vertical range selected to suit. Scale graduations are either 0.01″ or 0.02″.

Meriam draft gauges 40GE4 or 40GC4 are used where price or space considerations are paramount. Scale lengths are 12″ and 11″ respectively, vertical range is limited to 4″ and scale graduations are 0.02″ or 0.01″. These gauges use red oil as the indicating fluid.

Details on these manometers and others are available. Please write directly, or consult the Meriam Technical Sales Representative in your area for further information.

WORKING EQUATIONS FOR GAS FLOWS

When changing from one set of conditions to another, certain equations are useful. They cannot be applied indiscriminately, but will act as a guide when ordering or considering the use of Laminar Flow Elements. A list of the symbols appears on Page 7.

Meriam Laminar Flow Elements are usually calibrated in SCFM units where SCFM means "Standard Cubic Feet Per Minute." A standard cubic foot (SCF) of gas is defined as the mass of gas required to fill a one cubic foot volume at 14.73 PSIA and 60° Fahrenheit. A standard cubic foot (SCF) then is equal to a fixed weight for a given gas. But the weight of gas in an actual cubic foot (ACF) will vary depending on the temperature and pressure of the gas.

To find the actual cubic feet per minute flow knowing the SCFM, use the following equation:

$$\text{ACFM} = \text{SCFM} \times \frac{14.73}{P} \times \frac{T}{520}$$

(Eq. 4)

At ambient conditions, ACFM may be considered equivalent to SCFM within a few percent.

The Reynolds number in our present matrix may be determined from the relationship:

$$N_R = 150 \times \text{S.G.} \times \frac{P}{14.73} \times \frac{\mu_{70}}{\mu_T} \times \frac{h}{4} \times \frac{3}{L}$$

(Eq. 5)

To insure laminar flow, the Reynolds number should not be permitted to go above 1,000. Any time a Laminar Flow Element is to be used for conditions other than which it was calibrated for, a Reynolds calculation should be made.

Occasionally one may wish to compute the matrix area for a given flow:

$$\text{Matrix Area} = \frac{\text{SCFM}}{1.6} \times \frac{L}{3} \times \frac{1}{h} \times \frac{\mu_T}{\mu_{70}} \times \frac{14.73}{P} \times \frac{T}{520}$$

(Eq. 6)

To compute the diameter of a circle knowing the area:

$$D = 1.128 \sqrt{\text{Square Inch}}$$

(Eq. 7)

The last three equations can be combined in various ways to determine the geometric feasibility of a matrix for a given application.

To compute the mass flow, knowing the CFM:

$$\text{PPM} = 0.07655\ \text{SCFM} \times \text{S.G.}$$

(Eq. 8)

Symbols:

PPM = pounds per minute
ACFM = actual flowing cubic feet per minute
SCFM = standard cubic feet per minute
ρ = density pounds per cubic foot
μ_{70} = viscosity of air at 70° Fahrenheit
μ_T = viscosity of gas at flowing temperature, same units as μ_{70}
P = static pressure PSIA
T = temperature °Rankine = 460+ °Fahrenheit
h = differential pressure in inches of water
L = length of matrix metering section (standard length is 3")
D = diameter in inches
S.G. = specific gravity of flowing gas compared to air when both are at 60° Fahrenheit and 14.73 PSIA
N_R = Reynolds number

FLOW RANGES

Meriam Laminar Flow Elements have been fabricated in different sizes to cover a wide range of flows. Capillary units have been made to meter 0.01 cubic inches per minute, while the largest Meriam Laminar Flow Element yet made has a capacity of 2,000 CFM at 8" water differential and larger sizes have been designed. Temperature ranges covered have been from minus 40 to 800° Fahrenheit.

50MC2 LAMINAR FLOW ELEMENT

The standard instrument line is the Model 50MC2 series illustrated on Meriam Drawing No. 50MC2. Wherever possible, economy and availability recommend their use.

The 50MC2 series of Laminar Flow Elements was designed primarily to measure air intake to internal combustion engines. These flows use low pressure air that pulsates severely. Weight and cost are minimized by making the housing of spun aluminum. Inlet and outlet connections are for flexible rubber hoses. Pulsation dampers are included in the pressure taps.

Maximum recommended pressure is 20 PSIG..Maximum temperature is 150° Fahrenheit.

On these Laminar Flow Elements, and following the "50MC2" on the nameplate is a dash, a number and one or two letters. The number to the right of the dash is the outside diameter of the outlet connection in inches. The letter "P" refers to a piezometer ring which is used as a pressure pickup. It is used where the over-all pressure drop must be kept to a minimum. "S" is for flow straighteners. They act as additional damping in the system and are recommended if pulsations are particularly severe.

The suffix "F" is used to denote a filter which can be supplied in place of the inlet side housing for atmospheric applications.

The 50MC2-8 is supplied without flow straighteners or piezometer rings.

Standard sizes and dimensions are shown on Meriam Drawing No. 50MC2 (see page 8). Special requirements can be individually fabricated and some are mentioned on drawing 50MC2.

The flows and differentials listed are subject to a variation of plus or minus 5 percent for an individual element as it is impractical to fabricate standard units to a precise flow and differential. Ordinarily, this will cause no difficulty, but where critical, please consult the factory for the best combination of element and meter.

ORDERING INFORMATION FOR 50MC2

When ordering a standard 50MC2 for atmospheric air, only the model number, maximum nominal flow, and desired flow units need be specified. Linear interpolation may be used to obtain intermediate flow ranges. For example, the 50MC2-2P has a nominal maximum flow of 100 CFM at 8" differential pressure. It could also be ordered for a maximum of 12.5 CFM at 1", 25 CFM at 2", 50 CFM at 4", or 75 CFM at 6". The unit supplied in each case is the same but the calibration is made only over the range of interest to provide better accuracy and the calibration chart supplied is expanded to permit maximum readability.

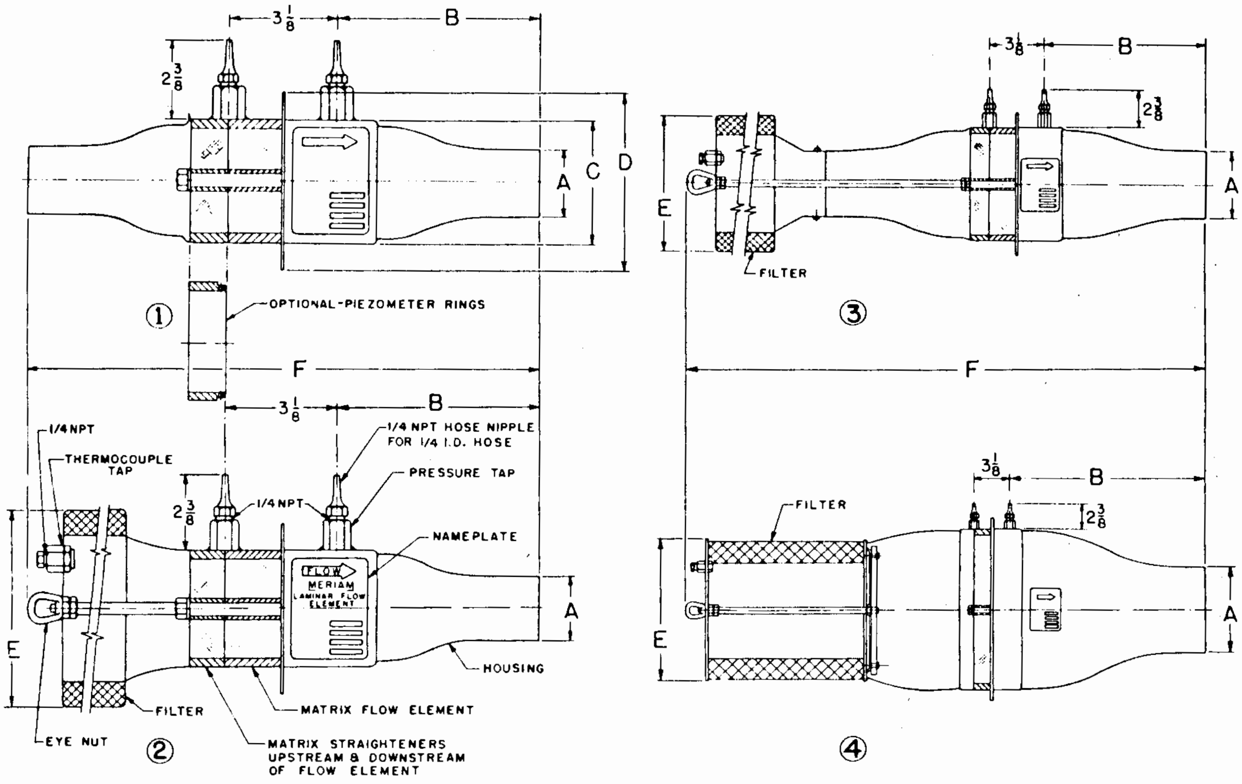
When ordering a unit for other conditions, please supply the information requested under "Order and Inquiry Information."

ORDER AND INQUIRY INFORMATION FOR OTHER APPLICATIONS

Proper design, selection and application of Laminar Flow Elements is best accomplished when all the conditions of use are known. Your assistance in furnishing the following information will be greatly appreciated.

Application or use
Specific gravity at 60° Fahrenheit
Maximum flow
Minimum flow
Normal flow
Duct or Pipe size
Pressure
Temperature
Viscosity (if available)
Maximum differential pressure
Flow units desired — Actual Cubic Feet Per Minute, Pounds per Minute, Standard Cubic Feet Per Minute, etc.
Type of differential pressure instrument

MERIAM LAMINAR FLOW ELEMENT
MODEL 50MC2



MERIAM MODEL 50MC2 SPECIFICATIONS											
MODEL NO.	REFERENCE FIGURE NUMBER	NOMINAL AIR FLOW AT INCHES OF H_2O ΔP SHOWN		A	B	C	D	E	F	NOMINAL PRESSURE DROP *	NET WEIGHT POUNDS
		4 INCHES	8 INCHES								
50MC2-2-S	1	50 CFM	100 CFM	2	5-11/16	3-11/16	5-1/4	—	14-1/2	9	3-3/4
50MC2-2-P	1	"	"	"	"	"	"	—	14-1/2	5	3-1/2
50MC2-2-SF	2	"	"	"	"	"	"	6-7/32	18-9/16	9	6
50MC2-2-PF	2	"	"	"	"	"	"	6-7/32	18-9/16	5	5-3/4
50MC2-4-S	1	200 CFM	400 CFM	4	10-7/16	6-13/16	8-1/2	—	24	8	11
50MC2-4-P	1	"	"	"	"	"	"	—	24	5	10-1/2
50MC2-4-SF	3	"	"	"	"	"	"	8-3/16	35-17/32	9	14
50MC2-4-PF	3	"	"	"	"	"	"	8-3/16	35-17/32	5	13-1/2
50MC2-6-S	1	500 CFM	1000 CFM	6	13-7/16	10-3/16	12	—	30	8	20-1/2
50MC2-6-P	1	"	"	"	"	"	"	—	30	5	20
50MC2-6-SF	3	"	"	"	"	"	"	10-5/16	46-3/32	9	27
50MC2-6-PF	3	"	"	"	"	"	"	10-5/16	46-3/32	5	26-1/2
50MC2-8	1	1000 CFM	2000 CFM	8	16-17/32	14-29/32	16-3/4	—	36-3/16	8	32-1/2
50MC2-8-F	4	"	"	"	"	"	"	12-1/2	44-3/4	9	42

ALL DIMENSIONS ARE IN INCHES.
ALL PRESSURES ARE IN INCHES OF WATER.
ALL OUTLETS ARE FOR FLEXIBLE HOSE.
* TOTAL PRESSURE DROP ACROSS THE ENTIRE LAMINAR FLOW ELEMENT WHEN THE PRESSURE ACROSS THE TAPS IS 4" OF H_2O.

MODELS THAT HAVE BEEN SPECIALLY FABRICATED		REF. FIGURE NUMBER
50MC2-2-SF-CLR	MADE TO FLOW 20 CFM AT 4" OF H_2O	2
50MC2-2	NOMINAL FLOW OF 10 CFM AT 6" OF H_2O	1 & 2
50MC2-2	NOMINAL FLOW OF 21 CFM AT 4" OF H_2O	1 & 2
50MC2-4-PF	NOMINAL FLOW OF 150 CFM AT 4" OF H_2O	3
50MC2-6-PF	NOMINAL FLOW OF 400 CFM AT 5" OF H_2O	3

LEGEND	
-F	FILTER
-S	STRAIGHTENERS (IMPACT REDUCERS)
-P	PIEZOMETER RINGS

Technical Note 2A—Printed in U.S.A. 2M

Since 1911 — Representatives in Principal Cities

THE MERIAM *Instrument* CO. 10920 MADISON AVENUE ⬩ CLEVELAND, OHIO 44102