



## LAMINAR FLOW

Cussons new range of Laminar Flow Meters (LFM) have been developed from the Ricardo Viscous Flow Air Meters (VFAM) originally introduced by J. F. Alcock for measuring pulsating air flows in internal combustion engine air intakes.

This new range of air flow meters retains all the attributes of the previous range, and also introduces new features, whilst extending the number of meter sizes which are available.

- Five sizes of housing for nominal element diameters at 95 mm, 120 mm, 160 mm, 215 mm and 305 mm.
- Elements of 0.61 mm passage size for multi-cylinder engines.
- Elements of 0.46 mm passage size for single cylinder and twin cylinder engines.
- The Elements can now be removed from the meter housings for ultrasonic cleaning.
- Housings incorporate provisions for mounting the pressure transducers (from Cussons P7028 Mass Flow Computer) on the housing in a sealed enclosure.
- Improved pneumatic damping is provided at the pressure connection points.

Laminar Flow Meters eliminate the measurement errors which occur with pulsating flows with kinetic meters of the orifice or venturi type. These errors, which are due to both root mean square effects and to pulsating flow in the measurement ports, are eliminated in LFMs as the resistance to flow of the element is directly proportional to velocity, and pressure tapping connection errors are eliminated by the special design of the connections, any square law entry and exit losses to the element are tuned out during calibration.

Because the pressure difference across the element is directly proportional to the flow rate, a much greater range of accurate flow rate measurement is possible with a LFM than with a kinetic type. The flow range which can be achieved with a LFM is dependent on the method of measuring the differential pressure across the element. For example:

Using a CUSSONS LFM with a CUSSONS Multi-slope Manometer, P7025, it is possible to obtain a turn down ratio of 20:1 compared with only 4.5:1 with an orifice plate for the same range of differential pressure.

Using a CUSSONS P7028 Mass Flow Computer a turn down ratio of 100:1 can be achieved.

## FEATURES

- ◆ Accurate Flow Measurement
- ◆ Ranges available 25 to 650 litres per second
- ◆ May be used with Pulsating Flows
- ◆ Unaffected by Elbows or Bends in Ducts
- ◆ True linear Characteristics
- ◆ "Square Law" Errors Eliminated by Tuning
- ◆ Large Turn Down Ratio
- ◆ Element Removable for Cleaning
- ◆ Improved Pneumatic Damping at Pressure Connections

## APPLICATIONS

- ◆ Engine, Pipe or Duct Air Flow Measurement
- ◆ Single or Multi-Cylinder Engines
- ◆ Naturally Aspirated or Supercharged Engines
- ◆ Research and Development
- ◆ Air Compressors

## OPTIONS

- ◆ Multi-Slope Manometers
- ◆ Mass Flow Micro-Computer
- ◆ Pressure Transducer Enclosure on LFM Housing

## CALIBRATION AND SERVICE

- ◆ All Meters Supplied with Traceable Calibration Certificates
- ◆ Recalibration Service available

## INSTALLATION

Laminar flow meters may be installed in pipelines for measurement of air flows under pressurised conditions. Elbows and bends upstream of the meter have no effect upon the meter's operation and no special precautions other than adequate filtration need be taken.

## CALIBRATION

Laminar flow meter readings are not in terms of absolute standards of measurement, so that each meter is calibrated under steady flow conditions against a standard before despatch. The meter reads volume independently of pressure but needs a temperature correction to allow for change in air viscosity. The correction used is based upon Breitenbach's figures. Constants and correction factors are supplied with each meter.

## OPERATION

In operation the laminar flow meter may be mounted in any position but preferably close to the engine or compressor whose air consumption is to be measured, while the manometer (which may be connected by long pipes) may be mounted on a control console or bench, free from vibration. For atmospheric induction the meter will be supplied with a renewable paper filter, but in locating the meter care should be taken to avoid dusty positions near the floor or proximity to chimneys or diesel exhausts.

## CHOICE OF METER

The appropriate size of meter can be chosen from the table below or calculated from this equation.

$$\text{Maximum Air Flow} = \frac{(C \times N)}{k} \times B$$

where

- C = Engine capacity (litres)  
N = Max. Engine Rotational Speed (rev/s)

- k = 1 for Two Stroke Engines  
k = 2 for Four Stroke Engines  
B = Boost Pressure Ratio (Supercharged Engines)

N.B. It may be advisable to seek the manufacturers recommendation for the exact specifications of the meter required. With your enquiry therefore, please supply answers to the following questions:

For I.C. Engines or Compressors

1. Two stroke or four stroke?
2. Number of cylinders?
3. Bore and stroke, or total cubic capacity?
4. Maximum rotational speed?
5. Atmospheric intake or supercharged?
6. If supercharged, maximum pressure and temperature.

If for Non-Engine Applications

1. Highest mean flow to be measured?
2. Lowest mean flow to be measured?
3. Maximum pressure and temperature?

## P7025 MULTI-SLOPE MANOMETER

Cussons Model P7025 manometer is adjustable to four pre-set slopes and vertical use, scaled 0-250 mm water gauge. For use with Laminar Flow Meters usually used with normally aspirated and supercharged engines operating at up to 1 bar (15lb/in<sup>2</sup>) boost.

## P7028 MASS FLOW COMPUTER

See separate leaflet.

N.B. When air meters are used in a pressurised application a suitable pipeline air filter must be fitted upstream of the meter. Cussons Technology Ltd. can recommend and supply suitable filters. The design of the pipeline must prevent oil and water from reaching the filter.

## RANGE

The various models of laminar flow meters available are shown.

MODEL NUMBER	MAXIMUM AIR FLOW (LITRES PER SECOND)		ELEMENT FITTED		OVERALL DIMENSIONS	
	Engine Rated Flow Capacity	Smooth Flow Capacity	Nominal Diameter (mm)	Passage Size (mm)	Length	Diameter
P7200	25	200	95	0.46	433	153
P7201	50	134	95	0.61	433	153
P7204	50	400	120	0.46	470	180
P7205	100	237	120	0.61	470	180
P7208	100	800	160	0.46	500	225
P7209	200	457	160	0.61	500	225
P7212	200	1600	215	0.46	615	285
P7213	350	887	215	0.61	615	285
P7216	350	2800	305	0.46	735	370
P7217	650	1733	305	0.61	735	370

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