

Coulton Instrumentation

Data Sheet

FEATURES

- * Six sizes of interchangeable orifice section
- * Measurement of very low flow rates, liquid or gas
- * Simple and precise installation using 2 oval flanges
- * Direct mounting onto DP transmitter
- * Body machined from single-piece stainless steel
- * Coulton slip-ring locates orifice section without bolting
- * Accuracy better than $\pm 2\%$ with flow calibration
- * Ex-stock delivery

SCOPE

Coulton Instrumentation will supply the integral orifice assembly for fitting to the Customers own transmitter or a complete system fully calibrated and ready for direct installation into the pipeline.

Devices that may be fitted directly to the integral orifice assembly include dp switches, dp indicators and dp transmitters. 3-valve manifolds may be used with these devices to set zero and enable removal while the line is under pressure.

The dp transmitter can be supplied with square root extraction, analogue or digital indicator, HART communication, Exi, ExN or Exd hazardous area certification and/or NACE specification. Please refer to the manufacturers data sheet.

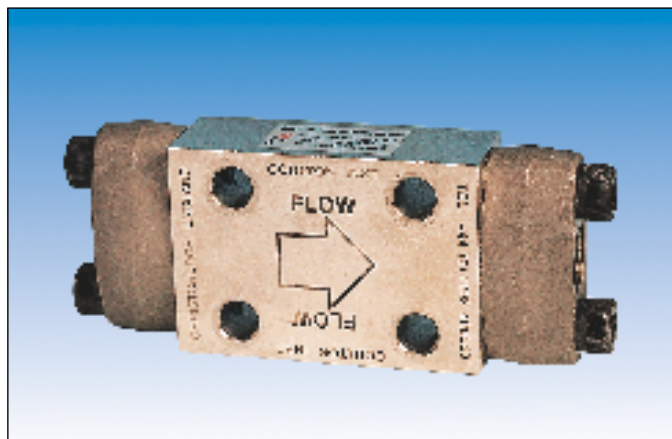
For mass flow, pressure and temperature transmitters can be built into a metered run and supplied complete with a mass flow computer.

One instruction manual is supplied with each shipment. A full set of drawings and certificates can also be supplied. For a description of what is available please refer to the back page.

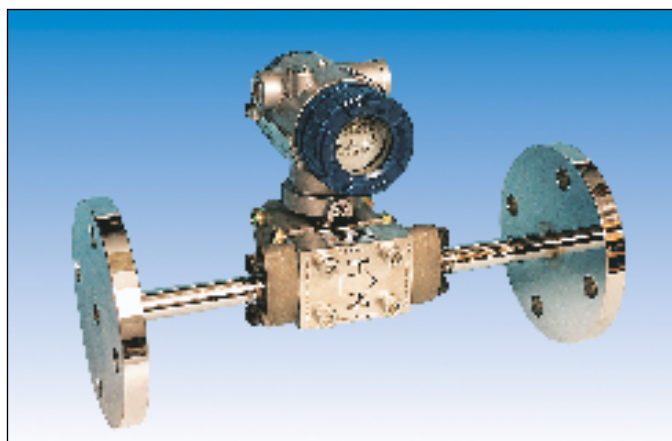
SPECIFICATION

The standard unit is supplied to the following specification. For different materials, threads and options please refer to the "Details Required" section on the back page, or the detailed engineering drawing.

Fluid:	Clean liquids and gases compatible with the materials of manufacture.
Process Pressure:	Vacuum to 160 BarG
Process Temperature:	-40 to + 120 degC
Ambient Temperature:	Depends upon transmitter
Body & Wetted Parts:	316 SS (see options)
Oval Flange:	316 SS
Bolts:	Cr Mo alloy (630 SS optional)
Seals:	Viton & PTFE
Process Connection:	1/2" NPT via oval flanges
Transmitter Connection:	Direct mounting on 54mm centres
Transmitter Bolt Threads:	M10 (7/16 UNF optional)
Oval Flange Bolt Threads:	M10



Integral Orifice



Transmitter mounted on integral orifice in pipeline

RED 66 INTEGRAL ORIFICE ASSEMBLY

Designed for safe and easy installation, the Coulton Red 66 will measure very low liquid or gas flow rates in small bore pipes. It may be bolted directly to almost any manufacturers DP transmitter that uses standard 54mm centres.

The body is machined from a single-piece of 316 SS (or other material) to give high pressure integrity. Its unique design incorporates the "Coulton Slip-Ring" to hold the orifice section in place without the use of additional bolts or screws.

Six different sizes of orifice section can be fitted without using any special tools. It is impossible for the orifice section to move out of place without removal from the pipeline. This significantly increases safety over other designs.

The complete assembly is fixed into the pipeline using standard oval flanges for easy maintenance. If a very high accuracy is required then the unit can be fitted into a metered run and flow calibrated as a complete assembly.

CE Mark Approval

DS1196-R66

DATE 21 Nov 1996



EXPLANATION OF SYMBOLS

Symbol	Denoting	Units
Q_E	Water equiv. flow rate @ 20°C	l/hr
Q	Volumetric flow rate	l/hr
ΔP	Differential pressure	mmH ₂ O
P	Absolute pressure	BarA
T	Absolute temperature	K
ρ	Density	kg/m ³
μ	Viscosity	cStokes
Subscript Denoting		
F	At flowing conditions	
S	At standard conditions (0 °C and 1.013 BarA)	

CHOOSING ORIFICE SIZE

Six sizes of orifice are available to cover a wide range of flow rates. The relationship $Q \propto \sqrt{\Delta P}$ will affect the overall cost. In order to choose the most suitable orifice size and hence range of flow transmitter, follow the simple steps described below.

Step 1 Convert volumetric flow rate into an equivalent flow rate of water using one of the following formulae.

Fluid	Process Conditions	Equivalent Volumetric Flow of Water (20°C)
Homogeneous Liquid	Any	$Q_E = Q_{F \max} \sqrt{\frac{\rho_F}{998.1}}$
Gases & Steam	Flowing	$Q_E = Q_{F \max} \sqrt{\frac{\rho_F}{998.1}}$
Gases	Standard (0°C, 1.013 Bar A)	$Q_E = Q_{S \max} \sqrt{\frac{\rho_F P_S T_F}{998.1 P_F T_S}}$

Step 2 Use the equivalent volumetric flow rate of water (Q_E) in the graph on the opposite page to establish the most appropriate differential pressure and orifice size.

Step 3a If a fixed DP range is required, for example 2500 mmH₂O. Use the table opposite to obtain the water equivalent full scale flow rate and then back-calculate the maximum flow rate of the fluid using the formula given in step 1.

Step 3b If a fixed full scale flow rate is required, for example 50 SI/min. Use the water equivalent flow rate in one of the following formulae to calculate the transmitter full scale DP.

Orifice Size Number	Differential Pressure (mm H ₂ O)
1	$10^{2.0 (\log_{10} Q_E) + 1.689}$
2	$10^{2.01 (\log_{10} Q_E) + 0.876}$
3	$10^{2.013 (\log_{10} Q_E) + 32 \times 10^3}$
4	$10^{2.007 (\log_{10} Q_E) - 1.174}$
5	$10^{2.007 (\log_{10} Q_E) - 2.026}$
6	$10^{2.012 (\log_{10} Q_E) - 3.00}$

Step 4 Check that the velocity of sound is not being exceeded. If $\frac{\Delta P}{P_F} > 1800$ then choose a larger size of orifice.

Orifice Size	Orifice Diameter (mm)	DP Range (mmH ₂ O)	Water Equiv Flow Rate (l/min)	Air Equiv Flow Rate (SI/min)
1	0.635	5000	0.166	14.9
		2500	0.119	10.6
		1250	0.084	8.6
		500	0.053	5.0
		250	0.038	3.8
2	0.99	5000	0.423	38.9
		2500	0.300	27.7
		1250	0.212	18.8
		500	0.135	12.8
		250	0.095	9.6
3	1.587	5000	1.105	86.8
		2500	0.783	62.4
		1250	0.555	43.6
		500	0.352	28.7
		250	0.205	21.3
4	3.175	5000	4.465	351.1
		2500	3.161	254.2
		1250	2.238	167.2
		500	1.418	120.5
		250	1.004	89.2
5	5.150	5000	11.867	854.8
		2500	8.402	618.8
		1250	5.950	427.6
		500	3.768	282.2
		250	2.667	200.1
6	8.700	5000	35.592	2387.0
		2500	25.220	1752.0
		1250	17.870	1215.0
		500	11.333	798.3
		250	8.030	564.0

Equivalent Flow Rates For Fixed DP

ACCURACY

Standard Unit without Calibration

30 - 100% Full Range	Better than ±2% of flow rate
10 - 30% Full Range	Better than ±0.6% of full range

In Metered Section with Flow Calibration

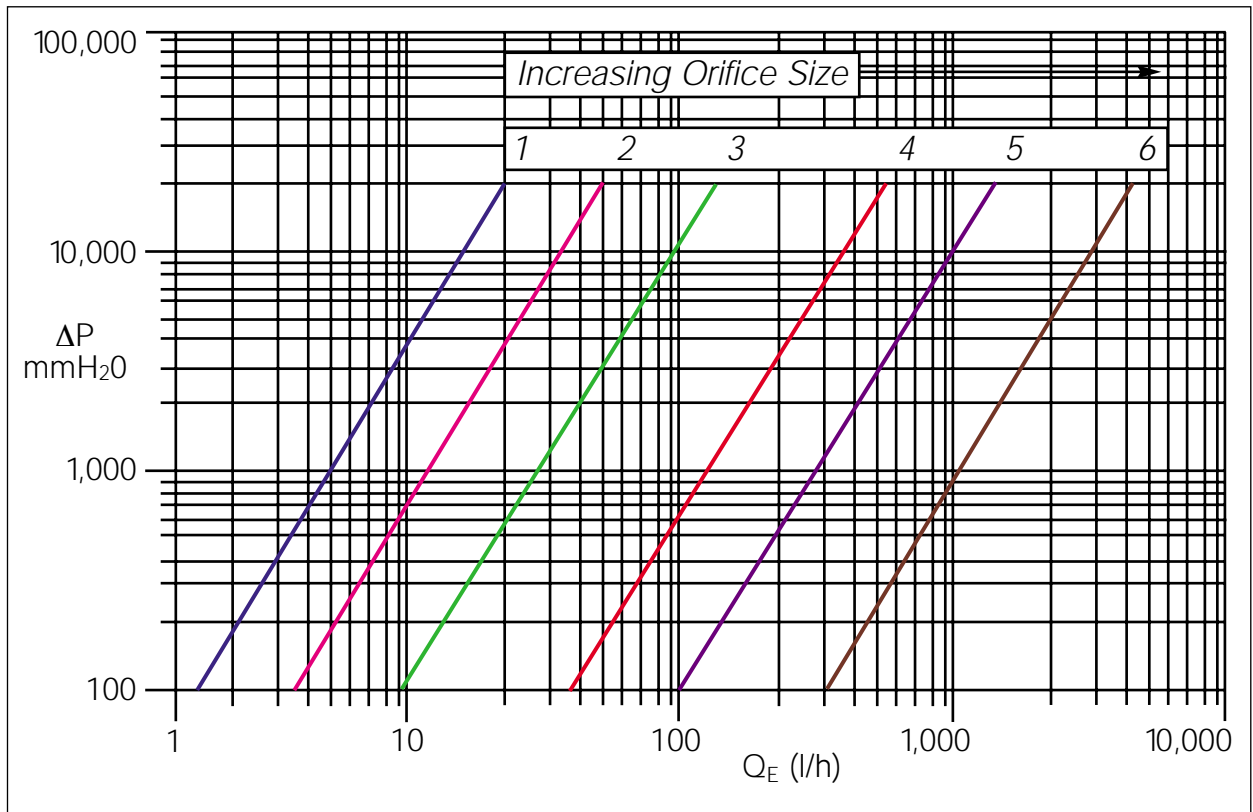
30 - 100% Full Range	Better than ±1% of flow rate
10 - 30% Full Range	Better than ±0.3% of full range

To achieve these accuracies the integral orifice assembly must be installed in a straight section of pipe clear of upstream and downstream disturbances. As a rough guide, the upstream section should be 500mm long and the downstream 250mm long. The fluid must also be clean and the following ratio satisfied:

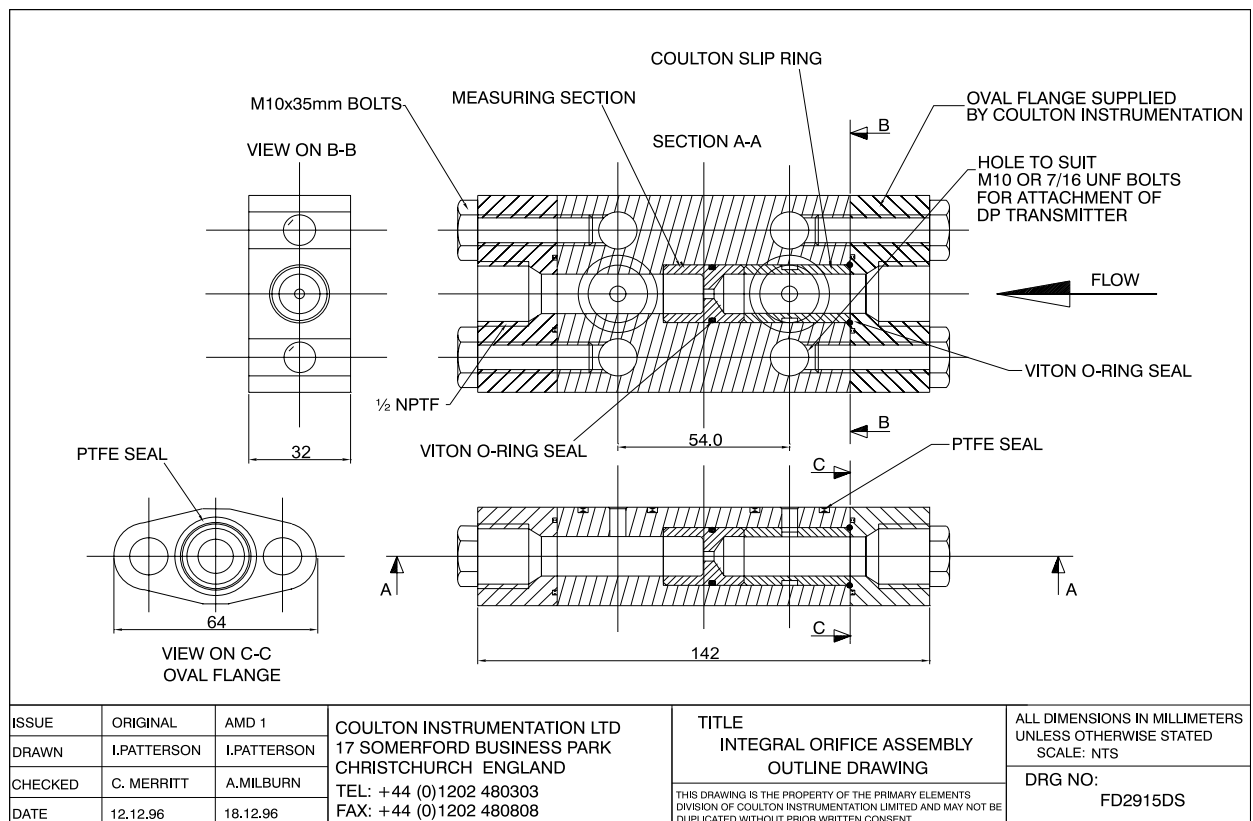
$$\frac{\mu_S \times Q_S \times \rho_F}{\mu_F \times Q_F \times \rho_S} \geq 1$$

If this ratio is less than 1, then the calibrated accuracy for rates above 30 percent of full flow rate will be reduced as shown in the table below:

Orifice Size:	1	2	3	4	5	6
Accuracy	Viscosity (cStokes)					
±1%	0 to 1	0 to 1	0 to 2	0 to 2	0 to 2	0 to 2
±2%	1 to 2	1 to 2	2 to 3	2 to 4	2 to 4	2 to 4
±5%	2 to 3	2 to 4	3 to 4	4 to 5	4 to 5	4 to 5



Orifice sizing graph



General arrangement drawing

