INSTRUCTION

for

EMCO Classical Venturi Tube

type KVR

Liquid, gas, and steam

Application

EMCO classical venturi tube with single pressure tapping's is the primary element in liquid, gas or steam flow measurement according to the differential pressure principle.

The fluid must be in one phase and the pipe shall run full in the measuring section. Changes of flow shall be slowly i.e., without pulsations.

Storage

Before installation, the primary element must be kept clean and protected against corrosion and physical damage.

Pipe Run

The EMCO classical venturi tube type KVR shall be fitted between 2 sections of straight cylindrical pipe of constant cross-sectional area without any obstructions.
The inner pipe diameter D must not vary more than 1% of D used in the bore calculation.

The required minimum straight lengths of pipe vary according to beta and the nature of obstruction - bends, reducers etc.
From the table below it can be seen how many times the inner pipe diameter D is required for "zero additional uncertainty".
The values in the brackets give "+/-0,5% additional uncertainty". These are applicable when the length of the straight pipe run is between the unbracket and the bracket values.
If the straight lengths are shorter than the bracketed values no information is available of the value of any further uncertainty.

Required straight lengths for Classical Venturi Tubes

Values expressed as multiples of *D*

Diameter ratio **ß**	Single 90° bend*)	Two or more 90° bends in the same or different planes*)	Reducer **3*D*** to ***D*** over a length of **3,5*D***	Expander **0,75*D*** to ***D*** over a length of ***D***	Full bore ball or gate valve fully open
0,30	**8 (3)**	**8 (3)**	**2,5** ****)	**2,5** ****)	**2,5** ****)
0,40	**8 (3)**	**8 (3)**	**2,5** ****)	**2,5** ****)	**2,5** ****)
0,50	**9 (3)**	**10 (3)**	**5,5 (0,5)**	**2,5** ****)	**3,5 (2,5)**
0,60	**10 (3)**	**10 (3)**	**8,5 (0,5)**	**3,5 (1,5)**	**4,5 (2,5)**
0,70	**14 (3)**	**18 (3)**	**10,5 (2,5)**	**5,5 (3,5)**	**5,5 (3,5)**
0,75	**16 (8)**	**22 (8)**	**11,5 (3,5)**	**6,5 (4,5)**	**5,5 (3,5)**

*) The radius of curvature and the bend shall be greater than or equal to the pipe diameter.
**) As the effect of these fittings may still be present after 40*D*, no values without parentheses can be given.
***) Since no fittings can be placed closer than 0,5*D*to the upstream pressure tapping in the Venturi tube, the "zero additional uncertainty" valves are the only ones applicable in this case.
****) The straight lengths give zero additional uncertainty; data are not available for shorter straight lengths which could be used to give required straight lengths.

NOTES
1 The minimum straight lengths required are the lengths between various fittings located upstream of the classical Venturi tube and the classical Venturi tube itself. All straight lengths shall be measured from the upstream pressure tapping plane of the classical Venturi tube. The pipe roughness, at least over the length indicated in this table, shall not exceed that of a smooth, commercially available pipe (approximately $k/D \leq 10^{-3}$).
2 Values without parentheses are "zero additional uncertainty" values (see 7.2.3).
3 Values in parentheses are "0.5% additional uncertainty" values (see 7.2.4).
4 For downstream straight lengths, fittings or other disturbances (as indicated in this table) situated at least four throat diameters downstream of the throat pressure tapping plane do not affect the accuracy of the measurement.

It is recommended to use full bore valves upstream the primary element. The valves shall be fully open.

The inside surface of the measuring pipe shall be clean, free from pitting and deposit for at least a length of 10 times D upstream and 4 times D downstream of the venturi tube. Typical inner pipe wall roughness's are stated below.

Material	Condition	***k*, mm**
brass, copper, aluminium, plastics, glass	**smooth, without sediments**	**< 0,03**
steel	**new, seamless cold drawn** **new, seamless hot drawn** **new, seamless rolled.** **new, welded longitudinally.** **new, welded spirally.** **slightly rusted.** **rusty** **encrusted** **with heavy encrustation's** **bituminized, new.** **bituminized, normal.** **galvanised**	**< 0,03** **0,05 to 0,10** **0,10** **0,10 to 0,20** **0,20 to 0,30** **0,50 to 2** **> 2** **0,03 to 0,05** **0,10 to 0,20** **0,13**
cast iron	**New** **Rusty** **Encrusted** **bituminized, new**	**0,25** **1,0 to 1,5** **> 1,5** **0,03 to 0,05**
asbestos cement	**coated and not coated, new.** **not coated, normal**	**< 0,03** **0,05**

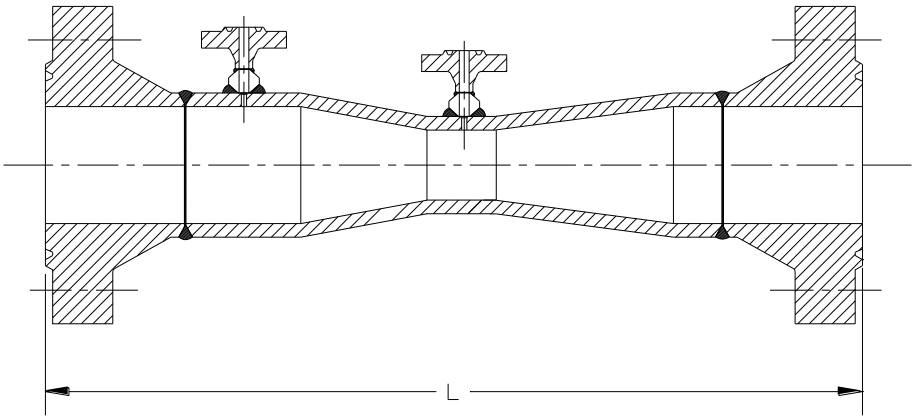
Installation

The EMCO classical venturi tube type KVR must be centred carefully in the pipeline.

With flanges: Centred by bolts.

With weld ends: The primary element is welded into the pipeline with an approved method of welding, and if necessary, a preheat and a post weld heat treatment must be used.

It is important to ensure that the welding grooves of the venturi tube and the mating pipe are the same and that the two inner pipe diameters are equal.



Tap location.

2 pressure tapping's provide the pressure upstream and the pressure downstream. The upstream pressure tapping is marked "+" and the downstream pressure is marked "-".

Liquid

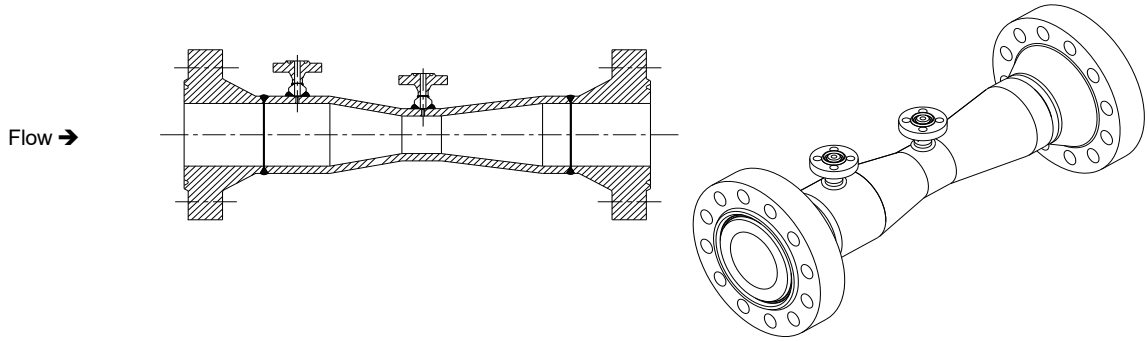
In a horizontal pipe the pressure taps shall be in the horizontal pipe axis or better below.

Gas

In a horizontal pipe the pressure taps shall be in the horizontal pipe axis or better above.

Steam

The orientation of the pressure taps is matched to either a vertical or horizontal pipe run. It is important that the 2 condensing chambers are at the same level to ensure equal water column above the differential pressure transmitter.



Instrument Connection

It is recommended to install the differential pressure transmitter below the venturi tube, apart from gas flow measurement.

The "+" side of the venturi tube is connected to the "+" side of the differential pressure transmitter and the "-" side is connected.
The impulse lines must be installed with a slope to let captured air escape.
The impulse lines should not be less 12 x 2 mm in a material suitable to the service condition.
The venturi tube is normally supplied with the primary isolating valves.
It is recommended to use a 5-way manifold valve in connection with the differential pressure transmitter to isolate, equalise and blow-down or depressurise the transmitter.

Safety

The pipe system, in which the venturi tube will be part of, must be equipped with a safety device, ensuring that the maximum allowable pressure is not exceeded. The venturi tube is not supplied with any safety devices and must not be used for higher pressure, than stated on the name plate.

During operation, the outer surface of the tube will reach nearly the same temperature as the operating fluid. Hence it is recommended, at elevated temperatures, to insulate the tube or ensure that the tube is inaccessible during operation.

Exposing the venturi tube to elevated temperatures may weaken the material. Therefore, the venturi tube must not be exposed to higher temperatures, than stated on the name plate.

Maintenance

The EMCO classical venturi tube requires no special maintenance. It is however important that the inside of the venturi and the mating pipe are free from deposits.

References

PED 2014/68/EU, EN 13445, ISO 5167, ASME MFC-3M, DIN 1952, Shell Flow Meter Engineering Handbook, R.W Miller: Flow Measurement Engineering Handbook.