INSTRUCTION

for

M-CONE differential pressure producer

Series EMF

Liquid, gas, and steam

Application

M-CONE differential pressure producer with single pressure tappings 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 pulsation's.

Storage

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

Pipe Run

The M-CONE differential pressure producer 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 0,4% of D for a length of 2 x D, used in the differential pressure calculation.

The required minimum straight lengths of pipe vary according to beta and the nature of obstruction - bends, 2 bends etc.
From the table below it can be seen how many times the inner pipe diameter D is required.
Are straight pipe run requirements not obtainable an additional uncertainty must be foreseen. The magnitude of additional uncertainty is 0,5 – 1 %.

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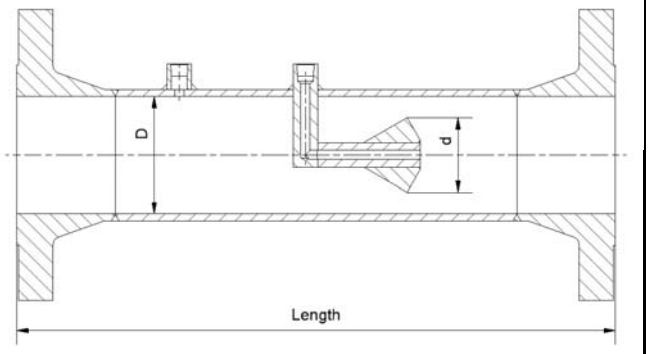
Required straight lengths for M-CONE

Values expressed as multiples of *D*

Diameter ratio **ß**	Single 90° bend*)	Two or more 90° bends in the same plan*)	Two or more 90° bends in different planes*)
0,40	**1**	**2**	**4**
0,50	**2**	**3**	**6**
0,60	**2**	**4**	**8**
0,70	**3**	**5**	**10**
0,85	**5**	**7**	**14**



*) The radius of curvature and the bend shall be greater than or equal to the pipe diameter.

NOTES
The minimum straight lengths required are the lengths between various fittings located upstream of the cone meter and the cone meter itself. All straight lengths shall be measured from the upstream pressure tapping plane of the cone meter. The pipe roughness, at least over the length indicated in this table, shall not exceed that of a smooth, commercially available pipe (approximately $k/D \leq 10^{-3}$).
For downstream straight lengths, fittings or other disturbances (as indicated in this table) situated at least 2 times D 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 5 times D upstream and 2 times D downstream of the cone meter.
Typical inner pipe wall roughness is 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**

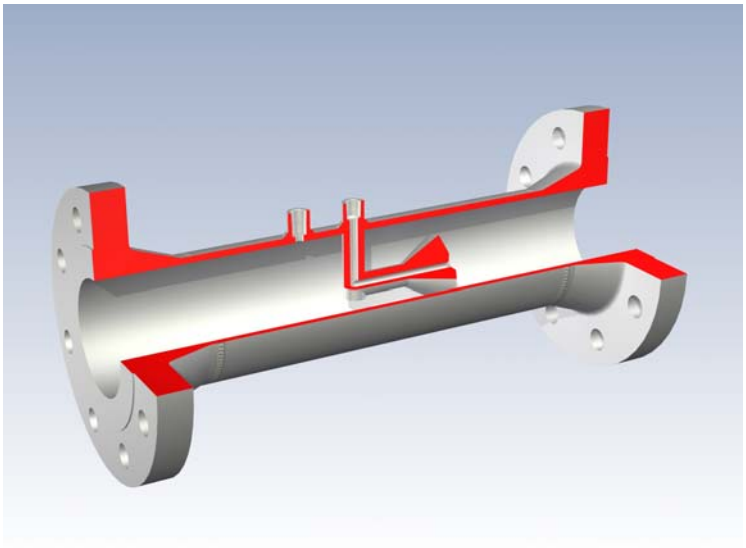
Installation

The M-CONE cone meter series EMF is delivered in 3 different mounting styles

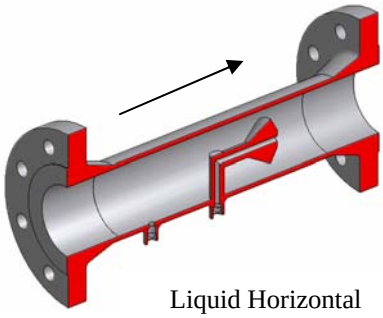
Flange connection, hub connection and with weld ends

When the primary element is welded into the pipe line an approved method of welding, and if necessary a preheat and a post weld heat treatment, must be used.

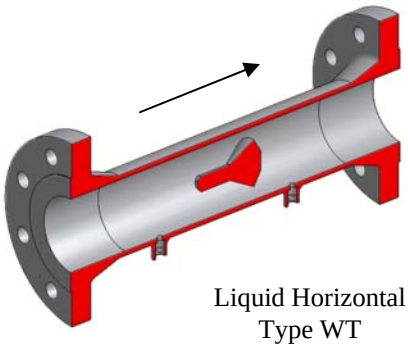
It is important to ensure that the welding grooves of the M-CONE and the mating pipe are the same and that the two inner pipe diameters are equal.



Liquid

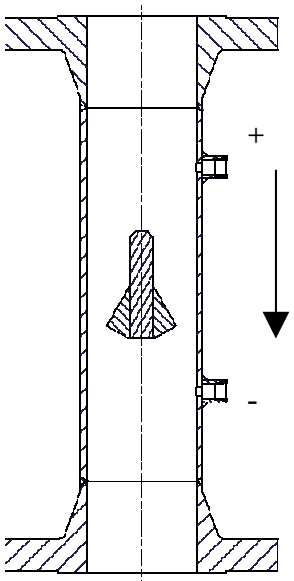


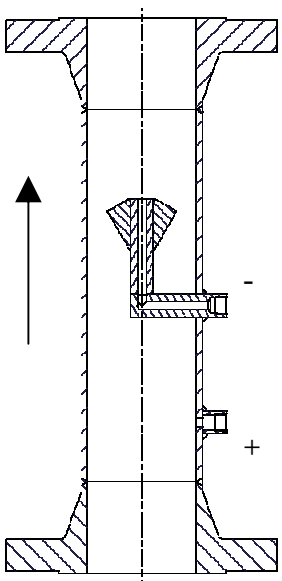
Liquid Horizontal
Type CT



Liquid Horizontal
Type WT

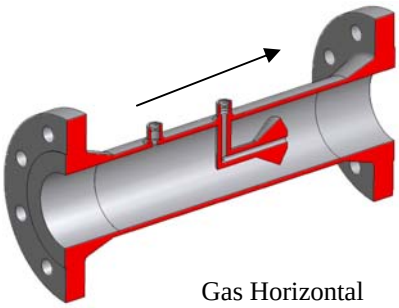
Liquid Vertical
Flow Downwards
Type WT



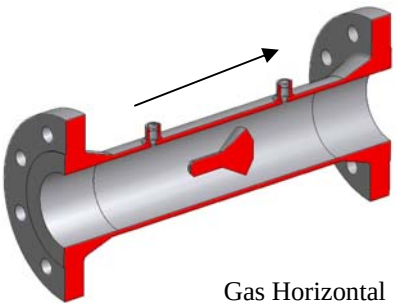


Liquid Vertical
Flow Upwards
Type CT

Gas

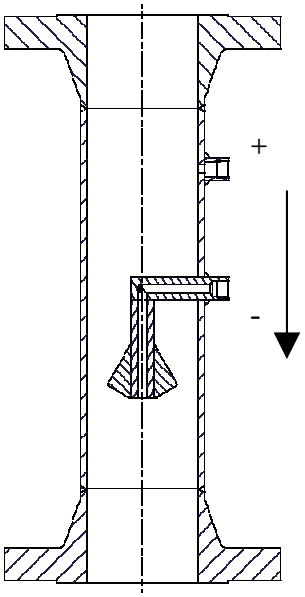


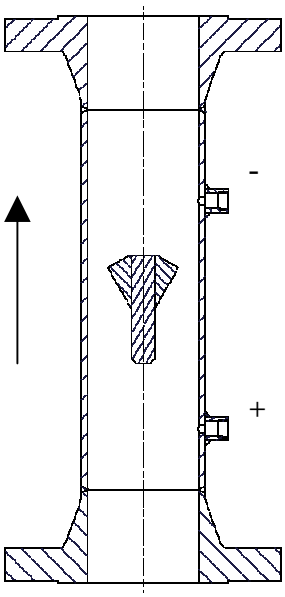
Gas Horizontal
Type CT



Gas Horizontal
Type WT

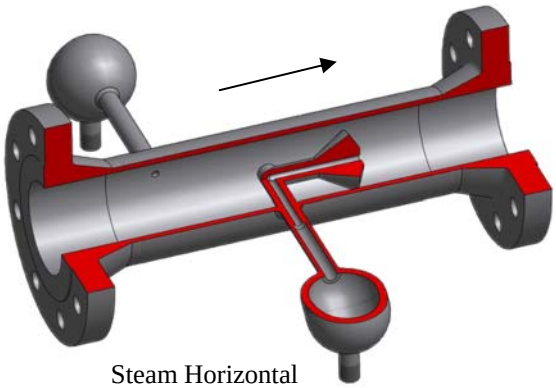
Gas Vertical
Flow Downwards
Type CT



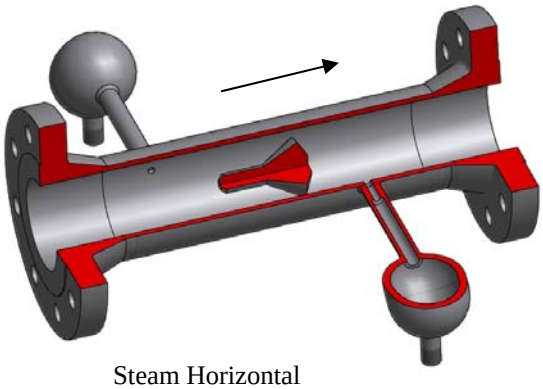


Gas Vertical
Flow Upwards
Type WT

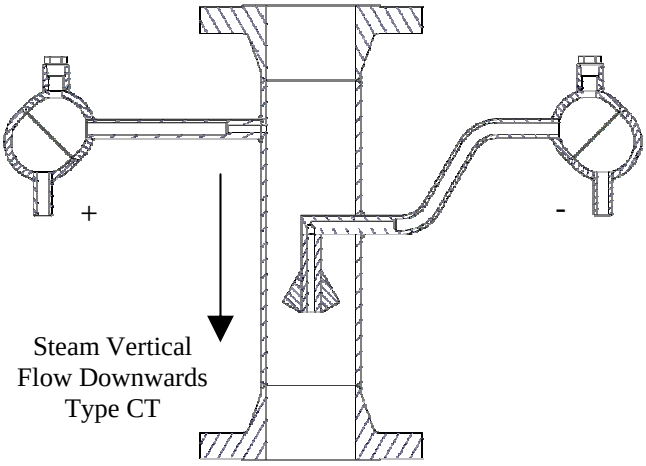
Steam



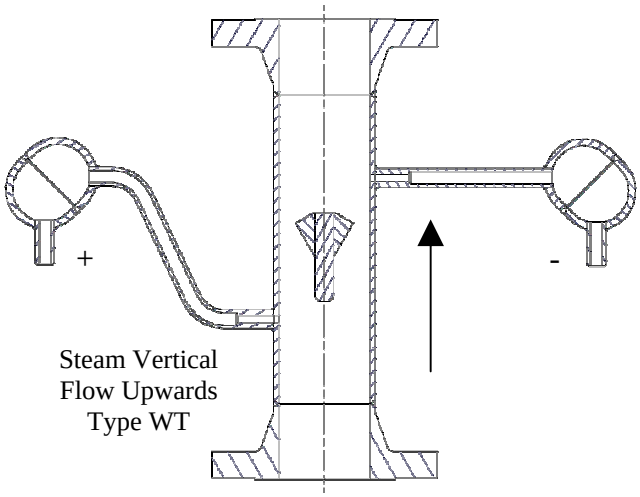
Steam Horizontal
Type CT



Steam Horizontal
Type WT



Steam Vertical
Flow Downwards
Type CT



Steam Vertical
Flow Upwards
Type WT

Tap location

2 pressure tappings 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 cone meter, a part from gas flow measurement.

The "+" side of the cone meter 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 gas escape.
The impulse lines should not be less 12 x 2 mm in a material suitable to the service condition.
The cone meter can be supplied with the primary isolating valves.
It is recommended to use a manifold valve in connection with the differential pressure transmitter in order to isolate and equalise the transmitter. (3 valve manifold).
Depending on type of selected 5 valve manifold the impulse lines may be blown down or the transmitter may be depressurized

Safety

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

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

Exposing the cone meter to elevated temperatures reduces the tensile strength of the material. Therefore the cone meter must not be exposed to higher temperatures, than stated on the name plate.

Pressurizing and de-pressurizing the cone meter shall take place slowly considering that the cone is hollow with small pressure equalizing holes.

Maintenance

The M-CONE differential producer requires no special maintenance. It is however important that the inside of the cone meter and the mating pipe are free from deposits.

References

R.W Miller: Flow Measurement Engineering Handbook, PED 97/23/EC, EN 13480, ISO 5167, ASME MFC-3M,