

## Measuring orifice VMO

Technical Information · GB  
3 Edition 12.18

- For use as a measuring or restricting orifice
- Can be combined with valVario valves and regulators
- Air and gas flow rate diagrams to facilitate configuration
- Easy installation thanks to flanges with internal thread
- Replaceable aluminium washers for optimal adjustment to local operating conditions



valVario®

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## 1 Application



The valVario measuring orifice VMO is installed in gas control and safety systems, as well as in air systems used in industrial and commercial gas heat generation. It can serve as a restricting orifice when used in conjunction with valVario gas solenoid valves and gas control valves.

The test points are located in the measuring orifice housing. The measuring orifice VMO is a good-value alternative in areas where no standardized measuring orifice is required. The replaceable washers with different hole sizes allow the orifice to be adjusted perfectly to the local operating conditions.



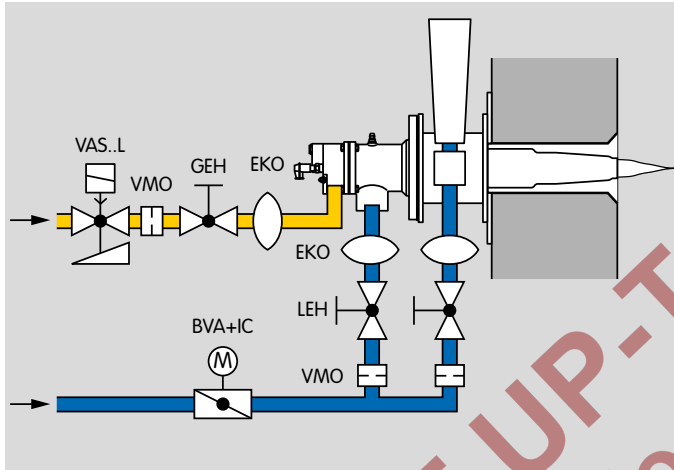
*Shaft melting furnace*



*Incineration installation for thermal regenerative flue air purification*

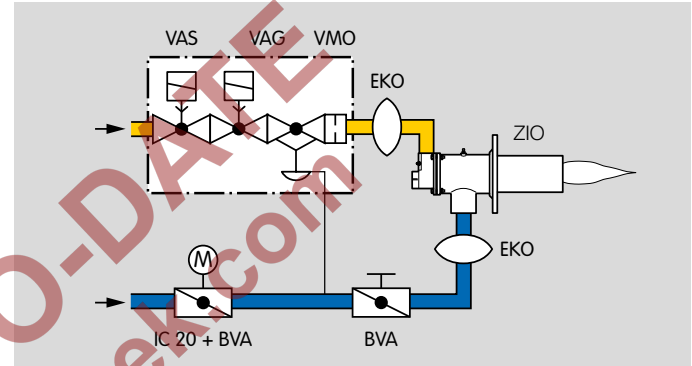
## 1.1 Examples of application

### 1.1.1 Self recuperative burner for direct heating systems



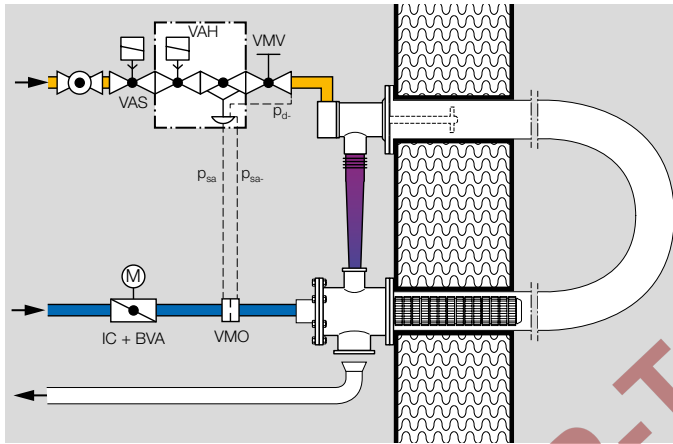
Self recuperative burner in a direct heating system with an inductor for evacuating the flue gases from the furnace. The inductor generates a vacuum with a centrally positioned nozzle and thus draws the flue gases out of the furnace chamber through the burner's heat exchanger. The measuring orifices VMO are designed to record the gas and air flow rates.

### 1.1.2 Continuous control with pneumatic ratio control system



With this type of control, the mixture setting can be maintained over a wide control range while at the same time preventing air deficiency. This type of control is used in melting furnaces in the aluminium industry or in regenerative incineration installations in the environment industry, for example. Here, the measuring orifice VMO is designed to record the gas flow rate.

### 1.1.3 Continuous or staged flow rate control



This application shows flow rate control for a tube firing burner system with plug-in recuperator for air preheating.

There are temperature-dependent air pressure losses in the recuperator. The ratio of gas pressure to air pressure does not remain constant. The fluctuating air flow rate is measured at the measuring orifice VMO and the VAH controls the gas flow rate proportionally.

The air index ( $\lambda$ ) can be set using the fine-adjusting valve VMV.

## 2 Certification

EU certified pursuant to



**Meets the requirements of the**

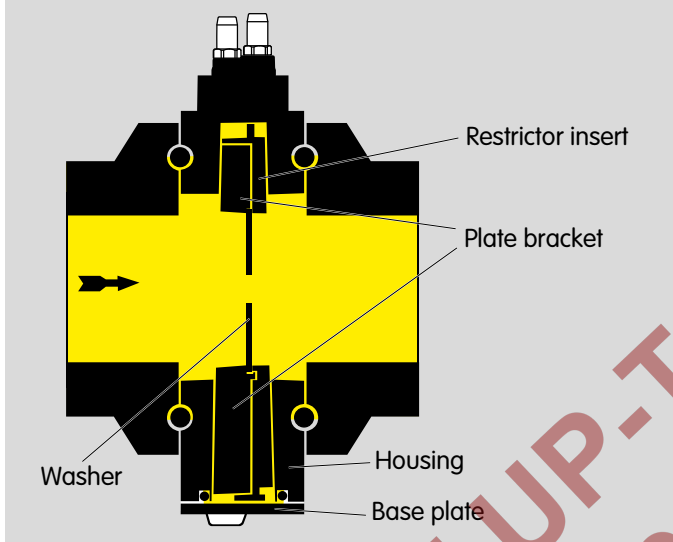
- Low Voltage Directive (2014/35/EU),
- EMC Directive (2014/30/EU).

Regulation:

- Gas Appliances Regulation (EU) 2016/426

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### 3 Function



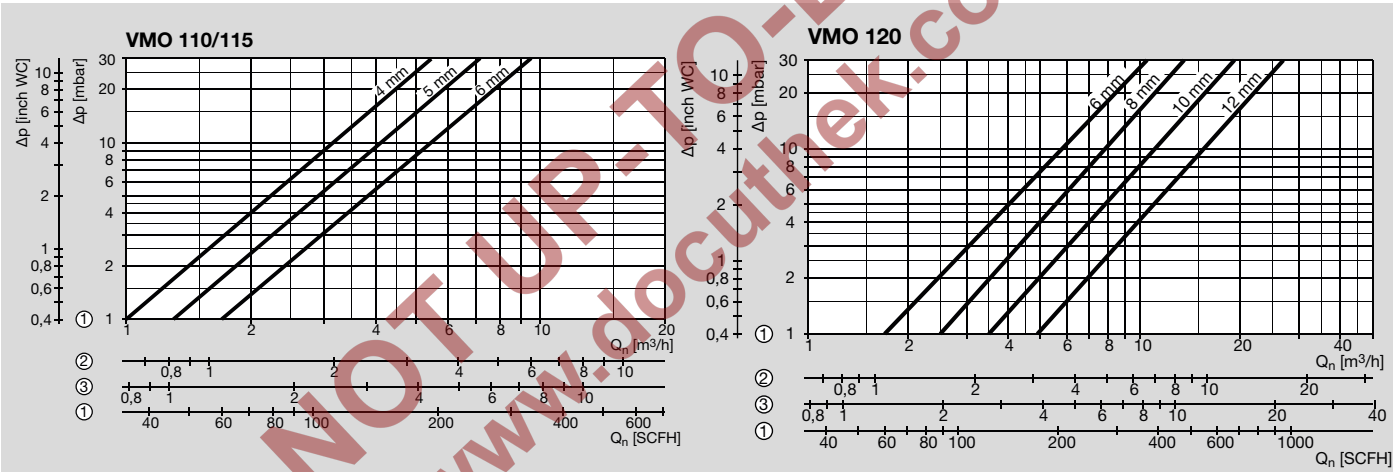
A plate bracket with a washer is placed in the VMO housing. There is a hole in the washer through which gas can flow. A circumferential seal on the restrictor insert reduces the leakage flow. For replacing the washer, the base plate of the housing can be removed in order to pull the plate bracket and washer together out of the housing.

## 4 Flow rate

The characteristic curves are measured at the test points at 15°C (59°F) for the individual washers with an inlet and outlet section of 5 x D, see also Project planning information.

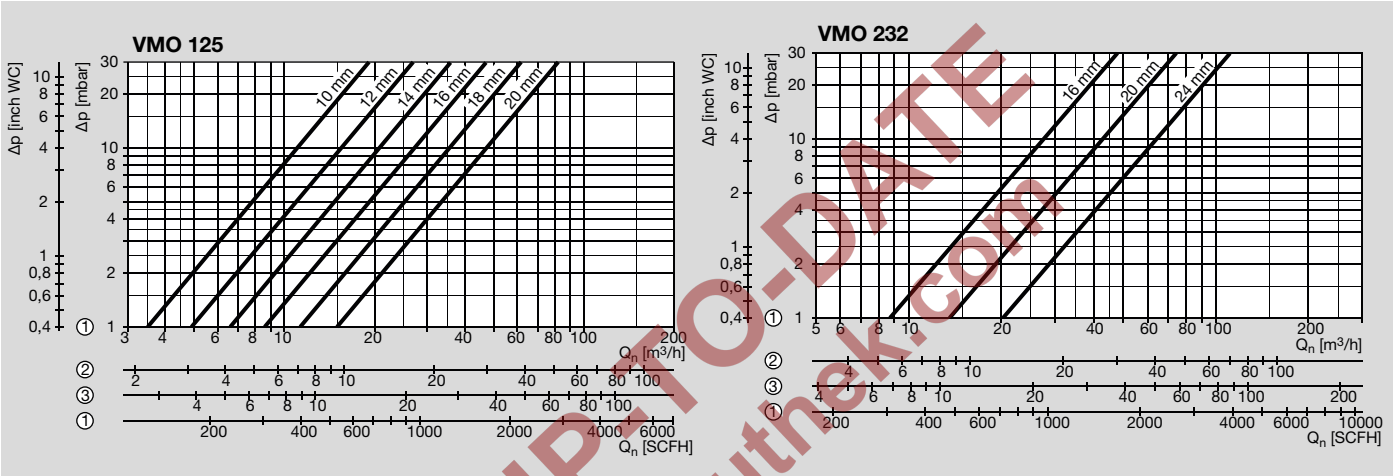
For calculating the nominal size, see [www.adlatus.org](http://www.adlatus.org)

### 4.1 VMO 110, VMO 115, VMO 120

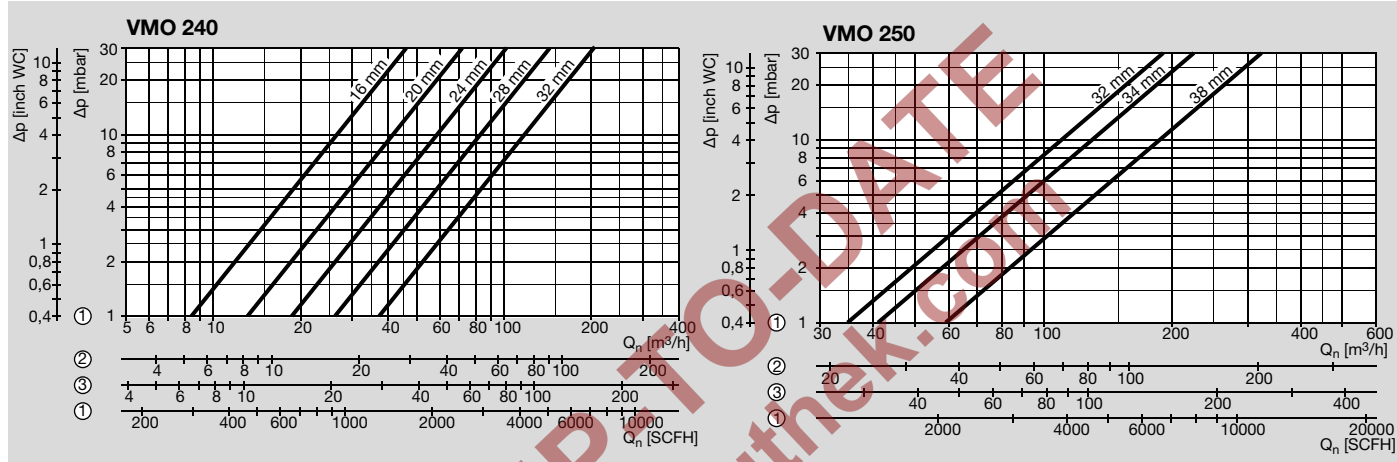




4.2 VMO 125, VMO 232



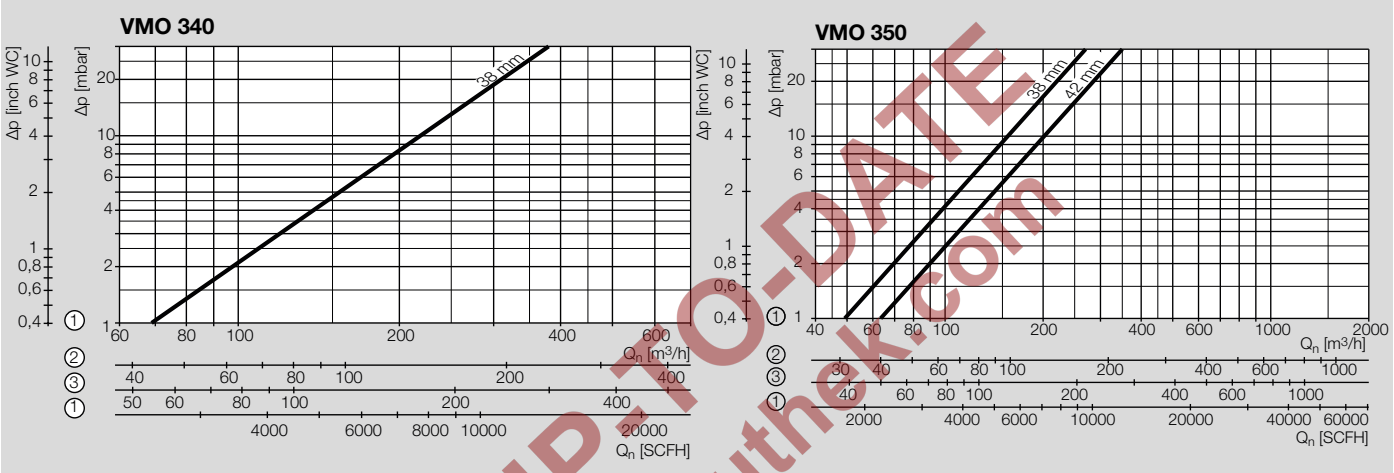
## 4.3 VMO 240, VMO 250



## Legend

① = natural gas ( $\rho = 0.80 \text{ kg/m}^3$ )② = propane ( $\rho = 2.01 \text{ kg/m}^3$ )③ = air ( $\rho = 1.29 \text{ kg/m}^3$ )

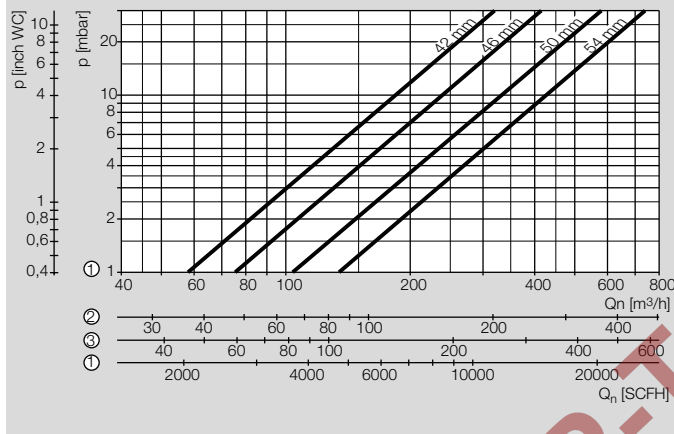
4.4 VMO 340, VMO 350



Legend

- ① = natural gas ( $\rho = 0.80 \text{ kg/m}^3$ )
- ② = propane ( $\rho = 2.01 \text{ kg/m}^3$ )
- ③ = air ( $\rho = 1.29 \text{ kg/m}^3$ )

## 4.5 VMO 365



## Legend

- ① = natural gas ( $\rho = 0.80 \text{ kg/m}^3$ )
- ② = propane ( $\rho = 2.01 \text{ kg/m}^3$ )
- ③ = air ( $\rho = 1.29 \text{ kg/m}^3$ )

4.6 k<sub>v</sub> value

The measuring orifice is determined using the flow rate diagram or by calculation using the k<sub>v</sub> value. The k<sub>v</sub> values are mean values calculated from the measured flow rate diagrams.

| Measuring orifice | Nominal flange size | Hole diameter Washer [mm] | k <sub>v</sub> [m³/h] |
|-------------------|---------------------|---------------------------|-----------------------|
| VMO 110           | DN 10               | 4                         | 0.95                  |
|                   |                     | 5                         | 1.2                   |
|                   |                     | 6                         | 1.6                   |
| VMO 115           | DN 15               | 4                         | 0.9                   |
|                   |                     | 5                         | 1.2                   |
|                   |                     | 6                         | 1.6                   |
| VMO 120           | DN 20               | 6                         | 1.55                  |
|                   |                     | 8                         | 2.25                  |
|                   |                     | 10                        | 3.2                   |
|                   |                     | 12                        | 4.5                   |
| VMO 125           | DN 25               | 10                        | 3.2                   |
|                   |                     | 12                        | 4.5                   |
|                   |                     | 14                        | 6.0                   |
|                   |                     | 16                        | 7.9                   |
|                   |                     | 18                        | 10.3                  |
|                   |                     | 20                        | 13.7                  |
| VMO 232           | DN 32               | 16                        | 8.0                   |
|                   |                     | 20                        | 12.4                  |
|                   |                     | 24                        | 18.6                  |
| VMO 240           | DN 40               | 16                        | 7.7                   |
|                   |                     | 20                        | 12.0                  |
|                   |                     | 24                        | 17.0                  |
|                   |                     | 28                        | 24.0                  |
| VMO 250           | DN 50               | 32                        | 34.0                  |
|                   |                     | 32                        | 31.8                  |
|                   |                     | 34                        | 37.5                  |
| VMO 340           | DN 40               | 38                        | 54.0                  |
| VMO 340           | DN 40               | 38                        | 67.0                  |
| VMO 350           | DN 50               | 38                        | 50.0                  |
| VMO 365           | DN 65               | 42                        | 64.0                  |
|                   |                     | 42                        | 66.0                  |
|                   |                     | 46                        | 61.0                  |
|                   |                     | 50                        | 80.0                  |
|                   |                     | 54                        | 97.0                  |

Q<sub>(n)</sub> = Flow rate (standard state) [m³/h]

k<sub>v</sub> = Valve coefficient (see table)

Δp = Pressure loss [bar]

p<sub>a</sub> = Outlet pressure (absolute) [bar]

ρ<sub>n</sub> = Density [kg/m³] (air 1.29/natural gas 0.80/propane 2.01/butane 2.71)

T = Medium temperature (absolute) [K]

$$k_v = \frac{Q_{(n)}}{514} \cdot \sqrt{\frac{\rho_n \cdot T}{\Delta p \cdot p_d}} \qquad Q_{(n)} = 514 \cdot k_v \cdot \sqrt{\frac{\Delta p \cdot p_d}{\rho_n \cdot T}}$$

$$\Delta p = \left( \frac{Q_{(n)}}{514 \cdot k_v} \right)^2 \cdot \frac{\rho_n \cdot T}{p_d}$$

### Example

We want to find the hole diameter for the washer and the nominal flange diameter for a measuring orifice VMO.

We have the maximum flow rate  $Q_{(n) \max.}$ , the outlet pressure  $p_a$  and the temperature  $T$  for the medium of natural gas.

$$Q_{(n) \max.} = 37 \text{ m}^3/\text{h}$$

$$p_a = 30 \text{ mbar} = 0.03 \text{ bar} \Rightarrow$$

$$p_{a \text{ absolute}} = 0.03 \text{ bar} + 1 \text{ bar} = 1.03 \text{ bar}$$

$$\Delta p_{\max.} = 0.01 \text{ bar (desired)}$$

$$T = 20^\circ\text{C} \Rightarrow$$

$$T_{\text{absolute}} = 20 + 273 \text{ K} = 293 \text{ K}$$

$$k_v = \frac{37}{514} \cdot \sqrt{\frac{0.83 \cdot 293}{0.01 \cdot 1.03}} = 11.1 \text{ m}^3/\text{h}$$

The measuring orifice with the next higher  $k_v$  value is to be selected (see table): e.g. VMO 125 with a washer hole diameter of 20 mm.

5 Selection

| Typ     | R | N | F | 05 | M | 04 | 05 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 28 | 32 | 34 | 38 | 42 | 46 | 50 | 54 |
|---------|---|---|---|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| VMO 110 | ● | ○ |   | ●  | ● | ●  | ●  | ●  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| VMO 115 | ● | ○ |   | ●  | ● | ●  | ●  | ●  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| VMO 120 | ● | ○ |   | ●  | ● |    |    | ●  | ●  | ●  | ●  |    |    |    |    |    |    |    |    |    |    |    |    |    |
| VMO 125 | ● | ○ |   | ●  | ● |    |    |    |    | ●  | ●  | ●  | ●  | ●  | ●  | ●  |    |    |    |    |    |    |    |    |
| VMO 232 | ● | ○ |   | ●  | ● |    |    |    |    |    |    |    | ●  |    | ●  | ●  |    |    |    |    |    |    |    |    |
| VMO 240 | ● | ○ | ○ | ●  | ● |    |    |    |    |    |    |    | ●  |    | ●  | ●  | ●  | ●  | ●  |    |    |    |    |    |
| VMO 250 | ● | ○ |   | ●  | ● |    |    |    |    |    |    |    |    |    |    |    |    | ●  | ●  |    | ●  |    |    |    |
| VMO 340 | ● | ○ |   | ●  | ● |    |    |    |    |    |    |    |    |    |    |    |    |    |    | ●  |    |    |    |    |
| VMO 350 | ● | ○ | ○ | ●  | ● |    |    |    |    |    |    |    |    |    |    |    |    |    |    | ●  | ●  |    |    |    |
| VMO 365 | ● | ○ |   | ●  | ● |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | ●  | ●  | ●  | ●  |

● = standard, ○ = available

Order example

VMO 115R05M05

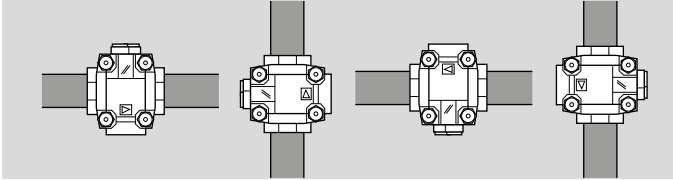
5.1 Type code

| Code        | Description                                                                |
|-------------|----------------------------------------------------------------------------|
| VMO         | Measuring orifice                                                          |
| 1-3         | Size                                                                       |
| -<br>10-65  | Without inlet and outlet flange<br>Nominal inlet and outlet diameter in DN |
| R<br>N<br>F | Rp internal thread<br>NPT internal thread<br>Flange to ISO 7005            |
| 05          | p <sub>U max</sub> 500 mbar                                                |
| M           | With pressure test points                                                  |
| 04 - 58     | Orifice diameter* in mm                                                    |

\* Delivery of washers with individual orifice diameter on request.

## 6 Project planning information

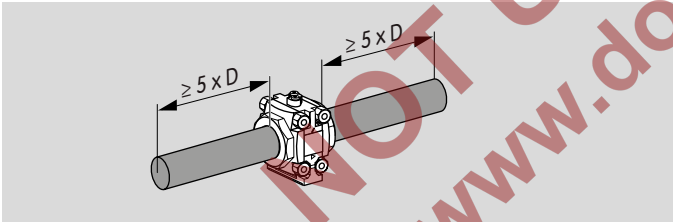
### 6.1 Installation



Installation position: VMO can be installed as required.

### 6.2 Gas line connection

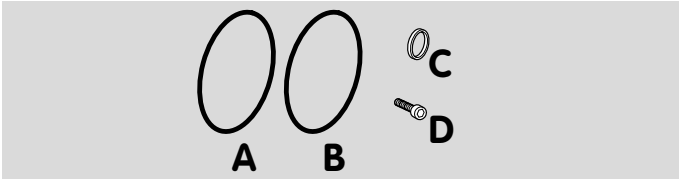
In order to take accurate measurements of the pressure differential on the measuring orifice VMO, it must be ensured that there is an undisturbed flow of gas at the inlet and outlet for a distance of  $\geq 5 \times DN$ .





7 Accessories

7.1 Seal set VMO/VMV



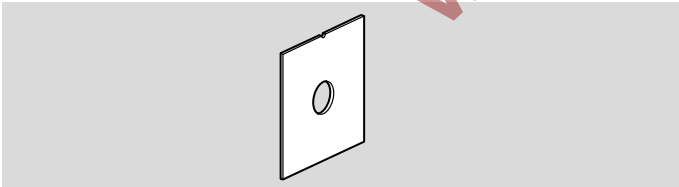
- Seal set VMO/VMV 1 /B: 74924936  
Seal set VMO/VMV 2 /B: 74924937  
Seal set VMO/VMV 3 /B: 74926024

Scope of delivery:

- A 1 x O-ring (base plate),
- B 1 x O-ring (restrictor insert),
- C 2 x profiled sealing ring,
- D 2 x or 4 x set screws.

7.2 Washer

For installing in the plate bracket of measuring orifice VMO. The hole diameter is engraved on the washer.  
Supply including the new seal for the base plate.



| Orifice      | Hole dia. | Order No. |
|--------------|-----------|-----------|
|              | [mm]      |           |
| VM01 D4 /B   | 4         | 74923803  |
| VM01 D5 /B   | 5         | 74923804  |
| VM01 D6 /B   | 6         | 74923805  |
| VM01 D8 /B   | 8         | 74923806  |
| VM01 D10 /B  | 10        | 74923807  |
| VM01 D12 /B  | 12        | 74923808  |
| VM01 D14 /B  | 14        | 74923809  |
| VM01 D16 /B  | 16        | 74923810  |
| VM01 D18 /B  | 18        | 74923811  |
| VM01 D20 /B  | 20        | 74923812  |
| VM01 Dx /B*  | xx*       | 74923813  |
| VM02 D16 /B  | 16        | 74923814  |
| VM02 D20 /B  | 20        | 74923815  |
| VM02 D24 /B  | 24        | 74923816  |
| VM02 D28 /B  | 28        | 74923817  |
| VM02 D32 /B  | 32        | 74923818  |
| VM02 D34 /B  | 34        | 74923819  |
| VM02 D38 /B  | 38        | 74923820  |
| VM02 Dx /B   | xx*       | 74923821  |
| VM0 3 D38 /B | 38        | 74926017  |
| VM0 3 D42 /B | 42        | 74926018  |
| VM0 3 D46 /B | 46        | 74926019  |
| VM0 3 D50 /B | 50        | 74926020  |
| VM0 3 D54 /B | 54        | 74926021  |
| VM0 3 Dx /B  | xx*       | 74926022  |

\* Hole diameter on request.

## 8 Technical data

Gas types: natural gas, LPG (gaseous), biologically produced methane (max. 0.1 %-by-vol.  $\text{H}_2\text{S}$ ) or air; other gases on request.

The gas must be dry in all conditions and must not contain condensate.

Max. inlet pressure  $p_e$ : max. 500 mbar (7.25 psig).

Medium and ambient temperatures:

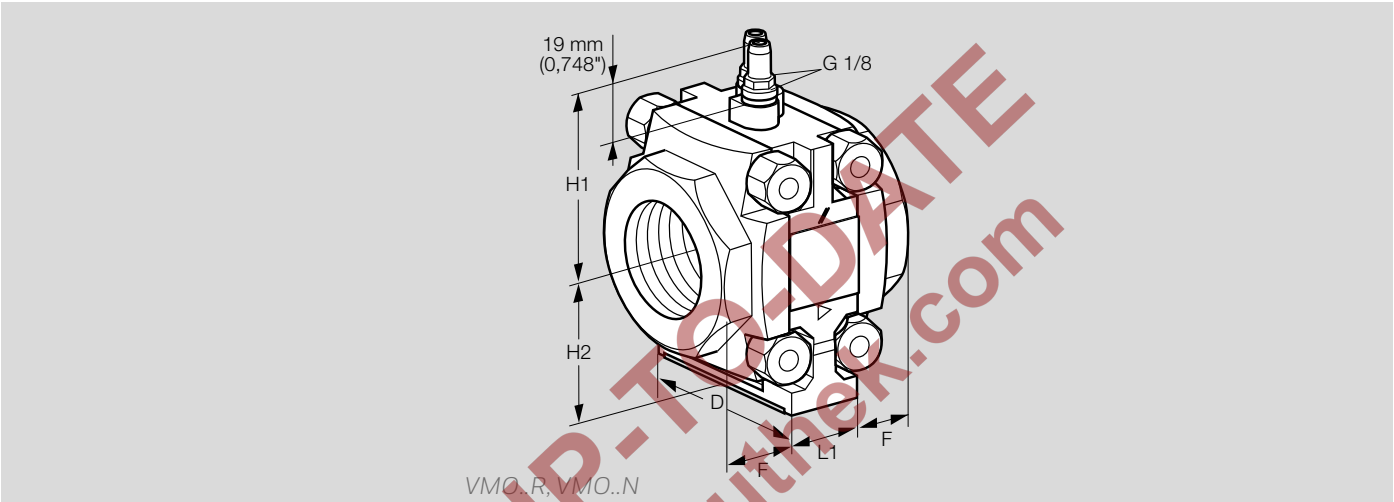
-10 to +60°C (14 to 140°F),  
no condensation permitted.

Storage temperature: 0 to +40°C (-4 to +104°F).

Housing: aluminium.

Connection flanges with internal thread: Rp to ISO 7-1,  
NPT to ANSI/ASME. : DN 40 and DN 50 to ISO 7005.

8.1 Dimensions



8.1.1 VMO..R

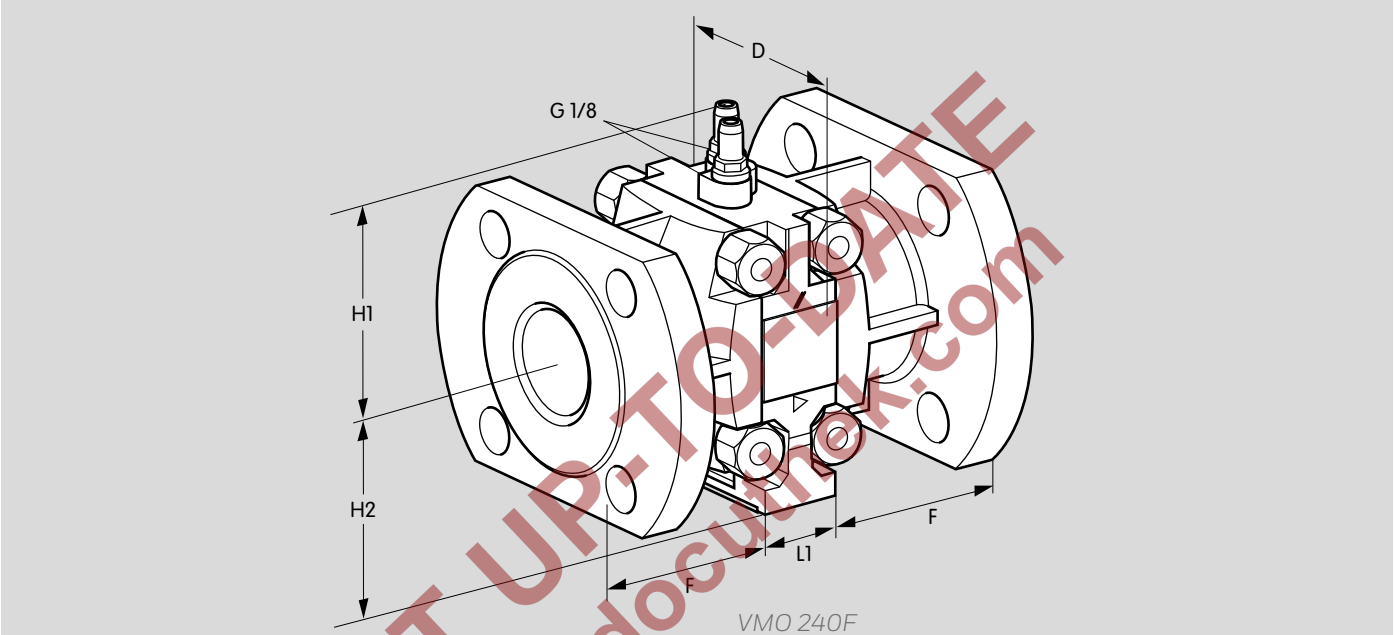
| Type    | Connection |    | Dimensions |         |         |          |          | Weight* |
|---------|------------|----|------------|---------|---------|----------|----------|---------|
|         | Rp         | DN | L1<br>mm   | F<br>mm | D<br>mm | H1<br>mm | H2<br>mm |         |
| VMO 110 | 3/8        | 10 | 30         | 15      | 62.7    | 69.1     | 44.2     | 0.245   |
| VMO 115 | 1/2        | 15 | 30         | 15      | 62.7    | 69.1     | 44.2     | 0.245   |
| VMO 120 | 3/4        | 20 | 30         | 23      | 62.7    | 69.1     | 44.2     | 0.245   |
| VMO 125 | 1          | 25 | 30         | 23      | 62.7    | 69.1     | 44.2     | 0.245   |
| VMO 225 | 1          | 25 | 34         | 29      | 88      | 82.8     | 64.6     | 0.505   |
| VMO 232 | 1¼         | 32 | 34         | 29      | 88      | 82.8     | 64.6     | 0.505   |
| VMO 240 | 1½         | 40 | 34         | 29      | 88      | 82.8     | 64.6     | 0.505   |
| VMO 250 | 2          | 50 | 34         | 29      | 88      | 82.8     | 64.6     | 0.505   |
| VMO 340 | 1½         | 40 | 36         | 36      | 106     | 94.6     | 77.5     | 1.3     |
| VMO 350 | 2          | 50 | 36         | 36      | 106     | 94.6     | 77.5     | 1.3     |
| VMO 365 | 2½         | 65 | 36         | 36      | 106     | 94.6     | 77.5     | 1.3     |

\* Without flanges and connection parts.

8.1.2 VMO..N

| Type    | Connection |    | Dimensions |           |           |            |            | Weight* |
|---------|------------|----|------------|-----------|-----------|------------|------------|---------|
|         | NPT        | DN | L1<br>inch | F<br>inch | D<br>inch | H1<br>inch | H2<br>inch |         |
| VMO 110 | 3/8        | 10 | 1.18       | 0.59      | 2.47      | 2.72       | 1.74       | 0.54    |
| VMO 115 | 1/2        | 15 | 1.18       | 0.59      | 2.47      | 2.72       | 1.74       | 0.54    |
| VMO 120 | 3/4        | 20 | 1.18       | 0.91      | 2.47      | 2.72       | 1.74       | 0.54    |
| VMO 125 | 1          | 25 | 1.18       | 0.91      | 2.47      | 2.72       | 1.74       | 0.54    |
| VMO 225 | 1          | 25 | 1.34       | 1.14      | 3.46      | 3.26       | 2.54       | 1.11    |
| VMO 232 | 1¼         | 32 | 1.34       | 1.14      | 3.46      | 3.26       | 2.54       | 1.11    |
| VMO 240 | 1½         | 40 | 1.34       | 1.14      | 3.46      | 3.26       | 2.54       | 1.11    |
| VMO 250 | 2          | 50 | 1.34       | 1.14      | 3.46      | 3.26       | 2.54       | 1.11    |
| VMO 340 | 1½         | 40 | 1.42       | 1.42      | 4.17      | 3.72       | 3.05       | 2.86    |
| VMO 350 | 2          | 50 | 1.42       | 1.42      | 4.17      | 3.72       | 3.05       | 2.86    |
| VMO 365 | 2½         | 65 | 1.42       | 1.42      | 4.17      | 3.72       | 3.05       | 2.86    |

\* Without flanges and connection parts.



8.1.3 VMO 240F

| Type    | Connection | Dimensions |      |     |      |      | Weight* |
|---------|------------|------------|------|-----|------|------|---------|
|         |            | L1         | F    | D   | H1   | H2   |         |
|         | DN         | mm         | mm   | mm  | mm   | mm   | kg      |
| VMO 240 | 40         | 34         | 66   | 88  | 81   | 65,2 | 0.505   |
| VMO 350 | 50         | 36         | 73.8 | 106 | 94.6 | 76   | 1.3     |

\* Without flanges and connection parts.

### 9 Maintenance

Check for external tightness at least once per annum,  
at least twice per annum for operation with biologically  
produced methane.

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## Feedback

Finally, we are offering you the opportunity to assess this "Technical Information (TI)" and to give us your opinion, so that we can improve our documents further and suit them to your needs.

### Clarity

Found information quickly  
Searched for a long time  
Didn't find information  
What is missing?  
No answer

### Comprehension

Coherent  
Too complicated  
No answer

### Scope

Too little  
Sufficient  
Too wide  
No answer



### Use

To get to know the product  
To choose a product  
Planning  
To look for information

### Navigation

I can find my way around  
I got "lost"  
No answer

### My scope of functions

Technical department  
Sales  
No answer

### Remarks

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[www.kromschroeder.de/Weltweit.20.0.html?&L=1](http://www.kromschroeder.de/Weltweit.20.0.html?&L=1)

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