

**Operating Instructions  
for  
Oval Wheel Flowmeter**

**Model: DOE**



We don't accept warranty and liability claims neither upon this publication nor in case of improper treatment of the described products.

The document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.

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## 1. Contents

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1. Contents.....	2
2. Note .....	3
3. Instrument Inspection.....	3
4. Regulation Use.....	3
5. Operating Principle.....	4
6. Mechanical Connection.....	5
7. Electrical Connection .....	6
7.1 General.....	6
7.2 Electronic options .....	6
7.3 Hall sensor output.....	7
7.4 Cable version Option „K“.....	8
7.5 Connector version Option „D“ (Connector EN 175301-801) .....	8
8. Commissioning.....	10
9. Maintenance .....	11
10. Technical Information.....	13
11. Order Codes .....	15
11.1 Accessories .....	15
12. Dimensions .....	16
13. EU Declaration of Conformance.....	18

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## **2. Note**

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Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.

The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

The device is an OEM device; therefore, the customer must ensure compliance with the EMC directive.

When used in machines, the measuring unit should be used only when the machines fulfil the EC-machine guidelines.

### **As per PED 2014/68/EU**

In acc. with Article 4 Paragraph (3), "Sound Engineering Practice", of the PED 2014/68/EU no CE mark.

## **3. Instrument Inspection**

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Instruments are inspected before shipping and sent out in perfect condition.

If the device undergoes some kind of damage, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

### **Scope of delivery:**

The standard delivery includes:

- Oval Wheel Flowmeter model: DOE
- Operating Instructions

## **4. Regulation Use**

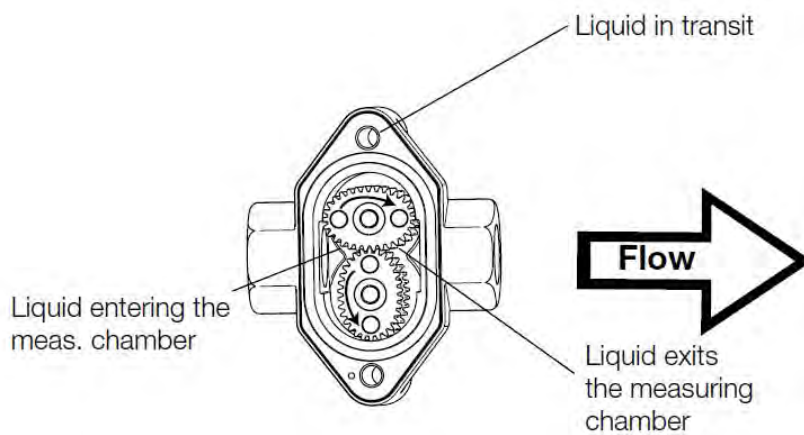
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Any use, which is beyond the manufacturer's specification, may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user is responsible for such damage.

## 5. Operating Principle

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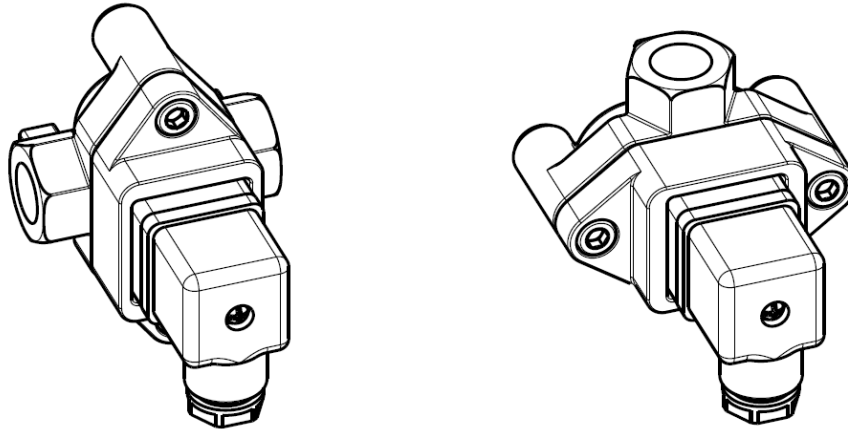
Oval gear flowmeters are categorised as positive displacement flow technology. When liquid flows through this type of positive displacement flowmeter, two oval geared rotors measure a constant volume per rotation within a precisely machined measuring chamber. With each rotation, a constant volume of liquid is measured. The rotation of the oval gears is sensed via magnets embedded within the rotors. These magnets transmit a high resolution pulse output. The output signal can be processed externally via a remote display controller or PLC or via a variety of output/display options available as accessories attached to the flowmeters.



The positive displacement flow technology allows for precise flow measurement of most clean liquids regardless of the media conductivity. Other liquid properties also have a minimal effect on the performance of this type of meter. Flow profile conditioning and straight pipes run are not required as with other flow technology making oval gear installations simple to install in tight spaces and at an economical price.

## 6. Mechanical Connection

Fluid entering the meter must maintain its liquid state without being solidified. In case of pressure surges, a pressure relief valve should be mounted to protect the device. The device should always be mounted with correct orientation as shown below:



### Orientation

If the above mentioned orientations are not complied with, the device's performance will be degraded leading to reduced life and the damages caused will be the responsibility of the customer.

It is highly recommended to INSTALL a filter immediately before (prior to) the meter. Filters are available and sold separately.

### Recommended Filter:

DOE-x05...DOE-x15: < 75  $\mu\text{m}$  particle size (200 mesh)

DOE-x20...DOE-x35: < 150  $\mu\text{m}$  particle size (100 mesh)

DOE-x40...DOE-x60: < 350  $\mu\text{m}$  particle size (45 mesh)

Flow conditioning: Flow conditions are not required since the DOE flowmeter does not require any straight pipe runs before or after the flowmeter.

Location: The recommended installation would be before of any flow control and/or shut off valves, this installation prevents complete emptying of the meter. This minimizes the risk of leakage and/or air entrapment which could result in damage to the flowmeter or inaccurate initial readings.

A by-pass installation is recommended for process or safety critical meters. Isolation valves enable the meter to be isolated from the system and serviced as needed. System purging is also possible with a by-pass arrangement. Accommodate all meter ratings and locate the meter on the discharge side of the process pump.

For outdoor applications, be sure all electrical entries are sealed properly via the proper glands, mounting, sealing or containment. For humid environments, mount the instrument appropriately as to avoid condensation build up. Generally these installations have the conduit connection pointing downward as to drain any condensate away from the electronics.

**Liquid State:** Liquid within the flowmeter must not freeze. If heat tracing is necessary, please be sure to adhere to the temperature limits of the flow meter. Ensure the liquid does not flash, do not exceed the max DP of the flowmeter.

**Hydraulic shock:** Surge dampeners or pressure relief valves must be installed if hydraulic shock or pressure spikes are present. Highly pulsating flow can also damage the DOE flowmeter. Diaphragm pumps and specific application profiles can cause high frequency pulsating flow. Proper pulsating dampers are highly recommended.

## 7. Electrical Connection

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### 7.1 General

Two types of output are available on DOE Oval Gear flow-meter; the standard output is a single NPN Hall Effect sensor, providing a square wave frequency output signal which is linearly proportional to volumetric flow.

The optional Fuel Consumption model provides a similar NPN Hall Effect sensor output combined with a Platinum temperature sensor output. The Fuel Consumption model has a specific magnetic sensor design which is tailored to produce accurate measurements on fuel injected combustion engines, which are typically prone to flow pulsations. In addition to the volume measurement, the Fuel Consumption option also provides a temperature measurement of the liquid inside the flowmeter; this allows for temperature compensation of liquid volumes between the inlet and outlet of an engine's fuel system.

### 7.2 Electronic options

#### Reed switch pulse output (... H0)

The reed switch output is a two wire normally open SPST voltage free contact.



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**Note: when using the reed switch output the liquid temperature must not change at a rate greater than 10 °C per minute.**

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Average switching life of reed contact (MTTF):

At max. load 100 V / 10 mA 5 x 10<sup>5</sup> switching cycles

At load <5 V / 10 mA 5 x 10<sup>8</sup> switching cycles

**Recommended load:** ≤10 V / 10 mA

**Hall sensor pulse output (... H0/T0)**

In these electronics options, a Hall Effect sensor used. The electrical connection is provided in 3-wire version. The output is switched to +Vs via pull up resistor. The external supply voltage is 5 ... 24 VDC. The high signal is approximately equal to the supply voltage +Vs and the low signal is approximately 0 V.

The electrical load will be connected to the supply voltage.

Maximum output current (current sink): 10 mA (not short circuit protected).

In addition to Hall sensor, the option H0 is equipped with a Reed switch.

### 7.3 Hall sensor output

The NPN Hall Effect is a high resolution solid state 3 wire device which provides an un-sourced, open collector, NPN transistor output. The term unsourced means that no voltage is applied to the output from within the flow-meter. The output of the Hall Effect must be pulled to a 'high' state by an external voltage between 5-24VDC, this is achieved by fitting a pull-up resistor between the signal output (white wire) and the voltage supply (red wire). The pull up resistor ties the open collector output to the available DC voltage level, providing a square wave pulse output, which alternates between ground potential and the DC voltage available at the signal wire.

The NPN Hall Effect output is a reliable output type, producing a consistent output irrespective of supply voltage variations below the maximum voltage limit, temperature variations, or mechanical shock. The service life of the Hall Effect output is theoretically infinite, so long as it is protected from high energy voltage spikes. Hall Effect outputs are protected against reverse polarity, and against low energy voltage spikes; however they are not protected against constant over-voltage above the maximum limit of 24V ( $\pm 5\%$ ).

Many secondary flow instruments are fitted with an integral pull-up resistor, but if connecting the Hall Effect output to an electronic device that does not contain an integral pull-up resistor, one MUST be fitted by the installer. The pull-up resistor is connected between the signal wire (white) and the +VDC wire (red); recommended pull-up resistor value is 10 kOhm, 2.4 kOhm is the minimum value. It is NOT recommended to combine any inductive loads on the same voltage supply as your flow-meter, as these components are commonly sources of high frequency interference that may affect the quality of the Hall Effect output signal. Another concern to do with inductive loads on a common voltage source is the potential for voltage spikes well in excess of the 24VDC limit of the Hall Effect sensors.



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**Caution! Make sure that the voltage values of your system correspond with the voltage values of the measuring unit.**

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- Make sure that the supply wires are de-energized.
- Plug in the system according to the connecting diagrams.



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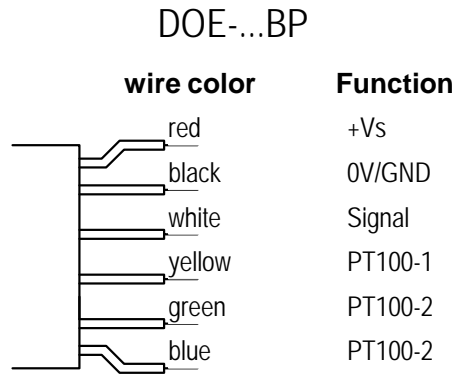
**Attention! Incorrect wiring will lead to damage of the unit's electronics.**

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# DOE

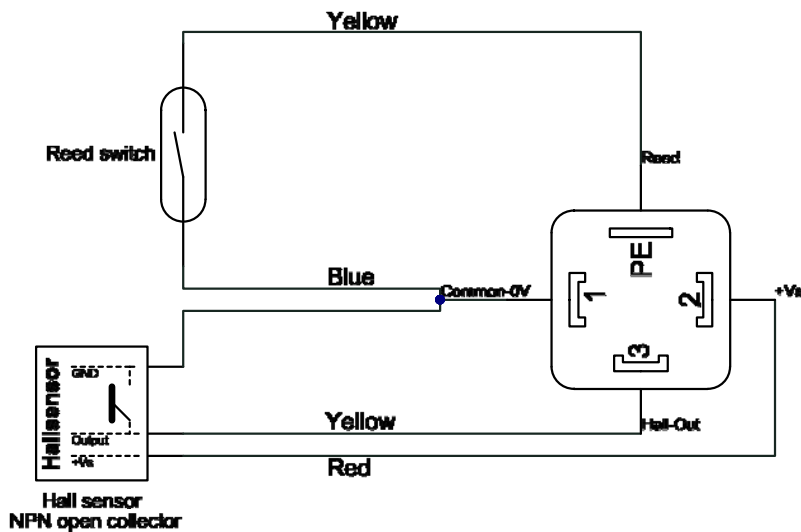
## 7.4 Cable version Option „K“

### 7.4.1 Connection

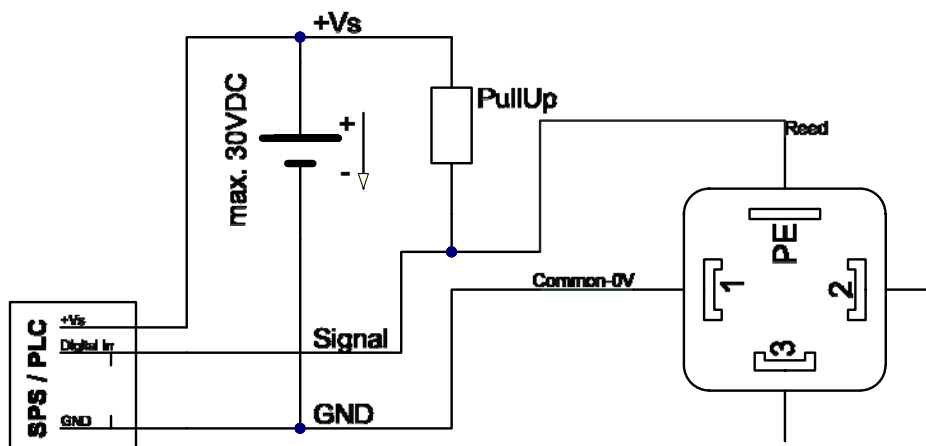


## 7.5 Connector version Option „D“ (Connector EN 175301-801)

### 7.5.1 Internal connections

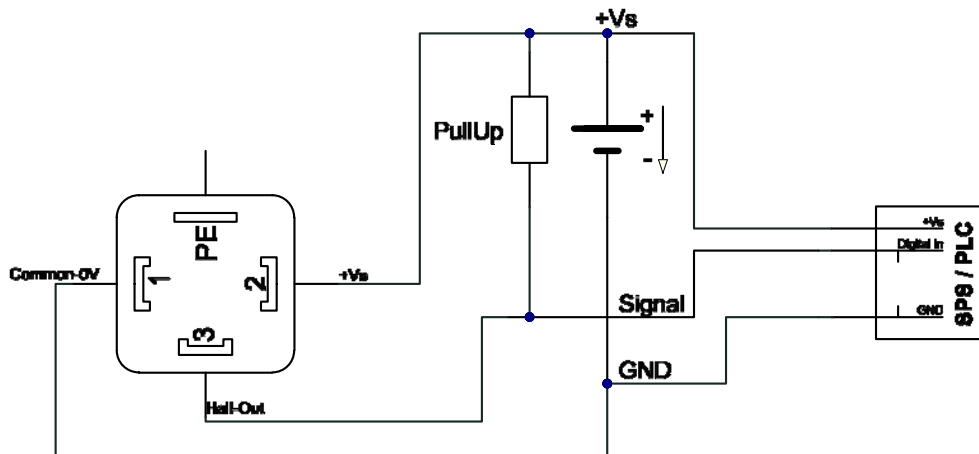


### 7.5.2 External connection with reed switch output



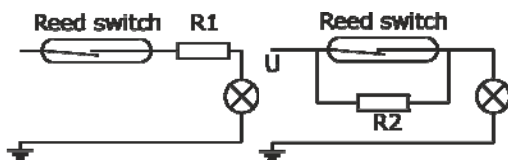


### 7.5.3 External wiring with Hall sensor output

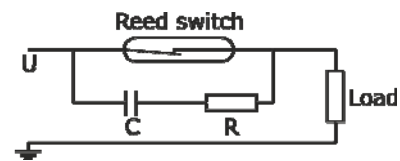


The individually specified maximum electrical values of the reed switch must never be exceeded, even for a moment. Higher switching values may reduce the service life or even destroy the contact.

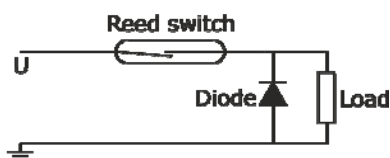
For capacitive and inductive loads (e.g. via long lines), we recommend the following protective circuits:



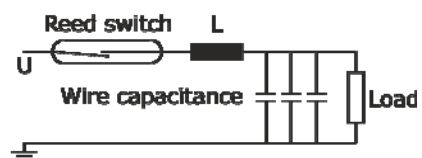
Lamp load with series or parallel resistance to the reed switch.



Protection with a RC suppressor  
For a.c. current and inductive load.



Protection with a diode  
for d.c. current and inductive load.



Protection with an inductance or  
Resistance for capacitive load.

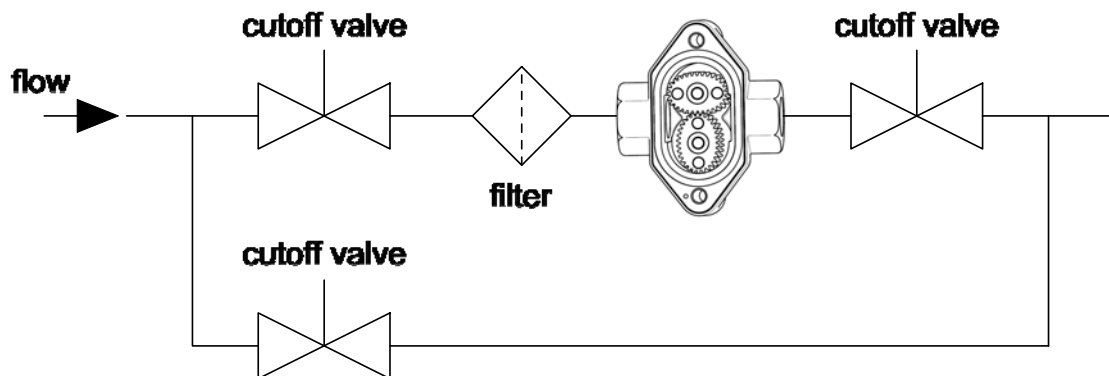
## 8. Commissioning

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The piping **MUST** be flushed of debris before installation. Debris such as slag from welding, grinding dust, rust, pipe tape or sealing compound are common within new piping installations and will damage the flowmeter if not flushed or filtered from the process piping before installation and operation.

A by-pass system is common for frequent system flushing or frequent meter removal. If a by-pass system is not practical or possible, removal of the gears before flushing is necessary.

For proper operation the flowmeter must be purged of air. During long periods of inactivity or after a flushing, air may be in the piping. Elimination of the air may be achieved by operating the meter at a low flow rate until all the air is eliminated. Damage may occur to the flowmeter if it is run above the maximum rated flow rate or if the maximum differential pressure of 15 psi (1 bar, 100 kPa) is exceeded.



## 9. Maintenance

Adhering to the installation instructions is the most important requirement to ensure that your Oval Gear meter provides the maximum level of operational performance. Oval Gear meters are a mechanical device, and so will be subject to some wear and tear over their operational life, except under ideal circumstances. The amount of normal wear that the meter will experience will be very dependent on the operational conditions such as; flow rate, temperature, cleanliness of the liquid, lubricity of the liquid, and the amount of continuous duty required of the meter.

In order to maximise the operational availability of your meter, and reduce system downtime, a periodic maintenance and inspection regime should be used. Frequency of maintenance depends on the operational conditions of the meter and the criticality of the system; it is the user's responsibility to determine inspection frequency however the manufacturer can provide guidance.

For any installations that require in-situ cleaning (CIP); it is important that the cleaning or flushing procedures do not produce operating conditions that are outside of the acceptable flow rate, pressure, or temperature ratings of the meter. Chemical compatibility of cleaning solutions should be checked against the materials of construction of the meter.

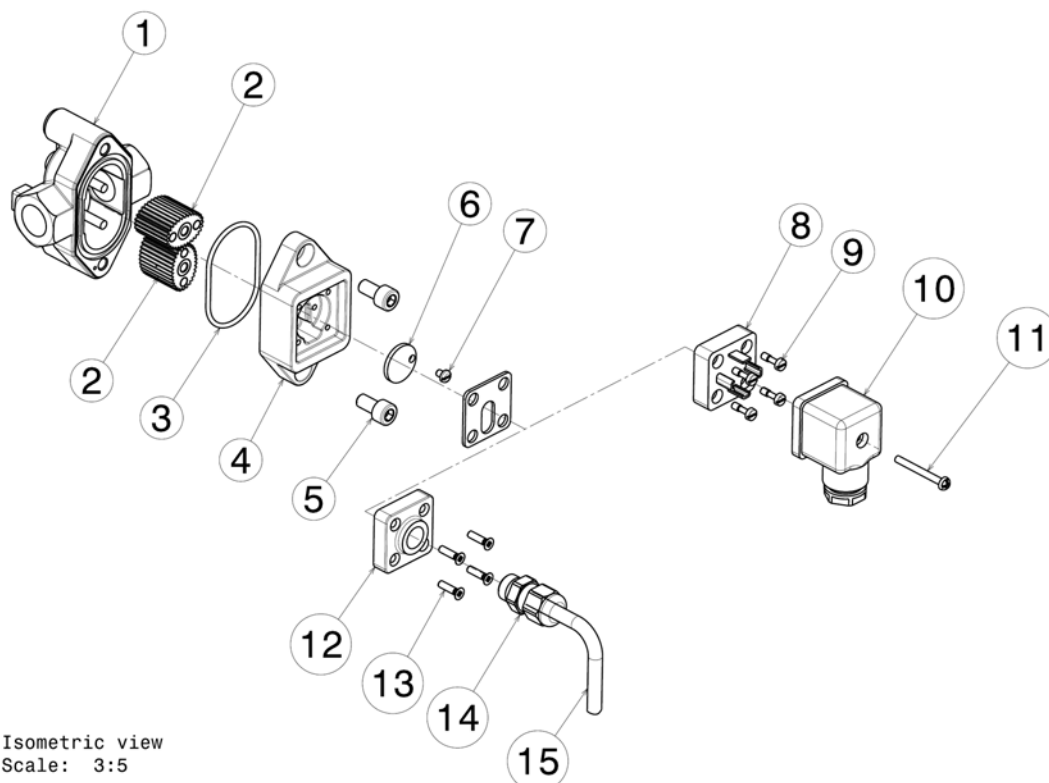
**Before undertaking meter maintenance ensure the following:**

*Associated alarm(s) or control output(s) are isolated so not to affect the process*

*Voltage supply is isolated from the meter*

*Liquid supply to the meter is closed off*

*The meter is depressurised and liquid drained from the meter / pipeline*



## 9.1 Disassembly of DOE (Refer to the exploded view diagram)

### 9.1.1 Removal of electronics

To remove the electronic assembly:

#### **Cable option D:**

Open the screw (11) of the plug (10). The plug can be removed by pulling it off the connector terminals. The removal of 4 screws (9) from the connector (8) will make the access to the PCB-Board (6) possible. The screw (7) of the PCB (6) should be unscrewed and the complete electronic assembly can be taken out.

#### **Cable option K:**

The removal of 4 screws (13) from the connector (12) will make the access to the PCB-Board (6) possible. The screw (7) of the PCB (6) should be unscrewed and the complete electronic assembly should be taken out carefully without damaging the soldered connections.

### 9.1.2 Removal of oval gears

To remove the oval gears:

Remove the 2 cylinder screws (5) carefully. This will make the removal of the cover (4) possible. The O-ring (3) can then be taken off the flow housing (1) and the oval gears (2) can be easily taken out of the housing.

## 9.2 Re-Assembly of DOE (Refer to the exploded view diagram)

When re-assembling, please insert the rotor (2) with the embedded magnet (for DOE-x05/10) nearest to the dimple located on the meter body (1) face outside the O-ring groove. Install the rotors exactly perpendicular from each other (90° in orientation). They will only work if installed precisely. Manually test full rotation after installation as the rotors will not completely rotate freely unless installed precisely 90° from each other. Proper placement of the O-ring (3) within the groove is necessary for leak free operation. Place the meter cover (4) such that the dimple located on the bottom side of the cover lies on the same side as the dimple on the meter body (1). Tighten the meter bodies (1&4) with the help of 2 cylinder screws (5).

#### **Cable option D:**

The electronic assembly in this case consists of (6), (7), (8), (9) along with the gasket. This assembly can be mounted by first putting the electronic PCB (6) in the cover (4) and screwing it fix with the help of screw (7). Then the gasket will be placed and the connector (8) will be fixed with the help of 4 screws (9). In the end the plug (10) is fixed with screw (11).

#### **Cable option K:**

The electronic assembly in this case consists of (6), (7), (12), (13), (14), (15) along with the gasket. This assembly can be mounted by first putting the electronic PCB (6) in the cover (4) and screwing it fix with the help of screw (7). Then the gasket will be placed and the connector (12) will be fixed with the help of 4 screws (13).

## Technical Information

**Material**

## DOE-1

Body: aluminium  
 Oval wheels: PEEK, encapsulated magnets  
 Axes: stainless steel 1.4404

## DOE-2

Body: stainless steel 1.4404  
 Oval wheels: stainless steel 1.4404, Magnete gekapselt  
 Bearing: carbon graphite  
 Axes: stainless steel 1.4404

## DOE-3

Body: stainless steel 1.4404  
 Oval wheels: stainless steel (gesintert), vernickelte Magnete  
 Bearing: carbon graphite  
 Axes: stainless steel 1.4404

## DOE-8

Body: stainless steel 1.4404  
 Oval wheels: PEEK for x05, x10, x15, PPS für x20  
 Bearing: carbon graphite  
 Axes: stainless steel 1.4404, encapsulated magnets

## O-rings:

medium temperature  
 FKM: -20...+100° C

## Accuracy (under reference conditions\*):

±1% of reading (DOE-x05...DOE-x15, DOE-820, DOE-810)

±0,5% of reading (DOE-220, DOE-320)

## Repeatability:

typ. ±0,03%

## Protection class:

IP65

## Medium temperature:

-20° C...+100° C (stainless steel)

-20° C...+80° C (PEEK)

## Max. pressure:

64 bar

## Ambient temperature:

-20° C...+80° C

## Electrical connection:

valve plug EN175301-803 form A or  
 2 m cable UL/cUL 6xAWG20

\*Reference conditions: x05...x20 (Mineralöl 10 cSt, 20° C, 5 bar)

**Recommended filter** (e.g. model MFR-DO...)

DOE-x05...DOE-x15 < 75 µm micron (200 mesh)

DOE-x20 < 150 µm micron (100 mesh)

# DOE

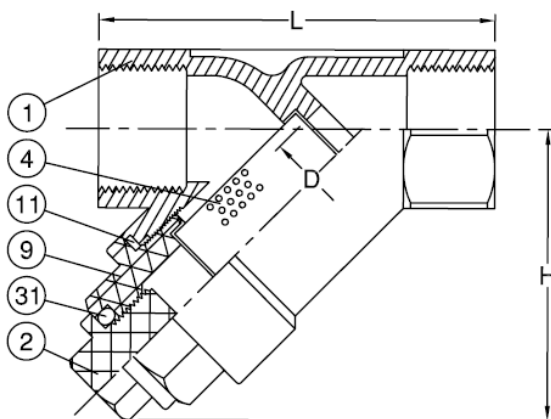
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## MFR-DO (version stainless steel)

Design:	two-part screwed body
Connections:	female G $\frac{1}{4}$ ...G $\frac{1}{2}$ DIN ISO 228 T1
Pressure rating:	PN40
Temperature range:	-30° C...+160° C
Mesh size:	200 mesh/75 $\mu$ m for G $\frac{1}{4}$ , G $\frac{3}{8}$ 100 mesh/150 $\mu$ m for G $\frac{1}{2}$
Mounting position:	cover toward bottom, note specified direction of flow

## Materials

Body(1):	stainless steel 1.4408, EN1503-1
Cover (2):	stainless steel 1.4408, EN 1503-1
Mesh (4):	stainless steel 316
Cap (9):	stainless steel 1.4408, EN1503-1
Seal (11):	PTFE
O-ring (31):	FPM



## 10. Order Codes

Example: **DOE-1 05H R1 1 R0 D 0**

Model	Material/ housing/ rotor	Measuring range	Connection	Gaskets	Elektronics	Cable exit/entry	Options
DOE-	1 = aluminium/ PEEK 2 = st. steel/ st. steel 3 <sup>2)</sup> = st. steel/ st. steel 8 <sup>3)</sup> = st. steel/ PEEK	<b>05H</b> = 0,5-36 l/h <b>05G</b> = 0,14-9,5 GPH	<b>R1</b> = G $\frac{1}{8}$ <b>N1</b> = $\frac{1}{8}$ " NPT	1 = FKM 4 = NBR	<b>T0</b> = pulse output (Hall sensor, NPN, Open Collector), calibrated <b>B0</b> <sup>4)</sup> = pulse output (Hall sensor bipolar, NPN, Open Collector) for pulsating flow calibrated <b>BP</b> <sup>14)</sup> = pulse output (Hall sensor bipolar, NPN, Open Collector) for pulsating flow, Pt100 (3-wire), calibrated <b>H0</b> = pulse output (Hall sensor, NPN, Open Collector + Reed switch), calibrated	<b>D</b> = switch acc. EN 175301- 803 form A <b>K</b> <sup>5)</sup> = 2 m cable	0 = without Y = special option (specify in clear text)
		<b>10H</b> = 2-100 l/h <b>10G</b> = 0,5-26,5 GPH	<b>R2</b> = G $\frac{1}{4}$ <b>N2</b> = $\frac{1}{4}$ " NPT				
		<b>15H</b> = 15-550 l/h <b>15G</b> = 4-145 GPH	<b>R3</b> = G $\frac{3}{8}$ <b>N3</b> = $\frac{3}{8}$ " NPT				
		<b>20H</b> <sup>2)</sup> = 1-40 l/min <b>20G</b> <sup>2)</sup> = 16-634 GPH	<b>R4</b> = G $\frac{1}{2}$ <b>N4</b> = $\frac{1}{2}$ " NPT				

<sup>1)</sup> Only in combination with cable connection "K"

<sup>2)</sup> In preparation

<sup>3)</sup> Stainless steel/PPS for DOE-820

<sup>4)</sup> Not for measuring ranges '05' and '10'

<sup>5)</sup> Only for option "BP"

### 10.1 Accessories

**MFR-DO** (version stainless steel)

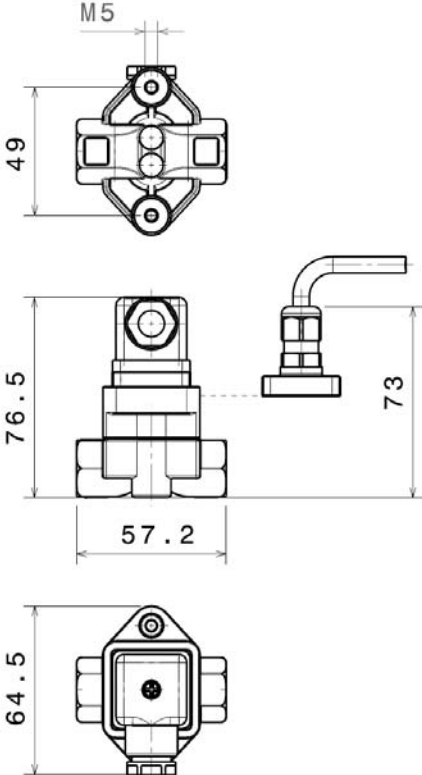
Example: **MFR-DOR15**

Order no.	Size		L [mm]	H [mm]	D [mm]
<b>MFR-DOR08</b>	DN08	G $\frac{1}{4}$	65,0	51,0	10,0
<b>MFR-DOR10</b>	DN10	G $\frac{3}{8}$	65,0	51,0	12,0
<b>MFR-DOR15</b>	DN15	G $\frac{1}{2}$	65,0	51,0	15,0

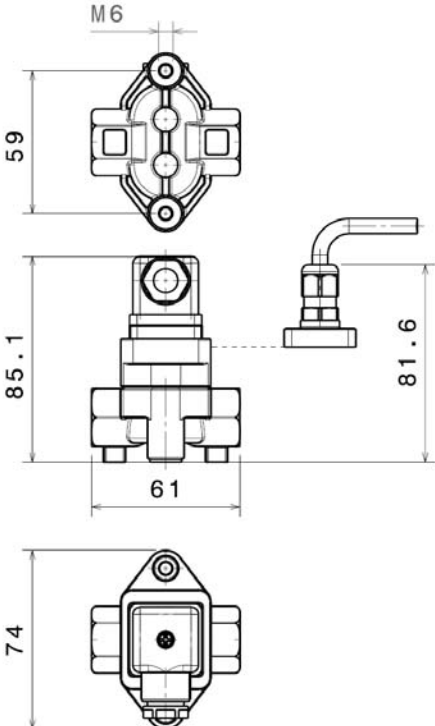
11. Dimensions

[mm]

DOE-x05...DOE-x10

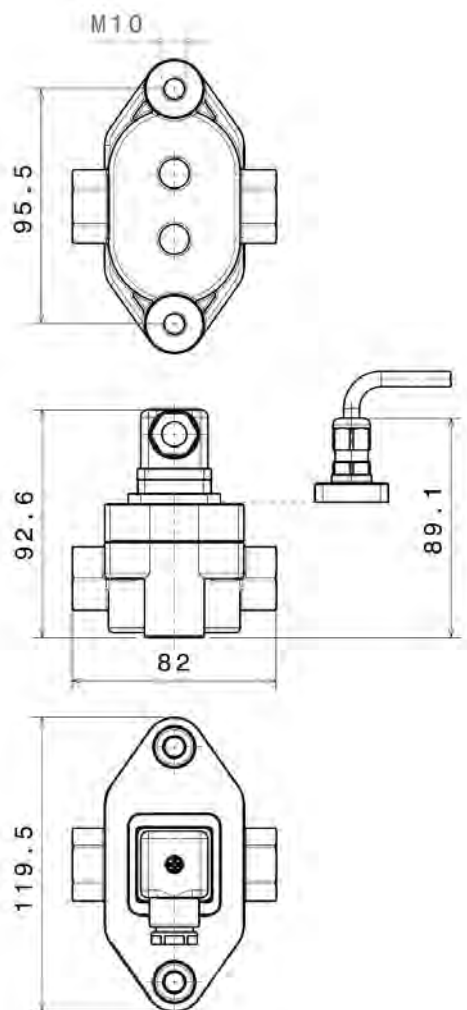


DOE-x15





DOE-x20



## 12. EU Declaration of Conformance

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We, KOBOLD Messring GmbH, Hofheim-Ts, Germany, declare under our sole responsibility that the product:

**Oval Wheel Flowmeter**

**Model: DOE-**

to which this declaration relates is in conformity with the directives noted below:

**2011/65/EU**

**RoHS** (category 9)

**EN 50581:2013**

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

All devices with electronic are in conformance with:

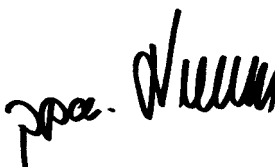
**2012/19/EU**

**WEEE**

Hofheim, 07. September 2017



H. Peters  
General Manager



M. Wenzel  
Proxy Holder