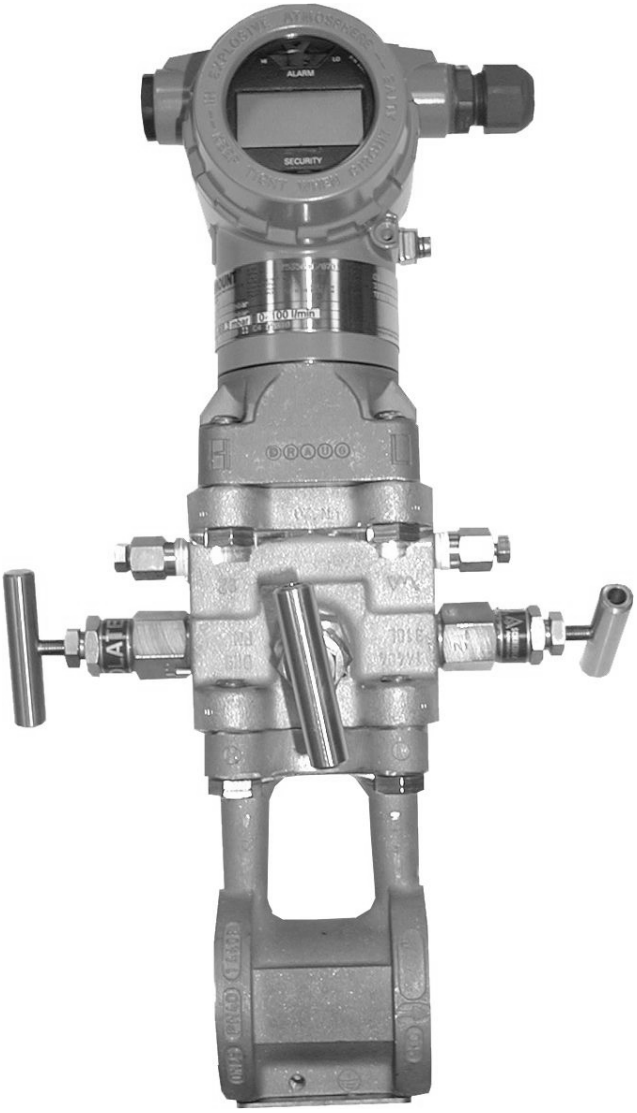
BOPP & REUTHER
MESSTECHNIK

Compact Orifice
with HART®-Communication

Oriflow

Operating manual



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1. Field of Application

These operating instructions must be observed for the assembly, maintenance and repair of the flow measurement device Compact Orifice Oriflow. Manufacturer's operating instructions for the pressure transmitter **MU** are enclosed.

The operating instructions in their current versions must therefore be available to those persons in charge of the above works.

2. Description

2.1 Introduction

Flow measurement is one of the most complex and demanding tasks in industry. Even today there does not exist a universal measuring instrument for all applications. Consequently both, manufacturers and users, face the task of selecting the most suitable method of measurement for each single application. Flow meters based on the differential pressure method are rated very highly.

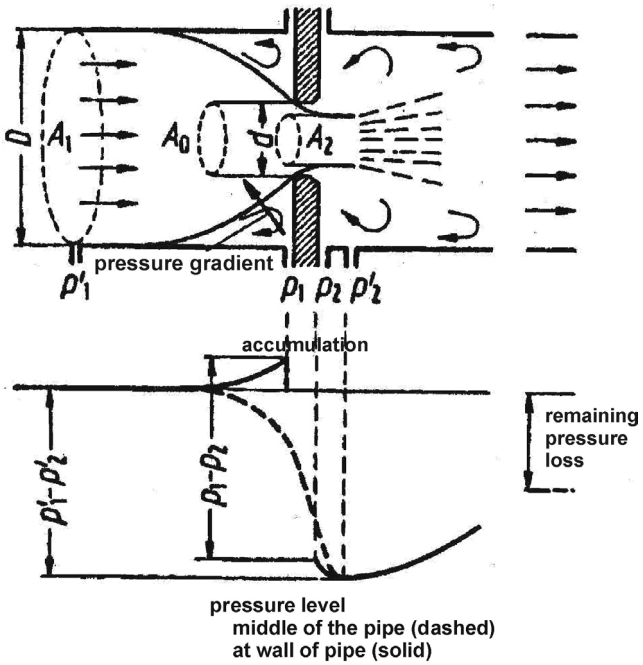
2.2 Design of the Compact Orifice Oriflow

The compact orifice consists of a differential pressure sensor **MWA** with throttle according to individual calculations made previously. Normally the MWA from nominal widths 6 – 150 is a one piece construction; larger nominal widths are produced consisting of one, two or three pieces, partially with removable throttle. Assembly dimension is 25, 30, 40, 70, or 80 mm depending on model/design. A differential pressure transmitter **MU** that preferably meets the devices recommendations is screwed onto the MWA. The MU is delivered with or without display according to customer's specifications (standard: Rosemount 3051 without display). Optionally a valve manifold **VB** may be fitted for testing, venting and shutting off. For use in water vapor measurement an angle **WI** is integrated to effect the formation of condensate.

2.3 Principle of Measurement

The principle of measurement is based on the incorporation of an orifice into the flow inside a pipe. Incorporating the orifice results in a difference between the static pressure of inlet and outlet of the throttle's opening. The flow capacity can be determined by the measured effective pressure, the fluid's properties, and by the operating conditions (picture 1).

The principle of measurement is so popular because related terms, definitions and specifications for equipment have been laid down in form of standards already at a very early stage.



pic 1

2.4 Basis for Calculation

Basis for Calculation is laid down in DIN EN ISO 5167 and VDI/VDE 2041.

For **estimates** the following equations may be used:

Liquid media: **qm** (kg/h) = 0.025 * d^2 * √ (pressure difference * density)

Gaseous media: **qm** (kg/h) = 0.025 * d^2 * Epsilon * √ (pressure difference * density)

Vaporous media: **qm** (kg/h) = 0.025 * d^2 * √ (pressure difference/density)

qv = qm / density
qn = qm / density (in relation to nominal conditions)

qm	=	mass flow kg/h
qv	=	volume flow rate m³/h
d	=	diameter (of measuring hole) mm
pressure difference	=	over the measuring throttle in mbar
density	=	operating density kg/m³
Epsilon	=	expansion constant (if pressure difference and pressure values differ very much, otherwise practice caution!))
Factor	=	0.025 (comprehends dimension states see VDI/VDE2040 and an assumed flow coefficient)

2.5 Modular Design of the Compact Orifice Oriflow

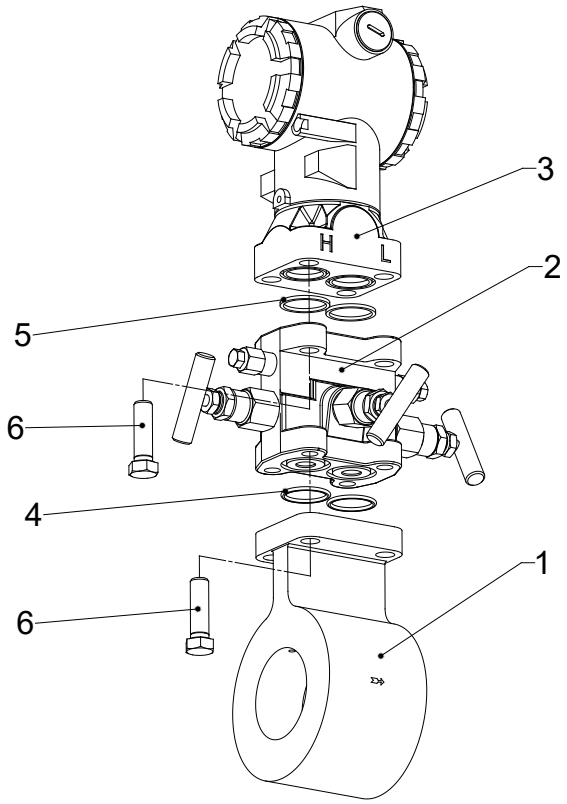
The Compact Orifice Oriflow as produced and delivered by the manufacturers Bopp & Reuther Messtechnik GmbH complies with all rules and regulations presently in force.

The Compact Orifice Oriflow has both ATEX and FM certification.
The Compact Orifice Oriflow complies with the guideline for pressure devices.

In case of repair and maintenance works or any changes correct function may only be guaranteed by Bopp & Reuther Messtechnik GmbH if original parts are used and operating and assembly instructions are adhered to.

1	Pressure Sensor MWA
2	Valve Manifold VB
3	Differential Pressure Transmitter
4	Circular Gasket
5	Flat Gasket
6	Screws

Table 1



2.6 Applications Pre-Calculations and Calibration

The compact throttle devices may be used for flow-rate measurement of gases, liquids and vapors.

The throttle devices may be pre-calculated and manufactured according to norm (ISO5167), (VDI/VDE 2041) and corresponding to customer needs.

Wet calibrations is recommended for nominal widths < 50 and for measuring holes < 12.5 mm or ß < 0.2 or. ß > 0.8.

Specifications for Operations

Nominal width:	6 to 1000
Nominal pressure:	10 to 325 bar
Temperature:	-40°C to +350°C
Types of gaskets:	B, C, D, E, F, L, RF, RTJ

Redundant measurement: 2 of 3 e. g.
Output signals: differential pressure, pressure, temperature, local display and flow-rate q_m, q_v, q_n

CENELEC-Approvals (e. g. Rosemount 3051C)

Safety

BAS97ATEX1089X
II 1G EEx ia IIC T5 (T_o= -60°C to +40°C)
II 1G EEx ia IIC T4 (T_o= -60°C to +70°C)
$U_{\max in} = 30Vdc$
$I_{\max in} = 200mA$
$P_{\max in} = 0{,}9W$
$C_{eq} = 0{,}012\mu F$

Pressure-proof housing

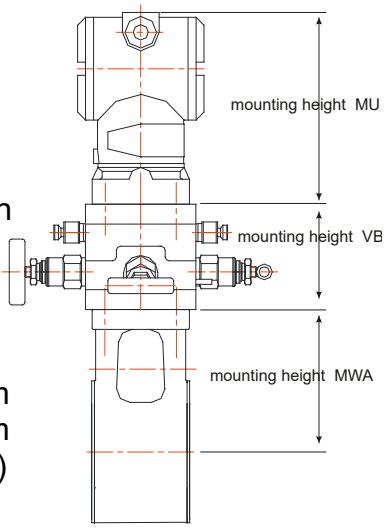
KEMA00ATEX2013X
II 1/2 GD EEx d IIC T5 (T_o= -50°C to +80°C)
II 1/2 GD EEx d IIC T6 (T_o= -50°C to +65°C)
Dust rating T90°C IP66

Non incendive

BAS00ATEX3105X
II 3 GD EEx nL IIC T6 (T_o= -40°C to 0°C)
$U_{\max in} = 55Vdc$
Dust rating T80°C (T_o= -20°C to 40°C) IP66

2.7 Dimensions and Weight

2.7.1 Dimensions



Mounting length
for sandwich construction 25, 70 mm ,
40 mm for 2-part-construction
HD 325 Lenticular gasket 30 and 80 mm
(other mounting lengths upon request)

Mounting height
Differential PressureTransmitter **MU**(3051 CD) 160 mm
Valve Manifold **VB** 82 mm
Differential Pressure Sensor see table (all figures are mm)

DN	25	50	100	200	300
PN 10	90.5	107.5	152	205	252
PN 40	90.5	107.5	152	217.5	287.5

*Table 2 Mounting height differential pressure sensor **MWA***
(other dimensions upon request)

2.7.2 Weight

Differential Pressure Sensor **MWA**

DN	**PN**	**kg**
25	40	1.8
50	40	3.5
100	10	6.3
200	10	16
300	10	22.5

Table 3 (other dimensions upon request)

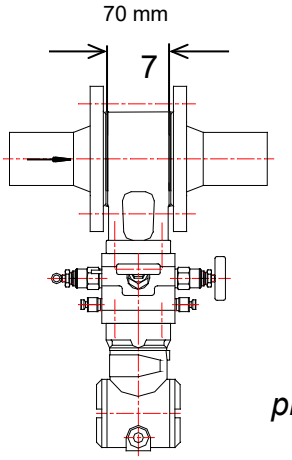
Angle **WI** (for measurement of vapors) 1.35 kg
Valve manifold **VB** 2.1 kg
Differential Pressure Transmitter **MU**
(e. g. Rosemount 3051CD) 2.3 kg

3. Fitting into Pipe

3.1 Different Nominal Pressures

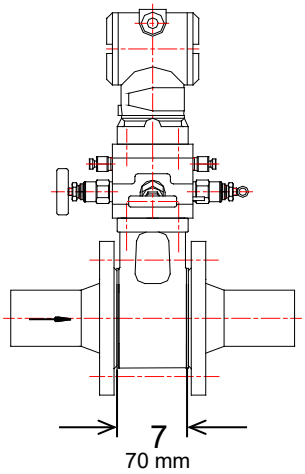
3.1.1 Nominal Pressure 40

3.1.1.1 Measuring Liquid Media



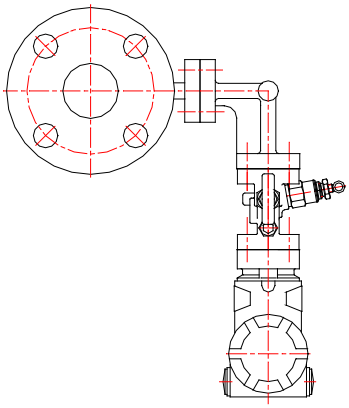
pic 1

3.1.1.2 Measuring Gaseous Media



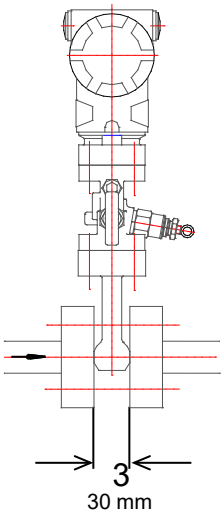
pic 2

3.1.1.3 Measuring Water Vapor, Horizontal Pipe

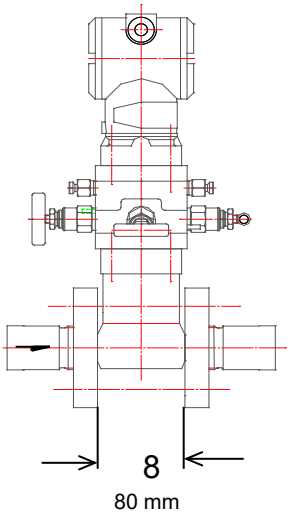


pic 3

3.1.2 Nominal Pressure 325 (Fitting into pipe see 3.1.1.1 and 3.1.1.2)



Nominal widths 6,10,16



Nominal widths 16 to 120

3.2 Putting in Operation

1. Fitting of the throttle device must be carried out according to rules and regulations regarding the installation of PLT-field devices presently in force. The throttle device must be fitted centrally when the in-line type (sandwich-installation) is installed. Transducer and MU must be grounded

2. Electric connection must be performed according to the operating instructions of the **MU**'s manufacturer.

3. When in operation, zero adjustment must be carried out immediately.The differential pressure output signal 4-20 mA is provided in linear mode (differential pressure mbar / current mA).Also available square rootData may be checked or new data may be entered with the HART®-Communicator (250 Ohms resistance).

4. The multi variable **MU** 3095 MA transmits a flow rate signal.

5. **Warning**

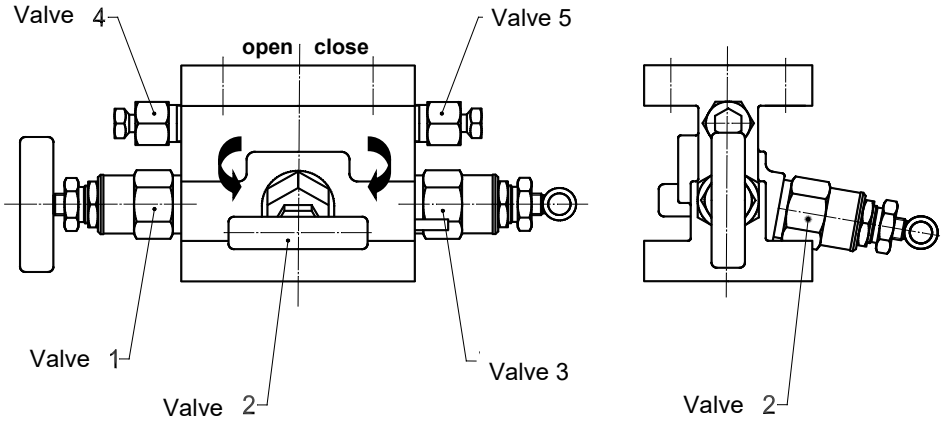
   Before putting the throttle device in operation the specifications and certifications must be observed. Do not tighten or loosen any connecting bolts. The throttle device has undergone a pressure test before delivery.

   When using the valve manifold option be sure to proceed according to table 3 and choose the appropriate setting. Venting screws are designed to serve as pressure compensation in the pressure transmitter or to blow out the short differential pressure ducts. No hot water vapors must be blown out.

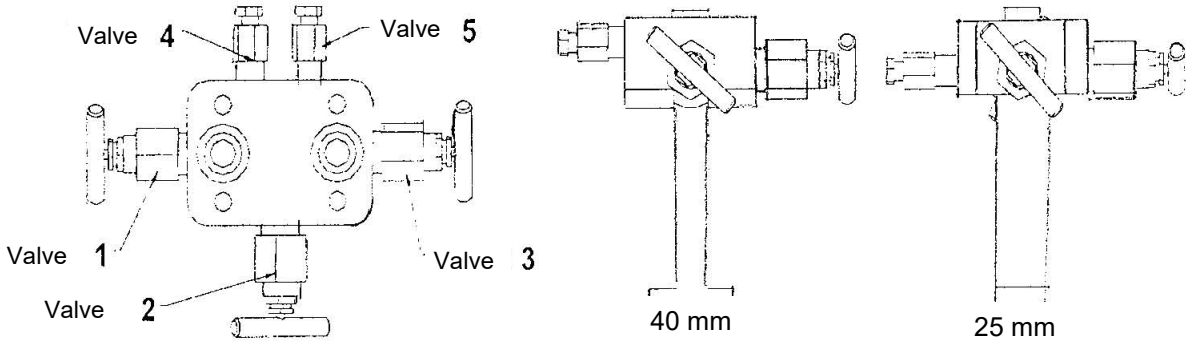
3.3 Switch Positions Valve Manifold

Function	Valve 1	Valve 2	Valve 3	Valve 4	Valve 5	Pos. of switch
Measuring	open	closed	open	closed	closed	**1**
Zero-adjustment, pressure compensation at sensor of pressure transmitter	closed	open	closed	closed	closed	**2**
Pressure compensation when dismantling the pressure transmitter	closed	open	closed	open	open	**3**
Venting Blowing out	open	closed	open	open	open	**4**
Putting in Operation Leak Test	open	open	open	closed	closed	**5**

Table 4



Flange with connection 40/25 mm



4. Flow Devices (Excerpt)

4.1 Modular Parts

Name of Part		Material
MWA MWA	DN 15 –150 ANSI ½“ bis 4“	1.4409 SS316L (1.4404)
MWA MWA	≥ DN 150 (2-part) ANSI 5“ bis 24“ (2-part)	1.4571 SS316L (1.4404)
Throttle		1.4571
VB	Standard	1.4404
WI	Standard	1.4409
Differential Pressure Transmitter – Diaphragm material		1.4404
MWA	NW 6 – 120 PN 325	1.4571

Table 5

4.2 Connecting Bolts

Name of Part	Material
Hexagon Head Bolt Inch 7/16” UNF x 26	A2-70
Hexagon Head Bolt Inch 7/16“ UNF x 32	A2-80
Hexagon Head Bolt Inch 7/16“ UNF x 37	A2-80
Hexagon Head Bolt Inch 7/16“ UNF x 46	A2-80
Hexagon Socket 5/16“ UNC x 22	A 193

Table 6

4.3 Gaskets

4.3.1 Flat Gaskets

Name of Part	Material
Flat Gasket Rosemount MU 30 x 26 x 2	PTFE filled with glas

Table 7

4.3.2 Circular Gasket

Name of Part	Material
Circular Gasket (Elastomere) 25,07 x 2.62 **Standard**	Kalrez 6375
Circular Gasket (Elastomere) 20 x 2.65 **DIN**	Kalrez 6375
Circular Gasket (Elastomere) 30 x 26 x 2 **DIN**	Kalrez 6375

Table 8

5. Assembly and Checks of the Compact Orifice Oriflow

5.1 Application and Visual Check

Only parts listed in tables 1 to 8 may be used to install the compact throttle device.

All parts of the custom-made throttle device must undergo a visual check for damage or any instructions marked on the device.

5.2 Assembly

P1. Mount differential pressure transmitter (**Coplanar connection** MU Rosemount 3051CD without coplanar flange) onto modular parts such as MWA with measuring throttle, VB or WI (at an angle of 90° for vaporous media).

P2. Insert original gasket (Rosemount Type 3051) into part at MU-side and connect modular part with bolts (table 6) according to the following procedure (previously fitted gasket still inside the MU may be used if undamaged).

P3. Apply fitting paste (manufactured by OPTIMOL Ölwerke GmbH, Munich, Product-No. 08464-215) to top of all five threads as well as at the transition of shaft and head.

P4. Screw bolts crosswise into the part with the threads using a torque meter, tightening them – one by one and in several goes – to the same torque level (torque 40 Nm).

P5. Tighten bolts crosswise – one by one and in several goes – to the maximum torque level (torque 50 Nm).

P6. Check clearance of fastened parts using a feeler gauge; clearance between fastened parts must be evenly $\leq$ 0.1 mm.

6.2 Wait 60 min (**see P5.**).

P7. Check – one bolt after the other – in crosswise direction if bolts are still tightened at maximum torque (50 Nm).

P8. Fit MU (**DIN 19213 – Pressure Transmitter Connection**) onto differential pressure sensor MWA.

8.2 Fit universal gasket (table 8) (Elastomere) circular gaskets on the module side and connect MU with bolts (table 6) according to the following procedure:

8.3 Prepare bolts as in **P3.**

P9. Screw bolts crosswise into the part with the threads using a torque meter, tightening them – one by one and in several goes – to the same torque level (torque 50 Nm).

P10. Check clearance of fastened parts using a feeler gauge; clearance between fastened parts must be evenly $\leq$ 0.1 mm.

P11. Fitting of differential pressure sensor MWA (**Coplanar connection**) onto modular parts VB or WI (at an angle of 90° when used for vapors).

P12. Put VB (table 4) into switch position 5 when fitting it.

P13. Insert circular gaskets (table 8) (Elastomere) in modular part VB and connect parts with bolts (table 6) as in **P3.** and **P4.** (50 Nm).

P14. Check clearance of fastened parts as in **P13.**

P15. Fitting of differential pressure sensor MWA (**DIN pressure transmitter connection**) onto modular parts VB or WI (at an angle of 90° when used for vapors).

P16. Put VB (table 4) into switch position 5 when fitting it.

P17. Insert circular gaskets (table 8) (Elastomere) into modular part MWA and connect parts with bolts (table 6) as in **P3.** and **P12.** at a torque of 50 Nm.

P18. Check clearance of fastened parts as in **P13.**

6. Pressure Check

6.1 Procedure

Seal MWA with a blind flange as well as connecting flange for pressure admission. When checking with gaseous media at high nominal pressures be sure to reduce volume as much as possible for safety reasons.
After the measuring device has been sealed with flanges and the valves 1, 2, 3 have been opened on the VB (switch position 5 **[see 3.3 page 10]**), it is lowered into a water bath as far as over the connection to the MU.

Admit pressure evenly, not abruptly up to the test pressure level.

The measuring device is kept at the test pressure level for five minutes; check for any rising water bubbles; if there are no bubbles the pressure check has been completed.

Use water or nitrogen as test medium.

Pressure check is performed at a test pressure of 130 % of nominal pressure for liquids or 110 % of nominal pressure for gaseous media.

7. Contact

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8. Abbreviations

MWA	=	Differential pressure sensor built into pipe
MU	=	Differential pressure transmitter
VB	=	Valve manifold for testing and shutting off
DIN	=	Pressure transmitter connection in compliance with DIN 19213
Coplanar	=	Pressure transmitter connection for Rosemount MU 3051CD and 3095 MA without coplanar flange
WI	=	Angle for measurement of vaporous media (formation of condensate)
GDB	=	Device data sheet for the flow measuring device (Compact Orifice)

9. EU-Declaration of conformity

BOPP & REUTHER MESSTECHNIK

EU - Konformitätserklärung
EU - Declaration of conformity
UE - Déclaration de conformité

Hiermit erklärt der Hersteller in alleiniger Verantwortung, dass die nachfolgend bezeichnete Baueinheit den Anforderungen der zutreffenden EU-Richtlinien entspricht. Bei nicht mit uns abgestimmten Änderungen verliert diese Erklärung ihre Gültigkeit.

The manufacturer herewith declares under sole responsibility that the unit mentioned below complies with the requirements of the relevant EU directives. This declaration is no longer valid if the unit is modified without our agreement.

Par la présente, le fabricant déclare sous sa seule responsabilité que les appareils décrits ci-dessous, correspondent aux exigences de la réglementation UE qui les concerne. Toute modification des appareils sans notre accord entraine la perte de validité de cette déclaration de conformité

Hersteller *Manufacturer* Fabricant	Bopp & Reuther Messtechnik GmbH Am Neuen Rheinhafen 4 67346 Speyer / Germany
Bezeichnung *Description* Description	Kompaktblende *Compact Orifice* Plaque à orifice
Typ, Modell *Type, model* Type, modèle	Oriflow OF

Richtlinie *Directive* Directive	2011/65/EU /UE L 174/88 Beschränkung gefährlicher Stoffe *Restriction of hazardous substances* Limitation de substances dangereuses
Delegierte Richtlinie *Delegated Directive* Directive Déléguée	(EU /UE) 2015/863 L 137/10 Änderung Anhang II der Richtlinie 2011/65/EU *Amending Annex II to Directive 2011/65/EU* Modifiant l'annexe II de la directive 2011/65/UE
Normen und normative Dokumente *Standards and normative documents* Normes et documents normatifs	EN IEC 63000:2018

Ort, Datum / *Place, Date* / Lieu, Date: **Speyer, 2023-01-30**

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Z-ML-KE Oriflow-V4 2022-01-30

Our product portfolio:

Volume flowmeter:

- Oval wheel meter
- Turbine meter
- Electromagnetic flowmeter

Mass flowmeter:

- Vortex meter
- Compact orifice
- Coriolis mass flowmeter

Density and concentration meter (Measuring and testing equipment)

Dosing measurement technology

- Electromagnetic flowmeter
- Coriolis mass flowmeter
- Oval wheel meter
- Dosing control system

Measurement Accessories

- Processing electronics
- Mechanical indicator
- Pulse pick-ups
- Components

Measuring and testing equipment

Conformity assessment according to MID Directive 2014/32/EU

After Sales Service

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