



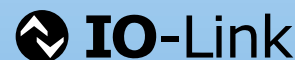
# Oval Wheel Flow Meter, High Pressure

for low and high viscous liquids



measuring  
•  
monitoring  
•  
analysing

## DON-H/DON-S



- Measuring range: 0.5 ... 36 l/h und 1 ... 40 l/min
- Viscosity range: up to 1000 cP higher on request
- Accuracy:  $\pm 0.2\%$  ...  $1\%$  of reading
- Material: stainless steel
- $p_{\max}$ : 400 bar;  $t_{\max}$ :  $120^{\circ}\text{C}$
- Pulse output, LCD display
- U-PACE electronics: temperature measuring, IO-Link



S4

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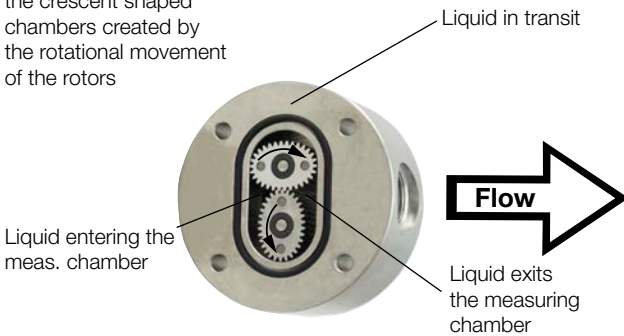
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### Principle of Operation

Oval wheel flow meters are categorised as positive displacement flow technology. When liquid flows through this type of positive displacement flow meter, 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 process externally via a remote display controller or PLC or via a variety of output/display options available as accessories attached to the flow meters.

#### Operation:

Liquid travels around the crescent shaped chambers created by the rotational movement of the rotors



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 is not required as with alternative flow technology options making oval gear installations simple to install in tight spaces and at an economical price.

### Areas of Application

For all viscous, non abrasive clean liquids like:

- Petroleum      ● Oil      ● Chemicals
- Grease      ● Fuels      ● Ink etc.
- Pastes

Stainless steel flow meters are suited to most products and chemicals and aluminium meters are suitable for fuels, fuel oils & lubricating liquids.

CSA certification of U-PACE electronics for Ordinary Locations (Ordloc).

International IECCE Certification acc. to CB-Scheme with U-PACE

### Technical Details

#### Material

- Body: stainless steel 1.4404
- Oval wheels: stainless steel 1.4404
- Bearing: carbon graphite
- Axes: stainless steel 1.4404
- O-rings: FKM: -20... +150 °C  
FKM Vi 840: -40... +150 °C  
NBR: -20... +100 °C  
FEP-O-seal: -15... +130 °C  
(FEP-O-seal, FEP encased, with solid core EPDM)  
Fluoroprene® acc. to EN 1935

**Note:** Choose appropriate sealing according to permissible temperature limits of the flow meter.

#### Cover for

- cable connection: polyamide PA6 GF35 UL94 HB/VO  
stainless steel 1.4404 (optional)

- Material screws: steel, coated with GEOMET® 321

- Magnet encapsulation: DON-x05, -x10 PEEK  
DON-x15, -x20 st. st. 1.4404

#### Accuracy

- (under reference conditions\*): ± 1 % of reading (DON-x05...DON-x15)  
± 0.5 % of reading (DON-x20)  
± 0.2 % of reading (DON-x20;  
with optional Z3-electronics based on linearisation function)

#### Max. pressure

- 400 bar  
200 bar for CSA and IECCE variant

#### Repeatability:

- typ. ± 0.03 %

#### Protection class:

- IP 66/67

#### Medium temp.:

- 20 °C... +80 °C for options Zx and  
-20 °C... +120 °C with pulse output and  
options Zx with cooling fins  
-40 °C... +120 °C with pulse output and  
O-rings FKM Vi 840

#### Ambient temper.:

- 20 °C... +80 °C

#### Cable entry:

- M20x1.5, ½" NPT adapter

### ATEX-approval

Mechanical explosion protection:

- ⊕ II 2G Ex h IIC T4/T3 Gb

Options 1A/2A/3A/5A:

- Intrinsic safety ⊕ II 2G Ex ia IIC T4 Gb  
(-20 °C ≤ Ta ≤ +60 °C)

Option HA:

- Intrinsic safety ⊕ II 3G Ex ic IIC T4/T3 Gc

Option HE:

- Flameproof enclosure ⊕ II 2G Ex db IIC T4/T6 Gb  
⊕ I M2 Ex db I Mb  
Only St.St. Enclosure



**Technical Details** (continued)

**IECEX-approval**

Option HE:

Flameproof

enclosure

Ex db IIC

Ex db I Mb

\* Reference conditions: x05 (calibration oil 10 cSt, 20 °C, 5 bar),  
x10...x20 (calibration oil 4,6 cSt, 25 °C, 1 bar)  
Accuracy data is valid for given viscosities and higher.

**Recommended Filter**

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

DON-x20 < 150 µm micron (100 mesh)

**Pulse Output (H0/HA/HE)**

Options H0/HA/HE are equipped with a Reed switch pulse output and a Hall sensor pulse output.

**Reed switch pulse output**

The reed switch output is a two wire normally open SPST voltage free contact ideal for installations without power or for use in hazardous area locations when Intrinsically Safe (I.S.) philosophy is adopted.

**Note:** When using the reed switch output the liquid temperature must not change at a rate greater than 10°C/min.

Average switching life of reed contact (MTTF):

max. Load (30 V / 10 mA) 5 x 10<sup>5</sup> switching cycles

min. Load (<5 V / 10 mA) 5 x 10<sup>8</sup> switching cycles

**Switching capacity:** max. 30 V<sub>DC</sub>, max. 20 mA

**Hall sensor pulse output**

In the electronics options H0/HA/HE, a Hall Effect sensor is combined with an active push-pull output. The electrical connection is provided in 3-wire version. The output is actively switched either to +Vs or to ground. The external supply voltage is 8...30 V<sub>DC</sub>. No additional external circuit is required (e.g pull up resistor). The high signal is approximately equal to the supply voltage +Vs and the low signal is approximately 0 V. The electrical load may optionally be connected to the supply voltage or to GND.

Maximum output current (current source or sink): 100 mA (short circuit protected).

**U-PACE electronics (...CT)**

The universal U-PACE electronics (Universal Precision and Control Electronics, order code CT) features two outputs arbitrarily configurable by the customer.

In addition, the U-PACE electronics offers various diagnostic functions and the following features:

- Flow- and temperature measurement
- Monitoring, dosing and transmitter function
- Dosing function with external control input
- Coloured, multi-parameter configurable TFT-display, rotatable in 90° steps
- Intuitive setup menu via 4 optical touch keys
- 2 configurable outputs (pulse-/frequency-/alarm- and analogue output)
- Grand and resettable totaliser
- IO link function

**Materials**

Housing: st. st. 1.4404  
Display screen: PC  
Housing screw cap: PA6

**Electrical Details U-PACE**

Supply voltage: 19-30 V<sub>DC</sub>, internal power consumption max. 200 mA

Display: TFT display, 128x128 pixels, 1.4" display orientation in 90° steps adjustable

Display repetition rate: 0.5...10 s, adjustable

Pulse output: Push-Pull, freely scalable, configurable for partial and accumulated totaliser

Frequency output: Push-Pull, freely scalable, 2 kHz @ overflow  
f<sub>min</sub> @ FS = 50 Hz  
f<sub>max</sub> @ FS = 1000 Hz

Alarm output: NPN, PNP, Push-Pull, configurable max. 30 V<sub>DC</sub>, max. 200 mA short-circuit proof

Analogue output: active, 3 wire, 0(4)-20 mA, max. load 500 Ω or 0(2)-10 V<sub>DC</sub>, (R<sub>i</sub> = 500 Ω) (factory calibrated with R<sub>L</sub> = 1 MΩ)

Control input: active signal U<sub>high</sub> max. 30 V<sub>DC</sub>  
0 < Low < 10 V<sub>DC</sub>  
15 V<sub>DC</sub> < High < Vs

Dosing function: Dosing output OUT2: Push-Pull, High active  
Control input OUT1: START/STOP 0.5 s < t<sub>high</sub> < 4 s  
RESET t<sub>high</sub> > 5 s

Response time electrical outputs: Size X05 to X20 and X45 to X60: < 1.5 s  
Size X25 to X40: < 0.5 s



### Temperature measurement

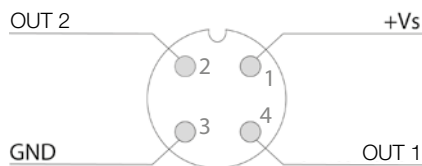
Meas. range: -20...+80 °C  
Accuracy: ±1.0 °C  
Response time  $t_{90}$   
(Sensor) < 30 s

### Configuration of outputs

Output 1 (OUT1, PIN 4)	Output 2 (OUT2, PIN 2)
Analogue output 4-20 mA	Analogue output 4-20 mA
Analogue output 0-20 mA	Analogue output 0-20 mA
Analogue output 2-10 V	Analogue output 2-10 V
Analogue output 0-10 V	Analogue output 0-10 V
Switching output NPN/PNP/PP	Switching output NPN/PNP/PP
Pulse output PP	Pulse output PP
Frequency output PP	Frequency output PP
Communication mode KofiCom	
Communication mode IO-Link	
Control input	
Control input dosing function	Dosing output

### IO-Link specification

Manufacturer ID: 1105 (decimal), 0 x 0451 (hex)  
Manufacturer name: Kobold Messring GmbH  
IO-Link specification: V1.1  
Bitrate: COM3  
Minimal cycle time: 1,1 ms  
SIO-Mode: yes (OUT1 in configuration IO-Link)  
Block parameterisation: yes  
Operational readiness: 10 s  
Max. cable length: 20 m



When operated under the CSA Label, the equipments shall be supplied with an external power supply which fulfils the requirements of Cl. 6.3.1, 6.3.2, 9.4 of IEC/CSA/UL 61010-1 and fulfils the requirements of the national authorities.

For example, by the use of a Class 2 Limited Power Source (LPS)



**Electronic with LCD Display**

Model	..Z1	..Z2	..Z3	..Z5	..1A	..2A	..3A	..5A
Function	dual totaliser	dosing unit	rate/ counter	rate/ counter	dual totaliser	dosing unit	rate/ counter	rate/ counter
<b>Power supply</b>								
Battery-powered (outputs inactive)	yes	no	yes	yes	optional <sup>2)</sup>	no	optional <sup>2)</sup>	yes
External	5 - 24 V <sub>DC</sub>	12 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>	5 - 24 V <sub>DC</sub>
<b>LCD display</b>								
Selectable units	yes	yes	yes	yes	yes	yes	yes	yes
Decimal point	yes	yes	yes	yes	yes	yes	yes	yes
Accumulative total	yes	yes	yes	yes	yes	yes	yes	yes
Resettable total	yes	yes	yes	yes	yes	yes	yes	yes
Linearisation	yes	no	yes	yes	yes	no	yes	yes
Rate display	yes	yes	yes	yes	yes	yes	yes	yes
Backlighting	yes	yes	yes	yes	no	no	no	no
<b>Input</b>								
Sensors	Hall sensor/ reed switch							
<b>Outputs</b>								
4-20 mA	no	no	yes	yes	no	no	yes	yes
Flow rate alarm min./max.	no	no	NPN/PNP/PP	NPN/PNP/PP	no	no	no	with solid-state relay board
Batch end & control	no	yes	no	no	no	yes	no	no
Pulse outputs	no	no	PP	PP	no	no	no	with solid-state relay board
2 x SPDT relays <sup>1)</sup>	no	yes	no	yes	no	with solid-state relay board	no	
<b>Installation</b>								
IP 65	yes	yes	yes	yes	yes	yes	yes	yes
Cable entries	M20x1.5/ ½" NPT							
Medium tempera- ture (Option: max. +150 °C)	-20...+80 °C							
Ambient temperature	-20 ... +80 °C				-20 ... +60 °C			
Housing material	PA6 GF35 UL94 HB/VO/PC UL94 V-2							
ATEX approval	no				yes			

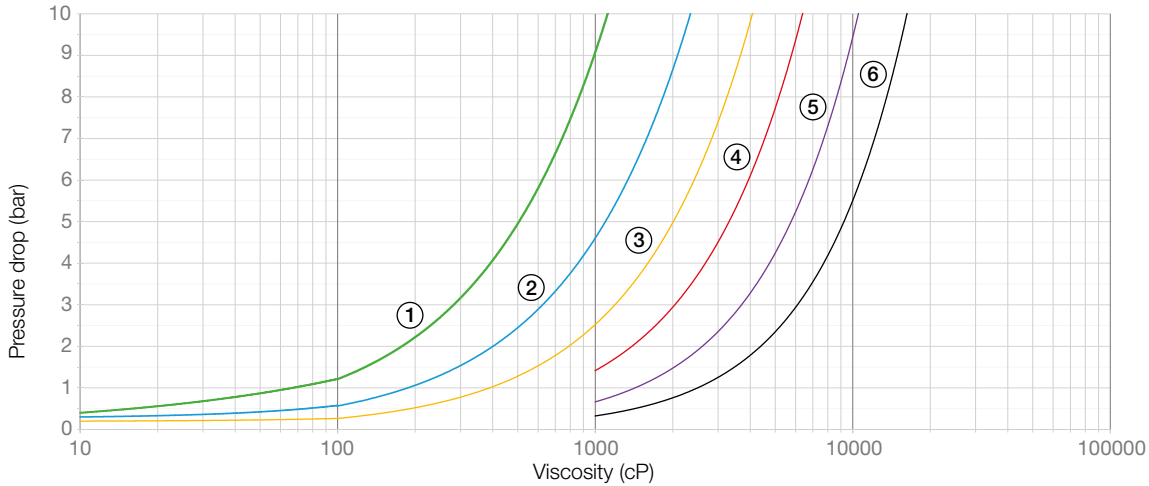
<sup>1)</sup> Replaces solid state outputs, for details see data sheet ZOK

<sup>2)</sup> See data sheet ZOK



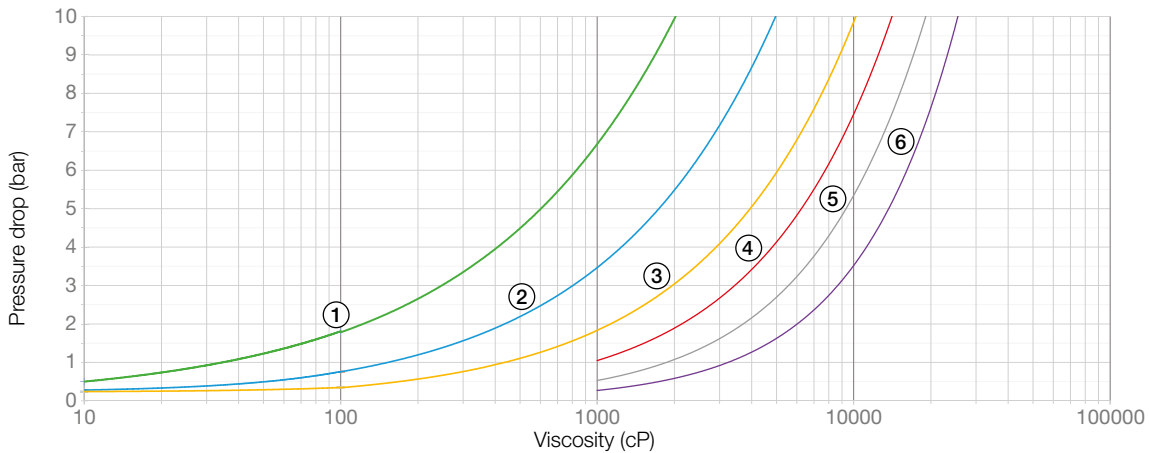
**DON Pressure Drop Curves versus Viscosity**

**DON x05... x15**



- |  |   |
|--|---|
| ① Standard rotors 100 % of full scale  | ④ Standard rotors 12.5 % of full scale<br>Special cut rotors 25 % of full scale |
| ② Standard rotors 50 % of full scale<br>Special cut rotors 100 % of full scale | ⑤ Standard rotors 5 % of full scale<br>Special cut rotors 10 % of full scale    |
| ③ Standard rotors 25 % of full scale<br>Special cut rotors 50 % of full scale  | ⑥ Standard rotors 2.5 % of full scale<br>Special cut rotors 5 % of full scale   |

**DON x20**



- |  |   |
|--|---|
| ① Standard rotors 100 % of full scale  | ④ Standard rotors 12.5 % of full scale<br>Special cut rotors 25 % of full scale |
| ② Standard rotors 50 % of full scale<br>Special cut rotors 100 % of full scale | ⑤ Standard rotors 5 % of full scale<br>Special cut rotors 10 % of full scale    |
| ③ Standard rotors 25 % of full scale<br>Special cut rotors 50 % of full scale  | ⑥ Standard rotors 2.5 % of full scale<br>Special cut rotors 5 % of full scale   |

**Pressure drop limit versus flowrate**

The curves above represent the pressure drop for standard cut oval rotors. Special cut rotors of DON-S... series have alternate tooth relieve which effectively reduces the pressure drop by approx. 50%.

Please note: Pressure surges are not permitted when starting up the system. Pressure surges >3 bar can lead to blocking of the gears, especially with sizes x05 ... x15.



**Maximum Flowrate Multiplier** (for higher viscosities)

Viscosities (cP)	Standard rotor	Special cut rotor
≤ 1000	1	1
≤ 2000	0.5	1
≤ 4000	0.42	0.84
≤ 6000	0.33	0.66
≤ 8000	0.25	0.5
≤ 30000	0.15	0.3
≤ 60000	0.12	0.25
≤ 150000	0.1	0.2
≤ 250000	0.05	0.1
≤ 1000000	0.025	0.05

**Special cut rotors for higher viscosities**

For viscosity >1000 cP, special cut rotors option «DON-Sxx» should be used to reduce pressure drop. This applies to DON-S15 and larger sizes. For higher viscosities, the flow meter max. flowrate is de-rated according to the attached chart. At viscosities <1000 cP these special rotors are less accurate.

Example: DON-S20 measuring oil at 8000 cP,  
 max. flow 40 l/min x 0.5 = 20 l/min new maximum flow rate.

**Output Pulse Resolution**

Model	Measuring range [l/min]	Pulse/litre	
		Reedswitch	Hall sensor
DON-x05	0.5 - 36 l/h	2670	2670
DON-x10	2 - 100 l/h	1054	1054
DON-x15	15 - 550 l/h	355	710
DON-x20	1 - 40	82	163

The values in above mentioned table are only approximate guidelines. The actual value for pulse rate can deviate from the values in this table and is mentioned in calibration certificate delivered with the flow meter.



Oval Wheel Flow Meter, High Pressure Model DON-H/DON-S

Order Details DON-H (Example: DON-H10H R1 1 H0 M 0)

Measuring range	Housing material	Connection	O-ring material	Electronics	Cable entry	Option
	Stainless steel					
0.5-36 l/h	DON-H05H	R1 = G 1/8 N1 = 1/8" NPT	<b>1</b> = FKM <b>3</b> = FEP-O-ring <b>4</b> = NBR <b>5<sup>5)</sup></b> = Fluoro-prene® <b>8<sup>6)</sup></b> = FKM Vi 840 <b>9</b> = Special materials (not for ATEX)	<b>H0</b> = Hall sensor (Push-Pull)/ Reed switch, pulse output <b>HA</b> = H0 + ATEX (Exi) <b>HE</b> = H0 + ATEX (Exd) <b>Z1</b> = dual LCD totaliser <b>Z2</b> = dosing unit LCD <b>Z3</b> = LCD totaliser, rate, outputs: 4-20 mA, alarm, pulse (ZOK-Z3) (impulses not for battery supply) <b>Z5</b> = as Z3, but with 2 relays/SPDT relays <b>1A<sup>4)</sup></b> = E1 + HA (ATEX Exi) <b>2A<sup>4)</sup></b> = E2 + HA (ATEX Exi) <b>3A<sup>4)</sup></b> = E3 + HA (ATEX Exi) <b>5A<sup>4)</sup></b> = E5 + HA (ATEX Exi)	<b>M</b> = M20 <b>N</b> = 1/2" NPT <b>S<sup>3)</sup></b> = M20 with cooling fin <b>T<sup>3)</sup></b> = 1/2" NPT with cooling fin <b>0</b> = without <b>N</b> = without battery <b>Y</b> = special option (specify in clear text; not for ATEX)	
0.13-9.5 GPH	DON-H05G					
2-100 l/h	DON-H10H	R2 = G 1/4 N2 = 1/4" NPT				
0.5-27 GPH	DON-H10G					
15-550 l/h	DON-H15H	R2 = G 1/4 N2 = 1/4" NPT				<b>CT<sup>7)</sup></b> = U-PACE, TFT display, 2 outputs (current/voltage/pulse/frequency/alarm output/IO link configurable), M12x1 plug, with cCSAus and IECCE CB Scheme Approval
4-145 GPH	DON-H15G					
1-40 l/min	DON-H20H	R4 = G 1/2 N4 = 1/2" NPT				<b>0</b> = without
0.26-10.6 GPM	DON-H20G					

<sup>3)</sup> Only for electronic options -Zx <sup>4)</sup> E1/E2/E3/E5 = Z1/Z2/Z3/Z5 in ATEX version (Exi), without backlighting <sup>5)</sup> This version is not calibrated (no calibration certificate) <sup>6)</sup> not for ATEX, only for Pulse Output <sup>7)</sup> l/min-package (nameplate (l/min or ml/min, °C, bar)), calibrated range and temperature °C; GPM-package (nameplate (GPM or GPH, °F, PSI)), calibrated range and temperature °F



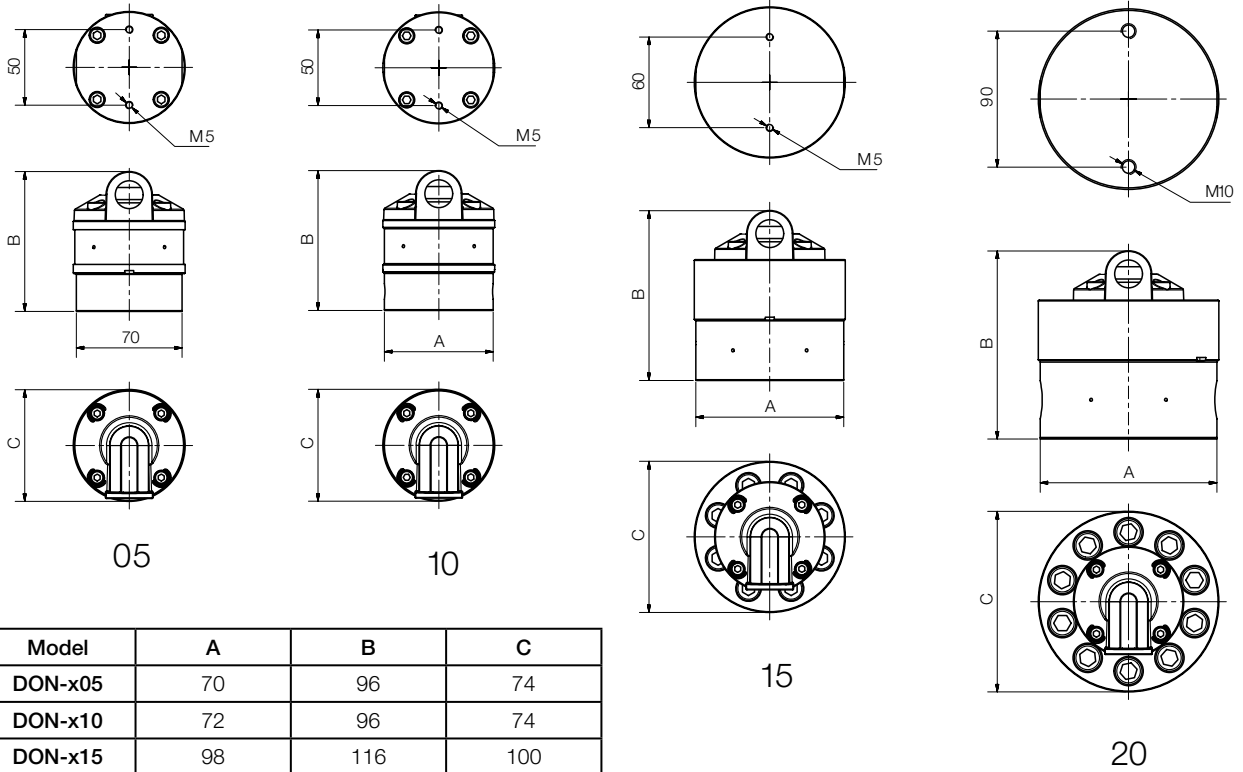
**Order Details DON-S for special rotors for higher viscosities > 1000 cP (Example: DON-S15H R2 1 H0 M 0)**

Measuring range	Housing material	Connection	O-ring material	Electronics	Cable entry	Option
	Stainless steel					
15 - 550 l/h	<b>DON-S15H</b>	R2 = G ¼ N2 = ¼" NPT	1 = FKM 3 = FEP-O-ring 4 = NBR 5 <sup>5)</sup> = Fluoro-prene® 8 <sup>6)</sup> = FKM Vi 840 9 = Special materials (not for ATEX)	<b>H0</b> = Hall sensor (Push-Pull)/ Reed switch, pulse output <b>HA</b> = H0 + ATEX (Exi) <b>HE</b> = H0 + ATEX (Exd) <b>Z1</b> = dual LCD totaliser <b>Z2</b> = dosing unit LCD <b>Z3</b> = LCD totaliser, rate, outputs: 4-20 mA, alarm, pulse (ZOK-Z3) (impulses not for battery supply) <b>Z5</b> = as Z3, but with 2 relays/SPDT relays <b>1A<sup>4)</sup></b> = E1 + HA (ATEX Exi) <b>2A<sup>4)</sup></b> = E2 + HA (ATEX Exi) <b>3A<sup>4)</sup></b> = E3 + HA (ATEX Exi) <b>5A<sup>4)</sup></b> = E5 + HA (ATEX Exi)	<b>M</b> = M20 <b>N</b> = ½" NPT <b>S<sup>3)</sup></b> = M20 with cooling fin <b>T<sup>3)</sup></b> = ½" NPT with cooling fin	<b>0</b> = without <b>N</b> = without battery <b>Y</b> = special option (specify in clear text; not for ATEX)
4 - 145 GPH	<b>DON-S15G</b>					
1 - 40 l/min	<b>DON-S20H</b>	R4 = G ½ N4 = ½" NPT		<b>CT<sup>7)</sup></b> = U-PACE, TFT display, 2 outputs (current/voltage/pulse/frequency/alarm output/IO link configurable), M12x1 plug, with cCSAus and IECCE CB Scheme Approval	<b>0</b> = without	
0.26 - 10.6 GPM	<b>DON-S20G</b>					

<sup>3)</sup> Only for electronic options -Zx <sup>4)</sup> E1/E2/E3/E5 = Z1/Z2/Z3/Z5 in ATEX version (Exi), without backlighting <sup>5)</sup> This version is not calibrated (no calibration certificate) <sup>6)</sup> not for ATEX, only for Pulse Output <sup>7)</sup> l/min-package (nameplate (l/min or ml/min, °C, bar)), calibrated range and temperature °C; GPM-package (nameplate (GPM or GPH, °F, PSI)), calibrated range and temperature °F

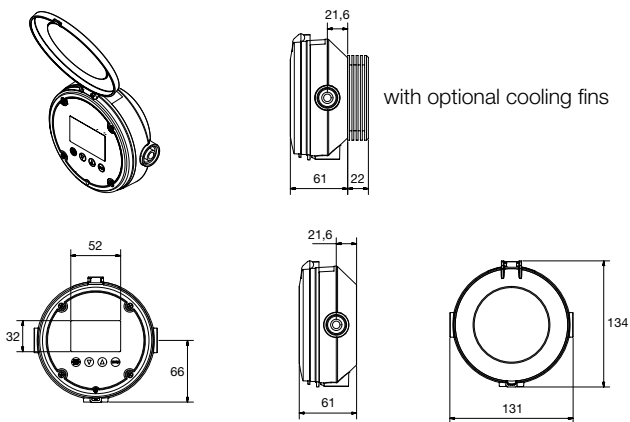


Dimensions [mm]



Model	A	B	C
DON-x05	70	96	74
DON-x10	72	96	74
DON-x15	98	116	100
DON-x20	117	128	120

Electronic with LCD display / Zx / Ex



U-PACE electronics (option DON-CT)

