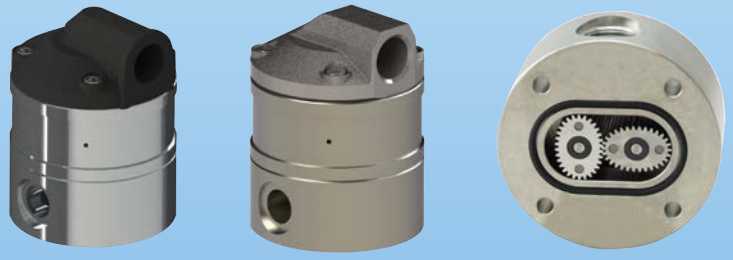
Zertifiziertes QM-System
DIN EN ISO 9001
Zertifikat-Nr. 01017

Oval Wheel Flowmeter

for low and high viscous liquids

measuring • monitoring • analysing

DON



- Measuring range: 0.5 … 36 l/h und 150 … 2500 l/min
- Viscosity range: 0…1000 cP (higher on request)
- Accuracy: ±0,2 % …2% of reading
- Material: aluminium or stainless steel
- p_{max}: 100 bar; t_{max}: 120 °C
- Pulse output, LCD display, 4…20 mA, alarms, mechanical register

S4

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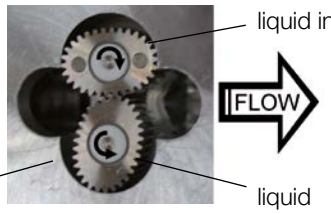
Principle of Operation

The Oval Wheel meters are positive displacement flowmeters where the passage of liquid causes two oval gears to rotate within a precision measuring chamber and with each rotation a fixed volume of liquid passes through the meter. Magnets embedded within the gears initiate a high resolution pulse train output. The pulse output can be wired directly to process control and monitoring equipment or can be used as an input to instruments supplied with or fitted directly onto the meter.

The flowmeter is available as a blind transmitter with pulse output capable of interfacing to most monitoring and control instrumentation or the meter can be fitted with or supplied with instruments such as totalisers, rate totalisers or batch controllers. These instruments also have monitoring and control output options including 4-20 mA, scaled pulse, flowrate alarms and batch control logic (preset metering).



This technology allows precise flow measurement and dispensing of most clean liquids regardless of their conductivity, with other liquid characteristics having no or minimal effect on meter performance. This metering technology does not require flow profile conditioning or straightline runs as required with alternative flow technologies making the installation relatively compact and low cost.

Positive displacement flowmeters are an inexpensive means to accurately meter high viscosity clean liquids as high as 1 million centipoises however, the appropriate meter must be sized so that the pressure drop across the primary measuring elements (oval rotor), does not exceed the maximum capability of either.

Areas of Application

For all viscous, non abrasive clean liquids like:

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

Stainless steel flowmeters are suited to most water based products and chemicals and aluminum meters are suitable for fuels, fuel oils & lubricating liquids.

Technical Details

Material

DON-1	
Body:	aluminium
Oval wheels:	PPS GF 30 / PTFE
Axes:	stainless steel 1.4404
DON-2	
Body:	stainl. steel 1.4404 DON-x05 ... DON-x15 stainl. steel 1.4404 / 1.3955 DON-x20 ... DON-x60
Oval wheels:	stainl. steel 1.4404 DON-x05 ... DON-x40 stainl. steel 1.3955 DON-x45 ... DON-x60
Bearing:	carbon graphite
Axes:	stainless steel 1.4404
DON-8	
Body:	stainl. steel 1.4404 DON-x05 ... DON-x15 stainl. steel 1.4404 / 1.3955 DON-x20 ... DON-x60
Oval wheels:	PPS GF 30 / PTFE
Axes:	stainless steel 1.4404
O-rings:	medium temperature FKM: -20 ... +120 °C EPDM: -50 ... +130 °C NBR: -20 ... +100 °C FEP-O-seal/EPDM: -15 ... +130 °C
Cover for cable connection:	polyamide PA6 GF35 UL94 HB/VO stainless steel 1.4404 (optional)

Material Screws

For aluminium	
Housing:	steel, coated with GEOMET® 321 (Standard)
For stainless steel	
Housing:	Stainless steel (Standard) steel, coated with GEOMET® 321 (optional) for higher pressure rating (see order details)
Accuracy:	± 1 % of reading (DON-x05…DON-x15)
SS Rotors:	± 0.5 % of reading (DON-x20…DON-x60) ± 0.2 % of reading (DON-x20…DON-x60; with optional Z3/E3-electronics based on linearization function) ± 1 % of reading (option M)
PPS Rotors:	± 1.5 % of reading (DON-x20) ± 2 % of reading (DON-x25…DON-x60) ± 1 % of reading (DON-x25…DON-x60; with optional Z3/E3-electronics based on linearization function) ± 2 % of reading (option M) (better accuracy for higher viscosities on request)
Additional max. inaccuracy for analogue outputs 4-20mA:	+/-0,15% full scale
Repeatability:	typ. ± 0.03 %
Protection class:	IP 66/67 (IP 65 for M4)
Medium temp.:	-20 °C ... +80 °C for options Lx, Zx, M4 and -20 °C ... +120 °C for pulse output and options Zx with cooling fins
Ambient temp.:	-20 °C ... +80 °C, option M4 0 °C ... +60 °C
Cable entry:	M 20 x 1.5, ½" NPT adapter
ATEX-approval (option E1/E3):	Ex II 2G EEx ia IIB T4 (-20 °C ≤ Ta ≤ +60 °C
(option HE, DE, GE, LE, RE):	Ex II 2G Ex d IIC T4...T6 Gb Ex I M2 Ex d I Mb (st. steel models only)

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Maximum Pressure (threaded version)

Model	Maximum pressure (bar)			
	DON-1	DON-2/8	DON-1.. (Option-M4)	DON-2/8 (Option–M4)
DON-x05	64	100	-	-
DON-x10			-	-
DON-x15		100	-	-
DON-x20		70*	40	40
DON-x25		60*		
DON-x30	40	50		
DON-x35				30
DON-x40	16	16	16	16
DON-x45				
DON-x50				
DON-x55				
DON-x60				

with flanges, maximum pressure rating as above or as per flange rating, whichever is lower

* max. pressure rating of 100 bar possible with steel screws (see order details)

Recommended Filter

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

DON-x20 ... DON-x35 < 150 µm micron (100 mesh)

DON-x40 ... DON-x60 < 350 µm micron (45 mesh)

Pulse Output

Reed switch pulse output (... R0 / RE)

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 per minute.

Average switching life of reed contact (MTTF):

max. Load (100 V / 10 mA) 5×10^5 switching cycles

min. Load (<5 V / 10 mA) 5×10^8 switching cycles

Power supply: max. 30 V_{DC}, max. 200 mA

Hall sensor pulse output (... H0/HE)

In the electronics options H0/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_{DC}. 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).

Hall sensor pulse output (...B0/BE)

Like options H0/HE, however with bipolar sensors and alternating polarised magnets. This option is used for pulsating flows, but has halved K-factor as compared to H0/HE.

High-resolution Hall sensor pulse output, (... G0/GE)

Like options H0/HE; model DON-x05 and DON-x10 can be supplied with four times the count of pulses per liter (see table «Output Pulse Resolution» on the following pages).

Quadrature hall effect pulse output (...D0/DE)

DON instrument with option D0/DE is provided with two independent Hall sensors The two hall effect sensors are arranged to give separate outputs out of phase with one another.

The QUAD output is mostly suitable for custody transfer with redundant signal or for detecting bidirectional flows (detection of flow direction).

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

Option L0/LE

The options L0 and LE (Ex) are available with loop powered 4-20 mA output. The loop is supplied with an external power supply 16 ... 32 V_{DC} The maximum resistance of the series loads (PLC analog input / display electronics) depends on the magnitude of the supply voltage and can be calculated as:

Max. load [Ohm] = (+Vs – 9 V_{DC}) / 0.02 A [Ω]

Example: +Vs = 32 V_{DC} = > max. load = 1150 Ω

+Vs = 16 V_{DC} => max. load = 350 Ω

The load can be inserted at any point in the current loop observing correct polarity.

Mechanical totaliser (...M4)

The flowmeters type DON-x20 ... up to DON-x60 ... are available with a 4-digit resetable mechanical totaliser and indication of accumulated total value. The motion of the rotors is transmitted to the mechanical register totaliser via an interfacing reduction gear train and dynamic seal assembly.

Option M4 is available for volume units litre and gallon.

Body material:	enamelled die-cast aluminium, powder-coated
Protection:	IP 65
Ambient temp.:	0 ... +60 °C
Medium temp.:	-20 ... +80 °C

Electronic with LCD Display

Model	..Z1 / Z6 / Z8	..Z2	..Z3 / Z7 / Z9	..E1	..E3
Function	dual totaliser	Dosing unit	Rate / Counter	dual totaliser	Rate / Counter
Power supply					
Battery-powered (outputs inactive)	yes	no	yes	yes	yes
External (also for backlighting)	8 - 24 V_{DC}	12 - 24 V_{DC}	8 - 24 V_{DC}	8 - 24 V_{DC}	8 - 24 V_{DC}
LCD display					
Selectable units	yes	yes	yes	yes	yes
Decimal point	yes	yes	yes	yes	yes
Accumulative total	yes	yes	yes	yes	yes
Resettable total	yes	yes	yes	yes	yes
Linearisation	no	no	yes	no	yes
Rate display	yes	yes	yes	no	yes
Backlighting	yes	yes	yes	no	yes
Input					
Un-powered sensors	Reed switch				
Powered sensors	Hall sensor				
Outputs					
4-20 mA	no	no	yes	no	yes
Flow rate Alarm min./max.	no	no	NPN/PNP/PP	no	NPN/PNP/PP
Batch end & control	no	yes	no	no	no
Pulse outputs	no	no	PP	no	PP
2 x SPDT relays	no	yes	option	no	option
Installation					
IP 65	yes	yes	yes	yes	yes
Cable entries	M20x1,5 / ½" NPT	M20x1,5 / ½" NPT	M20x1,5 / ½" NPT	M20x1,5 / ½" NPT	M20x1,5 / ½" NPT
Medium temperature (Option: max. +120 °C)	-20...+80 °C	-20...+80 °C	-20...+80 °C	-20...+80 °C	-20...+80 °C
Ambient temperature	-20 ... +80 °C			0 ... +60 °C	
Housing material	PA6 GF35 UL94 HB/VO / PC UL94 V-2				
ATEX approval	no	no	no	yes	yes

*replaces solid state outputs

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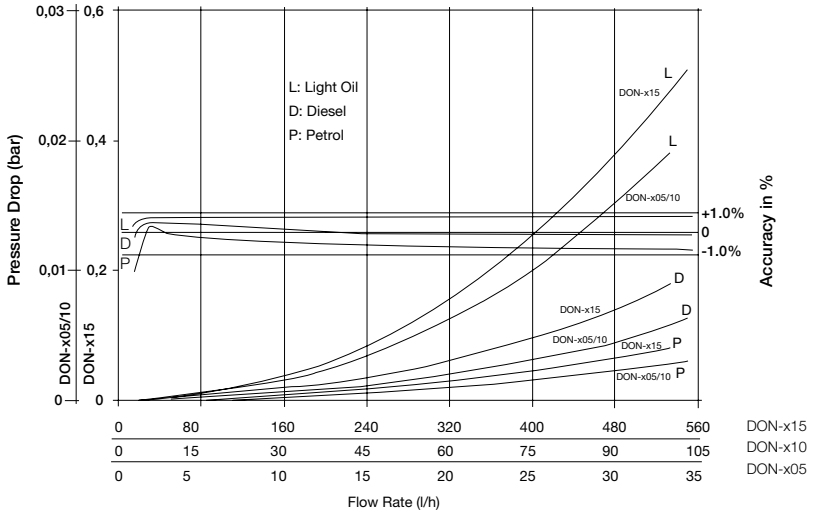
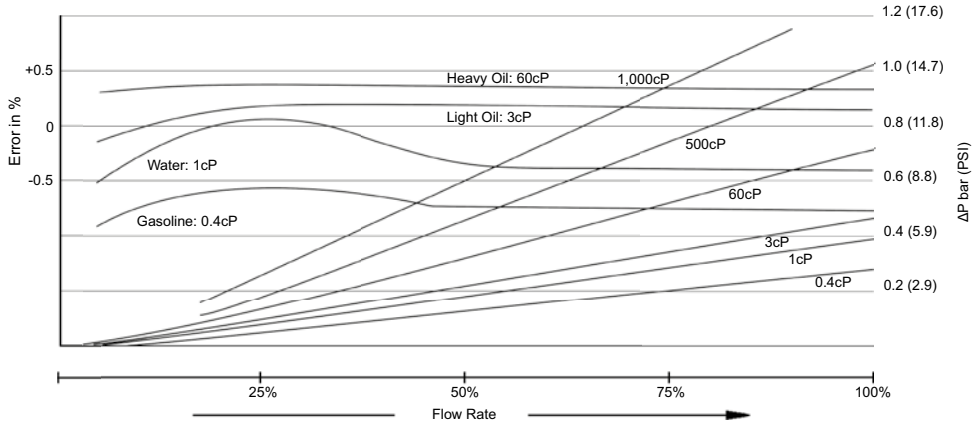
Accuracy and Pressure Drop for DON-x05/10/15...

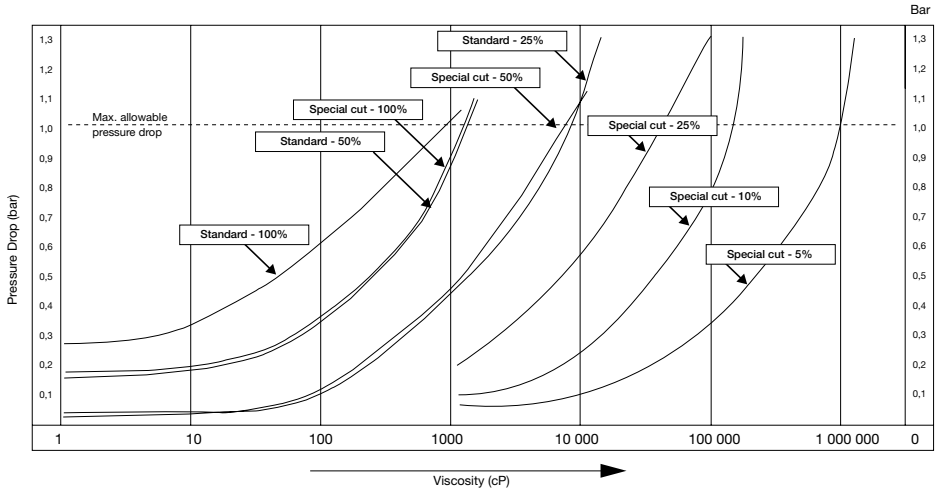


Accuracy and Pressure Drop for DON-x20... and above

*(**Note:** can also be used for DON-X05/10/15 for different fluids or viscosities not specifically covered in top graph)*



Pressure Drop Curves for Standard and Special Cut Rotors (option "S") in %age of max. Flow



Pressure drop limit verses flowrate

The curves above represent the pressure drop for standard and special cut high viscosity oval rotors at various viscosities. Special cut rotors have alternate tooth relieve which effectively reduces the pressure drop by 50%. When sizing a meter, be sure your selection falls on or below the 1 bar maximum allowable pressure drop line on the graph.

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 "S" should be used to reduce pressure drop. This applies to DON-x15 and larger sizes. For higher viscosities, the flowmeter max. flowrate is de-rated according to the attached chart.

Example: DON-x25 measuring oil at 8000 cP, max. flow 150 l/min x 0.5 = 75 l/min new maximum flow rate.

Output Pulse Resolution

Model	Measuring range [l/min]	Pulse/litre			
		Reed switch	Hall sensor	Quadr. hall sensor	Hall sensor, high-resolution
DON-x05	0.5 - 36 l/h	2800	2800	2800	11200
DON-x10	2 - 100 l/h	1050	1050	1050	4200
DON-x15	15 - 550 l/h	355	710	710	-
DON-x20	1 - 40	83	166	166	-
DON-x25	10 - 150	27	107	53.5	-
DON-x30	15 - 250	13	52.6	26.3	-
DON-x35	30 - 450	6.5	26	13	-
DON-x40	50 - 580	4.93	19.73	9.86	-
DON-x45	35 - 750	2.32	9.3	4.65	-
DON-x50	50 - 1000	1.55	6.2	3.1	-
DON-x55	75 - 1500	1.1	4.4	2.2	-
DON-x60	150 - 2500	0.56	2.24	1.12	-

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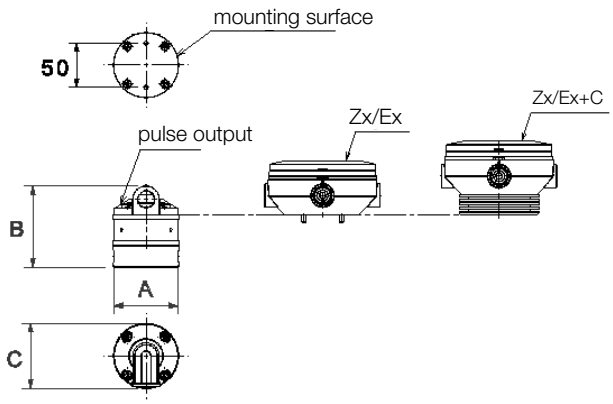
Order Details (Example: **DON-105H R1 1 L0 M 0**)

Measuring range	Housing material[4]			Connection	O-Ring Material	Electronics	Cable entry	Option
[l/min]	Aluminium with PPS Rotor	Stainless steel	St. steel with PPS Rotor					
0.5 - 36 l/h	**DON-105H**	**DON-205H**	**DON-805H**	**R1** = G ⅛ **N1** = ⅛" NPT	**1** = FKM **2** = EPDM **3** = FEP-O-ring **4** = NBR	**R0** = Reed switch pulse output **RE** = Reed switch pulse output ATEX (Exd) **H0** = Hall sensor (Push-Pull)/ Reed switch, pulse output **HE** = H0 + ATEX **B0** = for pulsating flow (not for DON-x05) **BE** = B0 + ATEX (Exd) **G0**[2] = high resolution hall sensor (Push-Pull) **GE**[2] = G0 + ATEX (Exd) **D0** = Quad. Hall sensor 2 phased outputs (Push-Pull) **DE** = as D0 + ATEX (Exd) **L0** = 4 ... 20 mA loop powered analogue output **LE** = L0 + ATEX (Exd) **Z1** = dual LCD totaliser **Z2** = Dosing unit LCD **Z3** = LCD totaliser, rate, outputs: 4-20 mA, alarm, pulse (ZOK-Z3) (impulses not for battery supply) **Z6** = Z1 + B0 **Z7** = Z3 + B0 **Z8** = Z1 + D0 **Z9** = Z3 + D0 **E1** = Z1 + ATEX (Exi) **E3** = Z3 + ATEX (Exi)	**M**= M20 **N**= ½" NPT **S**[7]= M20 with cooling fin **T**[7]= ½" NPT with cooling fin	**0** = without **K** = check valve (from DON-x30) **S**[3] = special cut rotors for higher viscosities **Y** = special option (specify in clear text)
2 - 100 l/h	**DON-110H**	**DON-210H**	**DON-810H**	**R2** = G ¼ **N2** = ¼" NPT				
15 - 550 l/h	**DON-115H**	**DON-215H**	**DON-815H**	**R3** = G ⅜ **N3** = ⅜" NPT				
1 - 40	**DON-120H**	**DON-220H**	**DON-820H**	**R4** = G ½ **N4** = ½" NPT **H4**[5] = G ½ (100 bar) **P4**[5] = ½" NPT (100 bar)				
10 - 150	**DON-125H**	**DON-225H**	**DON-825H**	**R6** = G 1 **N6** = 1" NPT **F6** = DIN flange, PN 16/40 (DN 25) **A6** = ANSI flange, 150 lbs (1") **B6** = ANSI flange, 300 lbs (1") **H6**[5] = G 1 (100 bar) **P6**[5] = 1" NPT (100 bar)				
15 - 250	**DON-130H**	**DON-230H**	**DON-830H**	**R8** = G 1½ **N8** = 1½" NPT **F8** = DIN flange, PN 16/40 (DN 40) **A8** = ANSI flange, 150 lbs (1½") **B8** = ANSI flange, 300 lbs (1½")				
30 - 450	**DON-135H**	**DON-235H**	**DON-835H**	**R9** = G 2 **N9** = 2" NPT **F9** = DIN flange, PN 16 (DN 50) **C9** = DIN flange, PN 40 (DN 50) **A9** = ANSI flange, 150 lbs (2") **B9**[1] = ANSI flange, 300 lbs (2")				
50 - 580	**DON-140H**	**DON-240H**	**DON-840H**					
35 - 750	**DON-145H**	**DON-245H**	**DON-845H**	**RB** = G 3 **NB** = 3" NPT **FB** = DIN flange, PN 16 (DN 80) **AB** = ANSI flange, 150 lbs (3")				
50 - 1000	**DON-150H**	**DON-250H**	**DON-850H**					
75 - 1500	**DON-155H**	**DON-255H**	**DON-855H**	**RC** = G 4 **NC** = 4" NPT **FC** = DIN flange, PN 16 (DN 100) **AC** = ANSI flange, 150 lbs (4")				
150 - 2500	**DON-160H**	**DON-260H**	**DON-860H**			**M4**[6] = mech. totaliser 4-digit	**0**= without	

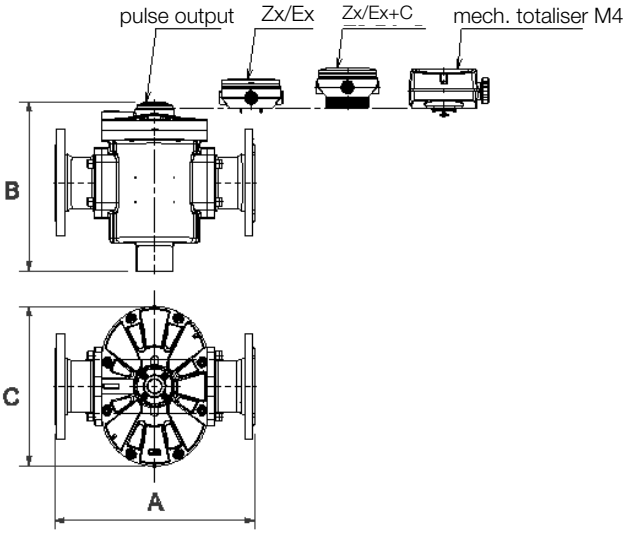
[1] Only for DON-x35; [2] Only for DON-x05 and DON-x10; [3] Not for DON-x05 and DON-x10; [4] Replace 'H' with 'G' to order GPH (GPM);
[5] With steel screws, only for DON-2... and DON-8... [6] Please specify the flow direction in clear text while ordering. Standard flow direction is from bottom to top.
[7] Only for electronic options -Zx

Dimensions DON-1(2/8)...

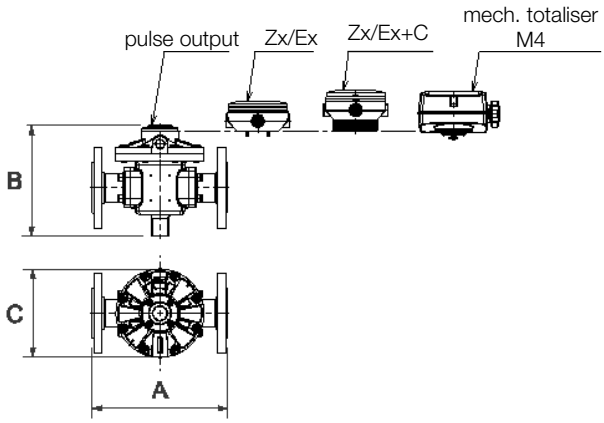
DON-x05 .... DON-x15



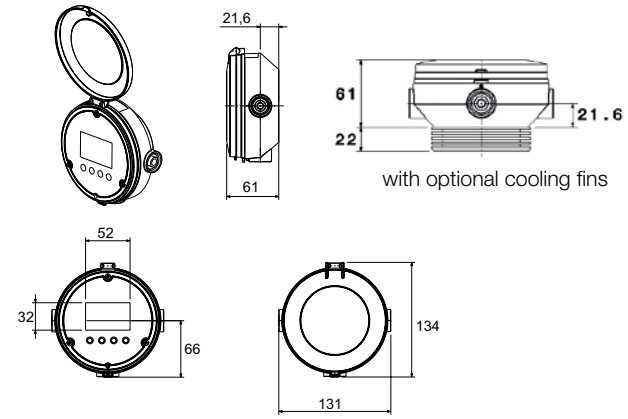
DON-x45 .... DON-x60



DON-x20 .... DON-x40



Electronic with LCD display / Zx / Ex



Dimensions DON-1(2/8)... (± 2 mm)

Model	A [mm]		B [mm]			C [mm]		
	Thread connection	Flange connection	Pulse out-put	Zx/Ex	Mechanical totaliser M4	Pulse output	Zx/Ex	Mechanical totaliser M4
DON-x05	68	-	92	131	-	72	134	-
DON-x10	68	-	92	131	-	72	134	-
DON-x15	68	-	99	138	-	72	134	-
DON-x20	110	-	105 (101)	134 (130)	182 (178)	112	134	165
DON-x25	176	237	136	165	194	120	134	170
DON-x30	188	252	166	195	223	163	163	200
DON-x35	212	277	172	201	244	180	180	200
DON-x40	212	277	246	275	299	180	180	200
DON-x45	266	354	232	261	284	238	238	239
DON-x50	294	382	229	258	302	290	290	290
DON-x55	294	388	274	303	347	290	290	290
DON-x60	320	414	351	380	424	331	331	331

Note: *Dimensions for DON-2/8... are specified in () only when they are different from DON-1...*