

# Insertion Paddle Wheel Flow Meter/Monitor for Low Viscous Liquids



measuring  
•  
monitoring  
•  
analysing

DOR



- Flow range:  
5.5 ... 180 gpm to 25,000 ... 800,000 gpm
- Flow velocity range: 1.0 - 33 ft/s
- $p_{\max}$ : 1160 psi;  $t_{\max}$ : 392 °F
- Connection: 1½" NPT, 2" NPT male, R 1½,  
& R 2 male for pipe sizes: 1½" - 100"
- Linearity:  $\pm 1.5\%$  with well established  
flow profile
- Material: stainless steel
- Outputs: pulse, LCD display,  
batching, totalizing, 4 - 20mA, relays



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KOBOLD Instruments Inc.  
1801 Parkway View Drive  
Pittsburgh, PA 15205  
412.788.2830  
412.788.4890  
info@koboldusa.com  
www.koboldusa.com



## Insertion Paddle Wheel Flow Meter/Monitor Model DOR

### Description

The DOR series insertion paddle wheel flow sensor is a very cost effective instrument for accurately measuring the flow of water or water-like liquids in large pipes.

The sensor is inserted into the process piping via a thread-onlet or half nipple fitting. Liquid flow through the pipe results in rotation of the affixed paddle wheel. The rotational speed of the paddle is proportional to the flow velocity, and therefore, proportional to the flowrate in the pipe.

The insertion type design provides a measuring technique that is much less expensive than full bore flowmeters, especially in larger pipe sizes. Insertion paddle wheel sensors are a robust measuring technology that boasts exceptional tolerance to dirt and solids.

The DOR series features an all 316L stainless steel body. The rotor is made of PVDF or PEEK, with a long-life graphite/PTFE self-lubricating bearing. The DOR has an integral, precision insertion mechanism that allows the installer to insert the rotor to the precise depth in the pipe for optimal readings.

Outputs include NPN open collector frequency, and/or reed contact frequency or millivolt frequency. Optional indicators include battery powered totalizers, loop powered ratemeter/totalizers with outputs and batch controllers.

The DOR-5 is suitable for "hot tap" installation. With its symmetrical design, the DOR may also be used for bi-directional flow measurement.

### Applications

- HVAC: Hot and Chilled water, Fire system and thermal energy monitoring
- Municipal: Water distribution, water management and water treatment
- Irrigation: Water management
- Water treatment: Chlorination, de-salination and mechanical filtration plants, chemical injection systems
- Refineries: Primary flow additive injection, fire and cooling systems
- Power generation: Boiler feed water, steam condensate, process water and water balancing
- Chemical: Process & cooling tower water, chemical and water batching
- Others: Cement Mfg, diesel fuel transferring, flow testing, fire truck and hydrant flow monitoring, food processing, pulp/paper, mining, memorial fountains

### Technical Details

|                          |   |
|--------------------------|---|
| Velocity range (linear): | 1.0...33 ft/s   |
| Linearity:               | ±1.5% with well est. flow profile   |
| Repeatability:           | ±1% of f. s. at factory conditions and optimal straight runs  |
| Max pressure:            | 1160 psi  |
| Temperature range:       | -4 ... +212°F standard, see max. allowable media temperature table for other options and restrictions |

### Material

|              |  |
|--------------|--|
| Body:        | 316L stainless steel   |
| Rotor:       | PVDF or PEEK (depending on model)  |
| Rotor shaft: | 316L stainless steel   |
| Bearing:     | graphite/PTFE  |
| Seals:       | FKM (standard): +5 ... +392°F<br>EPR (ethylene propylene rubber): -4 ... +248°F<br>PTFE encapsulated FKM: -4 ... +392°F<br>NBR (Nitrile): -85 ... +257°F |

### Electronics

|                              |   |
|------------------------------|---|
| Max. frequency:              | 220...240 Hz (hall effect and voltage output), 73...80 Hz (reed switch output)            |
| Supply voltage:              | see electronics comparison table  |
| Electronic features:         | see electronics comparison table  |
| Wiring (standard):           | 5 wire, screened cable, length 10 feet  |
| Transmission distance:       | 3000 feet maximum, without integrated electronics   |
| Cable entry (terminal box):  | M20x1.5, 1/2" NPT via adapter (optional)  |
| Protection Class:            | IP68 (cable connection), IP66/67 (all other electrical connections)                       |
| Straight piping requirement: | Minimum: 10xd (upstream), 5xd (downstream)<br>Optimal: 25xd (upstream), 10xd (downstream) |
| Weight:                      | (approx., without electronics): 3.6 lb (DOR-4), 5.5 lb (DOR-5)                            |



**Electrical Output Specifications**

**Hall Effect Sensor Output (Fx, Nx, Qx)**

The **Hall Effect Sensor** is a high resolution solid state 3 wire device providing an unsourced, open collector, NPN transistor output. The term "unsourced" means that no voltage is applied to the output from within the flowmeter. It must be pulled to a 'high' or 'on' state by between 5-24V<sub>DC</sub> supplied from an external source, typically the receiving instrument. The pulse output between signal and -0V is a voltage square wave with the high level being the DC voltage available at the open collector and the low level being -0V.

The receiving instrument must incorporate a pull up resistor (typically greater than 10kΩ in most instruments) which ties the open collector to the available DC voltage level when the Hall sensor is not energized. When energized the open collector output is pulled to ground through the emitter (-0V). Power supply: max. 5-24 V<sub>DC</sub>, max. 20 mA

**Voltage Pulse Output (Fx)**

A self generating 2 wire **voltage pulse output** with 1.5 V voltage spike of approximately 10 microseconds duration is generated with no dependence on rotor speed.

**Reed Switch Pulse Output (Rx)**

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 (simple apparatus) 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 18°F per minute. In general the reed switch life will exceed 2 billion actuations when switching less than 5V<sub>DC</sub> at 10mA.

Power supply: max. 30 V<sub>DC</sub>, 200 mA

**Quadrature Pulse Output (Qx)**

Two Hall Effect sensors arranged to give separate outputs out of phase with one another. The Quadrature output is typically suited to ensure output signal integrity or to measure bi-directional flow.

Power supply: max. 8-24 V<sub>DC</sub>, max. 20 mA

**NPN Inductive Pick-up (Ex)**

Inductive pick-up with non-magnetic rotor for applications with high ferrous content liquids.

Output is 3-wire NPN, 5-24 V<sub>DC</sub>, 20 mA max.

**Millivolt Inductive Pick-up (T5) for +257°F**

Inductive pick-up with non-magnetic rotor for applications with high ferrous content liquids.

Output is 2-wire pulse, 1500 mV max, 10 μSec duration. Good for process temperatures to 257°F.

**Millivolt Inductive Pick-up (H5) for +392°F**

Inductive pick-up with magnetic rotor for high temperature applications to 392°F.

Output is 2-wire pulse, 1,500 mV max, 10 μSec duration.

**Electronic with LCD display**

| Model                                  | Z1  | Z3                     | Z5                     | B1                      |
|--|---|------------------------|------------------------|-------------------------|
| Function                               | Dual totalizer                            | Rate totalizer         | Rate totalizer         | Batch controller        |
| <b>Power source</b>                    |   |                        |                        |                         |
| battery-powered                        | yes                                       | yes                    | yes                    | no                      |
| external (drives output, backlighting) | 8 - 24 V <sub>DC</sub>                    | 8 - 24 V <sub>DC</sub> | 8 - 24 V <sub>DC</sub> | 12 - 24 V <sub>DC</sub> |
| <b>LCD display</b>                     |   |                        |                        |                         |
| -line 1 / no. of digits                | 7.5 mm/5                                  | 9 mm/8                 | 17 mm/6                | 9 mm/8                  |
| -line 2 / no. of digits                | 3.6 mm/8                                  | -                      | 7 mm/8                 | -                       |
| selectable units                       | yes                                       | yes                    | yes                    | yes                     |
| decimal point                          | yes                                       | yes                    | yes                    | yes                     |
| subscripts displayed                   | yes                                       | yes                    | yes                    | yes                     |
| accumulative total                     | yes                                       | yes                    | yes                    | yes                     |
| resettable total                       | yes                                       | yes                    | yes                    | no                      |
| linearisation                          | no  | yes                    | no                     | no                      |
| rate display                           | no  | yes                    | yes                    | no                      |
| backlighting                           | no  | no                     | yes                    | no                      |
| <b>Input type</b>                      |   |                        |                        |                         |
| un-powered sensors                     | see display user manual                   |                        |                        |                         |
| powered sensors                        | see display user manual                   |                        |                        |                         |
| <b>Outputs</b>                         |   |                        |                        |                         |
| 4-20 mA (750 Ω)                        | no  | yes                    | no                     | no                      |
| high/low flow alarm                    | no  | NPN/PNP                | NPN                    | no                      |
| batch end & control                    | no  | no                     | no                     | NPN/PNP                 |
| pulse outputs                          | NPN/PNP                                   | NPN/PNP                | NPN                    | NPN/PNP                 |
| 2 x SPDT relays                        | no  | optional*              | no                     | optional*               |
| <b>Installation</b>                    |   |                        |                        |                         |
| IP 66/67                               | yes                                       | yes                    | yes                    | yes                     |
| cable entries                          | 2 x gland                                 | 3 x M 20               | 3 x M 16               | 3 x M 20                |
| intrinsic safe (option)                | yes                                       | yes                    | no                     | no                      |
| mounting                               | meter mount, wall, pipe or panel mounting |                        |                        |                         |
| temperature range                      | -4 ... +176 °F (Option: -4 ... +248 °F)   |                        |                        |                         |

\*replaces solid state outputs

**DOR Series Nominal Flow Measuring Ranges in Sch 40 Steel Pipe at 1...33 ft/s Fluid Velocity**

| Line Size (Sch. 40 Steel) in inches | Nominal Measuring Range (GPM) | Line Size (Sch. 40 Steel) in inches | Nominal Measuring Range (GPM) |
|-------------------------------------|-------------------------------|-------------------------------------|-------------------------------|
| 1-1/2                               | 6 - 210                       | 10                                  | 245 - 8,080                   |
| 2                                   | 10 - 345                      | 12                                  | 360 - 11,625                  |
| 2-1/2                               | 15 - 490                      | 14                                  | 480 - 15,850                  |
| 3                                   | 25 - 760                      | 16                                  | 560 - 18,175                  |
| 4                                   | 40 - 1,300                    | 18                                  | 700 - 23,100                  |
| 6                                   | 90 - 2,975                    | 20                                  | 875 - 28,550                  |
| 8                                   | 160 - 5,170                   | 24                                  | 1,250 - 41,250                |



**Insertion Paddle Wheel Flow Meter/Monitor Model DOR**

**Order Details** (Example: **DOR-42 2 F N9 H5 00**)

| Base Model                                   | Rotor/Shaft                      | Sealing Material                                   | Mechanical Connection  | Output/<br>Electrical Connection   | Electronics  |
|--|----------------------------------|--|--|--|--|
| <b>DOR-42</b><br>(for pipe size 1½" ... 36") | 2 = PVDF/st. steel (max. 212 °F) | <b>F</b> = FKM (standard)<br><b>N</b> = NBR        | <b>DOR-42</b><br><br><b>N8</b> = 1½" NPT male<br><b>N9</b> = 2" NPT male<br><br><b>R8</b> = R 1½ male<br><b>R9</b> = R2 male | <b>F1</b> = NPN OC + 1,5V-Pulse + 10' cable (standard)<br><b>F2</b> = NPN OC + 1,5V-Pulse + 30' cable<br><b>F3</b> = NPN OC + 1,5V-Pulse + 60' cable<br><b>F4</b> = NPN OC + 1,5V-Pulse + 150' cable<br><b>F5</b> = NPN OC + 1,5V-Pulse + terminal box on stem kit<br><b>F6</b> = NPN OC + 1,5V-Pulse + integral electronic on stem kit<br><br><b>N5*</b> = NPN OC + terminal box on stem kit + High Temp. Sensor<br><b>N6*</b> = NPN OC + integral electronic on stem kit + High Temp. Sensor   | <b>00</b> = Frequency output only  |
| <b>DOR-52</b><br>(for pipe size 2" ... 100") | 4 = PEEK/st. steel (max. 392 °F) | <b>P</b> = PTFE encapsulated FKM<br><b>E</b> = EPR | <b>DOR-52</b><br><br><b>N9</b> = 2" NPT male<br><br><b>R9</b> = R2 male  | <b>R1</b> = Reed switch + 10' cable<br><b>R2</b> = Reed switch + 30' cable<br><b>R3</b> = Reed switch + 60' cable<br><b>R4</b> = Reed switch + 150' cable<br><b>R5</b> = Reed switch + terminal box on stem kit<br><br><b>Q1</b> = 2xNPN OC + 10' cable<br><b>Q2</b> = 2xNPN OC + 30' cable<br><b>Q3</b> = 2xNPN OC + 60' cable<br><b>Q4</b> = 2xNPN OC + 150' cable<br><b>Q5</b> = 2xNPN OC + terminal box on stem kit<br><br><b>E1</b> = Non-magnetic rotor for ferrous media, NPN, 10' cable<br><b>E2</b> = Non-magnetic rotor for ferrous media, NPN, 30' cable<br><b>E3</b> = Non-magnetic rotor for ferrous media, NPN, 60' cable<br><b>E4</b> = Non-magnetic rotor for ferrous media, NPN, 150' cable<br><br><b>T5*</b> = Non-magnetic rotor for ferrous media, ind. coil, terminal box on stem kit<br><br><b>H5*</b> = High temp., inductive coil, terminal box on stem kit, +392 °F | <b>only for output F6/N6</b><br><br><b>B1</b> = Batch Controller<br><b>Z1</b> = Dual Totalizer<br><b>Z3</b> = Rate/Dual Totalizer<br><b>Z5</b> = Rate/Dual Totalizer |

\* only possible with PEEK rotor

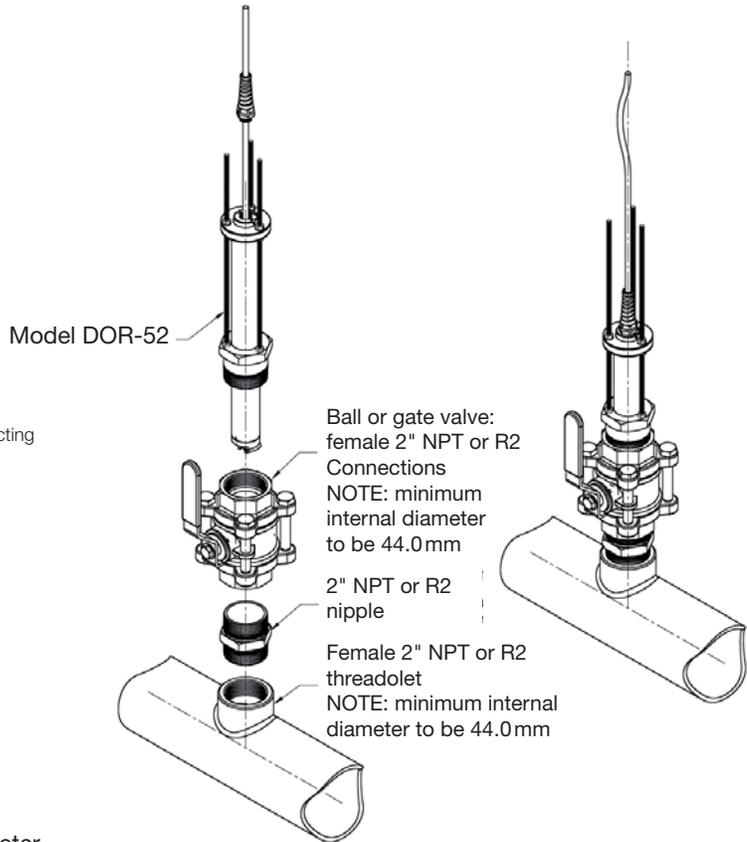


**Process Temperature Limits with Rotor and Output Options\***

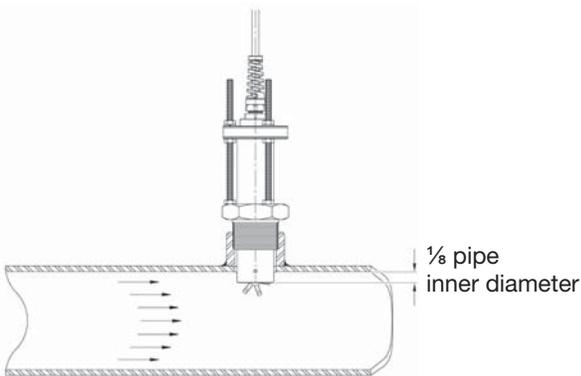
| Rotor                      | Max. medium temperature |
|----------------------------|-------------------------|
| PVDF                       | 212°F                   |
| PEEK                       | 392°F                   |
| <b>Output/Pick-up type</b> |                         |
| F1 -F6<br>R1 -R5<br>Q1 -Q5 | 212°F                   |
| N5, N6                     | 302°F                   |
| E1 -E4                     | 185°F                   |
| T5                         | 257°F                   |
| H5                         | 392°F                   |

\*choose PEEK rotor for all options > 212°F, keep temperature limits of sealing materials also in mind while selecting different options.

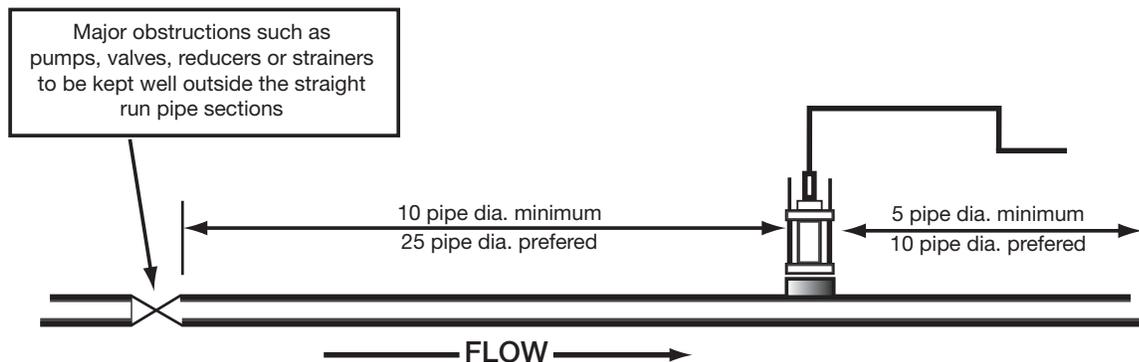
**Recommended Hot-Tap Installation for DOR-52 series**



**Standard Installation**



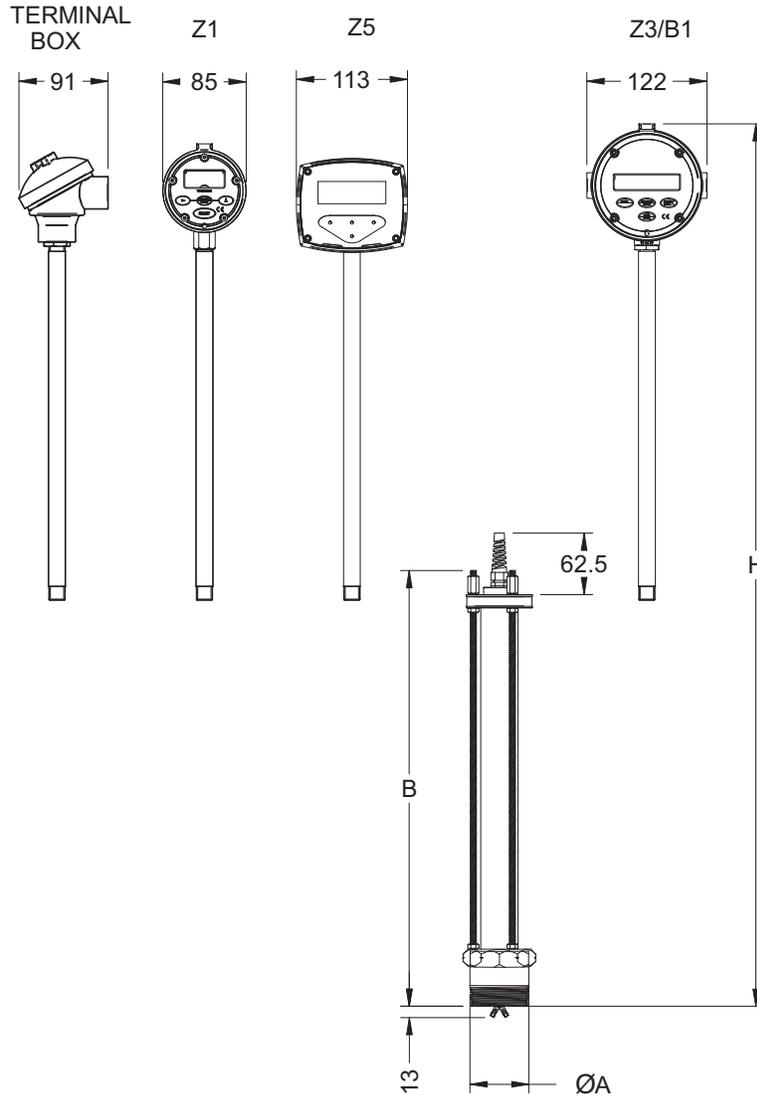
**Installation Straight Piping Requirements**





**Insertion Paddle Wheel Flow Meter/Monitor Model DOR**

**Dimensions (in mm)**



All dimensions in mm, ± 2 mm

|                      | <b>DOR-42</b>     | <b>DOR-52</b> |
|----------------------|-------------------|---------------|
| <b>ØA</b>            | 1 ½" or 2" NPT/R2 | 2" NPT/R2     |
| <b>B</b>             | 198               | 444           |
| <b>Configuration</b> | <b>H</b>          | <b>H</b>      |
| Terminal Box         | 385               | 869           |
| Z1                   | 394               | 880           |
| Z3/B1                | 415               | 900           |
| Z5                   | 380               | 865           |