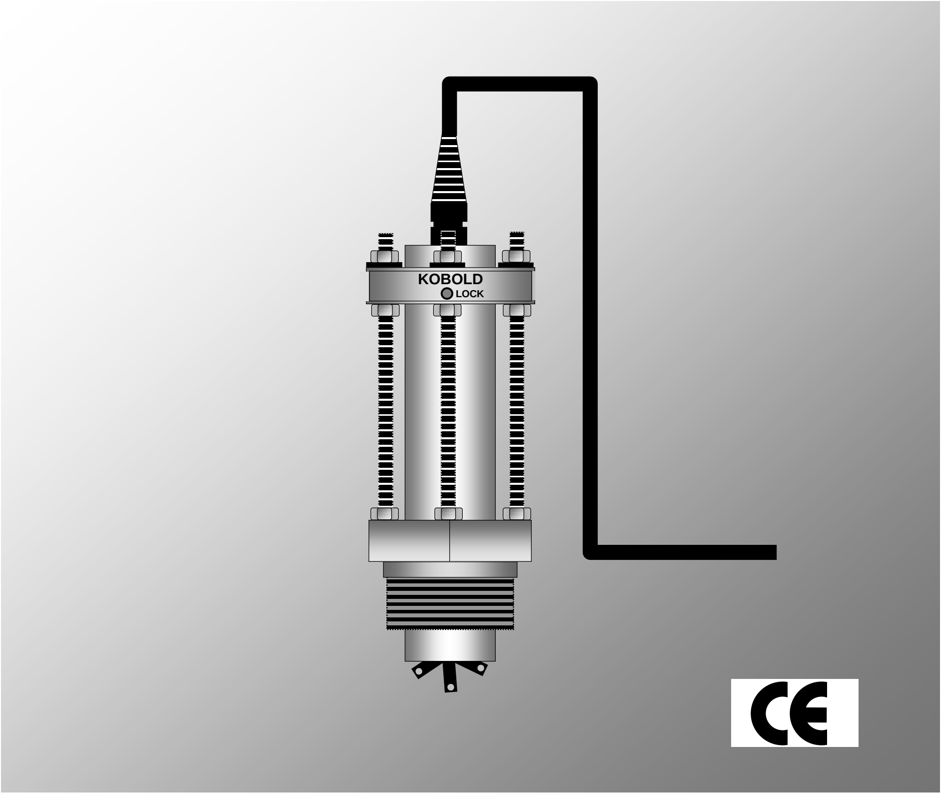
DOR-42 & DOR-52
BI-DIRECTIONAL INSERTION FLOW TRANSDUCER

INSTRUCTION MANUAL



FIMDP000-5106

IMPORTANT INFORMATION

Thank you for purchasing a Kobold Insertion Flowmeter. It is important that you read this manual to gain a full understanding of the capability and operational aspects of the equipment you are about to install.

This information is provided only to assist in the installation of the product and does not diminish your obligation to read the manual.

1. Select a location that meets the requirements as illustrated on the guideline sheet (yellow pages located in the centre of this manual). An ideal installation would provide for 25 diameters of straight pipe upstream from the meter and 10 diameters downstream.

You will also need to know the pipe internal diameter (NB) and pipe wall thickness for calculation of the insertion depth. *(refer page 5.)* Non ideal installations may require in-situ calibration *(refer to the factory for details).*

2. After screwing the flowmeter in place ensure the flow alignment mark located on the top positioning collar of the meter aligns with the flow in the pipe *(refer page 5).* This ensures the paddle is correctly aligned to the flow.
Note. the meter is bi-directional so a flow direction arrow is <u>not</u> provided.

3. Calculate and adjust the height of the flowmeter *(refer page 5).*

4. Electrical Installation depends on the model you have purchased.
If the dualpulse is fitted or supplied with a receiving instrument such as a totaliser or rate totaliser please refer to the appropriate manual and Page 10 of this manual. For pulse output meters, select the appropriate output and wire to your receiving device. *(refer pages 7 to 9).*

5. Calculate the flowmeter K *(scale)* factor to suit the installation. For ideal installations refer to page 11 or 12 or 13 of the flowmeter Manual. For non ideal installations the K-factor may be calculated by performing an in-situ calibration. Enter the appropriate K-factor into your receiving instrument.

CONTENTS **PAGE**

Base Model	Rotor/Shaft Material	Fitting	O-ring Material	Output/Display
DOR-42...=1-1/2" to 36" line sizes	**...2..**= PVDF Rotor/316L SS Shaft (standard), 250°F Max. **...3..**=PVDF Rotor/Hast. C Shaft, 250°F Max.	**N8..** =11/2" NPT male **N9..**= 2" NPT male **R8.**=1-1/2" BSPT male **R9..**= 2" BSPT male	**..F**= Viton® (standard) **..E**= EPDM **..N**= Buna-N **..P**= PTFE coated Viton®	**Outputs** **...F1** = Dual Pulse 10 Ft. Cable (standard) **...F2** = Dual Pulse 30 Ft. Cable **...F5** = Dual Pulse Junction Box **...Q1** = Dual NPN Pulse 10 Ft. Cable **...Q2** = Dual NPN Pulse 30 Ft. Cable **...Q5** = Dual NPN Pulse Junction Box **...R1** = Dual Reed Pulse 10 Ft. Cable **...R2** = Dual Reed Pulse 30 Ft. Cable **...R5** = Dual Reed Pulse Junction Box **...E1** = Non-magnetic Rotor, NPN Output 10 Ft. Cable **...H5** = Magnetic Rotor, Hi-Temp. Millivolt Output (390°F), Junction Box **...T5** = Non-magnetic Rotor, Hi-Temp. Millivolt Output (250°F), Junction Box **Displays** **...B1** = Batch Controller **...Z1** = Battery Powered Dual Totalizer **...Z3** = Battery/Loop powered Dual Totalizer/Rate meter **...Z5** = Battery Powered Dual Totalizer/Rate meter, Backlit LCD
DOR-52...= 2" To 100" line Sizes. hot tap capable	**...4..**= PEEK Rotor/316L SS Shaft, 390°F Max. **...5..**=PEEK Rotor/Hast. C Shaft, 390°F Max.	**N9..**= 2" NPT male **.R9..**= 2" BSPT male		

1.2 Overview

Kobold insertion flow transducers provide a cost effective and simple means of measuring the flow of a wide range of low viscosity liquids. Installation is quick and inexpensive for pipe diameters ranging from 40mm to 900mm (1.5-36") and up to 2500mm (100") nominal bore for the Hot tap capable model DP525.

The flowmeter has a linear measuring range of 0.3~10.0 metres/sec. (1~33 ft/sec.). Minimum detectable flow velocity is 0.15 m/sec. (0.5 ft/sec.). When used in conjunction with the Z3 flow rate totaliser NLC feature the linear flow range is extended down to 0.15 m/sec. (0.5 ft/sec.) with an improved linearity.

The flowmeter is constructed from 316 L (1.4404) stainless steel enabling use in many applications for metering water and low viscosity chemicals.

Two independent pulse outputs are standard & can directly input to a wide range of ancillary instruments, PLC's and computers. Both pulse outputs have a high level of immunity to electrical interference. Options include a reed switch.

1.3 Operating principle

Flow passes through a pipe causing the rotor to spin. Magnets installed in the rotor pass by pulse sensors within the transducer body & inturn this produces frequency outputs proportional to flow rate.

1.4 Specifications (subject to change without notice)

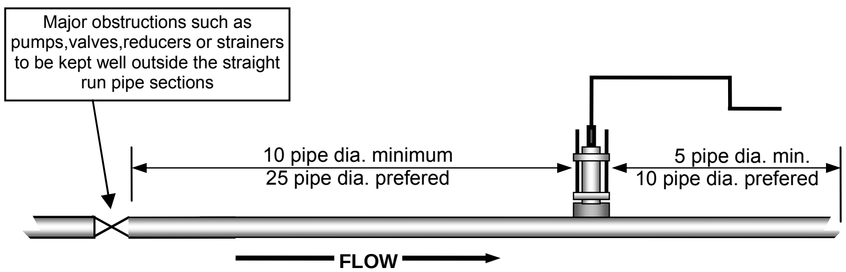
Model No.	DOR-42	DOR-52
Suits pipe sizes	40mm - 900mm (1.5 – 36 inches)	50mm - 2500mm (2 – 100 inches)
Flow range	0.25 - 6300 litres/sec. (4-99600 USGPM)	0.4 - 49000 litres/sec. (6-780000 USGPM)
Process connections	1.5" or 2" NPT or BSPT	2" NPT or BSPT
Velocity range	0.3 - 10 metres/sec. (1 - 33 feet/sec.)	
Linearity	typically ± 1.5%	
Repeatability	typically ± 0.5%	
Pressure (max)	80 Bar (1200PSI)	
Temperature range	-40°C to 100°C (-40°F to 212°F) – refer options	
Body material	316L stainless steel (1.4404)	
Rotor materials	PEEK rotor with graphite-PTFE impregnated PEEK bearing	
O-Ring material	VITON - options available	
(a) Voltage output (to 125°C)	1.5volt x 10μ sec pulse width, self-generated (2 wire)	
(b) Square wave (Hall Effect)	5-24vdc, 3wire NPN open collector (20mA max. current sink)	
(c) Reed Switch (to 100°C)	30vdc max. x 20mA max. (output freq. is 1/3 std. K-factor)	
Output freq. @ max. velocity	**(a & b)** outputs 220~240 Hz	**(c)** output 73~80 Hz
Output options	Ultra high temp. coil 204°C (400°F) or non magnetic	
Transmission distance	1000 metres (3300 feet) maximum	
Wiring (standard)	5 core, screened cable, length 3 metres (10 feet)	
Protection class	IP68 submersible (Nema 6X)	
Conduit entry (terminal box)	3/8" NPT or PG9	
Shipping Weight	1.2 kg (2.7 lbs.)	1.5 kg (3.3 lbs.)

2.0 INSTALLATION

2.1 Meter location

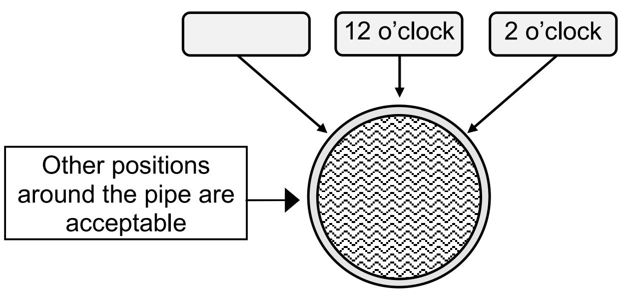
Choose an appropriate section of horizontal or vertical pipe as per the guidelines below. With vertical pipe installations the media should be pumped up through the pipe past the flow sensor so that any entrained air will pass freely.

The DOR flow sensor requires a fully developed turbulent flow profile to ensure maximum measurement accuracy and repeatability. This can be achieved by installing the DP in a straight run of pipe. We recommend <u>at least</u> 10 but ideally 25 straight pipe diameters upstream & <u>at least</u> 5 but ideally 10 pipe diameters downstream of the flowmeter. Major obstructions such as pumps, valves or strainers will require longer straight runs before and after the flowmeter.



2.2 Meter installation & orientation

Cut a 40mm diameter hole (1.6") on either the 2, 10 or 12 o'clock positions of the pipe. If there is any likelihood of air entrainment in a horizontal pipe do not locate the flow transducer in the 12 o'clock position.



Install a female threaded weld on fitting (threadolet) or service saddle.
Wrap the threads of the flowmeter with Teflon tape or sealing compound & screw the unit into the installed fitting.

2.3 Height adjustment calculation

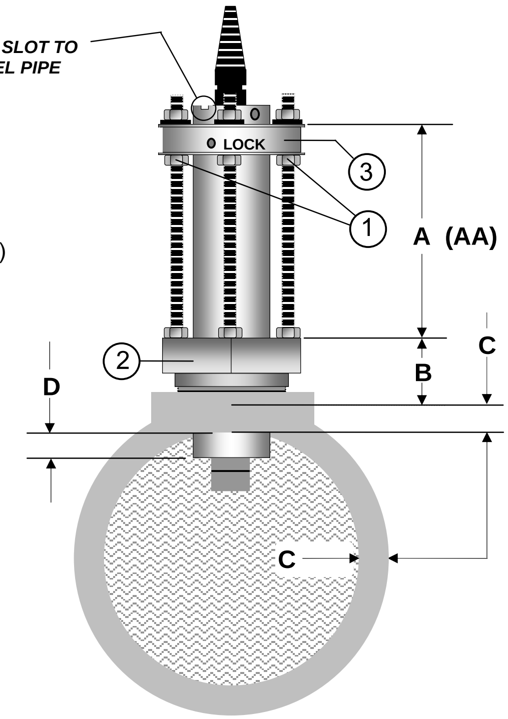
Calculate the adjustment height **A** for DOR-42 (or **AA** for the DOR-52) as follows:

A (for DOR-42) = 175mm (6.9") - (B + C + D)
AA (for DOR-52) = 420mm (16.5") - (B + C + D)

Where :
B = Distance between the top of the pipe & the top of the hex adaptor.
C = Pipe wall thickness
D = Insertion depth (pipe ID ÷ 8)

Examples of insertion depth **D** :

For 40mm pipe ID (**D=** 5.0 mm)
For 50mm pipe ID (**D=** 6.25 mm)
For 100mm pipe ID (**D=** 12.5 mm)
For 400mm pipe ID (**D=** 50.0 mm)



Turn the height adjustment nuts (1) as required so that the distance between the top of the hex adaptor (2) and the top of the positioning collar (3) equals your calculated distance **A** (for DOR-42) or **AA** for model DOR-52 Retighten the height adjustment nuts (1).

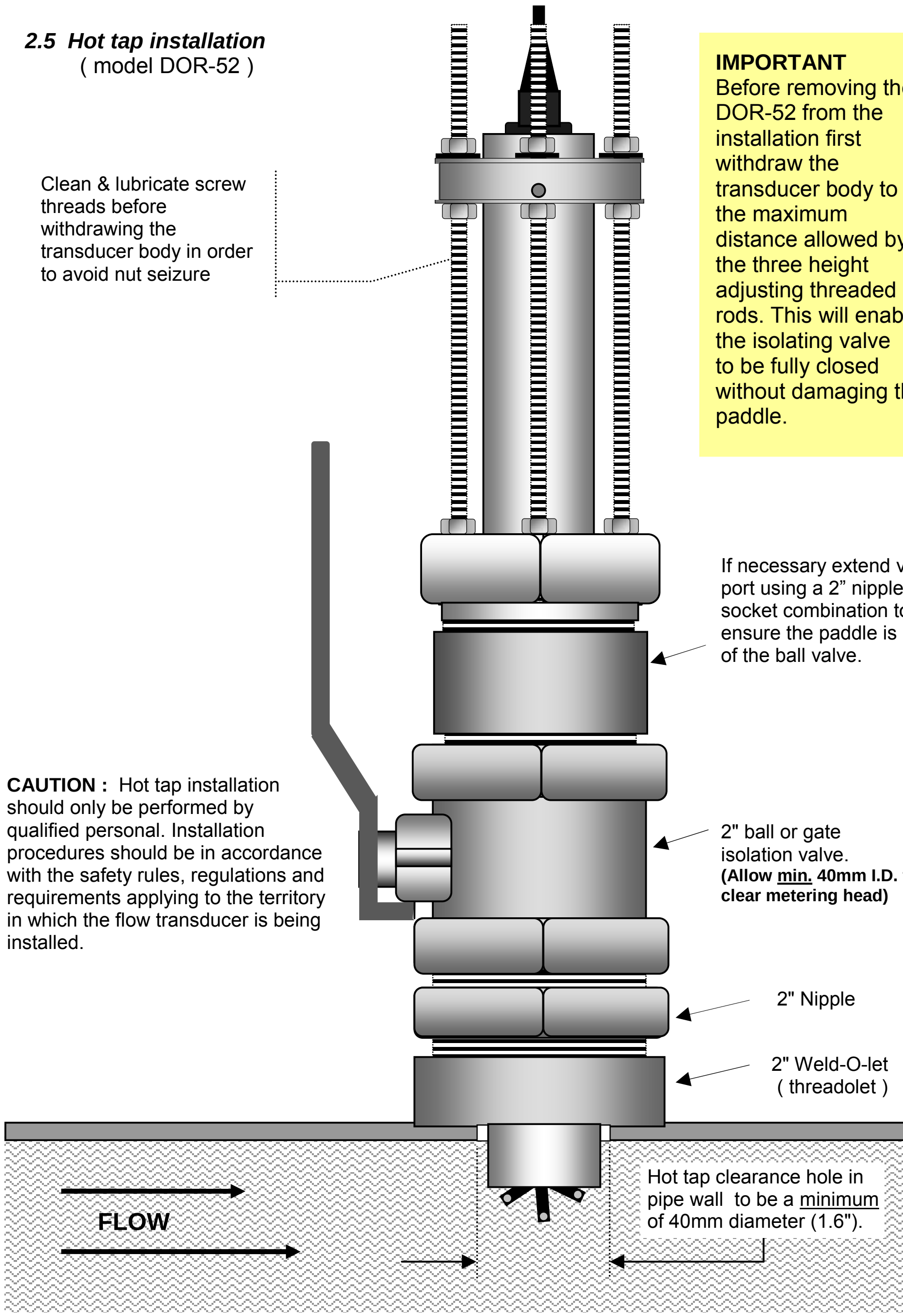
2.4 Flow direction orientation

The unit is bi-directional however the paddle must be aligned with the direction of flow.

Using a 2mm hex key (Allen key), unlock the locking screw located on the positioning collar (3) then insert the hex key (as a lever) in the body rotating hole located above the collar, turn the body until the alignment slot is parallel with the direction of pipe. Retighten the locking screw.

2.5 Hot tap installation
(model DOR-52)

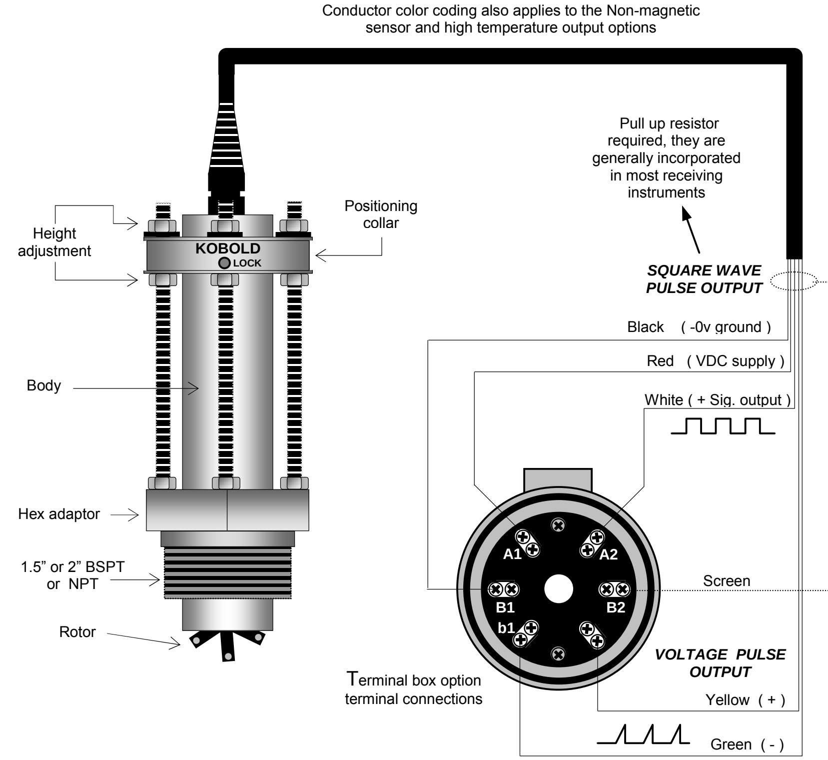
IMPORTANT
Before removing the DOR-52 from the installation first withdraw the transducer body to the maximum distance allowed by the three height adjusting threaded rods. This will enable the isolating valve to be fully closed without damaging the paddle.



CAUTION : Hot tap installation should only be performed by qualified personal. Installation procedures should be in accordance with the safety rules, regulations and requirements applying to the territory in which the flow transducer is being installed.

3.0 ELECTRICAL CONNECTIONS
(see page 9 for QP outputs)

3.1 Standard outputs

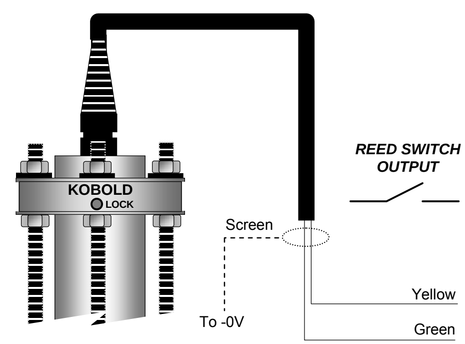


3.2 Optional Reed switch output

HAZARDOUS AREAS

The REED SWITCH output is classed as a "simple apparatus" as defined in the CENELEC standard EN50020 & recognized IEC & ATEX directive. It can be connected to an approved I.S. secondary instrument with both being located in the hazardous area.
The Reed Switch may also be connected through an approved I.S. barrier.

Note: The Reed switch produces 1/3rd the normal pulse output value (eg. 1/3 the standard K-factor)



3.3 Instrument cable installation requirements

Use twisted multi-core low capacitance shielded instrument cable (22 AWG ~ 7x 0.3 stranded) for electrical connection between the flow meter and the remote instrumentation. The screen should be earthed at the readout instrument end only to protect the transmitted signal from mutual inductive interference.

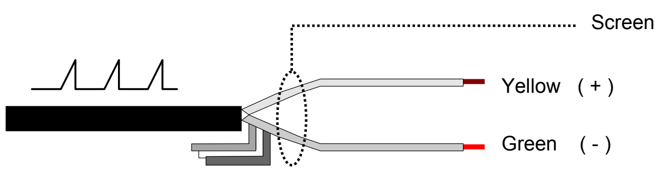
The cable should **not** be run in a common conduit or parallel with power and high inductive load carrying cables as power surges may induce erroneous noise transients onto the transmitted pulse signal. Run the cable in separate conduit or with other low energy instrument cables .

3.4 Pulse output selection (standard outputs)

The standard flowmeter has two independent pulse output signals that are linearly proportional to volumetric flow rate. Pulse transmission can be up to 1000 metres (3300 ft). An optional I.S. Reed Switch output is available *(see page 7).*

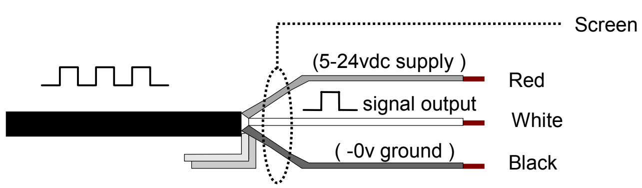
<u>Voltage pulse *(pulse wire)* output</u>

A self generating pulse output which produces a strong 1.5 volt voltage spike of approximately 10 micro/second duration with no dependence on rotor speed.



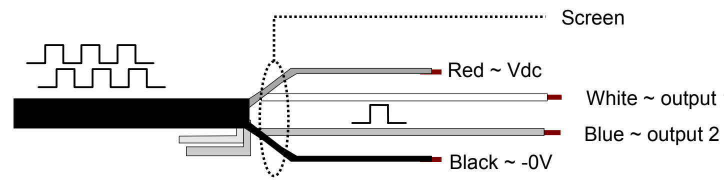
<u>Square Wave Pulse *(Hall sensor)*</u> *(also applies to non-magnetic & QP Hall outputs)*

An NPN open collector transistor pulse output produced by a solid state Hall Effect device. This three wire device requires 5~24vdc and produces an NPN square wave output (20mA max. sink), pulse width is 2~75 mSec. The Hall output requires a pull up resistor, these are generally incorporated in most receiving instruments. For (QP) Quadrature pulse output refer details page 9.



3.5 Quadrature outputs

DOR series flowmeters supplied with the QP option produce two NPN open collector pulse outputs from two Hall Effect sensors. The outputs are " phase offset " in their timing so that external electronics are able to differentiate. These outputs may be used to assure output signal integrity or to measure bi-directional flow.

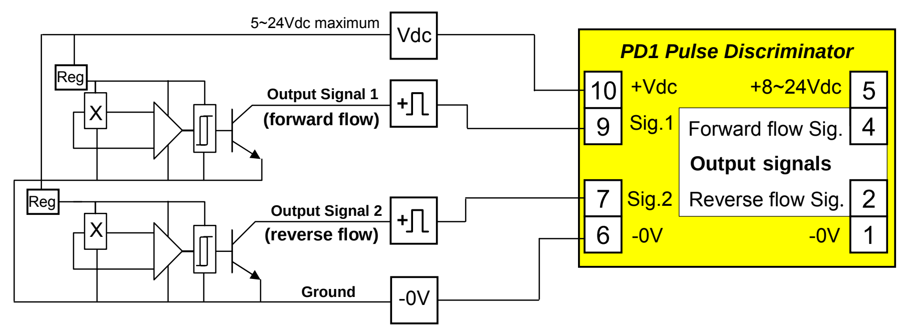


3.6 Bi-directional flow

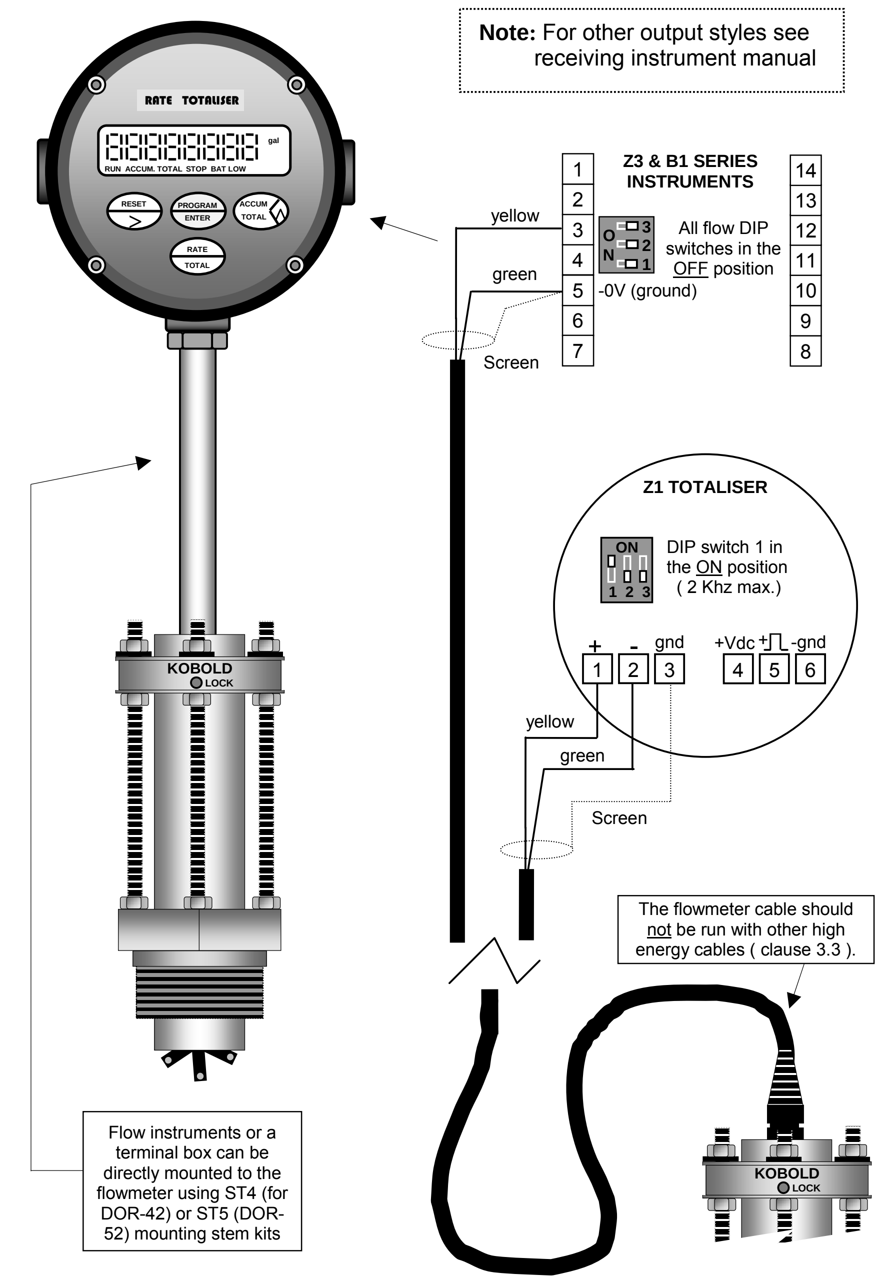
The DOR flow transducer is capable of accurately measuring flow in both directions without modification. Meters fitted with the QP output option (quadrature pulse output) may be interfaced with the Pulse Discriminator Module (PD1). The PD1 accepts the Quadrature pulse inputs & from these will discriminate between forward & reverse flow. Two individual & proportional pulse outputs can then be sent to appropriate totalising registers or a Z3 add and subtract flow rate totaliser.

It is **important to note** that the Quadrature Pulse option has the same pulse resolution (pulses/unit volume) as a standard flowmeter for both forward & reverse outputs.

Flowmeter with QP outputs



3.7 Voltage Pulse Connection to family instruments



4.0 K – FACTORS *(calibration factors for meter)*

The K-factor (pulses / litre, gallon etc.) will vary in relation to the bore size of the pipe in which the flowmeter is installed.

The K-factors and formula shown are a result of factory testing using smooth bore piping under ideal conditions. Variations to the given K-factors may occur when using rough bore piping or inadequate flow conditioning on either side of the flow transducer (refer clause 2.1). In these instances on site calibration may be used to determine the K-factor.

4.1 Flow transducer K- factors for common pipe sizes

Pipe detail		K-factors (standard K-factors for voltage & square wave outputs)					
NB	ID (#40)	Schedule 40 pipe - (#40)			Schedule 80 pipe - (#80)		
inches	mm	p / litre	p / m3	p / USgal	p / litre	p / m3	p / USgal
1.5"	40.9	18.678	18678	70.695	21.524	21524	81.468
2"	52.6	11.238	11238	42.534	12.818	12818	48.517
2.5"	62.7	7.880	7880	29.824	8.899	8899	33.682
3"	78.0	5.062	5062	19.161	5.676	5676	21.485
3.5"	90.2	3.768	3768	14.263	4.200	4200	15.896
4"	102	2.912	2912	11.021	3.233	3233	12.237
5"	128	1.839	1839	6.959	2.025	2025	7.665
6"	154	1.268	1268	4.798	1.402	1402	5.307
8"	203	0.719	719.0	2.721	0.787	787.2	2.980
10"	255	0.450	450.3	1.705	0.496	495.9	1.877
12"	303	0.316	316.0	1.196	0.347	347.4	1.315
14"	333	0.261	260.5	0.986	0.286	285.7	1.081
16"	381	0.198	198.0	0.750	0.217	217.0	0.821
18"	429	0.156	155.8	0.590	0.171	170.6	0.646
20"	478	0.125	125.4	0.475	0.138	137.8	0.521
24"	575	0.087	86.64	0.328	0.095	95.39	0.361

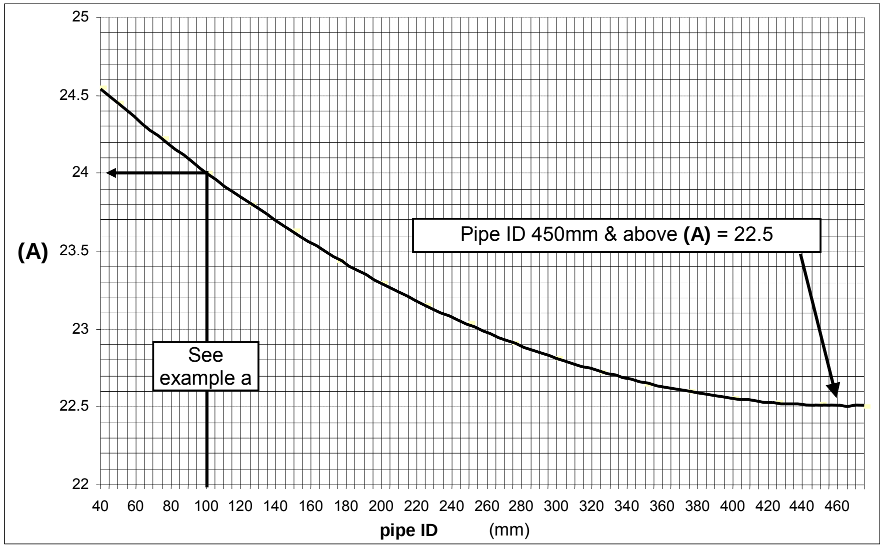
For other pipe sizes below 610mm (24") not listed above, use the graphs and apply the formula on the following pages (12 & 13).

4.2 K-factors for large pipes 460mm ID (18") and above use:

Pulses per litre = 28647 ÷ pipe ID² (mm)
Pulses per M³ = 28647000 ÷ pipe ID² (mm)
Pulses per US gallon = 168.14 ÷ pipe ID² (inches)
Pulses per Imp. gallon = 201.94 ÷ pipe ID² (inches)

NOTE : K-factors for Reed Switch output option are 1/3 the standard factors of voltage pulse output.

4.3 Calculating K-factors (litres or m³)



Calculate K-factor (pulses / litre) using the above graph and the metric constant of 1273.2 as follows :

$$\textbf{Pulses / litre} = \frac{1273.2 \times \textbf{(A)} \text{ from graph}}{\text{pipe ID}^2 \text{ (mm)}}$$

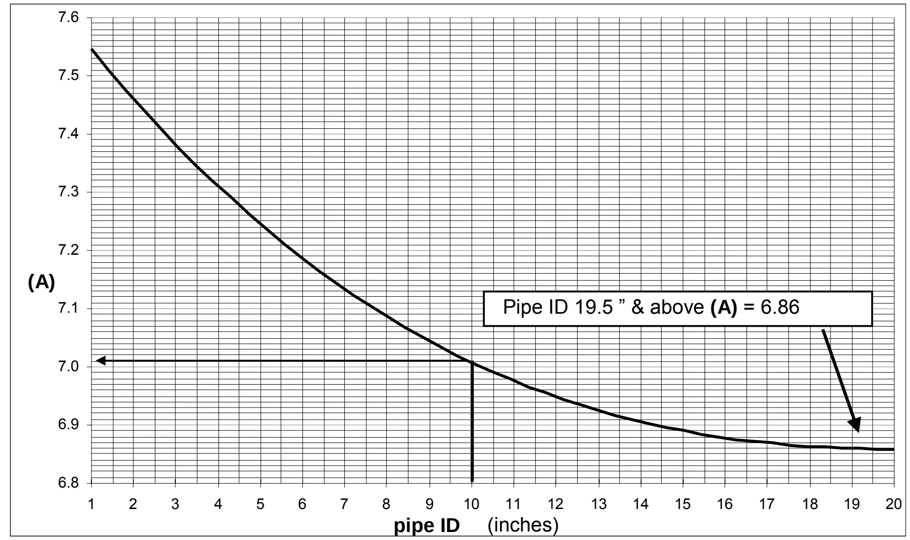
Example 'a' :
K-factor for 100mm pipe: **1)** from graph 100mm ID **(A)** = 24.0

2) pulses/litre. = $\frac{1273.2 \times 24.0}{10000}$ = **3.056** p/litre

K-factor for m³ : multiply by 1000 eg. K = 3056 p/m³
K-factor for megalitres : multiply by 1000000 eg. K = 3056000 p/megalitre

NOTE : K-factors for Reed Switch output option are 1/3 the standard factors of voltage pulse output.

4.4 Calculating K-factors (US gallons)



Calculate K-factor (pulses / gallon) using the above graph and the volumetric constant of 24.51 as follows :

$$\textbf{Pulses / US gal.} = \frac{24.51 \times \textbf{(A)} \text{ from graph}}{\text{pipe ID}^2 \text{ (inches)}}$$

Example 'b' :
K-factor for 10" pipe: **1)** from graph 10" ID **(A)** = 7.01

2) pulses/gal. = $\frac{24.51 \times 7.01}{100}$ = **1.718** p/gal

NOTE : K-factors for Reed Switch output option are 1/3 the standard factors of voltage pulse output.