

# Dairy & AG Wastewater Magnetic Flowmeter

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## Description

The VDP Wastewater Magnetic Flowmeter consists of the flowtube and easy-to-read electronic display. Valley Air Solutions' Magnetic flowmeters are a cost effective wastewater measurement solution for many dairy, agriculture and other applications compared to conventional flow technology, because they improve on-site measurement performance and decrease costs associated with maintenance. The VDP system uses unique sensing technology, which eliminates the large and costly magnetic coils used in conventional magmeters, as well as the need for a flowtube liner. The VDP flowtubes are constructed from polyvinylchloride (PVC) to be low cost and lightweight. They are intended for use in plastic pipework in sizes 2" - 12".

All VDP wastewater flowmeters offer a uniquely high signal-to-media noise ratio, up to 3x higher than conventional AC, and up to 30x higher than pulsed DC magmeters.



VDP FLOWTUBE FEATURE	BENEFIT
Unlined PVC flowtube construction No flowtube liner required	Lowest cost Valley Air Solutions wastewater flowtube for use with plastic piping systems; Low process pressures and temperatures;
Single Sensor or Dual Sensor	Accuracy and low cost; Dual sensor for redundancy & slight accuracy increase; Functions accurately with one sensor
Totally encapsulated sensor components	Magnetic coils and other sensors components encapsulated within a block of insulating material up to 1" thick; Field replacement without hydraulic recalibration; Reduces costs associated with stocking spare parts;
Patented coil excitation	Fast time constant of 30 milliseconds; High signal-to-noise ratio for high insensitivity to media noise; Accuracy unaffected by electrode coatings such as manure, sewage, grease, pulps, calcium carbonate, algae or similar; Media conductivity to > 0.08 $\mu\text{S}/\text{cm}$
Internal grounding electrode	No grounding rings normally required
Flowtubes manufactured to any length	Meets ISO/DIS 13359 for many sizes; Simplifies installation (no spacers or alteration)
Flexible ordering configurations	Single sensor PVC standard for lowest cost; Dual sensor, carbon steel flow tubes and flange options customizable to save you time

## INNOVATIVE SENSOR TECHNOLOGY

VDP Wastewater sensors insert into the VDP flowtube via standpipes. Each sensor includes a sensing coil, a reference coil, and is available in various electrically insulative materials. Two conical measurement electrodes and one grounding electrode protrude through the insulative material, which also insulates the electrodes from the piping. All internal sensor components and wiring are encapsulated using a solid setting insulator material. Two sensors may be installed on VDP flowtubes up to 12" in diameter (optional carbon steel flowtubes up to 48"). The sensors are ready wired and conduited to a junction box installed on the flowtube. The cables to and in the junction box are potted with a re-enterable gel. The complete assembly is indefinitely submersible to NEMA 6 and IP68 to 30 feet (10 m) water column. The measurement electrodes are also removable.

A patented high ratio exists between the distance apart of the electrodes and the flowtube diameter, such that the magnetic field is well distributed over the entire flowtube cross section. These combined effects, together with a uniquely powerful field strength, provides a truly weighted velocity signal, highly insensitive to velocity profile distortion. As a result VDP Wastewater flowtubes requires



**Enlarged VDP Wastewater Sensor**

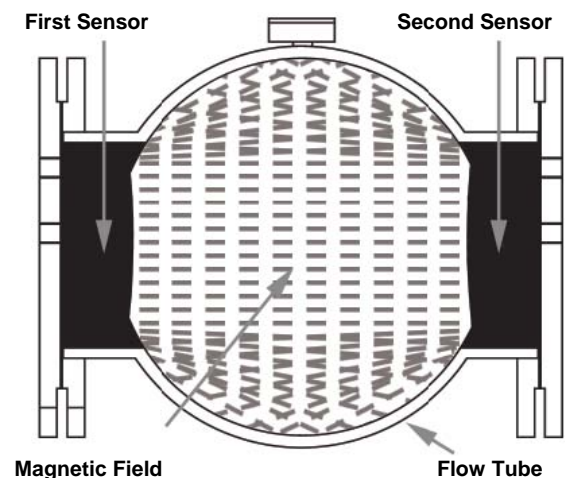
**Note: For media that coats the pipework greater than 1/8" (3 mm) thick, the use of optional extended electrodes protruding through such coating is recommended. Contact Valley Air Solutions.**

as little as 5 diameters of straight pipe upstream and 2 downstream, or less.

Each VDP sensor uniquely incorporates a reference coil, quite separately from the exciter coil. The reference coil measures magnetic fields in the media, and compensates for it. For media containing magnetite, consult Valley Air Solutions.

The use of one or two sensors has virtually no effect on accuracy, but does affect the minimum pipe run requirements (refer to flowtube specifications). Two sensors, in addition to making the flowtube less sensitive to velocity profile distortion and swirl effects, provides an inherent signal redundancy. The output signal will continue in the rare event of coil failure, with a typical accuracy of 0.5% -1% of rate, depending on straight pipe lengths available. The output will be interrupted if a sensor coil should fail, but can be quickly restored using the remaining sensor. This allows the convenience of scheduling downtime for sensor replacement. Any such failure in a conventional magmeter would cause immediate loss of signal and would mean returning the magmeter to the manufacturer.

### Magnetic Field Generated Inside VDP Flowtube



Valley Air Solutions' VDP sensors create a magnetic field over the entire flowtube area. The flow signal represents the true weighted velocity of the flowing media and is highly sensitive to velocity profile distortion/swirl effects.

## MODULAR CONSTRUCTION AND TRUE FIELD REPAIRABILITY

Many conventional magmeters can only be repaired by the manufacturer. Repair can run 80% of the initial cost of the flowtube and may take several weeks. Many conventional magmeter users have adopted a repair-by-replacement philosophy and stock spare flowtubes to minimize process downtime should a failure occur.

It is only necessary to stock spare sensors for the VDP System. Sensors have been designed for long life in even the harshest environments, and on the most difficult fluids. They can be easily replaced in the field, without having to remove the flowtube from the piping, and without any special know-how or equipment. Dedicated sensors (ordered and pre-calibrated at the factory with the flowtube) guaranty the same high accuracy after replacement, and without hydraulic recalibration. Any VDP sensor can be used with a VDP flowtube, and the same high repeatability and linearity are guaranteed.

VDP Wastewater series flowtubes and sensors have a standard 1 year warranty. The warranty is against defects in material and bad workmanship. Effects of media incompatibility, erosion or abrasion are not included.

## SIMPLIFIES INSTALLATIONS AND RETROFITS

Most size VDP wastewater series flowtubes can be manufactured to any convenient face-to-face dimension, including those recommended in ISO/DIS 13359. This greatly facilitates replacement of existing meters, without having to cut or alter the piping, or use costly spacers or spool pieces.

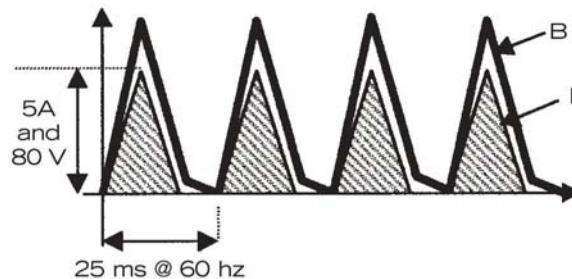
## FACTORY CALIBRATION

VDP Wastewater flowtubes are calibrated in the largest NIST traceable facility available, having a capacity of 120,000 gpm (27,000 m<sup>3</sup>/h). VDP wastewater flowtubes are calibrated in either a pump loop using master meters, or in a weigh tank/diverter system. Facility accuracy is 0.1% for the weight tank system, and 0.25% for the systems using master meters.

All VDP wastewater flowmeters are traceable to the National Institute for Science and Technology (NIST) and are shipped with a computer generated Calibration Certificate. They are normally calibrated at zero flow and three additional points.

## VDP TRANSMITTER/ELECTRONICS

The VDP transmitter uses an innovative and patented pulsed AC method of coil excitation to create an ultra stable flow signal having a signal to media noise ratio up to 50 times higher than other magmeter technologies. As a result, the VDP transmitter offers a clean and powerful bidirectional signal with unsurpassed fast response and the highest insensitivity to media noise from slurries, low conductivity media, pulps, manure, greasy sewage and similar.



The VDP transmitter is a most versatile and advanced magmeter transmitter. It features a user-friendly keypad for programming, a 10-year memory, data logging capability, batch control, HART protocol, RS-485 or RS-232 interfacing, two 4 – 20mA outputs and a scaleable pulse frequency output.

The VDP transmitter uses a patented type of Pulsed AC coil excitation. The magnetizing current (I) is fed to the coils of a VDP flowmeter. It is uni-polar and derived from half wave rectification of line voltage. The magnetizing current is uniquely high, up to 5.5 Amps base to peak. This creates ultra high signal strength. It is also applied in a series of pulses at the highest practical frequency. This combination provides an unsurpassed signal to media noise ratio, such that the signal is virtually unaffected by noise caused by such media as manure, greasy sewage, pulps, and dredging slurries, low conductivity media and media which coats the internal diameter.

## VDP WASTEWATER TRANSMITTER FEATURES & BENEFITS

VDP TRANSMITTER FEATURE	BENEFIT
Instantaneous Flow Rate and Totalized Flow Volume	Accurate information for making better decisions; Better record keeping and documentation
High excitation current (to 5.5A base to peak) and high exciter frequency (40 Hz or 33 Hz for all size VDP Sensors)	Suitable for problem media (manure, slurries, pulps, low conductivity media); Signal to media noise ratio up to 50x higher than other magmeters; Suitable for media that coat the inside of pipes.
4 lines of 20 character alphanumeric, backlit LCD display with sealed, tactile feedback and vandal resistant keyboard	Clear rate display, gross and net totals in forward and reverse directions, and batch control; Field configurable and user-friendly keypad.
Noise Countervailence and Auto-Zero Circuits, with RF and VFD filtration	Signal virtually immune to common noise effects. including eddy current drift, radio frequency, variable frequency drives and similar.
Bi-directional flow measurement	Accurately eliminates back flow from net totals.
Reference coils to compensate for media magnetic fields and media temperature	Allows accurate flow measurement of slurries with magnetite and wide media temperature variation.
Fast time constant of 30 milliseconds	Accurate measurement of pulsating pump flow; Suitable for high speed batch fill times to 1 second; Stable, fast acting proportional control.
Comprehensive alarm relays and setpoints	Control of min/max and batch flow control; Alarm relays for reverse flow; Non-full pipe alarm actuated by external switch or by uncovered electrodes.

Further signal quality enhancement is provided by a Noise Countervailence Circuit, which continuously integrates the erratic signal of media noise and algebraically compensates for it. The net result is a clean and powerful signal, having a signal to media noise ratio of up to 50 times higher than other magmeters.

The VDP transmitter incorporates the most advanced technology available, allowing for the first time powerful pulses to be used at a common high frequency for all size magmeters, from 1/16" to 80" (1.5 – 2000mm). Other technologies do not allow this ability, such that larger magmeters have to use a lower exciter frequency. Each powerful pulse has a duration of only 16.7ms (for 60 Hz supply), after which time it is switched off. The resultant generated magnetic field B, which includes the signal function, follows the current ( I ) by a few milliseconds and dissipates after 25ms (for 60 Hz supply). As such, an unsurpassed high efficiency energy management is accomplished, where the power consumption, utilizing resistive power only, is typically 20 Watts. This is despite having the highest signal strength and exciter frequency available. A resultant low operational temperature allows all VDP wastewater

flowmeters to be encapsulated with stiff setting compounds for solid state construction, as well as enhancing the life of the VDP transmitter to be typically double that of common transmitters.

The VDP transmitter incorporates the first auto zero for Pulsed AC technology. Eddy current drift, which has caused zero instability in Continuous AC meters since their inception as much as  $\pm 3\%$  per day, is proportional to rate of change of magnetic field with time, for a given frequency. The VDP transmitter incorporates a patented algebraic compensation of the integrated rate of change of magnetic field with time, resulting in virtual elimination of eddy current drift with unsurpassed signal stability.

The high exciter frequency has a frequency of 40 Hz (for 60 Hz supply) or 33.3 Hz (for 50 Hz supply). Such powerful and "clean" signals have a unique time constant as fast as 30 milliseconds. This allows high accuracy batching, particularly useful with small volumes. This feature is equally important in proportional control systems, where a fast time constant and high quality signal is vital for stable control and improved product quality.

## VDP Dairy & AG Wastewater Magnetic Flowtube Specifications

**ACCURACY**

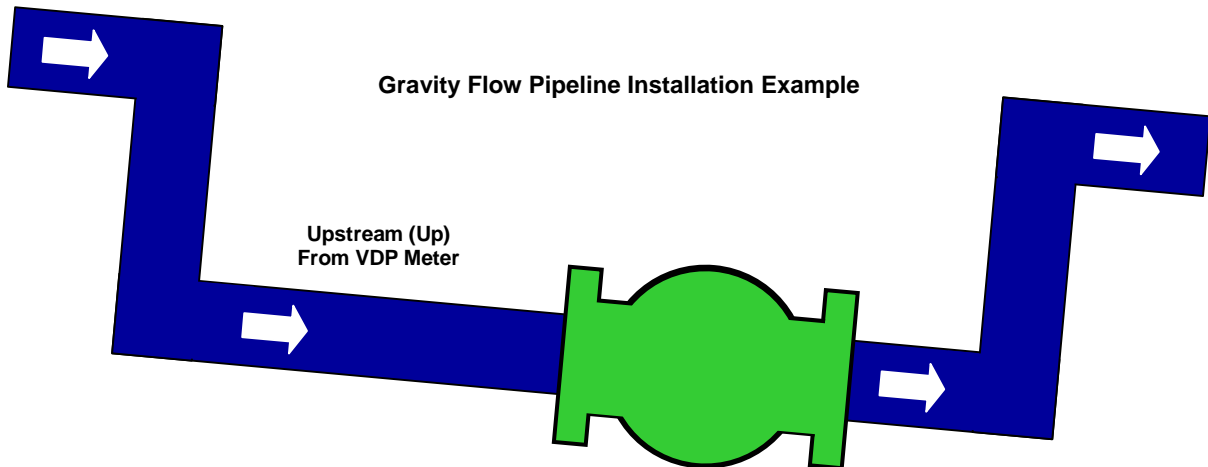
± 0.5% of rate for flows ≥ 1 fps (0.3 m/s) for 2 sensors or ≥ 2 fps (0.6 m/s) for 1 sensor  
 ± 0.005 fps (± 0.0015 m/s) for flows < 1 fps (0.3 m/s) for 2 sensors  
 ± 0.01 fps (± 0.003 m/s) for flows < 2 fps (0.6 m/s) for 1 sensor

Accuracy is unaffected by electrode coatings such as manure, sewage, grease, calcium carbonate, algae or similar.

Note: Accuracy is traceable to the National Institute of Science and Technology. A NIST traceable calibration certificate is provided with each flowtube. For media such as ferric chloride, ferric sulphate or similar, please consult Valley Air Solutions.

**MINIMUM STRAIGHT PIPING RUNS**

Piping  D = Diameters	Upstream / Downstream Piping Requirement	
	2 Sensors - Enhanced Accuracy	1 Sensor - Normal Accuracy
Minimum Requirement	5 D Up / 3 D Down	10 D Up / 5 D Down
Single elbow, or tee upstream	5 D Up / 3 D Down	10 D Up / 5 D Down
Two elbows coupled in same plane	5 D Up / 3 D Down	10 D Up / 5 D Down
Two elbows, close coupled and out of plane	10 D Up / 3 D Down	20 D Up / 5 D Down
Pump, blending point, control valve upstream	20 D Up / 3 D Down	30 D Up / 5 D Down
Pump, control valve downstream	----- / 5 D Down	----- / 5 D Down



**FLOW RANGE**

0 - 2 fps (0 - 0.6 m/s) minimum to 0 - 50 f/s (0 - 15 m/s) maximum

or

0 - 5D<sup>3</sup> gpm minimum to 0 - 120D<sup>3</sup> gpm maximum, where D is in inches  
 (0 - 0.0017D<sup>2</sup> m<sup>3</sup>/h minimum to 0 - 0.043D<sup>2</sup> m<sup>3</sup>/h maximum, where D is in millimeters)

**COIL EXCITATION**

Patented Pulsed AC excitation.

## VDP Dairy & AG Wastewater Magnetic Flowtube Specifications

### MEDIA CONDUCTIVITY

≥ 1.0  $\mu\text{S/cm}$  with conductivity option A (Standard)

≥ 0.08  $\mu\text{S/cm}$  with conductivity option B. (Optional)

Note: For deionized, distilled, or demineralized water, consult Valley Air Solutions.  
For < 5  $\mu\text{S/cm}$  an integral pre-amp is used.

### ENVIRONMENTAL PROTECTION

NEMA 6 and IP68 indefinitely submersible to 30 ft. (10 m) water column

### GROUNDING

Internal grounding electrode on each sensor

Note: 1. For cathodic protected pipes, consult Valley Air Solutions  
2. For transmission to a remote transmitter > 30 feet (10m), or when excessive unequal potentials exist between the pipeline and the flowmeter cable shields, it may be necessary to have a grounding ring or other grounding arrangement installed. Such excessive unequal potentials are beyond the control of Valley Air Solutions and additional cost to that of our normal supply.

### CABLING (TO VDP TRANSMITTER)

33 ft. (10 m) standard. For longer lengths, consult Valley Air Solutions. 2-core pair, 18 gauge (0.75 mm<sup>2</sup>) twisted and shielded (Beldon 8760). For VDP transmitters 3 such cables are required, for the electrodes, reference coils and exciter coils. A 4th cable is used for the optional pre-amp (conductivity < 5  $\mu\text{S/cm}$ ).

### MAXIMUM RECOMMENDED CABLE LENGTH

For media conductivity < 3  $\mu\text{S/cm}$  maximum cable length is 30 ft. (10 m)

For media conductivity > 3  $\mu\text{S/cm}$  maximum cable length is 300 ft. or 10x C (100 m or 3xC), whichever is less. C is the conductivity in  $\mu\text{S/cm}$ .

Note: For transmission > 30 feet (10 m) a grounding ring may be necessary at an additional cost.

### MAXIMUM TEMPERATURE AND PRESSURE

85 F max @ 80 psi (30 C max @ 5.5 bar)

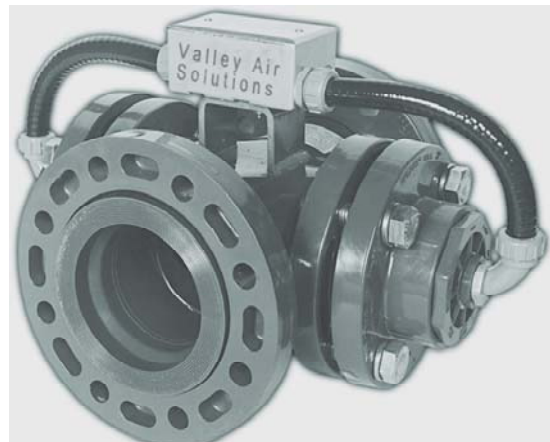
105 F max @ 60 psi (40 C max @ 4 bar)

140 F max @ 15 psi (60 C max @ 1 bar)

Note: The above is based on water.  
Other media may affect these ratings (Note 3).



**Non-Blocking Design**



**VDP Wastewater Flowmeter with 2 Sensors**

**VDP FLOWTUBE MATERIALS OF CONSTRUCTION**

FLANGES/FLOWTUBE                      Raised Face PVC flanges/Schedule 80 PVC flowtube

ELECTRODES                                      AISI 316 stainless steel, Hastelloy B and C, Titanium, Tantalum, Monel

SENSORS    PVDF with Elastomer gaskets and Viton electrode seals  
PVDF with Teflon gaskets and Viton electrode seals

Nominal		Dimensions						Weight (Flanged)		Weight (Flanged)	
Pipe Diameter		Length		Height		Width		2 Sensors		1 Sensor	
Inches	mm	Inches	mm	Inches	mm	Inches	mm	LB	KG	LB	KG
2	50	10	254	10	254	12	310	14	6.4	10	4.5
2.5	65	10	254	11	280	13	330	16	7.3	11	5.0
3	80	10	254	11	280	13.5	345	18	8.2	12	5.5
4	100	12	305	12	305	16	410	25	11.4	17	8.0
6	150	12	305	14	360	17	435	32	15	22	10
<b>8</b>	<b>200</b>	<b>18</b>	<b>457</b>	<b>16</b>	<b>410</b>	<b>18</b>	<b>460</b>	<b>58</b>	<b>26</b>	<b>40</b>	<b>18</b>
10	250	18	457	19	485	25	635	72	33	48	22
12	300	18	457	22	560	26	660	95	43	65	30

**NOTES**

1. PVC conforms to USA National Sanitation Foundation NSF61 for use with drinking water.
2. VDP series flowtubes are intended for use with plastic pipes. The product warranty cannot be extended for installation in metal piping systems unless flexible connectors are incorporated. Contact Valley Air Solutions for carbon steel flowtubes.
3. Maximum temperature and pressure relationships are based upon information provided by material suppliers. Valley Air Solutions holds no responsibility for the accuracy of this information.
4. Standard 1 year warranty applies for freedom from material defects and bad workmanship, but not including media compatibility, erosion and abrasion.

## VDP Dairy & AG Wastewater Flowmeter Transmitter/Electronics Specifications

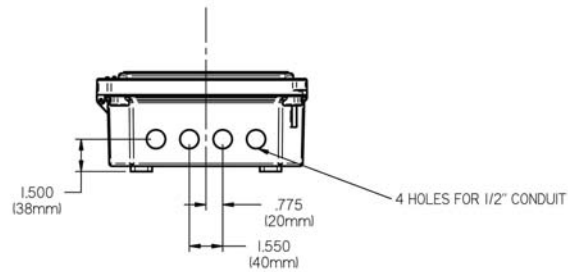
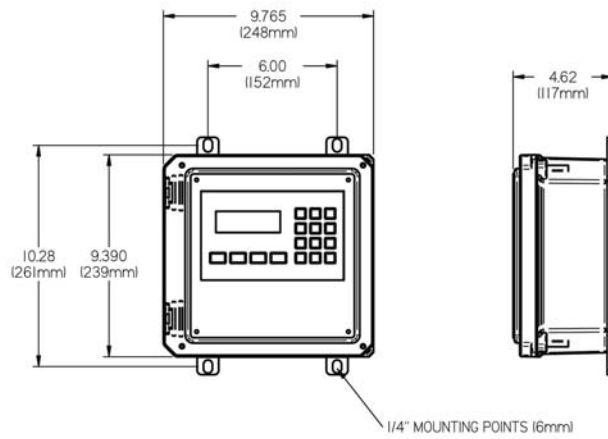
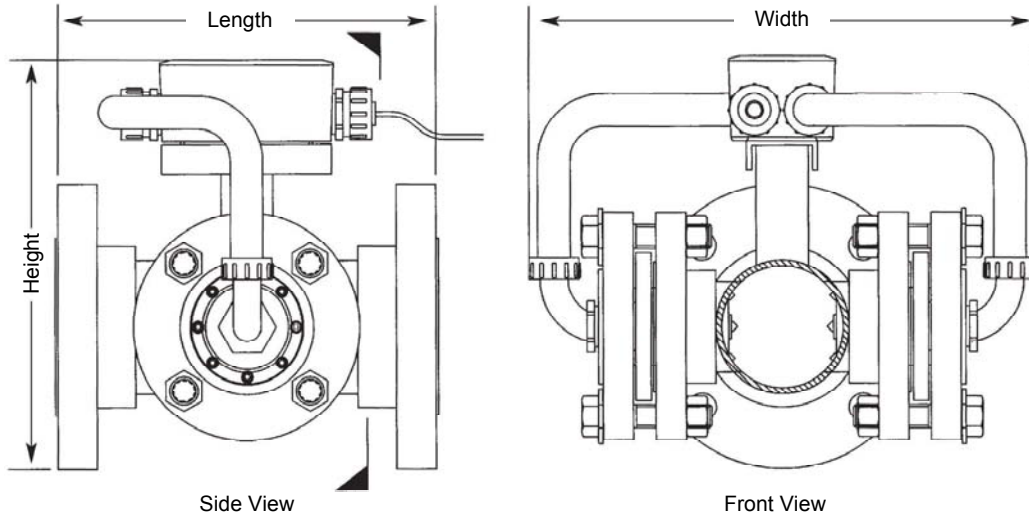
Accuracy	See VDP flowtube specification. This accuracy is unaffected by such electrode coatings as calcium carbonate, manure, sewage grease, pulps, iron oxide, algae or similar. For media > 1/4" (6mm) thick, the use of extended electrodes is recommended.
Weight	7 lb (3.2 kg)
Enclosure	Wall mounted UV resistant fiberglass with lockable stainless steel latches (locks not supplied).
Cable Entry	NEMA 4X and IP65
Cable Terminals	4 non-threaded holes for 1/2" conduit or M20 connectors. Approved non-conduit connectors are supplied for ATEX Zone 2 requirements. Internally accessible, but isolated from the electronics.
Security Tabs	Tabs provided for locks. Locks not included.
Supply Voltage	120V 60 Hz, 120V 50 Hz, 230V 50 Hz
Power Consumption	20 Watts typical including sensors
Magnetizing Current	Up to 5.5 Amps, depending on sensor size
Exciter Frequency	40 Hz (with 60 Hz) or 33 Hz (with 50 Hz)
Media Conductivity	0.5 microS/cm (micromhos/cm) standard 0.08 microS/cm with booster pre-amp supply to sensor
Ambient Temperature	-4° to +158° F (-20° to +70° C) Note: Outside these temperatures the LCD display function is restricted. A protective cover is recommended when operating in strong sunlight.
Storage Temperature	- 40° to +140° F (-40° to +70° C)
Temperature Error	< 0.0025% per °F (< 0.005% per °C) for analog output. < 0.5% of span for any variation
Time Constant (T)	Minimum 30 milliseconds
Signal Averaging (5 T)	Infinitely adjustable 150 ms - 300 seconds.
Flowmeter Cable Type	3 cables are required between the VDP transmitter and the VDP flowmeter. Each cable to be 2 core 18 AWG or 2 core 0.75mm 2 multi-stranded, twisted and shielded. We recommend Beldon 8760 or 9318, Alpha 5610/1801, 5611/1801 or equivalent. 1 cable is for a reference coil, which compensates for variation in supply voltage, 1 cable for the electrodes and 1 for the exciter coils.  Note: For VDP transmitters approved by Entela to CSA and NEC standards for use in Class 1, Division 2 or to ATEX Zone 2 explosive atmospheres contact Valley Air Solutions.
Maximum Cable Length	300 feet (90m) for conductivities < 3 microS/cm (micromhos/cm). 300 feet or 10 x C (90m or 3 x C) for conductivities > 3 microS/cm whichever is less, where C is the conductivity in microS/cm.
Flowmeter Analog Outputs	Two 4 – 20mA outputs from separate terminals are available for bi-directional flow. Either may be configured as an internally powered 2-wire output or an externally powered 2-wire output. When internally powered a loop voltage of 24 V dc is supplied with a maximum load of 800 Ohms. These outputs are isolated from all circuits, other than the contact inputs and each other. When externally powered the maximum load is calculated by: Maximum Ohms = [(48.83 x dc voltage) – 488.3] For an external 24 Vdc supply this would be [(48.83 x 24) – 488.3] = 683 Ohms. Minimum current 3.75mA, maximum 22mA.



## VDP Dairy & AG Wastewater Flowmeter Transmitter Specifications

Pulsed Outputs	<p>An externally powered, 2-wire scaled output (for totalizing flow) or frequency output (for rate of flow) is available as follows:</p> <p>Scaled Mode:</p> <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;">Speed</td> <td style="padding-right: 20px;">Pulse Width</td> <td>Maximum Frequency</td> </tr> <tr> <td>Slow</td> <td>100ms</td> <td>5 Hz</td> </tr> <tr> <td>Medium</td> <td>50ms</td> <td>10 Hz</td> </tr> <tr> <td>Fast</td> <td>5ms</td> <td>100 Hz</td> </tr> </table>	Speed	Pulse Width	Maximum Frequency	Slow	100ms	5 Hz	Medium	50ms	10 Hz	Fast	5ms	100 Hz
Speed	Pulse Width	Maximum Frequency											
Slow	100ms	5 Hz											
Medium	50ms	10 Hz											
Fast	5ms	100 Hz											
Frequency Mode	0 – 1000 Hz up to 10000 Hz square wave. The external isolated outputs are rated 30V dc maximum, current of 250mA.												
Communication Outputs	HART Protocol, RS-232 or RS-485 are available as standard.												
Relay Outputs	2 user configurable form C (changeover) relays with contact rating 125V AC, 1A, 30VA.												
Contact Inputs	2 user configurable inputs, rated 12V DC, 10mA. These inputs require a contact closure or transistor switch between the terminals.												
Non-Full Pipe Detection	Output signals are clamped at 4mA and 0 Hz when the level falls below the upper most electrode pair. Alternatively this can be actuated by an external pump switch or similar, via a contact input.												
Pre-Amp Supply	On some VDP flowmeters an internal booster pre-amp is recommended for media conductivity < 20 microS/cm. A supply of ± 5V, 10mA is available on VDP transmitters as standard.												
Input Impedance	10 <sup>12</sup> Ohms												
Analog Inputs (Including Level)	Two 4 – 20mA inputs with 2 wire, 18V DC supply. One may be a level input for use with an open channel or partially filled pipe flowmeter. The level signal is linearized if necessary and multiplied by the mean velocity from the flowmeter to provide continuous measurement of volumetric flow.												
Optional Batch Control	For batch control the total set amount is entered via the keypad and displayed. Keypad actuation of batch flow via a VDP transmitter relay initiates flow, counting from zero to total set amount.												
Display	<p>4 lines of 20 character of waterproof, backlit LCD display.</p> <p>Totals may be programmed as:</p> <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;"><b>Forward Total,</b></td> <td style="padding-right: 20px;">Rate of flow may be programmed as:</td> </tr> <tr> <td style="padding-right: 20px;"><b>Reverse Total, or</b></td> <td style="padding-right: 20px;"><b>Forward Rate or</b></td> </tr> <tr> <td style="padding-right: 20px;"><b>Net Forward Total.</b></td> <td><b>Reverse Rate.</b></td> </tr> </table>	<b>Forward Total,</b>	Rate of flow may be programmed as:	<b>Reverse Total, or</b>	<b>Forward Rate or</b>	<b>Net Forward Total.</b>	<b>Reverse Rate.</b>						
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<b>Reverse Total, or</b>	<b>Forward Rate or</b>												
<b>Net Forward Total.</b>	<b>Reverse Rate.</b>												
Front Panel Keypad	Tactile feedback, waterproof sealed.												
Diagnostics	All necessary diagnostics, readings and system status are available via front panel keypad without opening the door. A user security password is programmable. Diagnostics allows revalidation of flowmeter NIST traceable Calibration Certificates. A separate calibration box is unnecessary.												
PC/Windows Interface	Computer interface via serial connection, enabling programming of setup, ability to upload new firmware and download diagnostics and status.												

## VDP Dairy & AG Wastewater Flowmeter System Flowtube and Transmitter Diagrams



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