## CLARK SOLUTIONS

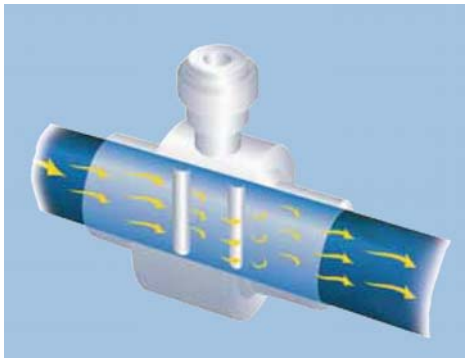
# RVL Vortex Flowmeters

*Technical Bulletin: Application, Design, Installation*

## INTRODUCTION

Selection of the best flow meter for your specific application is a critical step, one that will affect the quality of your process for years. Choosing the wrong meter can lead to inaccurate readings, high maintenance costs, and expensive downtime.

The following section is designed to explain the technology of vortex flow meters and the specifications of the Clark Solutions vortex product line. Our goal is to ensure that the vortex meter you select meets the requirements of your specific application.



## HOW VORTEX FLOW METERS WORK

The operation of the RVL vortex flow meter is based on the vortex shedding principle. As fluid moves around a body, vortices (eddies) are formed and move downstream. They form alternately, from one side to the other, causing pressure fluctuations. These are sensed by a piezoelectric crystal in the sensor tube, and are converted to a 4-20 mA or pulse signal. The frequency of the vortices is directly proportional to the flow. This results in extremely accurate and repeatable measurements with no troublesome moving parts.

## MATERIAL SELECTION

When choosing the best pipe material for your process, it is necessary to review the fluid to be transported, its concentration, the minimum and maximum operating temperatures, and the pressures to be accommodated. Choosing a flow meter is a similar process, but it is necessary to review a few additional considerations, such as fluid viscosity, suspended particles, density of the fluid and, most importantly, expected flow range. One advantage of utilizing a Universal vortex flow meter is that there are no gaskets or elastomers in the meter. Therefore, you only need to be concerned with the thermoplastic material used for the body construction. In a thermoplastic piping system, the material chosen for the flow meter should match that of the pipe if at all possible. If you are planning to install a meter in a metal pipe system, you must consider three operating conditions: temperature, media, and pressure. Chemical resistance data is available on request from Clark.

## FLOW RATE AND RANGE REQUIREMENTS

When choosing a flow meter, it is necessary to verify with the supplier that the unit selected is suited for your specific flow range needs. Most manufacturers state flow range capabilities by publishing maximum allowed flow rates. Then they provide a turndown ratio to determine minimum flow rate. To use the turndown ratio, simply divide the maximum rate by the ratio to determine the minimum rate.

RVL vortex flow meters offered by Clark have a 12:1 turndown ratio (exceptions: RVL025 1/4" unit and RVL050L 1/2" unit; 8:1).

## LINE FLUIDS

Many factors may affect the capability of a meter to accurately measure the flow of specific fluids. Different solutions have varying effects on meters. For instance, heavy particle suspension will wear down internal parts on some meters or cause sensing inaccuracies for non-obtrusive metering systems. For vortex flow meters, high viscosities tend to dampen the formation of vortices and reduce the effective range. Particles and internal bubbles do not usually affect vortex meters. PVDF models work very well in slurry services. However, slurries containing grit will wear down the bluff body, although it can withstand a 5% reduction before accuracy is affected. Also, long fibers will catch and build up on the bluff, decreasing accuracy. Standard factory calibration is for 32 SSU (1 CST) viscosity liquid. Viscosity above 1 CST will raise the minimum readable flow rate, reducing rangeability. The effect is linear to viscosity. No adjustments are required for specific gravities up to 2.0. Liquids with high specific gravities will adversely affect the permissible amount and duration of overrange flow. The following chart indicates the reduction of range based on viscosity.

| Viscosity | Min. | Max. | Flow Range |
|---|---|---|---|
| 1 CST | 1 | 12 | 12:1 |
| 2 CST | 2 | 12 | 6:1 |
| 3 CST | 3 | 12 | 4:1 |
| 4 CST | 4 | 12 | 3:1 |
| 5 CST | 5 | 12 | 2.4:1 |
| 6 CST | 6 | 12 | 2:1 |

## ACCURACY AND REPEATABILITY

Depending on your application, accuracy and repeatability may be critical. Accuracy is measured as a percentage by which the meter reading could vary from the actual flow. Repeatability is the percentage by which the meter may vary for a specific flow rate from reading to reading. In other words, if you are operating at a flow rate of 50 gpm and the rate increases to 75 gpm and then returns to 50 gpm, repeatability indicates the percentage within which you will now read the 50 gpm flow rate versus the original reading. Accuracy is normally published by the manufacturer in two formats: accuracy of full scale, or accuracy of rate. Accuracy of full scale is a percentage of the maximum flow rate, no matter what the actual flow. Accuracy of rate is a percent of the actual flow rate of the fluid the meter is currently reading.

## THE IMPORTANCE OF CALIBRATION

When choosing a meter for an application where accuracy and repeatability are critical, it is necessary to use a meter that is wet calibrated by the manufacturer, and supplied with documentation of that calibration. A meter that is not individually calibrated cannot be relied on as truly accurate to its specification.

Production tolerance differences can and will affect a meter's accuracy. For this reason, meters must be wet calibrated to ensure specified accuracy and functionality for the user.

## LINE CONNECTIONS

The next step is planning the installation of the unit into your pipe line. You may prefer to mount the unit permanently by welding it into the line, or you might provide access for meter removal from the line by using a flanged or threaded model. Certain line connections may require the use of a gasket. It is important to choose a gasket material that will not contaminate your media, and to be sure it is chemically resistant to the fluid being transported.

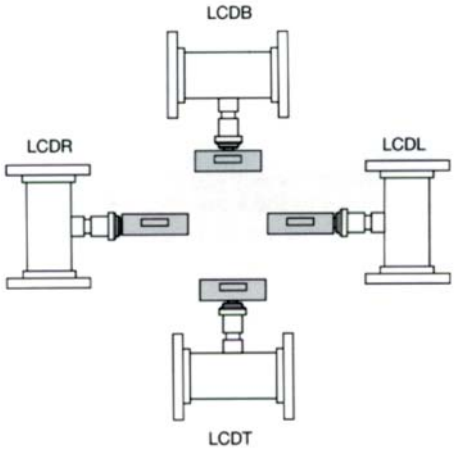
RVL vortex flow meters are available with a wide selection of line connection options. These options include butt, wafer, male thread socket, and threaded flare.

## MAXIMUM FLOW RATES

Maximum flow rates are indicated on the RVL specification pages in this catalog. You can safely and accurately measure up to 125% of the maximum flow rates listed, although units with the HT (High Temperature) option cannot be overranged. The signal for 125% overranging would be 24 mA. You must make sure you have sufficient voltage to overrange a meter.

## OUTPUT AND DISPLAYS

Universal vortex flow meters come with a variety of output options. The standard output is an analog signal ranging from 4 to 20 mA or 0-5 VDC. Pulse outputs are also available. For remote Indication Clark supplies a range of monitora and controllers. All RVL vortex flow meters are designed to be standalone units if required. Each unit can have its own individual local LCD flow rate display. The readout can be mounted in a variety of positions for convenient readability. For specifications, dimensions, and placement of the LCD, consult the factory. The figure below shows available mounting positions.




## PIPING REQUIREMENTS

Turbulence in the pipe line can affect the accuracy of most flow meters. Sources of turbulence are pumps, valves, or changes-in-direction in the line. To avoid these potential problems, it is standard practice to place the meter a certain distance from the turbulence source. Most manufacturers provide the user with minimum distances for their particular products. These distances are indicated in Pipe Diameters (PD). For example, 5 PD means place the flow meter five times its inside diameter away from the source of turbulence. It is also common to provide a minimum distance downstream between a meter and a valve or a change-in-direction.

For optimum accuracy, we recommend at least 20 PD upstream and 5 PD downstream for Universal vortex flow meters. If an upstream elbow is closely coupled to another elbow, 27 PD may be required upstream and 10 PD may be required downstream between the meter and a valve. When the diameter of the meter is smaller than the pipe line, you need at least 15 PD of pipe with the same diameter as the meter upstream, and 5 PD downstream. Overall, 25 PD of straight run prior to the meter is required. If there is a plane change in the installation, this requirement increases to 30 PD upstream. The downstream requirement is now 2 PD of pipe with the same diameter as the meter, and a minimum of 5 PD overall of straight run. The usual 10 PD downstream between the meter and a valve is still required. If the required piping parameters are not met, there will be a corresponding reduction in accuracy.

## WIRING

Connect a twisted wire pair (not provided) to the terminals of the transmitter marked + and -. If the twisted wire pair is shielded, do not connect the shield to the transmitter. The shield should be grounded at the receiver only (see Figure 4). The transmitter is reverse-polarity protected. The twisted wire pair should be connected to the receiving equipment. Twisted wire pair lengths of up to 1,000 feet are generally acceptable, and lengths up to 10,000 feet are often usable if the twisted wire pair is kept dry and distant from electrical noise sources. The receiving equipment must accept industry standard "true two wire" or "loop power" 4-20 mA process transmitter inputs. This means that the receiving equipment, such as a recorder or controller, must supply power for the transmitter along the twisted wire pair. If the receiving equipment does not provide power, a separate power supply, typically 24 Vdc at 30 mA, must be used, as shown in Figure below. There are many brands of receivers which provide 24 Vdc for this purpose.

Several receivers may be connected in a series as shown in Figure below, but only one should provide power, and all should have isolated inputs. If the receiver requires 1-5 Vdc, connect a 250 Ohm, 0.1%, 1/2-watt precision resistor across its input. The voltage provided by the receiver must be within the limits shown in the Required DC Voltage Chart below. To use this figure, first add the resistance of all the receivers, indicators, etc., and the wire in the loop. If the wire resistance is unknown, use a value of 50 Ohm for a twisted wire of 1,000 feet or less with a gauge of #22 AWG or heavier. If a 1-5
Vdc receiver is used with a 250 Ohm resistor, its resistance is 250 Ohm. Only one point on the 4-20 mA loop should be grounded. Some receiving equipment inputs are grounded by their manufacturers. This is sufficient. Always follow the receiver manufacturer's recommendations for "loop powered" or "true two wire" process transmitters. Always follow local electrical codes.

Service: General purpose.
Electrical classification: General purpose,
non-hazardous, or NEMA 4X

## QUICK SPECIFICATION

All flow meters 1/4" through 9" shall be of the vortex shedding style with no moving parts. Meters shall be constructed of PVC, CPVC, PP, or PVDF. Meters shall have a 12 to 1 turndown ratio with an accuracy of ±1% of full scale, ±1% of rate when used with the Vorsite 2000 flow indicator/controller, and be ±1/4% repeatable of point. All meters shall be wet calibrated at the factory and supplied with calibration records. Line connections for pipe systems shall be thread, metric butt, wafer or flange. Flare and sanitary connections shall be used for tubing systems. Output is either to be linear 4-20 mA or digital pulse to communicate with the Vorsite 2000 Flow Indicator/Controller.