

## Measuring Flow in Pipes and Closed Conduits

The Division recommends *direct* measurements in pipes or closed conduits using flowmeters due to their high degree of accuracy. Making the best flowmeter choice can be challenging because of the large variety of meters available. Long-term maintenance and operating costs are critical factors to consider during selection. Most flowmeters that perform unsatisfactorily can usually be traced to improper selection. The most efficient meters have fewer moving parts and have minimal impacts on line pressures, which are important factors in silty water conditions. A flowmeter that has a **totalizer** capable of recording continuous volume over time is required.

Acoustic meters, magnetic meters, and venturi meters with flow recorders are suitable devices for measuring flow rates. Acoustic meters are versatile and can be used inside pressured pipes, in partially filled pipes, or in open channels. Acoustic meters can also be mounted externally on plastic pipes.



Mag meter



Venturi meter



External Acoustic meter

The Division recommends Category I flowmeters, as specified in the Water Management Planner published by the USBR. Not all flowmeters are suitable in dirty water conditions and it may wise to consult a flowmeter specialist to assist with correct meter selection for specific applications. Some considerations for selecting a flowmeter are listed below.

- **Totalizers:** are used to measure the total quantity of water over time. Totalizers can be installed separately or as part of a flowmeter unit. They are particularly useful when pumping rates vary over time.
- **Water quality:** some flowmeters are limited to either clean or silty waters. If the water you are pumping is loaded with particulates, be sure to choose a meter suitable for dirty water like a Doppler or mag meter.
- **Maintenance:** excessive maintenance costs result with a poor match between the instrument and the application. With a wide range of prices for flowmeters, try to choose a meter with the lowest with moving parts. Installing a filter ahead of the meter will help minimize fouling and wear but could cause a pressure loss which equates to greater power consumption.
- **Rangeability:** is a flowmeter's ability to cover a range of flow rates, defined as the ratio of minimum to maximum flow rates. For example, a meter with minimum flow of 100 gal/min and maximum flow of 500 gal/min has a turndown ratio of 5. Select a meter with the lowest ratio that is suitable for your operating flow range. Rangeability is often referred to as the *turndown* ratio.

- **Pressure loss:** the presence of a flowmeter can cause increased pressure losses which increases pumping/energy costs. Consider selecting a meter that has minimal impacts to pressure loss in the pipe system.
- **Straight pipe requirements:** one of the most common installation mistakes is not allowing sufficient upstream and downstream *straight-run* piping for the flowmeter. A common problem is when the upstream unobstructed, straight pipe length recommendation cannot be met. Check with the flowmeter manufacturer since each meter has a recommended straight pipe-length upstream of the flowmeter.

References:

- [Venturi Meters Constructed with Pipe Fittings, Pap-1050, USBR](#)
- [Implementation of Magnetic Meters for Irrigation Volumetric Measurement, ITRC Paper No. P 12-006](#)
- [List of Flowmeter Vendors](#)