

Shunt Flow Meters for Irrigation Water Measurement¹

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Good irrigation water management starts with a knowledge of how much water is applied. Shunt flow meters can be used to accurately measure water flow in irrigation pipelines. Shunt flow meters work on the principle that a fraction of the water in the irrigation main pipeline is shunted through a small diameter pipeline parallel to the mainline for a short distance where it is measured before it is returned to the mainline.

METER OPERATION

Figure 1 illustrates the components of a shunt flow meter. The small diameter shunt pipeline is equipped with a totalizing flow meter which measures only the shunted flow. The flow in the main pipeline is then determined as a function of the amount of flow measured in the shunt pipeline.

A head loss must be created in the main pipeline to create the pressure difference that causes water to flow through the shunt pipeline. Because the shunt flow rate is a function of the head loss in the main pipeline, the relationship between the head loss and shunted flow must be determined by calibration.

One commercially available shunt flow meter uses a venturi constriction to create the head loss in the main pipeline to operate the shunt flow meter. The constriction increases velocity and decreases pressure in the throat of the venturi. The venturi is constructed in tube diameters to be compatible with mainline pipe diameters from 6 to 10.75 inches.

The venturi design has the advantage that much of the pressure loss in the throat of the venturi is recovered downstream of the constriction. The venturi is also a simple device whose hydraulic properties are well understood. Very importantly, there are no moving parts to wear out in the main pipeline.

FLOW REGISTER

Flow is registered by a small, low-cost totalizing water meter on the shunt pipeline. The meter gears and register used are sized to indicate the total flow in the main plus shunt pipelines. This design has the advantage that all of the register components are contained on the shunt line where they are readily accessible for calibration, repair, or replacement. Calibration can be performed without removal of the

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This publication was written to provide information on a commercially-available type of flow metering device. No endorsement of this or any other commercially-available product is intended, nor criticism of other similar products that may provide similar capabilities.

meter. The register components cost less than \$100 if the entire register needs to be replaced.

The meter register is a totalizer which does not directly measure flow rate. Rather, total volume of flow is measured in gallons, and this volume must be divided by the time of operation to determine the flow rate for any period of operation.

ACCURACY

The commercially available meter shown in Figure 1 has an accuracy of plus or minus 2 percent. To improve accuracy, this meter is equipped with straightening vanes in the mainline meter tube. However, as with all in-line flow meters, certain minimal lengths of straight pipeline are required upstream of the meter. Because of the straightening vanes used, the minimum upstream distance of straight pipeline recommended by the manufacturer is only 2 pipe diameters as compared to the 6 to 10 diameters required for conventional impeller meters without straightening vanes.

MATERIALS

The mainline meter tube is constructed of epoxy-coated steel for long life when subject to poor water quality or when chemigation is practiced. The meter is commercially-available as a plain-end or flanged tube.

SPECIFICATIONS

Specifications for a typical commercially-available shunt flow meter are given in Table 1. Flow capacities, mid-range friction losses, and typical costs are given. These specifications are for the Miller SLV Shunt Line Venturi Flow Meter manufactured by Master Manufacturing Company, Irrigation Division, P.O. Box 3806, Sioux City, IA 51102.

The cost of the shunt flow meter described here is nominal because it is fairly simple in design and the meter register used is a small, low-cost device that is readily available.

SUMMARY

A shunt flow meter can be used to accurately measure irrigation water. In a shunt flow meter, a fraction of the water in the irrigation main pipeline is shunted through a small diameter pipeline parallel to the mainline for a short distance where it is measured before it is returned to the mainline. The register is located on the shunt line where it is readily accessible for repair and calibration. The method of operation, specifications, and costs of a typical commercially-available shunt flow meter was described in this publication.

Capacity (gpm)	Size (inches)	Friction loss (psi)	Cost (\$)
200 - 850	6 - 6.625	2	480
500 - 2500	8 - 8.625	1	550
1000 - 3500	10 - 10.75	0.5	600