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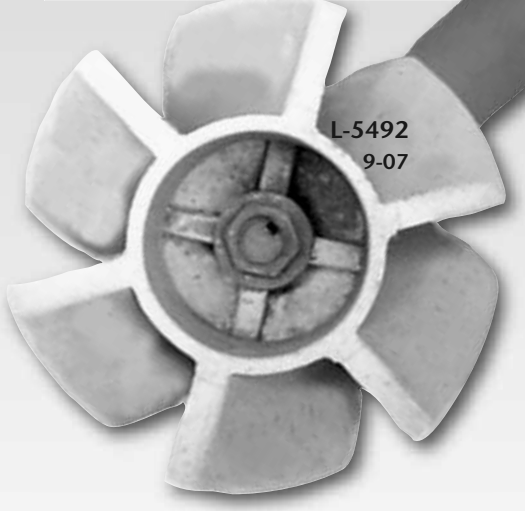

Propeller flow meters

Juan Enciso, Dean Santistevan and Aung K. Hla*

Propeller flow meters are the most common devices used in Texas for measuring water flow rate. Water meters help irrigators better manage and schedule irrigation. They are also a tool for estimating irrigation water use. This publication will help irrigators learn to select, install and maintain a propeller flow meter, interpret the meter readings, and use the data.

TABLE 1

Sizes and flow rates			
Meter size (in)	Minimum flow (gpm)	Maximum flow (gpm)	Head loss (in)
3	35	250	29.5
4	50	600	23.0
6	90	1200	17.0
8	100	1500	6.75
10	125	1800	3.75
12	150	2500	2.75
14	250	3000	2.00
16	275	4000	1.75

Selecting a meter

A propeller flow meter measures the velocity inside a pipe and shows the flow rate reading on a dial. **Table 1** shows approximate sizes and minimum and maximum flow rates.

There are three main types of flow meters. The saddle type can be welded or clamped (**Figs. 1A** and **1B**), open flow (**1C**), or flanged (**1D**). The weld in line flow meter of **Figure 1B** may also be fitted with straightening vanes.

Some of these meters are coupled to aluminum or PVC pipe, usually when they will be used in furrow irrigation (**Fig. 1E**). When there will be excessive trash in the water, the small propeller can be installed **(Fig.1F)**.

Installing a meter

The meter should be installed and placed correctly to ensure that readings will be accurate. It is also important to prevent debris from collecting on the propeller. Water should be clean, but if it contains sediment, the meter should be located properly so that settling sediment will not obstruct the flow.

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FIGURE 1: Flow meter types

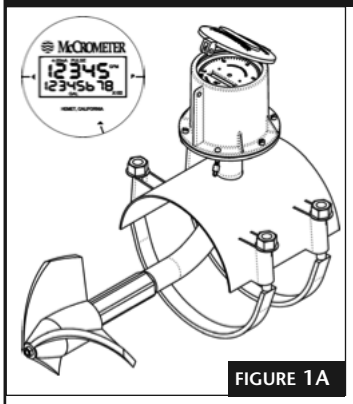


FIGURE 1A

FIGURE 1B

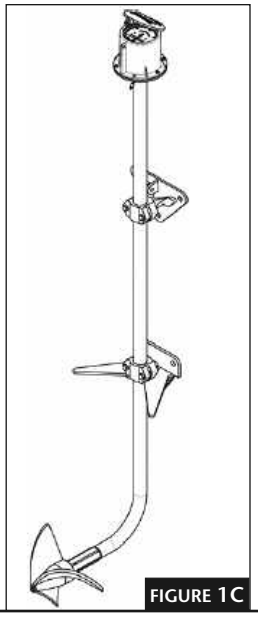


FIGURE 1C

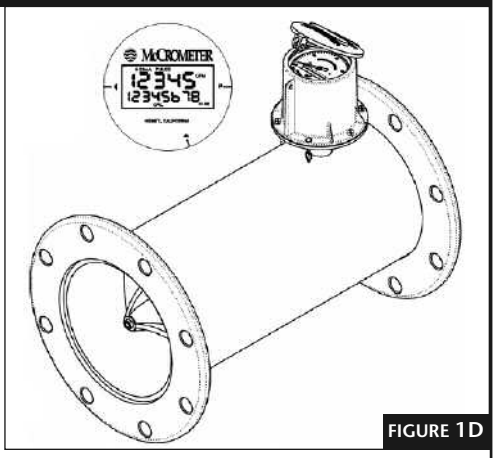


FIGURE 1D

FIGURE 1E

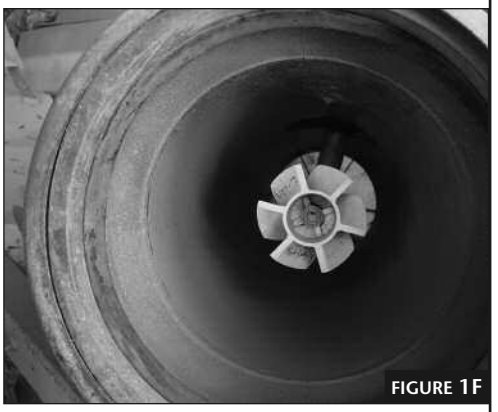


FIGURE 1F

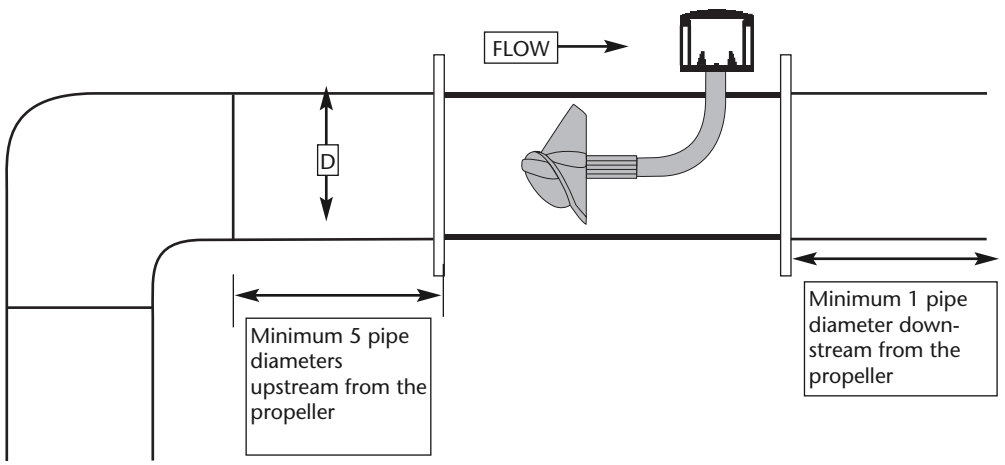
Illustrations and photos courtesy of McCrometer

Some obstructions before the meter, including elbows, valves, pumps or changes in diameter, can cause disturbances in the flow measurements. To avoid this, the meter should be minimum distances upstream and downstream of any obstructions, as shown in **Figure 2**. A minimum of five pipe diameters upstream from the propeller and one diameter downstream from the flange is usually sufficient, although the manufacturers' requirements may vary with different meter models and sizes. If five diameters are specified upstream and one diameter downstream, and if the pipe diameter is 10 inches, the length of the pipe upstream before any obstruction should be at least 50 inches and the length downstream should be 10 inches. If there is not enough length either upstream or downstream, meters should have straightening vanes as shown in **Figure 1B**. Adding vanes will reduce the undisturbed length requirement to about 1½ pipe diameters upstream and ½ diameter downstream.

Reading flow meters

Propeller meters are used to measure instant flow rate and the total volume over a period of time. The instant readings are in gallons per minute or cubic feet per second. The needle indicates the flow rate and the box below the needle indicates the total volume of water. The total volume can be measured in acre-inches, gallons, cubic feet or cubic meters. Some irrigators prefer the acre-inch because it

FIGURE 2: Distance requirements for installing flow meters



relates to their traditional terminology. On the dial faces shown in **Figures 3A** and **3B**, the flow rate is expressed in gallons per minute and the total volume in gallons. To obtain the volume, the reading is adjusted by a factor. In **Figure 3A** the factor is 100; in **Figure 3B** the factor is the three zeros to the right side of the dial. The readings for each flow meter are in the figure captions.

In **Figure 3C** the flow rate is measured in cubic feet per second and the total volume in acre-feet when the reading is multiplied by the factor of 0.001 indicated on the dial face. In **Figure 3D** the flow rate is measured in gallons per minute and the total volume in acre-feet when the reading is multiplied by a factor of 0.01. In **Figure 3E** the flow rate is measured in gallons per minute, but the total volume is measured in acre-feet when the reading is multiplied by a factor of 0.001. The factor for adjusting the readings of each flow meter is shown in the captions.

Common Conversions

A useful conversion table is given in **Table 2**.

FIGURE 3: Reading flow meters

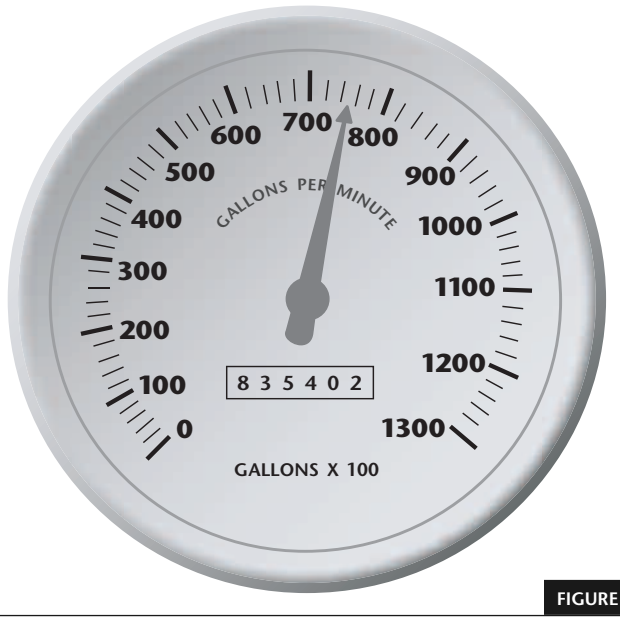


FIGURE 3A

Standard 8-inch dial face with gallons totalizer. Add two zeros to the six-digit number.
Dial face reading = 83,540,200 gallons.

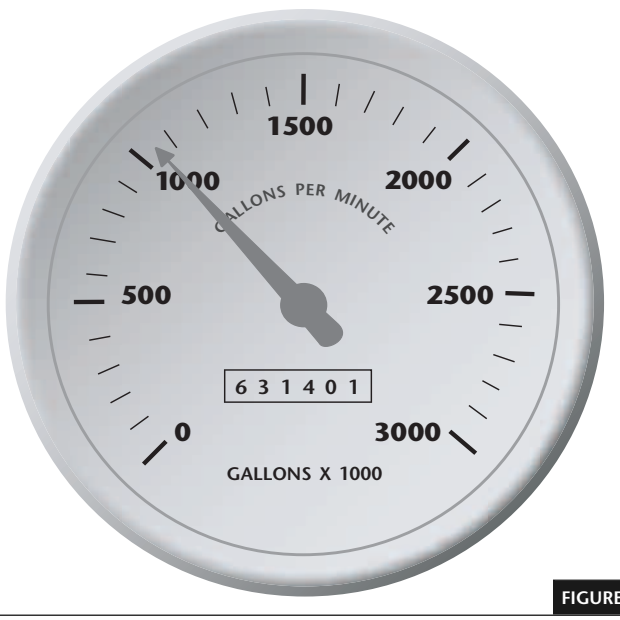


FIGURE 3B

A 10-inch dial face with gallons totalizer. Add three zeros to the six-digit number.
Dial face reading = 631,401,000 gallons.

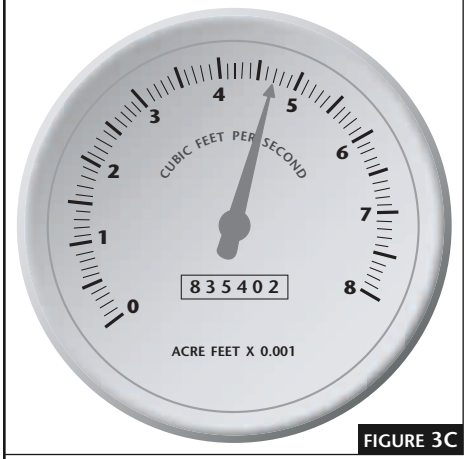


FIGURE 3C

Dial with cubic feet per second indicator and acre-ft totalizer. Place a decimal point three places to the left.
Acre-ft = 835.402

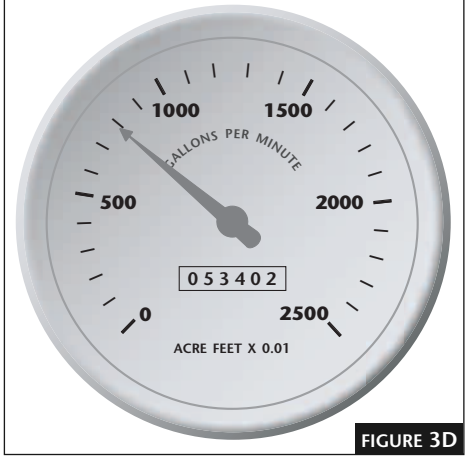


FIGURE 3D

Acre-ft totalizer. Place a decimal point two places to the left.
Acre-ft = 534.02

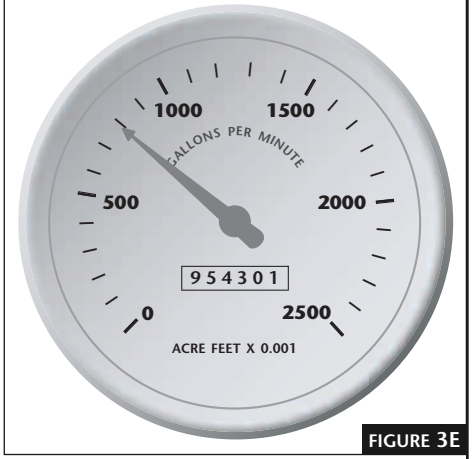


FIGURE 3E

Acre-ft totalizer. Place a decimal point three places to the left.
Acre-ft = 954.301

Conversion example 1:
Suppose the volumetric reading before irrigation was 48,563,000 and after irrigation it was 89,057,200. Determine the irrigation depth applied in acre-feet and in acre-inches.

Actual reading = 89,057,200 gallons
Previous reading = – 48,563,000 gallons
40,494,200 gallons

Acre-feet used = 40,494,200 ÷ 325,851 = 124.27 acre-feet
Acre-inches used = 40,494,200 ÷ 27,154 = 1,491.28 acre-inches

Conversion example 2:
What is the end reading if irrigation is applied to a depth of 1.5 inches over 3 acres? Assume irrigation efficiency is 80 percent and the initial reading was 8,595,560.

Volume required = (1.5 inches x 3 acres x 27,154 gallons/acre-inch) ÷ 0.80 = 152,741
Reading = Initial meter reading + Volume required
Reading = 8,595,560 + 152,741 = 8,748,301

Maintenance

Flow meters should be inspected regularly to check for mechanical wear and for breakage of the moving parts. Mechanical failures will cause erratic readings. A fogging dial may indicate leakage from a bearing assembly. A quick way to check the mechanical soundness of a meter is to see if the total volume equals the instant flow rate times the interval of time of the measurement. A failing meter should be repaired or serviced.

TABLE 2

Water volume and flow conversions and equivalents

Volume	Equals
1 gallon	8.33 pounds
1 cubic foot	7.48 gallons
1 acre-foot	325,851 gallons
1 acre-foot	43,560 cubic feet
1 acre-inch	27,154 gallons
1 acre-inch	3630 cubic feet
Flow	**Equals**
1 cfs	448.83 gpm
1cfs	1 acre-inch per hour
1 gpm	0.00223 cfs
1 gpm	0.00221 acre-in per hour
1 liter/second	15.85 gpm
1 cubic meter/minute	264.2 gpm
1 cfs for 1 hour	1 acre-inch
452 gpm for 1 hour	1 acre-inch

cfs - cubic feet per second, gpm - gallons per minute

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