A. WILLIAM FRY AND JOHN R. DAVIS

## Simple and accurate device for

# Sprinkler Irrigation

## flow measurements

An easily made device—a square-edged orifice—for measuring the rate of water flow in sprinkler irrigation pipe was the most accurate of several such devices evaluated at Davis.

The square-edged orifice can be made with ordinary shop tools, is sturdy enough to withstand field abuse, and produces a reasonable degree of accuracy with relatively low loss of velocity head. The device and pressure taps can be installed in 1–1½ hours with common shop tools.

All the devices included in the evaluation study were adapted to 4″ diameter aluminum tubing.

The square-edge eccentric orifice was made of $\frac{3}{16}''$ aluminium plate with an effective area—area open for water flow—at the orifice of 76% of the cross sectional area of a steel press-on coupler. The device was tested with a 20′ straight approach of pipe and with a 4′ straight approach.

When water is forced through the device, the reduced area of the orifice forms a jet of high velocity and low static pressure downstream from the orifice plate. In a level pipe the differences in pressure upstream and downstream from the orifice can be measured—on a differential pressure gauge or by a U tube air-water manometer—through taps in the side of the pipe in line with the deepest section of the orifice plate. The taps should be flush with the inside surface of the pipe, and all burrs removed to avoid unnecessary errors in pressure measurement.

On the basis of accuracy, ease of construction and adaptability to field conditions, the square-edged orifice is practical for measurement of flow in sprinkler systems. It is simple to construct, and to install, and the use of an air-water manometer is an advantage in field use.

The square-edged orifice method of measurement is accurate over the desired range of water flow in sprinkler irrigation systems.

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*A. William Fry is Junior Engineer, Department of Irrigation, University of California, Davis.*

*John R. Davis is Associate Irrigation Engineer, University of California, Davis.*

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**Eugene R. Perrier, James M. Davidson, and William R. Johnston**

## Pressure panel for

# Soil Moisture Removal

## measurements

Soil moisture desorption information can be measured accurately in the laboratory with a relatively simple research tool—porous membrane apparatus—and used to determine the energy status of water in the soil.

The forces with which moisture is held in the soil are adsorption, the attraction of water to the surface of soil particles, and capillarity, the surface tension of water in the soil pore spaces. The composite of these forces is termed soil moisture suction and is commonly expressed in terms of bars or atmospheres, 1.0 bar equals 0.9869 atmosphere. Moisture is removed from soil by plant roots, evaporation and gravity.

A suction of one third bar approximates the amount of water a soil will hold against the downward force of gravity and 15 bars of suction approximates the level of soil moisture at which plants show signs of severe stress or wilt. The amount of moisture between the one third bar and 15 bars of suction is an estimate of the total amount of water which is stored in the soil and available for plant use. Plants use water more readily when the soil moisture-suction is low.

Soil moisture desorption information can be used to estimate the amount of remaining available water when the soil moisture content is known; in studying the phenomenon of soil moisture movement; and for the study of other soil-moisture problems.

The apparatus for determining soil-moisture desorption information consists of a pressure panel, pressure-membrane units and porous-plate units. The pressure-membrane unit is used to obtain the high suction range from 1.0 bar to 15 or more bars. The bottom of the chamber has a screen soldered to a sheet metal disc with an outflow tube at the center. A cellulose membrane is fitted over the screen and soil samples placed on the membrane. The chamber is made airtight by bolting the top and bottom plates together.

The porous-plate unit has a ceramic membrane instead of a cellulose membrane and is used to obtain low suction values from 0–1.0 bar. Four to six porous ceramic plates, holding soil samples, are put into a pressure cooker, which facilitates a large number of determinations.

The pressure cookers used with the ceramic plates are individually controlled by extremely sensitive manual loading, pneumatically balanced regulators. The

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