UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

FLOW CHARACTERISTICS OF A 12-INCH TYPE "T" SUPERIOR IRRIGATION METER

Hydraulic Laboratory Report No. Hyd. 261

RESEARCH AND GEOLOGY DIVISION

BRANCH OF DESIGN AND CONSTRUCTION
DENVER, COLORADO

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Laboratory Report No. 261
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Subject: Flow characteristics of a 12-inch Type "T" Superior irrigation meter.

PURPOSE

To determine the registration accuracy of and the head loss for a 12-inch Type "T" Superior impeller water meter.

CONCLUSIONS

1. This meter will require registration correction as evidenced by a 9- to 15-percent low registration in the flow range of 1.4 to 9.0 cubic feet per second (Figure 4). This meter should not be used in field installations until the low registration is corrected. Correction might be accomplished by changing the gear ratio, altering the impeller design, or using a smaller throat section and decreasing the radius of the meter casting to fit this throat section.

2. The head loss through this meter is negligible (Figure 4).

THE INVESTIGATION

Description of the Superior Irrigation Meter

The meter tested, Serial No. 598, was manufactured by the Superior Irrigation Meter Company, San Juan, Texas, and was loaned on June 30, 1947, to the Bureau of Reclamation by the W. T. Liston Company, Mission, Texas, a distributing agent for Superior meters. Latest information indicates that the Superior Irrigation Company has dissolved, and the manufacturing rights are now held by the Peerless Equipment Company, 2117 East 25th Street, Los Angeles 11, California.

These impeller meters have been made in two types, a horizontal "T" type and a vertical "S" type. Diagramic installation sketches of both types are shown in Figure 1. The meter tested was Type "T." The meter includes a three-bladed impeller held in the center of the concrete pipe by placing the meter unit in a cast-iron oval ring grouted into the top of the concrete pipe. The revolutions of the impeller are transmitted by a worm gear and a vertical shaft through a pressure-stuffing box to the register, which records to one-thousandth of an acre-foot to six digits in line. An additional rotating pointer indicates tenths of the smallest digit to enable recordings to one ten-thousandth of an acre-foot. The main frame is of cast iron and wrought iron. The instrument parts are of brass and other materials that resist corrosion. The meter is assembled in one unit that is easily released and removed for inspection. A satisfactory water seal is obtained between the meter unit and the mounting ring by using a waterproofed 1/4-inch diameter fiber rope. The older model meters were attached to the mounting ring (grouted to the concrete pipe) by means of six bronze cap screws which usually necessitated working under water to remove the meter for inspection. The later model meters, like the one tested, were improved in this respect. The cap screws were replaced by a quick acting clamp actuated by a long T-handled wrench, enabling the meter to be installed and removed without working under water. The cylindrical lower surface of the meter casting was coincident with the inside surface of the 12-inch concrete pipe (Figure 2). Thus, no throat section was necessary for this test installation. A 12-inch throat section is recommended if this meter is used in larger than 12-inch concrete pipe lines (Figure 1). The throat section will increase the head loss through the metering section.

The manufacturer states that the meter will operate satisfactorily under 20 feet of water pressure. The concrete pipe in which the meter is placed must flow full of water. All Superior meters are more or less tamper proof. They are provided with a heavy, cast-iron cover that can be securely locked in place. A small opening in the cover over the register permits readings without the possibility of tampering with the tally mechanism. To insure long meter life and maximum efficiency, the meter should be removed and inspected at least once each year, and cleaned and oiled if necessary. The meter should be kept free of weeds, moss, or other trash which accumulates around the impeller. Long moss streamers occasionally stop the meter by wrapping around the exposed part of the shaft. Where the depth of cover on the concrete pipe line is 24 to 28 inches, the meter is built into a 3-foot length of concrete pipe (Figure 1). Where the cover on the concrete pipe line is 30 to 38 inches, the meter tube is lengthened to 48 inches by adding a 12-inch length to the upper part of the meter shell. This allows the meter head to stand above the ground surface. The approximate cost for the Type "T" meter installation was $130 in 1947.

Test Procedure

The test meter was installed in a 30-foot length of 12-inch concrete pipe between a 4- by 4- by 8-foot high head box and a 4- by 2- by 4-foot high tail box with overflow at the top (Figure 3). The purpose of the tail box was to insure that the concrete pipe line flowed full. The location of the meter in the pipe relative to the head box (Figure 3) was chosen to provide uniform velocity distribution at the meter impeller. The pipe entrance at the head box was rounded to assist in uniform flow. Flow was supplied to the head box by a 12-inch pump. The discharge was measured by calibrated venturi meters placed in the pump discharge line.

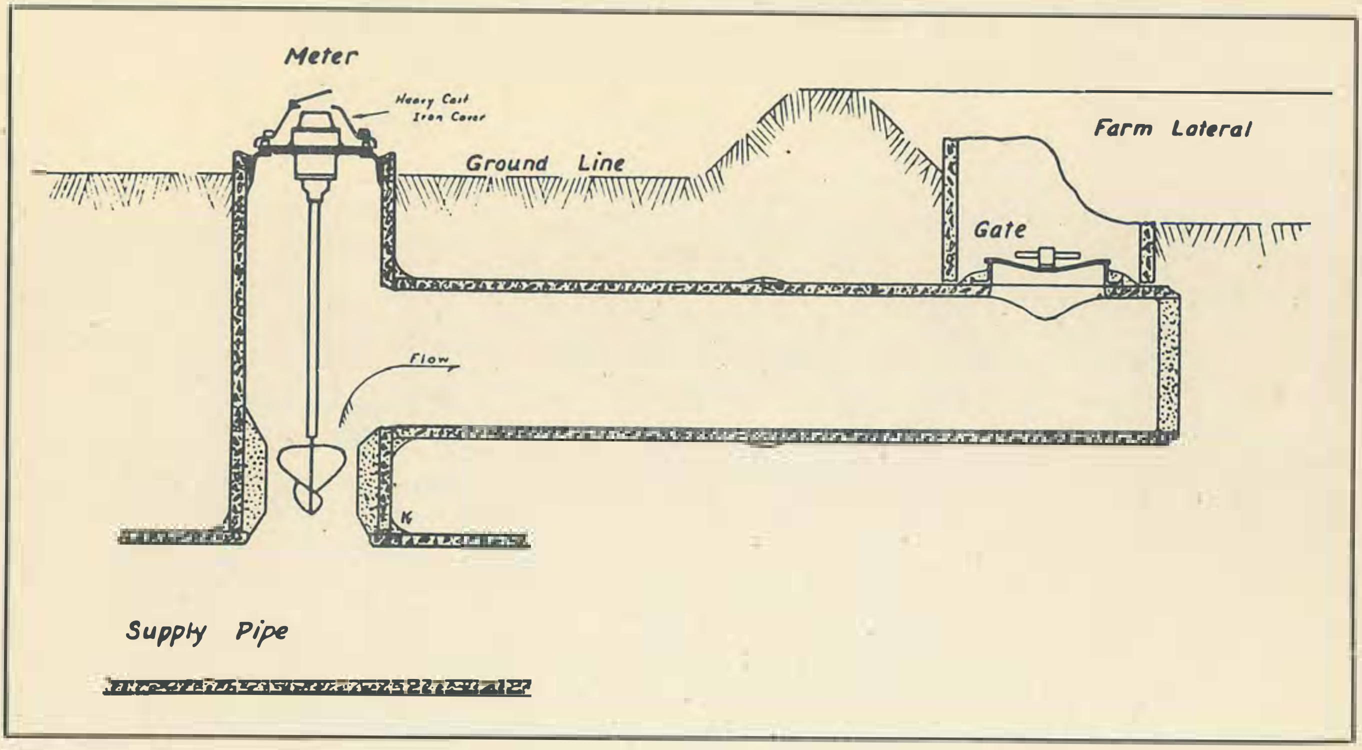
Four-tap piezometer rings were installed immediately upstream and downstream from the meter. A third four-tap piezometer ring was installed 3 feet downstream from the meter to make certain the head loss was measured. In taking data, approximately 30-minute runs were made, the exact time being recorded by stop watch. From the drop in pressure obtained from the piezometer readings was subtracted the loss due to friction. This pipe frictional loss was analytically determined by using Scobey's formula:

$$H = \frac{V^2}{C_s^2 \, d^{1.25}}$$

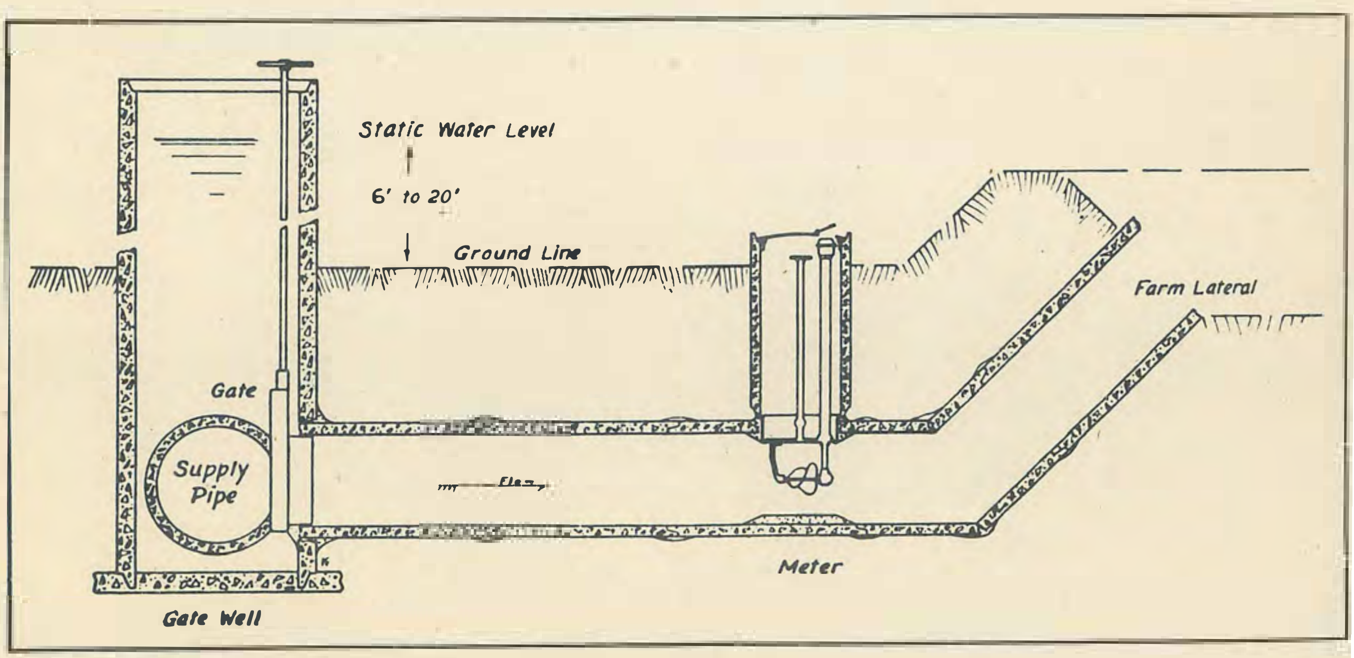
The value used for C_s was 0.345 as recommended by the Bureau of Reclamation Manual, Volume IX.

Test Results

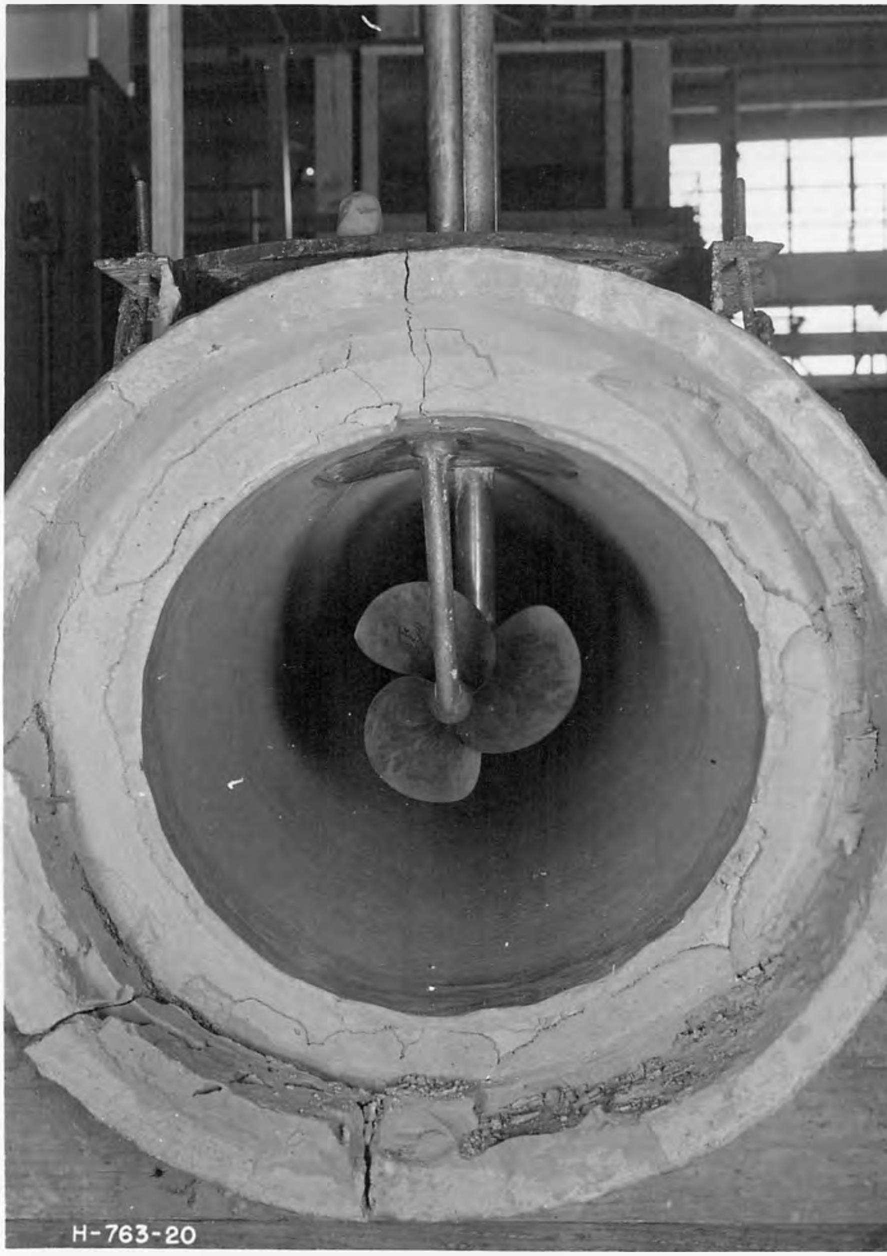
The meter registration accuracy was 85 to 91 percent in a flow range of 1.4 to 9.0 cubic feet per second (Figure 4). After the registration accuracy curve was obtained, the meter was removed and dismantled to check for any mechanical deficiencies. The vertical drive shaft was sprung somewhat, and bound slightly in the upper bearing. This was corrected and the meter cleaned and lubricated. Additional registration accuracy data were taken, and the results showed negligible improvement (Figure 4). The test set-up was checked thoroughly for leaks and none were found. Therefore, as stated in "Conclusions," paragraph 1, this meter is unsatisfactory for field use until the low registration is corrected. The head loss for the meter is low and is shown in Figure 4.



TYPE "S"—*Vertical, total-flow meter, installation shows simple farm delivery from underground pipe supply system, using alfalfa valve outlet gate.*



TYPE "T"—*Horizontal, total-flow meter, installation shows simple farm delivery from underground pipe supply system. May also be used from open canals and for pipe distribution.*

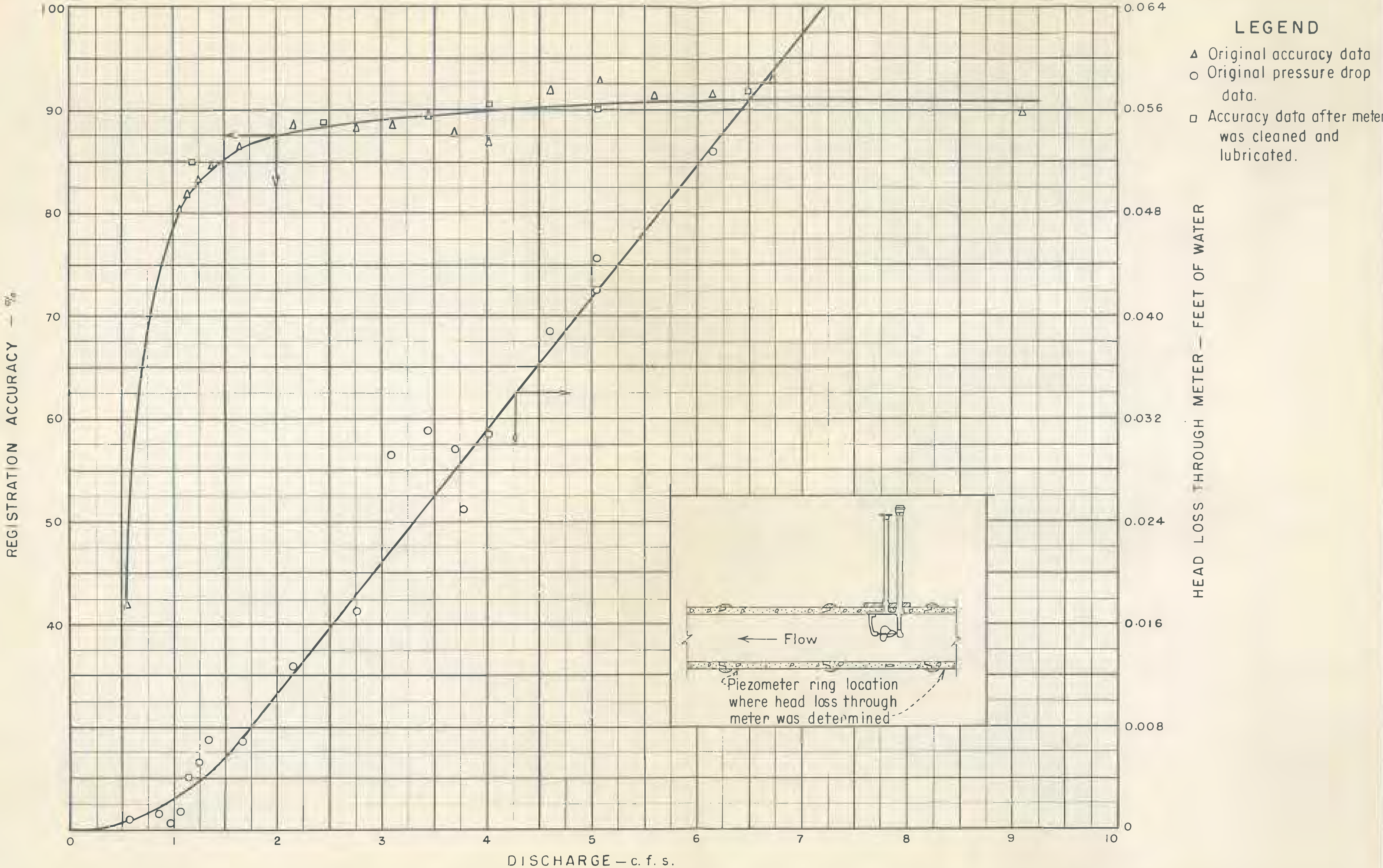


View from Upstream Showing the Coincidence of the Concrete Pipe Inside Surface with the Meter Casting Cylindrical Surface.

General View of Superior Irrigation Meter

Test Installation

Figure 3



CALIBRATION CURVES
12" SUPERIOR "T" METER

Note: Meter installed in 12" concrete pipe without throat section.