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WATER RESEARCH LABORATORY

REPORT ON TEST OF SIX INCH ORIFICE
PLATES AND CARRIER TUBES.

by

I.R. Wood



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Report on Test of Six Inch Orifice Plates and
Carrier Tubes.

Date _____

1. Description of Test

The six inch orifice plates in their accompanying carrier pipes were received on 20th December 1960. Tests were carried out on Carrier Pipe No.1, Orifice Plate Serial Number A129.61189 on 5.1.61 and on Carrier Pipe No.2 Orifice Plate Serial No. A129.61188 on 6.1.61.

The test was carried out by connecting the carrier tube to a six inch diameter water supply pipeline with a six inch diameter "Saunders" valve downstream of the carrier tube.

The carrier pipe in each case comprised an approach length of 20 diameters upstream of the orifice plate and 5 diameters downstream of the orifice plate. Tappings were located at single points in the pipe wall at a distance D upstream and $\frac{D}{2}$ downstream.

In addition to the straight length provided in the carrier pipe an additional straight length of 6-inch diameter pipe was provided 8 diameters in length upstream and 4 diameters downstream making a total straight length before the orifice plate of 28 diameters and 9 diameters downstream of the plate. A gate valve was used for isolating purposes only at the entrance to the u/s length. The rate of flow through the metering pipe was regulated by the "Saunders" type valve at the downstream end of the outlet straight.

The volume of the ballast tank was obtained by weighing in batches the amount of water in the tank. In every test the weight of water collected was $1175\frac{1}{2}$ lbs. in the ballast tank and approximately 800 lbs. in the weigh tank. The time for the accumulation of each batch was obtained within 0.2 of a second by a stopwatch. The periods of collection ranged from 300 seconds to 70 seconds according to the rate of flow. The flow rates were adjusted by use of the "Saunders" valve and time was allowed for each flow rate to become constant as indicated by steadiness of the manometer differentials. The outlet pressure at orifice plate was monitored by a pressure gauge. The outlet pressure at all times exceeded 23 feet.

The differential head at the orifice plate was measured using a simple air water manometer for heads in excess of 6 feet. Two "Cassella" micromanometers were adopted to read differential heads of 30 inches and less. The upper air loop was through a variable pressure air reservoir. The surface observations were made by observing sub-surface point gauges through eye pieces. The results are tabulated in Tables 1 and 2 of Part 2 on page 3. The readings for head are corrected to a temperature of 60° F in column (3). The discharges were calculated from the batch weights and the ballast tank weight (a correction was made for the variation of the ballast tank weight with temperature, column 4). The results were then compared with predicted discharges supplied by Bailey Meters and Controls (Aust.) Pty.Ltd. The predicted discharges were supplied for differential heads of 120 inches, 77 inches, 30 inches and 5 inches. The differential heads observed in the tests were as close as it was reasonable to obtain them. For comparison purposes the computed discharges were adjusted to the measured orifice heads using the square root relationship between discharge and head. The adjusted flows are shown in Column 5.

The difference between the recorded and computed discharges is in Column 6. Each test was repeated and the average difference between the recorded and computed discharges is in Column 7.

2. Table of Results

TABLE I.

Carrier Tube No. 1 Orifice Plate No. A129-61189.

1. Measured Head inches	2. Temp- erature °F	3. Head Corrected to 60°F inches	4. Discharge lbs/hr	5. Discharge computed lbs/hr	6. Diff- erence per cent	7. Average difference per cent
4.918"	73.5	4.911	17,979	17,836	-0.75	
4.971"	76.0	4.964	17,989	17,932	-0.32	-0.53
29.948	76°	29.898	44,004	44,007	+0.01	
30.166	76°	30.116	44,441	44,166	-0.62	-0.31
78.61"	75°	78.48	70,989	71,301	+0.44	
78.64"	75°	78.51	71,199	71,313	+0.16	+0.30
119.90	75°	119.70	87,658	88,055	+0.45	
119.90	75°	119.70	87,931	88,055	+0.13	0.29

Table 2.

Carrier Tube No. 2 Orifice Plate No. A129-61188

1. Measured Head inches	2. Temp- erature °F	3. Head Corrected to 60°F inches	4. Dis- charge lbs/hr	5. Dis- charge computed lbs/hr	6. Diff- erence per cent	7. Average difference per cent
5.658	78°	5.647	19,234	19,101	+0.70	+0.37
5.562	79°	5.551	18,930	18,938	+0.04	
32.608	78°	32.546	45,938	45,856	+0.16	+0.37
32.646	78°	32.584	46,145	45,883	+0.57	
79.32	76°	79.19	71,850	71,530	+0.45	+0.21
78.70	76°	78.56	71,219	71,244	+0.03	
119.40	75°	119.21	87,288	87,762	+0.54	+0.45
119.64	75°	119.45	87,527	87,850	+0.37	

3. Accuracy

The timing of the weighed discharge was accurate within one fifth of a second and the weight measurement was accurate to one half of a pound. The temperature of the water was read to 0.5° F. All volumetric readings were converted to weight measurement on the basis of 62.42 lbs. of water per cubic foot at 50° F.

The overall accuracy of the discharge measurement is therefore expected to be between ± 0.3 per cent for the high discharges and ± 0.1 per cent for the low discharges.

However, because of the difficulty in measuring accurately the head difference at the orifice plate, for low heads the overall accuracy of measurement is expected to be ± 0.3 per cent throughout the range of 5" to 120".

4. Conclusion

The orifice plate and carrier tube have been calibrated for heads of from 5 inches to 120 inches with an overall accuracy of ± 0.3 per cent. In all cases (except one at 5 inches head), the difference between the actual and those computed by Bailey Meter and Controls, Australia Pty.Ltd. fall within the above error limits.