

PD TN-46

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PHILLIPS DRISCOPIPE

Hazen-Williams Pipe Coefficient

ABSTRACT

Flow tests, on 8" SDR 17 Driscopipe 1000 HDPE pipe, were performed in December of 1995 by an independent hydraulics laboratory. Water head loss was measured through a 49.75 foot long section of the 8" SDR 17 HDPE pipe. The pipe was tested at flow rates from 1 to 26.7 fps. It was determined that the Hazen-Williams "C" value was 152. The equivalent sand roughness was determined to be .00003 feet. Phillips Driscopipe has adopted a conservative Hazen-Williams "C" factor of 150.

TESTS

Evaluation of roughness flow tests, on 8" SDR 17 Driscopipe 1000 HDPE pipe, were performed in December of 1995. These tests were performed by GIW Hydraulics Laboratory, 5000 Wrightsboro Road, Grovetown, Georgia. The tests were witnessed by Phillips Driscopipe.

A straight 155 ft section of 8" SDR 17 Driscopipe 1000 HDPE pipe was fused together. The first 100 ft of pipe would be used to allow the flow of water to reach equilibrium before measuring the water head loss. Three service saddles were fused at two separate locations, 100 ft and 149.5 ft. The service saddle on top would be used to vent air in the line. Differential pressure transducers were attached to the two service saddles on the side. The differential pressure transducers measured the water head loss over the latter 49.5 ft. The pipe assembly was placed into the testing loop.

A section of the 8" SDR 17 HDPE pipe's inner diameter was measured in 32 separate locations. There was a standard deviation of 0.08 inches. The value of $D = 7.50$ " was used in calculating results for the flow tests.

The test engineer made a series of measurements of the outer circumference of the pipe, in the test section. During the test, a flow control valve would be used, downstream from the test

section, to adjust the flow of water through the test section. Because of Driscopipe 1000's low value of the modulus of elasticity (130,000 psi), the Pipe's highest OD value would be at the low flow velocity and the lowest OD value would be at a higher flow velocity. The author of the report, Dr. M. R. Carstens, noted that flow rates greater than 12 fps produced no change in the pipe OD. He states that emphasis should be on runs with flow velocities greater than 12 fps.

A primary magnetic flowmeter and a back-up bend meter were tested for calibrated accuracy against a sharp-edged orifice. All meters results were essentially the same value of discharge if $Q > 1000$ GPM. Inaccuracy observed for $Q < 1000$ was due to the pressure transducers, at low values of the pressure differential. Again the author of the report, Dr. M. R. Carstens, would give greater credence to runs in which the flow rate is greater than 1000 GPM. He also uses these runs to estimate relative roughness, e/D .

Two test runs were conducted. The first run, Test 149-95, was used to check the calibration of the magnetic meters versus an orifice. During that run, data was collected. The second run, Test 150-95, was the actual run to determine the water head loss of the 8" SDR 17 conventional extruded pipe.

TEST RESULTS

The roughness in the 8" SDR 17 Driscopipe 1000 HDPE pipe is determined by the measurement of head loss in a straight section of pipe during steady flow. This is based on the concept that $f=fn(Re,e/D)$. In this expression, f is the Darcy-Weisbach boundary-drag coefficient, Re is the Reynolds number, and e/D is the relative roughness of the pipe. The determination of e/D requires obtaining physical data from which Re and f can be calculated. Using a variation of the Colebrook-White function, e/D can then be obtained which best fits the experimentally determined value of f and Re . This evaluation of pipe roughness was time consuming prior to the development of the computer. From the test results, e/D has been determined to be 0.00005 and e is 0.00003 feet.

The purpose of the Water Head Loss test(s) was to determine what the Hazen-Williams "C" factor was. The "C" factor is considered to be a measurement of the smoothness of the pipe wall. The formula for determining pressure drop, over a 100 foot section of pipe is $\Delta P_{100} = (452*Q^{1.85})/(C^{1.85}*D^{4.86})$, where Q is the rate of flow (GPM), D is the pipe's internal diameter (inches) and C is the Hazen-Williams smoothness pipe coefficient. During the test, measurements in the pressure drop over the 49.5 ft section and flow rates were measured. Plugging in these factors and the pipe's internal diameter, the Hazen-Williams pipe coefficient is obtainable. Driscopipe HDPE pipe has a Hazen-Williams "C" pipe coefficient of about 152. This is considered smoother than "extremely smooth".