CALIBRATION OF A 60-INCH RUBBER CHECK VALVE

Prepared for

WAPRO

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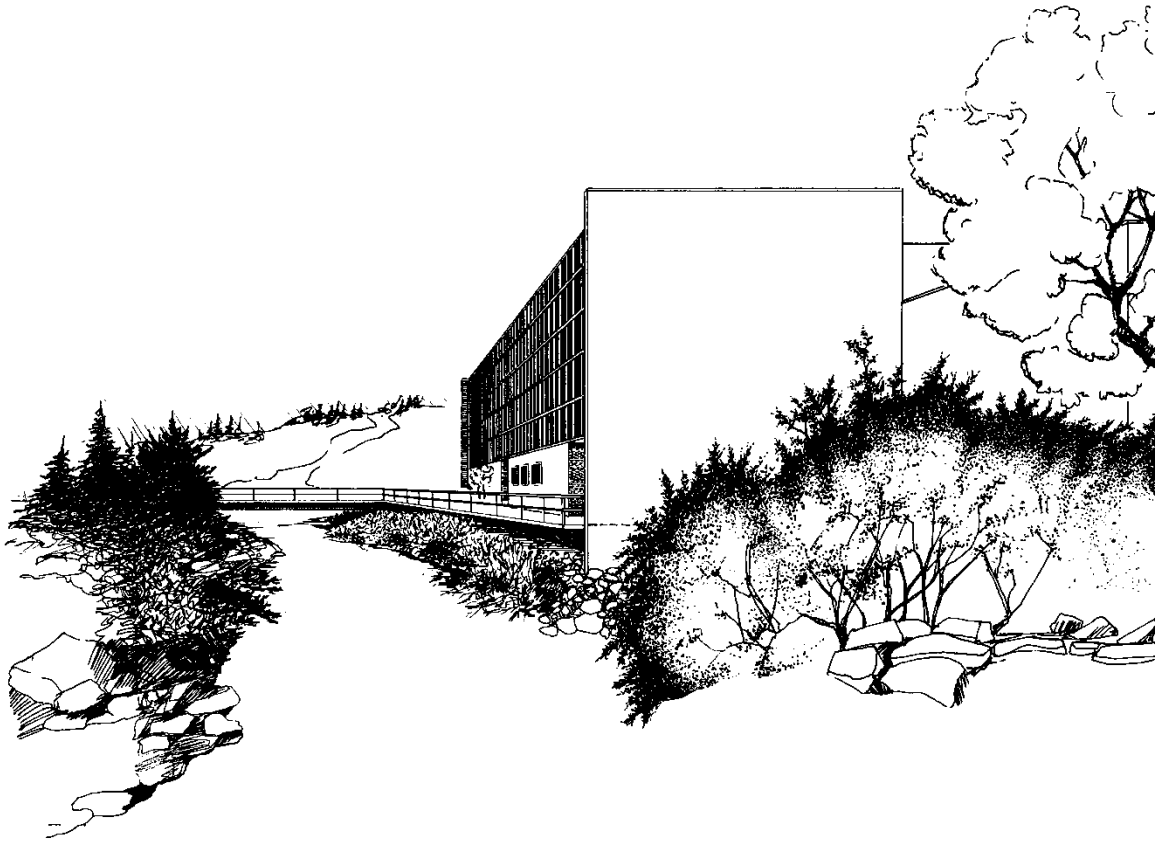

UTAH WATER RESEARCH LABORATORY

Utah State University

Logan, Utah

Report No. 3353

CALIBRATION OF A 60-INCH RUBBER CHECK VALVE

Submitted to:

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INTRODUCTION

Utah State University was contracted by WAPRO to perform a flow test at the Utah Water Research Laboratory (UWRL) in Logan, Utah on a 60-inch rubber check valve manufactured by WAPRO. A cold-water test was performed to determine the discharge coefficient (Cv) for the valve at nine different flow rates. Three individuals from WAPRO were at the laboratory during the valve tests.

EXPERIMENT SETUP

The valve was installed in a 48-inch supply line, which included more than 50 feet of standard schedule 60-inch carbon steel laboratory pipe (59.25-inch ID) installed immediately upstream of the valve. Further upstream was over 500 feet of straight 48-inch standard schedule pipe. A pressure tap was installed on the invert of the pipe at approximately 2 diameters upstream of the valve (Figure 1).

Figure 1. Test Setup for the 60-Inch Rubber Check Valve

Laboratory instrumentation was connected to the pressure tap so that differential pressure measurements during the test could be documented. Discharge from the valve was dumped to a laboratory waste channel.

FLOW COEFFICIENT

The coefficient Cv for the valve was calculated using the following equation:

$$Cv = \frac{Q}{\sqrt{\Delta P / sg}}$$

in which Q is the actual flow rate in gallons per minute, ΔP is the gross valve differential pressure reading in pounds per square inch (psi) and sg is the specific gravity of water during this test (sg = 1.0006).

PROCEDURE

Water was supplied to the test line from a reservoir near the hydraulics laboratory. The flow rate and differential pressure were measured for each run. The water temperature was also measured. The differential pressure measurement across the valve was determined by measuring the upstream pressure at the pipe pressure tap located at two diameters upstream of the valve (where the downstream pressure for the free-discharging valve is 0 psi at atmospheric pressure).

All flow measurements were made using either a calibrated 20-inch or 48-inch master laboratory venturi flow meter installed upstream of the test valve. The calibration for each venturi flow meter was previously performed using the laboratory weight tanks. The weight tank is regularly calibrated and is traceable to the National Institute of Standards and Technology. Discharge from the test line was controlled using a control valve upstream of the test section.

Valve differentials were measured using a Rosemount differential transmitter. The Rosemount transmitter was carefully zeroed to the invert of the pipe. The transmitter output was averaged during each individual run using an averaging Fluke volt/amp meter. Appropriate ranges were set on the transmitter to minimize uncertainties as the valve differentials changed.

The valve was tested over a wide range of flow rates. The differential pressure and the flow rate were accurately measured and the Cv was calculated for each run. The average Cv is provided in the data table. All instrumentation used is regularly calibrated and traceable to the National Institute of Standards and Technology.

RESULTS

Table 1 summarizes the test results for the valve test. Figure 2 illustrates the relationship between flow rate and the Cv for the valve.

Table 1. Utah Water Research Laboratory Flow Meter Calibration Data

Manufacturer:	WAPRO		
Calibration Date:	10/19/15		
Calibration Location:	48-inch test line	Valve Inside Diameter (in.) =	60.000
		Nominal Pipe Dia. =	60-inch
Manufacturer:	WAPRO	Pipe Diameter (in.) =	59.250
Valve Description:	Rubber check valve	Pipe Area (ft^2) =	19.15
		Water Temp. (F) =	51.9
Pipe Setup		Unit Weight (lb/ft^3) =	62.40
Upstream:	60-inch std carbon steel	Kin. Visc. (ft^2/s) =	1.37E-05
Downstream:	none		

Calibration Performed by: Zac Sharp
Calibration Witnessed by: WAPRO representatives

Run No.	Flow gpm	ΔH ft	Inlet Reynolds Number	Flow Area ft^2	Pipe Velocity fps	Pipe Flow Condition	Cv
1	2	3	4		5	6	5
1	1964.79	1.639	81,624	19.147	0.229	Open Channel	2331.93
2	4542.91	1.889	188,728	19.147	0.529	Open Channel	5022.03
3	8846.78	2.250	367,525	19.147	1.029	Open Channel	8962.46
4	15329.23	2.694	636,828	19.147	1.784	Open Channel	14192.42
5	27367.47	3.406	1,136,937	19.147	3.185	Open Channel	22532.99
6	37909.39	3.938	1,574,884	19.147	4.411	Open Channel	29029.11
7	49208.71	4.688	2,044,296	19.147	5.726	Open Channel	34532.99
8	72374.00	5.800	3,006,660	19.147	8.422	Full Pipe	45665.90
9	85277.89	6.744	3,542,732	19.147	9.923	Full Pipe	49896.25

Certified by:

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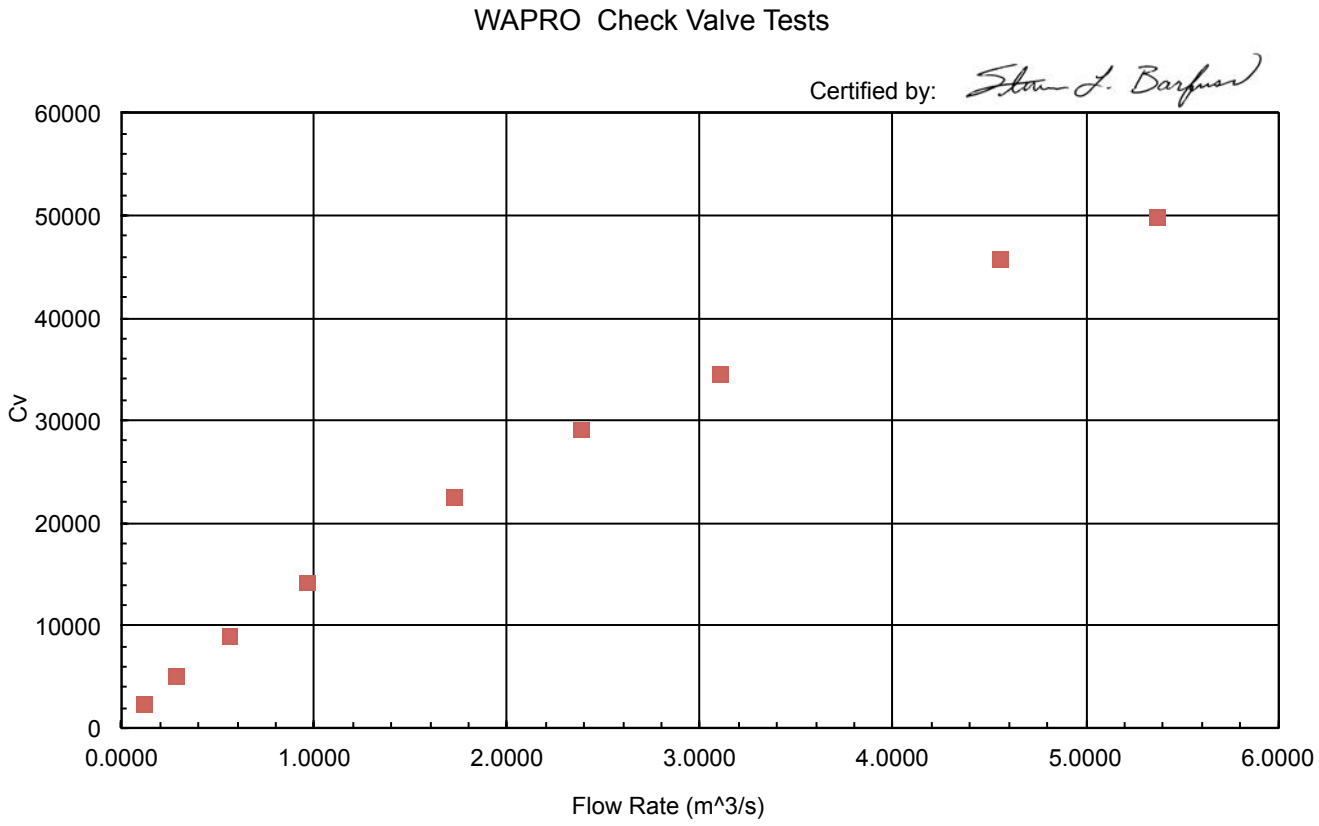

Figure 2. Flow Rate vs Cv for the 60-inch WAPRO rubber check valve