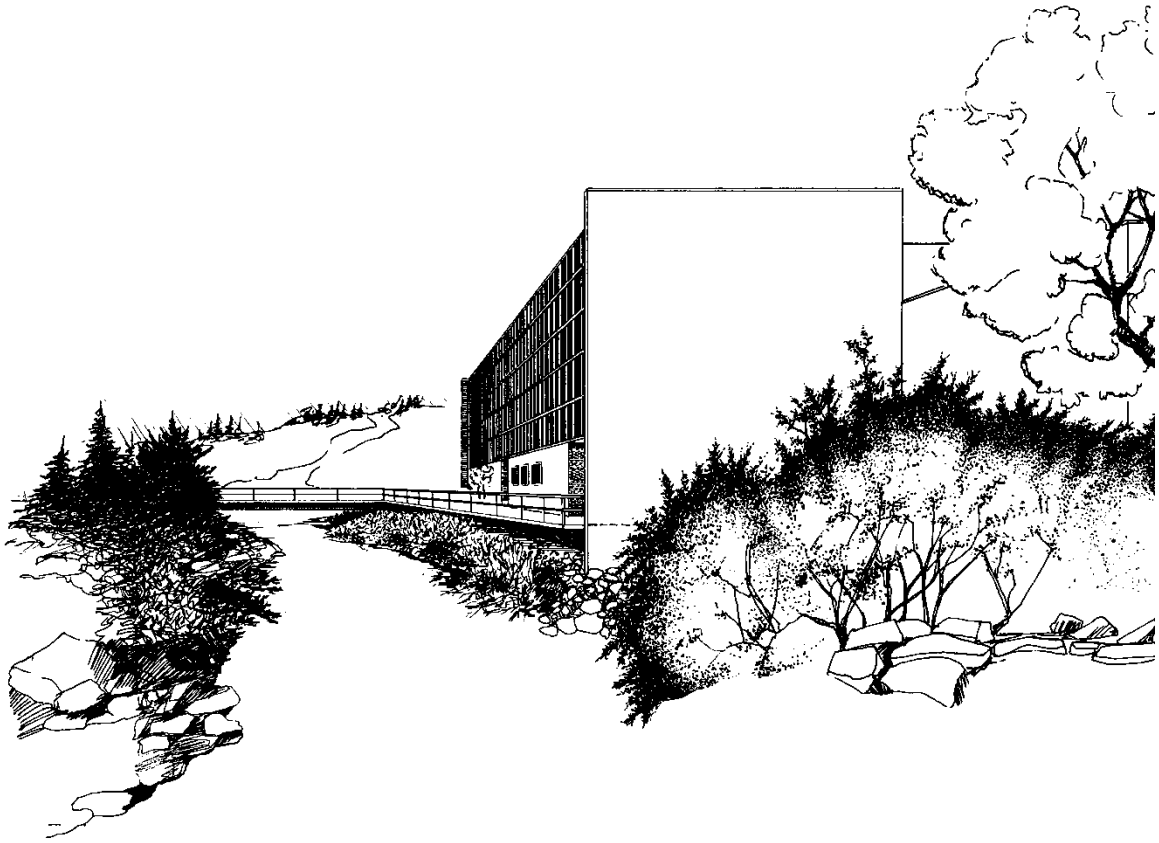
CALIBRATION OF A 12-INCH RUBBER INLINE CHECK VALVE

Prepared for

WAPRO

October 2015



UTAH WATER RESEARCH LABORATORY

Utah State University

Logan, Utah

Report No. 3351

CALIBRATION OF A 12-INCH RUBBER INLINE CHECK VALVE

Submitted to:

WAPRO AB
Munkahusvagen 103
374 31 Karlshamn SWEDEN

By:

Steven L. Barfuss, P.E.
Research Associate Professor

and

Zac Sharp
Research Engineer

Utah Water Research Laboratory
8200 Old Main Hill
Logan, UT 84322-8200

October 2015

Hydraulics Report No. 3351

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 12-inch rubber inline check valve manufactured by A cold-water test was performed to determine the discharge coefficient (Cv) for the valve at ten different flow rates. Three individuals from WAPRO were at the laboratory during the valve tests.

EXPERIMENT SETUP

The valve was installed in a 12-inch supply line, which included more than 30 diameters of upstream standard schedule 12-inch carbon steel laboratory pipe (12.000-inch ID). A pressure tap was installed on the invert of the pipe at approximately 2 diameters upstream of the valve (Figure 1).

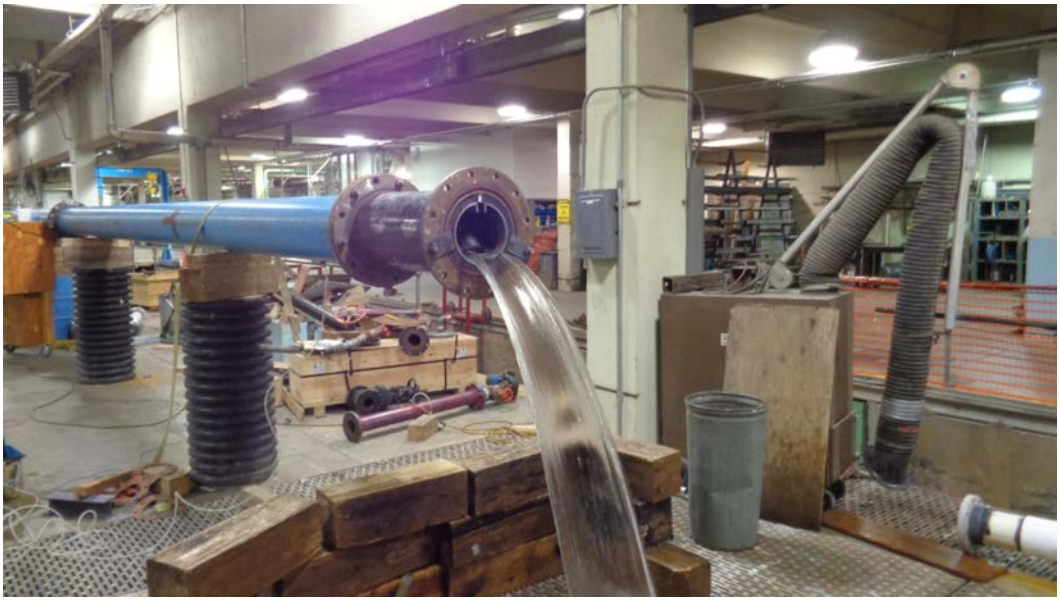


Figure 1. Test Setup for the 12-Inch Rubber Inline Valve

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 a calibrated 12-inch master laboratory magnetic flow meter installed upstream of the test valve and at a lower elevation so it was always running full. The calibration for the magnetic 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:
Calibration Date: 10/19/15
Calibration Location: 12-inch test line
Manufacturer:
Valve Description: Inline rubber check valve

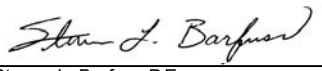
Pipe Setup
Upstream: 12" std steel
Downstream: none

Valve Inside Diameter (in.) = 8.875
Nominal Pipe Dia. = 12-inch
Pipe Diameter (in.) = 12.000
Pipe Area (ft^2) = 0.79
Water Temp. (F) = 52.3
Unit Weight (lb/ft^3) = 62.40
Kin. Visc. (ft^2/s) = 1.36E-05

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	119.60	0.682	33,801	0.570	0.467	Open Channel	220.12
2	196.64	0.829	55,574	0.696	0.629	Open Channel	328.17
3	65.31	0.556	18,458	0.449	0.324	Open Channel	133.08
4	272.32	0.968	76,962	0.778	0.780	Open Channel	420.63
5	812.08	1.930	229,507	0.785	2.304	Full Pipe	888.22
6	1342.88	3.813	379,519	0.785	3.809	Full Pipe	1044.93
7	1860.80	6.184	525,892	0.785	5.279	Full Pipe	1136.98
8	2325.60	9.020	657,252	0.785	6.597	Full Pipe	1176.63
9	2720.80	11.750	768,942	0.785	7.718	Full Pipe	1206.11
10	2921.60	13.370	825,691	0.785	8.288	Full Pipe	1214.12

Certified by:



Steven L. Barfuss P.E.
Research Associate Professor

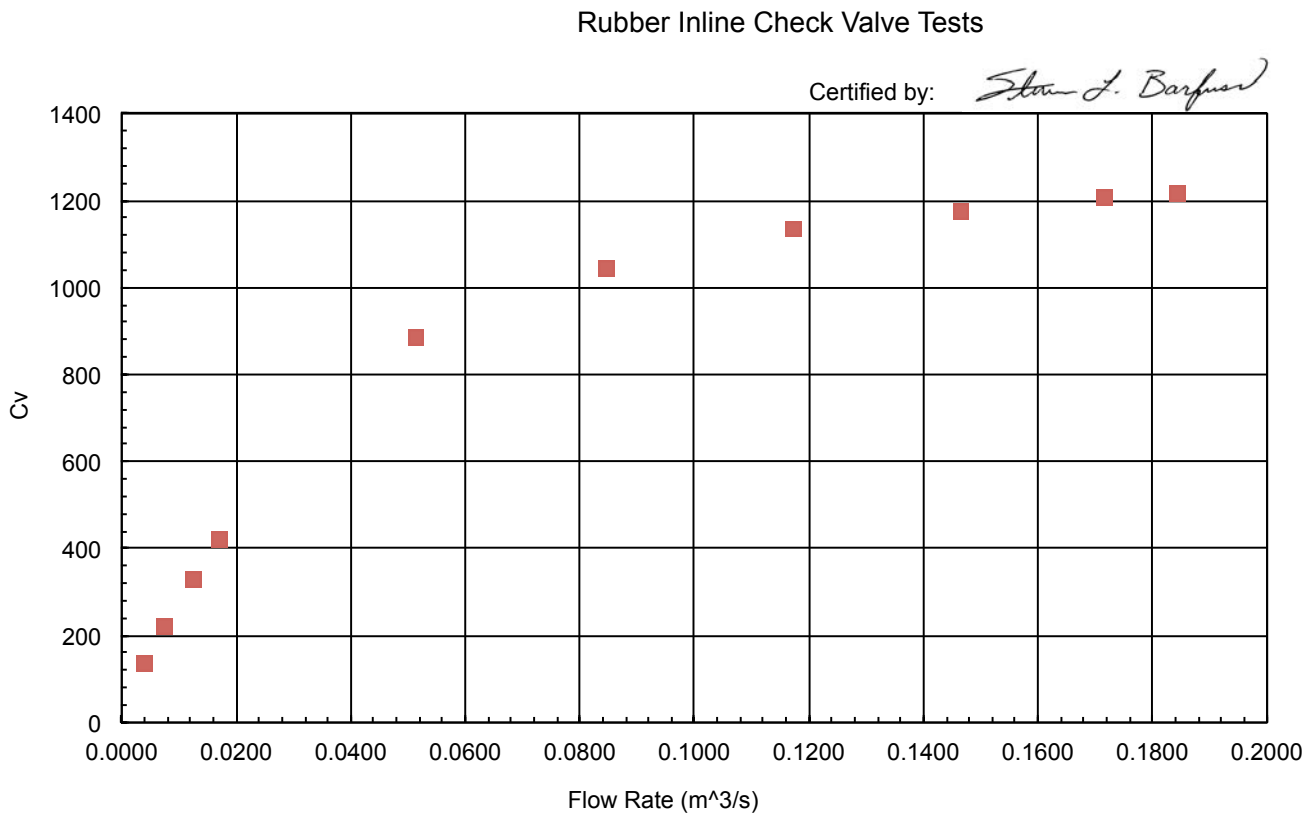


Figure 2. Flow Rate vs Cv for the 12-inch inline check valve