Reference Manual
00821-0100-4810, Rev EC
January 2023

Rosemount™ 405 Compact Orifice Series and Rosemount 1595 Conditioning Orifice Plate

Flow Test Data Book and Flow Handbook

ROSEMOUNT™

EMERSON™

Safety messages

⚠ WARNING

Read this manual before working with the product. For personal and system safety, and for optimum product performance, ensure you thoroughly understand the contents before installing, using, or maintaining this product.

Customer Central

1-800-999-9307 (7:00 a.m. to 7:00 P.M. CST)

National Response Center

1-800-654-7768 (24 hours a day)

Equipment service needs

International

1-(952) 906-8888

NOTICE

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

CE

Emerson satisfies all obligations coming from legislation to harmonize product requirements in the European Union.

Contents

1 Introduction

1.1 Product features

The Rosemount 405 Compact Orifice Series (standard and condition plate options) and Rosemount 1595 Conditioning Orifice Plate primary flow elements maintain the traditional strengths of orifice plate technology with improved features/ performance.

The strengths of the Rosemount 405 include:

- More economical than a traditional orifice plate installation
- Accurate and repeatable
- Short straight run requirements (405C — 2D upstream and 2D downstream)
- Self centering mechanism
- Based on ASME/ISO corner tap design

The strengths of the Rosemount 1595 include:

- Based on the most common primary element in the world with established standards for manufacture and installation.
- Easy to use, prove, and troubleshoot
- Accurate and repeatable
- Short straight run requirements (2D upstream and 2D downstream)
- Based on ASME/ISO/AGA standards

The Rosemount 405 and 1595 primary flow elements are sized using Rosemount's Instrument Toolkit sizing program. This program provides accurate flow calculations using installation details and fluid properties for the flowmeter and presents this on a calculation data sheet or specification sheet.

1.2 Testing

Tests performed on the Rosemount 405/1595 primary flow elements are divided into three major categories:

- Mechanical and structural testing
- In-house performance testing
- Independent laboratory testing

All categories are ongoing and continue to be a part of the current Rosemount test program for the Rosemount 405/1595 primary flow elements.

1.2.1 Structural testing

Emerson performed integrity testing for:

- Allowable stress limits
- Hydrostatic pressure
- Thermal effects
- Vibration

At the following labs:

- Hauser Laboratories, Boulder, CO
- Rosemount Vibration Laboratory, Eden Prairie, MN

1.2.2 In-house performance testing

Emerson conducted extensive in-house testing on Rosemount 1595, 405C, and 405P Orifice Plate Primary Elements to verify performance standards.

Emerson performed flow tests in the Rosemount flow laboratory in 2 in (51 mm) to 10 in (254 mm) pipeline, using independently certified magnetic flow meters or the laboratory's gravimetric system as primary reference.

In house performance tests

- Straight run requirements
- Run to run repeatability (with and without disassembly/re-assembly)
- Pipe adjustment factors
- Sensitivity to centering

Testing was also performed to determine minimum straight run requirements after the following upstream disturbances:

- Single elbow
- Double elbows in plane
- Double elbows out of plane
- Reduction
- Expansion
- Butterfly valve

Emerson also evaluated performance with up to 20 degrees of induced swirl.

1.2.3 Independent testing

Four independent laboratories tested the Rosemount 405 and 1595 primary flow element models.

- Colorado Engineering Experiment Station, Inc. (CEESI)

- Southwest Research Institute (SwRI)
- Foxboro Co. Flow Lab
- Rosemount Flow Lab

Each facility supplied certified flow data sheets.

Related information

Test facilities and flow tests

1.3 Product specifications

With testing, Emerson has confirmed that these products conform to the following specifications:

Table 1-1: Rosemount 405 Compact Orifice Flow Meter

Type	Beta	Discharge coefficient uncertainty
Conditioning	0.4	±0.50%
Conditioning	0.50	±1.00%
Conditioning	0.65	±1.00%
Standard (½ to 1½-in line size)(1)	0.4	±1.75%
Standard (½ to 1½-in line size)(1)	0.50	±1.75%
Standard (½ to 1½-in line size)(1)	0.65	±1.75%
Standard (2 to 8-in line size)	0.4	±1.25%
Standard (2 to 8-in line size)	0.50	±1.25%
Standard (2 to 8-in line size)	0.65	±1.25%

(1) Discharge coefficient uncertainty for ½-in units with Beta = 0.65 is ±2.25% (2.5% of flow).

Table 1-2: Rosemount 1595 Conditioning Orifice Plate

Beta ratio	Discharge coefficient uncertainty
β = 0.40	±0.50%
β = 0.50	±1.00%
β = 0.65	±1.00%

1.3.1 Straight pipe requirement

Use the appropriate lengths of straight pipe upstream and downstream of the Rosemount 405 to minimize the effects of moderate flow disturbances in the pipe.

Table 1-4 lists recommended lengths of straight pipe per ISO 5167.

Table 1-3: Rosemount 405C/1595 straight pipe requirements

Location of flow disturbance[1]	Beta	0.40	0.50	0.65
Upstream (inlet) side of primary	Reducer (1 line size)	2	2	2
	Single 90° bend or tee	2	2	2
	Two or more 90° bends in the same plane	2	2	2
	Two or more 90° bends in different plane	2	2	2
	Up to 10° of swirl	2	2	2
	Butterfly valve (75% to 100% open)	2	N/A	N/A
Downstream (outlet) side of primary	N/A	2	2	2

(1) Consult an Emerson representative if disturbance is not listed.

Table 1-4: Rosemount 405P straight pipe requirements

Location of flow disturbance[1][2][3]	Beta	0.40	0.50	0.65
Upstream (inlet) side of primary	Reducer	5	8	12
	Single 90° bend or tee	16	22	44
	Two or more 90° bends in the same plane	10	18	44
	Two or more 90° bends in different plane	50	75	60
	Expander	12	20	28
	Ball / gate valve fully open	12	12	18
Downstream (outlet) side of primary	N/A	6	6	7

(1) Consult an Emerson representative if disturbance is not listed.
(2) Recommended lengths represented in pipe diameters per ISO 5167.
(3) Refer to ISO 5167 for recommended lengths when using flow straighteners.

2 Theory of operation

2.1 Overview

The Rosemount 405 and 1595, based on orifice plate technology, are devices used to measure the flow of a liquid, gas, or steam fluid that flows through a pipe.

These devices enable flow measurement by creating a differential pressure (DP) that is proportional to the square of the velocity of the fluid in the pipe, in accordance with Bernoulli's theorem. This DP is measured and converted into a flow rate using a secondary device, such as a DP pressure transmitter.

The flow is related to DP through the following relationship.

Figure 2-1: Relationship of flow to differential pressure

$$Q = K\sqrt{\frac{DP}{\rho}}$$

where:

Q = Flow rate

K = Units conversion factor, discharge coefficient, and other factors

DP = Differential Pressure

ρ = Density

Related information

Flow calculations

2.2 Technical detail

Traditional orifice plate flow meters are based on Bernoulli's theorem, which states that along any one streamline in a moving fluid, the total energy per unit mass is constant, being made up of the potential energy (the pressure energy), and the kinetic energy of the fluid.

Figure 2-2: Bernoulli's theorem of differential pressure

$$P_1 + \frac{1}{2}\rho_1 V_1^2 = P_2 + \frac{1}{2}\rho_2 V_2^2$$

where:

P_1 = Upstream pressure

P_2 = Downstream pressure

ρ_1 = Upstream density

ρ_2 = Downstream density

V_1 = Upstream velocity

V_2 = Downstream velocity

When fluid passes through the orifice, the velocity of the fluid through the orifice increases. This increase in fluid velocity causes the kinetic energy of the fluid immediately downstream of the orifice plate to increase, while simultaneously decreasing the static pressure energy of the fluid at that same point. By sensing the static pressure on the upstream and downstream sides of the orifice plate, a flow meter can determine the fluid velocity.

Some assumptions were made in deriving the theoretical equation, which in practice are not valid:

1. Energy is conserved in the flow stream.
2. Pressure taps are at ideal locations.
3. Velocity profile is flat.

These items are corrected by the discharge coefficient which is derived from experimental data and is different for each primary element.

Figure 2-3: Discharge coefficient

$$C = \frac{A}{T}$$

Where:

A = Actual flow

T = Theoretical flow

C = Discharge coefficient

2.3 Compact orifice plate technology

The Rosemount 405P Compact Orifice Plate is a wafer style meter and has a traditional style orifice plate integrally machined into the wafer. The wafer is one inch thick. Meter inlet and outlet sections in this wafer are sized for schedule 40 pipe.

If the operator installs meter in a pipe where the schedule is something other than schedule 40, they must make adjustments in the flow calculations to accommodate the pipe schedule mismatch.

Orifice plates work well when the velocity profile is symmetrical about the longitudinal axis of the pipe in which the fluid is flowing. In such cases, where the flow is conditioned or there is an adequate amount of straight run, the highest velocity fluid is along the central axis of the pipe, coaxial with the orifice of the conditioning plate. This is the situation under which the discharge coefficient was determined and is how most standard orifice plates are used. However, if you install an orifice plate immediately after an upstream fitting, the velocity profile will be skewed. This may take the form of profile distortion and/or swirl.

Additionally, secondary flows may develop after the fitting. Any of these conditions will cause a subsequent change in the performance of the orifice plate. In general, profile distortion results in higher differential pressure being reported, and swirl results in lower differential pressure being reported. The differential pressure thus produced across the standard orifice plate will not be a true indication of the rate of fluid flow in this situation.

2.4 Conditioning orifice plate technology

The Rosemount 405C and 1595 Conditioning Orifice Plate has the added advantage of being able to operate with reduced straight run requirements.

With its multiple orifices in the flow stream, the plate much less susceptible to velocity profile distortion, swirl, and secondary flows. If the velocity profile is skewed, each of the orifices will conduct a part of the total fluid flow within the pipe. The fluid pressure on the downstream side of the conditioning plate that is attributable to each of the separate orifices will be averaged within the fluid to provide an average downstream pressure. The average downstream pressure is compared with the upstream pressure to provide an average differential pressure for whatever velocity profile is presented to the multiple orifice plate, resulting in an accurate measurement of the rate of fluid flow in the pipe.

Emerson flow calibrates every Rosemount 405C and 1595 as part of the manufacturing process. The purpose of this calibration is to determine a calibration factor which is applied to the flow calculations as an adjustment to correct for bias error from the ISO-5167 discharge coefficient equations. This results in an accurate flow meter which conforms to the ISO-5167 equations.

3 Test facilities and flow tests

3.1 Overview

The following descriptions of tests and testing methods are abbreviated versions.

For detailed descriptions of the individual laboratories, contact the facility in question.

3.2 Testing laboratories

Rosemount Boulder, Colorado Flow Laboratory

Emerson tests and calibrates the Rosemount 405 and 1595 in water. Line sizes available for testing range from 0.5 in (13 mm) to 12 in (305 mm). A secondary set of reference magnetic flow meters, routinely calibrated against a gravimetric primary standard, provide an uncertainty of 0.25 percent. Calibrations that use the primary-measurement device, gravimetric method, can be calibrated with an uncertainty of 0.1 percent.

SwRI Gas Research Institute (GRI), Meter Research Facility (MRF)

Flow meters are tested and calibrated on a recirculating natural gas loop. A sonic nozzle bank provides secondary flow calibration. This permits high repeatability and excellent test accuracy's via calibration against the gravimetric primary standards. The sonic nozzle banks produce an accuracy on flow rate of 0.25 percent of reading.

Colorado Engineering Experiment Station (CEESI), Inc.

The flow lab uses critical flow venturis (CFV) for calibrations in air. The uncertainty in mass flow rate is estimated to be ±0.50 percent. Calibrations are traceable by the National Institute of Standards and Technology (NIST).

Foxboro Co. Flow Lab

The flow lab uses a gravimetric system for water calibrations. Calibrations are NIST traceable.

Rosemount Flow Lab

The flow lab uses a dynamic weighing system for water calibrations. Calibrations are NIST traceable.

3.3 Gravimetric testing

The technician selects piping to match the inside diameter of the flow meter being tested. They normally use carbon steel piping for these tests. The technician also carefully installs and checks gaskets between pipe flanges to ensure that they not interfere with the flow. They make sure that proper alignment of the flow meter with the piping is maintained.

After all piping is secured with bolts, couplings, or clamps, the technician gradually introduces water into the line. They set flow to purge air from the system and to bring the flow meter to steady-state temperature. After operating the system for a period of time, they purge air from all instrumentation lines, instruments, and the flow meter. After air purging, they check all instrumentation for zero-flow indication.

Technicians set the flow rate by adjusting the control valve at the end of the test line to a desired flow. They allow this flow to stabilize and reach steady-state condition. This condition is achieved when the average flow-meter readout is constant with time. At this point, the technician begins the calibration run.

A calibration run consists of simultaneously recording the flow meter output while the weighing tank is filled and timing the filling process. The technician activates and deactivates electronic timers using electric eyes on the switch way. During this time, they record outputs at 1 Hz. The duration of the run is typically between 50 and 100 seconds.

In addition to recording weight and time, the technician also records the water temperature, air temperature at the weigh tank, and air temperature adjacent to the readout. They also record barometric pressure at the start and at the end of the test.

After a run is completed, the technician resets the control valve to another flow rate and repeats the process. They normally conduct runs at 10 different flow rates, approximately equally spaced from the maximum to the minimum flow rates. In some cases, the maximum flow obtainable by the test facility determines the upper flow limit of the test.

3.4 Flow tests

3.4.1 Run to run repeatability

Meter section was assembled, tested, disassembled, re-assembled and re-tested.

- Rosemount 405P, water, 06442, 1.5-in, 0.40 beta
- Rosemount 405P, water, 13443, 2-in, 0.65 beta
- Rosemount 405P, water, 26171, 4-in, 0.65 beta
- Rosemount 405C, water, 08261, 2-in, 0.40 beta
- Rosemount 405C, water, 12402, 2-in, 0.60 beta
- Rosemount 405C, water, 16261, 4-in, 0.40 beta
- Rosemount 405C, water, 24061, 4-in, 0.60 beta
- Rosemount 1595, water, AT24261, 6-in, 0.40 beta
- Rosemount 1595, water, AT39422, 6-in, 0.65 beta
- Rosemount 1595, water, AT48003, 12-in, 0.40 beta

Related information

Run to run repeatability

3.4.2 Meter installed 2D downstream of the following fittings

Single elbow

- Rosemount 405C, water, 08261, 2-in, 0.40 beta
- Rosemount 405C, natural gas, 08261, 2-in, 0.40 beta

Double elbows in plane

- Rosemount 405C, water, 08261, 2-in, 0.40 beta
- Rosemount 405C, natural gas, 08261, 2-in, 0.40 beta
- Rosemount 405C, water, 12402, 2-in, 0.60 beta

Double elbows out of plane

- Rosemount 405C, water, 08261, 2-in, 0.40 beta
- Rosemount 405C, natural gas, 08261, 2-in, 0.40 beta
- Rosemount 405C, water, 12402, 2-in, 0.60 beta

Swirl generator

- Rosemount 405C, water, 08261, 2-in, 0.40 beta
- Rosemount 405C, air, 08261, 2-in, 0.40 beta
- Rosemount 405C, natural gas, 08261, 2-in, 0.40 beta
- Rosemount 405C, water, 04D407574, 4-in, 0.40 beta
- Rosemount 1595, Water, AT24261, 6-in, 0.40 beta

8 × 6-in reduction

- Rosemount 1595, water, A24261, 6-in, 0.40 beta
- Rosemount 1595, water, A39421, 6-in, 0.65 beta

Butterfly valve at 75% open

- Rosemount 405C, water, 12402, 2-in, 0.60 beta
- Rosemount 1595, water, A24261, 6-in, 0.40 beta

Gate valve

- Rosemount 1595, water, 04D407574, 4-in, 040 beta

Related information

Single elbow tests
Double elbows in plane
Double elbows out of plane

Swirl generator
8 x 6-in reduction
Butterfly valve at 75 percent open
Gate valve

3.5 Run to run repeatability

Sensor serial number 06442

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405P
Fluid	Water
Sensor serial number	06442
Beta ratio	0.40
Pipe size	1.5 in (38 mm) schedule 40
Pipe inner dimension	1.61 in (40.9 mm)
Test date	March 8, 2001

Figure 3-1: Sensor 06442 test results

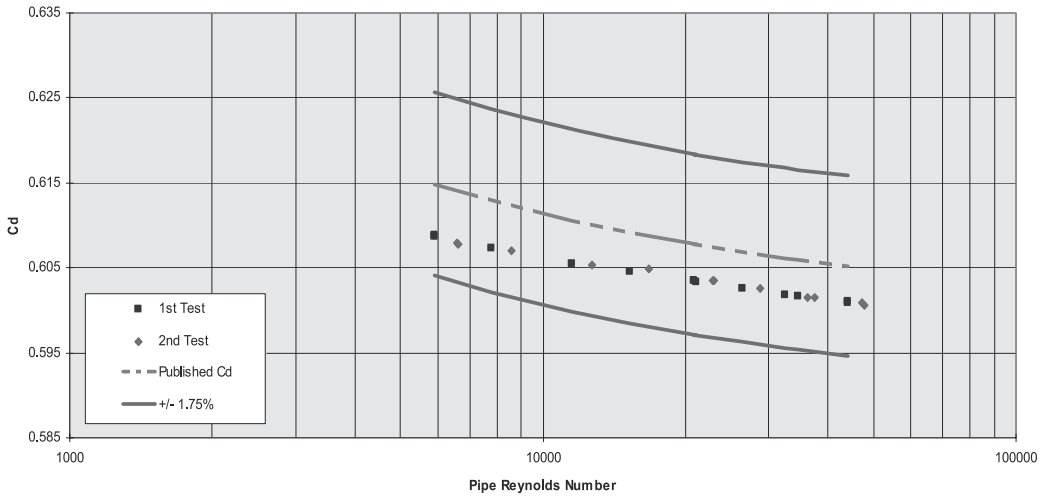


Table 3-1: Test 1, sensor serial number 06442

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.7	19.3	28.2	1.95	1.0204	62.3168	254.354	22.88	4.40E + 04	0.6009
2	66.7	19.3	28.2	1.94	1.0202	62.3167	254.120	22.88	4.40E + 04	0.6010
3	66.7	19.2	28.2	1.95	1.0306	62.3169	156.639	17.98	3.46E + 04	0.6016

Table 3-1: Test 1, sensor serial number 06442 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
4	66.7	19.3	28.2	1.95	1.0203	62.3167	137.781	16.87	3.24E + 04	0.6018
5	66.7	19.3	28.2	1.94	1.0204	62.3169	91.223	13.74	2.64E + 04	0.6026
6	66.9	19.4	28.1	1.94	1.0172	62.3151	56.368	10.82	2.09E + 04	0.6035
7	66.8	19.4	28.1	1.94	1.0179	62.3154	57.750	10.95	2.11E + 04	0.6034
8	67.0	19.5	28.1	1.93	1.0155	62.3142	30.006	7.91	1.53E + 04	0.6046
9	67.1	19.5	28.0	1.93	1.0137	62.3132	17.030	5.97	1.15E + 04	0.6055
10	67.3	19.6	28.0	1.93	1.0116	62.3124	7.628	4.01	7.77E + 03	0.6073
11	67.5	19.7	28.0	1.93	1.0091	62.3104	4.359	3.03	5.90E + 03	0.6088
12	67.5	19.7	28.0	1.93	1.0085	62.3103	4.342	3.03	5.89E + 03	0.6089

Table 3-2: Test 2, sensor serial number 06442

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	72.7	22.6	28.2	1.94	0.9415	62.2692	248.988	22.65	4.72E + 04	0.6009
2	72.7	22.6	28.1	1.94	0.9409	62.2688	255.919	22.95	4.78E + 04	0.6006
3	72.8	22.7	28.1	1.93	0.9394	62.2677	156.139	17.96	3.75E + 04	0.6015
4	72.9	22.7	28.0	1.93	0.9385	62.2671	146.624	17.40	3.63E + 04	0.6015
5	73.1	22.8	28.0	1.93	0.9359	62.2653	91.484	13.77	2.88E + 04	0.6026
6	73.4	23.0	27.9	1.92	0.9330	62.2633	57.017	10.89	2.29E + 04	0.6035
7	73.3	22.9	27.9	1.92	0.9337	62.2637	57.898	10.97	2.30E + 04	0.6035
8	73.7	23.2	27.9	1.92	0.9283	62.2598	30.126	7.93	1.67E + 04	0.6049
9	74.2	23.4	27.8	1.92	0.9230	62.2558	17.114	5.98	1.27E + 04	0.6054
10	75.1	23.9	27.8	1.91	0.9122	62.2480	7.602	4.00	8.59E + 03	0.6070
11	76.0	24.5	27.7	1.91	0.9017	62.2395	4.403	3.05	6.62E + 03	0.6077
12	76.1	24.5	27.7	1.91	0.9008	62.2384	4.347	3.03	5.59E + 03	0.6079

Sensor serial number 13443

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405P
Fluid	Water
Sensor serial number	13443
Beta ratio	0.65

Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.067 in (52.50 mm)
Test date	January 17, 2001

Figure 3-2: Sensor 13443 test results

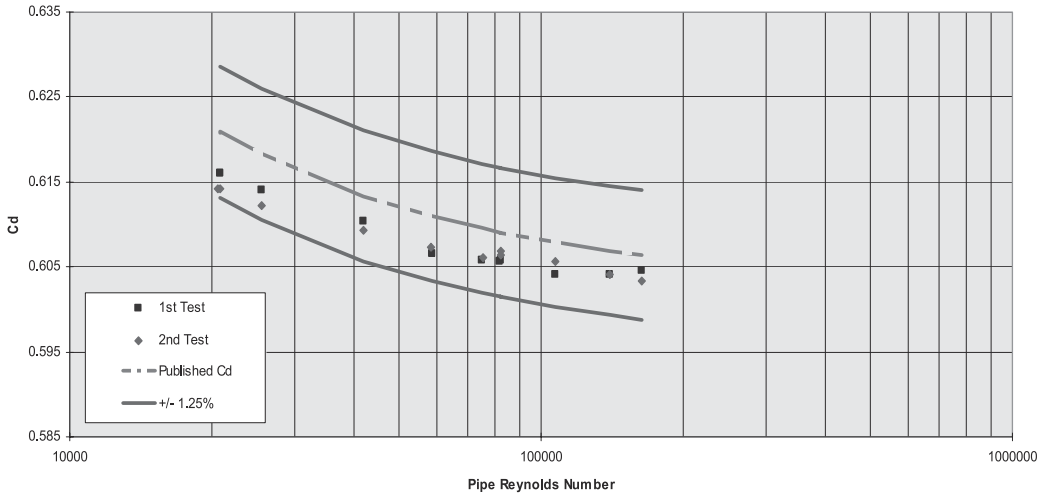


Table 3-3: Test 1, sensor serial number 13443

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.3	19.1	28.8	1.92	1.0250	62.3192	248.526	109.75	1.64E + 05	0.6046
2	66.4	19.1	28.2	1.94	1.0247	62.3190	182.047	93.84	1.40E + 05	0.6041
3	66.4	19.1	28.4	1.96	1.0238	62.3186	106.591	71.81	1.07E + 05	0.6041
4	66.5	19.2	28.5	1.96	1.0228	62.3180	61.849	54.84	8.19E + 04	0.6057
5	66.5	19.2	28.5	1.96	1.0224	62.3178	61.803	84.83	8.19E + 04	0.6058
6	66.5	19.2	28.4	1.96	1.0220	62.3176	51.317	49.97	7.47E + 04	0.6059
7	66.6	19.2	28.4	1.96	1.0207	62.3169	31.492	39.19	5.86E + 04	0.6066
8	67.8	19.3	28.3	1.95	1.0188	62.3159	15.869	27.99	4.20E + 04	0.6103
9	67.0	19.4	28.2	1.94	1.0160	62.3145	5.781	17.00	2.55E + 04	0.6140

Table 3-3: Test 1, sensor serial number 13443 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
10	67.2	19.6	28.1	1.94	1.0129	62.3129	3.783	13.80	2.08E + 04	0.6161
11	67.2	19.5	28.1	1.94	1.0135	62.3130	3.820	13.86	2.09E + 04	0.6160

Table 3-4: Test 2, sensor serial number 13443

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.5	19.2	27.8	1.92	1.0228	62.3180	248.957	109.62	1.64E + 05	0.6034
2	66.5	19.2	28.2	1.94	1.0222	62.3177	181.498	93.71	1.40E + 05	0.6041
3	66.6	19.2	28.5	1.96	1.0214	62.3173	106.147	71.85	1.07E + 05	0.6057
4	66.7	19.3	28.5	1.96	1.0205	62.3168	62.069	55.05	8.24E + 04	0.6069
5	66.7	19.3	28.5	1.96	1.0201	62.3166	61.437	54.72	8.19E + 04	0.6064
6	66.7	19.3	28.4	1.96	1.0195	62.3163	52.008	50.32	7.54E + 04	0.6061
7	66.7	19.3	28.4	1.96	1.0184	62.3157	30.888	38.87	5.83E + 04	0.6074
8	66.9	19.4	28.3	1.95	1.0165	62.3147	15.937	28.01	4.21E + 04	0.6094
9	67.0	19.4	28.3	1.95	1.0160	62.3145	5.821	17.01	2.56E + 04	0.6123
10	67.1	19.5	28.2	1.95	1.0140	62.3134	3.759	13.71	2.06E + 04	0.6142
11	67.1	19.5	28.2	1.95	1.0139	62.3134	3.815	13.81	2.08E + 04	0.6141

Sensor serial number 26171

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405P
Fluid	Water
Sensor serial number	26171

Beta ratio	0.65
Pipe size	4 in (102 mm) schedule 40
Pipe inner dimension	4.026 in (102.26 mm)
Test date	February 12, 2001

Figure 3-3: Sensor 26171 test results

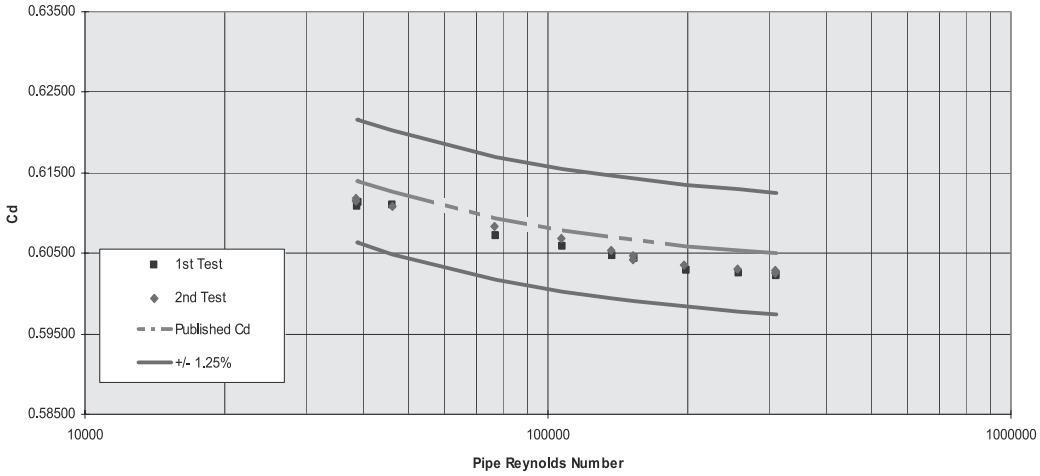


Table 3-5: Test 1, sensor serial number 26171

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	67.1	19.5	39.1	2.70	1.0145	62.3137	239.216	401.62	3.11E + 05	0.6024
2	67.1	19.5	39.1	2.70	1.0138	62.3133	239.236	401.59	3.11E + 05	0.6023
3	67.1	19.5	36.3	2.51	1.0148	62.3138	165.292	333.92	2.58E + 05	0.6025
4	67.5	19.7	39.8	2.75	1.0092	62.3108	96.979	255.97	1.99E + 05	0.6030
5	67.6	19.8	40.2	2.77	1.0068	62.3095	56.898	196.54	1.53E + 05	0.6044
6	67.7	19.8	40.2	2.77	1.0061	62.3091	56.884	196.50	1.53E + 05	0.6044
7	67.4	19.7	36.2	2.50	1.0097	62.3111	46.432	177.61	1.38E + 05	0.6046
8	67.5	19.7	36.8	2.54	1.0081	62.3102	27.880	137.90	1.07E + 05	0.6058
9	67.7	19.8	37.3	2.57	1.0062	62.3092	14.235	98.76	7.70E + 04	0.6072
10	67.8	19.9	37.6	2.59	1.0042	62.3081	5.057	59.23	4.63E + 04	0.6109

Table 3-5: Test 1, sensor serial number 26171 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
11	68.0	20.0	37.8	2.60	1.0022	62.3069	3.538	49.53	3.88E + 04	0.6108
12	68.0	20.0	37.8	2.60	1.0015	62.3066	3.557	49.71	3.89E + 04	0.6114

Table 3-6: Test 2, sensor serial number 26171

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.8	19.3	39.1	2.69	1.0188	62.3160	238.770	401.39	3.09E + 05	0.6026
2	66.8	19.3	39.0	2.69	1.0182	62.3156	238.510	401.34	3.09E + 05	0.6028
3	66.8	19.3	36.7	2.53	1.0188	62.3159	164.445	333.38	2.57E + 05	0.6031
4	67.0	19.4	38.1	2.62	1.0162	62.3146	96.245	255.27	1.97E + 05	0.6036
5	67.2	19.5	39.0	2.69	1.0135	62.3131	56.888	196.62	1.52E + 05	0.6047
6	67.2	19.6	39.0	2.69	1.0129	62.3128	56.943	196.52	1.52E + 05	0.6041
7	67.1	19.5	36.0	2.48	1.0137	62.3132	46.106	177.19	1.37E + 05	0.6053
8	67.3	19.6	36.6	2.52	1.0119	62.3123	27.775	137.87	1.07E + 05	0.6068
9	67.4	19.7	37.2	2.56	1.0100	62.3113	14.234	98.94	7.69E + 04	0.6083
10	67.6	19.8	37.5	2.58	1.0079	62.3101	5.058	59.22	4.61E + 04	0.6109
11	67.6	19.8	37.6	2.60	1.0077	62.3100	3.535	49.56	3.86E + 04	0.6115
12	67.6	19.8	37.6	2.59	1.0079	62.3101	3.530	49.56	3.89E + 04	0.6119

Sensor serial number 08261

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)

Test date	May 29, 2002

Figure 3-4: Sensor 08261 test results

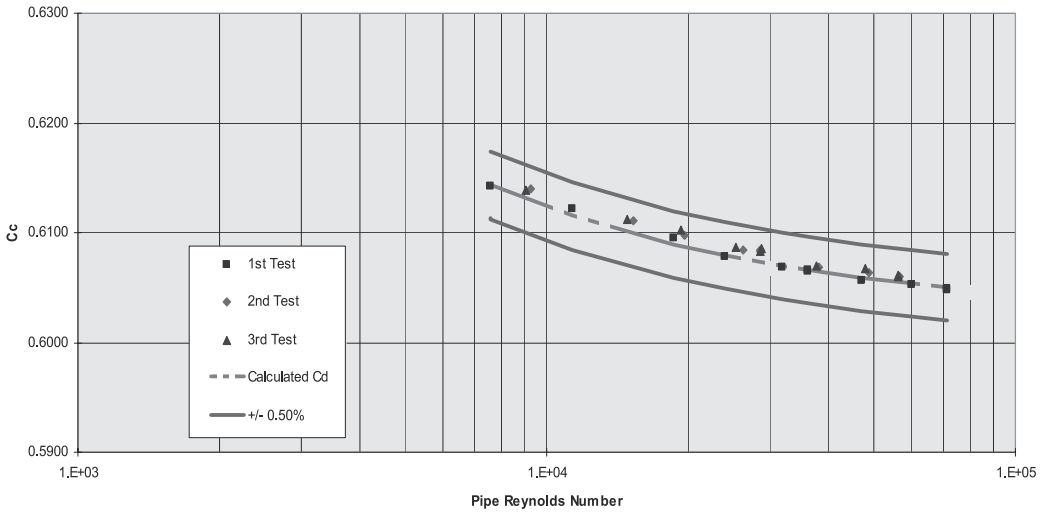


Table 3-7: Test 1, sensor serial number 08261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	85.0	29. 4	28.3	1.95	0.8074	62.1497	246.390	37.87	7.15E + 05	0.6049
2	85.1	29.5	28.3	1.95	0.8062	62.1484	246.087	37.84	7.15E + 05	0.6048
3	85.1	29.5	28.3	1.95	0.8057	62.1479	173.118	31.76	6.01E + 05	0.6052
4	85.2	29.6	28.2	1.94	0.8050	62.1470	105.641	24.83	4.70E + 05	0.6056
5	85.1	29.5	28.3	1.95	0.8059	62.1480	61.992	19.05	3.60E + 05	0.6066
6	85.1	29.5	28.2	1.95	0.8062	62.1484	62.056	19.06	3.60E + 05	0.6065
7	85.1	29. 5	28.2	1.95	0.8061	62.1483	48.369	16.83	3.18E + 05	0.6069
8	85.1	29.5	28.1	1.94	0.8060	62.1481	27.581	12.73	2.41E + 05	0.6078
9	85.2	29.6	28.2	1.94	0.8054	62.1475	16.431	9.85	1.86E + 04	0.6095
10	85.2	29.6	28.1	1.94	0.8050	62.1471	6.005	5.98	1.13E + 04	0.6122

Table 3-8: Test 2, sensor serial number 08261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	67.5	19.7	28.4	1.96	1.0088	62.3106	240.299	37.41	5.67E + 04	0.6060
2	67.4	19.7	28.4	1.95	1.0099	62.3112	240.572	37.43	5.66E + 04	0.6060
3	67.5	19.7	28.3	1.95	1.0094	62.3109	177.971	32.21	4.88E + 04	0.6064

Table 3-8: Test 2, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
4	67.6	19.8	28.2	1.95	1.0079	62.3101	107.432	25.05	3.80E + 04	0.6068
5	67.6	19.8	28.3	1.95	1.0075	62.3099	60.460	18.84	2.86E + 04	0.6084
6	67.6	19.8	28.3	1.95	1.0073	62.3097	60.423	18.83	2.86E + 04	0.6084
7	67.6	19.8	28.3	1.95	1.0070	62.3096	50.926	17.29	2.62E + 04	0.6085
8	67.7	19.8	28.2	1.94	1.0057	62.3089	28.372	12.93	1.97E + 04	0.6098
9	67.9	19.9	28.2	1.95	1.0038	62.3078	17.078	10.06	1.53E + 04	0.6111
10	68.0	20.0	28.1	1.94	1.0014	62.3066	6.160	6.07	9.26E + 03	0.6140

Table 3-9: Test 3, sensor serial number 08261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.6	19.2	28.4	1.96	1.0218	62.3175	242.040	37.55	5.62E + 04	0.6060
2	66.6	19.2	28.4	1.96	1.0216	62.3174	241.797	37.52	5.61E + 04	0.6060
3	66.6	19.2	28.3	1.95	1.0207	62.3170	174.615	31.92	4.78E + 04	0.6067
4	66.8	19.3	28.3	1.95	1.0190	62.3160	107.910	25.11	3.77E + 04	0.6070
5	66.9	19.4	28.3	1.95	1.0173	62.3151	61.892	19.06	2.86E + 04	0.6084
6	66.9	19.4	28.3	1.95	1.0168	62.3149	62.009	19.08	2.87E + 04	0.6086
7	67.0	19.4	28.2	1.95	1.0161	62.3145	48.438	16.87	2.54E + 04	0.6087
8	67.2	19.5	28.2	1.94	1.0131	62.3129	27.870	12.83	1.94E + 04	0.6102
9	67.4	19.7	28.2	1.94	1.0105	62.3115	16.348	9.84	1.49E + 04	0.6112
10	67.6	19.8	28.1	1.94	1.0071	62.3095	5.917	5.95	9.02E + 03	0.6139

Sensor serial number 12402

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	12402
Beta ratio	0.60
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	May 29, 2002

Figure 3-5: Sensor 12402 test results

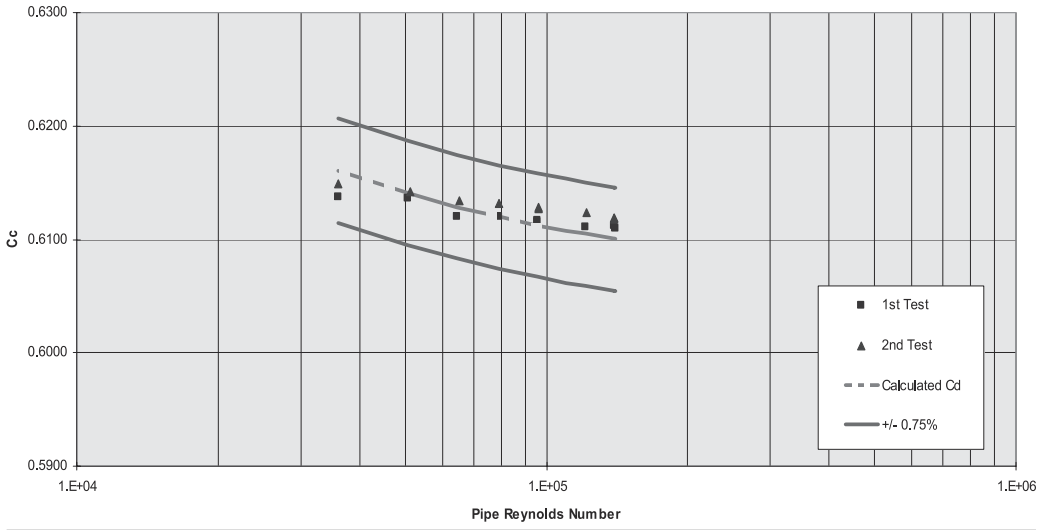


Table 3-10: Test 1, sensor serial number 12402

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	66.6	19.2	28.2	1.95	1.0215	62.3174	265.761	93.08	1.39E + 05	0.6112
2	66.6	19.2	28.2	1.94	1.0218	62.3175	269.224	93.66	1.40E + 05	0.6110
3	66.6	19.2	28.4	1.96	1.0217	62.3175	200.526	80.84	1.21E + 05	0.6111
4	66.6	19.2	28.5	1.96	1.0210	62.3171	125.494	64.00	9.57E + 04	0.6115
5	66.6	19.2	28.4	1.96	1.0210	62.3171	125.292	63.97	9.57E + 04	0.6117
6	66.6	19.2	28.4	1.96	1.0208	62.3170	86.271	53.10	7.95E + 04	0.6120
7	66.7	19.3	28.4	1.96	1.0197	62.3164	56.759	43.08	6.45E + 04	0.6121
8	66.8	19.4	28.4	1.96	1.0178	62.3154	34.709	33.77	5.07E + 04	0.6136
9	67.0	19.4	28.3	1.95	1.0159	62.3145	17.529	24.01	3.61E + 04	0.6137

Table 3-11: Test 2, sensor serial number 12402

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.0	19.4	28.2	1.94	1.0160	62.3145	263.666	92.83	1.40E + 05	0.6119
2	67.0	19.4	28.2	1.94	1.0162	62.3146	264.049	92.87	1.40E + 05	0.6118
3	67.0	19.4	28.3	1.95	1.0159	62.3144	200.742	81.05	1.22E + 05	0.6123
4	67.1	19.5	28.4	1.96	1.0148	62.3139	124.906	63.99	9.63E + 04	0.6129
5	67.1	19.5	28.4	1.96	1.0149	62.3139	124.940	63.98	9.63E + 04	0.6127

Table 3-11: Test 2, sensor serial number 12402 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
6	67.1	19.5	28.4	1.96	1.0146	62.3137	84.779	52.74	7.94E + 04	0.6132
7	67.1	19.5	28.3	1.95	1.0137	62.3132	57.319	43.38	6.54E + 04	0.6133
8	67.3	19.6	28.3	1.95	1.0115	62.3120	35.026	33.96	5.13E + 04	0.6142
9	67.4	19.7	28.2	1.95	1.0095	62.3109	17.140	23.78	3.60E + 04	0.6149

Sensor serial number 16261

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	16261
Beta ratio	0.40
Pipe size	4 in (102 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	October 31, 2002

Figure 3-6: Sensor 16261 test results

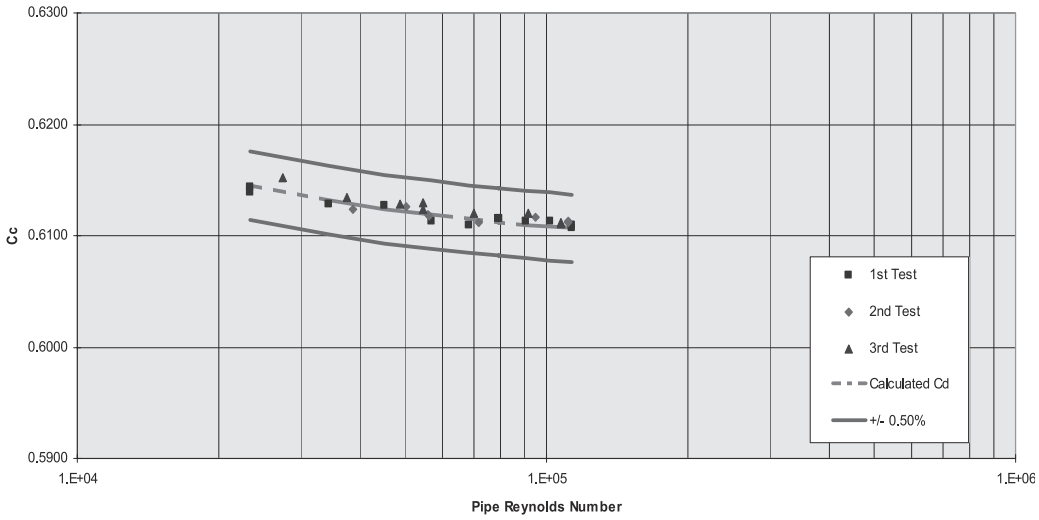


Table 3-12: Test 1, sensor serial number 16261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	68.0	20.0	36.4	2.51	1.0025	62.3071	243.769	144.92	1.13E + 05	0.6107
2	68.0	20.0	36.4	2.51	1.0025	62.3072	243.604	144.93	1.13E + 05	0.6109
3	67.9	20.0	35.8	2.47	1.0028	62.3073	195.795	130.02	1.02E + 05	0.6114
4	67.9	20.0	35.9	2.48	1.0028	62.3073	155.412	115.82	9.06E + 04	0.6113
5	67.9	20.0	36.0	2.48	1.0028	62.3073	118.376	101.13	7.91E + 04	0.6115
6	67.9	20.0	36.0	2.48	1.0028	62.3073	118.489	101.18	7.91E + 04	0.6116
7	67.9	20.0	36.1	2.49	1.0028	62.3073	88.385	87.29	6.83E + 04	0.6109
8	67.9	20.0	36.2	2.50	1.0028	62.3073	61.124	72.65	5.68E + 04	0.6114
9	67.9	20.0	36.3	2.50	1.0027	62.3073	38.574	57.84	4.52E + 04	0.6128
10	67.9	20.0	36.4	2.51	1.0028	62.3073	22.125	43.81	3.43E + 04	0.6128

Table 3-13: Test 2, sensor serial number 16261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	67.9	19.9	36.5	2.52	1.0035	62.3077	235.362	142.54	1.11E + 05	0.6113
2	67.9	19.9	36.5	2.52	1.0035	62.3077	235.241	142.48	1.11E + 05	0.6112
3	67.9	19.9	36.0	2.48	1.0038	62.3079	169.396	121.00	9.45E + 05	0.6117
4	67.9	19.9	36.2	2.49	1.0038	62.3079	98.261	92.08	7.19E + 04	0.6112
5	67.9	19.9	36.3	2.50	1.0038	62.3079	59.770	71.88	5.62E + 04	0.6117
6	67.9	19.9	36.3	2.50	1.0038	62.3079	59.255	71.60	5.59E + 04	0.6120
7	67.9	19.9	36.3	2.50	1.0039	62.3079	47.923	64.46	5.04E + 04	0.6126
8	67.9	19.9	36.3	2.51	1.0039	62.3079	28.196	49.42	3.68E + 04	0.6124

Table 3-14: Test 3, sensor serial number 16261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	barg	cP	lb/ft^3	in water	GPM		
1	67.0	19.4	34.4	2.38	1.0158	62.3144	225.173	139.36	1.08E + 05	0.6111
2	67.0	19.4	34.5	2.38	1.0159	62.3144	224.968	139.33	1.08E + 05	0.6112
3	67.0	19.4	34.7	2.39	1.0159	62.3144	162.283	118.48	9.15E + 04	0.6120
4	67.0	19.4	35.2	2.43	1.0156	62.3143	94.731	90.54	6.99E + 04	0.6121
5	67.0	19.4	35.7	2.46	1.0155	62.3142	57.254	70.49	5.44E + 04	0.6130
6	67.0	19.4	36.0	2.48	1.0154	62.3142	57.511	70.58	5.45E + 04	0.6124
7	67.0	19.4	36.1	2.49	1.0153	62.3141	45.688	62.95	4.86E + 04	0.6128
8	67.0	19.4	36.2	2.49	1.0153	62.3141	27.085	48.52	3.75E + 04	0.6135
9	67.0	19.4	36.2	2.50	1.0153	62.3140	14.370	35.45	2.74E + 04	0.6152

Sensor serial number 24061

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	24061
Beta ratio	0.60
Pipe size	4 in (102 mm) schedule 40
Pipe inner dimension	4.026 in (102.26 mm)
Test date	October 31, 2002

Figure 3-7: Sensor serial number 24061 test results

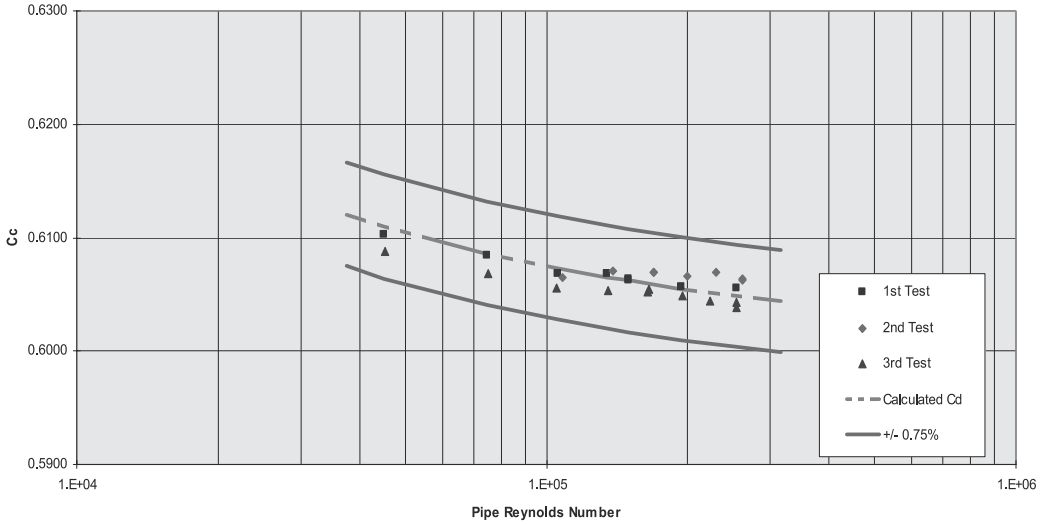


Table 3-15: Test 1, sensor serial number 024061

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.3	19.6	37.4	2.58	1.0116	62.3121	236.845	327.56	2.54E + 05	0.6055
2	67.3	19.6	37.8	2.61	1.0110	62.3118	138.245	250.32	1.94E + 05	0.6057
3	67.4	19.7	38.2	2.63	1.0103	62.3115	81.917	192.90	1.50E + 05	0.6064
4	67.4	19.7	38.2	2.63	1.0102	62.3114	81.996	192.96	1.50E + 04	0.6063
5	67.3	19.6	37.4	2.58	1.0112	62.3119	66.511	173.96	1.35E + 04	0.6069
6	67.3	19.6	37.6	2.59	1.0111	62.3119	40.670	136.01	1.05E + 04	0.6068
7	67.2	19.6	35.8	2.47	1.0126	62.3127	20.340	96.45	7.47E + 04	0.6084
8	67.2	19.6	36.1	2.49	1.0127	62.3127	7.372	58.24	4.51E + 04	0.6102

Table 3-16: Test 2, sensor serial number 24061

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.4	19.7	37.5	2.59	1.0097	62.3111	250.530	337.26	2.621E + 05	0.6062
2	67.5	19.7	37.5	2.58	1.0093	62.3108	250.424	337.27	2.62E + 05	0.6063
3	67.6	19.8	37.7	2.60	1.0075	62.3099	190.834	294.71	2.29E + 05	0.6069
4	67.8	19.9	38.3	2.64	1.0052	62.3086	144.725	256.53	2.00E + 04	0.6067
5	67.9	19.9	38.5	2.66	1.0035	62.3077	102.499	215.98	1.69E + 04	0.6069

Table 3-16: Test 2, sensor serial number 24061 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
6	67.9	20.0	38.5	2.66	1.0028	62.3073	102.378	215.86	1.69E + 04	0.6069
7	67.9	19.9	36.5	2.52	1.0036	62.3077	68.912	177.12	1.38E + 04	0.6070
8	68.0	20.0	36.7	2.53	1.0021	62.3069	41.880	137.97	1.08E + 04	0.6065

Table 3-17: Test 3, sensor serial number 24061

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.2	19.5	37.4	2.58	1.0133	62.3130	237.830	327.55	2.54E + 05	0.6043
2	67.2	19.6	37.3	2.57	1.0128	62.3128	238.520	327.80	2.54E + 05	0.6039
3	67.3	19.6	37.6	2.59	1.0113	62.3120	184.534	288.58	2.24E + 04	0.6044
4	67.4	19.7	37.8	2.61	1.0096	62.3111	139.408	251.02	1.95E + 04	0.6048
5	67.5	19.7	38.1	2.63	1.0081	62.3102	99.134	211.80	1.65E + 04	0.6052
6	67.6	19.8	38.1	2.63	1.0074	62.3099	99.382	212.16	1.65E + 04	0.6055
7	67.6	19.8	37.5	2.58	1.0071	62.3097	66.986	174.14	1.36E + 04	0.6053
8	67.6	19.8	34.4	2.37	1.0073	62.3098	40.265	135.07	1.05E + 04	0.6056
9	67.7	19.8	34.8	2.40	1.0060	62.3091	20.458	96.48	7.52E + 04	0.6069
10	67.8	19.9	35.4	2.44	1.0044	62.3082	7.360	58.05	4.53E + 04	0.6088

Sensor serial number AT24261

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Fluid	Water
Sensor serial number	AT24261
Beta ratio	0.40
Pipe size	6 in (152.4 mm) schedule 40
Pipe inner dimension	6.065 in (154.05 mm)
Test date	June 25, 2003

Figure 3-8: Sensor serial number AT24261 test results

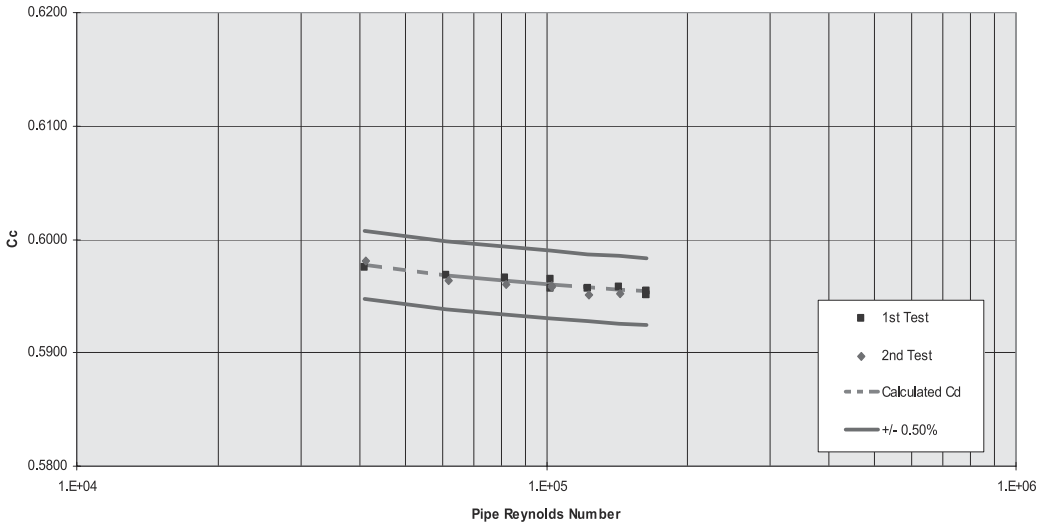


Table 3-18: Test 1, sensor serial number AT24261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.9	19.9	37.0	2.55	1.0033	62.3076	242.929	314.82	1.63E + 05	0.5951
2	67.9	19.9	37.0	2.55	1.0032	62.3076	242.995	315.07	1.63E + 05	0.5955
3	67.9	20.0	37.2	2.57	1.0029	62.3073	184.667	274.84	1.43E + 05	0.5958
4	68.0	20.0	37.6	2.59	1.0025	62.3071	136.368	236.09	1.23E + 04	0.5956
5	68.0	20.0	37.9	2.62	1.0019	62.3068	94.751	196.82	1.02E + 04	0.5657
6	68.0	20.0	37.9	2.61	1.0018	62.3067	94.573	196.88	1.02E + 04	0.5964
7	67.8	19.9	35.5	2.45	1.0046	62.3083	60.441	157.43	8.16E + 04	0.5966
8	67.8	19.9	35.9	2.47	1.0046	62.3083	34.000	118.12	6.12E + 04	0.5968
9	67.8	19.9	36.5	2.52	1.0043	62.3081	15.167	78.98	4.09E + 04	0.5975

Table 3-19: Test 2, sensor serial number AT24261

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	68.3	20.2	36.8	2.54	0.9975	62.3043	184.537	274.44	1.43E + 05	0.5952
2	68.4	20.2	37.0	2.55	0.9958	62.3043	136.605	236.11	1.23E + 05	0.5952
3	68.5	20.3	37.2	2.57	0.9950	62.3029	94.477	196.61	1.03E + 05	0.5959
4	68.5	20.3	37.2	2.56	0.9950	62.3029	94.477	196.56	1.03E + 04	0.5958
5	68.4	20.2	34.3	2.37	0.9969	62.3040	60.230	157.01	8.20E + 04	0.5960
6	68.4	20.2	34.7	2.39	0.9969	62.3040	34.353	118.65	6.19E + 04	0.5964
7	68.4	20.2	35.0	2.41	0.9969	62.3040	15.183	79.11	4.13E + 04	0.5981

Sensor serial number AT39422

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Fluid	Water
Sensor serial number	AT39422
Beta ratio	0.65
Pipe size	6 in (152.4 mm) schedule 40
Pipe inner dimension	6.065 in (154.05 mm)
Test date	December 8, 2003

Figure 3-9: Sensor serial number AT39422 test results

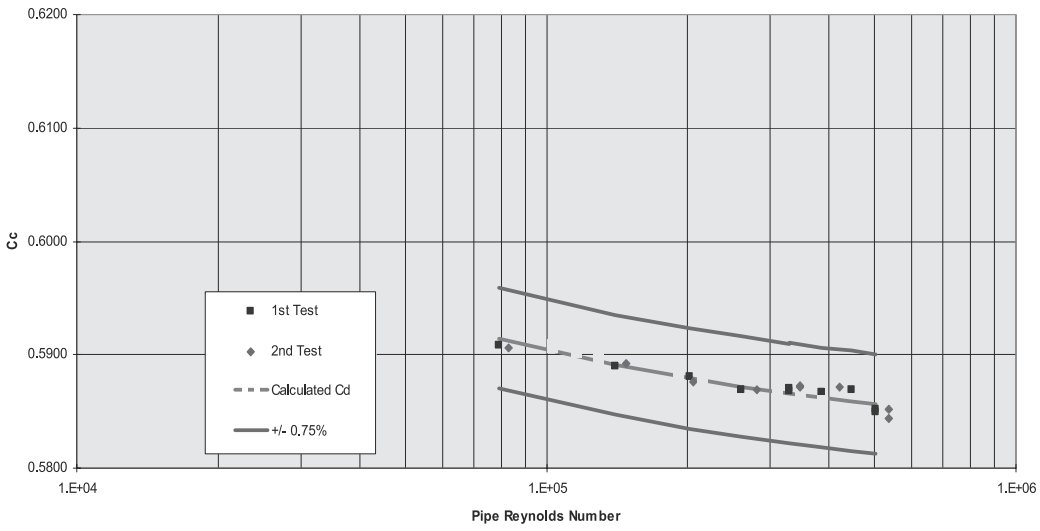


Table 3-20: Test 1, sensor serial number AT39422

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	73.7	23.1	34.9	2.41	0.9293	62.2605	246.421	896.37	5.02E + 05	0.5849
2	73.7	23.1	34.9	2.41	0.9287	62.2601	246.243	896.42	5.02E + 05	0.5852
3	73.8	23.2	35.6	2.46	0.9274	62.2592	194.094	798.20	4.48E + 05	0.5869
4	73.9	23.3	36.2	2.50	0.9259	62.2581	143.752	686.74	3.86E + 05	0.5867
5	74.1	23.4	36.7	2.53	0.9243	62.2569	104.087	584.45	3.29E + 05	0.5868
6	74.1	23.4	36.7	2.53	0.9238	62.2565	104.126	584.84	3.29E + 05	0.5871
7	74.3	23.5	37.4	2.58	0.9217	62.2550	64.776	461.19	2.60E + 05	0.5870
8	74.5	23.6	38.0	2.62	0.9195	62.2534	38.887	358.02	2.02E + 05	0.5881
9	74.4	23.6	36.6	2.52	0.9204	62.2540	18.604	248.00	1.40E + 05	0.5890
10	74.4	23.6	33.8	2.33	0.9206	62.2541	5.895	140.06	7.91E + 04	0.5909

Table 3-21: Test 2, sensor serial number AT39422

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	78.6	25.9	34.7	2.40	0.8732	62.2155	248.832	901.54	5.37E + 05	0.5852
2	78.6	25.9	34.7	2.40	0.8727	62.2151	249.404	901.42	5.37E + 05	0.5844
3	78.8	26.0	36.1	2.49	0.8703	62.2129	151.249	705.21	4.21E + 05	0.5871
4	78.9	26.1	36.7	2.53	0.8688	62.2117	102.724	581.20	3.48E + 04	0.5871
5	79.0	26.1	36.7	2.53	0.8683	62.2112	102.445	580.57	3.47E + 04	0.5873
6	79.1	26.2	37.3	2.57	0.8667	62.2098	66.413	467.17	2.80E + 04	0.5869
7	79.3	26.3	38.0	2.62	0.8647	62.2079	35.660	342.70	2.06E + 04	0.5876

Table 3-21: Test 2, sensor serial number AT39422 *(continued)*

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
8	79.3	26.3	37.1	2.62	0.8649	62.2081	18.254	245.89	1.48E + 05	0.5892
9	79.3	26.3	36.4	2.62	0.8647	62.2079	5.715	137.91	8.29E + 05	0.5906

Sensor serial number AT48003

Test laboratory	Foxboro Co. flow lab
Model	Rosemount 1595
Fluid	Water
Sensor serial number	AT48003
Beta ratio	0.40
Pipe size	12 in (304.8 mm) schedule 40
Pipe inner dimension	12 in (304.8 mm)
Test date	June 4, 2003

Figure 3-10: Sensor serial number AT39422 test results

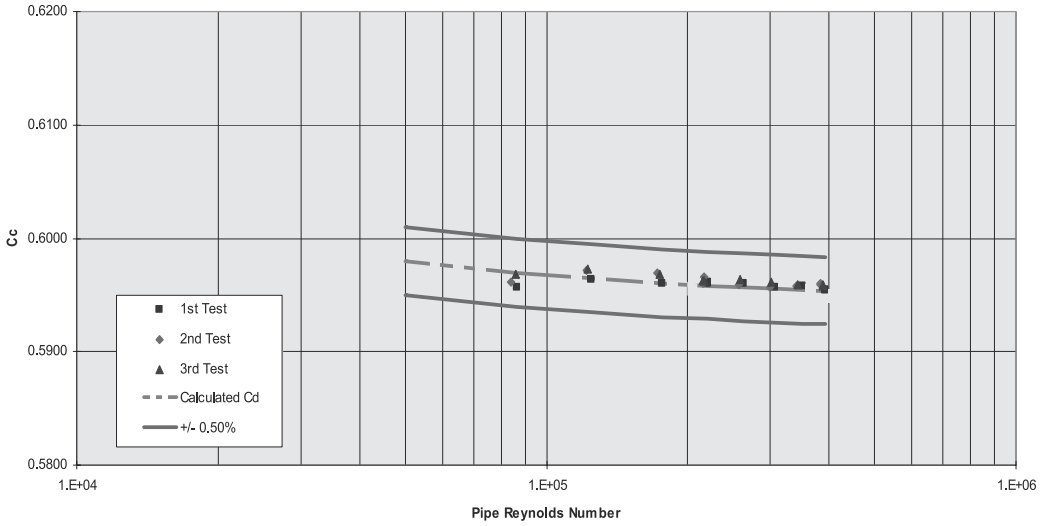


Table 3-22: Test 1, sensor serial number AT48003

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	GPM		
1	83.8	28.8	37.4	2.58	0.8163	62.1338	243.953	1230.24	3.93E + 05	0.5954
2	83.7	28.7	37.4	2.58	0.8172	62.1348	244.527	1231.76	3.93E + 05	0.5955
3	83.8	28.8	37.8	2.61	0.8163	62.1338	194.976	1094.78	3.50E + 05	0.5958
4	83.9	28.8	38.3	2.64	0.8153	62.1328	147.445	956.92	3.06E + 05	0.5957
5	83.9	28.8	38.3	2.64	0.8153	62.1328	108.420	820.97	3.63E + 05	0.5960
6	84.0	28.9	38.3	2.64	0.8143	62.1318	76.038	687.71	2.20E + 05	0.5962
7	84.2	29.0	38.3	2.64	0.8123	62.1297	76.047	687.65	2.21E + 05	0.5961
8	84.3	29.1	38.3	2.64	0.8114	62.1287	48.144	547.09	1.76E + 05	0.5960
9	84.3	29.1	38.3	2.64	0.8114	62.1287	24.195	388.06	1.25E + 05	0.5964
10	84.4	29.1	38.3	2.64	0.8104	62.1276	11.587	268.23	8.64E + 04	0.5956

Table 3-23: Test 2, sensor serial number AT48003

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	GPM		
1	81.7	27.6	37.4	2.58	0.8374	62.1550	244.394	1232.03	3.84E + 05	0.5959
2	81.7	27.6	37.4	2.58	0.8374	62.1550	244.315	1232.16	3.84E + 05	0.5960
3	81.7	27.6	37.8	2.61	0.8374	62.1550	192.074	1092.15	3.41E + 05	0.5958
4	81.8	27.7	38.3	2.64	0.8364	62.1540	148.351	959.64	3.00E + 05	0.5957
5	82.0	27.8	38.3	2.64	0.8343	62.1520	108.735	821.89	2.57E + 05	0.5959
6	82.2	27.9	38.3	2.64	0.8323	62.1500	76.239	688.29	2.16E + 05	0.5960
7	82.3	27.9	38.3	2.64	0.8313	62.1490	76.240	689.03	2.16E + 05	0.5966
8	82.7	28.2	38.3	2.64	0.8272	62.1450	47.980	546.88	1.73E + 05	0.5969
9	82.1	27.8	38.3	2.64	0.8333	62.1510	24.072	387.54	1.21E + 05	0.5972
10	82.0	27.8	38.3	2.64	0.8343	62.1520	11.542	267.86	8.38E + 04	0.5961

Table 3-24: Test 3, sensor serial number AT48003

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge co-efficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	GPM		
1	82.0	27.8	37.4	2.58	0.8343	62.1520	248.670	1242.69	3.89E + 05	0.5958
2	82.0	27.8	37.4	2.58	0.8343	62.1520	248.517	1242.52	3.89E + 05	0.5959
3	82.0	27.8	37.8	2.61	0.8343	62.1520	192.911	1094.65	3.43E + 05	0.5959
4	82.1	27.8	38.3	2.64	0.8333	62.1510	148.520	960.95	3.01E + 05	0.5962
5	82.3	27.9	38.3	2.64	0.8313	62.1490	108.433	821.33	2.58E + 05	0.5963
6	82.4	28.0	38.3	2.64	0.8302	62.1480	75.718	686.29	2.16E + 05	0.5963
7	82.7	28.2	38.3	2.64	0.8272	62.1450	75.828	686.79	2.17E + 05	0.5963
8	83.1	28.4	38.3	2.64	0.8232	62.1410	48.240	548.29	1.74E + 05	0.5968
9	82.4	28.0	38.3	2.64	0.8302	62.1480	24.287	389.31	1.22E + 05	0.5973
10	82.4	28.0	38.3	2.64	0.8302	62.1480	12.004	273.51	8.60E + 04	0.5968

3.6 Single elbow tests

Tests at Rosemount flow lab

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	June 10, 2002

Figure 3-11: Single elbow test results for sensor 08261 in water

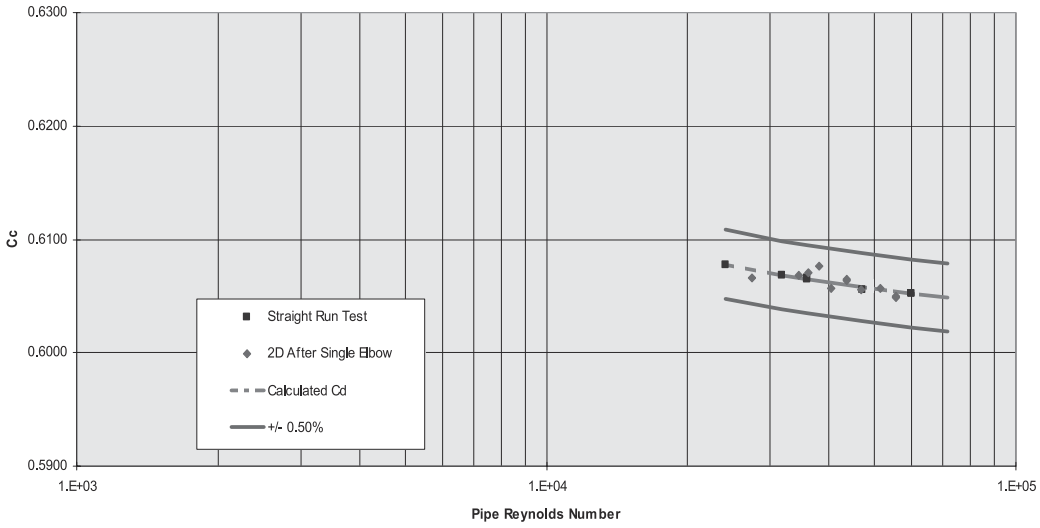


Table 3-25: Straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	85.1	29.5	28.3	1.95	0.8057	62.1479	173.118	31.76	6.01E + 05	0.6052
2	85.2	29.6	28.2	1.94	0.8050	62.1470	105.641	24.83	4.70E + 05	0.6056
3	85.1	29.5	28.3	1.95	0.8059	62.1480	61.992	19.05	3.60E + 05	0.6066
4	85.1	29.5	28.2	1.95	0.5062	62.1484	62.056	19.06	3.60E + 05	0.6065
5	85.1	29.5	28.2	1.95	0.8061	62.1483	48.369	16.83	3.18E + 05	0.6069
6	85.1	29.5	28.1	1.94	0.8060	62.1481	27.581	12.73	2.41E + 05	0.6078

Table 3-26: Test 2, sensor serial number AT48003

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in water	GPM		
1	67.3	19.6	36.7	2.53	1.0119	62.3123	232.053	36.70	5.54E + 05	0.6050
2	67.3	19.6	36.7	2.53	1.0119	62.3123	231.905	36.68	5.54E + 05	0.6049
3	67.3	19.6	36.7	2.53	1.0119	62.3123	199.157	34.04	5.14E + 05	0.6057
4	67.3	19.6	36.7	2.53	1.0120	62.3123	164.700	30.94	4.67E + 05	0.6055
5	67.3	19.6	36.7	2.53	1.0120	62.3123	142.917	28.87	4.36E + 05	0.6064
6	67.3	19.6	36.7	2.53	1.0120	62.3123	142.762	28.86	4.36E + 05	0.6065
7	67.3	19.6	36.7	2.53	1.0119	62.3123	123.567	26.81	4.05E + 05	0.6057
8	67.3	19.6	36.8	2.54	1.0120	62.3123	108.320	25.18	3.80E + 05	0.6076
9	67.3	19.6	36.8	2.54	1.0120	62.3123	97.560	23.87	3.61E + 05	0.6070
10	67.3	19.6	36.8	2.54	1.0120	62.3123	89.285	22.83	3.45E + 05	0.6069
11	67.3	19.6	36.8	2.54	1.0120	62.3123	56.824	18.21	2.75E + 05	0.6066

Testing at SwRI flow lab

Model	Rosemount 405C
Fluid	Natural gas
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm)
Pipe inner dimension	2.066 in (52.48 mm)
Test date	August 21, 2002

Figure 3-12: Test results for sensor 08261 in natural gas

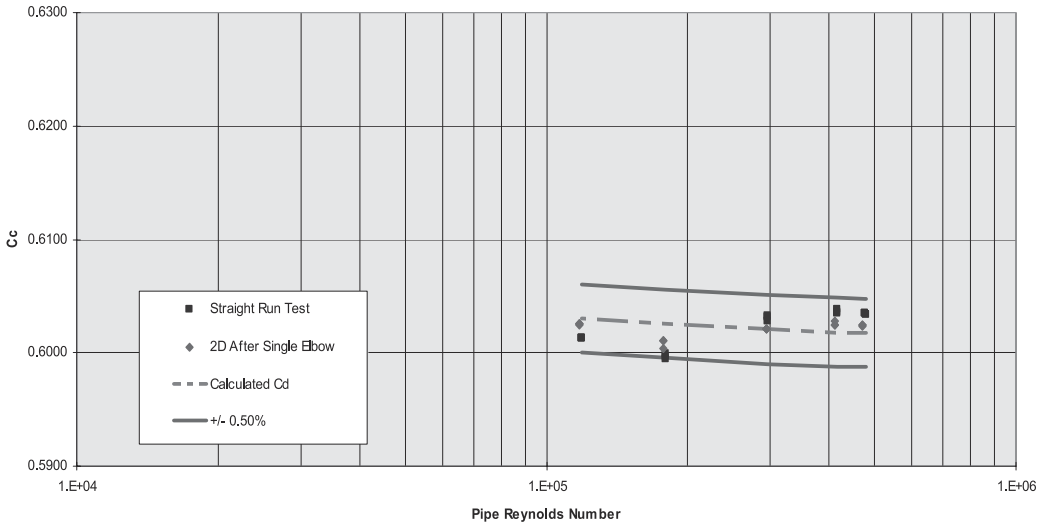


Table 3-27: Straight run test results for sensor 08261 in natural gas

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
1	74.6	23.7	188.7	13.01	0.5918	230.638	0.4877	4.78E + 05	0.6034
2	74.4	23.6	188.6	13.00	0.5917	230.319	0.4874	4.78E + 05	0.6035
3	74.4	23.5	188.5	12.99	0.5913	230.159	0.4871	4.78E + 05	0.6035
4	74.8	23.8	189.1	13.04	0.5868	175.674	0.4252	4.17E + 05	0.6036
5	74.8	23.8	189.0	13.03	0.5865	175.634	0.4249	4.16E + 05	0.6035
6	74.7	23.7	188.8	13.02	0.5861	175.256	0.4247	4.16E + 05	0.6038
7	76.4	24.7	189.8	13.09	0.5781	90.143	0.3035	2.97E + 05	0.6031
8	76.4	24.7	189.7	13.08	0.5779	90.043	0.3033	2.97E + 05	0.6033
9	76.4	24.7	189.7	13.08	0.5776	90.143	0.3032	2.96E + 05	0.6028
10	75.5	24.3	190.2	13.12	0.5738	33.370	0.1835	1.80E + 05	0.5996
11	75.8	24.3	190.2	13.11	0.5736	33.370	0.1834	1.79E + 05	0.5995

Table 3-27: Straight run test results for sensor 08261 in natural gas *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
12	76.0	24.4	190.09	13.11	0.5732	33.309	0.1833	1.79E + 05	0.5999
13	77.3	25.2	190.5	13.14	0.5709	14.696	0.1219	1.19E + 05	0.6013
14	77.6	25.3	190.49	13.13	0.5704	14.696	0.1218	1.19E + 05	0.6013
15	77.8	25.5	190.4	13.13	0.5700	14.696	0.1218	1.19E + 05	0.6012

Table 3-28: Natural gas test results after single elbow, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
1	81.5	27.5	189.2	13.04	0.5903	292.520	0.4853	4.71E + 05	0.6025
2	81.1	27.3	189.1	13.04	0.5904	229.361	0.4851	4.71E + 05	0.6024
3	80.9	27.2	189.0	13.03	0.5904	229.361	0.4850	4.71E + 05	0.6023
4	80.7	27.1	189.5	13.07	0.5864	174.977	0.4237	4.12E + 05	0.6027
5	80.7	27.0	189.5	13.06	0.5863	175.116	0.4237	4.12E + 05	0.6025
6	80.6	27.0	189.4	13.06	0.5862	175.116	0.4236	4.12E + 05	0.6024
7	80.9	27.2	190.0	13.10	0.5781	89.843	0.3025	2.94E + 05	0.6021
8	81.0	27.2	189.9	13.10	0.5778	89.843	0.3025	2.94E + 05	0.6021
9	81.1	27.3	189.9	13.09	0.5776	89.483	0.3024	2.94E + 05	0.6021
10	82.1	27.8	190.7	13.15	0.5726	33.127	0.1829	1.77E + 05	0.6004
11	82.3	27.9	190.7	13.15	0.5725	33.066	0.1829	1.779E + 05	0.6011
12	82.5	28.0	190.7	13.15	0.5723	33.066	0.1828	1.77E + 05	0.6011

Table 3-28: Natural gas test results after single elbow, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
13	83.0	28.3	190.4	13.13	0.5687	14.535	0.1212	1.17E + 05	0.6025
14	83.3	28.5	190.4	13.13	0.5684	14.535	0.1212	1.17E + 05	0.6026
15	83.5	28.6	190.4	13.13	0.5681	14.535	0.1212	1.17E + 05	0.6026

3.7 Double elbows in plane

Rosemount flow lab

Test laboratory	Rosemount Boulder, CO flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (50.8 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	July 2, 2002

Figure 3-13: Double elbows in plane test results in water

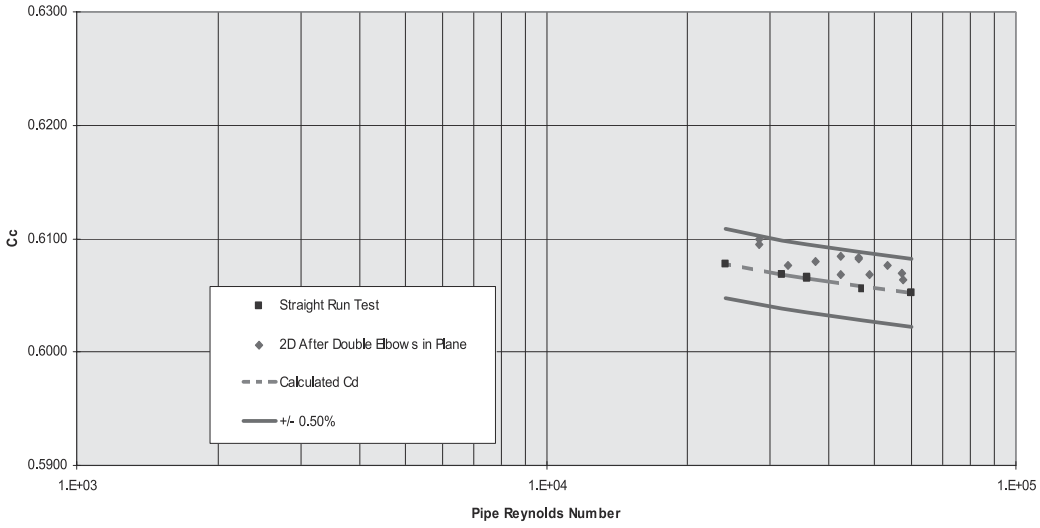


Table 3-29: Straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in water	lbm/sec		
1	85.1	29.5	28.3	1.95	0.8057	62.1479	173.118	31.76	6.01E + 05	0.6052
2	85.2	29.6	28.2	1.94	0.8050	62.1470	105.641	24.83	4.70E + 05	0.6056
3	85.1	29.5	28.3	1.95	0.8059	62.1480	61.992	19.05	3.60E + 05	0.6066
4	85.1	29.5	28.2	1.95	0.8062	62.1484	62.056	19.06	3.60E + 05	0.6065
5	85.1	29.5	28.2	1.95	0.8061	62.1483	48.369	16.83	3.18E + 05	0.6069
6	85.1	29.5	28.1	1.94	0.8060	62.1481	27.581	12.73	2.41E + 05	0.6078

Table 3-30: Double elbows in plane, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in Water	lbm/sec		
1	68.4	20.2	37.5	2.59	0.9959	62.3035	241.008	37.48	5.75E + 05	0.6063
2	68.4	20.2	37.5	2.59	0.9961	62.3035	238.773	37.35	5.73E + 05	0.6070
3	68.3	20.2	36.6	2.52	0.9972	62.3042	207.099	34.82	5.34E + 05	0.6076
4	68.4	20.2	36.6	2.52	0.9970	62.3041	173.629	31.84	4.88E + 05	0.6069
5	68.4	20.2	36.6	2.52	0.9969	62.3040	155.267	30.18	4.63E + 05	0.6083
6	68.4	20.2	36.6	2.52	0.9969	62.3040	154.624	30.12	4.62E + 05	0.6083
7	68.4	20.2	36.6	2.52	0.9967	62.3039	130.075	27.63	4.24E + 05	0.6085
8	68.4	20.2	36.6	2.52	0.9967	62.3039	130.759	27.63	4.24E + 05	0.6068

Table 3-30: Double elbows in plane, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in Water	lbm/sec		
9	68.4	20.2	36.6	2.52	0.9965	62.3037	101.582	24.40	3.74E + 05	0.6080
10	68.4	20.2	36.6	2.52	0.9962	62.3037	77.884	21.35	3.28E + 05	0.6076
11	68.4	20.2	36.6	2.52	0.9961	62.3035	58.274	18.54	2.84E + 05	0.6100

SwRI flow lab

Model	Rosemount 405C
Fluid	Natural gas
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (50.8 mm)
Pipe inner dimension	2.066 in (52.48 mm)
Test date	August 21, 2002

Figure 3-14: Double elbows in plane test results in natural gas

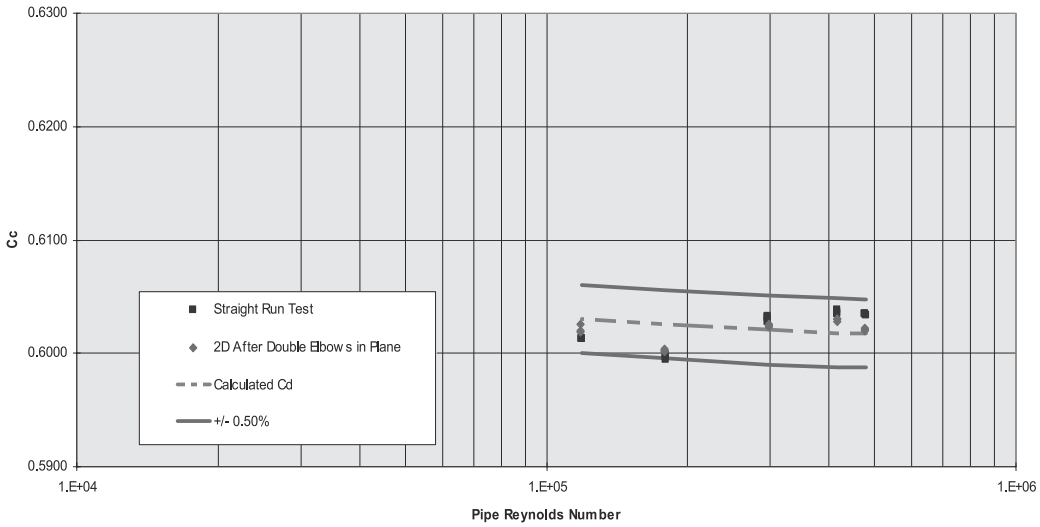


Table 3-31: Natural gas straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
1	74.6	23.7	188.7	13.01	0.5918	230.638	0.4877	4.78E + 05	0.6034
2	74.4	23.6	188.6	13.00	0.5917	230.319	0.4874	4.78E + 05	0.6035
3	74.4	23.5	188.5	12.99	0.5913	230.159	0.4871	4.78E + 05	0.6035
4	74.8	23.8	189.1	13.04	0.5868	175.674	0.4252	4.17E + 05	0.6036
5	74.8	23.8	189.0	13.03	0.5865	175.534	0.4249	4.16E + 05	0.6035
6	74.7	23.7	188.8	13.02	0.5861	175.256	0.4247	4.16E + 05	0.6038
7	76.4	24.7	189.8	13.09	0.5781	90.143	0.3035	2.97E + 05	0.6031
8	76.4	24.7	189.7	13.08	0.5779	90.043	0.3033	2.97E + 05	0.6033
9	76.4	24.7	189.7	13.08	0.5776	90.143	0.3032	2.96E + 05	0.6028
10	75.7	24.3	190.2	13.12	0.5738	33.370	0.1835	1.80E + 05	0.5996
11	75.8	24.3	190.2	13.11	0.5736	33.370	0.1834	1.79E + 05	0.5995
12	76.0	24.4	190.2	13.11	0.5732	33.309	0.1833	1.79E + 05	0.5999
13	77.3	25.2	190.5	13.14	0.5709	14.696	0.1219	1.19E + 05	0.6013
14	77.6	25.3	190.4	13.13	0.5704	14.696	0.1218	1.19E + 05	0.6013
15	77.8	25.5	190.4	13.13	0.5700	14.696	0.1218	1.19E + 05	0.6012

Table 3-32: Natural gas, double elbows in plane, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
1	77.9	25.5	188.8	13.02	0.5928	230.798	0.4873	4.76E + 05	0.6021

Table 3-32: Natural gas, double elbows in plane, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	lbm/sec		
2	77.6	25.4	188.7	13.01	0.5927	230.638	0.4870	4.75E + 05	0.6020
3	77.5	25.3	188.6	13.00	0.5927	230.319	0.4868	4.75E + 05	0.6022
4	77.3	25.2	189.6	13.07	0.5901	175.953	0.4264	4.16E + 05	0.6030
5	77.2	25.1	189.5	13.07	0.5899	175.814	0.4262	4.16E + 05	0.6030
6	77.1	25.1	189.4	13.06	0.5897	175.814	0.4260	4.16E + 05	0.6028
7	77.4	25.2	190.2	13.12	0.5825	90.243	0.3045	2.97E + 05	0.6025
8	77.6	25.4	190.2	13.12	0.5821	90.243	0.3044	2.97E + 05	0.6025
9	77.5	25.3	190.2	13.11	0.5821	90.243	0.3043	2.96E + 05	0.6023
10	78.5	25.9	190.4	13.13	0.5754	33.248	0.1836	1.79E + 05	0.6004
11	78.6	25.9	190.4	13.13	0.5753	33.248	0.1836	1.79E + 05	0.6003
12	78.7	26.0	190.4	13.12	0.5749	33.248	0.1835	1.79E + 05	0.6002
13	79.4	26.4	190.3	13.12	0.5719	14.616	0.1218	1.19E + 05	0.6019
14	79.6	26.4	190.2	13.11	0.5715	14.616	0.1217	1.18E + 05	0.6019
15	79.8	26.6	190.1	13.11	0.5712	14.575	0.1217	1.18E + 05	0.6026

Test results for sensor serial number 12402

Model	Rosemount 405C
Fluid	Water
Sensor serial number	12402
Beta ratio	0.60
Pipe size	2 in (50.8 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)

Test date	July 9, 2002

Figure 3-15: Test results for sensor 12402

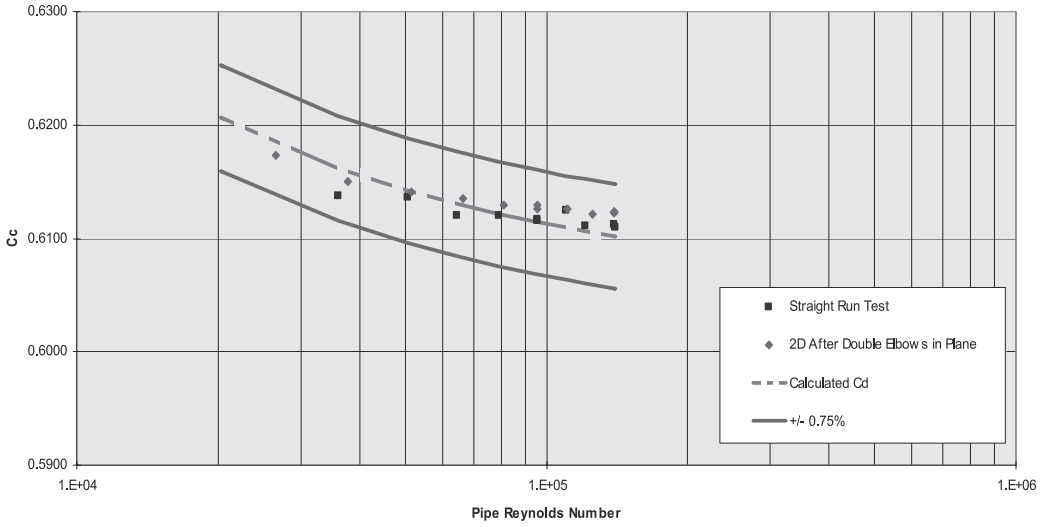


Table 3-33: Straight run test, sensor serial number 12402

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	66.6	19.2	28.2	1.95	1.0215	62.3174	265.761	93.08	1.39E + 05	0.6112
2	66.6	19.2	28.2	1.94	1.0218	62.3175	269.224	93.66	1.40E + 05	0.6110
3	66.6	19.2	28.4	1.96	1.0217	62.3175	200.526	80.84	1.21E + 05	0.6111
4	66.6	19.2	28.4	1.96	1.0214	62.3173	165.081	73.51	1.10E + 05	0.6124
5	66.6	19.2	28.5	1.96	1.0210	62.3171	125.494	64.00	9.57E + 05	0.6115
6	66.6	19.2	28.4	1.96	1.0210	62.3171	125.292	63.97	9.57E + 05	0.6117
7	66.6	19.2	28.4	1.96	1.0208	62.3170	86.271	53.10	7.95E + 05	0.6120
8	66.7	19.3	28.4	1.96	1.0197	62.3164	56.759	43.08	6.45E + 05	0.6121
9	66.8	19.4	28.4	1.96	1.0178	62.3154	34.709	33.77	5.07E + 05	0.6136

Table 3-33: Straight run test, sensor serial number 12402 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dis-charge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
10	67.0	19.4	28.3	1.95	1.0159	62.3145	17.529	24.01	3.61E + 05	0.6137

Table 3-34: Double elbows in plane, sensor serial number 12402

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Rey-nolds number	Dischar ge co-efficien t
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	68.0	20.0	35.1	2.42	1.0014	62.3066	254.411	91.24	1.39E + 05	0.6123
2	68.0	20.0	35.2	2.42	1.0014	62.3066	254.177	91.21	1.39E + 05	0.6123
3	68.1	20.1	36.0	2.48	1.0010	62.3063	207.469	82.38	1.26E + 05	0.6121
4	68.1	20.1	36.5	2.52	1.0006	62.3061	161.025	72.62	1.11E + 05	0.6125
5	68.1	20.1	36.7	2.53	1.0004	62.3060	119.624	62.63	9.56E + 05	0.6129
6	68.1	20.1	36.7	2.53	1.0004	62.3060	119.516	62.57	9.55E + 05	0.6126
7	68.1	20.1	36.6	2.52	1.0003	62.3059	85.703	53.01	8.09E + 05	0.6129
8	68.1	20.1	36.7	2.53	1.0002	62.3059	57.811	43.59	6.65E + 05	0.6136
9	68.1	20.1	36.7	2.53	1.0001	62.3057	34.682	33.79	5.16E + 05	0.6141
10	68.1	20.1	36.8	2.53	1.9999	62.3057	18.440	24.68	3.77E + 05	0.6150
11	68.2	20.2	36.8	2.54	1.9998	62.3057	9.030	17.33	2.65E + 05	0.6173

3.8 Double elbows out of plane

Testing sensor 08261 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	June 5, 2003

Figure 3-16: Test results for sensor 08261 in water

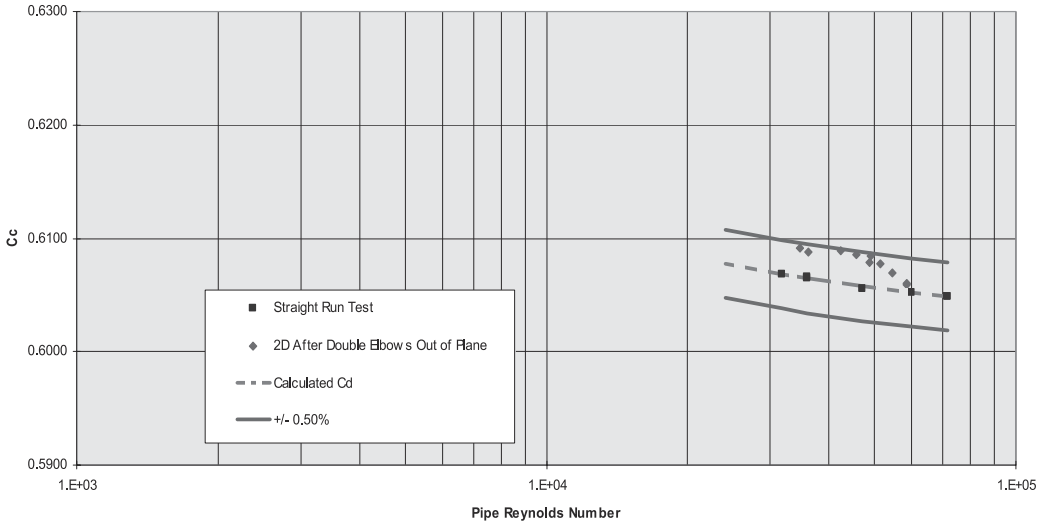


Table 3-35: Straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds Numbe r	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	85.0	29.4	28.3	1.95	0.8074	62.1497	246.390	37.87	7.15E + 04	0.6049
2	85.1	29.5	28.3	1.95	0.8062	62.1484	246.087	37.84	7.15E + 04	0.6048
3	85.1	29.5	28.3	1.95	0.8057	62.1479	173.118	31.76	6.01E + 04	0.6052

Table 3-35: Straight run test, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds Numbe r	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
4	85.2	29.6	28.2	1.94	0.8050	62.1470	105.641	24.83	4.70E + 04	0.6056
5	85.1	29.5	28.3	1.95	0.8059	62.1480	61.992	19.05	3.60E + 04	0.6066
6	85.1	29.5	28.2	1.94	0.8062	62.1484	62.056	19.06	3.60E + 04	0.6065
7	85.1	29.5	28.2	1.94	0.8061	62.1483	48.369	16.83	3.18E + 04	0.6069

Table 3-36: Double elbows out of plane, sensor serial number 08261 in water

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	68.0	20.0	37.0	2.55	1.0013	62.3065	253.472	38.42	5.86E + 04	0.6059
2	68.1	21.1	37.0	2.55	1.0005	62.3060	253.453	38.42	5.87E + 04	0.6060
3	68.2	21.1	36.1	2.49	0.9990	62.3052	217.241	35.63	5.45E + 04	0.6070
4	68.2	21.1	36.2	2.49	0.9989	62.3051	192.623	33.59	5.14E + 04	0.6077
5	68.2	21.1	36.2	2.49	0.9992	62.3052	174.461	31.98	4.89E + 04	0.6079
6	68.2	21.1	36.2	2.49	0.9992	62.3053	174.474	32.01	4.89E + 04	0.6085
7	68.2	21.1	36.2	2.49	0.9994	62.3054	153.099	29.99	4.58E + 04	0.6086
8	68.2	21.1	36.2	2.49	0.9995	62.3055	130.873	27.74	4.24E + 04	0.6089
9	68.1	21.1	36.2	2.49	0.9999	62.3057	95.054	23.64	3.61E + 04	0.6088
10	68.1	21.1	36.2	2.49	1.0000	62.3057	87.212	22.65	3.46E + 04	0.6092

Test results for sensor 08261 in natural gas

Test laboratory	SwRI flow lab
Model	Rosemount 405C
Fluid	Natural gas
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	August 22, 2003

Figure 3-17: Natural gas straight run test results, sensor serial number 08261

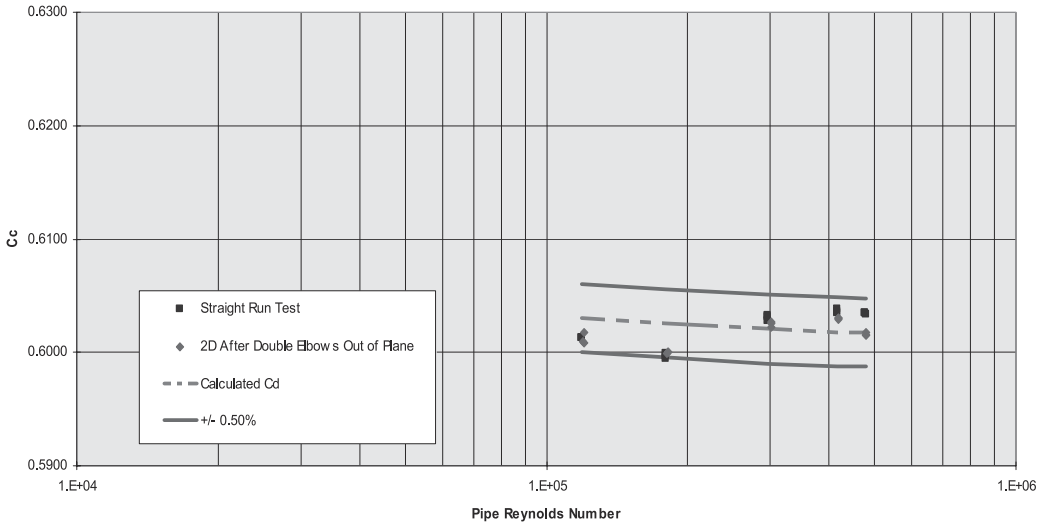


Table 3-37: Natural gas straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
1	74.6	23.7	188.7	13.01	0.5918	230.638	0.4877	4.78E + 05	0.6034
2	74.4	23.6	188.6	13.00	0.5917	230.319	0.4874	4.78E + 05	0.6035
3	74.4	23.5	188.5	12.99	0.5913	230.159	0.4871	4.78E + 05	0.6035
4	74.8	23.8	189.1	13.04	0.5868	175.674	0.4252	4.17E + 05	0.6036

Table 3-37: Natural gas straight run test, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
5	74.8	23.8	189.0	13.03	0.5865	175.534	0.4249	4.16E + 05	0.6035
6	74.7	23.7	188.8	13.02	0.5861	175.256	0.4247	4.16E + 05	0.6038
7	76.4	24.7	189.8	13.09	0.5781	90.143	0.3035	2.97E + 05	0.6031
8	76.4	24.7	189.7	13.08	0.5779	90.043	0.3033	2.97E + 05	0.6033
9	76.4	24.7	189.7	13.08	0.5776	90.143	0.3032	2.96E + 05	0.6028
10	75.7	24.3	190.2	13.12	0.5738	33.370	0.1835	1.80E + 05	0.5996
11	75.8	24.3	190.2	13.11	0.5736	33.370	0.1834	1.79E + 05	0.5995
12	76.0	24.4	190.2	13.11	0.5732	33.309	0.1833	1.79E + 05	0.5999
13	77.3	25.2	190.5	13.14	0.5709	14.696	0.1219	1.19E + 05	0.6013
14	77.6	25.3	190.5	13.13	0.5704	14.696	0.1218	1.19E + 05	0.6013
15	77.8	25.5	190.4	13.13	0.5700	14.696	0.1218	1.19E + 05	0.6012

Table 3-38: Natural gas, double elbows out of plane, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
1	74.7	23.7	188.7	13.01	0.5980	231.119	0.4894	4.80E + 05	0.6017
2	74.5	23.6	188.5	13.00	0.5978	231.119	0.4891	4.80E + 05	0.6015
3	74.4	23.5	188.4	12.99	0.5976	230.958	0.4889	4.80E + 05	0.6015
4	74.1	23.4	189.0	13.03	0.5934	175.534	0.4271	4.19E + 05	0.6031
5	74.0	23.3	188.9	13.02	0.5933	175.534	0.4270	4.19E + 05	0.6029

Table 3-38: Natural gas, double elbows out of plane, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
6	74.0	23.3	188.8	13.02	0.5932	175.395	0.4268	4.19E + 05	0.6031
7	74.0	23.3	190.3	13.12	0.5885	90.543	0.3065	3.01E + 05	0.6023
8	74.1	23.4	190.3	13.12	0.5882	90.443	0.3064	3.01E + 05	0.6026
9	74.2	23.4	190.2	13.11	0.5881	90.443	0.3063	3.01E + 05	0.6026
10	74.7	23.7	190.4	13.13	0.5818	33.370	0.1848	1.81E + 05	0.6000
11	74.8	23.8	190.5	13.13	0.5817	33.370	0.1848	1.81E + 05	0.6000
12	74.9	23.8	190.4	13.13	0.5816	33.370	0.1848	1.81E + 05	0.5999
13	75.1	23.9	190.2	13.11	0.5785	14.696	0.1226	1.20E + 05	0.6009
14	75.3	24.1	190.2	13.11	0.5781	14.656	0.1226	1.20E + 05	0.6017
15	75.6	24.2	190.1	13.11	0.5777	14.696	0.1225	1.20E + 05	0.6009

Testing sensor 12402 in water

Test laboratory	Rosemount Boulder, Colorado Flow lab
Model	Rosemount 405C
Sensor serial number	12402
Beta ratio	0.60
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	June 5, 2003

Figure 3-18: Test results for sensor 12402 in water

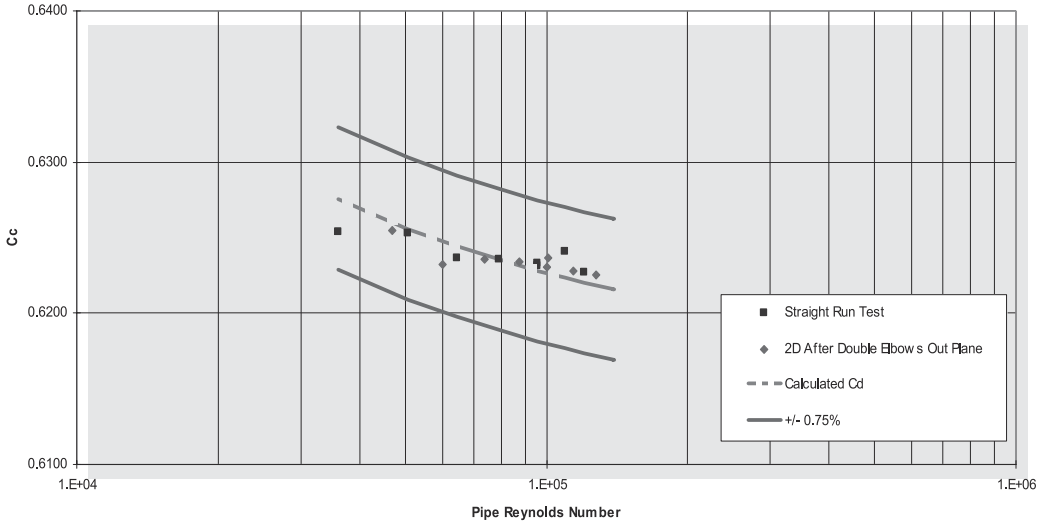


Table 3-39: Water, straight run test, sensor serial number 12402

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	66.6	19.2	28.4	1.96	1.0217	62.3175	200.526	80.84	1.21E + 05	0.6227
2	66.6	19.2	28.4	1.96	1.0214	62.3173	165.081	73.51	1.10E + 05	0.6241
3	66.6	19.2	28.5	1.96	1.0210	62.3171	125.494	64.00	9.56E + 05	0.6231
4	66.6	19.2	28.4	1.96	1.0210	62.3171	125.292	63.97	9.56E + 05	0.6233
5	66.6	19.2	28.4	1.96	1.0208	62.3170	86.271	53.10	7.94E + 05	0.6236
6	66.7	19.3	28.4	1.96	1.0197	62.3164	56.759	43.08	6.44E + 05	0.6237
7	66.8	19.4	28.4	1.96	1.0178	62.3154	34.709	33.77	5.06E + 05	0.6253
8	67.0	19.4	28.3	1.95	1.0159	62.3145	17.529	24.01	3.60E + 05	0.6254

Table 3-40: Rosemount Boulder, Colorado Flow Lab, Water. Double Elbows Out of Plane, Sensor Serial Number 12402

Data point number	Temperature		Pressure		Viscosity	Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	68.2	20.1	35.5	2.45	0.9994	62.3054	215.473	83.79	1.28E + 05	0.6225
2	68.2	20.1	35.5	2.45	0.9995	62.3055	172.473	74.98	1.14E + 05	0.6228
3	68.2	20.1	35.6	2.45	0.9996	62.3056	133.280	66.01	1.01E + 05	0.6236
4	68.2	20.1	35.6	2.45	0.9997	62.3056	132.542	65.77	1.00E + 05	0.6231
5	68.2	20.1	35.7	2.46	0.9998	62.3056	100.698	57.35	8.75E + 05	0.6234
6	68.1	20.1	35.7	2.46	0.9999	62.3057	71.827	48.45	7.39E + 05	0.6235
7	68.1	20.1	35.8	2.47	1.0000	62.3057	47.333	39.31	6.00E + 05	0.6232
8	68.1	20.1	35.8	2.47	1.0001	62.3058	28.913	30.84	4.70E + 05	0.6255

3.9 Swirl generator

Testing sensor 08261 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)

Figure 3-19: Test results for sensor 08261 in water

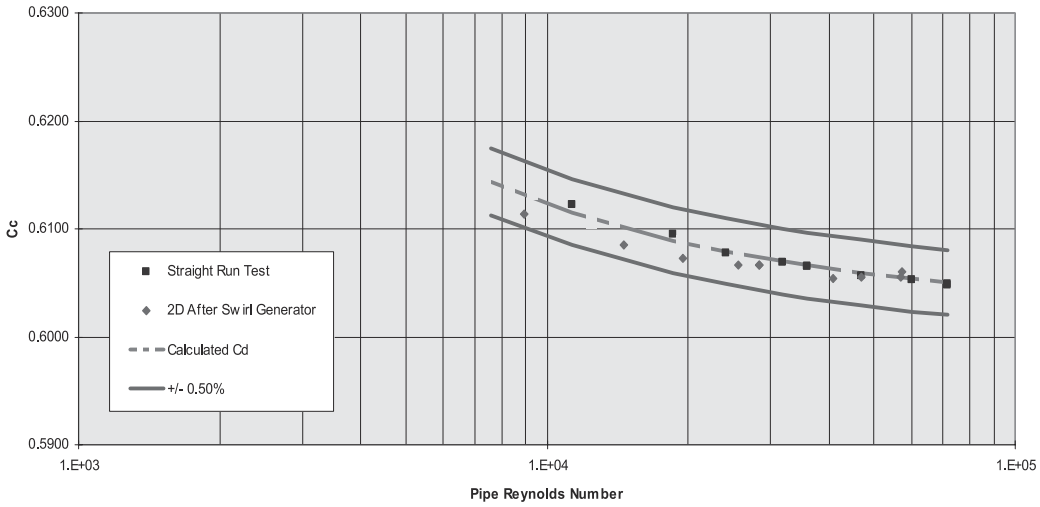


Table 3-41: Water straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	85.0	29.4	28.3	1.95	0.8074	62.1497	246.390	37.87	7.15E + 04	0.6049
2	85.1	29.5	28.3	1.95	0.8062	62.1484	246.087	37.84	7.15E + 04	0.6048
3	85.1	29.5	28.3	1.95	0.8057	62.1479	173.118	31.76	6.01E + 04	0.6052
4	85.2	29.6	28.2	1.94	0.8050	62.1470	105.641	24.83	4.70E + 04	0.6056
5	85.1	29.5	28.3	1.95	0.8059	62.1480	61.992	19.05	3.60E + 04	0.6066
6	85.1	29.5	28.2	1.95	0.8062	62.1484	62.056	19.06	3.60E + 04	0.6065
7	85.1	29.5	28.2	1.95	0.8061	62.1483	48.369	16.83	3.18E + 04	0.6069
8	85.1	29.5	28.1	1.94	0.8060	62.1481	27.581	12.73	2.41E + 04	0.6078
9	85.2	29.6	28.2	1.94	0.8054	62.1475	16.431	9.85	1.86E + 04	0.6095
10	85.2	29.6	28.1	1.94	0.8050	62.1471	6.005	5.98	1.13E + 04	0.6122

Table 3-42: Test results for sensor 08261 in water after swirl generator

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	67.3	19.6	28.4	1.96	1.0121	62.3124	246.487	37.88	5.72E + 04	0.6060
2	67.2	19.5	28.4	1.96	1.0133	62.3130	246.808	37.88	5.71E + 04	0.6055
3	67.0	19.4	28.3	1.95	1.0162	62.3146	168.363	31.28	4.70E + 04	0.6055
4	67.0	19.5	28.3	1.95	1.0154	62.3141	126.037	27.06	4.07E + 04	0.6054
5	67.0	19.4	28.3	1.95	1.0159	62.3144	61.311	18.91	2.85E + 04	0.6066
6	67.0	19.4	28.3	1.95	1.0161	62.3146	61.210	18.90	2.84E + 04	0.6066
7	67.1	19.5	28.3	1.95	1.0140	62.3135	49.420	16.98	2.56E + 04	0.6066
8	67.3	19.6	28.2	1.94	1.0114	62.3120	28.640	12.94	1.96E + 04	0.6072
9	67.5	19.7	28.2	1.94	1.0083	62.3105	15.748	9.62	1.46E + 04	0.6085
10	67.8	19.9	28.1	1.94	1.0048	62.3086	5.825	5.88	8.93E + 04	0.6113

Testing sensor 08261 in air

Test laboratory	CEESI, Colorado
Model	Rosemount 405C
Fluid	Air
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	February 27, 2002

Figure 3-20: Test results for sensor 08261 in air

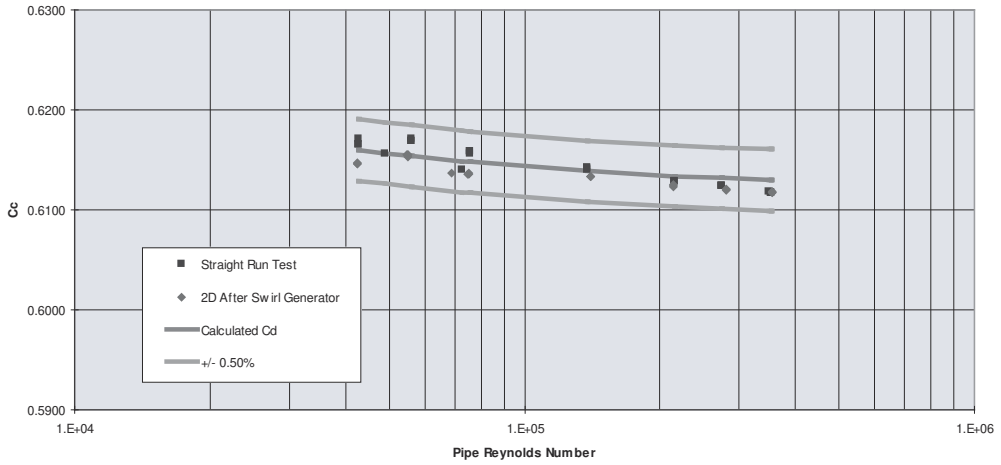


Table 3-43: Air straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	65.8	18.8	152.5	10.52	0.0181	0.7863	241.75	0.5728	3.50E+05	0.6119
2	62.9	17.2	150.2	10.35	0.0180	0.7784	248.50	0.5773	3.54E+05	0.6117
3	61.1	16.2	150.2	10.35	0.0180	0.7812	245.20	0.5747	3.54E+05	0.6117
4	61.0	16.1	150.2	10.35	0.0179	0.7816	245.14	0.5747	3.54E+05	0.6118
5	60.8	16.0	150.2	10.35	0.0179	0.7817	245.07	0.5747	3.54E+05	0.6118
6	62.9	17.2	150.2	10.35	0.0180	0.7784	148.03	0.4489	2.75E+05	0.6124
7	63.1	17.3	150.2	10.35	0.0180	0.7782	148.03	0.4489	2.75E+05	0.6125
8	63.1	17.3	150.2	10.36	0.0180	0.7783	148.02	0.4489	2.75E+05	0.6125
9	65.1	18.4	150.2	10.36	0.0181	0.7752	91.59	0.3539	2.16E+05	0.6129
10	65.4	18.6	150.1	10.35	0.0181	0.7745	91.62	0.3537	2.16E+05	0.6128

Table 3-43: Air straight run test, sensor serial number 08261 ***(continued)***

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
11	65.5	18.6	150.2	10.35	0.0181	0.7746	91.56	0.3537	2.16E+05	0.6129
12	68.5	20.3	150.2	10.36	0.0182	0.7702	37.78	0.2277	1.39E+05	0.6140
13	68.8	20.5	150.2	10.36	0.0182	0.7697	37.73	0.2275	1.38E+05	0.6142
14	69.0	20.6	150.2	10.36	0.0182	0.7695	37.70	0.2274	1.38E+05	0.6142
15	71.8	22.1	150.2	10.36	0.0182	0.7655	11.42	0.1254	7.59E+04	0.6158
16	71.9	22.2	150.3	10.36	0.0182	0.7654	11.42	0.1254	7.59E+04	0.6158
17	72.1	22.3	150.2	10.36	0.0182	0.7649	11.41	0.1252	7.58E+04	0.6156
18	73.2	22.9	150.1	10.35	0.0183	0.7627	10.67	0.1207	7.29E+04	0.6140
19	74.7	23.7	150.2	10.36	0.0183	0.7610	6.32	0.0932	5.62E+04	0.6169
20	74.7	23.7	150.2	10.35	0.0183	0.7609	6.31	0.0932	5.62E+04	0.6171
21	74.7	23.7	150.2	10.35	0.0183	0.7607	6.32	0.0932	5.62E+04	0.6169
22	74.6	23.7	150.2	10.36	0.0183	0.7613	4.86	0.0815	4.92E+04	0.6157
23	74.8	23.8	150.2	10.36	0.0183	0.7610	3.71	0.0713	4.30E+04	0.6165
24	74.9	23.8	150.2	10.36	0.0183	0.7608	3.71	0.0714	4.30E+04	0.6166
25	75.0	23.9	150.2	10.36	0.0183	0.7605	3.70	0.0714	4.30E+04	0.6171

Table 3-44: Air after swirl generator, sensor serial number 08261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	60.2	15.7	150.0	10.34	0.0179	0.7836	246.82	0.5775	3.56E+05	0.6117
2	60.0	15.6	150.1	10.35	0.0179	0.7840	246.70	0.5776	3.56E+05	0.6118
3	59.8	15.5	150.1	10.35	0.0179	0.7843	246.73	0.5777	3.57E+05	0.6117
4	61.2	16.2	150.1	10.35	0.0180	0.7821	154.14	0.4588	2.83E+05	0.6120
5	61.2	16.2	150.1	10.35	0.0180	0.7824	154.13	0.4588	2.83E+05	0.6120
6	61.1	16.2	150.1	10.35	0.0180	0.7825	154.15	0.4590	2.83E+05	0.6121
7	62.6	17.0	150.1	10.35	0.0180	0.7803	88.98	0.3498	2.15E+05	0.6124
8	62.5	17.0	150.1	10.35	0.0180	0.7803	89.00	0.3498	2.15E+05	0.6123
9	62.4	16.9	150.1	10.35	0.0180	0.7802	88.94	0.3498	2.15E+05	0.6126
10	64.4	18.0	150.1	10.35	0.0180	0.7774	38.32	0.2302	1.41E+05	0.6134
11	64.7	18.2	150.1	10.35	0.0180	0.7769	38.31	0.2301	1.41E+05	0.6134
12	64.9	18.3	150.1	10.35	0.0181	0.7765	38.27	0.2299	1.41E+05	0.6134
13	67.9	20.0	150.1	10.35	0.0181	0.7723	11.09	0.1237	7.55E+04	0.6137
14	68.1	20.1	150.2	10.35	0.0181	0.7720	11.08	0.1236	7.54E+04	0.6136
15	68.2	20.1	150.1	10.35	0.0181	0.7717	11.09	0.1236	7.54E+04	0.6136
16	70.0	21.1	150.2	10.36	0.0182	0.7696	9.45	0.1140	6.93E+04	0.6137
17	70.4	21.4	150.0	10.34	0.0182	0.7677	5.98	0.0908	5.52E+04	0.6155
18	70.5	21.4	150.1	10.35	0.0182	0.7680	5.98	0.0909	5.52E+04	0.6153

Table 3-44: Air after swirl generator, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
19	70.6	21.5	150.1	10.35	0.0182	0.7680	5.98	0.0909	5.52E+04	0.6155
20	70.6	21.5	150.0	10.34	0.0182	0.7676	5.97	0.0908	5.52E+04	0.6155
21	71.0	21.7	150.1	10.35	0.0182	0.7675	3.61	0.0705	4.28E+04	0.6146
22	71.1	21.7	150.1	10.35	0.0182	0.7675	3.61	0.0705	4.28E+04	0.6147
23	71.1	21.7	150.1	10.35	0.0182	0.7673	3.61	0.0705	4.28E+04	0.6146

Testing sensor 08261 in natural gas

Test laboratory	SwRI flow lab
Model	Rosemount 405C
Fluid	Natural gas
Sensor serial number	08261
Beta ratio	0.40
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	August 20, 2002

Figure 3-21: Test results for sensor 08261 in natural gas

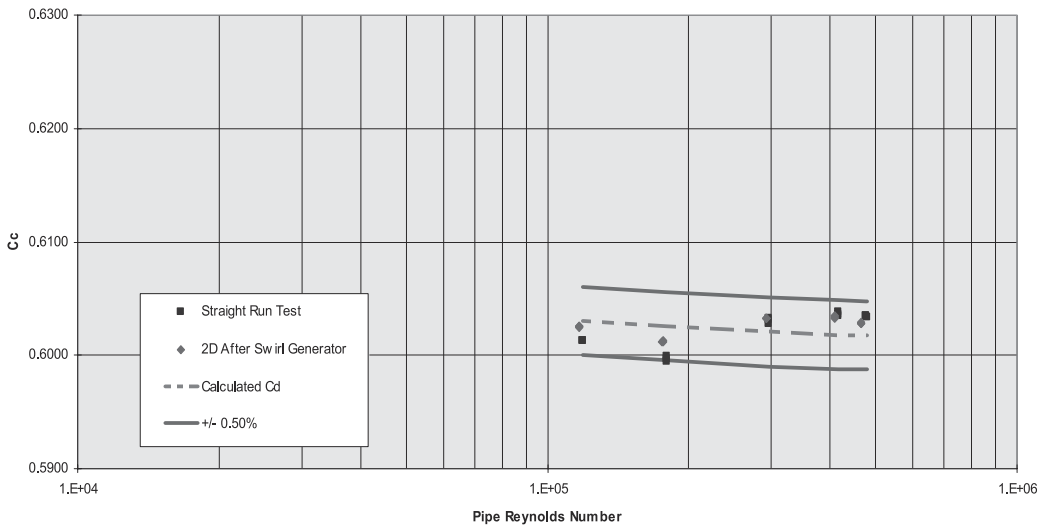


Table 3-45: Natural gas straight run test, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in Water	USGPM		
1	74.6	23.7	188.7	13.01	0.5918	230.638	0.4877	4.78E + 04	0.6034
2	74.4	23.6	188.6	13.00	0.5917	230.319	0.4874	4.78E + 04	0.6035
3	74.4	23.5	188.5	12.99	0.5913	230.159	0.4871	4.78E + 04	0.6035
4	74.8	23.8	189.1	13.04	0.5868	175.674	0.4252	4.17E + 04	0.6036
5	74.8	23.8	189.0	13.03	0.5865	175.534	0.4249	4.16E + 04	0.3035
6	74.7	23.7	188.8	13.02	0.5861	175.256	0.4247	4.16E + 04	0.6038
7	76.4	24.7	189.8	13.09	0.5781	90.143	0.3035	2.97E + 04	0.6031
8	76.4	24.7	189.7	13.08	0.5779	90.043	0.3033	2.97E + 04	0.6033
9	76.4	24.7	189.7	13.08	0.5776	90.143	0.3032	2.96E + 04	0.6028
10	75.7	24.3	190.2	13.12	0.5738	33.370	0.1835	1.80E + 04	0.5996

Table 3-45: Natural gas straight run test, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in Water	USGPM		
11	75.8	24.3	190.2	13.11	0.5736	33.370	0.1834	1.79E + 04	0.5995
12	76.0	24.4	190.1	13.11	0.5732	33.309	0.1833	1.79E + 04	0.5999
13	77.3	25.2	190.5	13.14	0.5709	14.696	0.1219	1.19E + 04	0.6013
14	77.6	25.3	190.5	13.13	0.5704	14.696	0.1218	1.19E + 04	0.6013
15	77.8	25.5	190.4	13.13	0.5700	14.696	0.1218	1.19E + 04	0.6012

Table 3-46: Natural gas after swirl generator, sensor serial number 08261

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
1	85.0	29.4	188.5	12.99	0.5828	228.882	0.4818	4.65E + 04	0.6028
2	84.5	29.2	188.3	12.98	0.5829	228.723	0.4816	4.65E + 04	0.6028
3	84.1	28.9	188.2	12.97	0.5829	228.405	0.4814	4.66E + 04	0.6029
4	83.2	28.4	189.3	13.05	0.5814	174.698	0.4220	4.09E + 04	0.6033
5	83.0	28.3	189.2	13.04	0.5814	174.559	0.4219	4.09E + 04	0.6034
6	82.8	28.2	189.1	13.04	0.5812	174.420	0.4217	4.09E + 04	0.6034
7	82.7	28.2	189.8	13.08	0.5742	89.444	0.3014	2.92E + 04	0.6032
8	83.0	28.3	189.7	13.08	0.5736	89.444	0.3013	2.92E + 04	0.6033
9	83.1	28.4	189.7	13.08	0.5737	89.444	0.3013	2.92E + 04	0.6033
10	84.2	29.0	190.4	13.12	0.5682	33.006	0.1821	1.76E + 04	0.6013
11	84.3	29.1	190.3	13.12	0.5679	33.006	0.1820	1.76E + 04	0.6012

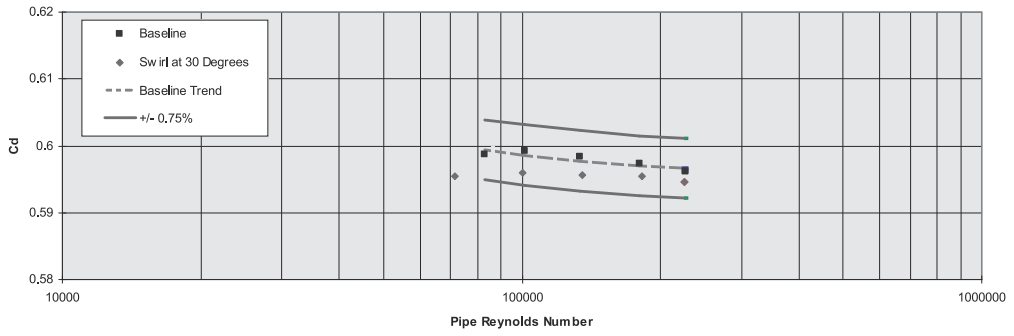
Table 3-46: Natural gas after swirl generator, sensor serial number 08261 *(continued)*

Data point number	Temperature		Pressure		Density	Differential pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	lb/ft^3	in water	USGPM		
12	84.5	29.2	190.2	13.12	0.5675	33.006	0.1820	1.76E + 04	0.6012
13	84.8	29.4	190.3	13.12	0.5652	14.535	0.1209	1.17E + 04	0.6026
14	85.1	29.5	190.2	13.11	0.5648	14.535	0.1208	1.17E + 04	0.6026
15	85.2	29.6	190.1	13.11	0.5643	14.535	0.1208	1.17E + 04	0.6024

Testing sensor serial number 04D407574 in water

Test laboratory	Rosemount Flow Products, Inc. flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	04D407574
Beta ratio	0.40
Pipe size	4 in (102 mm) schedule 40
Pipe inner dimension	4.026 in (102.26 mm)
Test date	January 23, 2004

Figure 3-22: Test results for sensor 04D407574 in water



Note
0.75% spec. for 20 to 30 degrees of swirl angle.

Table 3-47: Water baseline test, sensor serial number 04D407574

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	absolute	lb/ft^3	in Hg(1)	ft^3/min		
1	67.8	19.9	80.4	5.54	0.0101	62.3176	85.511	38.87	2.27E+05	0.5963
2	67.8	19.9	79.8	5.50	0.0100	62.3170	85.291	38.81	2.27E+05	0.5962
3	68.3	20.2	80.1	5.52	0.0100	62.3138	53.319	30.74	1.81E+05	0.5973
4	68.8	20.4	80.1	5.52	0.0099	62.3102	28.605	22.56	1.33E+05	0.5984
5	69.0	20.5	80.2	5.53	0.0099	62.3088	16.386	17.10	1.01E+05	0.5992
6	78.2	25.7	80.4	5.55	0.0088	62.2327	8.6850	12.44	8.31E+04	0.5986

(1) Inches of Hg under water

Table 3-48: Water, high swirl at 30 degrees, sensor serial number 04D407574

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	absolute	lb/ft^3	in Hg(1)	ft^3/min		
1	67.6	19.8	80.1	5.52	0.0101	62.3188	85.281	38.71	2.25E + 05	0.5946
2	67.5	19.7	80.1	5.52	0.0101	62.3197	85.480	38.75	2.25E + 05	0.5945
3	69.1	20.6	79.9	5.51	0.0099	62.3076	53.161	30.60	1.82E + 05	0.5954
4	69.7	20.9	79.8	5.50	0.0098	62.3034	28.784	22.53	1.35E + 05	0.5955
5	68.3	20.2	80.1	5.52	0.0100	62.3135	16.497	17.06	1.00E + 05	0.5959
6	68.5	20.3	80.1	5.52	0.0099	62.3121	8.3600	12.14	7.15E + 04	0.5954

(1) Inches of Hg under water

Testing sensor AT24261 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Fluid	Water
Sensor serial number`	AT24261
Beta ratio	0.40
Pipe size	6 in (152 mm) schedule 40
Pipe inner dimension	6.065 in (154.05 mm)
Test date	June 25, 2003

Figure 3-23: Test results for sensor AT24261 in water

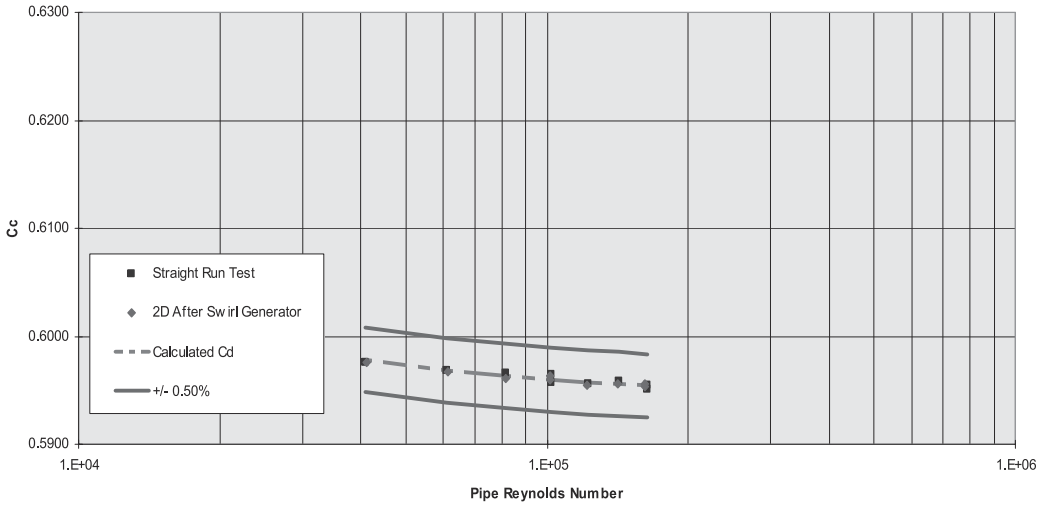


Table 3-49: Water straight run test, sensor serial number AT24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	67.9	19.9	37.0	2.55	1.0033	62.3076	242.929	314.82	1.63E + 04	0.5951
2	67.9	19.9	37.0	2.55	1.0032	62.3076	242.995	315.07	1.63E + 04	0.5955
3	67.9	19.9	37.2	2.57	1.0029	62.3073	184.667	274.84	1.43E + 04	0.5958
4	68.0	20.0	37.6	2.59	1.0025	62.3071	136.368	236.09	1.23E + 04	0.5956

Table 3-49: Water straight run test, sensor serial number AT24261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
5	68.0	20.0	37.9	2.62	1.0019	62.3068	94.751	196.82	1.02E + 04	0.5957
6	68.0	20.0	37.9	2.62	1.0018	62.3067	94.573	196.88	1.02E + 04	0.5964
7	67.8	19.9	35.5	2.45	1.0046	62.3083	60.441	157.43	8.16E + 04	0.5966
8	67.8	19.9	35.9	2.47	1.0046	62.3083	34.000	118.12	6.12E + 04	0.5968
9	67.8	19.9	36.5	2.52	1.0043	62.3081	15.167	78.98	4.09E + 04	0.5975

Table 3-50: Water after swirl generator, sensor serial number AT24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	67.2	19.9	37.0	2.55	1.0122	62.3125	242.519	314.69	1.62E + 05	0.5954
2	67.3	19.9	37.0	2.55	1.0116	62.3121	242.436	314.72	1.62E + 05	0.5955
3	67.4	19.7	37.2	2.57	1.0095	62.3110	185.200	275.12	1.42E + 05	0.5956
4	67.6	19.8	37.7	2.60	1.0072	62.3097	136.328	235.99	1.22E + 05	0.5955
5	67.8	19.9	38.0	2.62	1.0052	62.3087	94.236	196.36	1.02E + 05	0.5960
6	67.8	19.9	38.0	2.62	1.0045	62.3082	94.252	196.50	1.02E + 05	0.5963
7	67.8	19.9	36.2	2.49	1.0048	62.3084	60.524	157.40	8.15E + 04	0.5961
8	67.9	20.0	36.4	2.51	1.0030	62.3074	34.133	118.32	6.14E + 04	0.5967
9	68.0	20.0	36.1	2.49	1.0016	62.3066	15.357	79.49	4.13E + 04	0.5976

3.10 8 x 6-in reduction

Testing sensor A24261 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Fluid	Water
Sensor serial number	A24261
Beta ratio	0.40
Pipe size	6 in (152 mm) schedule 40
Pipe inner dimension	6.065 in (154.05 mm)
Test date	July 8, 2003

Figure 3-24: Test results for sensor A24261 in water

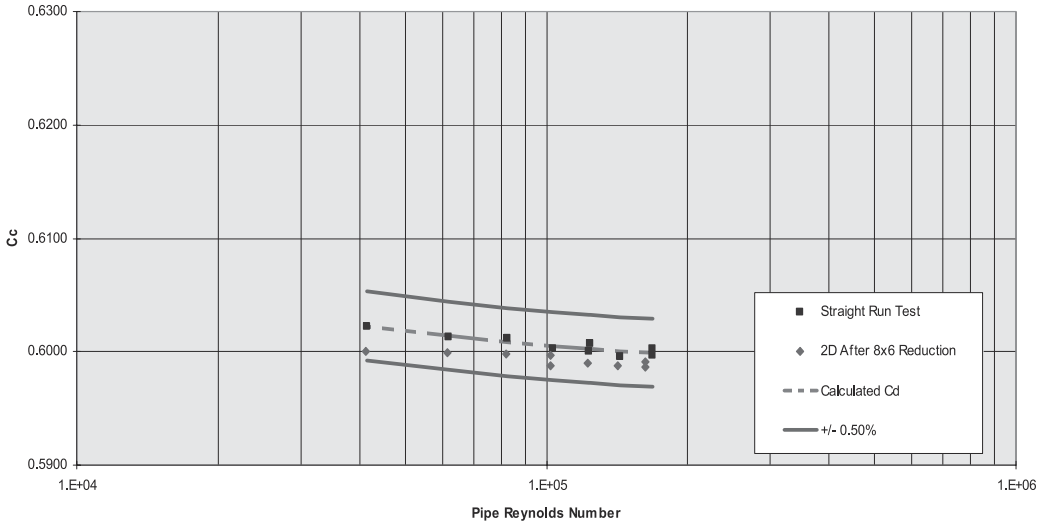


Table 3-51: Water straight run test, sensor serial number A24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	68.1	20.1	37.1	2.56	1.0006	62.3061	252.276	323.31	1.68E + 04	0.5997
2	68.1	20.1	37.1	2.56	1.0007	62.3061	252.559	323.79	1.68E + 04	0.6003
3	68.1	20.1	37.4	2.58	1.0002	62.3059	182.830	275.19	1.43E + 04	0.5996

Table 3-51: Water straight run test, sensor serial number A24261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
4	68.2	20.1	37.7	2.60	1.9997	62.3056	135.598	237.46	1.24E + 04	0.6008
5	68.2	20.1	37.7	2.60	1.9996	62.3055	135.561	237.11	1.23E + 04	0.6000
6	68.2	20.1	37.9	2.62	1.9992	62.3053	94.516	198.09	1.03E + 04	0.6003
7	68.0	20.0	35.8	2.47	1.0018	62.3067	60.437	158.64	8.24E + 04	0.6012
8	68.0	20.0	36.1	2.49	1.0017	62.3067	33.918	118.86	6.18E + 04	0.6013
9	68.0	20.0	36.6	2.52	1.0014	62.3066	15.333	80.04	4.16E + 04	0.6022

Table 3-52: Water after 8 x 6 reduction, sensor serial number A24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
1	67.4	19.7	37.2	2.56	1.0100	62.3113	239.719	314.82	1.62E + 05	0.5991
2	67.5	19.7	37.2	2.57	1.0093	62.3108	239.842	314.69	1.62E + 05	0.5987
3	67.6	19.8	37.6	2.59	1.0069	62.3096	183.478	275.28	1.42E + 05	0.5988
4	67.8	19.9	37.8	2.61	1.0049	62.3085	134.915	236.17	1.22E + 05	0.5990
5	67.9	20.0	38.1	2.63	1.0031	62.3074	93.659	196.70	1.02E + 05	0.5988
6	68.0	20.0	38.1	2.63	1.0024	62.3071	93.596	196.93	1.02E + 05	0.5997
7	68.0	20.0	37.4	2.58	1.0019	62.3068	60.060	157.79	8.20E + 05	0.5999
8	68.1	20.1	37.6	2.60	1.0000	62.3057	33.642	118.11	6.15E + 05	0.5999

Table 3-52: Water after 8 x 6 reduction, sensor serial number A24261 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in Water	USGPM		
9	68.3	20.2	37.9	2.61	1.9981	62.3047	15.175	79.33	4.14E + 05	0.6000

Testing sensor A39421 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Sensor serial number	A39421
Beta ratio	0.65
Pipe size	6 in (152 mm) schedule 40
Pipe inner dimensions	6.065 in (154.05 mm)
Test date	July 3, 2003

Figure 3-25: Test results for sensor A39421 in water

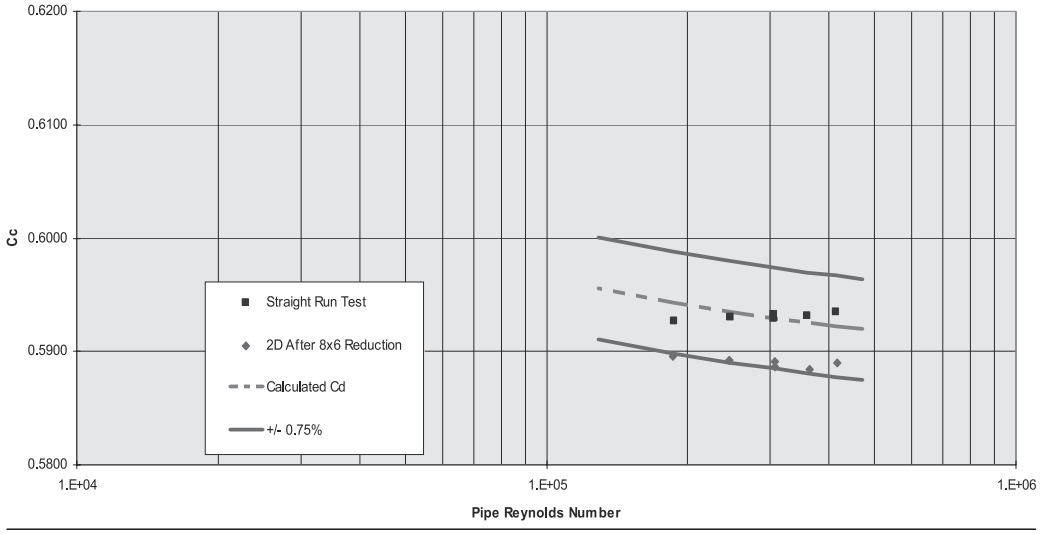


Table 3-53: Water straight run test, sensor serial number A39421

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	67.9	19.9	35.8	2.47	1.0033	62.3076	0.593	799.89	4.15E + 04	0.5935
2	68.0	20.0	36.5	2.51	1.0017	62.3067	0.593	691.96	3.60E + 04	0.5931
3	68.2	20.1	37.0	2.55	0.9997	62.3056	0.593	584.16	3.04E + 04	0.5929
4	68.2	20.1	37.0	2.55	0.9991	62.6052	0.593	583.78	3.04E + 04	0.5932
5	68.4	20.2	37.6	2.59	0.9969	62.3040	0.593	471.89	2.46E + 04	0.5931
6	68.6	20.3	38.3	2.64	0.9944	62.3025	0.593	356.62	1.87E + 04	0.5927

Table 3-54: Water after 8 x 6 reduction, sensor serial number A39421

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	68.5	20.3	35.8	2.47	0.9955	62.3032	191.064	794.40	4.15E + 04	0.5890
2	68.6	20.3	36.4	2.51	0.9945	62.3026	146.954	696.11	3.64E + 04	0.5885
3	68.6	26.0	36.9	2.49	0.9938	62.3022	104.287	586.60	3.07E + 04	0.5887
4	68.6	26.1	36.9	2.53	0.9938	62.3022	104.102	586.56	3.07E + 04	0.5892
5	68.7	26.1	37.6	2.53	0.9929	62.3017	65.934	466.88	2.45E + 04	0.5892
6	68.8	26.1	38.3	2.57	0.9914	62.3008	37.840	353.91	1.86E + 04	0.5896

3.11 Butterfly valve at 75 percent open

Testing sensor 12402 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	12402
Beta ratio	0.60
Pipe size	2 in (51 mm) schedule 40
Pipe inner dimension	2.066 in (52.48 mm)
Test date	April 22, 2002

Figure 3-26: Test results for sensor 12402 in water

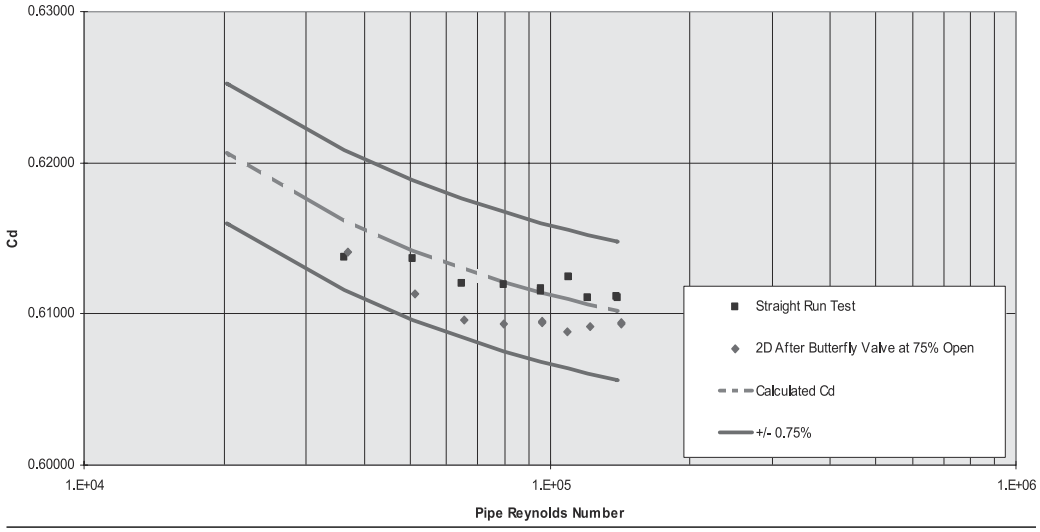


Table 3-55: Water straight run test, sensor serial number 12402

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Dischar ge coeffici ent
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	66.6	19.2	28.2	1.95	1.0215	62.3174	265.761	93.08	1.39E + 05	0.6112
2	66.6	19.2	28.2	1.94	1.0218	62.3175	269.224	93.66	1.40E + 05	0.6110
3	66.6	19.2	28.4	1.96	1.0217	62.3175	200.526	80.84	1.21E + 05	0.6111

Table 3-55: Water straight run test, sensor serial number 12402 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
4	66.6	19.2	28.4	1.96	1.0214	62.3173	165.081	73.51	1.10E + 05	0.6124
5	66.6	19.2	28.5	1.96	1.0210	62.3171	125.494	64.00	9.57E + 04	0.6115
6	66.6	19.2	28.4	1.96	1.0210	62.3171	125.292	63.97	9.57E + 04	0.6117
7	66.6	19.2	28.4	1.96	1.0208	62.3170	86.271	53.10	7.95E + 04	0.6120
8	66.7	19.3	28.4	1.96	1.0197	62.3164	56.759	43.08	6.45E + 04	0.6121
9	66.8	19.4	28.4	1.96	1.0178	62.3154	34.709	33.77	5.07E + 04	0.6136
10	67.0	19.4	28.3	1.95	1.0159	62.3145	17.529	24.01	3.61E + 04	0.6137

Table 3-56: Water after butterfly valve at 75 percent open, sensor serial number 12402

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds Number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	67.3	19.6	28.2	1.95	1.0120	62.3123	273.212	94.11	1.42E + 05	0.6094
2	67.3	19.6	28.2	1.94	1.0121	62.3124	273.273	94.11	1.42E + 05	0.6094
3	67.3	19.6	28.4	1.96	1.0117	62.3122	202.406	80.96	1.22E + 05	0.6091
4	67.3	19.6	28.4	1.96	1.0112	62.3119	161.512	72.28	1.09E + 05	0.6088
5	67.3	19.6	28.5	1.97	1.0112	62.3119	125.685	63.84	9.64E + 04	0.6095
6	67.4	19.6	28.5	1.97	1.0106	62.3116	125.710	63.84	9.65E + 04	0.6095
7	67.4	19.7	28.5	1.96	1.0101	62.3113	85.354	52.60	7.95E + 04	0.6094

Table 3-56: Water after butterfly valve at 75 percent open, sensor serial number 12402 *(continued)*

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds Numbe r	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
8	67.4	19.7	28.4	1.96	1.0101	62.3113	57.501	43.18	6.53E + 04	0.6096
9	67.6	19.8	28.4	1.96	1.0079	62.3101	35.038	33.81	5.12E + 04	0.6113
10	67.7	19.8	28.3	1.95	1.0061	62.3091	17.864	24.25	3.68E + 04	0.6140

Testing sensor A24621 in water

Test laboratory	Rosemount Boulder, Colorado flow lab
Model	Rosemount 1595
Sensor serial number	A24621
Beta ratio	0.40
Pipe size	6 in (152 mm) schedule 40
Pipe inner dimension	6.065 in (154.05 mm)
Test date	October 6, 2003

Figure 3-27: Test results for sensor A24261 in water

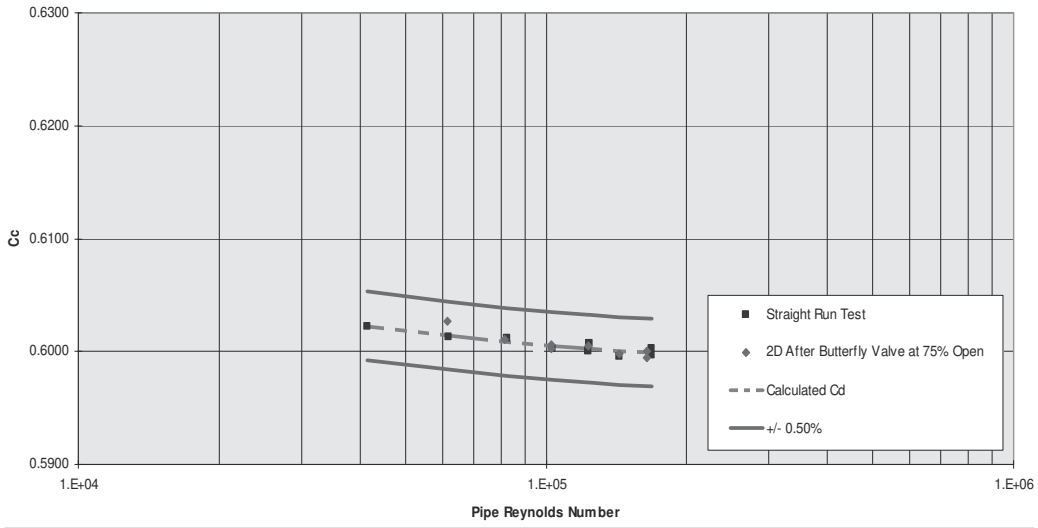


Table 3-57: Water straight run test, sensor serial number A24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	68.1	20.1	37.1	2.56	1.0006	62.3061	252.276	323.31	1.68E + 05	0.5997
2	68.1	20.1	37.1	2.56	1.0007	62.3061	252.559	323.79	1.68E + 05	0.6003
3	68.1	20.1	37.4	2.58	1.0002	62.3059	182.830	275.19	1.43E + 05	0.5996
4	68.2	20.1	37.7	2.60	1.9997	62.3056	135.598	237.46	1.24E + 05	0.6008
5	68.2	20.1	37.7	2.60	1.9996	62.3055	135.561	237.11	1.23E + 04	0.6000
6	68.2	20.1	37.9	2.62	1.9992	62.3053	94.516	198.09	1.03E + 04	0.6003
7	68.0	20.0	35.8	2.47	1.0018	62.3067	60.437	158.64	8.24E + 04	0.6012
8	68.0	20.0	36.1	2.49	1.0017	62.3067	33.918	118.86	6.18E + 04	0.6013
9	68.0	20.0	36.6	2.52	1.0014	62.3066	15.333	80.04	4.16E + 04	0.6022

Table 3-58: Water after butterfly valve at 75 percent open, sensor serial number A24261

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
1	68.4	20.2	36.4	2.51	0.9965	62.3037	238.643	314.20	1.64E + 05	0.5994
2	68.4	20.2	36.4	2.51	0.9965	62.3037	238.600	314.46	1.64E + 05	0.6000
3	68.4	20.2	36.6	2.52	0.9964	62.3037	182.066	274.63	1.43E + 05	0.5999
4	68.4	20.2	36.7	2.53	0.9963	62.3037	133.842	235.71	1.23E + 05	0.6005
5	68.4	20.2	36.9	2.54	0.9961	62.3035	93.363	196.92	1.03E + 04	0.6006

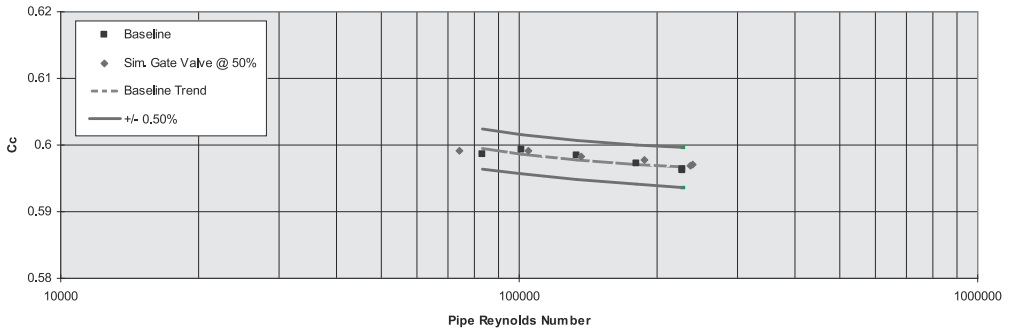
Table 3-58: Water after butterfly valve at 75 percent open, sensor serial number A24261 ***(continued)***

Data point number	Temperature		Pressure		Viscos-ity	Density	Differe n-tial pressur e	Flow rate	Pipe Reynol ds number	Discharge coefficient
	°F	°C	psig	bar	cP	lb/ft^3	in water	USGPM		
6	68.4	20.2	36.9	2.54	0.9961	62.3036	93.286	196.73	1.03E + 04	0.6003
7	68.3	20.2	33.9	2.34	0.9977	62.3045	59.160	156.85	8.18E + 04	0.6010
8	68.3	20.2	34.3	2.37	0.9977	62.3045	33.318	118.03	6.16E + 04	0.6027

3.12 Gate valve

Test laboratory	Rosemount Flow Products, Inc. flow lab
Model	Rosemount 405C
Fluid	Water
Sensor serial number	04D407574
Beta ratio	0.40
Pipe size	4 in (102 mm) schedule 40
Pipe inner dimension	4.026 in (102.26 mm)
Test date	January 23, 2004

Figure 3-28: Gate valve test results for sensor 04D407574



Note
Gate valve was simulated using a segmental orifice plate.

Table 3-59: Water baseline test, sensor serial number 04D407574

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	absolute	lb/ft^3	in Hg(1)	ft^3/min		
1	67.8	19.9	80.4	5.54	0.0101	62.3176	85.511	38.87	2.27E+05	0.5963
2	67.8	19.9	79.8	5.50	0.0100	62.3170	85.291	38.81	2.27E+05	0.5962
3	68.3	20.2	80.1	5.52	0.0100	62.3138	53.319	30.74	1.81E+05	0.5973
4	68.8	20.4	80.1	5.52	0.0099	62.3102	28.605	22.56	1.33E+05	0.5984
5	69.0	20.5	80.2	5.53	0.0099	62.3088	16.386	17.10	1.01E+05	0.5992
6	78.2	25.7	80.4	5.55	0.0088	62.2327	8.6850	12.44	8.31E+04	0.5986

(1) Inches of Hg under water

Table 3-60: Water, simulated gate valve at 50 percent, sensor serial number 04D407574

Data point number	Temperature		Pressure		Viscos-ity	Density	Differen-tial pressure	Flow rate	Pipe Reynolds number	Discharge coefficient
	°F	°C	psig	bar	absolute	lb/ft^3	in Hg[(1)]	ft^3/min		
1	69.7	21.0	79.7	5.50	0.0098	62.3032	87.675	39.40	2.36E + 05	0.5969
2	70.8	21.6	80.1	5.53	0.0096	62.2949	87.678	39.41	2.39E + 05	0.5970
3	71.0	21.6	79.7	5.50	0.0096	62.2939	53.559	30.84	1.88E + 05	0.5978
4	71.1	21.7	80.0	5.52	0.0096	62.2928	28.317	22.44	1.37E + 05	0.5982
5	71.2	21.8	79.7	5.50	0.0096	62.2923	16.527	17.17	1.05E + 05	0.5991
6	71.3	21.8	80.0	5.51	0.0096	62.2913	8.2390	12.12	7.41E + 04	0.5991

(1) Inches of Hg under water.

4 Flow calculations

The Rosemount 405 and 1595 Primary Flow Elements are sized using the Instrument Toolkit™ sizing program. This program provides accurate flow calculations using installation details and fluid properties for the flow meter and presents this on a calculation data sheet or specification sheet.

4.1 Rosemount 405C and 1595 Conditioning Orifice Plate

4.1.1 Calculated values and variables designations

C =	Discharge coefficient
C_C =	Discharge coefficient corrected by calibration factor
d =	Bore diameter corrected for thermal expansion (inches [US units], m [SI units])
d_c =	Calculated bore diameter (inches [US units], m [SI units])
d_{meas} =	Measured typical orifice bore diameter (assumed to be 68 °F (20 °C)). See Table 4-1 or Table 4-2. (inches [US units], m [SI units])
F_C =	Calibration factor (0.750 << F_c << 1.250)
F_S =	Pipe schedule adjustment factor (see Table 4-6 for value)
h_w =	Differential pressure (inwc [US units], Pa[SI units])
ΔP =	Differential pressure (inwc [US units], Pa [SI units])
M_{ID} =	Meter internal diameter corrected for thermal expansion (inches [US units], m [SI units])
$M_{ID_{meas}}$ =	Meter internal ID (assumed to be 68 °F (20 °C)) See Table 4-1. (inches [US units], m [SI units])
P_{ID} =	Pipe internal diameter corrected for thermal expansion (inches [US units], m [SI units])
$P_{ID_{meas}}$ =	Measured ID (assumed to be 68 °F (20 °C)) (inches [US units], m [SI units])
P_1 =	Upstream static pressure (PSI [US units], Pa [SI units])
P_2 =	Downstream static pressure (PSI [US units], Pa [SI units])
q_m =	Mass flow rate (in lbm/s [US units] or kg/s [SI units], a conversion factor must be applied to other units)
R_D =	Pipe Reynolds number
t =	Process temperature (°F [US units], °C [SI units])
t_{meas} =	Temperature at bore / pipe internal diameter measurement (assumed to be 68 °F (20 °C)) (°F [US units], °C [SI units])
Y_1 =	Gas expansion factor
α_P =	Thermal expansion factor of the pipe (in./in./°F [US units], m/m/°C [SI units])

α_{PE} =	Thermal expansion factor of the primary element (in./in./°F [US units], m/m/°C [SI units])
β_c =	Beta ratio using calculated bore diameter
ε_1 =	Gas expansion factor
κ =	Isentropic exponent
μ =	Viscosity (cP [US units], Pa-s [SI units])
ρ =	Density (lbm/ft^3 [US units])
ρ_{F_1} =	Density (kg/m^3 [SI units])

4.1.2 Equations

Figure 4-1: Equation 1: Flow rate equations (ASME MFC-3M and ISO-5167)

US units

$$q_m = 0.09970190 C_c Y_1 d_c^2 \sqrt{\frac{h_w \rho}{1-\beta_c^4}}$$

SI units

$$q_m = \frac{\pi}{4} C_c \varepsilon_1 d_c^2 \sqrt{\frac{2\Delta p \rho_{f_1}}{1-\beta_c^4}}$$

Figure 4-2: Equation 2: Reynolds number equation

US units

$$R_D = \frac{22737.47 q_m}{\mu P_{ID}}$$

SI units

$$R_D = \frac{q_m}{\frac{\pi}{4}\mu P_{ID}}$$

Figure 4-3: Equation 3: Calculated bore size

The calculated bore size is twice the typical hole size (size of one of the four holes).

$d_c = 2d$

Figure 4-4: Equation 4: Beta

$$\beta_c = \frac{d_c}{M_{ID}}$$

Beta is calculated using the meter internal diameter and calculated bore diameter.

Figure 4-5: Thermal expansion corrections

$d_c = [1 + \alpha_{PE}(t - t_{meas})]d_{meas}$

$M_{ID} = [1 + \alpha_{PE}(t - t_{meas})]M_{ID_{meas}}$

$P_{ID} = [1 + \alpha_P(t - t_{meas})]P_{ID_{meas}}$

Figure 4-6: Equation 5: Discharge coefficient equations (ISO-5167)

$$C = 0.5961 + 0.0261\beta_c^2 - 0.216\beta_c^8 + 0.000521\left(\frac{10^6\beta_c}{R_D}\right)^{0.7} + \left(0.0188 + 0.0063\left(\frac{19000\beta_c}{R_D}\right)^{0.8}\right)\beta_c^{3.5}\left(\frac{10^6}{R_D}\right)^{0.3}$$

Rosemount 405C Compact Conditioning Orifice Plate, line sizes 2 in (51 mm) to 8 in (203 mm)

For 2 in (51 mm) models, add this additional term when calculating C:

US units	SI units
$+ 0.011(0.75 - \beta_c)(2.8 - M_{ID})$	$+ 0.011(0.75 - \beta_c)\left(2.8 - \frac{M_{ID}}{25.4}\right)$

Figure 4-7: Equation 6: Discharge coefficient calibration factory adjustment

$C_c = CF_cF_s$

Figure 4-8: Equation 7: Rosemount 1595 Conditioning Orifice Plate line sizes 2 in (51 mm) to 24 in (610 mm)

$$\beta_c = \frac{d_c}{P_{ID}}$$

Beta is calculated using the pipe diameter and calculated bore diameter.

Figure 4-9: Equation 8: Discharge coefficient calibration factory adjustment

$C_c = CF_c$

Figure 4-10: Equation 9: Calculated bore size

$$C = 0.5961 + 0.0261\beta_c^2 - 0.216\beta_c^8 + 0.000521\left(\frac{10^6\beta_c}{R_D}\right)^{0.7} +$$

$$\left(0.0188 + 0.0063\left(\frac{19000\beta_c}{R_D}\right)^{0.8}\right)\beta_c^{3.5}\left(\frac{10^6}{R_D}\right)^{0.3} +$$

$$\left(0.043 + 0.080e^{-10L_1} - 0.123e^{-7L_1}\right)\left(1 - 0.11\left(\frac{19000\beta_c}{R_D}\right)^{0.8}\right)\left(\frac{\beta_c^4}{1-\beta_c^4}\right) -$$

$$0.031(M_2' - 0.8M_2'^{1.1})\beta_c^{1.3}$$

The calculated bore size is twice the typical hole size (size of one of the four holes).

$d_c = 2d$

Where:

US units	SI units
$L_1 = L_2' = \left(\frac{1}{P_{ID}}\right)$	$L_1 = L_2' = \left(\frac{25.4}{P_{ID}}\right)$
$M_2' = \left(\frac{2L_2'}{1-\beta_c}\right)$	

If the 2 in (51 mm) model or pipe internal diameter is less than 2.8 in (71 mm), add this additional term when calculating C:

US units	SI units
$+ 0.011(0.75 - \beta_c)(2.8 - P_{ID})$	$+ 0.011(0.75 - \beta_c)\left(2.8 - \frac{P_{ID}}{25.4}\right)$

Figure 4-11: Equation 10: Gas expansion factor (ISO-5167) equation

US units

$$Y_1 = 1 - (0.351 + 0.256\beta_c^4 + 0.93\beta_c^8)\left[1 - \left(1 - \frac{h_w}{27.73P_1}\right)^{\frac{1}{k}}\right]$$

SI units

$$\varepsilon_1 = 1 - (0.351 + 0.256\beta_c^4 + 0.93\beta_c^8)\left[1 - \left(\frac{P_2}{P_1}\right)^{\frac{1}{k}}\right]$$

4.2 Rosemount 405P Compact Orifice Plate

4.2.1 Calculated values and variables designations

C_d =	Discharge coefficient
C_S =	Discharge coefficient corrected by pipe schedule adjustment factor
d =	Bore diameter corrected for thermal expansion (inches [US units], m [SI units])
d_{meas} =	Measured typical orifice bore diameter (assumed to be 68 °F (20 °C)). See Table 4-1 or Table 4-2. (inches [US units], m [SI units])
F_s =	Pipe schedule adjustment factor (see Table 4-5 for value)
h_w =	Differential pressure (inwc [US units], Pa[SI units])
ΔP =	Differential pressure (inwc [US units], Pa[SI units])
M_{ID} =	Meter internal diameter corrected for thermal expansion (inches [US units], m [SI units])
$M_{ID_{meas}}$ =	Meter internal ID (assumed to be 68 °F (20 °C)) See Table 4-1. (inches [US units], m [SI units])
P_{ID} =	Pipe internal diameter corrected for thermal expansion (inches [US units], m [SI units])
$P_{ID_{meas}}$ =	Measured ID (assumed to be 68 °F) (inches [US units], m [SI units])
P_1 =	Upstream static pressure (PSI [US units], Pa [SI units])
P_2 =	Downstream static pressure (PSI [US units], Pa [SI units])
q_m =	Mass flow rate (in lbm/s [US units] or kg/s [SI units], a conversion factor must be applied to other units)
R_D =	Pipe Reynolds number
t =	Process temperature (°F [US units], °C [SI units])
t_{meas} =	Temperature at bore / pipe internal diameter measurement (assumed to be 68 °F (20 °C)) (°F [US units], °C [SI units])
Y_1 =	Gas expansion factor
α_P =	Thermal expansion factor of the pipe (in./in./°F [US units], m/m/°C [SI units])
α_{PE} =	Thermal expansion factor of the primary element (in./in./°F [US units], m/m/°C [SI units])
β =	Beta ratio
ε_1 =	Gas expansion factor
κ =	Isentropic exponent
μ =	Viscosity (cP [US units], Pa-s [SI units])
ρ =	Density (lbm/ft^3 [US units])
ρ_{F_1} =	Density (kg/m^3 [SI units])

A, B, C, D, E, F, G, H, I, J	See ½, 1, 1½ discharge coefficient table of coefficients
A, B, C, D, E, F	See effective beta table of coefficients

4.2.2 Equations

Figure 4-12: Equation 11: Flow rate equations (ASME MFC-3M and ISO-5167)

US units

$$q_m = 0.09970190 C_S Y_1 d^2 \sqrt{\frac{h_w \rho}{1-\beta^4}}$$

SI units

$$q_m = \frac{\pi}{4} C_S \varepsilon_1 d^2 \sqrt{\frac{2\Delta p \rho_{f_1}}{1-\beta^4}}$$

Figure 4-13: Equation 12: Reynolds number equation

US units

$$R_D = \frac{22737.47 q_m}{\mu P_{ID}}$$

SI units

$$R_D = \frac{q_m}{\frac{\pi}{4}\mu P_{ID}}$$

Figure 4-14: Thermal expansion corrections

$d = [1 + \alpha_{PE}(t - t_{meas})]d_{meas}$

$M_{ID} = [1 + \alpha_{PE}(t - t_{meas})]M_{ID_{meas}}$

$P_{ID} = [1 + \alpha_P(t - t_{meas})]P_{ID_{meas}}$

Figure 4-15: Equation 13: Discharge coefficient equations (ISO-5167)

$$C_d = A\beta^4 + B\beta^3 + C\beta^2 + D\beta + E + \frac{F\beta^4 + G\beta^3 + H\beta^2 + I\beta + J}{\sqrt{\frac{R_D}{\beta}}}$$

Line sizes 0.5 in (13 mm), 1 in (25 mm), and 1.5 in (38 mm)

Figure 4-16: Equation 14

Line sizes 0.5 in (13 mm), 1 in (25 mm), and 1.5 in (38 mm)

$C_S = C_d F_S$

Figure 4-17: Equation 15

$$C_d = 0.5959 + 0.0312\beta^{2.1} - 0.184\beta^8 + \frac{91.706\beta^{2.5}}{R_D^{0.75}}$$

Line sizes 2 in (51 mm), 3 in (76 mm), 4 in (102 mm), 6 in (152 mm), and8 in (203 mm)

Figure 4-18: Equation 16

Line sizes 2 in (51 mm), 3 in (76 mm), 4 in (102 mm), 6 in (152 mm), and8 in (203 mm)

$C_S = C_d F_S$

Figure 4-19: Equation 17: Gas expansion factor (ISO-5167) equation

US units

$$Y_1 = 1 - (0.351 + 0.256\beta^4 + 0.93\beta^8)\left[1 - \left(1 - \frac{h_w}{27.73P_1}\right)^{\frac{1}{k}}\right]$$

SI units

$$\varepsilon_1 = 1 - (0.351 + 0.256\beta^4 + 0.93\beta^8)\left[1 - \left(\frac{P_2}{P_1}\right)^{\frac{1}{k}}\right]$$

4.3 Flow calculation tables

Table 4-1: Rosemount 405C nominal meter inside diameter and typical orifice hole size

Line size	Beta ratio (β)	Meter inside diameter	Typical orifice hole size
2 in (51 mm)	0.40	2.067 in (52.5 mm)	0.413 in (10.5 mm)
	0.50	2.067 in (52.5 mm)	0.517 in (13.13 mm)
	0.60	2.067 in (52.5 mm)	0.62 in (15.7 mm)
3 in (76 mm)	0.40	3.068 in (77.9 mm)	0.614 in (15.6 mm)
	0.50	3.068 in (77.9 mm)	0.767 in (19.48 mm)
	0.65	3.068 in (77.9 mm)	0.997 in (25.3 mm)
4 in (102 mm)	0.40	4.026 in (102.3 mm)	0.805 in (20.4 mm)
	0.50	4.026 in (102.3 mm)	1.007 in (25.58 mm)
	0.65	4.026 in (102.3 mm)	1.309 in (33.2 mm)
6 in (152 mm)	0.40	6.065 in (154.1 mm)	1.213 in (30.8 mm)
	0.50	6.065 in (154.1 mm)	1.516 in (38.51 mm)
	0.65	6.065 in (154.1 mm)	1.971 in (50.1 mm)

Table 4-1: Rosemount 405C nominal meter inside diameter and typical orifice hole size *(continued)*

Line size	Beta ratio (β)	Meter inside diameter	Typical orifice hole size
8 in (203 mm)	0.40	7.981 in (202.7 mm)	1.596 in (40.5 mm)
	0.50	7.981 in (202.7 mm)	1.995 in (50.67 mm)
	0.65	7.981 in (202.7 mm)	2.594 in (65.9 mm)
10 in (254 mm)	0.40	10.02 in (254.5 mm)	2.004 in (50.9 mm)
	0.50	10.02 in (254.5 mm)	2.505 in (63.63 mm)
	0.65	10.02 in (254.5 mm)	3.257 in (82.73 mm)
12 in (305 mm)	0.40	12 in (305 mm)	2.4 in (60.96 mm)
	0.50	12 in (305 mm)	3 in (76.2 mm)
	0.65	12 in (305 mm)	3.9 in (99.06 mm)

Table 4-2: Rosemount 1595 typical orifice hole size

Line size	Beta ratio (β)	Typical orifice hole size
2 in (51 mm)	0.40	0.413 in (10.5 mm)
	0.50	0.517 in (13.13 mm)
	0.60	0.62 in (15.7 mm)
3 in (76 mm)	0.40	0.614 in (15.6 mm)
	0.50	0.767 in (19.48 mm)
	0.65	0.997 in (25.3 mm)
4 in (102 mm)	0.40	0.805 in (20.4 mm)
	0.50	1.007 in (25.58 mm)
	0.65	1.309 in (33.2 mm)
6 in (152 mm)	0.40	1.213 in (30.8 mm)
	0.50	1.516 in (38.51 mm)
	0.65	1.971 in (50.1 mm)
8 in (203 mm)	0.40	1.596 in (40.5 mm)
	0.50	1.995 in (50.67 mm)
	0.65	2.594 in (65.9 mm)
10 in (254 mm)	0.40	2.004 in (50.9 mm)
	0.50	2.505 in (63.63 mm)
	0.65	3.257 in (82.7 mm)
12 in (305 mm)	0.40	2.4 in (61 mm)
	0.50	3 in (76 mm)
	0.65	3.9 in (99 mm)

Table 4-2: Rosemount 1595 typical orifice hole size *(continued)*

Line size	Beta ratio (β)	Typical orifice hole size
14 in (356 mm)	0.40	2.625 in (66.7 mm)
	0.50	3.281 in (83.34 mm)
	0.65	4.265 in (108.3 mm)
16 in (406 mm)	0.40	3 in (76 mm)
	0.50	3.75 in (95.2 mm)
	0.65	4.875 in (123.8 mm)
18 in (457 mm)	0.40	3.375 in (85.7 mm)
	0.50	4.219 in (107.16 mm)
	0.65	5.485 in (139.3 mm)
20 in (508 mm)	0.40	3.762 in (95.6 mm)
	0.50	3.762 in (95.6 mm)
	0.65	6.114 in (155.3 mm)
24 in (610 mm)	0.40	4.525 in (114.9 mm)
	0.50	5.656 in (143.66 mm)
	0.65	7.353 in (186.8 mm)

Table 4-3: Rosemount 405P nominal inside diameter and orifice bore diameter

Line size	Beta ratio (β)	Meter inside diameter	Typical orifice hole size
0.5 in (13 mm)	0.40	0.622 in (15.8 mm)	0.249 in (6.3 mm)
	0.50	0.622 in (15.8 mm)	0.311 in (7.90 mm)
	0.65	0.622 in (15.8 mm)	0.404 in (10.3 mm)
1 in (25 mm)	0.40	1.049 in (26.6 mm)	0.42 in (10.7 mm)
	0.50	1.049 in (26.6 mm)	0.525 in (13.33 mm)
	0.65	1.049 in (26.6 mm)	0.682 in (17.3 mm)
1.5 in (38 mm)	0.40	1.61 in (40.9 mm)	0.644 in (16.4 mm)
	0.50	1.61 in (40.9 mm)	0.805 in (20.45 mm)
	0.65	1.61 in (40.9 mm)	1.047 in (26.6 mm)
2 in (51 mm)	0.40	2.067 in (52.5 mm)	0.827 in (21.0 mm)
	0.50	2.067 in (52.5 mm)	1.034 in (26.26 mm)
	0.65	2.067 in (52.5 mm)	1.344 in (34.1 mm)
3 in (76 mm)	0.40	3.068 in (77.9 mm)	1.227 in (31.2 mm)
	0.50	3.068 in (77.9 mm)	1.534 in (38.96 mm)
	0.65	3.068 in (77.9 mm)	1.994 in (50.6 mm)
4 in (102 mm)	0.40	4.026 in (102.3 mm)	1.61 in (40.9 mm)

Table 4-3: Rosemount 405P nominal inside diameter and orifice bore diameter *(continued)*

Line size	Beta ratio (β)	Meter inside diameter	Typical orifice hole size
	0.50	4.026 in (102.3 mm)	2.013 in (51.13 mm)
	0.65	4.026 in (102.3 mm)	2.617 in (66.5 mm)
6 in (152 mm)	0.40	6.065 in (154.1 mm)	2.426 in (61.6 mm)
	0.50	6.065 in (154.1 mm)	3.033 in (77.04 mm)
	0.65	6.065 in (154.1 mm)	3.942 in (100.1 mm)
8 in (203 mm)	0.40	7.981 in (202.7 mm)	3.192 in (81.1 mm)
	0.50	7.981 in (202.7 mm)	3.991 in (101.37 mm)
	0.65	7.981 in (202.7 mm)	5.188 in (131.8 mm)

Table 4-4: Coefficients for determination of 0.5 in (13 mm), 1 in (25 mm), and 1.5 in (38 mm) Cd

	A	B	C	D	E
D = 0.5 in (13 mm)	2.854437	-3.378356	1.205753	-0.07817863	0.5884229
D = 1 in (25 mm)	0.07300363	-0.346828	0.2588337	-0.03890471	0.595342
D = 1.5 in (38 mm)	-0.3459831	0.040353	0.2830634	-0.1111218	0.6051001
	F	**G**	**H**	**I**	**J**
D = 0.5 in (13 mm)	52.11968	-77.01062	56.26178	-17.54468	3.146987
D = 1 in (25 mm)	6.377415	12.17111	-6.079081	0.6620094	1.408031
D = 1.5 in (38 mm)	89.79559	-124.0909	66.42804	-13.71296	2.337983

Table 4-5: Rosemount 405P pipe adjustment factors

Pipe size	Beta ratio (β)	Schedule 10 (F_s)	Schedule 40 (F_s)	Schedule 80 (F_s)
0.5 in (13 mm)	0.40	1.0148	1.0208	1.0299
	0.50	0.9899	0.9921	1.0271
	0.65	0.9540	0.9768	1.0112
1 in (25 mm)	0.40	1.0139	1.0188	1.0287
	0.50	1.0186	1.0151	1.0302
	0.65	1.0143	1.0339	1.0737
1.5 in (38 mm)	0.40	1.0103	1.0163	1.0262
	0.50	0.9959	1.0075	1.0253
	0.65	1.0038	1.0288	1.0702
2-in. (50.8 mm)	0.40	1.0058	1.0097	1.0157
	0.50	0.9934	1.0000	1.0094

Table 4-5: Rosemount 405P pipe adjustment factors *(continued)*

Pipe size	Beta ratio (β)	Schedule 10 (F_s)	Schedule 40 (F_s)	Schedule 80 (F_s)
	0.65	0.9915	1.0163	1.0553
3 in (76 mm)	0.40	1.0026	1.0083	1.0141
	0.50	0.9911	1.0000	1.0078
	0.65	0.9793	1.0133	1.0496
4 in (102 mm)	0.40	1.0034	1.0073	1.0118
	0.50	0.9878	1.0000	1.0104
	0.65	0.9896	1.0106	1.0368
6 in (152 mm)	0.40	0.9988	1.0027	1.0052
	0.50	0.9918	1.0000	1.0085
	0.65	0.9819	0.993	1.0178
8 in (203 mm)	0.40	0.9970	0.990	1.0036
	0.50	0.9911	1.000	1.0091
	0.65	0.9833	0.9937	1.0212
10 in (254 mm)	0.40	0.9960	0.9999	1.0052
	0.50	0.9911	1.0000	1.0085
	0.65	0.9764	0.9968	1.0178
12 in (305 mm)	0.40	0.9950	0.9979	1.0036
	0.50	0.9943	1.0000	1.0091
	0.65	0.9740	0.9908	1.0212

Table 4-6: Rosemount 405C pipe adjustment factors

Pipe size	Beta ratio (β)	Schedule 10 (F_s)	Schedule 40 (F_s)	Schedule 80 (F_s)
2 in (51 mm)	0.40	0.9984	1.0000	1.0077
	0.50	0.9957	1.0000	1.0062
	0.60	0.9950	1.0000	1.0165
3 in (76 mm)	0.40	0.9960	1.0000	1.0050
	0.50	0.9980	1.0000	1.0018
	0.65	0.9927	1.0000	1.0033
4 in (102 mm)	0.40	0.9965	1.0000	1.0064
	0.50	0.9955	1.0000	1.0038
	0.65	0.9945	1.0000	1.0052
6 in (152 mm)	0.40	0.9973	0.9999	1.0021
	0.50	0.9975	1.0000	1.0026
	0.65	0.9896	1.0001	1.0095

Table 4-6: Rosemount 405C pipe adjustment factors *(continued)*

Pipe size	Beta ratio (β)	Schedule 10 (F_s)	Schedule 40 (F_s)	Schedule 80 (F_s)
8 in (203 mm)	0.40	0.9984	1.0003	1.0016
	0.50	0.9974	1.0000	1.0026
	0.65	0.9836	0.9998	1.0048
10 in (254 mm)	0.40	0.9989	1.0003	1.0010
	0.50	0.9978	1.0000	1.0015
	0.65	0.9980	0.9997	1.0032
12 in (305 mm)	0.40	0.9985	1.0001	0.9967
	0.50	0.9983	1.0000	1.0043
	0.65	0.9871	0.9997	0.9845

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