

00809-0100-4810  
English  
Rev. AA  
EC003086

# Model 405P Compact Orifice



**ROSEMOUNT®**

  
**EMERSON**  
Process Management



## Model 405P Compact Orifice

### NOTICE

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

Within the United States, Rosemount Inc. has two toll-free assistance numbers:

**Customer Central**

Technical support, quoting, and order-related questions.

1-800-999-9307 (7:00 am to 7:00 pm CST)

**North American Response Center**

Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local Rosemount representative.

### ⚠ CAUTION

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 Rosemount Sales Representative.

*Rosemount and the Rosemount logotype are registered trademarks of Rosemount Inc.*

*CoPlanar is a trademark of Rosemount Inc.*

*Adobe and Acrobat are trademarks of Adobe Systems Inc.*

*AutoCAD is a registered trademark of Autodesk, Inc.*

*Inconel is a registered trademark of International Nickel Co.*

*Teflon is a registered trademark of E.I. du Pont de Nemours & Co.*

*All other marks are the property of their respective owners.*

COVER PHOTO: 405P\_405PH0102



---

# Table of Contents

## SECTION 1 Introduction

Using this Manual . . . . .	1-1
Inspection Upon Delivery . . . . .	1-1
Return of Materials . . . . .	1-2

## SECTION 2 Installation

Safety Messages . . . . .	2-1
Warnings . . . . .	2-1
Considerations . . . . .	2-2
Environmental . . . . .	2-2
Functional Limitations . . . . .	2-2
Straight Run Requirements . . . . .	2-2
Location and Orientation . . . . .	2-3
Bolting a transmitter to the Model 405P . . . . .	2-3
Direct Mount Installation . . . . .	2-4
Gas in Horizontal Pipes . . . . .	2-4
Liquid or Steam in Horizontal Pipes . . . . .	2-4
Liquid in Vertical Pipes . . . . .	2-5
Gas in Vertical Pipes . . . . .	2-5
Remote Mount Installation . . . . .	2-6
Gas in Vertical or Horizontal Pipes . . . . .	2-6
Liquid or Steam in Vertical or Horizontal Pipes . . . . .	2-6
Process Connections (Remote Mount Only) . . . . .	2-7
High Temperature Units (Option Code T) . . . . .	2-7
Installation . . . . .	2-8

## SECTION 3 Configuration

Safety Messages . . . . .	3-1
Warnings . . . . .	3-1
Direct Mount Applications . . . . .	3-2
Liquid Service . . . . .	3-2
Gas Service . . . . .	3-3
Steam Service . . . . .	3-4
Remote Mount Applications . . . . .	3-5
Steam Service . . . . .	3-5
Gas Service . . . . .	3-6
Liquid Service . . . . .	3-7

## SECTION 4 Troubleshooting

Safety Messages . . . . .	4-1
Warnings . . . . .	4-1
Troubleshooting . . . . .	4-1
Check Flow Direction . . . . .	4-1
Check Orientation . . . . .	4-1
Check Zero . . . . .	4-1
Check Valves . . . . .	4-1
Check Configuration/Scaling . . . . .	4-1
Check Model 3095MV Configuration . . . . .	4-2

## APPENDIX A Reference Data

Specifications . . . . .	A-1
Functional . . . . .	A-1
Physical . . . . .	A-1

---

Performance . . . . .	A-3
Dimensional Drawings . . . . .	A-5
Ordering Information . . . . .	A-6
Spare Parts. . . . .	A-7

# Introduction

---

Using this Manual .....	page 1-1
Inspection Upon Delivery .....	page 1-1
Return of Materials .....	page 1-2

---

## USING THIS MANUAL

This product manual provides installation, commissioning, and troubleshooting instructions for the Model 405P flow element.

### Section 2: Installation

### Section 3: Configuration

### Section 4: Troubleshooting

### Appendix A: Reference Data

## INSPECTION UPON DELIVERY

Upon receipt of the shipment, check the packing list against the material received and the purchase order. A XXX in the model code on the purchase order would be replaced with either a 040 or a 065 on the packing list depending on the outcome of the bore size calculation. All items are tagged with a model number, serial number, and customer tag number.

Unless the Configuration Data Sheet (CDS) specified “Default Configuration,” a flow calculation should be included in the box. This calculation includes the process conditions, sizing, and relates the differential pressure induced across the primary for minimum, normal, and maximum flow rates.

Inspect the orifice edge to ensure no damage occurred during shipment. Report any damage to the carrier

---

### NOTE

Do not hold the Model 405P by the orifice plate bore when carrying. The edge of the plate could be inadvertently damaged.

---

## **RETURN OF MATERIALS**

To expedite the return process outside the United States, contact the nearest Rosemount representative.

Within the United States, call the Rosemount National Response Center using 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you. The center will ask for the product model, serial numbers, and what material the product was last exposed. The Rosemount National Response Center will detail the additional information and procedures necessary to return products exposed to hazardous substances.

---

### **CAUTION**

People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned products.

---



<b>Safety Messages</b> .....	<b>page 2-1</b>
<b>Considerations</b> .....	<b>page 2-2</b>
<b>Functional Limitations</b> .....	<b>page 2-2</b>
<b>Location and Orientation</b> .....	<b>page 2-3</b>
<b>Installation</b> .....	<b>page 2-8</b>

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

### Warnings

#### WARNING

**Failure to follow these installation guidelines could result in death or serious injury.**

Failure to install proper flange adapter o-rings can cause process leaks, which can result in death or serious injury.

The body, valves, and vents of the Model 405P Compact Orifice may become hot when used in high temperature processes or cold when used in low temperature processes. Operators should take appropriate measures to protect themselves when servicing the Model 405P in high or low temperature processes.

Opening drain/vents will release process fluid to the atmosphere. Operators should take appropriate safety measures to ensure safe venting.

Check the Model 405P materials of construction for compatibility with the intended process fluid.

The process should be isolated and vented before the Model 405P is removed.

If the isolating diaphragms of the associated transmitter are accessible at any time, take care not to damage them. Damage to the isolating diaphragms may lead to inaccurate measurement.

Make sure only qualified personnel perform the installation.

Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed with intrinsically safe or non-incendive field wiring practices.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous location certifications.

Both transmitter covers must be fully engaged to meet explosion-proof requirements

## CONSIDERATIONS

### Environmental

Location of the Model 405P in pulsating flow will cause a noisy signal. Vibration can also distort the output signal and compromise the structural limits of the flowmeter. Mount the Model 405P in a secure run of pipe as far as possible from pulsation sources such as check valves, reciprocating compressors or pumps, and control valves.

Mount the transmitter to minimize ambient temperature changes. Mount the transmitter to avoid vibration, mechanical shock, and external contact with corrosive materials.

---

#### WARNING

Drain/vents must be oriented so that process fluid is directed away from technicians when the valves are used.

---

### FUNCTIONAL LIMITATIONS

The Model 405P produces the most accurate and repeatable measurement when it is used in single-phase flow or steam flow above the saturation temperature.

Install the Model 405P in the correct location within the piping branch to prevent measurement inaccuracies caused by flow disturbances.

Maximum temperature for direct mount applications is 450 °F (232 °C). Maximum temperature for remote mount applications is 850 °F (454 °C).

### Straight Run Requirements

Use Table A-2 on page A-3 to determine the proper straight run requirements for the Model 405P.

---

#### NOTE

If longer lengths of straight run are available, position the Model 405P where 80% of the run is upstream of the Model 405P and 20% is downstream. Flow conditioners may be used to reduce required straight run length and improve performance.

---

---

## LOCATION AND ORIENTATION

The Model 405P has two mounting methods:

- integral mount (or direct mount)
- remote mount.

An integrally mounted Model 405P may be shipped with the transmitter already bolted directly to the sensor.

## Bolting a transmitter to the Model 405P

If the Model 405P is ordered separately from the Models 3051, or 3095MV transmitter and will be used in a direct mount configuration, it will need to be assembled to the transmitter. Follow the directions below to assemble the Model 405P to a transmitter with a coplanar configuration.

---

### NOTE

Units shipped from the factory direct mounted are pressure tested and characterized with the primary attached. Factory assembly is recommended for best performance.

---

- ⚠ 1. Remove the body bolts (4) from the transmitter.
2. Remove the socket head cap screws from the bottom of the coplanar flange and remove the coplanar flange.

---

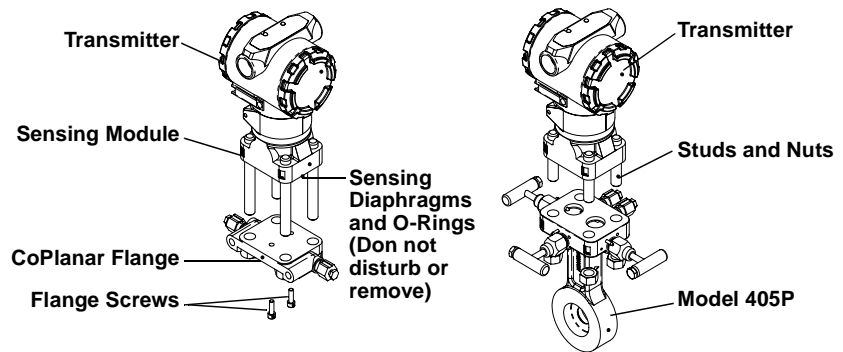
### NOTE

Protect the transmitter sensing diaphragms and do not remove the o-rings in transmitter sensor module.

---

3. Carefully assemble the Model 405P to the pressure transmitter sensor making sure the “H” and “L” on transmitter and primary match.
4. Use studs and nuts supplied with the Model 405P to connect the transmitter sensor to the manifold head of the Model 405P.
5. Preload to 150 in./lbs then final torque at 300 in./lbs.

Figure 2-1. Bolting the Model 405P to a transmitter



405P\_81-49312-999

## Direct Mount Installation

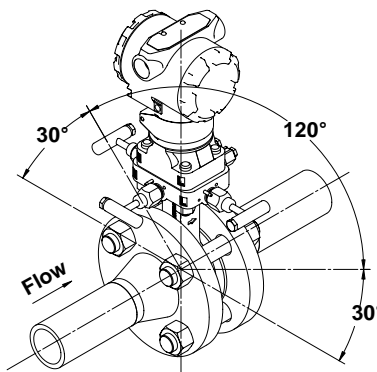
### NOTE

The maximum acceptable temperature for direct mounting is 450 °F (232 °). Refer to “Remote Mount Installation” on page 2-6 if the process could potentially exceed this temperature.

### ⚠ Gas in Horizontal Pipes

The Model 405P should be mounted above the pipe to ensure that condensate does not collect on the transmitter sensing diaphragms. Orient the unit within the 120° recommended zone as shown in Figure 2-2.

Figure 2-2. Direct Mount Gas in Horizontal Pipes

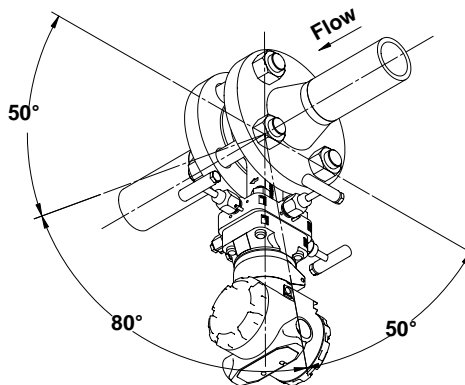


405P\_405A4930A

### ⚠ Liquid or Steam in Horizontal Pipes

The Model 405P should be mounted below the pipe to ensure that gases do not collect on the transmitter sensing diaphragms. Orient the unit within the 80° recommended zone as shown in Figure 2-3.

Figure 2-3. Direct Mount Liquid or Steam in Horizontal Pipes



405P\_405A4931A

---

**⚠ Liquid in Vertical Pipes**

The Model 405P should be mounted with the vents on top to allow gas to be bled off.

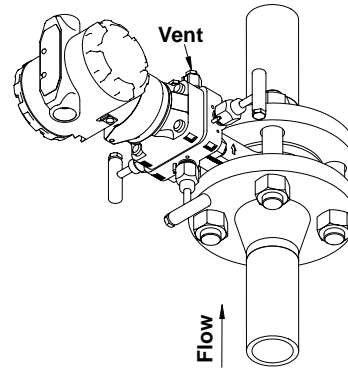
---

**NOTE**

The Model 405P should not be used in vertical liquid or steam applications if the fluid is flowing down.

---

Figure 2-4. Direct Mount Liquid in Vertical Pipes



405P\_405A4932A

**⚠ Gas in Vertical Pipes**

The Model 405P should be mounted with vents on bottom to allow condensate drainage.

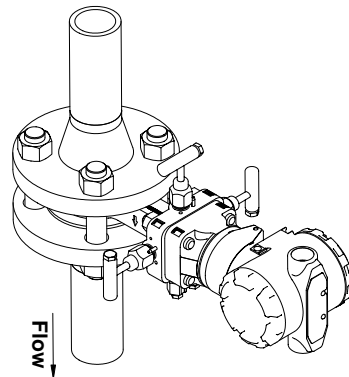
---

**NOTE**

Due to drain vent orientation, a direct mount Model 405P should not be used in vertical gas applications if the fluid is flowing up. Consider remote mounting the pressure transmitter to facilitate condensate draining.

---

Figure 2-5. Direct Mount Gas in Vertical Pipes

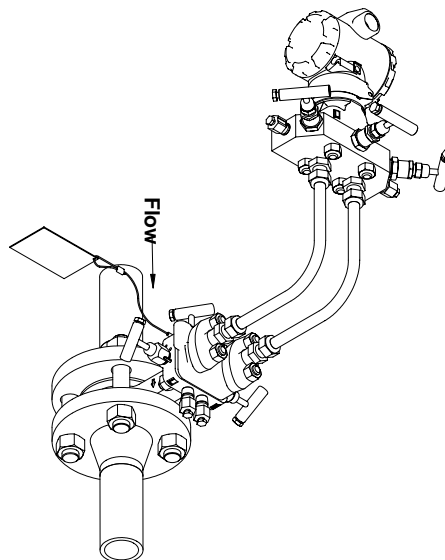


405P\_405A4933A

## Remote Mount Installation Gas in Vertical or Horizontal Pipes

Mount the transmitter above the Model 405P with the instrument lines sloping down.

Figure 2-6. Remote Mount Gas in Vertical or Horizontal Pipes



405P\_405A4934A

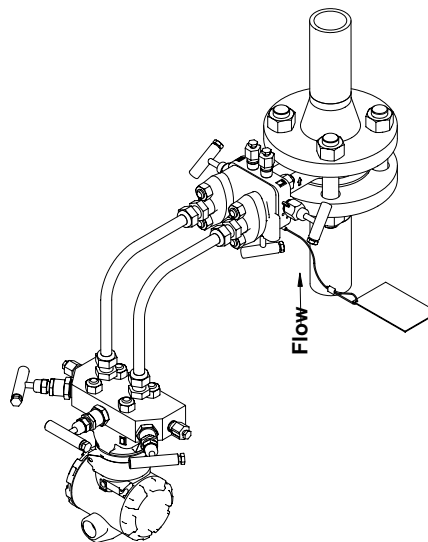
## Liquid or Steam in Vertical or Horizontal Pipes

Mount the transmitter below the Model 405P with the instrument lines sloping up.

### NOTE

The Model 405P should not be used in vertical liquid or steam applications if the fluid is flowing down.

Figure 2-7. Remote Mount Liquid in Vertical or Horizontal Pipes



405P\_405A4934A

## Process Connections (Remote Mount Only)

The Model 405P is available with either ¼-in. – 18 NPT connections (standard) or ½-in. – 14 NPT connections (option code E). The ½-in. connections can be rotated to attain connection centers of 2-in. (51 mm), 2 ⅛-in. (54 mm), or 2 ¼-in. (57 mm). The threads are Class 2; use a lubricant or sealant when making the process connections.

Ensure all four flange studs are installed and tightened prior to applying pressure to prevent process leakage. When properly installed, the flange studs will protrude through the top of the module housing.

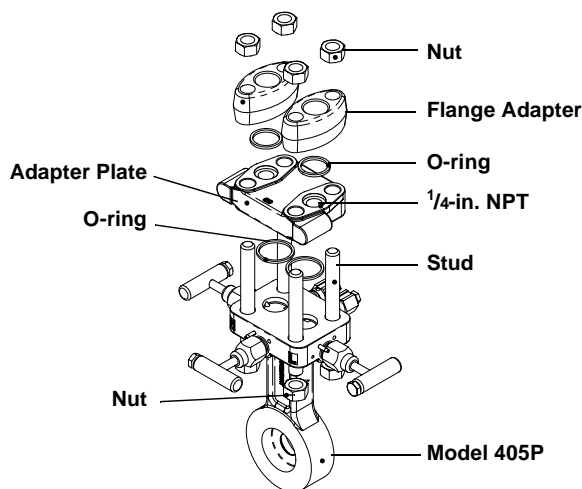
### NOTE

Do not attempt to loosen or remove the flange studs while the Model 405P is in service.

Perform the following procedure to install flange adapters to the head of the Model 405P.

- ⚠ 1. Place o-ring in the groove on bottom of the flange adapter.
2. Position flange adapters over NPT connections on the adapter plate.
3. Insert studs through Model 405P head, adapter plate, and flange adapters.
4. Thread nuts onto studs. Tighten nuts to 300 in-lbs. (34 N-m).

Figure 2-8. Installing the Flange Adapters to a Model 405P



When compressed, Teflon® (PTFE) o-rings tend to cold flow, which aids in their sealing capabilities. Whenever you remove adapter plate or adapters, visually inspect the Teflon o-rings. Replace them if there are any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them. If you replace the o-rings, retorque the nuts after installation to compensate for cold flow.

### High Temperature Units (Option Code T)

- ⚠ Inconel® o-rings should be replaced any time the unit is disassembled.

405P\_81-49313-999

## INSTALLATION

Install the Model 405P according to the procedure below.

- ⚠ 1. Orient the assembly according to the guidelines provided in “Location and Orientation” on page 2-3. Ensure that the flow arrow is pointing in the same direction as the process flow.
2. Insert two studs through the flange holes located opposite the head of the Model 405P
3. Place the alignment ring on the Model 405P body (see Figure 2-9).
4. Insert gaskets.

### NOTE

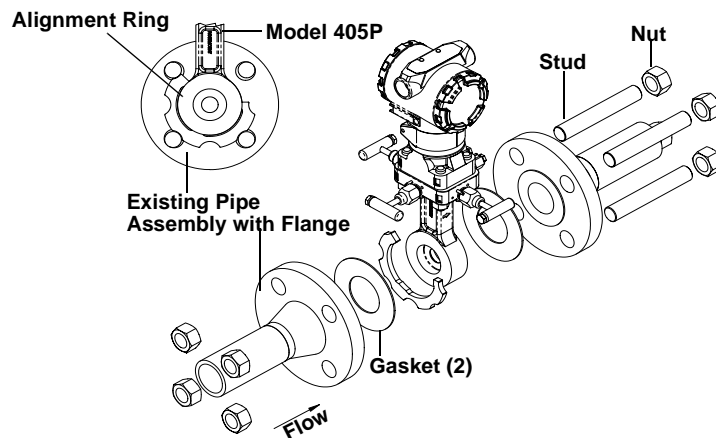
For ease of installation, the gasket may be secured to the flange face with small pieces of tape. Be sure the gasket and/or tape do not protrude into the pipe.

5. Insert the Model 405P between the flanges so that the indentations on the alignment ring contact the installed studs. The studs must contact the alignment ring in the indentation marked with the appropriate flange rating to ensure proper alignment.
6. Install remaining studs and nuts (hand tight). Ensure that three of the studs are in contact with the alignment ring.
7. Lubricate studs and tighten nuts in a cross pattern to the appropriate torque per local standards.

### NOTE

Standard fiber gaskets are recommended for use with the Model 405P. Using other gaskets could potentially caused a bias shift in the measurement.

Figure 2-9. Model 405P Installation



405P\_405A4935A



<b>Safety Messages</b> .....	<b>page 3-1</b>
<b>Direct Mount Applications</b> .....	<b>page 3-2</b>
<b>Remote Mount Applications</b> .....	<b>page 3-5</b>

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

### Warnings

#### **WARNING**

**Failure to follow these installation guidelines could result in death or serious injury.**

- Make sure only qualified personnel perform the installation.
- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous location certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements
- If the line is pressurized, serious injury or death could occur by opening valves.
- Opening drain/vents will release process fluids to the atmosphere. Operators should take appropriate safety measures to ensure safe venting.

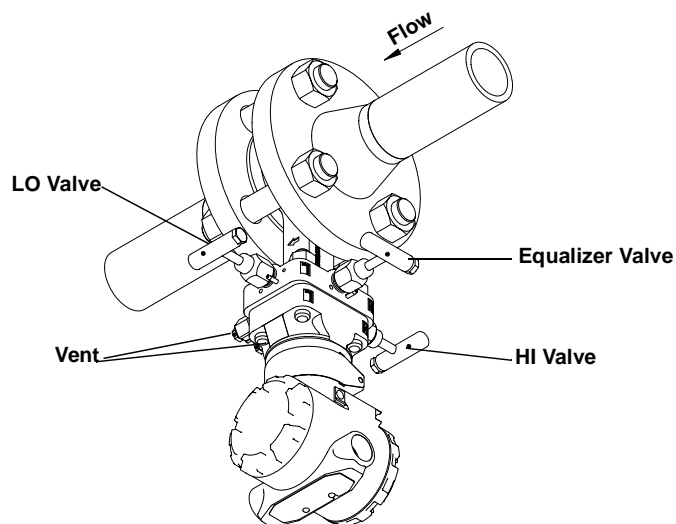
## DIRECT MOUNT APPLICATIONS

### Liquid Service

The commissioning process differs between direct and remote mounting.

- ⚠ 1. Pressurize line.
- 2. Open the equalizer valve.
- 3. Open the high and low side valves.
- 4. Bleed drain/vent valves until no gas is apparent in the liquid.
- 5. Close the vent/drain valves.
- 6. Close the low side valve.
- 7. Check the transmitter zero according to the transmitter product manual so that the output on the test meter reads zero percent of span.
- 8. Close the equalizer valve.
- 9. Open the low side valve. The system is now operational.

Figure 3-1. Direct Mount Liquid Service



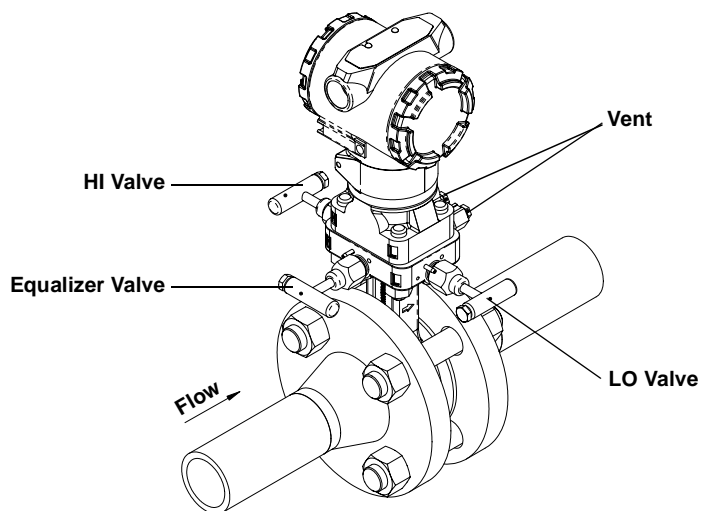
405P\_81-49314-999

---

## Gas Service

- ⚠ 1. Pressurize line.
2. Open the equalizer valve.
3. Open the high and low side valves.
4. Open drain/vent valves to ensure no liquid is present.
5. Close the vent/drain valves.
6. Close the low side valve.
7. Check the transmitter zero according to the transmitter product manual so that the output on the test meter reads zero percent of span.
8. Close the equalizer valve.
9. Open the low side valve. The system is now operational.

Figure 3-2. Direct Mount Gas Service

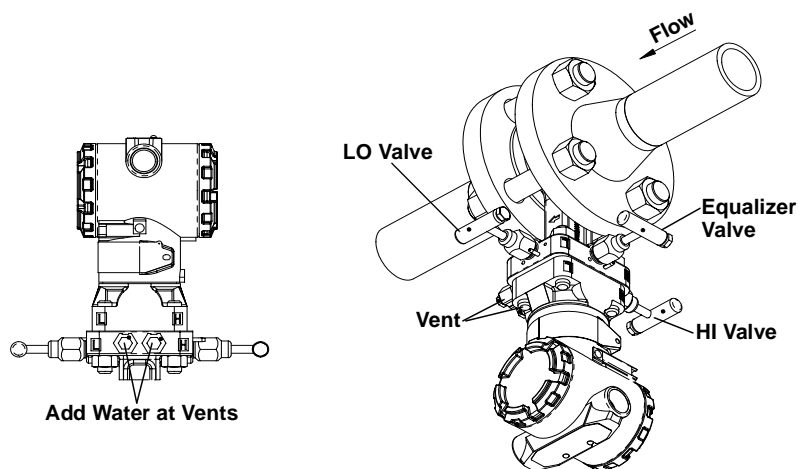


405P\_81-49315-999

## Steam Service

- ⚠ 1. Remove pressure from line.
2. Open equalizer, high, and low side valves.
3. Zero electronics.
4. Fill manifold and transmitter with water via drain vents.
5. Close low side valve.
6. Pressurize line.
7. Gently tap electronics body, manifold head, and Model 405P body with a small wrench to dislodge any entrapped air.
8. Check the transmitter zero according to the transmitter product manual so that the output on the test meter reads zero percent of span.
9. Close the equalizer valve and then open low side valve. The system is now operational.

Figure 3-3. Direct Mount  
Steam Service



405P\_81-49316-999

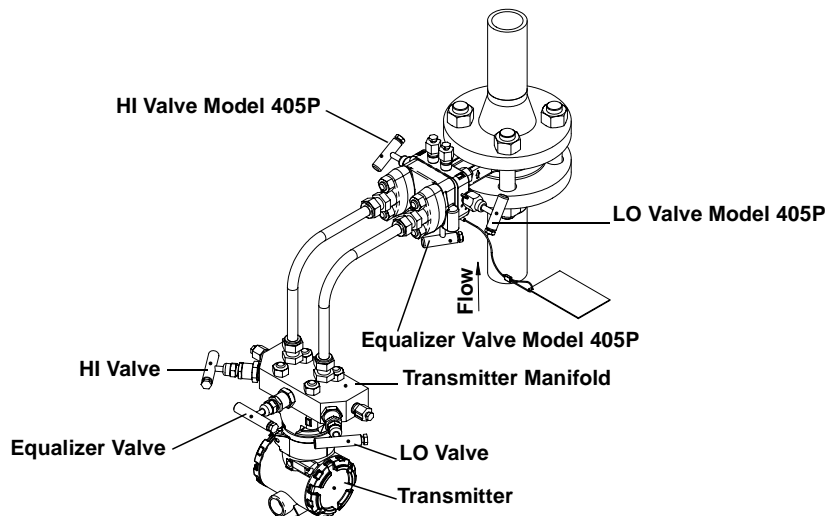
## REMOTE MOUNT APPLICATIONS

### Steam Service

The commissioning process differs between direct and remote mounting.

- ⚠ 1. Remove pressure from line.
2. Open equalizer valves, high side valves, and low side valves on both the Model 405P and transmitter manifold.
3. Zero electronics.
4. Fill transmitter manifold, instrument lines, and Model 405P with water via drain vents on transmitter manifold.
5. Close Model 405P equalizer valve and transmitter manifold vents.
6. Close low side transmitter manifold valve.
7. Pressurize line.
8. Gently tap electronics body, transmitter manifold, instrument lines, and Model 405P with a small wrench to dislodge any trapped air.
9. Check transmitter zero. If transmitter does not read zero repeat steps 4-8.
10. Close the transmitter equalizer and open low side valve on transmitter manifold. The system is now operational.

Figure 3-4. Remote Steam Service

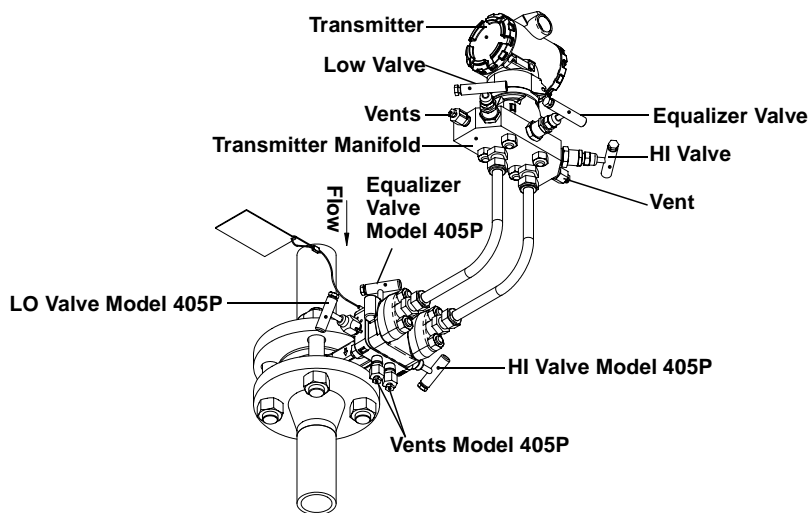


405P\_81-49317-999

## Gas Service

- ⚠ 1. Zero electronics and pressurize line.
2. Open equalizer valves on transmitter manifold and Model 405P.
3. Open high and low side transmitter manifold valves and Model 405P valves.
4. Open drain/vent valves on transmitter manifold to ensure no liquids are present.
5. Close drain/vent valves.
6. Close low side transmitter manifold valve.
7. Close Model 405P equalizer valve.
8. Check transmitter zero. If transmitter does not read zero repeat steps 1-7.
9. Close equalizer on transmitter manifold.
10. Open low side valve on transmitter manifold. The system is now operational.

Figure 3-5. Remote Gas Service



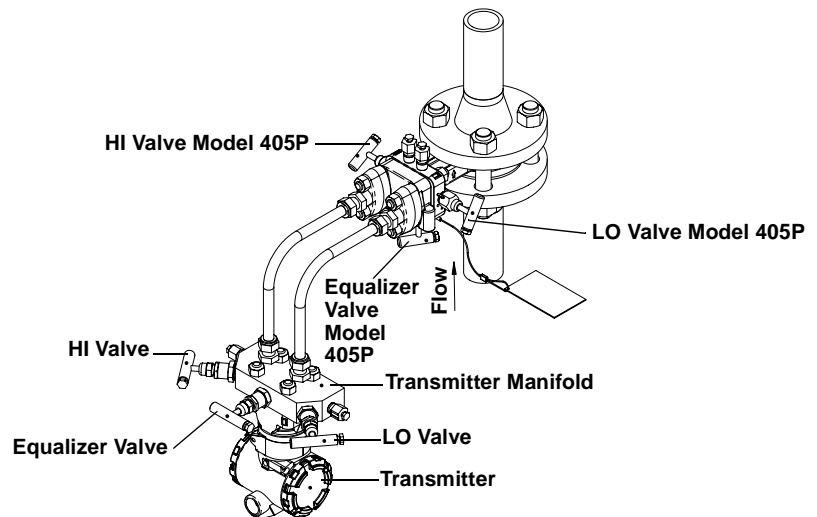
405P\_81-49318-999

---

## Liquid Service

- ⚠ 1. Zero electronics and pressurize line.
2. Open equalizer valves on transmitter manifold and Model 405P.
3. Open high and low side transmitter manifold valves and Model 405P valves.
4. Bleed drain vent valves on transmitter manifold until no air is present.
5. Close drain vent valves.
6. Close low side valve on transmitter manifold.
7. Close equalizer valve on Model 405P.
8. Check transmitter zero. If transmitter does not read zero repeat steps 1-7.
9. Close equalizer valve on transmitter manifold.
10. Open low side valve on transmitter manifold. The system is now operational.

Figure 3-6. Remote Liquid Service



405P\_81-49317-999





# Troubleshooting

<b>Safety Messages</b> .....	<b>page 4-1</b>
<b>Troubleshooting</b> .....	<b>page 4-1</b>

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

### Warnings

#### ⚠ WARNING

Explosions could result in death or serious injury.

## TROUBLESHOOTING

⚠ The following information is intended to assist in troubleshooting efforts.

### Check Flow Direction

Check that the flow arrow on the neck of the Model 405P points in the direction of flow. If the DP transmitter is remote mounted from the Model 405P, be sure that the impulse tubing is connected correctly from the Model 405P to the DP transmitter (high to high and low to low).

### Check Orientation

Improper orientation can result in inaccurate measurements. Consult Section 2: Installation for guidelines.

### Check Zero

The transmitter may read off in the high or low direction if not zeroed properly at start-up/commissioning. Refer to the Section 3: Configuration for this procedure.

### Check Valves

The correct valve setting for flow measurement are; equalizer valve fully closed, high and low side valves fully open.

### Check Configuration/Scaling

Is the 20mA DP URL of the Model 405P set properly? This may involve sizing the Model 405P in the Toolkit Software program to confirm.

Confirm the DCS or PLC and transmitter on Model 405P are scaled consistently.

Is the square root being taken in the DCS or transmitter attached to the Model 405P? The square root should not be taken in both places.

### **Check Model 3095MV Configuration**

If a Model 3095MV transmitter is being used, its enhanced functionality should be taken into account during configuration and troubleshooting. The square root should not be taken in the DCS if a Model 3095MV transmitter is being used.

When a Model 3095MV is used a “Test Calculation” may be run using the Engineering Assistant (EA) software package. In the Test Calc screen enter a DP, absolute pressure, and temperature, and hit calculate. The calculated mass flow should match the flow calculation provided with the Model 405P. If the density does not match check the fluid type in the EA to confirm consistency with the flow calculation. If the flow coefficient does not match check pipe ID and Bore size to make sure they are consistent. If the calculated flow is off more than one percent, EA should be used to receive the configuration from the Model 3095MV and the set-up data should be reviewed.

## Reference Data

---

Specifications .....	page A-1
Dimensional Drawings .....	page A-5
Ordering Information .....	page A-6
Spare Parts .....	page A-7

---

### SPECIFICATIONS

#### Functional

##### Service and Flow Range

- Liquid
- Gas
- Vapor

##### Operating Process Temperature Limits

Standard (direct/remote mount):

- -40 to 450 °F (-40 to 149 °C)

Extended (remote mount only with option code T):

- -148 to 850 °F (-100 to 454 °C)

##### Maximum Working Pressure

- Pressure retention per ANSI B16.5 600# or DIN PN100

##### Assembly to a Transmitter

Select option code S3 in the transmitter option code to factory assemble the Model 405P to a Rosemount pressure transmitter. The S3 option will drive square-root mode operation (output proportional to flow rate.) If the Model 405P and transmitter are not factory assembled, they may be shipped separately. For a consolidated shipment, inform the Rosemount representative when placing the order.

#### Physical

##### Material of Construction

Flange Studs and Nuts

- Customer supplied
- Available as a spare part (see Table A-6)

Body/Plate

- 316 SST

Transmitter Connection Studs and Nuts

- Studs— A193 Grade B8M.
- Nuts— A194 Grade 8M.

Gasket and O-rings

- Gaskets are customer supplied.
- Durlon 8500 fiber gaskets are recommended. Consult factory for use with other gaskets.
- Available as a spare part (see Table A-6)

## NOTE

Gaskets and O-rings must be replaced when the Model 405P is disassembled.

## Process Connections

Mounts between the following flange configuration:

ASME B16.5 (ANSI):

- Class 150
- Class 300
- Class 600

DIN:

- PN16
- PN40
- PN100

## Bore Sizes (d)

Line Size	$\beta = 0.40$	$\beta = 0.65$
1/2-in. (DN 15)	0.249	0.404
1-in. (DN 25)	0.420	0.682
1 1/2-in. (DN 40)	0.644	1.047
2-in. (DN 50)	0.827	1.344
3-in. (DN 80)	1.227	1.994
4-in. (DN 100)	1.610	2.617

Tolerance =  $\pm 0.002$ -in.

## Transmitter Connections

Direct Mount

- Integrally mount to Models 3051 and 3095 transmitters range 1, 2, and 3.

Remote Mount

- Available with 1/4-in. (standard) or 1/2-in. (option code E) connections

Orifice Type

- Square edged
- Corner tapped
- Concentric
- Wafer-style

## Weight

Line Size (in.)	Direct Mount (D3) <sup>(1)</sup>	Remote Mount (R3) <sup>(1)</sup>
1/2-in. (DN 15)	4.0 (1.81)	8.0 (3.63)
1-in. (DN 25)	4.5 (2.04)	8.5 (3.86)
1 1/2-in. (DN 40)	5.25 (2.38)	9.25 (4.20)
2-in. (DN 50)	6.0 (2.72)	10 (4.54)
3-in. (DN 80)	7.75 (3.52)	11.75 (5.33)
4-in. (DN 100)	9.5 (4.31)	13.5 (6.12)

<sup>(1)</sup> Measurement in lb (kg).

## Straight Pipe Requirement

Use the appropriate lengths of straight pipe upstream and downstream of the Model 405P to minimize the effects of moderate flow disturbances in the pipe. Table A-2 lists recommended lengths of straight pipe per ISO 5167.

## Performance

Table A-1. Pipe Orientation

## Pipe Orientation

Orientation/ Flow Direction	Process <sup>(1)</sup>		
	Gas	Liquid	Steam
Horizontal	D/R	D/R	D/R
Vertical Up	R	D/R	R
Vertical Down	D/R	NR	NR

(1) D = Direct mount acceptable (recommended) R = Remote mount acceptable  
NR = Not recommended

## Flow Coefficient Uncertainty

Model 405P Compact Orifice Size	Discharge Coefficient Uncertainty
1/2-in. (DN 15) <sup>(1)</sup>	1.75%
1-in. (DN 25)	1.75%
1 1/2-in. (DN 40)	1.75%
2-in. (DN 50)	1.25%
3-in. (DN 80)	1.25%
3-in. (DN 100)	1.25%

(1) Discharge Coefficient Uncertainty for 1/2-in. units with Beta = 0.65 is 2.25% (2.5% of flow).

## Sizing

Perform a flow calculation using the Instrument Toolkit software package. Alternatively, contact a Rosemount sales representative or Rosemount Customer Central at 1-800-999-9307 for assistance. A Configuration Data Sheet is required prior to order for application verification. See Tables A-3, A-4, and A-5.

Table A-2. Straight Pipe Requirements<sup>(1)(2)</sup>

Beta ( $\beta$ )	Upstream (inlet) Side of Primary							Downstream (outlet) side of primary
	Single 90° bend or tee	Reducer	Two or more 90° bends in the same plane	Two or more 90° bends in different planes	Expander	Globe valve fully open	Gate Valve fully open	
0.40	14 (7)	5	18 (9)	36 (18)	16 (8)	20 (10)	12 (6)	6 (3)
0.65	22 (11)	11 (6)	32 (16)	54 (27)	25 (13)	28 (14)	16 (8)	7 (3.5)

(1) Recommended lengths represented in pipe diameters according to ISO 5167.

(2) Values in parentheses associated with additional 0.5% discharge coefficient uncertainty according to ISO 5167.

Rosemount Model 405P Compact Orifice

Table A-3. Model 405P Steam Sizing  
Graph (saturated steam at 150 psig)

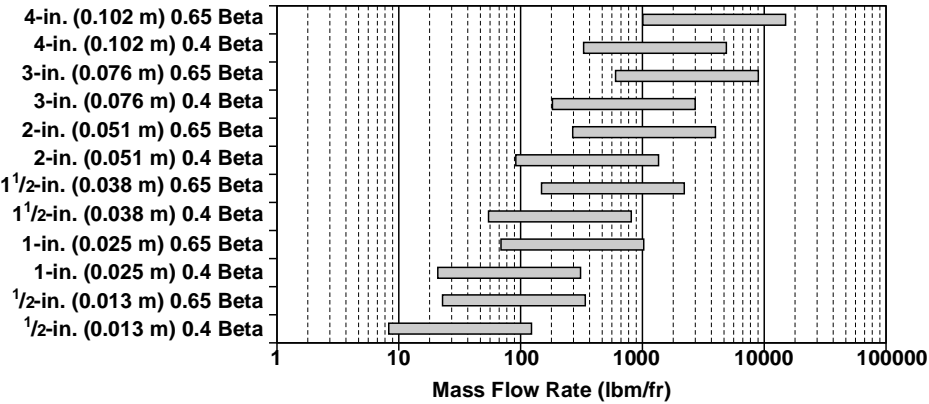


Table A-4. Model 405P Air Sizing  
Graph (at 14.7 psia and 68 °F)

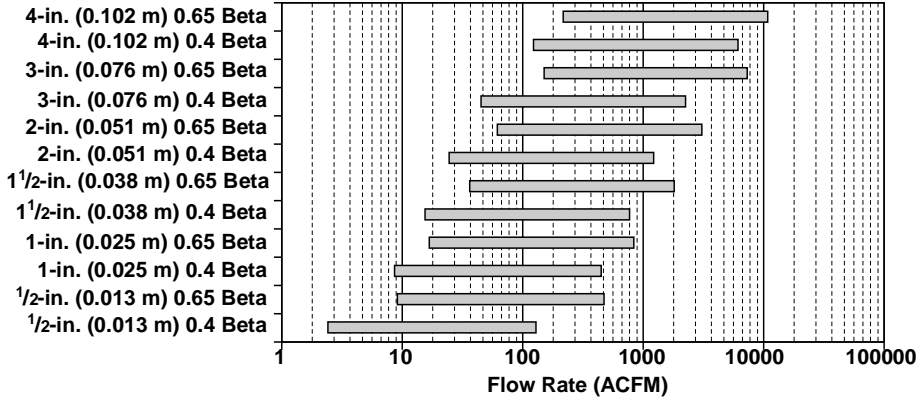
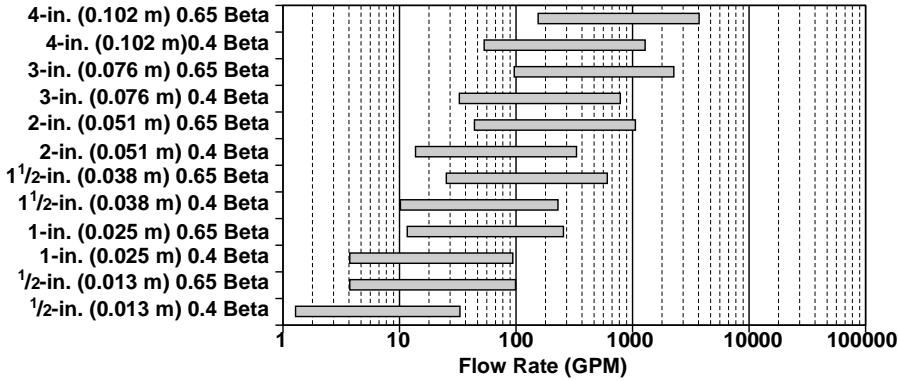
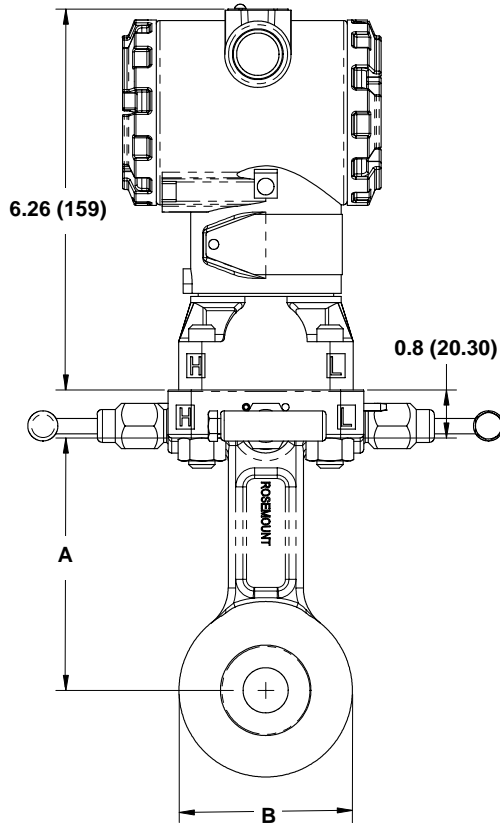


Table A-5. Model 405P Water  
Sizing Graph



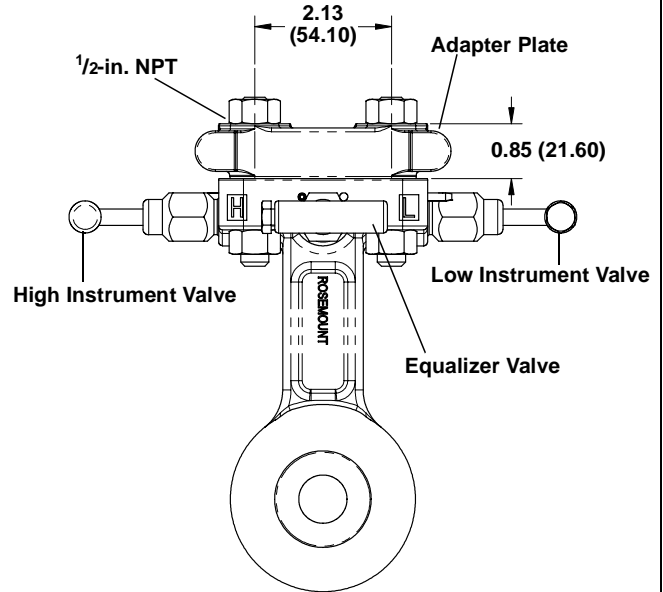
# **DIMENSIONAL DRAWINGS**

**Direct Mount, 3-valve Integral Manifold**  
Option Code D3

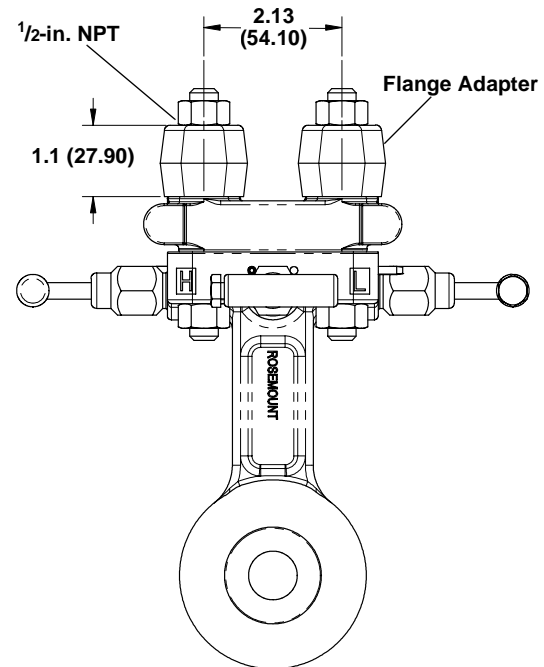


Size	A	B
005	3.30 (83.80)	1.33 (33.90)
010	3.69 (93.70)	2.00 (50.80)
015	4.19 (106.00)	2.88 (73.20)
020	4.44 (113.00)	3.63 (92.20)
030	5.25 (133.00)	5.00 (127.00)
040	6.24 (159.00)	6.19 (157.00)

**Remote Mount, 3-valve Integral Manifold**  
Option Code R3



**Remote Mount, 3-valve Integral Manifold**  
Option Code R3 without Flange Adapters (option code E)<sup>(1)</sup>



Dimensions are in inches (millimeters)

(1) Flange adapters can be rotated to give connection centers of 2-in., 2.13-in., or 2 1/4-in.

## ORDERING INFORMATION

Model	Product Description
405P	Compact Orifice Plate Type
Code	Materials of Construction
S	316 SST
Code	Line Size
005	1/2-in. (12.5 mm) (DN 15)
010	1-in. (25 mm) (DN 25)
015	1 1/2-in. (37.5 mm) (DN 40)
020	2-in. (50 mm) (DN 50)
030	3-in. (75 mm) (DN 80)
040	4-in. (100 mm) (DN 100)
Code	O-Plate Type
N	Square Edged, Concentric
Code	Beta
040	0.40 Beta
065	0.65 Beta
XXX	To be determined (either 040 or 0.65)
Code	Transmitter Connection <sup>(1)</sup>
D3	Direct Mount, 3-valve Integral Manifold, SS
R3	Remote Mount, 3-valve Integral Manifold, SS
Code	Optional
High Temperature Application	
T <sup>(2)</sup>	Graphite valve packing (T <sub>max</sub> = 850 °F)
Installation Accessories	
G	DIN Alignment Ring
E <sup>(3)</sup>	Flange Adapters 316 SST (1/2-in. NPT)
Quality Codes	
P2 <sup>(4)</sup>	Cleaning for Special Services
Q8	Material Traceability Certification per EN 10204 3.1B
Typical Model Number: 405P S 020 N 040 D3	

- (1) Assembly to a transmitter: select option code S3 in the transmitter option code to factory assemble the Model 405P to a Rosemount pressure transmitter. The S3 option will drive square-root mode operation (output proportional to flow rate.) If the Model 405P and transmitter are not factory assembled, they may be shipped separately. For a consolidated shipment, inform the Rosemount representative when placing the order.
- (2) Not available with option code D3 or P2.
- (3) Not available with option code D3.
- (4) Not available with option code T.



## SPARE PARTS

Table A-6. Mounting Stud and Nut Kit Spare Parts List

Mounting Stud and Nut Kit	Description	Mounting Stud and Nut Kit	Description
08951-0100-0101	1/2-in. 150# Mounting Kit	08951-0101-0101	DN15 PN16 Mounting Kit
08951-0100-0102	1-in. 150# Mounting Kit	08951-0101-0102	DN25 PN16 Mounting Kit
08951-0100-0103	1 1/2-in. 150# Mounting Kit	08951-0101-0103	DN40 PN16 Mounting Kit
08951-0100-0104	2-in. 150# Mounting Kit	08951-0101-0104	DN50 PN16 Mounting Kit
08951-0100-0105	3-in. 150# Mounting Kit	08951-0101-0105	DN80 PN16 Mounting Kit
08951-0100-0106	4-in. 150# Mounting Kit	08951-0101-0106	DN 100 PN 16 Mounting Kit
08951-0100-0201	1/2-in. 300# Mounting Kit	08951-0101-0201	DN15 PN40 Mounting Kit
08951-0100-0202	1-in. 300# Mounting Kit	08951-0101-0202	DN25 PN40 Mounting Kit
08951-0100-0203	1 1/2-in. 300# Mounting Kit	08951-0101-0203	DN40 PN40 Mounting Kit
08951-0100-0204	2-in. 300# Mounting Kit	08951-0101-0204	DN50 PN40 Mounting Kit
08951-0100-0205	3-in. 300# Mounting Kit	08951-0101-0205	DN80 PN40 Mounting Kit
08951-0100-0206	4-in. 300# Mounting Kit	08951-0101-0206	DN 100 PN40 Mounting Kit
08951-0100-0301	1/2-in. 600# Mounting Kit	08951-0101-0301	DN15 PN100 Mounting Kit
08951-0100-0302	1-in. 600# Mounting Kit	08951-0101-0302	DN25 PN100 Mounting Kit
08951-0100-0303	1 1/2-in. 600# Mounting Kit	08951-0101-0303	DN40 PN100 Mounting Kit
08951-0100-0304	2-in. 600# Mounting Kit	08951-0101-0304	DN50 PN100 16 Mounting Kit
08951-0100-0305	3-in. 600# Mounting Kit	08951-0101-0305	DN80 PN100 Mounting Kit
08951-0100-0306	4-in. 600# Mounting Kit	08951-0101-0306	DN 100 PN100 Mounting Kit

Table A-7. Other Spare Parts

Gasket Kit	Description
08951-0200-0101	1/2-in. 150# Gasket Kit
08951-0200-0102	1-in. 150# Gasket Kit
08951-0200-0103	1 1/2-in. 150# Gasket Kit
08951-0200-0104	2-in. 150# Gasket Kit
08951-0200-0105	3-in. 150# Gasket Kit
08951-0200-0106	4-in. 150# Gasket Kit
08951-0200-0201	1/2-in. 300# Gasket Kit
08951-0200-0202	1-in. 300# Gasket Kit
08951-0200-0203	1 1/2-in. 300# Gasket Kit
08951-0200-0204	2-in. 300# Gasket Kit
08951-0200-0205	3-in. 300# Gasket Kit
08951-0200-0206	4-in. 300# Gasket Kit
08951-0200-0301	1/2-in. 600# Gasket Kit
08951-0200-0302	1-in. 600# Gasket Kit
08951-0200-0303	1 1/2-in. 600# Gasket Kit
08951-0200-0304	2-in. 600# Gasket Kit
08951-0200-0305	3-in. 600# Gasket Kit
08951-0200-0306	4-in. 600# Gasket Kit
Remote Retrofit Kit	Description
08951-0300-0001	Remote Retrofit Kit, 1/4-in. NPT
08951-0300-0002	Remote Retrofit Kit, 1/2-in. NPT
Vents/Valves	Description
08951-0400-0001	Drain/Vent Replacement Kit
08951-0401-0001	Valve Bonnet, SS
Spare Alignment Rings	Description
08951-0402-0001	1/2-in. Alignment Ring
08951-0402-0002	1-in. Alignment Ring
08951-0402-0003	1 1/2-in. Alignment Ring
08951-0402-0004	2-in. Alignment Ring
08951-0402-0005	3-in. Alignment Ring
08951-0402-0006	4-in. Alignment Ring



# Index

## A

Assembly to a Transmitter . . . .A-1

## B

Bolting a transmitter to the Model  
405P . . . . .2-3  
Bore Sizes . . . . .A-2

## C

Considerations  
environmental . . . . .2-2

## D

Direct Mount  
gas in horizontal pipes . . . .2-4  
gas in vertical pipes . . . . .2-5  
gas service . . . . .3-3  
liquid in vertical pipes . . . .2-5  
liquid or steam in horizontal  
pipes . . . . .2-4  
liquid service . . . . .3-2  
Orientation . . . . .2-4  
steam service . . . . .3-4  
transmitter connections . . .A-2  
Drawings . . . . .A-5  
direct mount, 3-valve integral  
manifold . . . . .A-5  
remote mount, 3-valve integral  
manifold . . . . .A-5

## E

Environmental considerations . .2-2

## F

Flow Coefficient Uncertainty . . .A-3  
Functional Limitations . . . . .2-2  
straight run requirements .2-2  
Functional Specifications . . . .A-1  
assembly to a transmitter . .A-1  
maximum working pressure A-1  
operating process Temperature  
Limits . . . . .A-1  
operating process temperature  
limits  
standard . . . . .A-1  
operating process temperature  
limits  
extended . . . . .A-1  
service and flow range . . . .A-1

## G

Gas Service  
direct mount . . . . .3-3  
remote mount . . . . .3-6

## I

Inspection Upon Delivery  
return of materials . . . . .1-1  
Installation  
direct mount . . . . .2-4  
gas in horizontal pipes .2-4  
gas in vertical pipes . . .2-5  
liquid in vertical pipes .2-5  
liquid or steam in horizontal  
pipes . . . . .2-4  
remote mount . . . . .2-6  
gas in vertical or horizontal  
pipes . . . . .2-6  
liquid or steam in vertical or  
horizontal pipes . . . . .2-6

## L

Liquid Service  
direct mount . . . . .3-2  
remote mount . . . . .3-7  
Location and Orientation . . . .2-3  
bolting a transmitter to the  
Model 405P . . . . .2-3

## M

Material of Construction . . . . .A-1  
body . . . . .A-1  
flange studs and nuts . . . .A-1  
gasket and o-rings . . . . .A-1  
plate . . . . .A-1  
transmitter connection studs and  
nuts . . . . .A-1  
Maximum Working Pressure . .A-1

## O

Operating Process Temperature  
Limits . . . . .A-1  
extended . . . . .A-1  
standard . . . . .A-1  
Ordering Information  
tables . . . . .A-6  
Orientation  
direct mount . . . . .2-4  
remote mount . . . . .2-6  
Orifice Type . . . . .A-2

## P

Performance Specifications . . . .A-3  
flow coefficient uncertainty A-3  
pipe orientation . . . . .A-3  
sizing graph . . . . .A-3  
Physical Specifications  
bore sizes . . . . .A-2  
material of construction . . .A-1  
body . . . . .A-1  
flange studs and nuts . .A-1  
gasket and o-rings . . .A-1  
plate . . . . .A-1  
transmitter connection studs  
and nuts . . . . .A-1  
process connections . . . . .A-2  
ASME B16.5 (ANSI) . .A-2  
DIN . . . . .A-2  
straight pipe requirements A-3  
transmitter connections . . .A-2  
direct mount . . . . .A-2  
orifice type . . . . .A-2  
remote mount . . . . .A-2  
weight . . . . .A-2  
Physical specifications . . . . .A-1  
Pipe Orientation . . . . .A-3  
Pipes  
horizontal  
gas . . . . .2-4  
liquid or steam . . . . .2-4  
vertical  
gas . . . . .2-5  
liquid . . . . .2-5  
vertical or horizontal  
gas . . . . .2-6  
liquid or steam . . . . .2-6  
Process Connection  
ASME B16.5 (ANSI) . . . . .A-2  
Process Connections . . . .2-7, A-2  
DIN . . . . .A-2

## R

Remote Mount . . . . .3-5  
gas in vertical or horizontal pipes  
. . . . .2-6  
gas service . . . . .3-6  
liquid or steam in vertical or  
horizontal pipes . . . . .2-6  
liquid service . . . . .3-7  
orientation . . . . .2-6  
process connections . . .2-7  
steam service . . . . .3-5  
transmitter connections . . .A-2

## Rosemount Model 405P Compact Orifice

---

Return of Materials . . . . . 1-2

### S

Service and Flow Range . . . . . A-1

Sizing Graph . . . . . A-3

Specifications . . . . . A-1

    functional . . . . . A-1

    performance . . . . . A-3

    physical . . . . . A-1

Steam Service

    direct mount . . . . . 3-4

    remote mount . . . . . 3-5

Straight Pipe Requirement . . . . A-3

Straight Run Requirements . . . 2-2

### T

Transmitter Connection

    direct mount . . . . . A-2

    remote mount . . . . . A-2

Transmitter Connections . . . . . A-2

    orifice type . . . . . A-2

Troubleshooting

    check configuration . . . . . 4-1

    check flow direction . . . . . 4-1

    check Model 3095MV

        configuration . . . . . 4-2

    check orientation . . . . . 4-1

    check scaling . . . . . 4-1

    check valves . . . . . 4-1

    check zero . . . . . 4-1

### U

Using this Manual . . . . . 1-1

### W

Weight . . . . . A-2



**Rosemount Inc.**  
8200 Market Boulevard  
Chanhassen, MN 55317  
USA  
Tel 1-800-999-9307  
Fax (952) 949-7001  
© 2001 Rosemount, Inc.



00809-0100-4810, Rev. AA, 7/01  
EC003086



**ROSEMOUNT®**



Fisher-Rosemount satisfies all obligations coming from legislation to harmonise product requirements in the European Union.

Product documentation available at...  
[www.rosemount.com](http://www.rosemount.com)



**EMERSON™**  
Process Management