TEKTROL

Technology Solutions

TEK-DP 1610D

Integral Orifice Assembly

Instruction Manual

Document Number: IM-1610D

www.tek-trol.com

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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.

For technical assistance, contact
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Table of Contents

1 Safety Instructions

1.1 Intended Use

The Tek-DP 1610D Integral Orifice Assembly accurately measures liquid, gas, or steam flow.

1.2 Safety Instructions from the Manufacturer

1.2.1 Disclaimer

The manufacturer will not be held accountable for any damage that happens by using its product, including, but not limited to, direct, indirect, or incidental and consequential damages. Any product purchased from the manufacturer is warranted by the relevant product documentation and our terms and conditions of sale. The manufacturer has the right to modify the content of this document of any time with any reason without prior notice and will not be answerable for the possible consequence of changes.

1.2.2 Product Liability and Warranty

The operator shall have authority for the suitability of the device for the specific application. The manufacturer accepts no accountability for the consequences of misuse by the operator. A wrong installation or operation of the devices (systems) will cause the warranty to be void. The respective Terms and Conditions of Sale, which forms the basis for the sales contract, shall also apply.

1.2.3 Information Concerning the Documentation

To prevent any injury to the operator or damage to the device, it is essential to read the information in this document and the applicable national standard safety instructions. This operating manual consists of all the information that is required in various stages, such as product identification, incoming acceptance and storage, mounting, connection, operation and commissioning, troubleshooting, maintenance, and disposal.

1.3 Safety Precautions

You must read these instructions carefully before installing and commissioning the device. These instructions are an essential part of the product and must be kept for future reference. Only by observing these instructions, optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device can be ensured. For additional information that is not discussed in this manual, contact the manufacturer.

The following safety symbol marks are used in this operation manual and on the instrument.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

1.4 Packaging, Transportation and Storage

1.4.1 Packaging

The Original Package Comprising of:

1. Orifice Block Assembly
2. Orifice Plate (installed within the block)
3. Upstream and Downstream meter runs (if ordered)
4. RTD assembly (if ordered)

NOTE

Unpack and check the contents for damages or sign of rough handling. Report damage to the manufacturer immediately. Check the contents against the packing list provided.

1.4.2 Transportation

- Avoid impact shocks to the device and prevent it from getting wet during transportation.
- Verify local safety regulations, directives, and company procedures with respect to hoisting, rigging, and transportation of heavy equipment.
- Transport the product to the installation site using the original manufacturer's packing whenever possible.

1.4.3 Storage

If this product is to be stored for an extended period before installation, take the following precautions:

- Store your product in the manufacturer's original packing used for shipping.
- The storage location should comply with the following requirements:
  - Free from rain and water
  - Free from vibration and impact shock
  - At room temperature with minimal temperature and humidity variation
- Before storing a used flow meter, remove any fluid from the flow meter line completely. Properties of the instrument can change when stored outdoors.

1.4.4 Nameplate

The nameplate lists the order number and other important information, such as design details and technical data.

NOTE

Check the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

2 Product Description

2.1 Introduction

The TEK-DP 1610D Integral Orifice Assemblies are used in combination with a transmitter to accurately measure liquid, gas, or steam flow in. ½", 1", and 1 ½" (approximately DN 15, DN 25, and DN 40) size pipes.

2.2 Dimensional Drawings

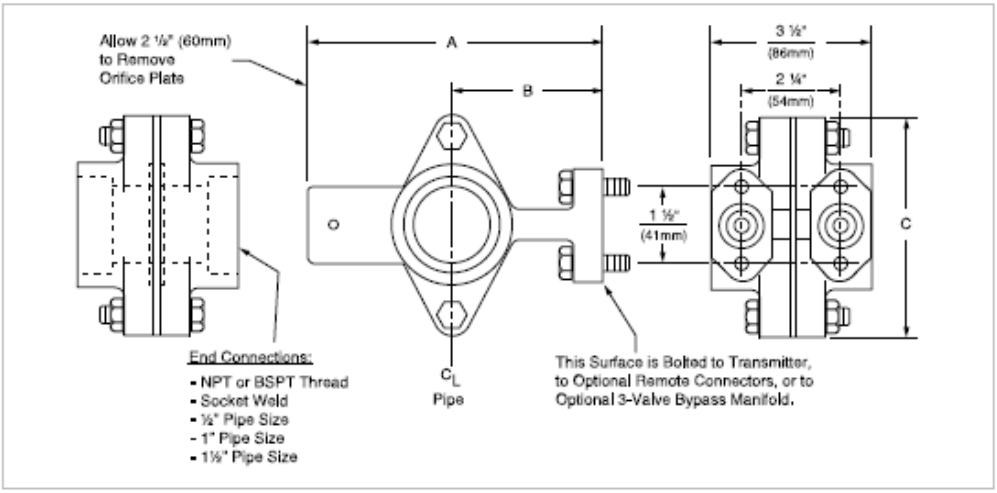


Fig 1: Assembly without Associated Piping

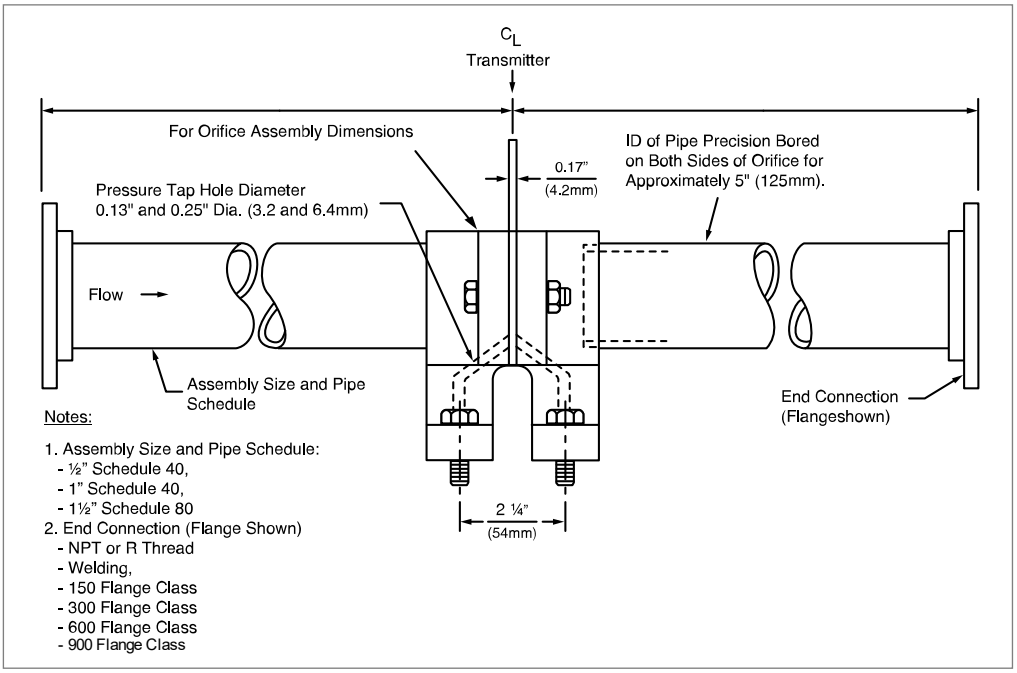


Fig 2: Assembly with Associated Piping

***Note:** Dimensions are subject to vary at time of manufacturing based on final Beta selected. Dimensional drawing with a final engineering sizing sheet will be provided within 1-2 weeks of order acceptance

2.3 Model Chart

Example	Tek-DP 1610D	015	A	01	G	05	A	XX	D	A	01	#	TEK-DP 1610D-015-A-01-G-05-A-XX-D-A-01
Series	Tek-DP 1610D												Integral Orifice Assemblies
Pipe Size		015 025 040											½" 1" 1 ½"
Meter Body			A X										316L SS Special
Pipe Schedule				01 XX									STD (Standard Pipe SCH) Special
Process Connection					A B C D E F G X								Slip On RF Weld Neck RF Slip On RTJ Weld Neck RTJ Beveled End Socket NPTF Special
Pressure Rating						01 02 03 04 05 XX							150# 300# 600# 900# Threaded Special
Orifice Plate Material							A B X						316 SST Alloy C-276 Special
Beta								XX					Special
Mounting									D R X				Direct Mount Remote Mount Special
Additional Meter Taps (D/S)										A B C X			None Temperature Tap (3D) Validation/Diagnostic Tap (6D) Special
Flow Transmitters /Computers											01 02 03 04 05 06 XX		None (Customer Supplied) Tek-Bar 3110 (Liquids) - Smart DP Tek-Bar 3800 (MVT Steam & Compressed Gases) Tek-FC 8000 (Natural Gas - Flow Computer) TekValsys DPRO (Flow Validation) TekValsys DPRO WFGM (Wet Gas) Special
Options												MTR MC PMI COC HYD XRT DPT MPT O2C TAG UMR DMR CDE MRB DFT CPC 3WH 5WH	Material Test Report EN3.1 Material Cert EN2.1 Positive Material Identification (NDE) Certificate of Conformity Hydro Test X-Ray Dye Penetrant Magnetic Particle Testing O2 Clean SS Tag Plate Upstream Meter Run - 1PC Downstream Meter Run - 1PC Certified Drawing Electronic (As Built) Manufacturing Record Book Dry Film Thickness - Custom Paint Spec Custom Product Code 3 Way Manifolds (Type H) 5 Way Manifolds (Type H)

3 Installation

This section covers instructions on installation and commissioning of the instrument. Trained, and qualified specialists authorized to perform such work must carry out installation of the device.

CAUTION

- Ensure that the operating staff is competent and trained to operate this pressurized equipment.
- Ensure that the installation personnel confirm the maximum allowable operating pressure of each item in the system before pressurizing the system.

3.1 General Instructions

- The method of measurement applies only to fluids flowing through a pipeline of circular cross section.
- The pipe shall run full at the measuring section.
- The primary device shall be installed in the pipeline at a position such that the flow conditions immediately upstream approach those of a fully developed profile and are free from swirl.
- This section covers instructions on installation and commissioning of the instrument. Trained, and qualified specialists authorized to perform such work must carry out installation of the device.
- The pipe bore shall be circular over the entire minimum length of straight pipe required. The cross-section is taken to be circular if it appears so by visual inspection. The circularity of the outside of the pipe can be taken as a guide, except in the immediate vicinity of the primary device where special requirements shall apply according to the type of primary device used.
- Seamed pipe may be used provided that the internal weld bead is parallel to the pipe axis throughout the length of the pipe and satisfies the special requirements for the type of primary element. The seam shall not be situated in any sector of ±30°centered on any pressure tapping.
- The internal diameter D of the measuring pipe shall comply with the values given for each type of primary device.
- The inside surface of the measuring pipe shall be clean and free from encrustations, pitting and deposits, and shall conform to the rough criterion for at least a length of 10D upstream 4D downstream of the primary device.
- The pipe may be provided with drain hole and/or vent holes for the removal of solid deposits and fluids other than the measured fluid. However, there shall be no flow through the drain holes and vent holes during the measurement of the flow.
- The drain holes and vent holes shall not be located near to the primary device unless it is unavoidable to do so. In such a case, the diameter of these holes shall be smaller than 0.08D and their location shall be such that the distance, measured on a straight line from one of these holes to a pressure tapping of the primary device placed on the same side to this primary device, is always greater than 0.5D. The axial planes of the pipe containing respectively the centerline of a pressure tapping and the centerline of a drain hole or vent hole shall be offset by at least 30°.
- The pipe and the pipe flanges shall be lagged. It is, however, unnecessary to lag the pipe when the temperature of the fluid, between the inlet of the minimum straight length of the upstream pipe and the outlet of the minimum straight length of the downstream pipe, does not exceed any limiting value for the accuracy of flow measurement required.

3.2 Installation Requirements for Orifice Plates, Nozzles and Venturi Tubes

3.2.1 Circularity of The Pipe

In the immediate vicinity of the primary device following requirements shall apply:

- The length of the upstream pipe section adjacent to the primary device (or to the carrier ring if there is one) shall be at least 2D and cylindrical. The pipe is said to be cylindrical when no diameters in any plane differs by more than 0.3% from the mean value of D obtained from the measurements.
- The value for the pipe diameter D shall be the mean of the internal diameters over a length of 0.5D upstream of the upstream pressure tapping. The internal mean diameter shall be the arithmetic mean of measurements of at least twelve diameters namely four diameters positioned at approximately equal angles to each other, distributed in each of at least three cross-sections evenly distributed over a length of 0.5D, two of these sections being at distance 0 and 0.5D from the upstream tapping and one being in the plane of the weld in the case of a weld-neck construction. If there is a carrier ring this value of 0.5D shall be measured from the upstream edge of the carrier ring.
- Beyond 2D from the primary device, the upstream pipe run between the primary device and the first upstream fitting or disturbance may be made up of one or more sections of pipe.
- No additional uncertainty in the discharge coefficient is involved provided that the diameter step between any two sections does not exceed 0.3% of the mean value of D obtained from the measurements.
- No diameter of the downstream straight length, considered along a length of at least 2D from the upstream face of the primary device, shall differ from the mean diameter of the upstream straight length by more than 3%. This can be judged by checking a single diameter of the downstream straight length.

3.3 Installation Requirements for Classical Venturi Tubes

3.3.1 Circularity of The Pipe

In the immediate vicinity of the classical Venturi tube, the following requirements shall apply:

- Over an upstream length of at least 2D measured from the upstream end of the entrance cylinder of the Venturi tube, the pipe shall be cylindrical.
- The mean diameter of the pipe where it joins the classical Venturi tube shall be within 1% of the classical Venturi tube entrance cylinder diameter D. Moreover, no single diameter of this inlet pipe section shall differ from the mean of the measured diameters by more than 2% for two pipe diameters upstream of the classical Venturi tube.
- The diameter of the pipe immediately downstream of the Venturi tube need not be measured accurately but it shall be checked that the downstream pipe diameter is not less than 90% of the diameter at the end of the Venturi tube divergent section. This means that, in most cases, pipes having the same nominal bore as that of the Venturi tube can be used.

3.3.2 Roughness of The Upstream Pipe

The upstream pipe shall have a relative roughness of k/D <= 10 on a length at least equal to 2D measured upstream from the classical Venturi tube.

3.3.3 Alignment of The Classical Venturi Tube

The offset or distance between the centerlines of the upstream pipe and of the venturi tube, as measured in the connecting plane of the upstream pipe and entrance cylinder shall be less than

0.005D. The angular alignment uncertainty of the Venturi tube centerline with respect to the upstream pipe centerline shall be less than 1°. Finally, the sum of the offset and half the diameter deviation shall be less than 0.0075D.

3.4 Mounting

3.4.1 Straight Length Requirements

- Reducer

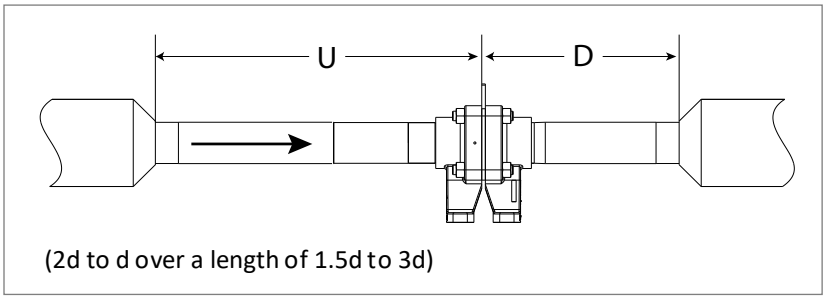


Fig 3: Reducer

- Single 90° Bend Flow from One Branch

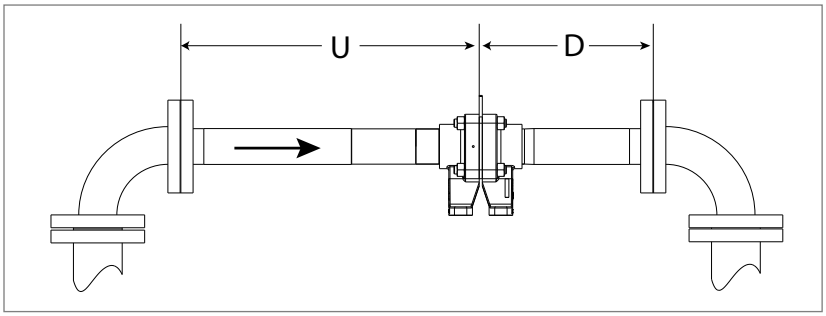


Fig 4: Single 90° Bend Flow from One Branch

- Two or More 90° Bends in Same Planes

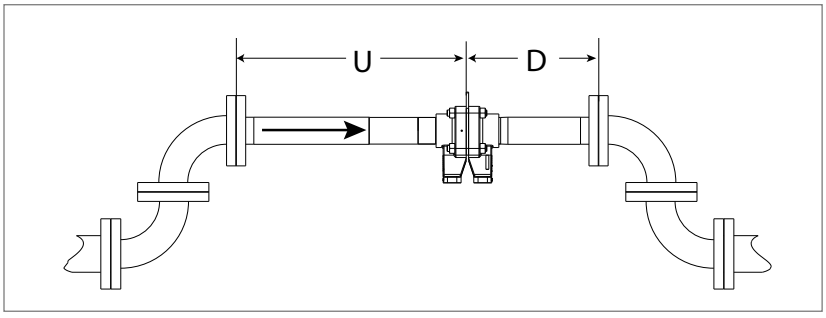


Fig 5: Two or More 90° Bends in Same Planes

- Two or More 90° Bends in Different Planes

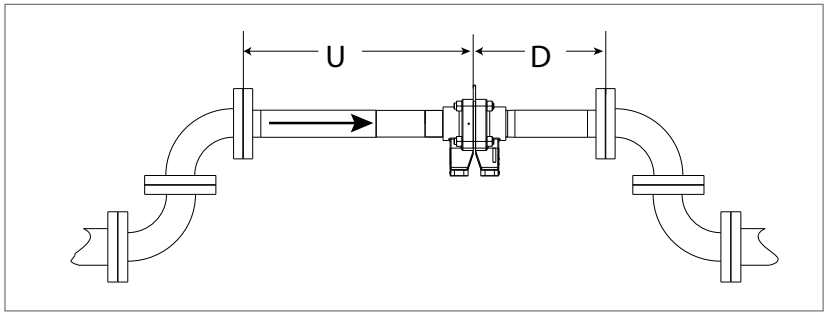


Fig 6: Two or More 90° Bends in Different Planes

- Expander

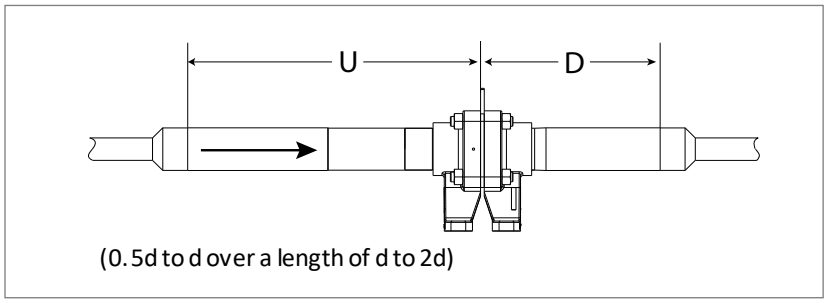


Fig 7: Expander

- Ball Valve or Gate Valve Fully Open

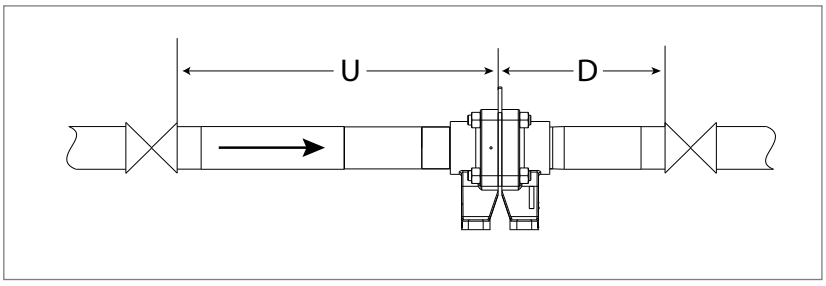


Fig 8: Ball Valve or Gate Valve Fully Open

3.5 Exploded View

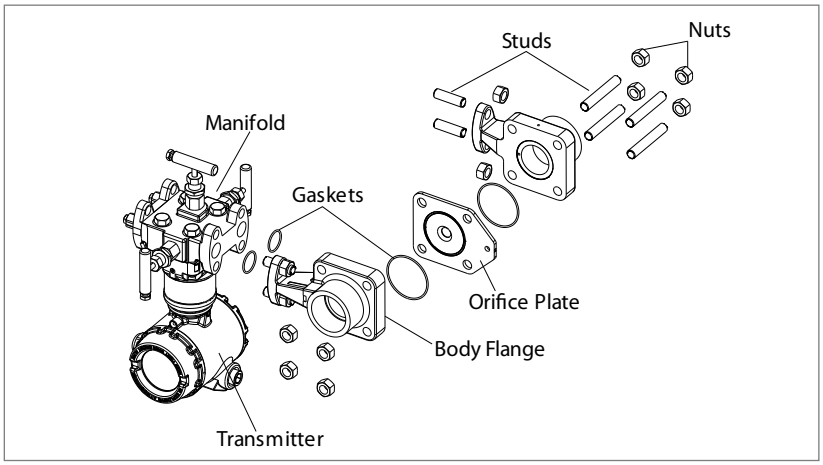


Fig 9: Exploded view

Table 1: Required Straight Lengths for Orifice Plate, Nozzle

	Upstream Side of Primary Devices (U1)																				Downstream Primary Devices (D1)	
Beta Ratio	Single 90 bend or tee (Flow from one branch only)		Two or 0 more 90 bends in the same plane*)		Two or 0 more 90 bends in different planes		Reducer 2D to D over a Length of 1.5D to 3D		Expander 0.5D to D over a Length of D to 2D		Globe valve fully open		Full bore ball valve or gate valve fully open		Abrupt symmetrical reduction having a diameter ratio >=0.5		Thermometer pocket or well*) of diameter <=0.03D		Thermometer pocket or well*) of diameter between <=0.03D and 0.13D		Fitting (All mentioned in Upstream Side of Primary Devices	
0.20	10	(6)	14	(7)	34	(17)	5		16	(8)	18	(9)	12	(6)	30	(15)	5	(3)	20	(10)	4	(2)
0.25	10	(6)	14	(7)	34	(17)	5		16	(8)	18	(9)	12	(6)	30	(15)	5	(3)	20	(10)	4	(2)
0.30	10	(6)	16	(8)	34	(17)	5		16	(8)	18	(9)	12	(6)	30	(15)	5	(3)	20	(10)	5	(2.5)
0.35	12	(6	16	(8)	36	(18)	5		16	(8)	18	(9)	12	(6)	30	(15)	5	(3)	20	(10)	5	(2.5)
0.40	14	(7)	18	(9)	36	(18)	5		16	(8)	20	(10)	12	(6)	30	(15)	5	(3)	20	(10)	6	(3)
0.45	14	(7)	18	(9)	38	(19)	5		17	(9)	20	(10)	12	(6)	30	(15)	5	(3)	20	(10)	6	(3)
0.50	14	(7)	20	(10)	40	(20)	6	(5)	18	(9)	22	(11)	12	(6)	30	(15)	5	(3)	20	(10)	6	(3)
0.55	16	(8)	22	(11)	44	(22)	8	(5)	20	(10)	24	(12)	14	(7)	30	(15)	5	(3)	20	(10)	6	(3)
0.60	18	(9)	26	(13)	48	(24)	9	(5)	22	(11)	26	(13)	14	(7)	30	(15)	5	(3)	20	(10)	7	(3.5)
0.65	22	(11)	32	(16)	54	(27)	11	(6)	25	(13)	28	(14)	16	(8)	30	(15)	5	(3)	20	(10)	7	(3.5)
0.70	28	(14)	36	(18)	62	(31)	14	(7)	30	(15)	32	(16)	20	(10)	30	(15)	5	(3)	20	(10)	7	(3.5)
0.75	36	(18)	42	(21)	70	(35)	22	(11)	38	(19)	36	(18)	24	(12)	30	(15)	5	(3)	20	(10)	8	(4)
0.80	46	(23)	50	(25)	80	(40)	30	(15)	54	(27)	42	(22)	30	(15)	30	(15)	5	(3)	20	(10)	8	(4)
U_2	14		18		31		7		15		16		10		15		3		10			

Note*:

- The installation of thermometer pockets or wells will not alter the required minimum upstream straight lengths for the other fittings.
- All straight lengths are expressed in multiples of diameter D.
- Values without parentheses are "Zero additional Uncertainty" values.
- Values in parentheses are "0.5% additional Uncertainty" values.

Table 2: Required Straight Lengths for Classical Venturi Tubes

Beta Ratio	Upstream Primary Devices (U_1)												Downstream Primary Devices (D_1)	
	Single 90° bend*)		Two or more 90° bends in the same plane*)		Two or more 90° bends in Different plane*)**)		Reducer 3D to D over a Length of 3.5 D		Expander 0.75D to D over a Length of D		Full bore ball valve or gate valve fully open		Fitting (All Mentioned in Upstream Side of Primary Devices	
0.30	0.5!		1.5	(0.5)		(0.5)	(0.5)!		1.5	(0.5)	1.5	(0.5)	4	
0.35	0.5!		1.5	(0.5)		(0.5)	1.5	(0.5)	1.5	(0.5)	2.5	(0.5)	4	
0.40	0.5!		1.5	(0.5)		(0.5)	2.5	(0.5)	1.5	(0.5)	2.5	(1.5)	4	
0.45	1	(0.5)	1.5	(0.5)		(0.5)	4.5	(0.5)	2.5	(1)	3.5	(1.5)	4	
0.50	1.5	(0.5)	2.5	(1.5)		(8.5)	5.5	(0.5)	2.5	(1.5)	3.5	(1.5)	4	
0.55	2.5	(0.5)	2.5	(1.5)		(12.5)	6.5	(0.5)	3.5	(1.5)	4.5	(2.5)	4	
0.60	3	(1)	3.5	(2.5)		(17.5)	8.5	(0.5)	3.5	(1.5)	4.5	(2.5)	4	
0.65	4	(1.5)	4.5	(2.5)		(23.5)	9.5	(1.5)	4.5	(2.5)	4.5	(2.5)	4	
0.70	4	(2)	4.5	(2.5)		(27.5)	10.5	(2.5)	5.5	(3.5)	5.5	(3.5)	4	
0.75	4.5	(3)	4.5	(3.5)		(29.5)	11.5	(3.5)	6.5	(4.5)	5.5	(3.5)	4	

U_2	14	18	31	7	15	10	

Note*:

* The radius of curvature of the bend shall be greater than or equal to the pipe diameter.

** As the effect of these fittings may still be present after 40D, no values without parentheses can be given.

! Since no fitting can be placed closer than 0.5D to the upstream pressure tapping in the Venturi Tube, the "Zero Additional Uncertainty" values are only ones applicable in this case.

- All straight lengths are expressed in multiples of diameter D.
- Values without parentheses are "Zero additional Uncertainty" values.
- Values in parentheses are "0.5% additional Uncertainty" values.

The unbracketed values are "zero additional uncertainty" values.
The bracketed values are " ± 0.5% additional uncertainty values.

- The performance of orifice flow meters is greatly affected when not presented with a fully developed flow pattern, specifically in the high ratios.
- It is strongly recommended to apply the figures corresponding to a ratio of 0.7 thus obtaining the maximum flexibility in changing the orifice size at any time without affecting the zero additional uncertainty.

3.6 Installation of Flow Conditioners

3.6.1 General Instruction

- The use of flow conditioners is recommended to permit the installation of primary devices downstream of fittings not included in Table 1 or 2.
- When a large diameter ratio primary device is to be used, the inclusion of such devices sometimes permits the use of shorter installation lengths upstream of the primary device that given in Table 1 or 2.

3.6.2 Instruction of Flow Conditioner Installation

- Any flow conditioner used shall be installed in the upstream straight length between the primary device and the disturbance or fitting closest to the primary device. Unless it can be verified that the flow conditions at the inlet of the primary device conform with fully developed profile and are free from swirl, the straight length between this fitting and the conditioner itself shall be equal to at least 20D, and the straight length between the conditioner and the primary device shall be equal to at least 22D. These lengths are measured from the upstream face and the downstream face respectively of the conditioner. Conditioners are only fully effective if their installation is such that the smallest possible gaps are left around the resistive elements of the device, therefore permitting no by-pass flows, which would prevent their proper functioning.
- When correctly built conditioners are used with the pipe length combinations described above, they can be used in conjunction with any entrance velocity profile.
- When installed as described above, the use of a flow conditioner does not introduce any additional uncertainty in the discharge coefficient.

3.7 Relation to Read Out Devices

The distance between the transmitter and flow sensor should be as short as possible. If the distance from transmitter to sensor is less than 15 meters, 1/4" OD tubing is satisfactory. For each additional 15 meter use tubing 1/8" larger in size. The impulse lines shall have a gradient to horizontal at least 1:20.

3.8 Pipe Orientation and Flow Direction (Position in The Pipe)

3.8.1 Pipe Orientation

The flow meter pipe orientation shall be as follows:

- H shall be mounted in horizontal pipes only.
- V shall be mounted in vertical pipes only.
- A may be mounted in pipes of any orientation.

- Flow meters should not be inclined unless they can be mounted in any direction. Preferred orientations are indicated in parentheses.
  - Corner tapped orifice plate flow meter (with any plate) H
  - Flange tapped orifice plate flow meter (with any plate) A (Pref. V)
  - Radius tapped orifice plate flow meter (with any plate) A (Pref. V)
  - Venturi tube A (Pref. V)
  - Flow nozzle A (Pref. V)
  - Pitot tubes (including Pitot Venturis) A

- For those flow meters mounted in a vertical pipe it is desirable, but not essential, that a wet gas or saturated steam flow is downward through the flow meter (Fig. 9) and a vapour-containing liquid flow is upward through the flow meter (Fig. 10).

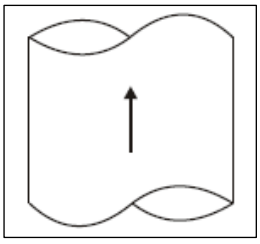


Fig 9: Wet Gas or Saturated Steam Flow

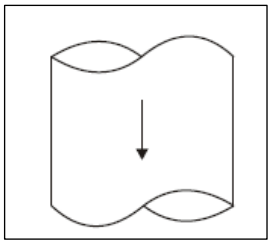
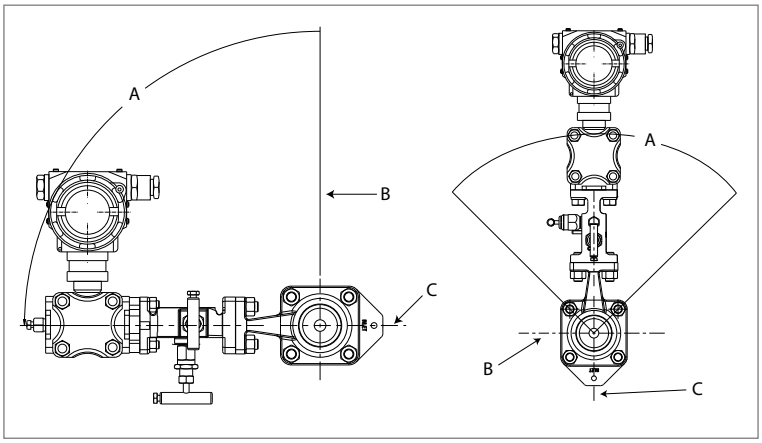


Fig 10: Vapour Containing Liquid Flow

3.8.2 Direct Mount Orientation

3.8.2.1 Installation in Horizontal Pipes (for Gas)

Tek-DP 1610D Integral Orifice Assemblies should be mounted above the pipe to ensure that condensate does not collect on the transmitter sensing diaphragms, as shown in figure 11.

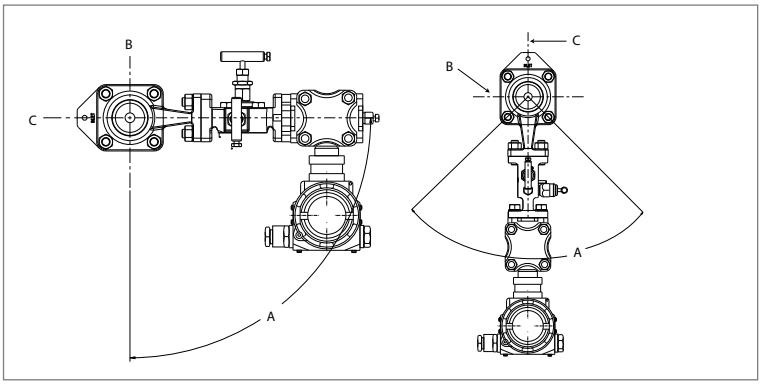


Where, A is 90° Recommended Zone
B is Vertical Plane
C is Horizontal Plane

Fig 11: Direct Mount Gas in Horizontal Pipes

3.8.2.2 Installation in Horizontal Pipes (for Liquids or Steam)

Tek-DP 1610D Integral Orifice Assemblies should be mounted below the pipe to ensure that that gases do not collect on the transmitter sensing diaphragms, as shown in figure 12.



Where, A is 90° Recommended Zone
B is Vertical Plane
C is Horizontal Plane

Fig 12: Direct Mount Liquid or Steam in Horizontal Pipes

3.8.2.3 Installation in Vertical Pipes (for Gas)

- If the fluid is flowing up, a direct mount Tek-DP 1610D should not be used in vertical gas applications because of drain and vent orientation.
- Consider remote mounting the pressure transmitter to facilitate condensate draining.

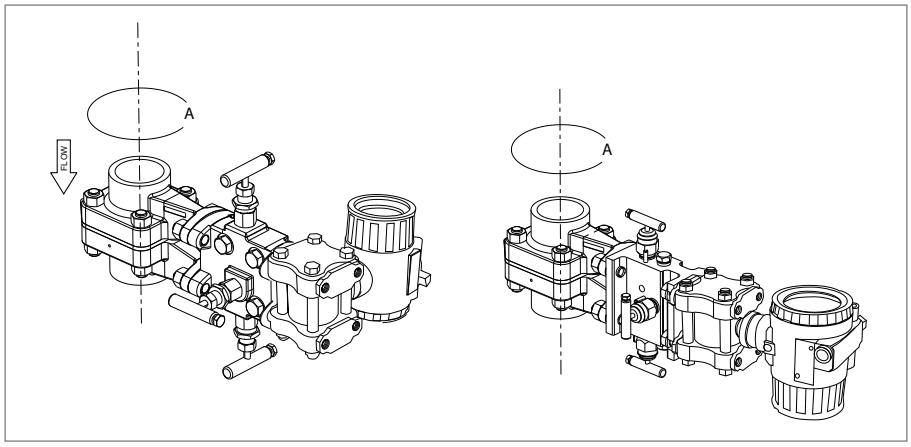


Fig 13: Direct Mount Gas in Vertical Pipes

Where A is 360° Recommended Zone.

3.8.2.4 Installations in Vertical Pipes (for Liquid or Steam)

- If the fluid is flowing down, a direct mount Tek-DP 1610D should not be used in vertical liquid or steam applications.
- Vertical Steam should be remote mount.

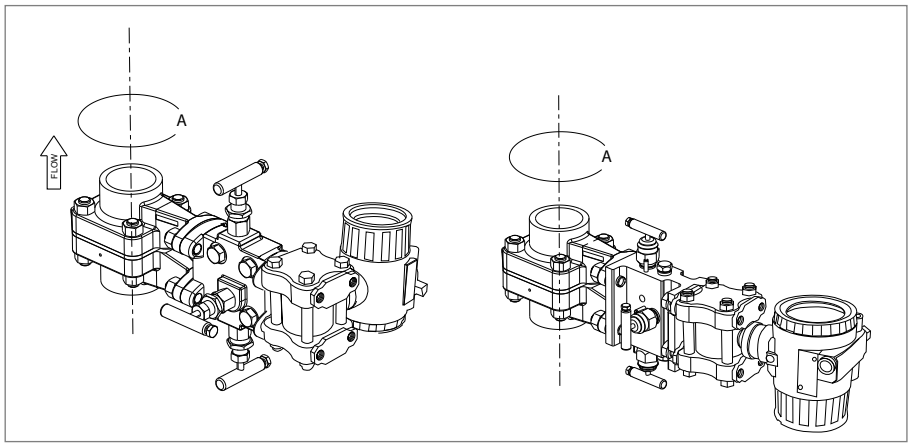


Fig 14: Direct Mount Liquid in Vertical Pipe

Where A is 360° Recommended Zone.

3.8.2.5 Location of the Bleed Hole in Orifice Plates

- An orifice plate flow meter in a vertical line should not have a bleed hole.
- An orifice plate flow meter in a horizontal line in liquid service should have the orifice plate positioned with the bleed hole (if there is one) at the top of the plate.
- An orifice plate flow meter in a horizontal line in gas, vapour or steam service should have the orifice plate positioned with the bleed hole (if there is one) at the bottom of the plate.

3.8.2.6 Location of a Segmental Orifice Plate

Orifice flow meters with a segmental orifice shall be used on horizontal pipes only and be placed at the bottom of the pipe to allow of the easy passage of the secondary phase. Flange pressure tapping are recommended.

3.8.2.7 Location of an Eccentric Orifice Plate

Orifice flow meter with an eccentric orifice shall be use on horizontal pipe only and be placed at the bottom of the pipe to allow of the easy passage of secondary phase. Corner tapping is recommended.

4 Electrical Connection

This section covers all electrical connection requirement. Electrical connection of the device must be carried out by trained; qualified specialists authorized to perform such work by the installation site.

WARNING

- Connect all electrical cables when the power is switched off. If the device does not have switch-off elements, then, overcurrent protection devices, lightning protection and/or energy isolating devices must be provided by the customer.
- The device must be grounded as per the regulations to protect personnel against electric shocks.

NOTE

When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

- To obtain accurate readings from differential pressure flow meters, it is necessary to install the differential pressure measuring instrument (i.e., the secondary device) and the impulse lines such as to avoid the possibility of unequal heads of liquid. In liquid service this necessitates avoiding air or vapour blocking the impulse lines, in gas service it necessitates preventing liquid from blocking the impulse lines. In vapour and steam applications it is assumed that liquid will condense out of the gas phase, so that the installation is suitably arranged for the liquid levels in the two impulse lines to be kept the same.
- It should be realized that ensuring equal heads of liquids in liquid filled impulse lines also requires that the liquid inside the impulse lines be of the same density. Difference in temperature between lines can result in the liquid inside being of different density and hence, although of equal level, they can generate a significant difference in hydrostatic head. The problem is alleviated by keeping impulse lines short, running them over the same route, clipping them together, lagging them together and ensuring that the temperature difference over their length is small.
- It is important that impulse lines are self-cleaning, i.e., that gas bubbles migrate continually upward to a chosen high point and that liquid bubbles and dense solids migrate continually downward to a chosen low point. This is usually ensured by using impulse lines of at least 10mm (3/8") OD, laid over all parts of their length, with a gradient to the horizontal of at least 1:20. It is desirable to arrange the installation such that the chosen high and low points can never accumulate the unwanted phase. In doing so this removes the need for pots, i.e., local enlargement of impulse line diameter, to avoid line blockage, and avoids the need for venting valves to allow the unwanted, slowly Produced accumulations to be released and also the need for regular manual attention to release the accumulation.

4.1 Operating Instructions for Transmitter

WARNING

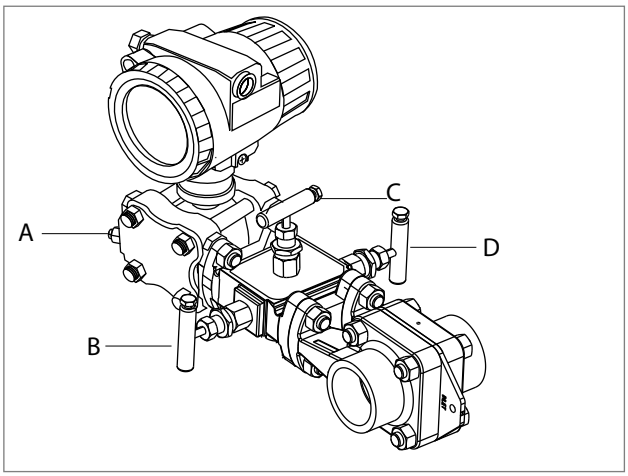
- Severe personal injury or damage to property may result if: The venting valves and/or the screw plug are missing or not fitted properly and/or the valves are improperly or incorrectly operated.
- When working with a hot medium, the individual steps described below must be performed in quick succession; otherwise, the valves & transmitter may overheat and be damaged.

4.1.1 Direct Mount Applications

4.1.1.1 Gas Measurement

- Pressurize line.
- Open the equalizer valve.
- Open the high and low side valves.
- Open drain/vent valves to ensure the liquid is not present.

- Close the vent/drain valves.
- Close the low side valve.
- Check the zero offset of the transmitter according to the transmitter product manual. Therefore, the output on the test meter reads zero percent of span.
- Close the equalizer valve.
- Open the low side valve.
- The system is now operational.

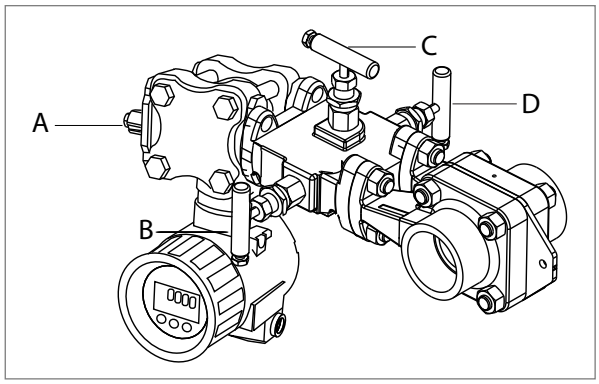


Where A is Vent
B is High Valve
C is Equalizer
D is Equalizer Valve

Fig 15: Direct Mount Gas Measurement

4.1.1.2 Liquid Measurement

- Pressurize line.
- Open the equalizer valve.
- Open the high and low side valves.
- Bleed drain/vent valves until no gas is detectable in the liquid.
- Close the vent/drain valves.
- Close the low side valve.
- Check the zero offset of the transmitter according to the transmitter product manual. Therefore, the output on the test meter reads zero percent of span.
- Close the equalizer valve.
- Open the low side valve.
- The system is now operational.

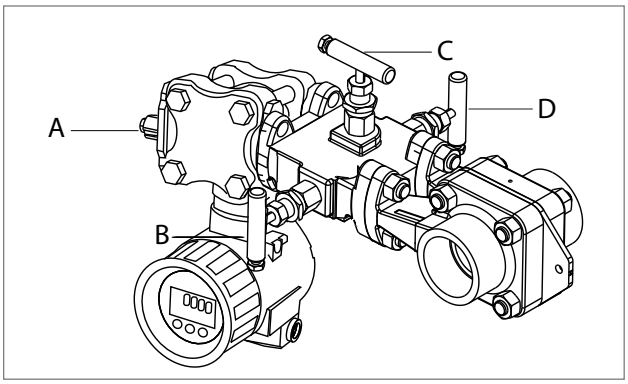


Where A is Vent
B is Low Valve
C is Equalizer Valve
D is High Valve

Fig 16: Direct Mount Liquid Measurement

4.1.1.3 Steam Measurement

- Remove pressure from the line.
- Open equalizer.
- Open high and low side valves.
- Fill manifold and transmitter with water through drain vents.
- Close low side valve.
- Pressurize line.
- Slowly tap electronics body, manifold head and Tek- 1610D body with a small wrench to dislodge any entrapped air.
- Zero electronics.
- Close equalizer valve.
- Open the low side valve.
- The system is now operational.



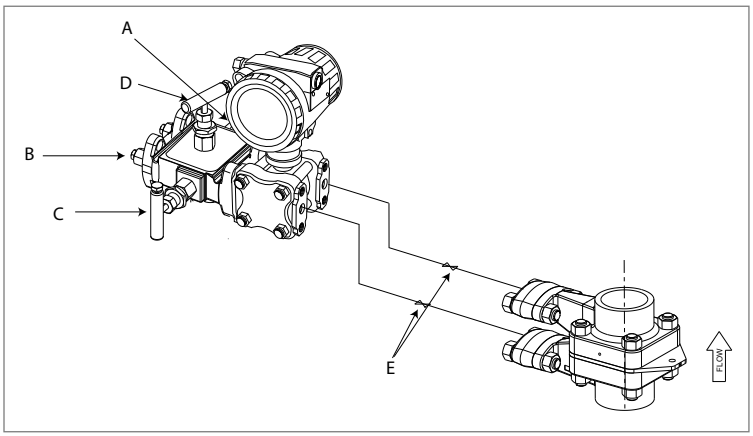
Where A is Vent
B is Low Valve
C is Equalizer Valve
D is High Valve

Fig 17: Direct Mount Steam Measurement

4.1.2 Remote Mount Applications

4.1.2.1 Gas Measurement

- Pressurize line.
- Open equalizer valve on transmitter manifold.
- Open high and low side transmitter manifold valves.
- Open drain/vent valves on transmitter manifold to ensure the liquid is not present.
- Close drain/vent valves.
- Close low side transmitter manifold valve.
- Check zero offset of transmitter according to transmitter manual.
- Close equalizer on transmitter manifold.
- Open low side valve on transmitter manifold.
- The system is now operational.

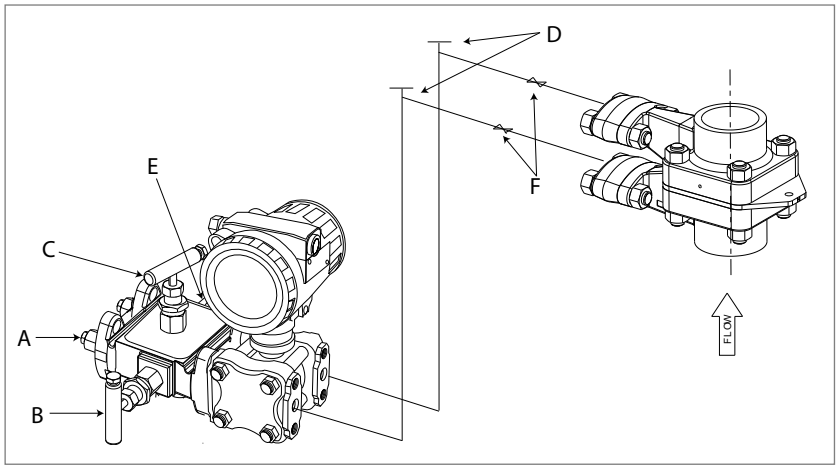


Where A is Low Valve
B is Vent
C is High Valve
D is Equalizer Valve
E is Block Valves

Fig 18: Remote Gas Measurement

Liquid Measurement

- Pressurize line.
- Open equalizer valve on transmitter manifold.
- Close equalizer valve if one is used.
- Open high and low side transmitter manifold valves and block valves.
- Bleed drain/vent valves on transmitter manifold until no air is present.
- Close drain vent valves.
- Close bleed vent valves and block valves until no air is present.
- Close vent valves and block valves.
- Close equalizer valve at transmitter manifold.
- Close low and high side block valves.
- Open vent valves and block valves.
- Check zero offset of the transmitter according to the transmitter manual.
- Close vent valves and block valves.
- Open high and low side block valves.

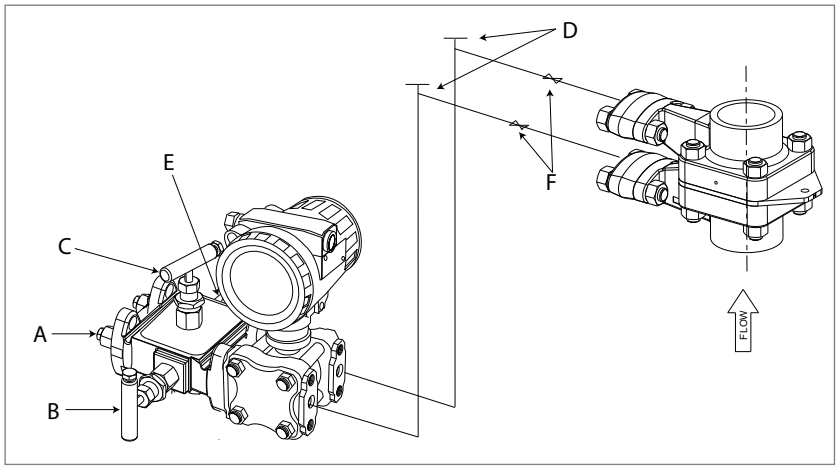


Where A is Vent
B is High Valve
C is Equalizer Valve
D is Vent Valves
E is Low Valve
F is Block Valves

Fig 19: Remote Liquid Measurement

4.1.2.2 Steam Measurement

- Remove pressure from the line or close block valves.
- Open equalizer valves on the transmitter manifold.
- Open high and low side valves on the transmitter manifold.
- Close equalize valve if one is used.
- Open vent valves and block valves.
- Fill transmitter manifold and instrument lines with water through low side vent and block valves.
- Open and close vent valves at the transmitter to bleed out trapped air.
- Close the equalizer valve at the transmitter manifold.
- Complete filling the low side sensing line.
- Slowly tap electronics body, transmitter manifold, instrument lines, and Tek-DP 1610D with a
- small wrench to dislodge any trapped air.
- Check zero offset of the transmitter to the transmitter manual.
- Close vent valves and block valves.
- If block valves had been closed, they should now be opened.
- The system is now operational for steam flow measurement.



Where A is Vent
B is High Valve
C is Equalizer Valve
D is Vent Valves
E is Low Valve
F is Block Valves

Fig 20: Remote Steam Measurement

5 Maintenance

WARNING

- Severe personal injury or damage to property may result if:
  - Do not remove the instrument cover in explosive environments when the circuit is live.
  - When working with a hot medium, the individual steps described below must be performed in quick succession, otherwise the valves and transmitter may overheat and can be damaged.
  - Both transmitter covers must be fully engaged to meet explosion-proof requirements.
  - Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incentive field wiring practices.
  - Avoid contact with the leads and the terminals.

- Check Flow Direction
  - Check that the side of the orifice plate marked “Inlet” is facing upstream.
  - If the DP transmitter is remote mounted from the Tek-DP 1610D, be sure that the impulse tubing is connected correctly from the Tek-DP 1610D to the DP transmitter (high to high and low to low).

- Check Orientation
  Improper orientation can result in inaccurate measurements.

- Check Zero
  The transmitter may read off in the high or low direction if not zeroed properly at start-up/commissioning.

- Check Valves
  equalizer valve fully closed, high and low side valves fully open to set the correct valve for flow measurement.

- RTD Maintenance
  To test the 4-wire RTD procedure as follows:
  - Please power off the transmitter.
  - Remove the temperature terminal housing cover.
  - Disconnect the RTD lead wires from the terminal block.
  - Separate the wires so that the un-insulated ends are not affecting.
  - Check that the resistance measured between the two red wires and two white wires is same (within +/- 0.1Ω).
  - Note down the resistance value measured between the two white wires for use in next step.
  - Measure the resistance between one red and one white wire. Subtract the resistance measured in above step from the resistance measured in this step.
  - If resistance matches the temperature that the RTD is in contact with.

- Check the resistance between any wire and the RTD head or sheath. An acceptable resistance is 200KΩ or greater.
- If any of the above measurements are not within the acceptable range as stated above, please contact an Tek-Trol representative for a replacement RTD.
- To return the RTD to service, connect the lead wires.
- Replace the Temperature Terminal Housing cover.
- Re-connect power to the transmitter.

6 Troubleshooting

This section provides troubleshooting techniques for most common operating problems shown in table 3.

Table 3: Troubleshooting Techniques

Symptom	Possible Cause	Corrective Actions
Questionable accuracy or erroneous flow signal	Improper Installation	• Check flow arrow pointed in the direction of the flow. • Verify that the cross reservoirs are correctly level with one another. • Check the sufficient straight run upstream and downstream of the flow meter.
	System Leaks	• Check instrument piping leaks. • Repair and seal all leaks.
	Contamination or Plugging	• Remove the flow meter and check for contamination.
	Closed Valve	• Verify both High and Low manifold valves are open. • Verify vent, equalizer and line valves are properly positioned per startup procedure.
	Connections (remote mount only)	• Verify the high side of the transmitter is connected to the high side of the flow meter. • Check the same for the low side.
	Entrapped Air (liquid and steam applications)	• Check uneven water legs caused by air entrapment in the instrument connections, if so, bleed air.
	Operating Conditions	• Check the operating conditions in compliance with those given at • the time the flow meter was purchased. • Check the flow calculation and the fluid parameters for accuracy. • Cross check pipe inside diameter for proper sizing.
Raising flow signal	Two-phase flow	• The flow meter is a head measurement device and will not measure a two-phase flow accurately.
Raising flow signal (Stream Service)	Improper insulation (vertical pipes only), Excessive vibration	• Additional insulation may be required to ensure a phase change occurs at the cross reservoirs. • Check the impulse piping for vibration.

mA reading is zero		• Check if power terminals are reversed. • Verify voltage across terminals (should be 10 to 55 Vdc). • Check for bad diode in terminal block. • Replace transmitter terminal block.
Transmitter is not communicating		• Check power supply voltage of transmitter (10.5 Vdc minimum). • Check load resistance (250Ω minimum). • Check if unit is addressed properly. • Replace transmitter.
mA reading is high or low		• Check pressure variable reading for saturation. • Check if output is in alarm condition. • Perform 4–20 mA output trim. • Replace Transmitter.
No response to changes in applied flow		• Check test equipment. • Check impulse piping for blockage. • Check for disabled span adjustment. • Check transmitter security switch. • Verify calibration settings (4 and 20mA points). • Contact factory for replacement.
Low or High reading		• Check impulse piping for blockage. • Check test equipment. • Perform full sensor trim. • Contact factory for replacement.
Unpredictable reading for pressure variable		• Check impulse piping for blockage. • Check damping. • Check for EMF interference. • Contact factory for replacement.

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