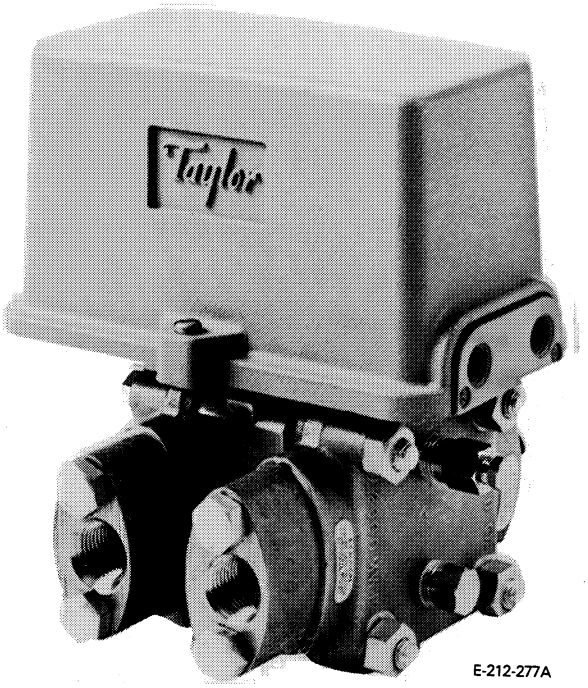
INSTRUCTIONS

DIFFERENTIAL PRESSURE TRANSMITTER

392T, 393T, 394T, 397T, and 398T Model A

IB-2B214
Issue 2
Apr 1984



E-212-277A

ABB Instrumentation

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WARNING - Hazards which could result in personal injury.

CAUTION - Hazards which could result in equipment or property damage.

NOTE - Alerts user to pertinent facts and conditions.

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INTRODUCTION

1.1 DESCRIPTION

The Taylor 390T Series Differential Pressure Transmitters are force balance instruments which measure differential pressure and transmit a proportional pneumatic output signal. The various forms of the transmitter provide capability for measuring differential spans from 5 to 800 inches of water (1.2 to 200 kPa) at working pressures ranging from full vacuum to 6000 psig (40 000 kPa).

The span of each transmitter is continuously adjustable. A micrometer type scale on the span adjustment permits any previously calibrated span to be reproduced without recalibration.

A die-cast aluminum case houses the pneumatic transmitter section, which includes a direct acting, non-bleed output relay. Case and transmitter assembly is identical on all forms of the instrument.

The zero adjustment is accessible through the instrument cover. Adjustment sensitivity is the same on all forms of the transmitter at all span settings. An optional suppression/elevation spring is available for biasing zero on liquid level applications.

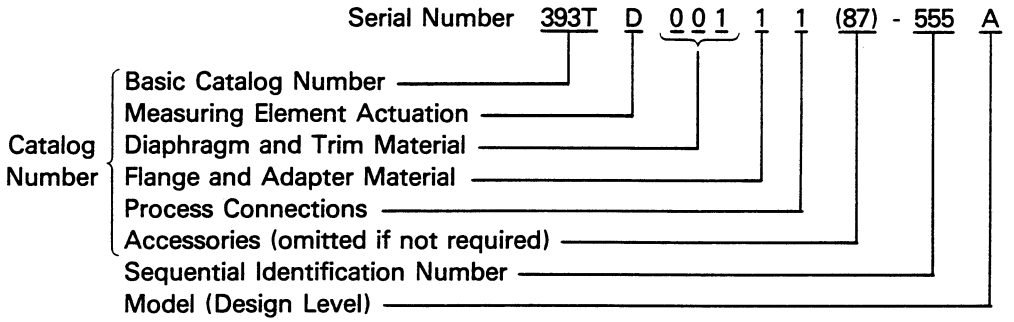
Adjustable input damping is optionally available on some transmitters. The damping adjustment changes the transmitter response time to fit specific process requirements.

Pipe adapters can be connected to either the front or back of the measuring element on transmitters with pipe adapter process connections. This feature provides mounting and connection versatility.

1.2 SERIAL AND CATALOG NUMBERS

The serial number stamped on the data plate consists of the catalog number and a sequential identification number. The catalog number describes the construction of the transmitter.

An X before the serial number indicates that the instrument has been built to meet a customer's special requirements.



Note: Model letter A may not be stamped on data plates of some Model A instruments.

BASIC CATALOG NUMBER

392T — Low Range Transmitter
Span adj from 5 to 50 in. water
(1.2 to 12 kPa)
1000 psig (6 800 kPa)
max working pressure[1]

393T — Medium Range Transmitter
Span adj from 20 to 250 in. water
(5 to 60 kPa)
2000 psig (13 000 kPa)
max working pressure[1]

[1]Maximum working pressure is lower for some forms of the transmitter. Refer to **1.5 Specifications.**

394T — High Range Transmitter
Span adj from 200 to 800 in. water (50 to 200 kPa)
2000 psig (13 000 kPa) max working pressure[1]
397T — Medium Range Transmitter
Span adj from 20 to 250 in. water[2] (5 to 60 kPa)
6000 psig (40 000 kPa) max working pressure[1]
398T — High Range Transmitter
Span adj from 200 to 800 in. water (50 to 200 kPa)
6000 psig (40 000 kPa) max working pressure[1]

MEASURING ELEMENT ACTUATION
D — Differential Pressure

DIAPHRAGM AND TRIM MATERIAL
Without adjustable damping:
000 — Hastelloy-C diaphragm and type 316L SST trim per NACE standard MR-01-75 (1980 Rev)
001 — Hastelloy-C[3] diaphragm and type 316L SST trim
003 — Hastelloy-C
004 — K-Monel[4]
005 — Duranickel[4]
006 — Tantaloy[5] diaphragm and Tantalum trim

With adjustable damping:
007 — Hastelloy-C diaphragm and type 316L SST trim
008 — Type 316L SST

FLANGE AND ADAPTER MATERIAL
1 — Zinc Plated Carbon Steel
2 — Type 316 SST
3 — Hastelloy-C
4 — K-Monel
5 — Duranickel
8 — Kynar[6]

[1]Maximum working pressure is lower for some forms of the transmitter. Refer to **1.5 Specifications.**
[2]Span is lower for some forms of the transmitter. Refer to **1.5 Specifications.**

[3]T.M. of Union Carbide Corp.
[4]T.M. of International Nickel Co.
[5]T.M. of Fansteel Metals Co.
[6]T.M. of Pennwalt Corp.

PROCESS CONNECTIONS
0 — For use with pipe adapters (adapters not supplied)
1 — Pipe Adapters, 1/2-inch Int NPT
2 — Pipe Adapters, 1/4-inch Int NPT
3 — Pipe Adapters, welding neck for 1/2-inch schedule 80 pipe
4 — Flange Face Connections, 1/4-inch Int NPT
5 — Flange Face Connections, 1/2-inch Int NPT

ACCESSORIES
(83) — Integral 3-Valve Manifold (AGCO) for use with pipe adapters
(84) — Integral 3-Valve Manifold (AGCO) for use with tubing
(86) — Integral Orifice Assembly, 1-inch
(87) — Suppression/Elevation Spring
(88) — Integral Orifice Assembly, 1-1/2 inch
(91) — Close Coupling Nipples, 1/2-inch NPT by 3-inch extra heavy hex
( ) — Air Sets, refer to Table 1.
(141) — Integral 3-Valve Manifold (Hoke) for use with pipe adapters
(142) — Integral 3-Valve Manifold (Hoke) for use with tubing
(146) — Mounting Bracket Kit
(151) — Steam Tracing Bolts
(277) — Fiberglas cover and epoxy-coated subbase
(278) — Fiberglas cover
(289) — Integral 3-Valve Manifold (UNICELL) for use with pipe adapters
(290) — Integral 3-Valve Manifold (UNICELL) for use with tubing
(311) — Integral Wedge with 1-inch NPT or BSPT Connection
(312) — Integral Wedge with 1-1/2-inch NPT or BSPT Connection

EXAMPLE:
Serial Number 393TD00111(87)-555A identifies a medium range transmitter with a span adjustable from 20 to 250 inches of water (5 to 60 kPa) and a 2000 psig (13 000 kPa) maximum working pressure (393T), actuated by differential pressure (D). It has Hastelloy-C diaphragms and type 316 SST trim (001), carbon steel flange and adapter material (1), 1/2-inch Int NPT pipe adapters (1) and a suppression/elevation spring (87). The sequential identification number is 555 and the design level is Model A.

Table 1. Accessory Numbers for Air Sets

Accessory Number	Filter Regulator	Air Supply Gage	Air Supply Gage 0-200 kPa	Output Gage 0-100% ±1	Output Gage 0-100% ±1 (20-100 kPa)	Output Gage 0-10 Sq Rt ±1%	Output Gage 0-10 Sq Rt ±1% (20-100 kPa)
(103)	X						
(104)	X	X					
(105)	X	X		X			
(107)	X	X				X	
(109)				X			
(111)						X	
(297)	X	X			X		
(298)	X	X					X
(299)					X		
(300)							X
(302)			X				

E-1209-201(1)

1.3 WETTED MATERIAL IDENTIFICATION

The following abbreviations are used on the instrument data plate to identify materials wetted by the process.

Hastelloy-C — HAST
Type 316 SST — 316
K-Monel — KMON
Duranickel — DURNI
Tantalum — TANT
Tantaloy — TLOY
Carbon Steel — CS
Kynar — KNR

When the instrument has more than one wetted material, the data plate identifies the materials in the following sequence:

Diaphragm — Trim/Flange — Adapter

1.4 FILLING MEDIUM IDENTIFICATION

The following abbreviations are stamped on the diaphragm capsule to identify the filling medium:

SI — Silicone
FL — Fluorolube*

*Trademark of Hooker Chemical

1.5 SPECIFICATIONS

SPAN
392T: Adj from 5 to 50 in. water (1.2 to 12 kPa)
393T: Adj from 20 to 250 in. water (5 to 60 kPa)
397TD__3,4,5,7__: Adj from 20 to 250 in. water (5 to 60 kPa)
397TD__6,8__: Adj from 20 to 200 in. water (5 to 50 kPa)
394T, 398T: Adj from 200 to 800 in. water (50 to 200 kPa)

CALIBRATION ACCURACY (Zero Based)
±0.5% of span (0.25% ultimate capability)

RANGE LIMITS
Refer to Table 2

MAXIMUM WORKING PRESSURE
Refer to Table 3

OUTPUT
3 to 15 psig (20 to 100 kPa)

AIR SUPPLY PRESSURE
20 psig (140 kPa) - recommended
18 psig (125 kPa) - minimum
25 psig (170 kPa) - maximum

AIR CONSUMPTION
0.2 scfm maximum (0.0056 m^3/min)

INPUT DAMPING
Fixed: 0.7 second for 63.2% response (approx);
Adjustable: 0.16 to 1.0 second for 63.2% response (approx); continuously adjustable

AMBIENT TEMPERATURE LIMITS
Measuring Element: −40°F (−40°C) min, 300°F (149°C) max
Transmitter Housing: −40°F (−40°C) min, 180°F (83°C) max
Storage: −90°F (−68°C) min, 180°F (83°C) max

WEIGHT
392T: 25 lbs (11.4 kg)
393T: 13.5 lb (6.2 kg)
394T: 12 lb (5.5 kg)
397T: 27 lb (12.3 kg)
398T: 15 lb (6.8 kg)

VOLUMETRIC DISPLACEMENT
(for maximum differential)
392T: 0.22 cu in. (3.6 cc)
393T, 396T: 0.03 cu in. (0.5 cc)
394T, 398T: 0.01 cu in. (0.16 cc)

VOLUMETRIC CAPACITY
(each side of measuring element)
392T: 3.24 cu in. (55.7 cc)
393T, 396T: 1.55 cu in. (26.2 cc)
394T, 398T: 0.71 cu in. (12.0 cc)

Table 2. Range Limits

Range	Calibration	Range Limits			
		Inches of Water		Kilopascals	
		Lower (3 psi output)	Upper (15 psi output)	Lower (20 kPa output)	Upper (100 kPa output)
392T Low Range	Zero Based	±5% of Span	+4.75 to +50	±5% of Span	+1.14 to +12
	Suppressed Zero	0 to +45	+5 to +50	0 to +10.8	+1.2 to +12
	Elevated Zero	−50 to 0	−45 to +50	−12 to 0	+10.8 to +12
	Center Zero	−25 to −2.5	+2.5 to +25	−6 to −0.6	−0.6 to +6
393T, 397TD__3,4,5,7 Medium Range	Zero Based	±5% of Span	+19 to +250	±5% of Span	+4.8 to +60
	Suppressed Zero	0 to +230	+20 to +250	0 to +55	+5 to +60
	Elevated Zero	−250 to 0	−230 to +250	−60 to 0	−55 to +60
	Center Zero	−125 to −10	+10 to +125	−30 to −2.5	+2.5 to +30
397TD__6,8 Medium Range	Zero Based	±5% of Span	+19 to +200	±5% of Span	+4.8 to +50
	Suppressed Zero	0 to +180	+20 to +200	0 to +45	+5 to +50
	Elevated Zero	−200 to 0	−180 to +200	−50 to 0	−45 to +50
	Center Zero	−100 to −10	+10 to +100	−25 to −2.5	+2.5 to +25
394T, 398T High Range	Zero Based	±5% of Span	+190 to +800	±5% of Span	+48 to +200
	Suppressed Zero	0 to +600	+200 to +800	0 to +150	+50 to +200
	Elevated Zero	−800 to 0	−600 to +800	−200 to 0	−150 to +200
	Center Zero	−400 to −100	+100 to +400	−100 to −25	+25 to +100
Transmitters with suppression/elevation spring, Accessory (87), can be calibrated for suppressed, elevated or center zero.					

Table 3. Maximum Working Pressure

Catalog No.	Maximum Working Pressure		Pressure Limitations
	psig	kPa	
392T	1000	6 800	Reduced to 600 psig (4 000 kPa) at 250°F (121.1°C) on measuring element with Accessory (151)
393T	2000	13 000	Reduced to 300 psig (2 000 kPa) at 80°F (27°C) or 125 psig (850 kPa) at 150°F (66°C) on transmitters with Kynar flanges
394T	2000	13 000	Reduced to 1500 psig (10 000 kPa) when used with 1-1/2" Integral Orifice, Accessory (88); and 1-1/2" Integral Wedge, Accessory (312)
397T	6000	40 000	Reduced to 3000 psig (20 000 kPa) when used with 1-inch Integral Orifice, Accessory (86); and 1" Integral Wedge, Accessory (311) Reduced to 1500 psig (10 000 kPa) when used with 1-1/2 inch Integral Orifice, Accessory (88); and 1-1/2" Integral Wedge, Accessory (312)
398T	6000	40 000	Reduced to 3000 psig (20 000 kPa) for 398TD__2, 398TD__6, 398TD__8

2

INSTALLATION

2.1 MOUNTING

2.1.1 General

Refer to **Process Installation Section, IB-12B922,** for information on locating the transmitter for specific applications.

Select a mounting location where there is minimum vibration. The ambient temperature must not exceed the limits listed under **1.5 Specifications.**

Mount the transmitter so that the measuring element diaphragms are vertical and the measuring element is below the case, Figures 1 through 3. Operation is not affected by mounting in other positions, but some rezeroing may be required (refer to **3.2 Field Zero Adjustment**).

2.1.2 Transmitter with Pipe Adapter Process Connections

When the transmitter catalog number contains Process Connection Digit 1, 2 or 3, it can be mounted using the four 7/16-20 NF mounting holes on either the front or back of the measuring element, Figure 1. If the front mounting holes are to be used, move the plugs in the process ports from the back to the front of the measuring element before mounting. Catalog number 392T, 393T, or 394T transmitters can be mounted directly on the process pipeline using Accessory (91) close coupling nipples, Figure 4.

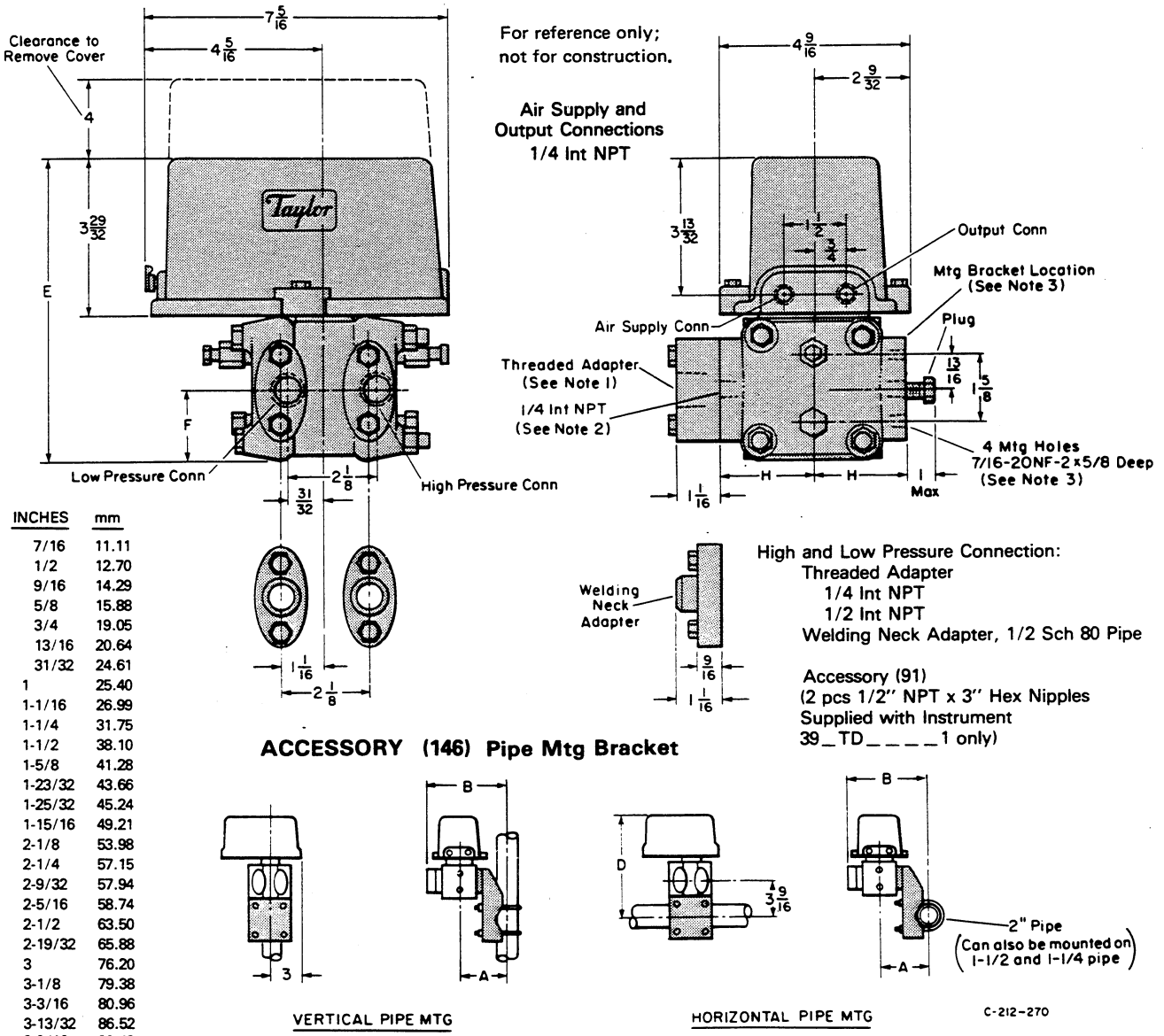
An optional mounting bracket kit, Accessory (146), provides a bracket, U-bolts, and fasteners, Figure 5. The bracket is suitable for pipe mounting. It accepts 1-1/4 through 2-inch pipe and can be used on either horizontal or vertical pipes, Figure 1.

2.1.3 Transmitter with Flange Face Process Connections

2.1.3.1 392T, 393T, 394T, and 398T

When the transmitter catalog number contains Process Connection Digit 4 or 5, it can be mounted using the two 5/16-18 mounting holes in the measuring element, Figure 2.

An optional mounting bracket kit, Accessory (146), provides a bracket, U-bolts, and fasteners, Figure 6. The bracket is suitable for either pipe or surface mounting. For pipe mounting, the bracket accepts 1-1/4 through 2-inch pipe, Figure 2.



INCHES	mm
7/16	11.11
1/2	12.70
9/16	14.29
5/8	15.88
3/4	19.05
13/16	20.64
31/32	24.61
1	25.40
1-1/16	26.99
1-1/4	31.75
1-1/2	38.10
1-5/8	41.28
1-23/32	43.66
1-25/32	45.24
1-15/16	49.21
2-1/8	53.98
2-1/4	57.15
2-9/32	57.94
2-5/16	58.74
2-1/2	63.50
2-19/32	65.88
3	76.20
3-1/8	79.38
3-3/16	80.96
3-13/32	86.52
3-9/16	90.49
3-29/32	99.22
4	101.60
4-5/16	109.54
4-9/16	115.89
4-27/32	123.03
5-3/32	129.38
5-23/32	145.26
5-25/32	146.84
6-19/32	167.48
7-5/16	185.74
7-9/16	192.09
8-5/32	207.17
8-21/32	219.87
8-29/32	226.22
9-5/16	236.54
9-11/32	237.33
9-13/32	238.92
9-29/32	251.62
10-1/32	254.79
10-9/32	261.14

All dimensions in inches.

ACCESSORY (146) Pipe Mtg Bracket

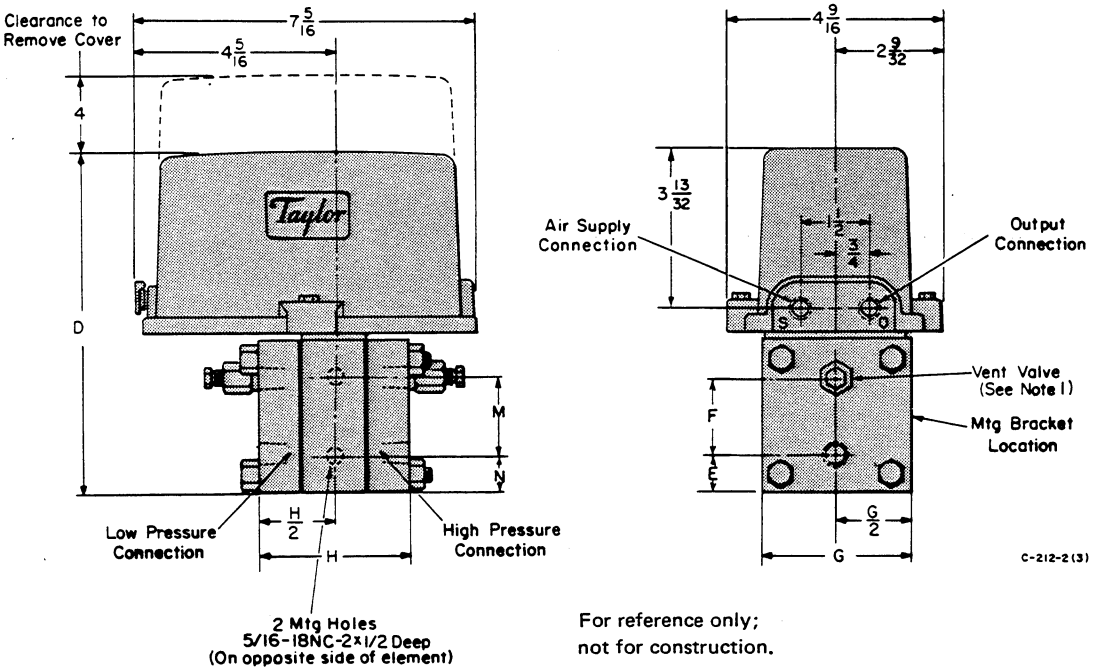
CATALOG NO.	A	B	D	E	F	H
392TD_ _ _ _0,1,2,3	5-23/32	9-29/32	10-9/32	9-5/16	2-19/32	3-1/8
393TD_ _ _ _0,1,2,3	4-27/32	8-5/32	9-13/32	7-9/16	1-23/32	2-1/4
394TD_ _ _ _0,1,2,3	5-3/32	8-21/32	8-29/32	6-19/32	1-1/4	2-1/2
397TD_ _ _ _0,1,2,3	5-25/32	10-1/32	9-11/32	7-9/16	1-25/32	3-3/16
398TD_ _ _ _0,1,2,3	5-3/32	8-21/32	8-29/32	6-19/32	1-1/4	2-1/2

Notes:

1. Threaded adapters are eccentric and can be pcsitioned to obtain center-to-center pressure connection of 1-15/16, 2-1/8, and 2-5/16. Adapters not supplied on 392T, 393T, 394T, 397T, and 398TD_ _ _ _0.
2. The 1/4 NPT threaded connections in the High and Low Pressure flanges have a center-to-center dimension of 2-9/32.
3. Pipe mounting bracket is fastened to the flange using the adapter mounting holes. Bracket can be mounted on opposite end of flange by moving pipe plug and pipe adapters.

Figure 1. Mounting Dimensions for 392T, 393T, 394T, 397T, and 398T Transmitters with Pipe Adapter Connections

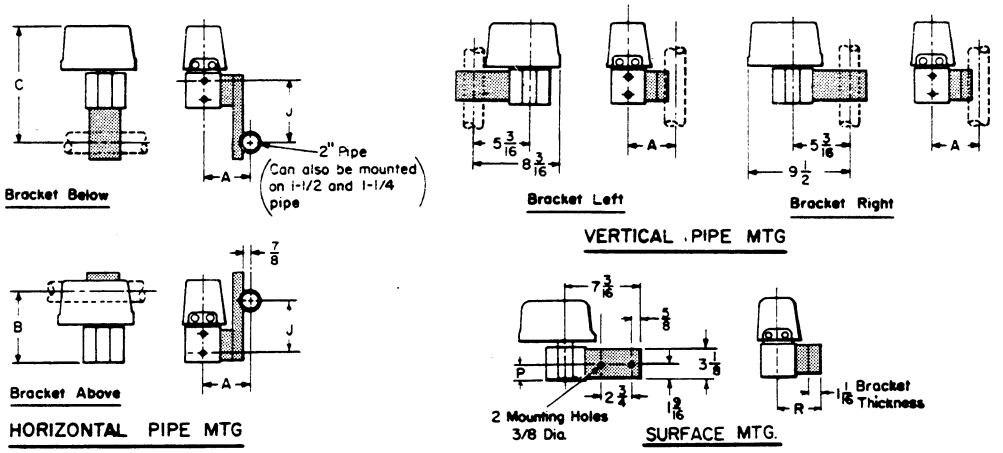
INSTALLATION



For reference only; not for construction.

INCHES	mm
5/16	7.94
3/8	9.53
1/2	12.70
5/8	15.88
23/32	18.26
3/4	19.05
25/32	19.84
13/16	20.64
7/8	22.23
1-1/16	26.99
1-5/32	29.37
1-1/4	31.75
1-1/2	38.10
1-9/16	39.69
1-5/8	41.28
1-23/32	43.66
1-3/4	44.45
2-9/32	57.94
2-1/2	63.50
2-3/4	69.85
2-27/32	72.23
3-3/32	78.58
3-1/8	79.38
3-1/4	82.55
3-13/32	86.52
3-9/16	90.49
3-19/32	91.28
3-15/32	96.04
4	101.60
4-1/8	104.78
4-9/32	108.74
4-5/16	109.54
4-7/16	112.71
4-9/16	115.89
4-19/32	116.68
5	127.00
5-3/16	131.76
5-5/16	134.94
5-9/16	141.29
5-7/8	149.23
6-1/2	165.10
6-19/32	167.48
6-11/16	169.86
6-23/32	170.66
6-3/4	171.45
6-27/32	173.83
7-3/16	182.56
7-5/16	185.74
7-15/32	189.71
7-9/16	192.09
8-3/16	207.96
9-7/32	234.16
9-1/2	241.30
10-25/32	273.84
10-29/32	277.02
11-25/32	299.24

ACCESSORY (146) Pipe Mounting Bracket



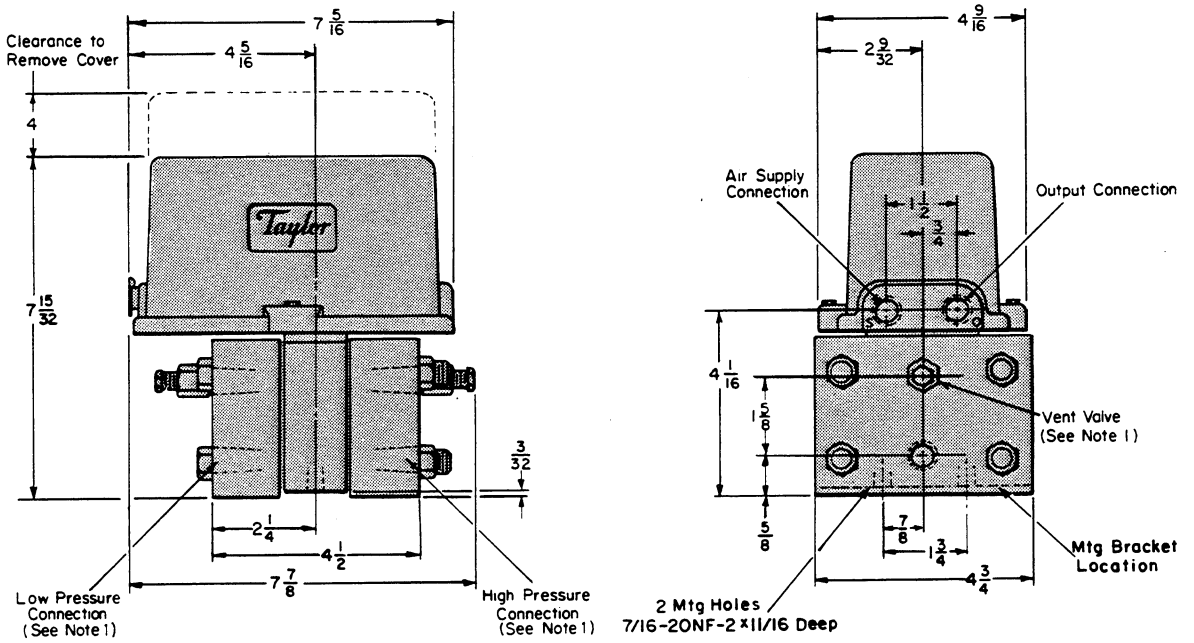
CATALOG NO.	A	B	C	D	F	G	H	J	M	N	P	R
392TD_ _ _ 34	5-5/16	7-9/16	11-25/32	9-7/32	3-9/16	5	2-27/32	6-27/32	1-3/4	1-5/8	2-1/2	4-7/16
392TD_ _ _ 54	5-5/16	7-9/16	11-25/32	9-7/32	3-9/16	5	3-3/32	6-27/32	1-3/4	1-5/8	2-1/2	4-7/16
392TD_ _ _ 85	5-5/16	7-9/16	11-25/32	9-7/32	3-9/16	5	4-9/32	6-27/32	1-3/4	1-5/8	2-1/2	4-7/16
393TD_ _ _ 54	4-7/16	6-23/32	10-29/32	7-15/32	1-5/8	3-1/4	3-19/32	5-7/8	1-23/32	3/4	1-5/8	3-9/16
393TD_ _ _ 85	4-7/16	6-3/4	10-29/32	7-15/32	1-23/32	3-1/4	3-25/32	5-7/8	1-23/32	3/4	1-5/8	3-9/16
394TD_ _ _ 34	4-7/16	6-19/32	10-25/32	6-1/2	7/8	3-1/4	2-27/32	5-7/8	23/32	25/32	1-5/32	3-9/16
394TD_ _ _ 54	4-7/16	6-19/32	10-25/32	6-1/2	7/8	3-1/4	3-3/32	5-7/8	23/32	25/32	1-5/32	3-9/16
394TD_ _ _ 85	4-7/16	6-19/32	10-25/32	6-1/2	——	3-1/4	3-25/32	5-7/8	23/32	25/32	1-5/32	3-9/16
398TD_ _ _ 34	4-7/16	6-19/32	10-25/32	6-1/2	7/8	3-1/4	4-19/32	5-9/16	23/32	25/32	1-5/32	3-9/16

Notes:

1. Vent valves installed as shown for self-draining. If self-venting required, move both vent valves to lower connections.

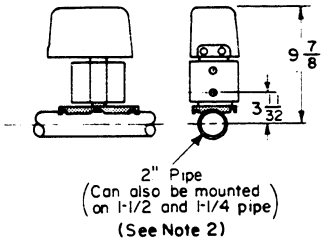
All dimensions in inches. Air Supply and Output Connections 1/4 Int NPT

Figure 2. Mounting Dimensions for 392T, 393T, 394T, and 398T Transmitters with Flange Face Connections

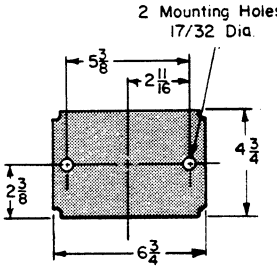


Air Supply and Output Connections 1/4 Int NPT
High and Low Pressure Connections 1/4 Int NPT

ACCESSORY (146) Pipe Mtg Bracket

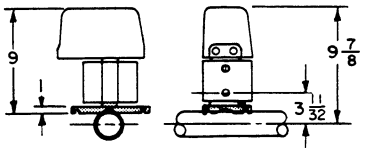


For reference only; not for construction.



BRACKET USED for SURFACE MOUNTING

C-212-124(2)



BRACKET USED for PIPE MOUNTING

INCHES	mm	INCHES	mm	INCHES	mm
3/32	2.38	1-3/4	44.45	4-9/16	115.89
7/16	11.11	2-1/4	57.15	4-3/4	120.65
17/32	13.49	2-9/32	57.94	5-3/8	136.53
5/8	15.88	2-3/8	60.33	6-3/4	171.45
11/16	17.46	2-11/16	68.26	7-5/16	185.74
3/4	19.05	3-11/32	84.93	7-15/32	189.71
7/8	22.23	4	101.60	7-7/8	200.03
1	25.40	4-1/16	103.19	9	228.60
1-1/2	38.10	4-5/16	109.54	9-7/8	250.83
1-5/8	41.28	4-1/2	114.30		

All dimensions in inches.

Notes:

1. Vent valve installed for self-draining. If self-venting required, move both vent valves to lower connections.

2. Bracket clamped to mounting pipe with U-Bolt.

Figure 3. Mounting Dimensions for 397T Transmitters with Flange Face Connections

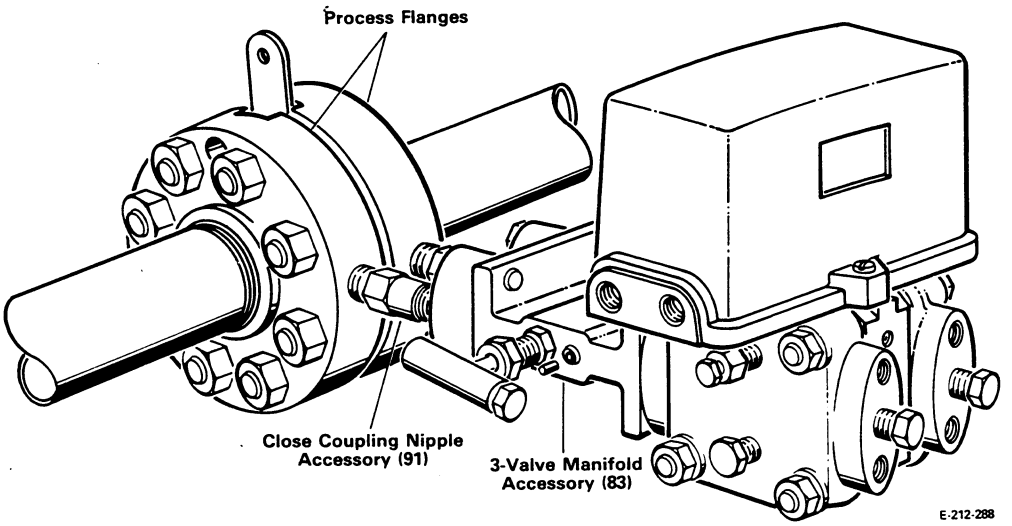


Figure 4. Transmitter Mounted with Close Coupling Nipples, Accessory 91

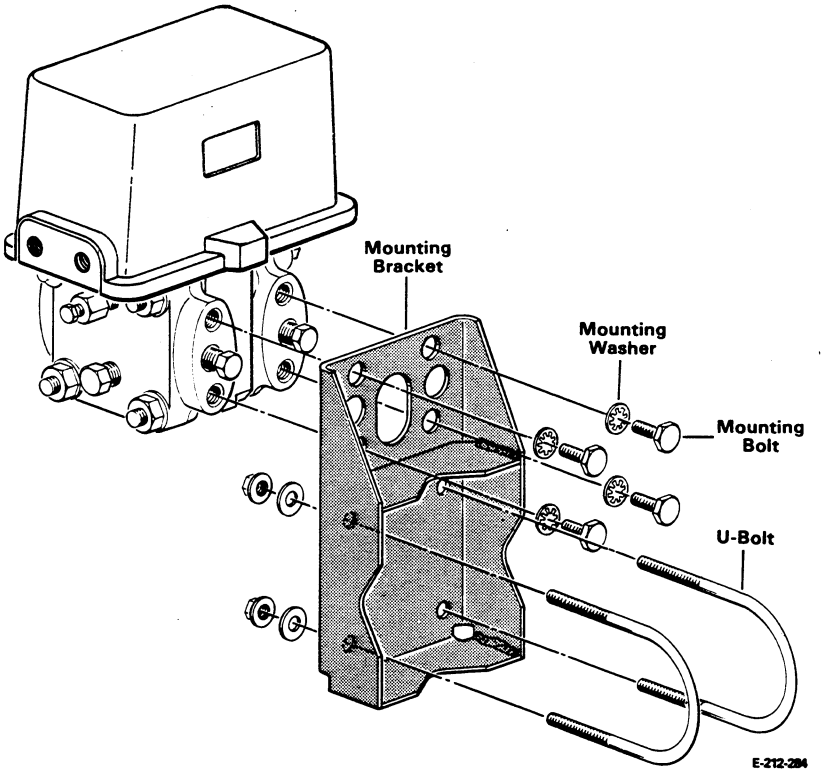


Figure 5. Assembling Optional Mounting Bracket Kit, Accessory (146), on Transmitters with Pipe Adapter Connections

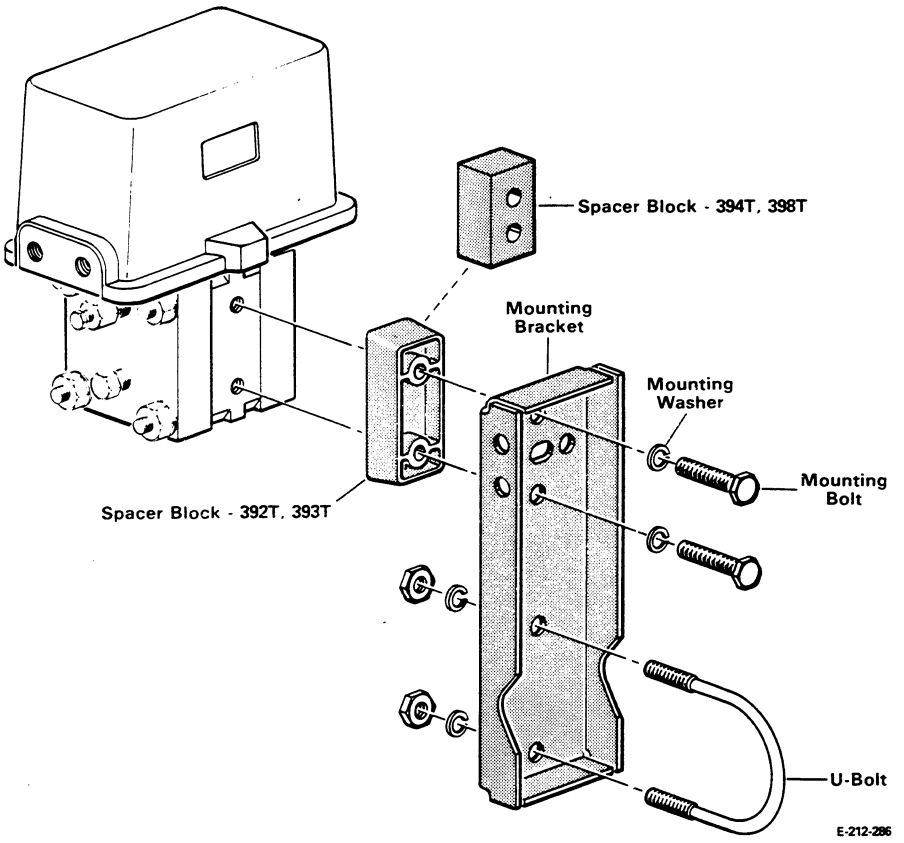


Figure 6. Assembling Optional Mounting Bracket Kit, Accessory (146), on 392T, 393T, 394T, or 398T Transmitters with Flange Face Connections

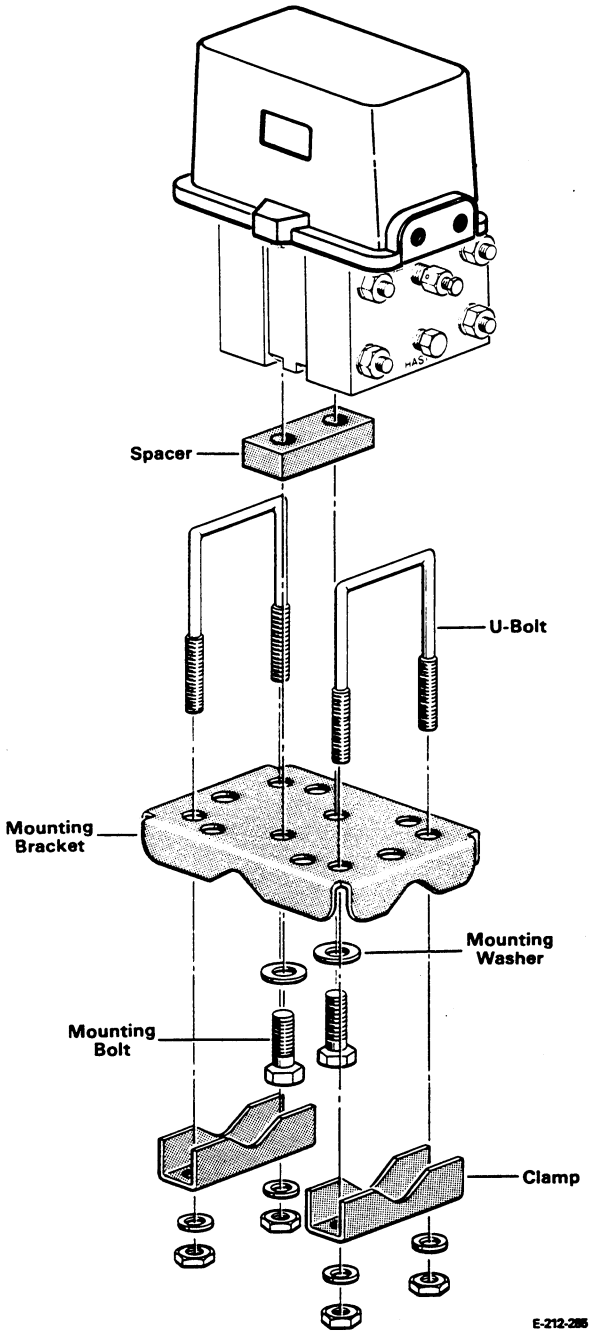


Figure 7. Assembling Optional Mounting Bracket-Kit, Accessory (146), on 397T Transmitters with Flange Face Connections

2.1.3.2 397T

The transmitter can be mounted using the two 7/16-20 mounting holes in the bottom of the measuring element, Figure 7. An optional mounting bracket kit, Accessory (146), provides a bracket, U-bolts, clamps and fasteners, Figure 7. The bracket is suitable for either pipe or surface mounting. For pipe mounting, the bracket accepts 1-1/4 through 2-inch pipe, Figure 3.

2.2 PNEUMATIC CONNECTIONS

WARNING

Use of a supply gas other than air can create a hazardous environment because a small amount of the gas continuously vents to the atmosphere.

The air supply and output ports are located on the end of the transmitter case, Figure 8. Both ports are 1/4-inch Int NPT. One-quarter inch tubing is recommended for air lines.

Connect a clean, dry 20 psig (140 kPa) air supply to the port marked **S**. Connect the output from the port marked **O** to the receiver. The output line must be free of leaks.

2.3 PROCESS CONNECTIONS

Refer to **Process Installation, IB-12B922**, for information on locating the transmitter for specific applications.

2.3.1 Pipe Adapters — 39_TD_ _ _ _1,2,3

When the transmitter catalog number contains Process Connection Digit 1, 2 or 3, adapters for threaded or welded pipe connections are packaged with the instrument. Bolts and gaskets are included.

The adapters can be connected to either the front or back of the measuring element. The transmitter is supplied with plugs installed in the process ports on the back of the measuring element so that the adapters can be connected to the front. If it is necessary to connect the adapters to the back, move the plugs to the front.

2.3.1.1 Threaded Adapters

The threaded adapters are the eccentric type. The center of the process port is located 3/32 inch (2.38 mm) from the center line of the adapter mounting holes, Figures 1 and 2. Thus, adapters can be positioned to obtain process connection center distances of 1-15/16 inches (49.21 mm), 2-1/8 inches (53.98 mm), or 2-5/16 inches (58.72 mm).

Connect adapters to the process line **prior** to connecting the transmitter. When connecting the transmitter, remove plastic plugs from process ports, in-

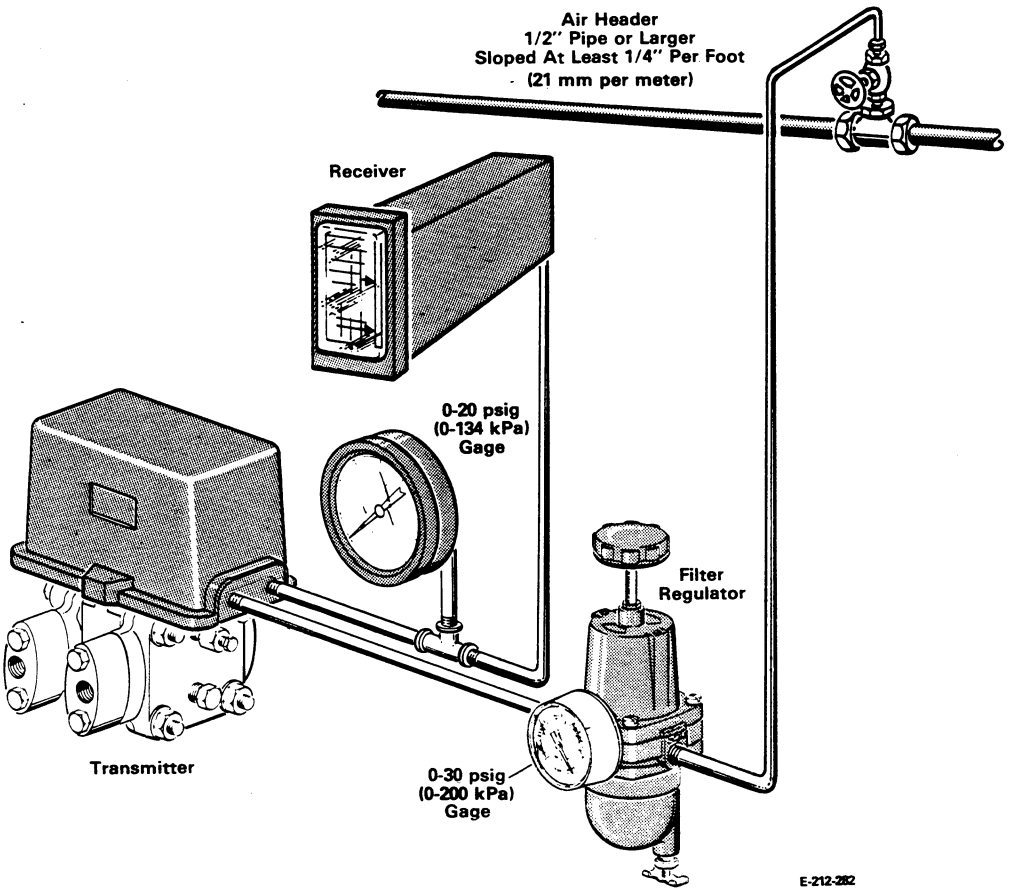


Figure 8. Pneumatic Connections

stall gaskets in adapters, and bolt instrument to adapters.

2.3.1.2 Welding Neck Adapters

The center of the process port in the welding neck adapter is on the center line of the adapter mounting holes, Figures 1 and 2. The 1/2-inch schedule 80 welding neck is beveled for a butt type weld.

Weld the adapters to the process line and allow adapters to cool **prior** to connecting the transmitter. When connecting the transmitter, remove plastic plug from process port, install gaskets in adapters, and bolt instrument to adapters.

2.3.2 Flange Face Connections — 39_TD_ _ _ _4,5

When the transmitter catalog number contains Process Connection Digit 4 or 5, process ports are provided in the flange faces, Figures 2 and 3.

The transmitter is shipped with the vent valves installed in the upper ports to provide for venting when the measuring element is being filled with liquid. If the installation requires drains, move the valves to the lower ports and connect the process lines to the upper ports.

2.3.3 Integral By-Pass Accessories

When the transmitter catalog number contains Accessory (83), (84), (141), (142), (289), or (290), the instrument is supplied with an integral 3-valve by-pass assembly mounted on the measuring element. Accessories (83), (141), and (289) have pipe adapter connectors. Make process connections as described under **2.3.1 Pipe Adapters**. Accessories (84), (142), and (290) provide 1/2-inch Int NPT ports for tube fittings. Connect process tubing directly to the ports.

3

OPERATION

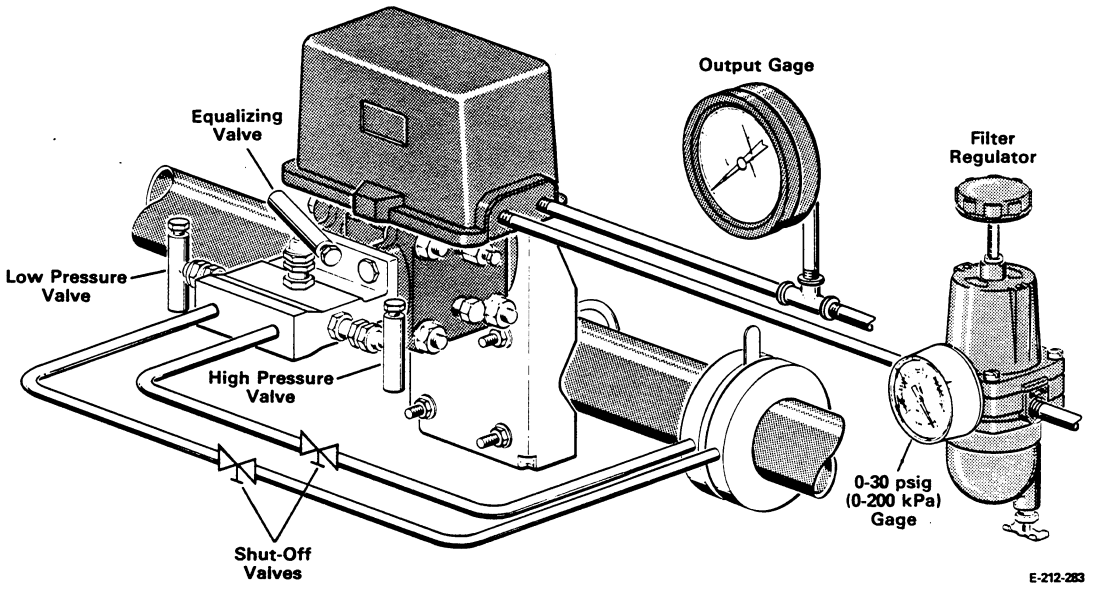


Figure 9. Flow Installation

3.1 PUTTING INTO OPERATION

This section described start-up of the transmitter, assuming that it has been installed as recommended in the **Process Installation Section.**

Turn on the air supply and adjust to 20 psig (140 kPa); then use the following procedure:

3.1.1 Flow Installations

3.1.1.1 Liquid or Gas Service

1. Make sure low pressure and high pressure valves, Figure 9, are closed.
2. Open shut-off valves and equalizing valve.
3. Slowly open high pressure valve to admit process fluid to both sides of measuring element.
4. On liquid service, vent all entrapped air from both sides of measuring element using vent valves. Venting is not required on gas service.
5. After venting, output should be 3 psig (20 kPa). If it is not, turn **ZERO** adjustment, Figure 10, to obtain required output. Clockwise rotation increases output.
6. Close equalizing valve; then open low pressure valve.

3.1.1.2 Steam or Corrosive Fluid Service

1. With shut-off valves closed, open high pressure, low pressure and equalizing valves, Figure 9.
2. Fill measuring element and connecting lines with water or other suitable seal liquid.
3. Vent all entrapped air from connecting lines and measuring element using vent valves. After venting, refill lines as required.
4. Close low pressure and high pressure valves. Equalizing valve remains open.
5. Open shut-off valves.
6. Slowly open high pressure valve to admit process pressure to both sides of measuring element. Output should be 3 psig (20 kPa).

If it is not, adjust zero screw through access hole in end of cover. Clockwise rotation increases output.

7. Close equalizing valve, then open low pressure valve.

NOTE

Equalizing valve must be closed first to insure that seal fluid is not blown out of connecting lines.

3.1.2 Liquid Level Installations

3.1.2.1 Closed Tank Service — Wet Leg

1. Close shut-off valve between tank and **LO** side of measuring element.
2. Fill **LO** side of measuring element and seal leg with liquid.
3. Vent all entrapped air from **LO** side, using vent valve in measuring element.
4. Open shut-off valve between tank and **HI** side of measuring element.
5. Vent all entrapped air from **HI** side.
6. Open **LO** side shut-off valve.

3.1.2.2 Closed Tank Service — Dry Leg

1. Open shut-off valve between tank and **HI** side of measuring element.
2. Open shut-off valve between tank and **LO** side of measuring element.
3. Purge **HI** side of all entrapped air using vent valve.
4. Purge all entrapped condensate from **LO** side, using drain valve in measuring element.

3.1.2.3 Open Tank Service

1. Open shut-off valve between tank and **HI** side of measuring element.
2. Vent all entrapped air from **HI** side using vent valve in measuring element.
3. Make sure **LO** side of measuring element is open to atmosphere.

3.2 FIELD ZERO ADJUSTMENT

To adjust zero on an installed transmitter, use the following procedure:

3.2.1 Flow Installations

1. Close low pressure valve, Figure 9.
2. Open equalizing valve to put zero differential across measuring element. Output should be 3 psig (20 kPa).

   If it is not, turn **ZERO** adjustment, Figure 10, to obtain required output. Clockwise rotation increases output.

NOTE

On liquid or steam service, make sure all entrapped air is vented from measuring element before rezeroing.

3. Close equalizing valve.
4. Open low pressure valve.

3.2.2 Liquid Level Installations

NOTE

Accessory (87) is normally required on transmitters being used for closed tank service.

1. Bring level to minimum condition or to a known reference.
2. Determine required output pressure, using the applicable following equation:

   a. Using U.S. units: (1)

$$\text{Out} = 12\left[\frac{(\text{Ref Level} - \text{Min Level})\, G_t}{\text{Span}}\right] + 3$$

where Out = Output in psig
Min Level = Lowest level to be measured, inches above datum line
Ref Level = dny known level between minimum and maximum, inches above datum line
G_t = Specific gravity of process liquid
Span = Transmitter span setting, inches of water

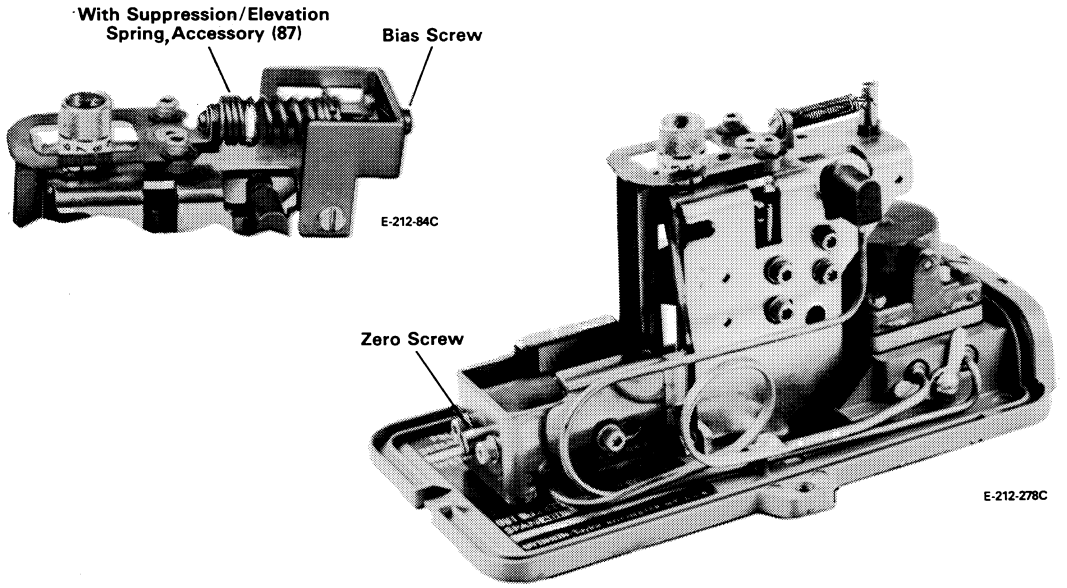


Figure 10. Zero Adjustment

b. Using SI units: (2)

$$Out = 12\left[\frac{(Ref\ Level - Min\ Level)\ (G_t)\ (C)}{Span}\right] + 3$$

where Out = Output in kPa
Min Level = Lowest level to be measured, centimeters above datum line
Ref Level = Any known level between minimum and maximum, centimeters above datum line
G_t = Specific gravity of liquid in tank
C = 0.098 (kilopascal conversion constant, kPa/cm)
Span = Transmitter span setting, kPa

NOTE

Transmitter datum line is at center of seal element diaphragm.

3. If output does not agree with that obtained in Step 2, turn bias screw, Figure 10, until required output is obtained. If necessary, trim zero by adjusting zero screw. Clockwise adjustment of either screw increases output.

NOTE

On closed tank installations, check the condition of the compensating leg before rezeroing. If the transmitter has a dry leg, make sure all condensate is drained from the measuring element. If the transmitter has a wet leg, make sure measuring element and leg are free of entrapped air and filled to the required level.

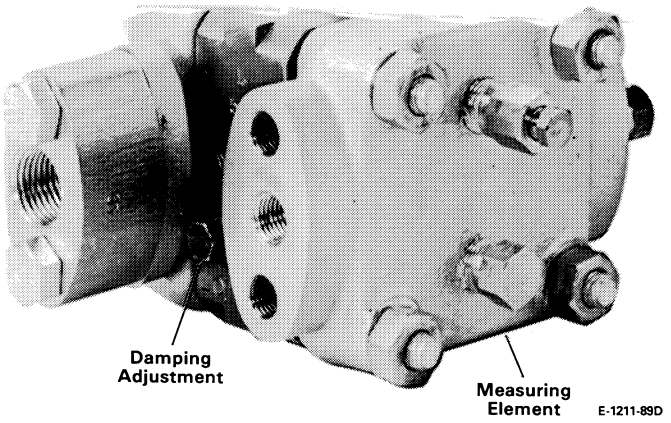


Figure 11. Damping Adjustment

3.3 DAMPING ADJUSTMENT

If the transmitter is equipped with the optional damping adjustment, the response time can be changed by adjusting input damping in the measuring element. Maximum damping (slowest response time) is obtained when the damping adjustment, Figure 11, is turned clockwise to its stop. The adjustment cannot make the instrument inoperative.

Before putting the transmitter into operation, adjust for minimum damping by turning the damping adjustment counterclockwise to its stop. In operation, increase damping as required by process conditions.

3.4 CALIBRATION INDEX

The calibration index reproduces any previously calibrated span within ±0.5% without recalibration. The index scale, Figure 12, divides the span scale into sixty increments. One full turn of the span screw moves the scale indicator one increment; and the vernier scale on the span screw divides the increment into tenths. Using these scales, span settings can be converted into index numbers.

For example, if a transmitter has been calibrated for 100 inches (25 kPa) of water, the index reading might be 26.53. Digits in front of the decimal are read from the index scale using the top edge of the indicator. Digits after the decimal are read from the vernier scale. With the index number noted, the span can be changed and then returned to 100 inches by adjusting the scale indicator to the index number. Only rezeroing may be required.

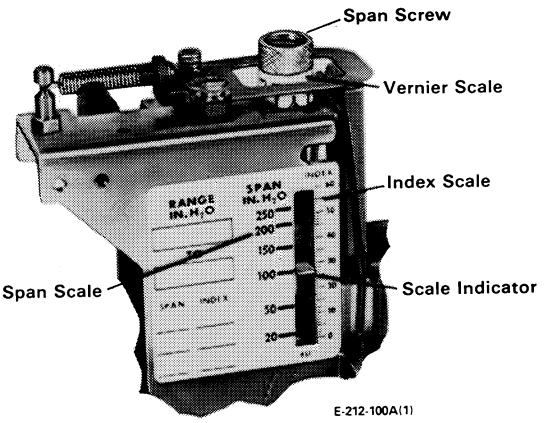


Figure 12. Calibration Index

4

FUNCTIONAL DESCRIPTION

4.1 GENERAL

The transmitter operates on the force balance principle; force developed by the measuring element is balanced by the force produced by output pressure acting on the follow-up bellows, Figure 13.

An increase in differential pressure, acting on the measuring element diaphragms, develops force which moves the lower end of the force beam to the right. The nozzle-baffle gap decreases and nozzle back pressure increases. This pressure is fed to chamber A of the output relay.

As the pressure in chamber A increases, the diaphragm assembly moves the relay stem downward, closing the vent port and opening the air supply port to increase the output. The output increases until it balances the downward force on the diaphragm assembly.

The output pressure is fed to the follow-up bellows which applies force to the span lever. This force is transferred through the flexible strip back to the force beam. The nozzle-baffle gap is restored approximately to its original position as equilibrium is established between measuring element force and follow-up force. Since the follow-up force is produced by output pressure, the output is proportional to differential.

4.2 SUPPRESSION/ELEVATION SPRING, ACCESSORY (87)

The suppression/elevation spring biases output to compensate for the effect of initial head pressures which are often encountered in liquid level applications.

On an open tank liquid level installation where the minimum level is above the elevation of the HI side process tap, output will be above the required zero value at minimum level. The suppression/elevation spring, compressed by adjustment of the bias screw, provides force which balances the measuring element force resulting from the initial head pressure. Thus, the spring **suppresses** the output to the required zero value.

On a closed tank liquid level installation with a wet leg, output will be below the required zero value at minimum level. The suppression/elevation spring, tensioned by adjustment of the bias screw, provides balancing force which **elevates** the output to the required zero value.

Suppression or elevation adjustments are made as part of the transmitter calibration procedure. The head pressures are simulated by calibration pressures applied to the measuring element.

4.3 DAMPING

The liquid filled measuring element provides damping which determines the speed with which the transmitter output responds to changes in differential pressure. When a change in differential pressure occurs, a very small amount of liquid flows through the connecting path between the high and low side diaphragm cavities. The size of the connecting path determines the amount of damping. The transmitter is available with either fixed or adjustable damping.

When the transmitter has **fixed** damping, liquid flows through the restricted connecting path around the diaphragm rod, Figure 13. The restriction is sized so that the nominal full scale (99%) response time following a step change in differential is approximately 3 seconds.

When the transmitter has optional **adjustable** damping, a damping adjustment is built into the measuring element. When the damping adjustment is fully open, as shown in Figure 13, liquid flows unrestricted past the adjustment screw and also through the clearance around the diaphragm rod. This is the minimum damping condition and the transmitter response is fast.

As the damping adjustment is turned to close off the variable restriction, damping increases. With the adjustment fully closed, only the highly restricted path around the diaphragm rod is open. This is the maximum restriction and the slowest response condition. The restrictions are sized so that the nominal full scale response time following a step change in differential can be adjusted from 0.8 to 5 seconds.

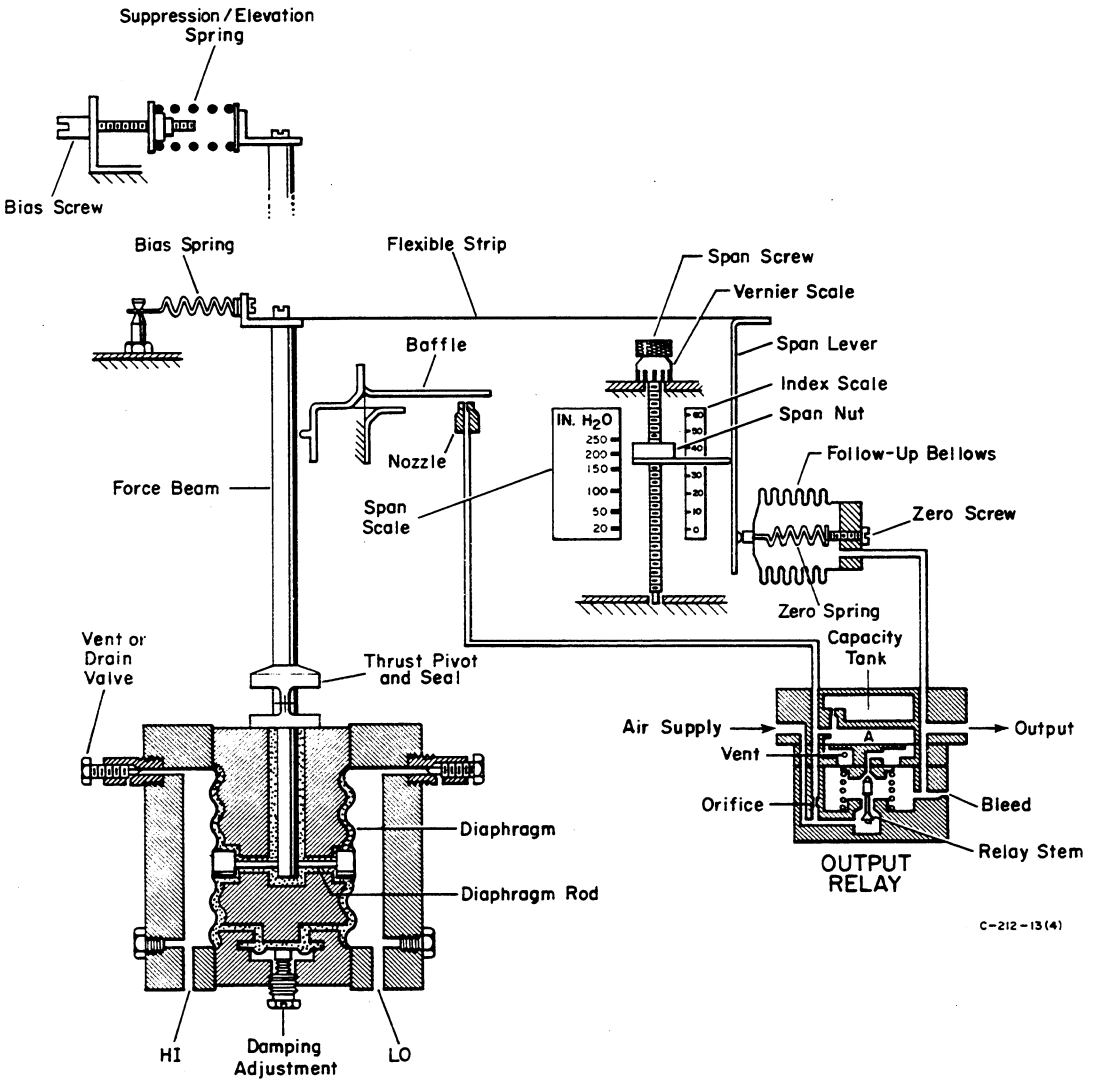


Figure 13. Schematic Diagram of Transmitter