

FLOBAR™ ELEMENT
FLOW DATA SHEET
(English Units)

Customer Name Universal Controls Filled in by Kenneth R. Marshall
 Customer P.O. No. _____ (job# 05-85-5306)
 _____ para 2-1-16?
 (Address to which copy of Flow Data Sheet is to be mailed)
 Street Address _____ or P.O. Box No. _____
 City _____ State _____ Zip Code _____
 To the Attention of: Kenneth R. Marshall

HOW TO ORDER

1. Obtain process pipe and process flow information.
2. Select appropriate model number of Flobar element for application.
3. Verify that flow rates meet maximum and minimum flow conditions stated on Flobar's specification sheet.
4. Approximate the differential pressure (by graph on product specification sheet or by calculation) in order to specify the transmitter.
5. Fill out data tag information on sample tag below.

Pipe Size (Inches)	D (SCH 40)	K Factor
1/2	.672	.395
3/4	.824	.425
1	1.049	.537
1-1/4	1.380	.568
1-1/2	1.610	.573
2	2.067	.595
2-1/2	2.469	.630
3	3.068	.640
3 1/2	3.548	.644
4	4.026	.648
5	5.047	.620
6	6.065	.637
8	7.981	.645
10	10.020	.636
12	11.938	.627
14	13.126	.625
16	15.000	.623
18	16.876	.620
20	18.814	.617
24	22.628	.616
Larger Sizes		.616

Process pipe size 2"
 Process pipe schedule schedule 40
 Process pipe material carbon steel
 Pipe position and flow direction? (Horizontal; vertical-flowup; vertical-flowdown) horizontal
 Is process shutdown acceptable for installation and/or replacement?
 (Yes) (No)
 Fluid water
 Flow Rate (U.S. gpm) scfh, lb/hr

Min	Nom	Max
<u>13</u>	<u>35.5</u>	<u>40</u>

 Process Temperature (°F) 50° 70° 90
 Process Pressure (PSIG) 60 80 100
 Specific Gravity at Base Temp. _____
 Specific Gravity at Flowing Temp. _____
 Fluid Viscosity 1

LIQUID	GAS	STEAM
$h = 9f \times \left(\frac{\text{U.S. gpm}}{5.663 \text{ KD}^2} \right)^2$	$h = \left(\frac{TfG}{Pf} \right) \times \left(\frac{\text{scfh}}{7727 \text{ KD}^2} \right)^2$	$h = V \times \left(\frac{\text{lb/hr}}{359 \text{ KD}^2} \right)^2$

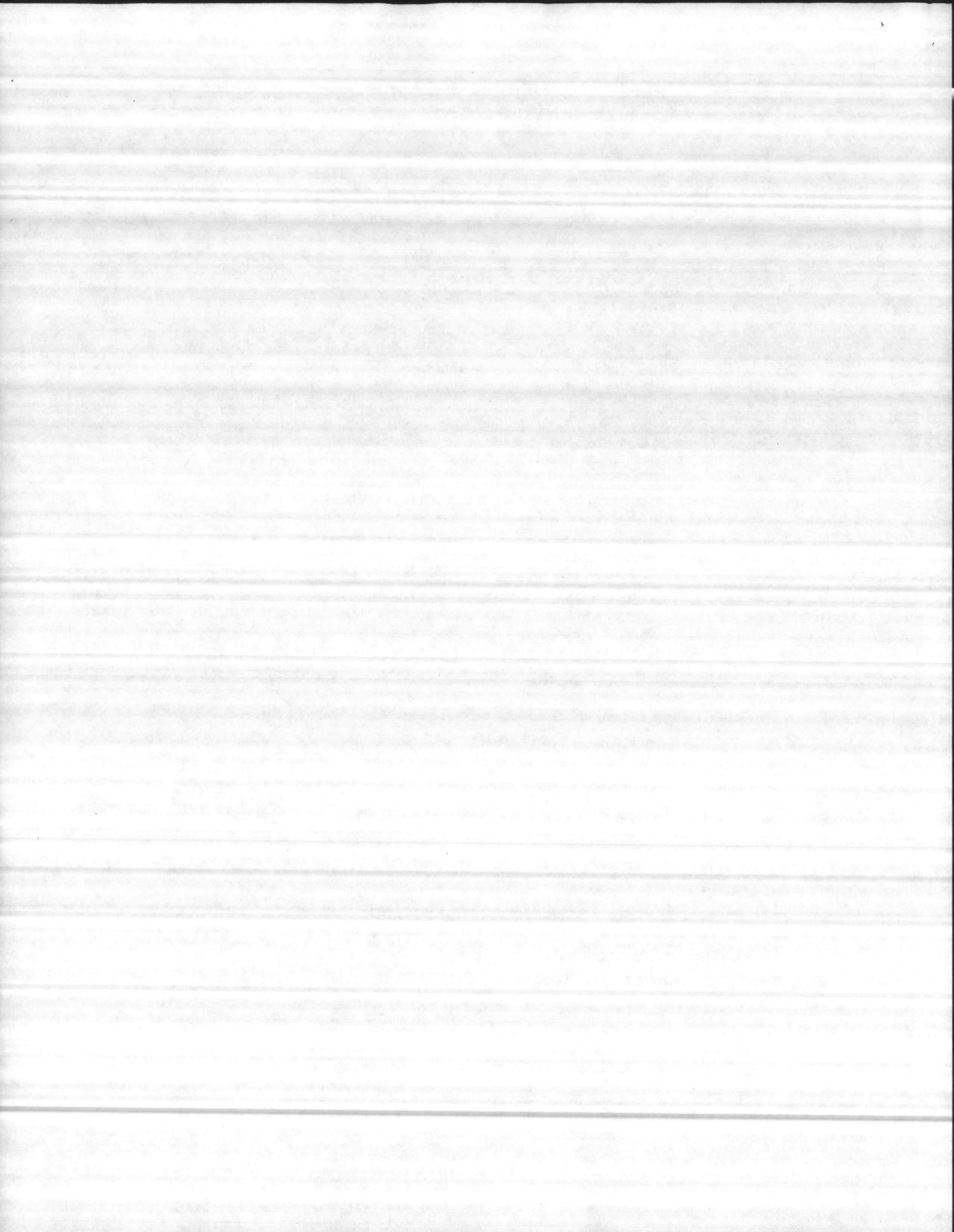
TRANSMITTER CALIBRATION DATA
 $h = \Delta P =$ _____
 for max. flow rate

- D - Inside pipe diameter (Inches) (see flow data book)
- 9f - Liquid specific gravity at flowing temperature
- G - Gas, specific gravity
- h - Differential pressure (Inches of water)
- K - Flow coefficient (See table above)
- lb/hr - Steam flow rate (pounds per hour)
- Pf - Gas flowing pressure (Pf = 14.7 + psig)
- scfh - Gas flow rate (cubic feet per hour) at 60°F and 14.7 psia

$$\left(\text{scfh} = \text{scfh} \times \frac{Pf}{14.7 \text{ psia}} \times \frac{520}{Tf} \right)$$
- Tf - Gas flowing temperature (°R, Tf = 460 + °F)
- U.S. gpm - Liquid flow rate (U.S. Gallons per minute at flowing temperature)
- V - Specific volume of steam (cubic feet per pound)

FLOBAR™ ELEMENT

SERIAL _____
 PIPE SIZE _____ PIPE SCHEDULE _____
 MWP _____ COEF. "K" _____
 WETTED MATERIALS SEE INSTRUCTION MANUAL
 TAYLOR INSTRUMENT COMPANY
 ROCHESTER N.Y. U.S.A.



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(English Units)

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3 1/2	3.548	.644
4	4.028	.648
5	5.047	.620
6	6.065	.637
8	7.981	.645
10	10.020	.638
12	11.938	.627
14	13.128	.625
16	15.000	.623
18	16.876	.620
20	18.814	.617
24	22.626	.616
Larger Sizes		.616

Process pipe size 2 1/2"
 Process pipe schedule schedule 40
 Process pipe material carbon steel
 Pipe position and flow direction? (Horizontal; vertical-flowup; vertical-flowdown) horizontal
 Is process shutdown acceptable for installation and/or replacement?
 (Yes/No) (Yes)
 Fluid water

	Min	Norm	Max
Flow Rate (U.S. gpm, scfh, lb/hr)	<u>30</u>	<u>73.5</u>	<u>100</u>
Process Temperature (°F)	<u>50</u>	<u>70</u>	<u>90</u>
Process Pressure (PSIG)	<u>60</u>	<u>80</u>	<u>100</u>
Specific Gravity at Base Temp.			
Specific Gravity at Flowing Temp.			
Fluid Viscosity		<u>1</u>	

LIQUID	GAS	STEAM
$h = g_f \times \left(\frac{\text{U.S. gpm}}{6.663 \text{ KD}^2} \right)^2$	$h = \left(\frac{T_f G}{P_f} \right) \times \left(\frac{\text{scfh}}{7727 \text{ KD}^2} \right)^2$	$h = V \times \left(\frac{\text{lb/hr}}{359 \text{ KD}^2} \right)^2$

TRANSMITTER CALIBRATION DATA
 h ... ΔP - _____
 for max. flow rate

- D = Inside pipe diameter (inches) (see flow data book)
 - g_f = Liquid specific gravity at flowing temperature
 - G = Gas, specific gravity
 - h = Differential pressure (inches of water)
 - K = Flow coefficient (See table above)
 - lb/hr = Steam flow rate (pounds per hour)
 - P_f = Gas flowing pressure (P_f = 14.7 + psig)
 - scfh = Gas flow rate (cubic feet per hour) at 80°F and 14.7 psia
- $$\left(\text{scfh} = \text{scfh} \times \frac{P_f}{14.7 \text{ psia}} \times \frac{620}{T_f} \right)$$
- T_f = Gas flowing temperature (°R, T_f = 460 + °F)
 - U.S. gpm = Liquid flow rate (U.S. Gallons per minute at flowing temperature)
 - V = Specific volume of steam (cubic feet per pound)

FLOBAR™ ELEMENT

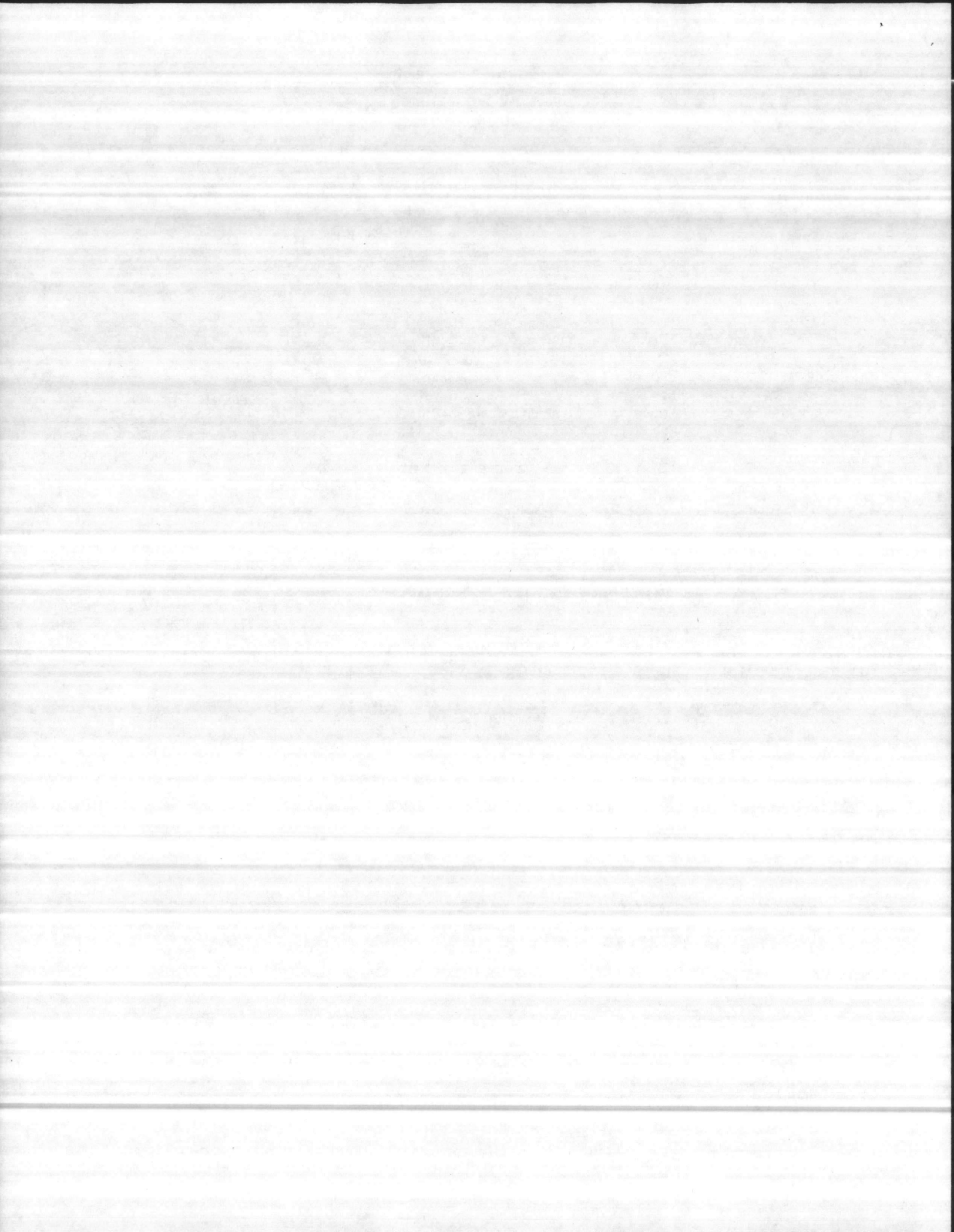
SERIAL _____

PIPE SIZE _____ PIPE SCHEDULE _____

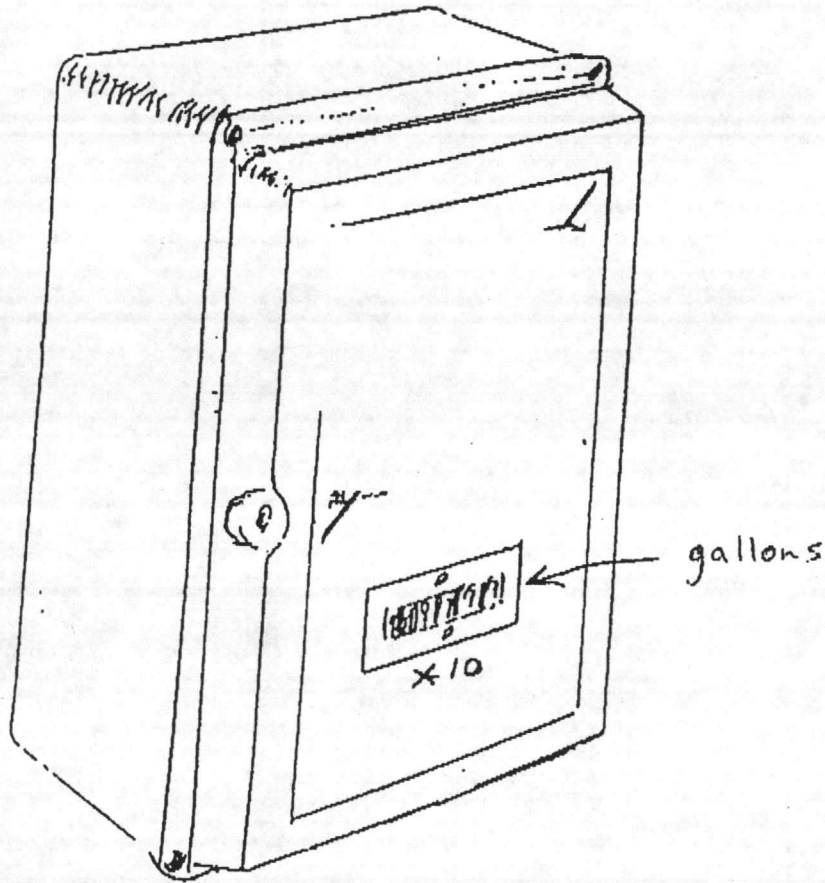
MWP _____ COEF. "K" _____

WETTED MATERIALS _____ SEE INSTRUCTION MANUAL

TAYLOR INSTRUMENT COMPANY
ROCHESTER, N.Y. U.S.A.



Water Flow Totalizer and Flow Rate Transmitter



CONSISTS OF:

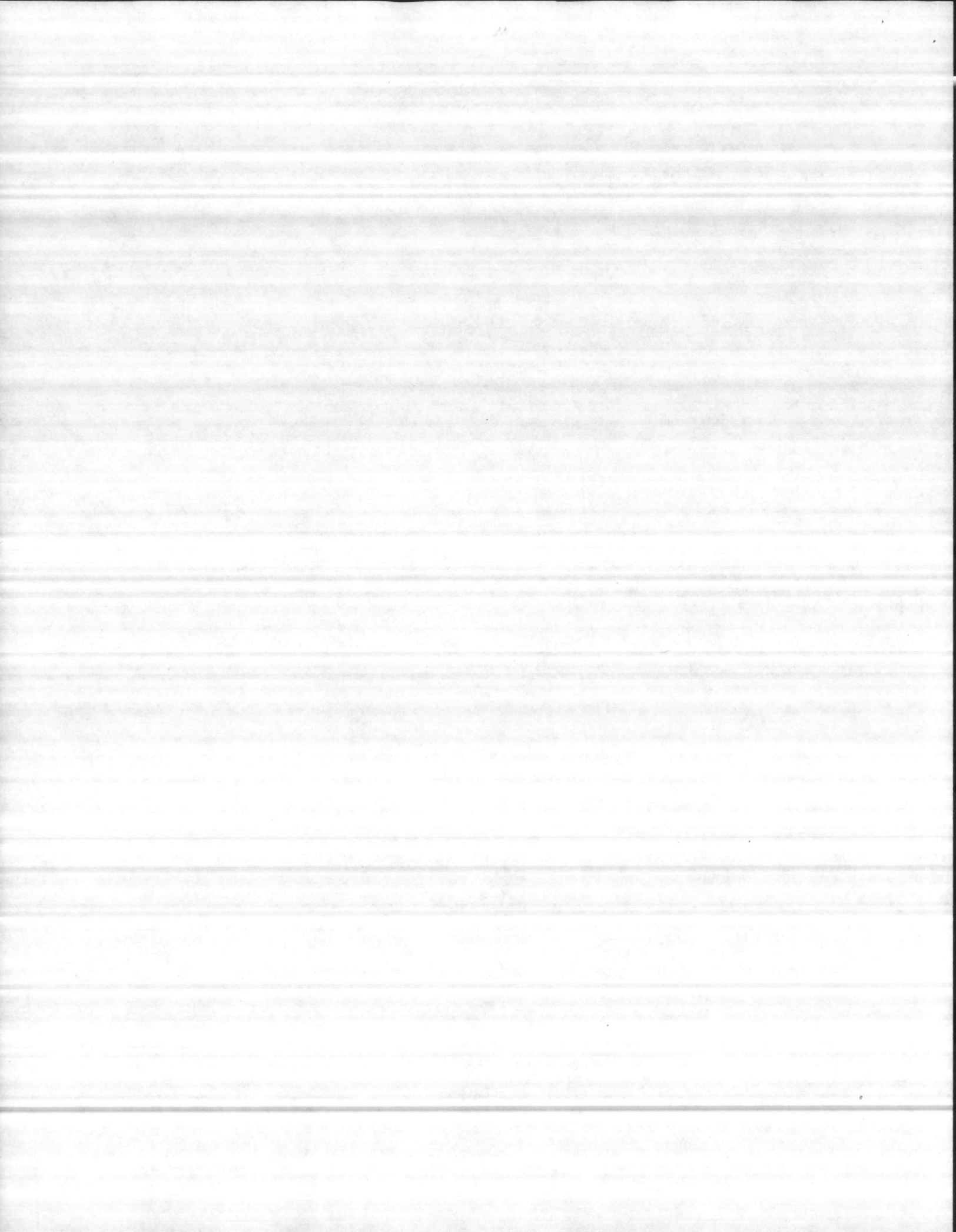
"NOT TO SCALE"

Hoffman A 1066JFG
Enclosure

RIS 1358 ■ square root
Integrator

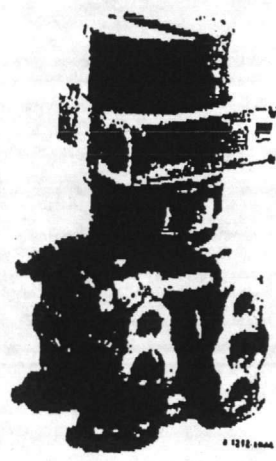
RIS 1330 E square root
extractor

Durant 7Y-41349-402ME
on Reset 7-Digit Counter



9400T SERIES ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER

- ± 0.25% OF SPAN ACCURACY
- SPANS FROM 0.8 IN. H₂O TO 800 IN. H₂O
- OUTSTANDING TEMPERATURE STABILITY
- RUGGED, LIGHTWEIGHT DESIGN



PRODUCT DESCRIPTION

The 9400T Series Electronic Differential Pressure Transmitter is a two-wire, 24V dc transmitter with a 4 to 20 mA dc output signal linear to the input pressure (square root extraction for a linearized flow signal is optionally available). The transmitter employs a ceramic capacitance sensor and unique, hermetically sealed, thick-film hybrid circuit. Each hybrid circuit is dynamically laser trimmed to match the performance characteristics of the sensor to create a high-performance, high-reliability transmitter. Combined accuracy, temperature, and pressure stability are unmatched by other electronic pressure transmitters.

FEATURES

- Laser-trimmed, hybrid circuitry
- Hermetically sealed electronics
- Capacitance sensor
- Spans from 0.8 in. H₂O to 800 in. H₂O
- ± 0.25% of span accuracy
- Lightweight design
- NACE-compatible materials

BENEFITS

- High reliability and performance
- Unsurpassed protection from atmosphere
- No moving parts
- Up to 8:1 span turndown for greater application versatility
- Higher accuracy for a more reliable output signal
- Reduced installation and maintenance costs
- NACE-compatible sensor, flanges, adapters, and bolt material available for sour gas service

SPECIFICATIONS

FUNCTIONAL CHARACTERISTICS

Transmitter	Span Limits	Range Limits		Overrange and Static Pressure Limits
		Lower	Upper	
9403T	0-0.8 to 0.5 in. H ₂ O (0.2 to 1.2 kPa)	-3.3 in. H ₂ O (-0.8 kPa)	5 in. H ₂ O (1.2 kPa)	Standard: 2,500 psig (17 600 kPa) Optional: 8,000 psig (40 000 kPa)
9404T	0.5 to 0.30 in. H ₂ O (1.2 to 7.5 kPa)	-20 in. H ₂ O (-5 kPa)	30 in. H ₂ O (7.5 kPa)	
9405T	0-25 to 0-150 in. H ₂ O (6 to 38 kPa)	-100 in. H ₂ O (-25 kPa)	150 in. H ₂ O (38 kPa)	
9408T	0-150 to 0-800 in. H ₂ O (38 to 200 kPa)	-500 in. H ₂ O (-124 kPa)	800 in. H ₂ O (200 kPa)	

Zero Elevation/Suppression: Zero is infinitely adjustable provided that the calibrated range is within the span end range limits above.

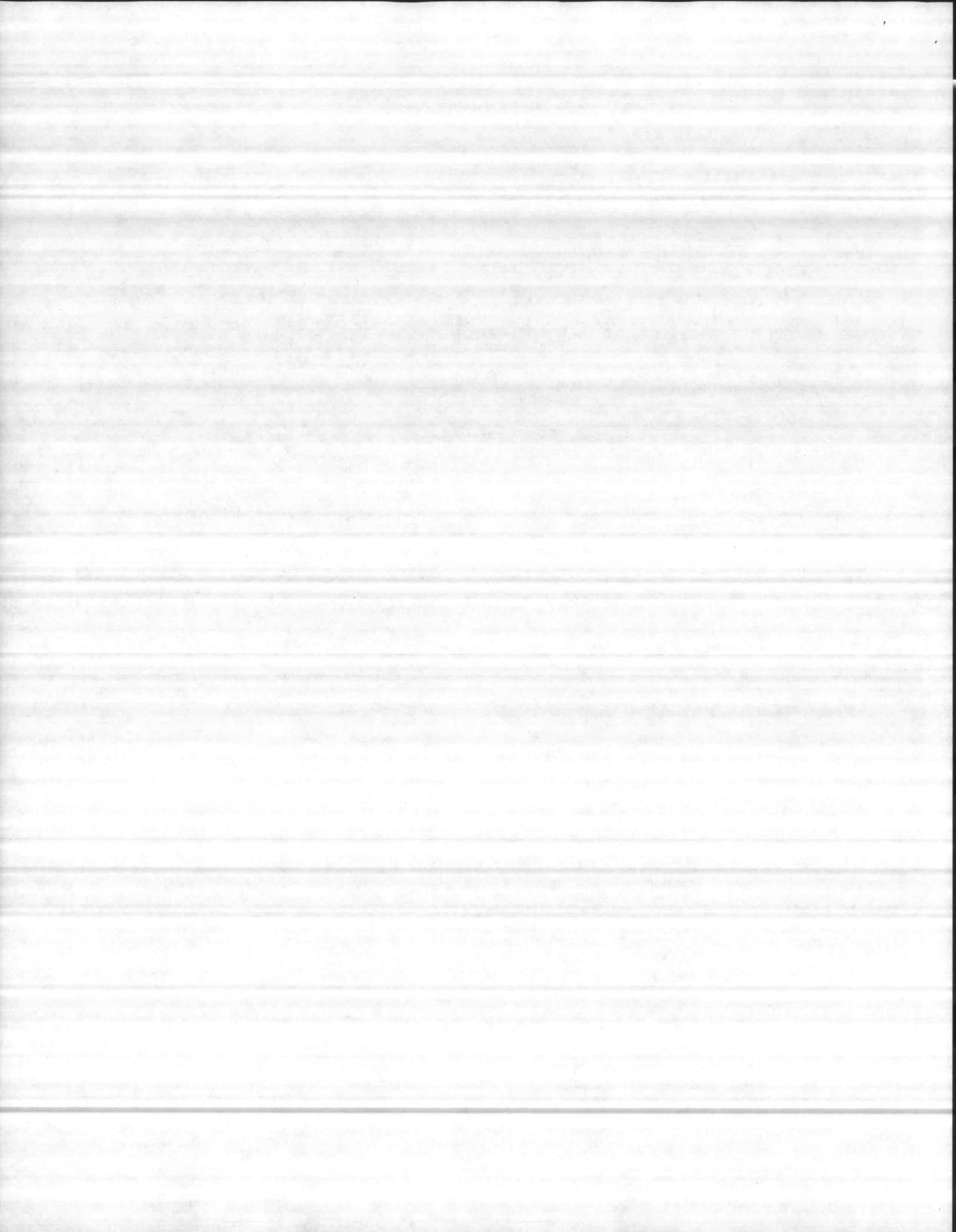
Electrical Classification (Agency approval covers all forms listed except as noted under Ordering Information)
 FM Approved

CSA Approved

- Non-Incendive Class I, Division 2, Groups A thru D.
- Explosion-Proof Class I, II, III, Division 1, Groups B, C, D, E, G.
- Intrinsically Safe Class I, II, III, Division 1, Groups per applicable approved barriers.

- Non-Incendive Class I, Division 2, Groups A thru D.
- Explosion-Proof Class I, II, III, Division 1, Groups B thru G.
- Intrinsically Safe Class I, II, III, Division 1, Groups per applicable approved barriers.

Warranty: Taylor Instrument, Rochester, NY, warrants the 9400T Series Transmitter for 1 year from date of shipment. Contact Taylor Instrument for complete information.



File 12-14
BASEEFA (Pending)

Type N per British Std. 4883: Part 3.
Intrinsically Safe per CENELEC Std.
EN50020.

Operati...
12V dc minimum
45V dc maximum

SAA Approved (Pending)

Type N ExIICT8 (AS2238-1982).
Flameproof ExdIICT5 (AS2480-1981).
Intrinsically Safe ZO ExIICT8
(AS1829-1981).

Load Limitations
Drive Impedance = $\frac{\text{Supply V dc} - 12V \text{ dc}}{0.020}$
Maximum Drive Impedance 1,650 ohms

Temperature Limit
Primary
Primary Peak
Ambient
Storage

-40 to 250 °F (-40 to 121 °C)
275 °F (135 °C) for 30 minutes
-20 to 180 °F (-29 to 71 °C)
-85 to 200 °F (-54 to 83 °C)

Relative Humidity 0 to 100% RH
Vacuum Service Full vacuum

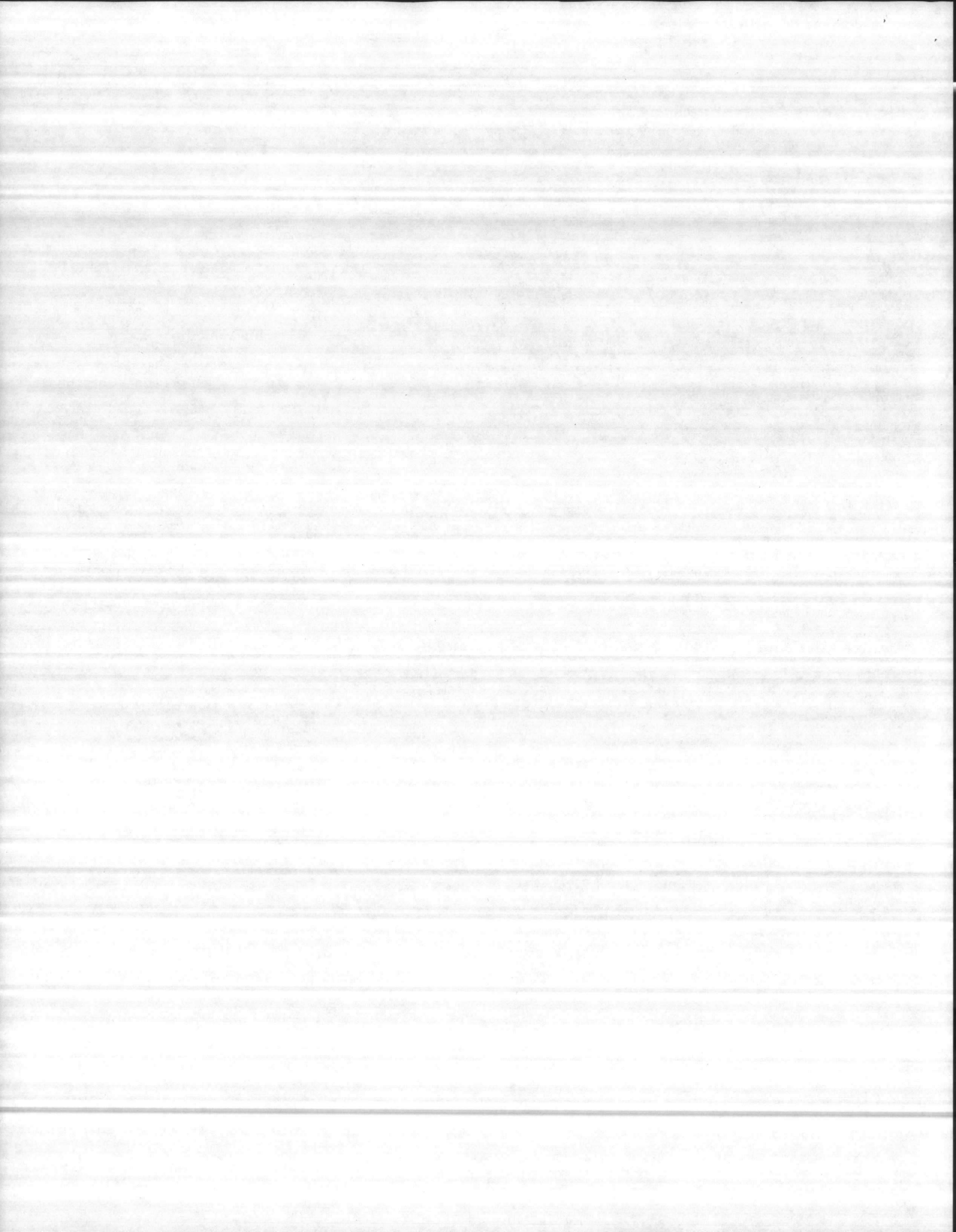
PERFORMANCE CHARACTERISTICS

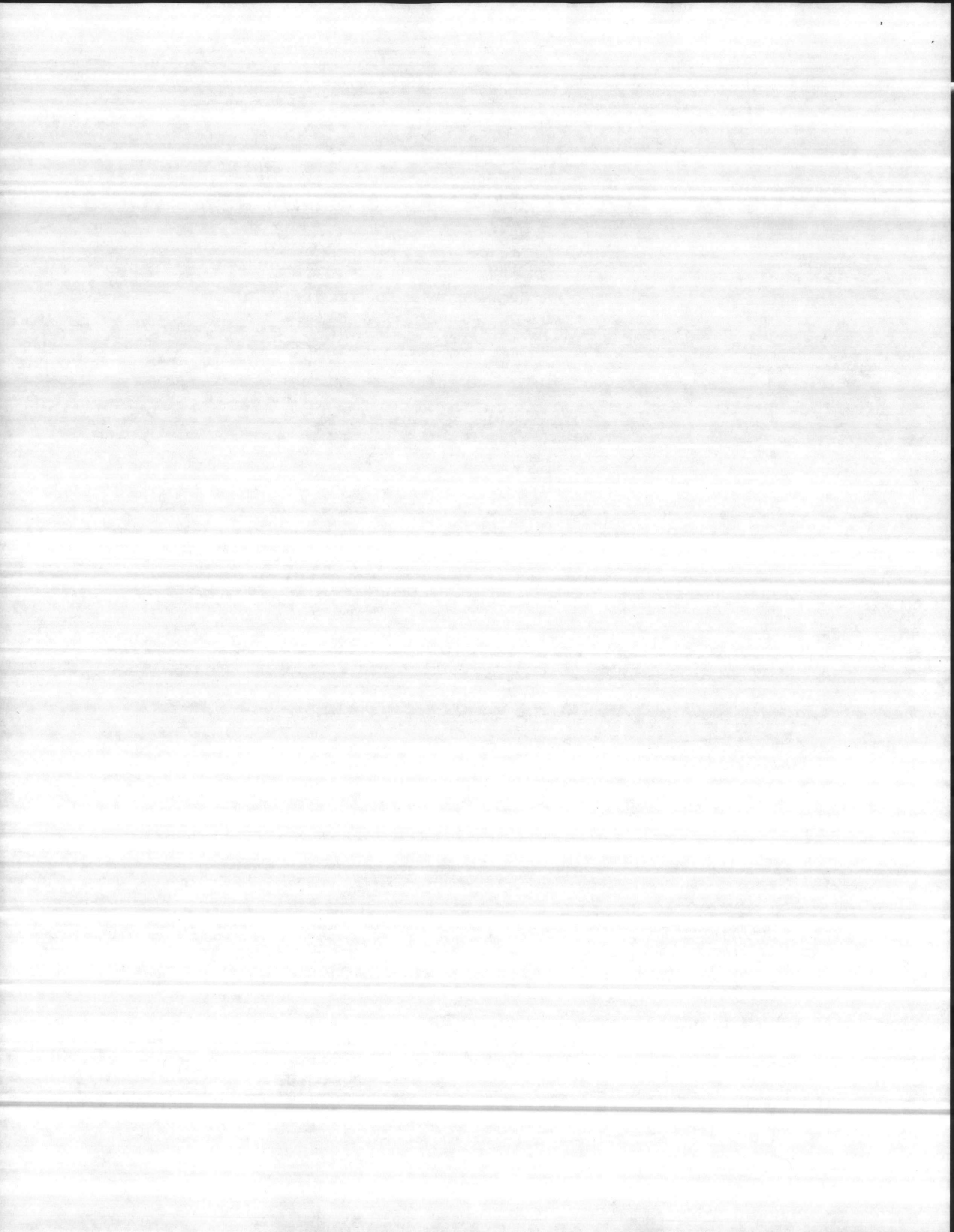
Service	Liquid, gas, or steam	Output Signal	4 to 20 mA dc
Accuracy	± 0.25% of calibrated span (includes effects of linearity, hysteresis, and repeatability)	Long-Term Stability	Better than ± 0.3% of URL after 8 months
Hysteresis and Deadband Combined	Better than 0.2%	Supply Voltage Effect	Less than 0.005% per V dc
Repeatability	Better than 0.1%	Load Effect	None
Ambient Temperature Effect On Zero	± 0.5% per 50 °F (28 °C) at maximum span	Mounting Position Effect	No effect if mounted in plane of diaphragm
Total	± 1.0% per 50 °F (28 °C) at maximum span	Vibration Effect	± 0.2% URL/2g at 15 to 150 Hz ± 0.2% URL/g at 151 to 2,000 Hz
Static Pressure Effect	± 0.45% of upper range limit (URL) on zero per 1,000 psi change ± 0.15% of reading on span per 1,000 psi change	RFI Effect	Meets SAMA Standard PMC 33.1-1978. Tested over a full frequency range of 20 to 1,000 MHz.
		Volumetric Displacement	0.02 cubic in. or less

PHYSICAL CHARACTERISTICS

Process Diaphragm Standard Optional (9404T thru 9406T)	Type 316L sat Hastelloy C1 alloy Tantalum	NACE (National Association of Corrosion Engineers)	Taylor's interpretation of NACE Specification MR-01-75, 1980 Revision, is that it applies only to process-wetted parts. Flange bolts, although not process-wetted, are also available in NACE-compatible materials, if required. NACE qualified selections are clearly identified under Ordering Information.
Process Flanges and Adapters Standard Optional	Type 316 sat (9403T) Carbon steel (9404T, 9405T, 9406T) Type 316 sat (94011, 94061, 940011)	Weight 9403T 9404T, 9405T, 9406T (with Flange Material of Carbon Steel) Type 316 sat (2,500 psi) Type 316 sat (8,000 psi)	16 lb (7.3 kg) approximately 7.9 lb (3.6 kg) 8.5 lb (3.9 kg) 11.3 lb (5.1 kg)
Flange Bolts Standard Optional	Alloy steel ASTM A354, Grade BD Custom 450 sat Steam tracing (Morse K-500)	Process Connection Standard Optional	½ in. Int. NPT in flange on 2 ½ in. center ½ in. Int. NPT adapters on 2 in., 2 ½ in., or 2 ¾ in. centers
Fill Fluid Standard Optional	Silicone 200 fluid Fluorolube composite; 20 to 250 °F (-6 to 121 °C) process limit	Electrical Connection	½ in. Int. NPT
Transmitter Housing	Low copper cast aluminum with baked epoxy ester, urea formaldehyde melamine finish (NEMA 4 IP 65)		
Flange and Adapter Gasket	Glass-filled Teflon		

*Trademark of Cabot Corp.
†Trademark of Carpenter Technology Corp.
‡Trademark of Huntington Alloy, Inc., The International Nickel Co., Inc.
§Trademark of Dnw Corning Corp.
¶Trademark of Hooker Chemical Corp.
‡‡Trademark of E.I. du Pont de Nemours & Co., Inc.





ORDERING INFORMATION

1. Select one character or set of characters from each category and specify catalog number as per sample below.
2. Specify tagging if required. Tagging information is provided on the exterior unless steel data plate to a limit of 40 characters
3. Specify calibration in in. H₂O or kPa.

BASE NUMBER - 1st thru 5th characters

- 9403T Electronic Differential Pressure Transmitter, Span Adjustable from 0 to 5 in. H₂O (0.2 to 1.2 kPa)
- 9404T Electronic Differential Pressure Transmitter, Span Adjustable from 5 to 30 in. H₂O (1.2 to 7.5 kPa)
- 9405T Electronic Differential Pressure Transmitter, Span Adjustable from 25 to 150 in. H₂O (6 to 38 kPa)
- 9406T Electronic Differential Pressure Transmitter, Span Adjustable from 150 to 800 in. H₂O (38 to 200 kPa)

PRIMARY FILL-FLUID AND PROCESS TEMPERATURE RANGE - 6th character

- B Silicone 200¹, -40 to 250 °F (-40 to 121 °C) No Extra
- C Fluorolube², 20 to 250 °F (-8 to 121 °C) No Extra

ELECTRICAL CODE - 7th and 8th characters

- 01 FM Approved: Non-Incendive (Division 2), Explosion-Proof (Division 1), Intrinsic Safety (Division 1) No Extra
- 02 BASEEFA Certified: Type N Protection (Zone 2) to BS 4883: Part 3, Intrinsic Safety (Zone 0) to CENELEC Standard EN50020 No Extra
- 04 CSA Certified: Non-Incendive (Division 2), Explosion-Proof (Division 1), Intrinsic Safety (Division 1) No Extra
- 08 SAA Certified: Type N Protection (Zone 2), Flameproof (Zone 1), Intrinsic Safety (Zone 0) No Extra
- 10 General Purpose, Taylor Standard No Extra

DIAPHRAGM MATERIAL - 9th character

- 2 Type 316L sst - NACE Standard MR-01-75, 1980 Revision No Extra
- 3 Hastelloy C³ (9404T, 9405T, 9406T only) No Extra
- 7 Tantalum (9404T, 9405T, 9406T only) No Extra

FLANGE MATERIAL AND MAXIMUM WORKING PRESSURE (MWP) - 10th character

- 1 Carbon Steel, Nickel Plated, 2,500 psig (17 500 kPa) MWP (9404T, 9405T, 9406T only) No Extra
- 4 Type 316 sst - NACE Standard MR-01-75, 1980 Revision; 8,000 psig (40 000 kPa) MWP (9404T, 9405T, 9406T only) No Extra
- 5 Type 316 sst - NACE Standard MR-01-75, 1980 Revision; 2,500 psig (17 500 kPa) MWP (9404T, 9405T, 9406T only) No Extra
- 6 Type 316 sst - NACE Standard MR-01-75, 1980 Revision; 1,000 psig (6 900 kPa) MWP (9403T only) No Extra

PROCESS CONNECTION - 11th character

- 0 Without Adapters, 1/2 in. Int. NPT in Flange No Extra
- 1 With 1/2 in. Int. NPT Adapters, Carbon Steel, Nickel Plated No Extra
- 2 With 1/2 in. Int. NPT Adapters, Type 316 sst - NACE Standard MR-01-75, 1980 Revision No Extra

MODEL (Design Level) - 12th character

A Model A

UNUSED CHARACTER - 13th character

0

MOUNTING BRACKET - 14th character

- 0 None No Extra
- 1 Bracket for 1 1/2 in. to 2 in. (32 mm to 50 mm) Pipe or Surface Mounting No Extra

UNUSED CHARACTERS - 15th and 16th characters

00

HYPHEN - 17th character

-

FLANGE BOLTS - 18th character

- 1 Alloy Steel, ASTM A3b4, Grade BD Bolts No Extra
- 2 Custom 450⁴ Bolts - NACE Standard MR-01-75, 1980 Revision No Extra
- 4 Steam Tracing Bolts (not available with Flange Material 4) No Extra

OXYGEN SERVICE - 19th character

- 0 None No Extra
- 1 Cleaned for Oxygen Service (not available with Primary Fill-Fluid B or Flange Material 4) No Extra

UNUSED CHARACTERS - 20th and 21st characters

00

SAMPLE CATALOG NUMBER

9404T B 01 2 1 1 A 0 1 00 - 1 0 00

¹Trademark of Dow Corning Corp.
²Trademark of Hooker Chemical Corp.

³Trademark of Cabot Corp.
⁴Trademark of Carpenter Technology Corp.

Specifications subject to change without notice.

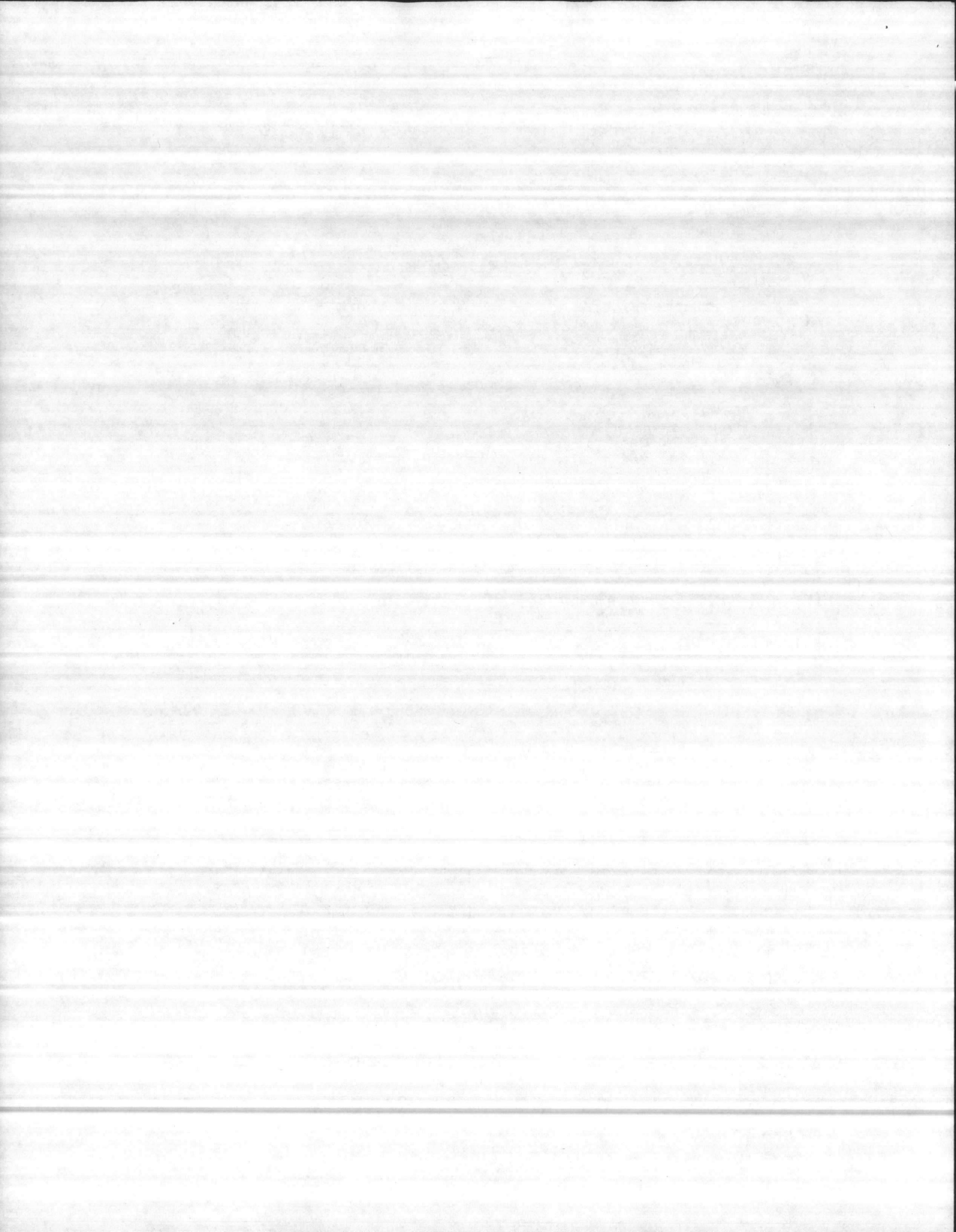
Taylor Instrument
 Combustion Engineering, Inc.

P.O. Box 110
 Rochester, NY 14692

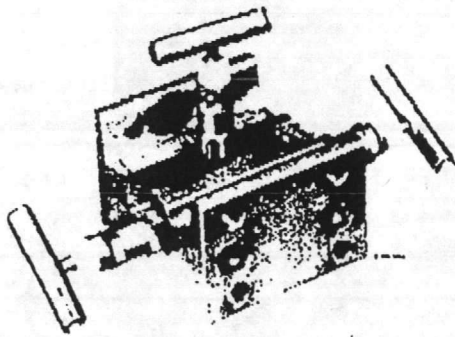
(716) 235-5000

Printed in U.S.A.

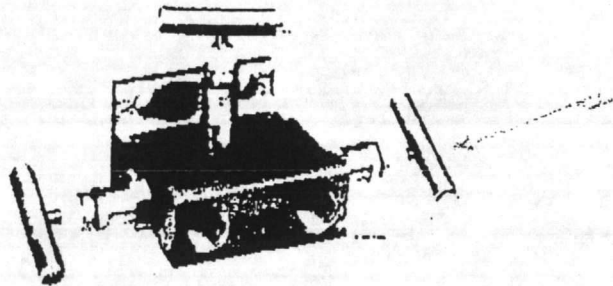
TRANSMITTERS



ANDERSON, GREENWOOD MANIFOLDS



Double-Flanged
48S201S or 48S201J
Accessory (83)

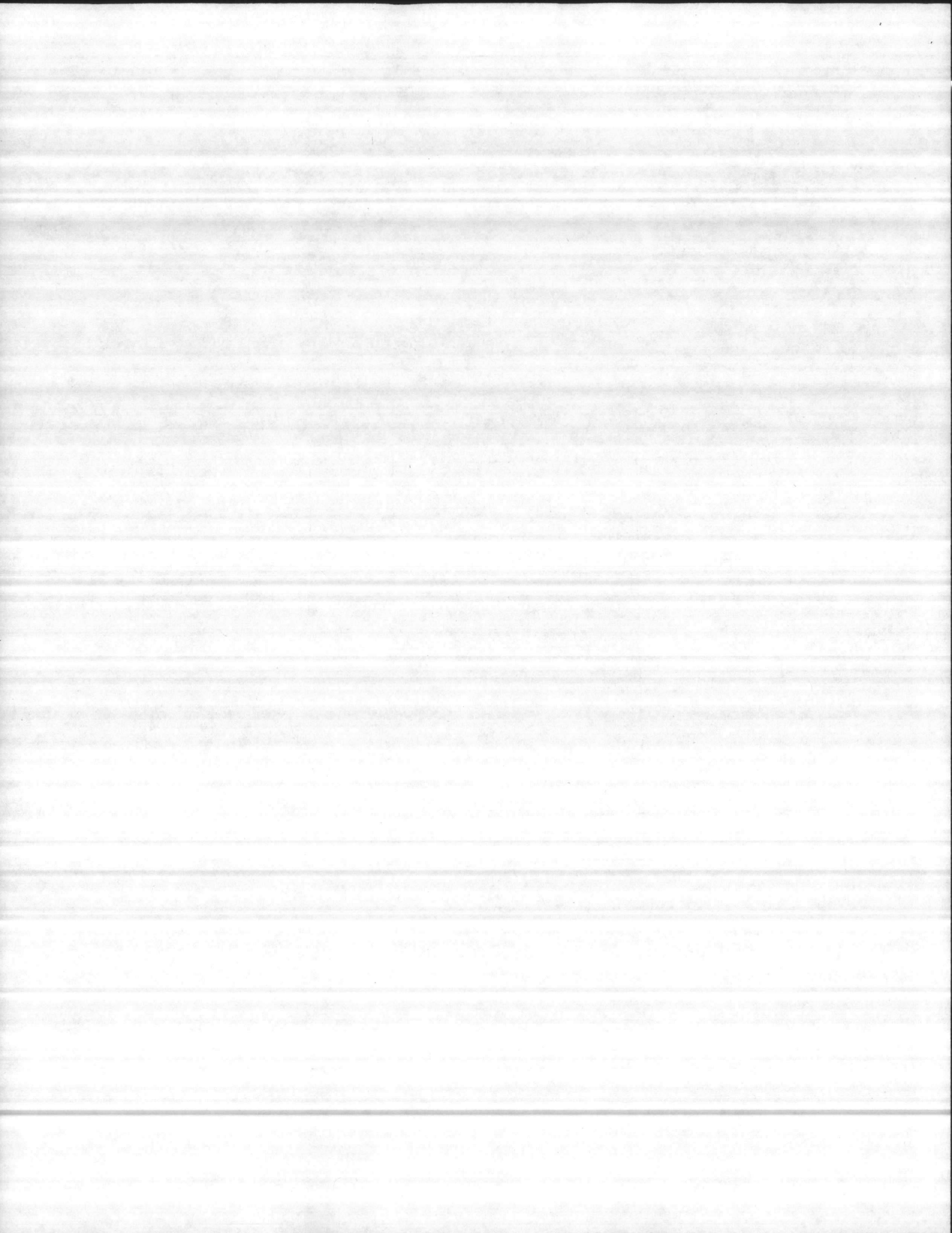


Single-Flanged / Pipe Thread
48S202S or 48S202J
Accessory (84)

Accessory No.	Double-Flanged			Single-Flanged / Pipe Thread		
	(83)			(84)		
Taylor Cat. No.	48S201S	48S201J	48S380J <i>(Note 3)</i>	48S202S	48S202J	48S381J <i>(Note 3)</i>
Body	Carbon Steel	316 SST	316 SST	Carbon Steel	316 SST	316 SST
Bonnet	Carbon Steel	316 SST	316 SST	Carbon Steel	316 SST	316 SST
Stem	303 SST	316 SST	316 SST	303 SST	316 SST	316 SST
Ball Seat	316 SST					
Packing	TFE					
Seats	Part of body					
Maximum Working Pressure <i>(Note 1)</i>	4000 psi (28 000 kPa)					
Maximum Operating Temperature <i>(Note 1)</i>	500 °F (260 °C)					
Pipe Thread (Process Pipe Connection)	None			½ in. Int NPT		
AGCO (Anderson, Greenwood & Co.) Reference <i>(Note 2)</i>	M4AVC T	M4AVS T	M4AVS T SG	M4TVC T	M4TVS T	M4TVS T SG

NOTES:

1. All manifolds may be used up to 6000 psi (40 000 kPa) at reduced maximum operating temperature of 200°F (93°C).
2. These 3 valve manifolds are designed for Taylor seal design of manifold to transmitter and adapter to manifold.
3. National Association of Corrosion Engineers (NACE) form of manifold, Taylor's interpretation of NACE standard MR 01-76, 1980 Revision, is that it applies only to process-wetted parts. Therefore, bolts are not included since they are not process wetted in normal usage.

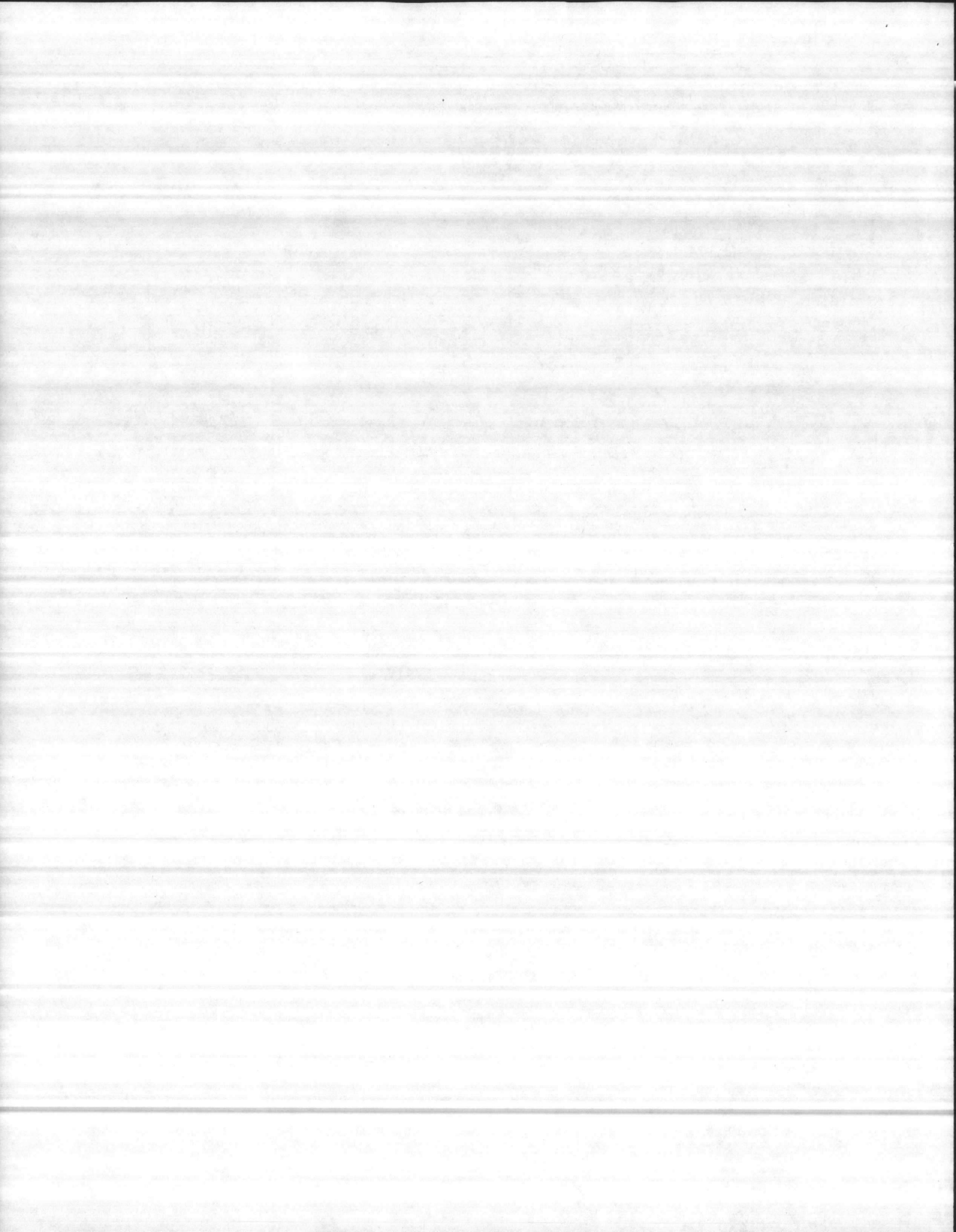


HOW TO ORDER

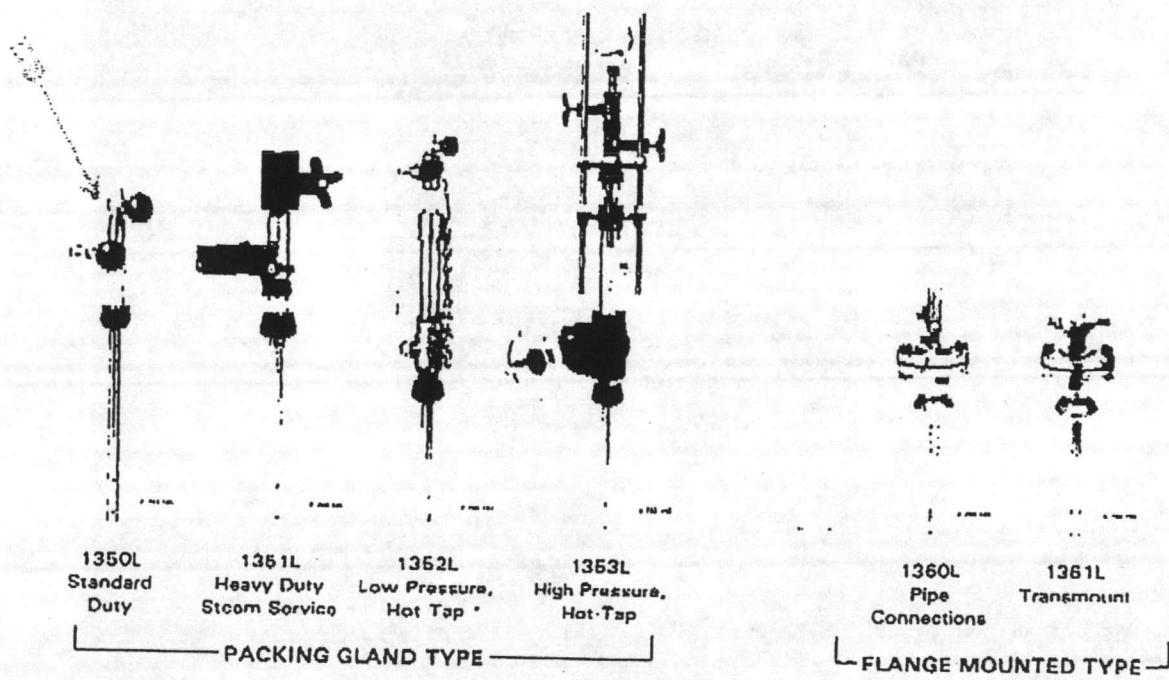
Manifolds can be ordered mounted and leak tested on the transmitter, or separately.

1. To order mounted to the transmitter at a Taylor factory, specify accessory number and material of construction.
Example: 3403TD _____ (83) and specify material of construction; for example 316 SST.
2. To order separately, enter separate order page and specify Taylor Catalog Number.
Example: 48S201J AGCU 3-Valve Manifold

Material	Mounted on Transmitter		Separate		Available From
	Accessory No.	Price	Catalog No.	Price	
Steel	(83)		48S201S		Taylor-USA Taylor-England
316 SST	(83)		48S201J		Taylor-USA Taylor-England
NACE Requirement	(83)		48S380J		Taylor-USA Taylor-England
Steel	(84)		48S202S		Taylor-USA Taylor-England
316 SST	(84)		48S202.I		Taylor-USA Taylor-England
NACE Requirement	(84)		48S381.I		Taylor-USA Taylor-England
Steel	(335)	Refer to Taylor-England	48S233S	Refer to Taylor-England	Taylor-England
316 SST	(336)		48S233J		Taylor-England
Steel	(337)		48S234S		Taylor-England
316 SST	(338)		48S234J		Taylor-England
Steel	None		48S235S		Taylor-England
316 SST	None		48S235J		Taylor-England
Carbon Steel	None		48S236S		Taylor-England
316 SS1	None		48S236J		Taylor-England



FLOBAR™ ELEMENT
MULTI-PORT AVERAGING FLOW SENSOR



PRODUCT DESCRIPTION

The FLOBAR™ element is a multiport averaging flow sensor. It is designed to provide reliable, efficient, and economical flow measurement. The strong double-wall construction provides superior strength for high flow rates. Multiple sensing ports are positioned to obtain the critically important downstream and upstream average pressures. The downstream ports are located before the fluid separation point on the tube. The large internal upstream sensor

passage provides a large volume in which to average the impact pressure. An equally large volume averages the downstream pressure. Six basic models and two basic mounting configurations are available to match the process and piping requirements. The static pressure outlet option and integral thermocouple or RTD options simplify total installation.

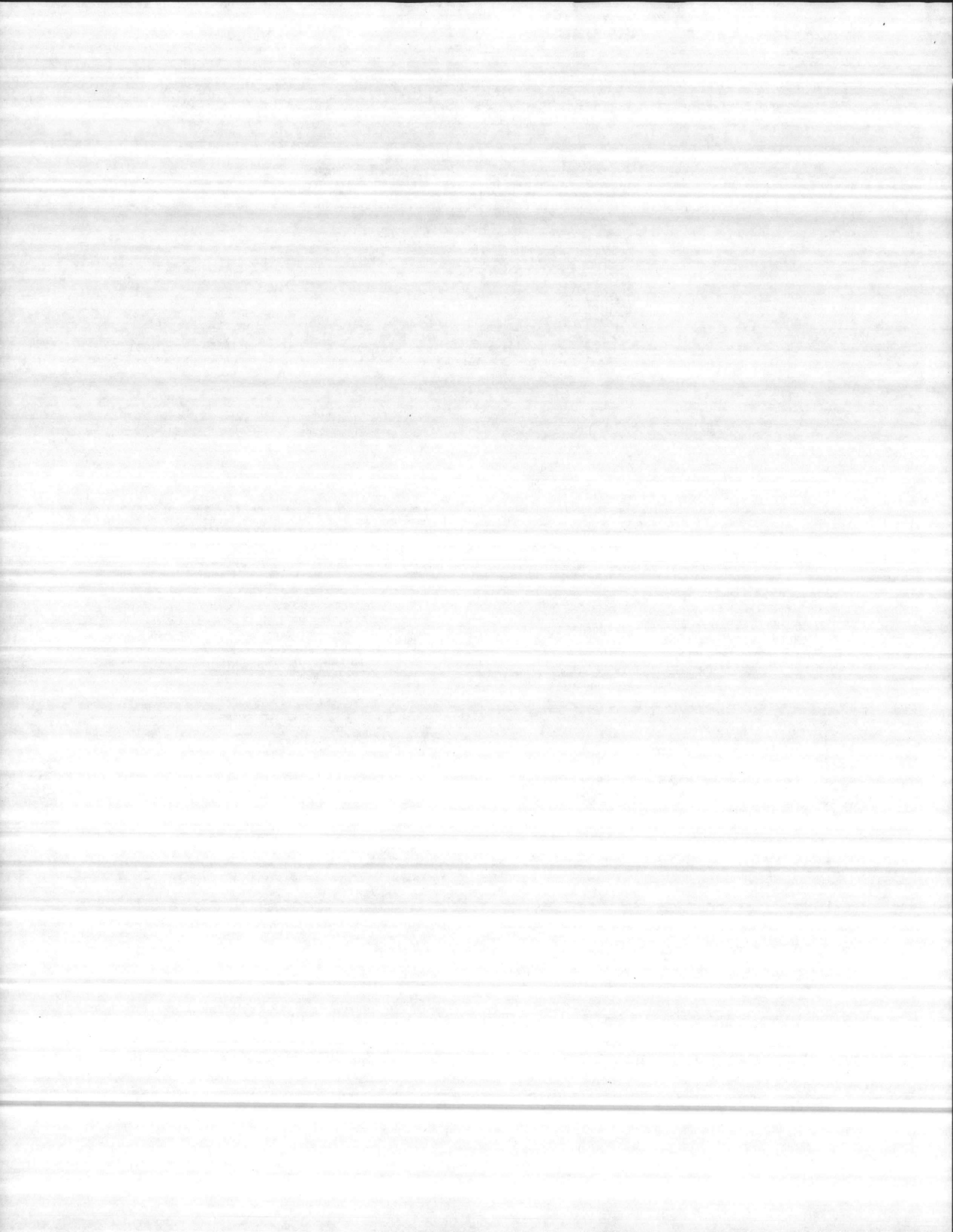
FEATURES	BENEFITS
• Simple design and simple installation	Lower installed cost
• Small, streamlined structure	Increased energy savings
• Hot-tap installation capability	Installation and replacement without process disturbance
• Strong double wall construction with no process-wetted weld joints	Low maintenance cost
• No-wear, non-clog design	Long, reliable life

FLOW COEFFICIENT UNCERTAINTY*

An uncertainty of ± 1% is obtainable when flow element is correctly applied.

*Refer to page 11.

MEASUREMENT ELEMENTS

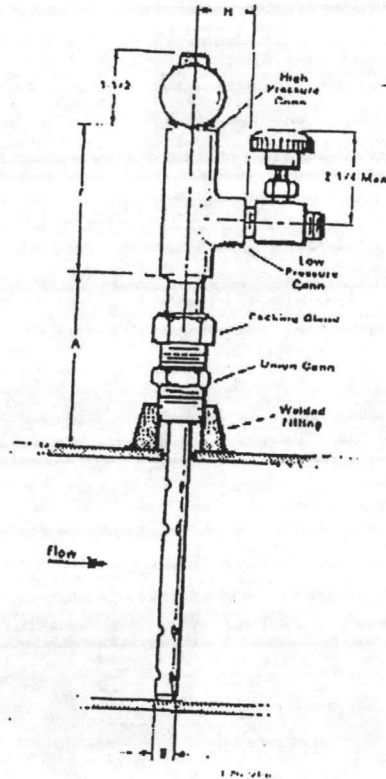


File 4-15
SPECIFICATIONS

1350L STANDARD DUTY FLOWBAR ELEMENT

Used for general purpose applications on liquids and gases when the process can be shut down for installation and replacement. Also used on steam applications where pipe size is 10 in. or greater with carbon steel valves.

Pipe Size	1/2 to 48 in. and larger
Pressure/Temperature Limits (without valves)	50 psig (1000 °F)/300 psi (500 °F) 345 kPa (538 °C)/2070 kPa (280 °C)
Tube Construction	316 sst, double wall, double D tubing
Welded Fitting	3000 lb forged steel standard. 316 sst and bronze available. Contoured to fit pipe diameter.
Packing Gland	Through-bored 316 sst compression fitting with 316 sst rings
Instrument Head	316 sst
Instrument Head Connection	1/2 in. Int. NPT standard. 1/2 in. Int. NPT available on pipe sizes 10 in. and larger.
Instrument Valves	Refer to Page 8, Table 1



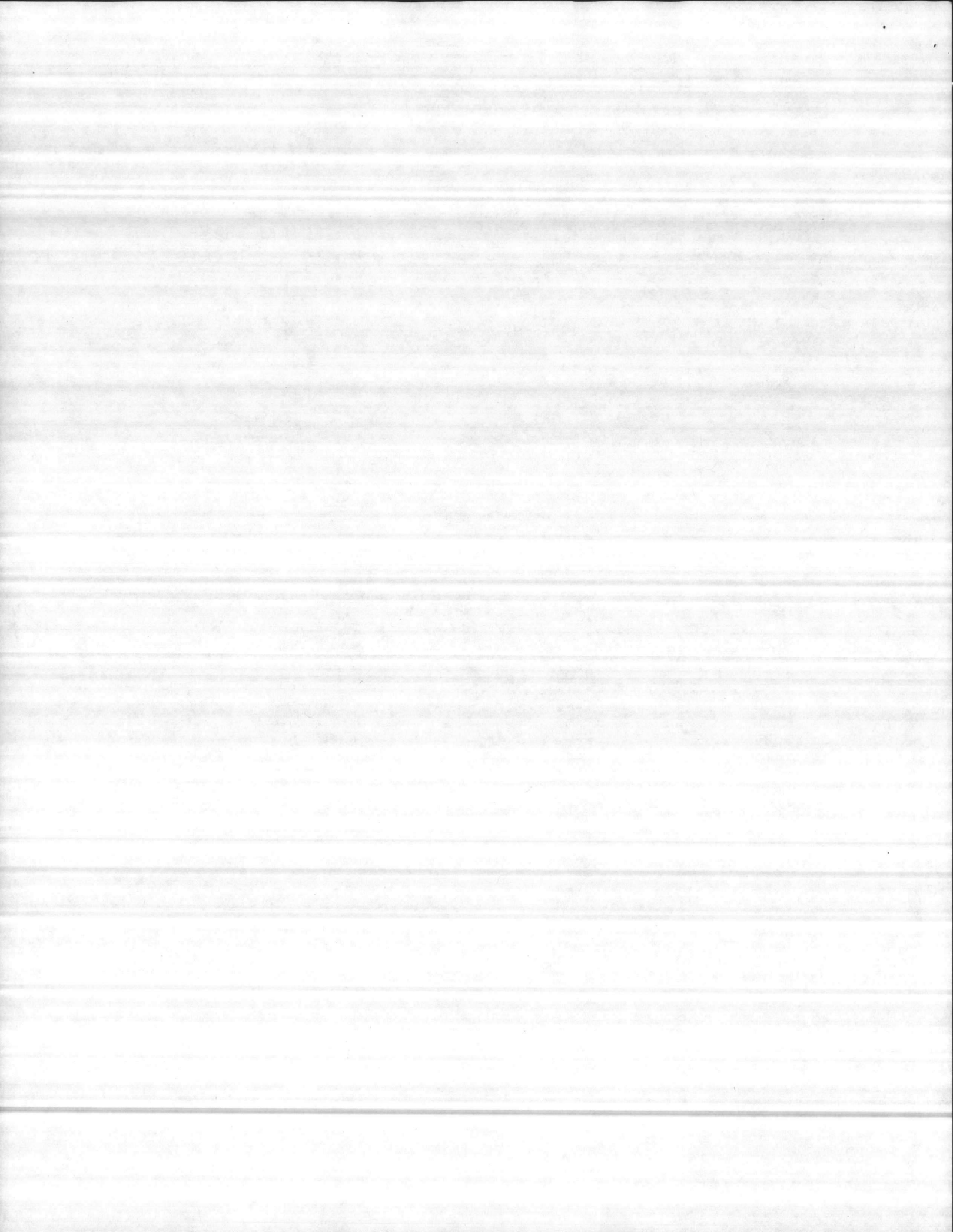
1350L STANDARD DUTY (Note 1)

Pipe Size	Dimension A	Dimension B (Note 2)	Dimension F (1/2 NPT)	Dimension G (1/2 NPT)	Dimension H	Dimension E (Pipes) (Note 3)	Dimension C (Ducts) (Note 3)	Welded Fitting	Compression Fitting	Estimated Shipping Wt.
1/2 to 1	3 1/2 (83)	1/2 (8)	2 1/4 (56)	NA	1 3/4 (24)	NA	NA			
1 1/2 to 4	3 1/2 (83)	1/2 (10)	2 1/4 (56)	NA	1 3/4 (24)	NA	NA	1/2 (10)	1/2 (10)	2 lb (0.9 kg)
5 to 8	3 1/2 (89)	1/2 (13)	2 1/4 (56)	NA	1 3/4 (24)	NA	NA	1/2 (10)	1/2 (10)	2 lb (0.9 kg)
10 to 14	3 1/2 (92)	1/2 (19)	2 1/4 (57)	3 (78)	1 1/2 (32)	4 (102)	3 (76)	1/2 (13)	1/2 (13)	3 lb (1.4 kg)
16 to 30	4 1/2 (108)	1 (25)	2 1/4 (70)	3 (76)	1 1/2 (38)	4 (102)	3 (76)	1/2 (19)	1/2 (19)	4 lb (1.8 kg)
36 and up	4 1/2 (108)	1 (25)	2 1/4 (70)	3 (76)	1 1/2 (38)	4 (102)	3 (76)	1 (25)	1 (25)	7 lb (3.2 kg)
								1 (25)	1 (25)	11 lb (5.0 kg)

NOTES

- 1 All dimensions are in inches; dimensions in parentheses are in millimeters.
- 2 Pipe hole tap is 1/8 in. larger than Dimension B.
- 3 Double Mount option available for 6 in. units and larger only; Dimension F (not shown) refers to Double Mount installation (refer to page 8).

FLOWBAR ELEMENTS



OPTIONS AND ACCESSORIES

OPTIONAL MOUNTING OF FLOBAR ELEMENTS - DOUBLE MOUNT

Double mounting of a FLOBAR element is recommended for high differential pressure applications or for very large diameter pipes. In addition to the welded fitting that is supplied standard with each FLOBAR element, a second fitting is welded on the opposite (180°) pipe wall. A specially designed sleeve threads into this fitting and accepts the extended FLOBAR element. A close tolerance fit exists between the outer diameter of the FLOBAR element and the inside diameter of the sleeve, providing excellent support and eliminating vibration. This option is available for FLOBAR elements 1350L, 1351L, 1360L, and 1361L for pipe diameters 8 inch and larger. Refer to Table 3 to determine if double mounting is required. Double mounting is not recommended for FLOBAR elements 1352L and 1353L since process shutdown is required to install a FLOBAR element with double mounting.

INSTRUMENT VALVES

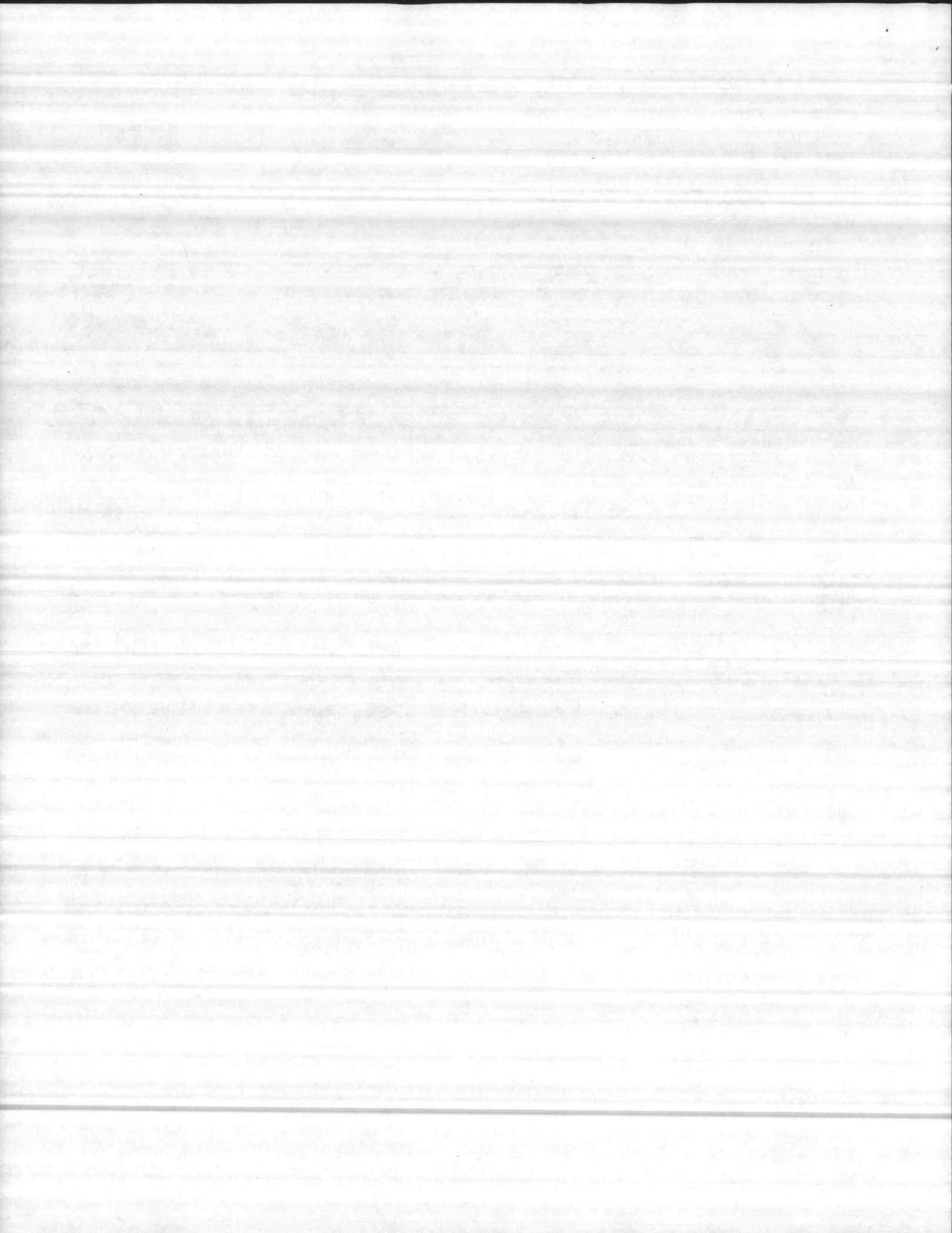
FLOBAR elements (except 1361L) can be supplied with optional instrument valves as shown in Table 1. Note the 1/2 in. NPT is only available in certain size FLOBAR elements and that brass valves are only for use with the 1350L or 1352L elements.

Table 1. Instrument Valves

Size (Material)	Max. Process Temperature (Note 1)	Dimension K (Note 2)	Valve Type	Packing	1350L	1351L	1352L	1353L	1360L
1/2" NPT (Brass)	350 °F (177 °C)	1 1/2 (38)	Needle	Teflon	All Sizes	N/A	All Sizes	N/A	N/A
1/2" NPT (Carbon Steel)	850 °F (454 °C)	2 1/2 (60)	Needle	Graphite	All Sizes	All Sizes	All Sizes	All Sizes	All Sizes
1/2" NPT (Carbon Steel)	850 °F (454 °C)	2 1/2 (60)	Needle	Asbestos	All Sizes	All Sizes	All Sizes	All Sizes	All Sizes
1/2" NPT (316 SS)	350 °F (177 °C)	1 1/2 (38)	Needle	Teflon	All Sizes	All Sizes	All Sizes	N/A	All Sizes
1/2" NPT (Carbon Steel)	850 °F (454 °C)	3 1/2 (83)	Needle	Graphite	10" and up	All Sizes	8" and up	8" and up	All Sizes
1/2" NPT (316 SS)	350 °F (177 °C)	2 1/2 (40)	Ball	Asbestos	10" and up	All Sizes	8" and up	N/A	All Sizes
				Teflon	10" and up	All Sizes	8" and up	N/A	All Sizes

NOTES

- 1 Maximum Process Temperature refers only to valve.
- 2 All dimensions are in inches, dimensions in parentheses are in millimeters.



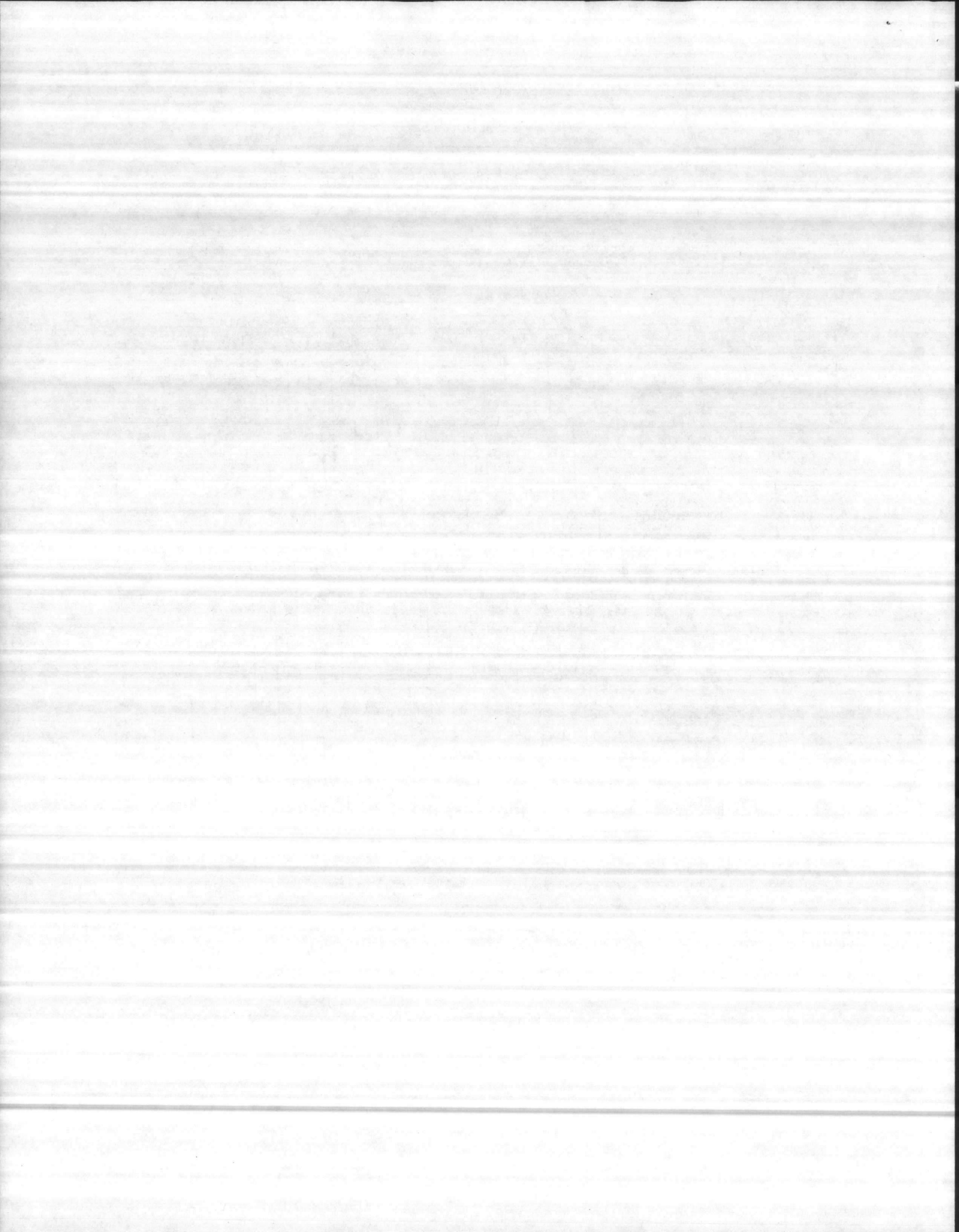


Table 4. FLOBAR Capacity Table - Water GPM

Size	K	Assumed Pipe I. D.	Differential Pressure in Inches of Water					
			5	10	20	50	75	100
0.50	0.315	0.622	1.5	2.2	3.1	4.9	6.0	6.9
0.75	0.420	0.824	3.8	5.1	7.2	11.4	14.0	16.2
1.00	0.540	1.049	7.5	10.7	15.1	23.8	29.2	33.7
1.25	0.568	1.380	13.7	19.4	27.4	43.4	53.1	61.3
1.50	0.595	1.610	18.8	26.8	37.6	59.5	72.9	84.2
2.00	0.630	2.067	32.2	45.6	64.4	101.9	124.8	144.1
2.50	0.640	2.489	48.7	68.8	97.3	153.9	188.5	217.7
3.00	0.648	3.068	76.3	108.0	152.7	241.4	295.7	341.4
4.00	0.620	4.026	133.1	188.3	266.2	421.0	515.6	595.3
5.00	0.637	5.047	200.2	283.1	400.3	633.0	776.2	896.1
6.00	0.637	6.065	297.0	420.0	593.9	939.1	1150.2	1328.1
8.00	0.645	7.981	520.7	736.4	1041.4	1646.6	2016.7	2328.0
10.00	0.638	10.020	809.3	1144.5	1610.6	2668.2	3134.4	3619.3
12.00	0.627	11.838	1132.5	1601.6	2265.0	3581.3	4388.2	5084.8
14.00	0.625	13.124	1364.4	1829.5	2728.7	4314.5	5284.1	6101.6
16.00	0.623	15.000	1776.6	2512.5	3553.2	5618.0	6880.7	7945.1
18.00	0.620	16.876	2237.9	3164.9	4475.9	7076.9	8667.4	10008.3
20.00	0.617	18.812	2767.4	3913.7	5534.8	8751.2	10718.0	12376.1
24.00	0.616	22.624	3996.1	5651.3	7992.2	12636.7	15476.0	17871.0
30.00	0.618	29.000	6665.9	9286.6	13131.7	20783.1	25429.5	29363.4
36.00	0.618	35.000	9563.8	13525.3	19127.7	30243.5	37040.5	42770.7
42.00	0.616	41.000	13123.8	18580.0	26247.8	41501.4	50828.7	58691.9
48.00	0.616	47.000	17246.1	24389.7	34492.2	54537.0	66793.9	77127.0

NOTE: This table is for approximation purposes only. For actual differential pressure, calculate by using the formula:

$$h = gf \left(\frac{q \text{ (U.S. GPM)}}{5.668 \cdot K \cdot D^2} \right)^2$$

Where: D is pipe I.D. (actual)
 gf is specific gravity at flow conditions
 K is flow coefficient (see Table 3 on page 11)
 q is flow rate in gallons per minute

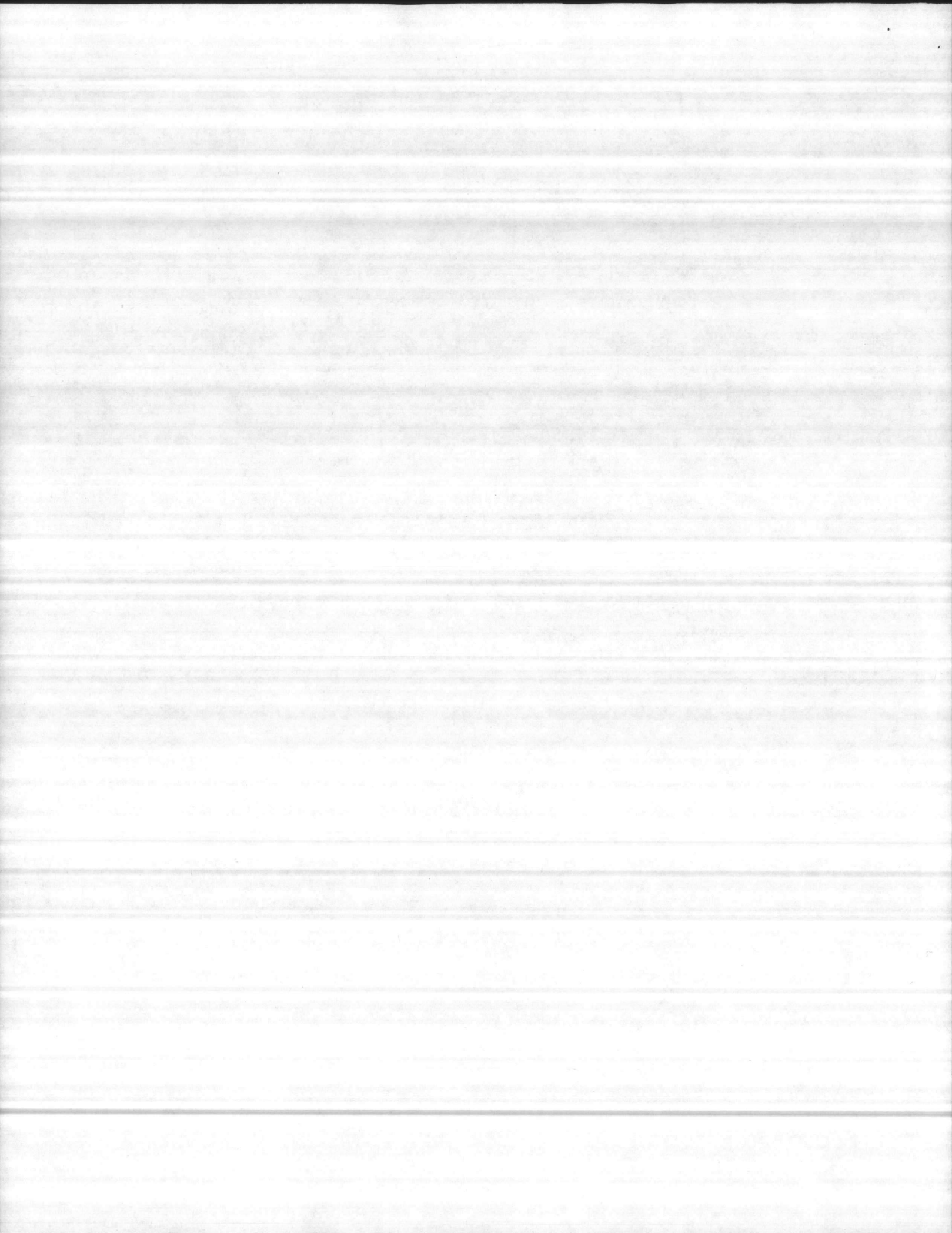


Table 6. FLOBAR Capacity Table

h) (at 338 °F, 100 psig)

File 4-15

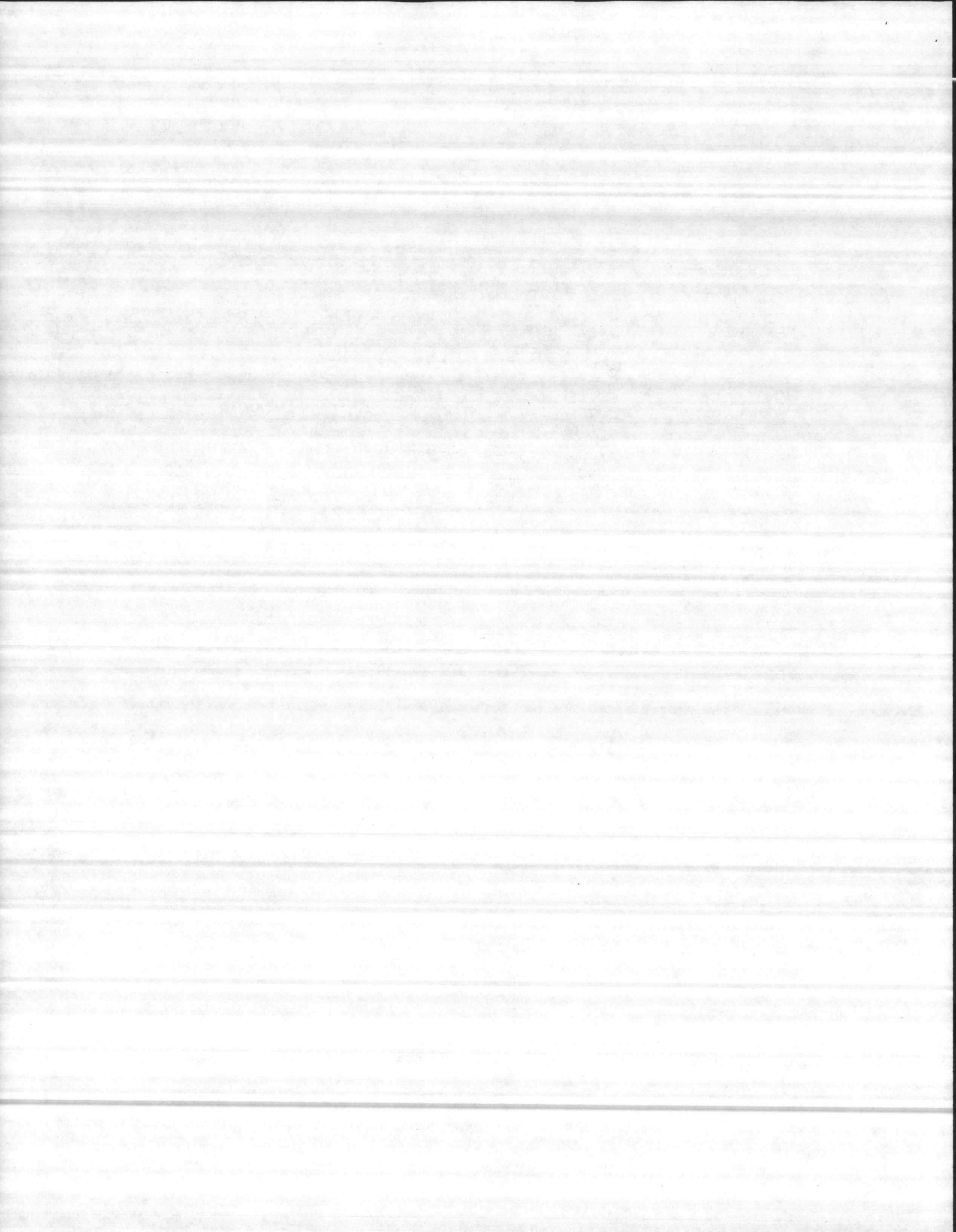
Size	K	Assumed Pipe I. D.	Pressure in Inches of Water					
			5	10	20	50	75	100
0.50	0.315	0.822			99.3	157.0	192.3	222.1
0.75	0.420	0.824	49.7	70.2	232.4	367.4	450.0	519.6
1.00	0.540	1.049	116.2	164.3	484.2	765.7	937.7	1082.8
1.25	0.568	1.380	242.1	342.4	881.5	1393.8	1707.0	1971.1
1.50	0.573	1.610	440.8	623.3	1210.4	1913.8	2343.9	2706.5
2.00	0.595	2.067	805.2	855.9	2071.7	3276.6	4011.8	4832.4
2.50	0.630	2.469	1035.8	1464.9	3129.7	4948.5	6060.6	6998.2
3.00	0.640	3.088	1564.9	2213.0	4909.2	7762.1	9506.6	10977.3
4.00	0.648	4.026	2454.6	3471.3	8658.4	13533.6	16575.2	19139.4
5.00	0.620	5.047	4279.7	6052.4	12870.0	20349.3	24922.7	28778.2
6.00	0.637	6.065	6435.0	9100.6	19095.1	30192.0	36977.5	42697.9
8.00	0.645	7.981	9547.5	13502.3	33480.7	52937.7	64835.2	74865.2
10.00	0.836	10.020	16740.4	23674.5	52037.1	82277.9	100769.5	116358.6
12.00	0.627	11.938	26018.6	36795.8	72820.1	115138.8	141015.6	162830.8
14.00	0.625	13.124	36410.1	51491.6	87727.0	138708.6	169882.6	196163.5
16.00	0.623	15.000	43863.5	62032.4	114233.0	180618.2	221211.2	255432.6
18.00	0.620	16.876	57116.5	80774.9	143896.9	227621.0	278655.2	321763.3
20.00	0.617	18.812	71948.5	101750.5	177941.0	281349.4	344581.2	397888.1
24.00	0.616	22.624	88970.5	125823.3	256945.1	406265.9	497572.0	574546.7
30.00	0.616	29.000	128472.5	181687.6	422179.9	667525.0	817647.9	944022.9
36.00	0.616	35.000	211089.9	298526.3	614946.9	972318.6	1190839.6	1375063.1
42.00	0.616	41.000	307473.5	434833.1	843857.8	1334256.3	1634123.6	1886923.4
48.00	0.616	47.000	421928.9	596697.6	1108912.5	1753344.6	2147398.8	2478603.7
			554456.2	784119.5				

NOTE: This table is for approximation purposes only. For actual differential pressure, calculate by using the formula:

$$h = \bar{V} \left(\frac{W \text{ (pph)}}{359 \cdot K \cdot D^2} \right)^2$$

Where D is pipe I.D. (actual)
 K is flow coefficient (see Table 3 on page 11)
 \bar{V} is specific volume of steam (see Flow Data Book, Table 6, Properties of Saturated Steam)
 W is flow rate in pph

MEASURING ELEMENTS



CATALOG NUMBER SCHEDULE

1. Review instructions given on page 10.
2. Place an "X" in front of model number if ordering a FLOBAR element for metric pipe, lined pipe, or ducts. Specify pipe ID and wall thickness when ordering.

BASE NUMBER - 1st thru 5th characters

- 11350L FLOBAR Element, Standard Duty No Extra
- 11351L FLOBAR Element, Heavy Duty Steam Service No Extra
- 11352L FLOBAR Element, Low Pressure Hot-Tap No Extra
- 1353L FLOBAR Element, High Pressure Hot-Tap No Extra

PROCESS PIPE DIRECTION - 6th character

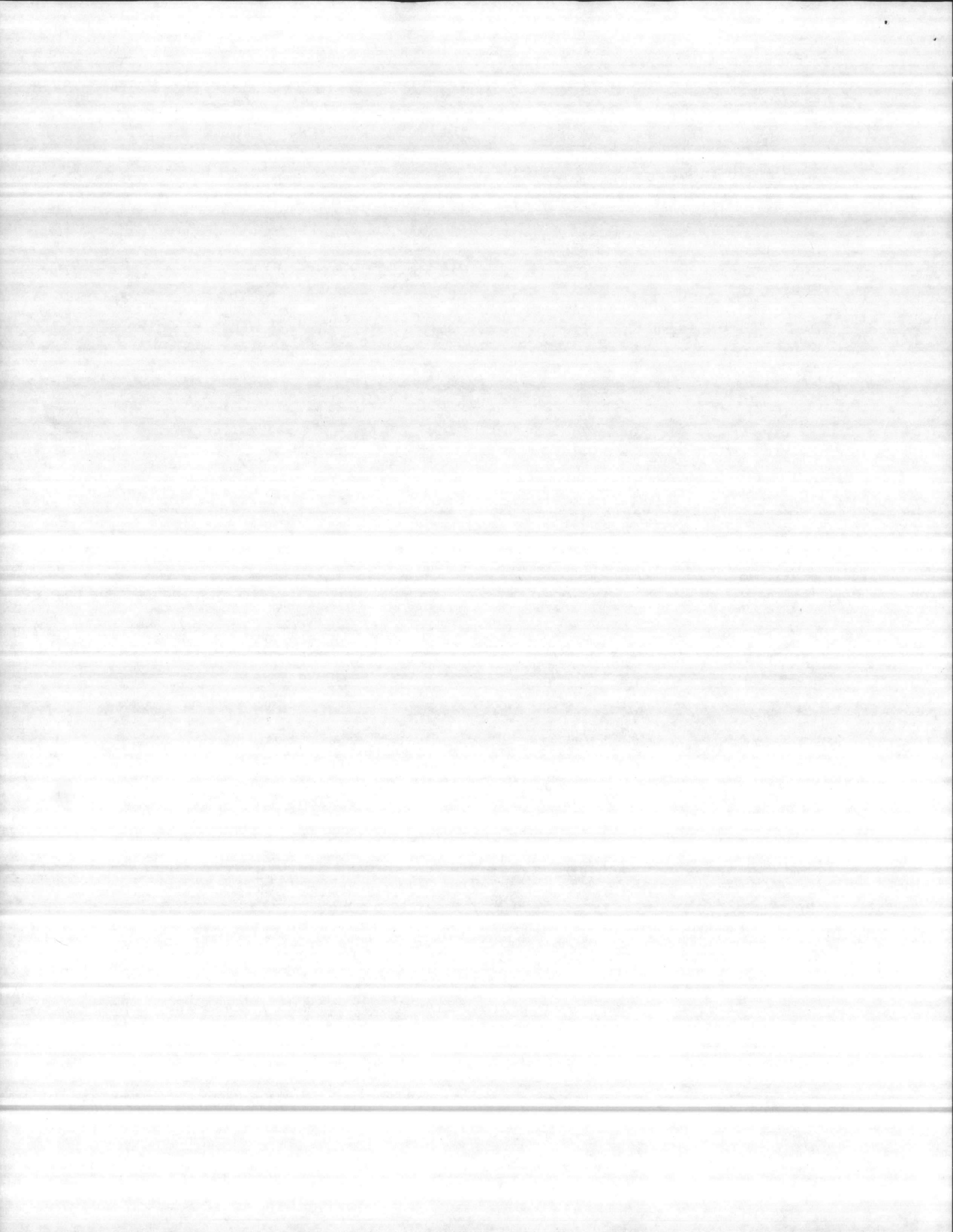
- 1A Liquid or Gas Service - Vertical or Horizontal Pipe; Steam Service - Horizontal Pipe No Extra
- 1B Steam Service - Vertical Pipe, Up Flow No Extra
- C Steam Service - Vertical Pipe, Down Flow No Extra

PROCESS PIPE NOMINAL SIZE - 7th and 8th characters

	<u>1350L</u>	<u>1351L</u>	<u>111352L</u> (Standard)	<u>111352L</u> (sst)	<u>1353L</u>
50 1/2 in.					
75 3/4 in.					
01 1 in.					
13 1 1/4 in.					
15 1 1/2 in.					
02 2 in.					
25 2 1/2 in.					
03 3 in.					
35 3 1/2 in.					
04 4 in.					
05 5 in.					
06 6 in.					
08 8 in.					
10 10 in.					
12 12 in.					
14 14 in.					
16 16 in.					
18 18 in.					
20 20 in.					
22 22 in.					
24 24 in.					
26 26 in.					
28 28 in.					
30 30 in.					
32 32 in.					
34 34 in.					
36 36 in.					
38 38 in.					
40 40 in.					
42 42 in.					
44 44 in.					
46 46 in.					
48 48 in.					

PROCESS PIPE SCHEDULE OR WEIGHT - 9th and 10th characters (Refer to Table 2)

- 10 Carbon Steel Pipe Schedule 10 No Extra
- 11 Carbon Steel Pipe Schedule 20 No Extra
- 12 Carbon Steel Pipe Schedule 30 No Extra
- 13 Carbon Steel Pipe Schedule 40 No Extra
- 14 Carbon Steel Pipe Schedule 60 No Extra
- 15 Carbon Steel Pipe Schedule 80 No Extra
- 16 Carbon Steel Pipe Schedule 100 No Extra
- 17 Carbon Steel Pipe Schedule 120 No Extra
- 18 Carbon Steel Pipe Schedule 140 No Extra
- 19 Carbon Steel Pipe Schedule 160 No Extra
- 20 Stainless Steel Pipe Schedule 5S No Extra
- 21 Stainless Steel Pipe Schedule 10S No Extra
- 22 Stainless Steel Pipe Schedule 40S No Extra
- 23 Stainless Steel Pipe Schedule 80S No Extra
- 30 Carbon Steel Pipe LW (Light Weight) No Extra
- 31 Carbon Steel Pipe SF (Standard Weight) No Extra
- 32 Carbon Steel Pipe FX (Extra Strong) No Extra
- 33 Carbon Steel Pipe XX (Double Extra Strong) No Extra
- 40 Brass and Copper Pipe Regular No Extra
- 41 Brass and Copper Pipe Extra Strong No Extra



PACKING GLAND MATERIAL - 11th character
 13 Type 316 sst (all elements) No Extra
 4 Type 316 sst Gland, Isolating Valve, and (for 1352L only) See Process Pipe Nominal Size

MODEL (Design Level) - 12th character
 A Model A

PIPE MOUNT WELD FITTING (should match pipe material) - 13th character
 1 Brass (brass or copper pipe) No Extra
 2 Carbon Steel (carbon steel pipe) No Extra
 3 Type 316 sst (stainless steel pipe)

DOUBLE MOUNT WELD FITTING - 14th character (Note 1)
 0 None No Extra
 1 Brass (1350L only)
 2 Carbon Steel (1350L and 1351L only)
 3 Type 316 sst (1350L and 1351L only)

INSTRUMENT CONNECTIONS AND SHUTOFF VALVES - 15th character
 1 1/2 in. Ext NPT Connections, Brass Valves (not available on 1351L or 1353L) No Extra
 2 1/2 in. Int NPT Connections, Without Valves No Extra
 3 1/2 in. Int NPT Connections, Carbon Steel Valves
 4 1/2 in. Ext NPT Connections, Type 316 sst Valves (Note 2)
 5 1/2 in. Int NPT Connections, Without Valves (Note 3)
 6 1/2 in. Int NPT Connections, Carbon Steel Valves (Note 3)
 7 1/2 in. Int NPT Connections, Type 316 sst Valves (Notes 2 and 3)

PROCESS PRESSURE COMPENSATION - 16th character (Note 4)
 0 None No Extra
 1 1/2 in. Int NPT Connection
 2 1/2 in. Int NPT Connection

HYPHEN - 17th character

PROCESS TEMPERATURE COMPENSATION - 18th character
 0 None No Extra
 1 Thermocouple, Type J
 2 Thermocouple, Type K
 3 Thermocouple, Type T
 4 RTD, Platinum
 5 RTD, Nickel
 6 RTD, Nickel-Iron

RTD RESISTANCE (with RTD option only) - 19th character
 0 None No Extra
 1 100 Ohms No Extra
 2 200 Ohms No Extra
 5 500 Ohms No Extra

RTD RANGE (with RTD option only) - 20th character
 0 None No Extra
 1 -328 to 500 °F (-200 to 260 °C) No Extra
 2 -328 to 1220 °F (-200 to 660 °C) No Extra

RTD CONFIGURATION (with RTD option only) - 21st character
 0 None No Extra
 2 Two-Wire No Extra
 3 Three-Wire No Extra
 4 Four-Wire No Extra

1350L A 01 13 3 A 3 0 4 0 - 4 1 1 4 SAMPLE CATALOG NUMBER

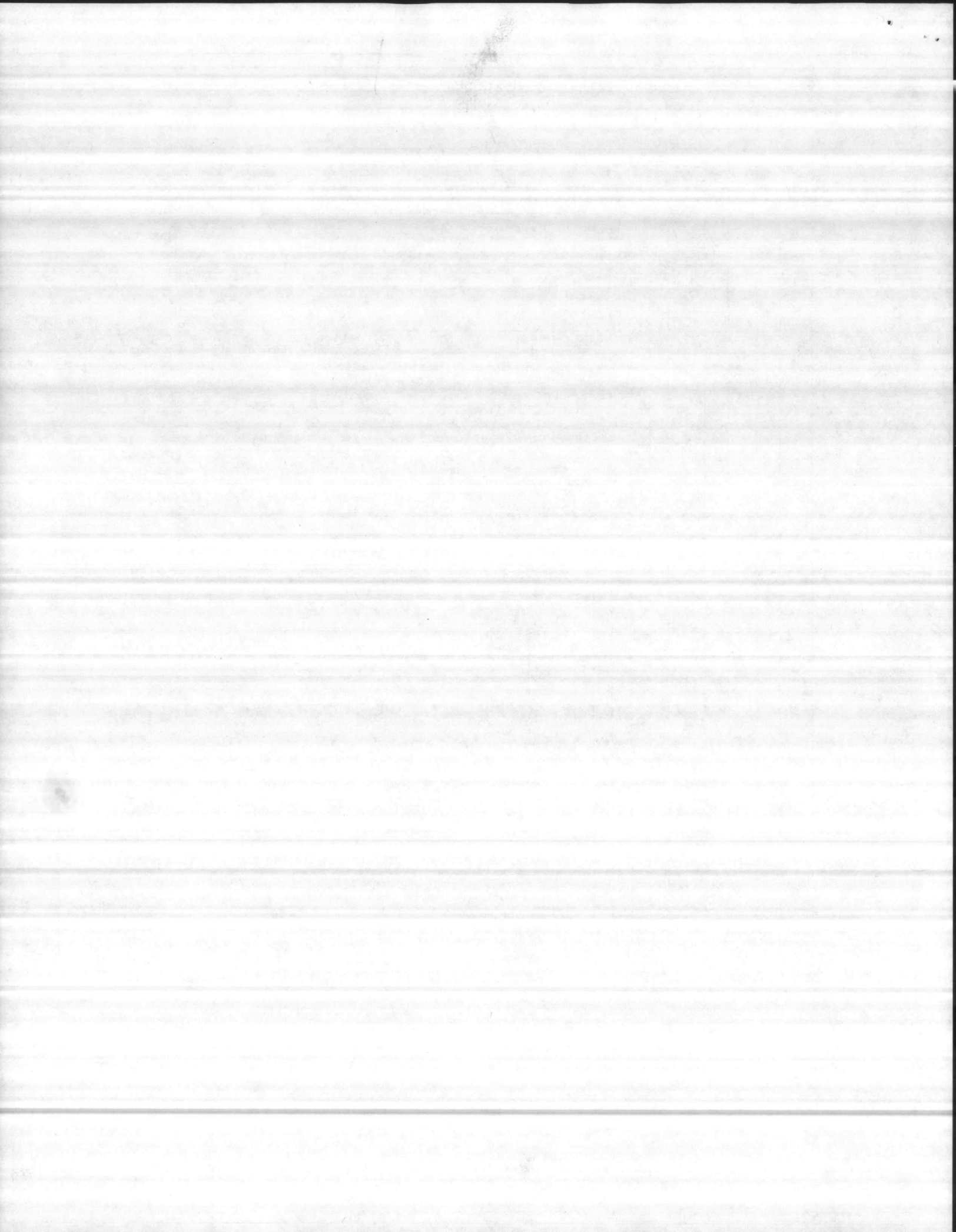
NOTES

- 1 Refer to Table 3 to see if double mount is required. If so, it should match pipe mount weld fitting.
2. Type 316 sst valves with Teflon seats are rated at 350 °F, 200 psi (177 °C, 1380 kPa).
- 3 1/2 in. Int NPT is restricted to the following sizes: 1350L - 10 in. and larger; 1351L - all sizes; 1352L - 8 in. and larger; 1353L - 6 in. and larger
- 4 Not available on Models 1350L and 1351L.

f Indicates that unit can be built for quick delivery.
 * If 1352L is ordered with packing gland suffix 3, use standard pricing. If 1352L is ordered with all sst support hardware suffix 4, use sst pricing.

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MEASURING ELEMENTS



SPEC 15971

P721

WATER METERS

ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511

APPROVED *S.C.*
APPROVED AS NOTED
DISAPPROVED

SUBJECT TO THE REQUIREMENTS OF
CONTRACT NO. N624708SC-5142
APPROVAL OF A SUBMITTAL DOES NOT INCLUDE
APPROVAL OF ANY DEVIATION FROM THE CON-
TRACT REQUIREMENTS UNLESS THE CONTRACT
FOR CALLS ATTENTION TO AND SUPPORTS THE
DEVIATION---THE CONTRACTOR SHALL BE RES-
PONSIBLE FOR PROVIDING PROPER PHYSICAL
DIMENSIONS & WEIGHTS, COORDINATION OF
TRADES, ETC., AS REQUIRED

REVIEWER: J. N. PEASE *J. N. Pease* DATE 02/03/88
FOR OFFICER IN CHARGE OF CONSTRUCTION

"It is hereby certified that the (material) (equipment) shown and marked in this submittal, shop drawings, catalog cut(s), etc., and approved/proposed to be incorporated into Contract Number 85C-5142, is in compliance with the contract drawings and specifications, and can be installed in the allocated space, and is approved for use. submitted for Government approval.

Authorized Reviewer *Ernie Anderson* Date 17-8-87
Signature CQC Rep. *Joseph Reagan* Date 12-8-87

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