RAY STURGILL & ASSOCIATES, INC.
1875 I-85 SOUTH, CHARLOTTE, NORTH CAROLINA 28208, (704) 392-5301

U.S. MARINE CORPS BASE
Camp Lejeune, N.C.

REPAIRS TO WATER PLANT EQUIPMENT
CONTRACT NO. N62470-81-B-3554

INSTRUMENTATION SUBMITTALS

Contractor: East Coast Construction Company
Jacksonville, N. C.
Purchase Order: Verbal - Woody Myers

Engineers: Design Div., Public Works Department
Marine Corps Base, Camp Lejeune, N. C.

INSTRUMENTATION EQUIPMENT LIST

TARAWA TERRACE WATER TREATMENT PLANT-SHEET 3

1 - Elevated Tank WAter Depth Meter System per paragraphs 4.4, 4.4.1, and 4.4.2, consisting of:.

- 1 - Foxboro Tank Level Transmitter.
- 1 - Moore Industries Telemetry Transmitter.
- 1 - Moore Industries Telemetry Receiver.
- 1 - Foxboro Circular Chart Indicating and Recording Meter with auxiliary switch for the control of four (4) pumps.

1 - Reservoir Water Depth Meter System per paragraphs 4.3, 4.3.1, and 4.3.2, consisting of:

- 1 - Process Control Equipment-Monitek Reservoir Level Transmitter.
- 1 - Foxboro Circular Chart Indicating and Recording Meter.

1 - Service Water Flowmeter System per paragraphs 4.5, 4.5.1, and 4.5.2, consisting of:

- 1 - Foxboro Rate-of-Flow Transmitter for use with existing 12" venturi.
- 1 - Foxboro Circular Chart Indicating,Recording, and Totalizing Meter.

1 - Raw Water Flowmeter System per paragraphs 4.2.2,4.6, 4.6.1, 4.6.2, and 5., consisting of:

- 1 - Badger 10" Venturi Tube, cast-iron with 125# flanges.
- 1 - Foxboro Rate-of-Flow Transmitter.
- 1 - Foxboro Circular Chart Indicating,Recording and Totalizing Meter.

NOTE: The four (4) meters listed above will be provided for mounting in the existing panel.

HADNOT POINT WATER TREATMENT PLANT-SHEETS 4 & 5

1 - Well Line Flowmeter System consisting of:

- 1 - Foxboro Rate-of-Flow Transmitter for use with existing 16" venturi.
- 1 - Foxboro Circular Chart Indicating,Recording, and Totalizing Meter.
- 1 - Panel Box.

INSTRUMENTATION EQUIPMENT LIST - 2

HADNOT POINT(Continued)

1 - Service Line Flowmeter System per paragraphs 4.5, 4.5.1, and 4.5.2, consisting of:

- 1 - Foxboro Rate-of-Flow Transmitter for use with existing 16" venturi.
- 1 - Foxboro Circular Chart Indicating,Recording, and Totalizing Meter.
- 1 - Panel Box.

1 - Raw Water Flowmeter System per paragraphs 4.2.1,4.6, 4.6.1, and 4.6.2, consisting of:

- 1 - Foxboro 16" Orifice Plate with a pair of threaded end orifice flanges.
- 1 - Foxboro Circular Chart Indicating,Recording, and Totalizing Meter for wall mounting.

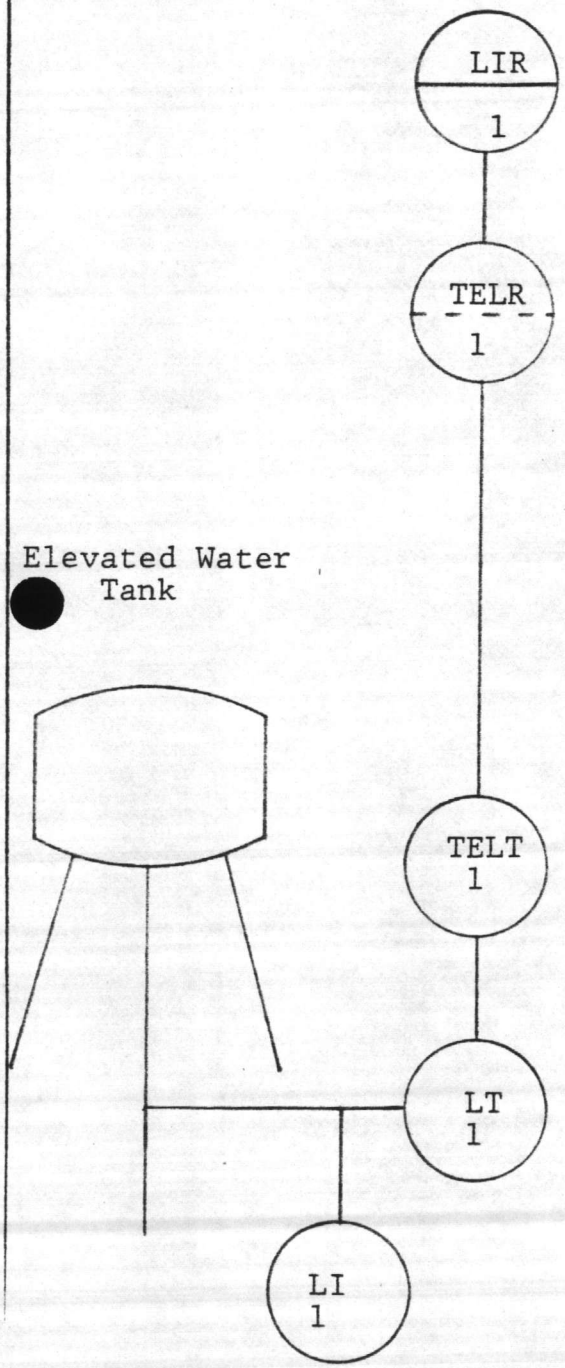
5 - 8" Rate-of-Flow Controllers per paragraph 4.7.

5 - Kennedy 8" Butterfly Valves per paragraph 4.8 and per AWWA C504 mounted to Foxboro electric motor actuators.

1 - Set of Spare Parts as specified in Paragraph 4.10.

1 - Field Service as specified in paragraphs 6 and 7.2 to check out the above instrumentation after it has been installed by others. We will calibrate, make necessary adjustments, place the equipment in operation and instruct the operating personnel.

Please confirm range desired. Sheet 3 of plans show 0-25 feet and refer to an operating range of 34 feet. The specs.,page 4, say 0-30 feet.



LI-1	Altitude Gauge,0-25 ft.*
LT-1	Foxboro E11GM Level Transmitter per Work Sheet 2A-1,No. 3. *0-25 ft. range, 4-20 mA output, suppression head 112 ft.
TELT-1	Moore Ind. PDT Telemetering Transmitter in Nema 4 housing. 4-20 mA input. Pulse duration output.
TELR-1	Moore Ind. PDR Telemetering Receiver. Pulse duration input. 4-20 mA output.
LIR-1	Foxboro 40PR Level Indicating Recorder per Work Sheet3-1,No. 1A *0-25 ft. range,4-20 mA input. Includes contacts to control 4 pumps through existing Automatic Program Control and indicate high water level alarm & telemetry reception outage.

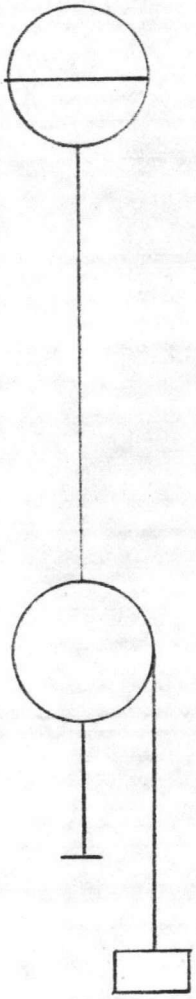
TARAWA TERRACE WATER PLANT
ELEVATED WATER TANK LEVEL

HI-RAN SYSTEMS
RAY STURGILL & ASSOCIATES, INC.

JOB: CAMP LEJEUNE, N. C.
DATE: 12-20-81
DRAWING: CL-811201

LIT-2 Process Control-Monitek Float Type Level Transmitter with Indicator Reading 0-12 feet. Output 4-20 mA.

LIR-2 Foxboro 40PR Level Indicating Recorder per Work Sheet 3-1, No. 1A.



TARAWA TERRACE WATER PLANT RESERVOIR LEVEL	**HI-RAN SYSTEMS** RAY STURGILL & ASSOCIATES, INC.	JOB CAMP LEJEUNE, N. C.	
		DATE 12-20-81	DRAWING CL-811202

4-9-82

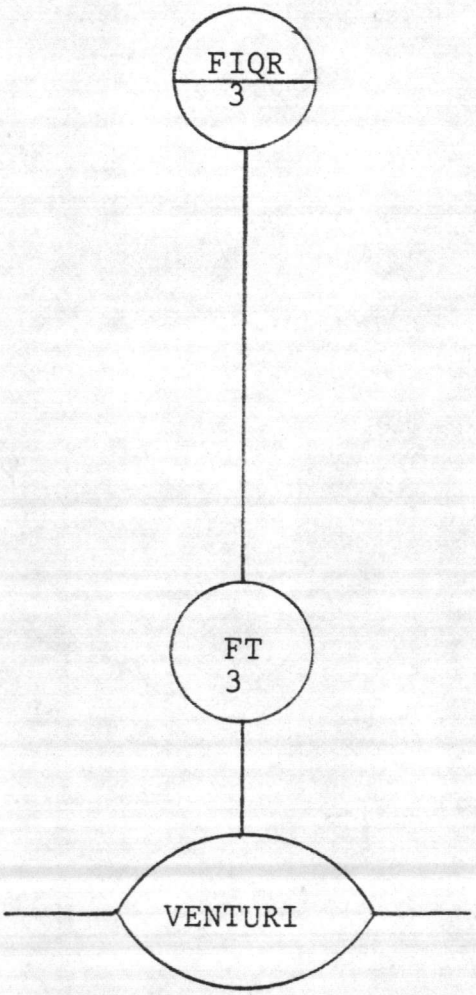
Weaver to check with Charlotte on changing raw water meter range from 0-2500 GPM to 0-1200 GPM will let me know

14.39
11.25

123

FT-3 Foxboro E13DM Flow Transmitter including 3 valve manifold and square root extractor. Range 0-2500 GPM. Calibrated for differential of 86"water at 2500 GPM Output 4-20 mA. per Work Sheet 2A-1,No. 5A

FIQR-3 Foxboro 40 PR Indicating and Totalizing Recorder. Input 4-20 mA., 0-2500 GPM range. Per Work Sheet 3-1,No. 1A



(Existing)

TERRAWA TERRACE WATER PLANT
SERVICE WATER FLOW METERING

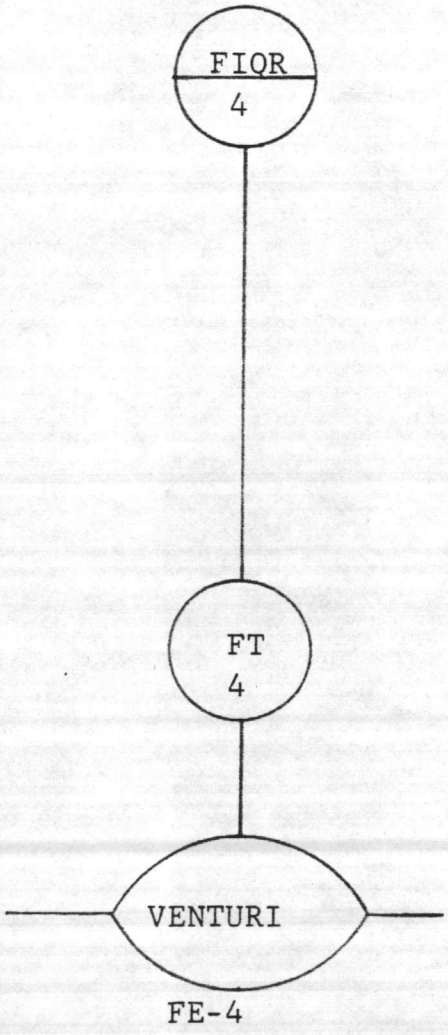
HI-RAN SYSTEMS
RAY STURGILL & ASSOCIATES, INC.

JOB: CAMP LEJEUNE, N.C.
DATE: 12-20-81
DRAWING: CL-811203

FE-4 Badger 10" PMT-S Venturi Flow Tube, 125# flanged ends, Cast iron, bronze throat. Tube coated per MIL-P-24441.

FI-4 Foxboro E13DM Flow Transmitter, including 3 valve manifold and square root extractor. Range 0-2500 GPM. Output 4-20 mA per Work Sheet 2A-1, No. 5A.

FIQR-4 Foxboro 40PR Indicating and Totalizing Recorder. Input 4-20 mA. 0-2500 GPM range. Per Work Sheet3-1, No. 1A.



FE-4

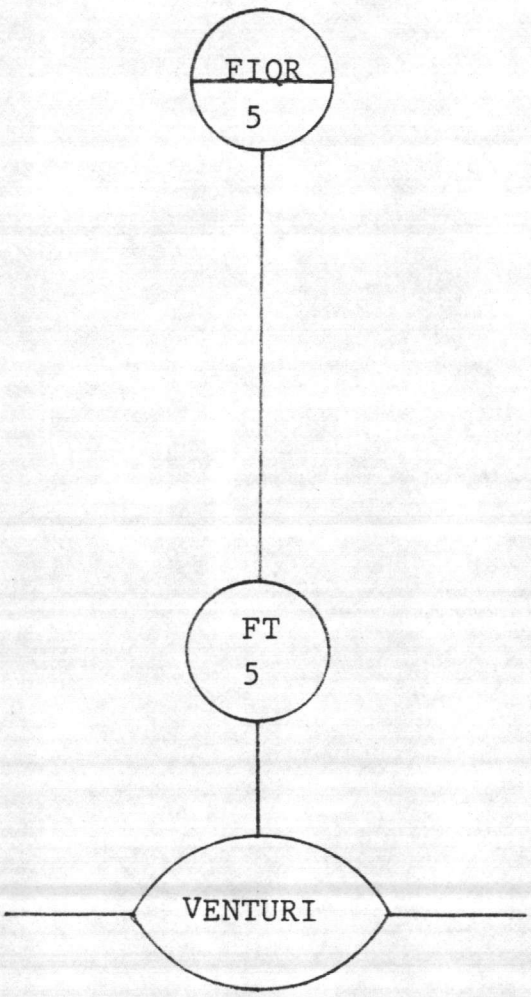
TARAWA TERRACE WATER PLANT
RAW WATER FLOW METERING

HI-RAN SYSTEMS
RAY STURGILL & ASSOCIATES, INC.

JOB: CAMP LEJEUNE, N. C.
DATE: 12-20-81
DRAWING: CL-811204

FT-5 Foxboro E13DM Flow Transmitter, including 3 valve manifold and square root extractor. Range 0-6000 GPM. Output 4-20 mA per Work Sheet 2A-1, No. 5A.

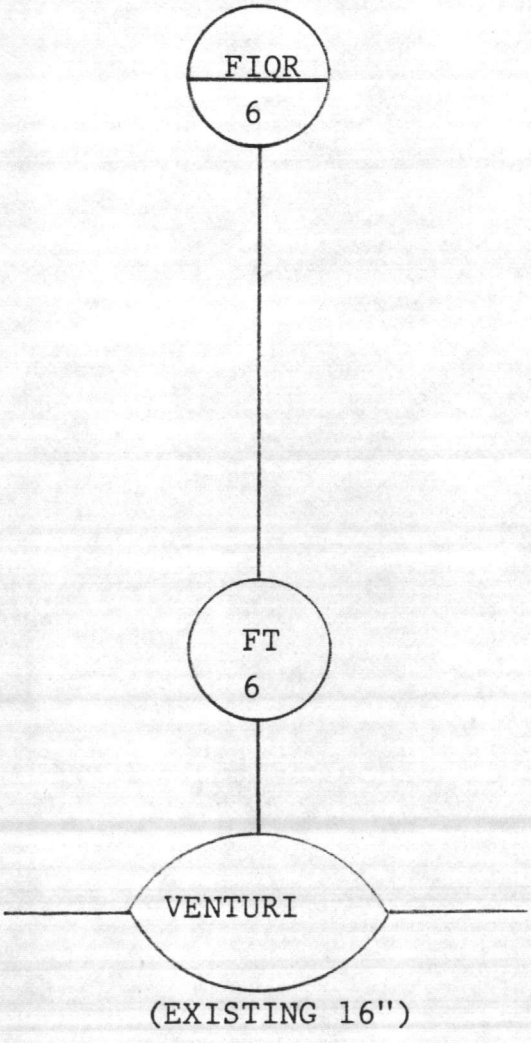
FIQR-5 Foxboro 40PR Indicating and Totalizing Recorder. Input 4-20 MA, Range 0-6000 GPM per Work Sheet 3-1, No. 1A.



HADNOT POINT WATER TREATMENT PLANT WELL LINE FLOWMETER	**HI-RAN SYSTEMS** RAY STURGILL & ASSOCIATES, INC.	JOB CAMP LEJEUNE, N. C.	
		DATE 12-20-81	DRAWING CL-811205

FT-6 Foxboro E13DM Flow Transmitter, including 3 valve manifold and square root extractor. Range 0-6000 GPM. Output 4-20 mA per Work Sheet 2A-1, No. 5A.

FIQR-6 Foxboro 40P R Indicating and Totalizing Recorder. Input 4-20,mA Range 0-6000 GPM per Work Sheet 3-1, No. 1A.



HADNOT POINT WATER TREATMENT PLANT SERVICE LINE FLOWMETER

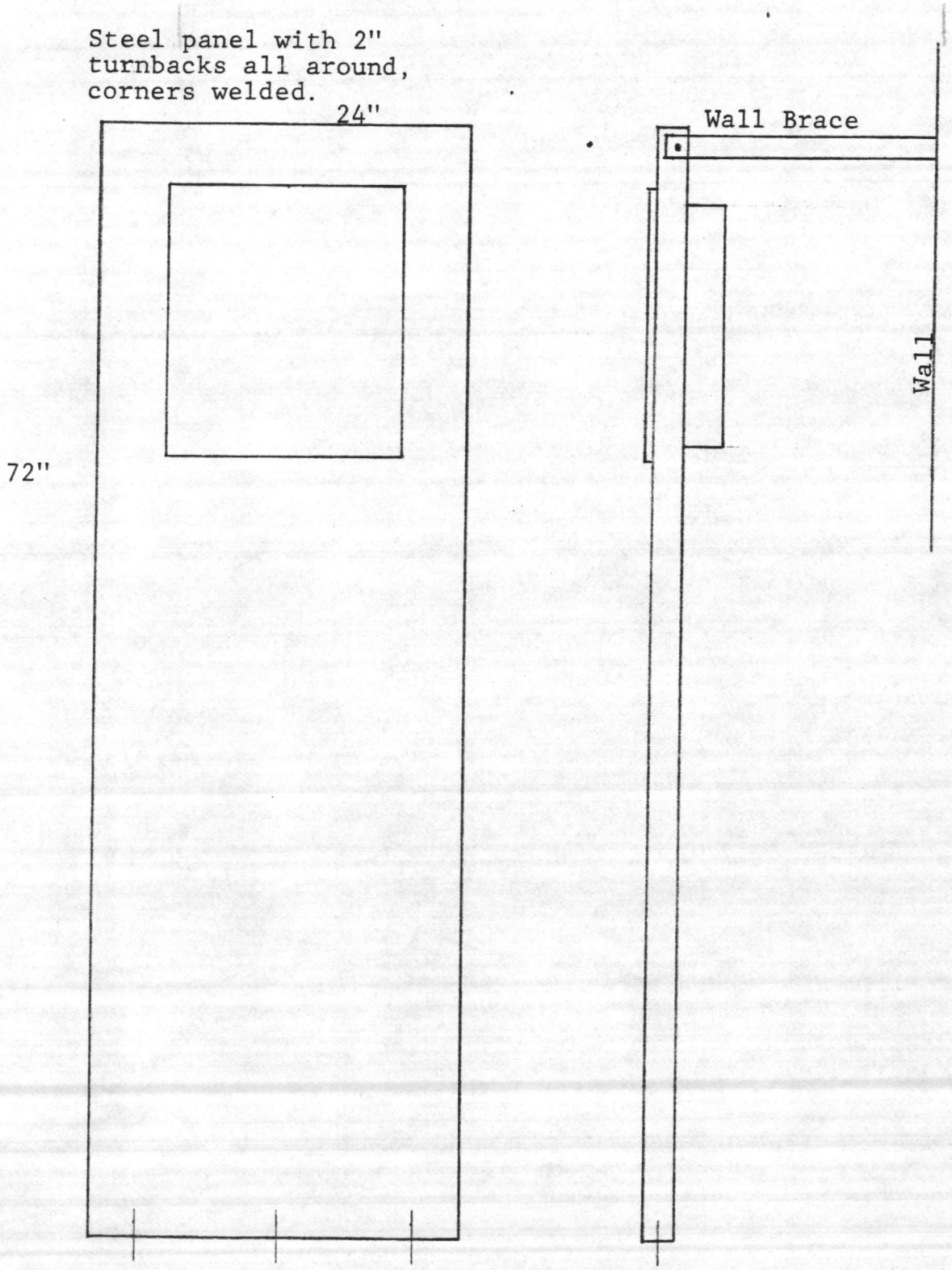
HI-RAN SYSTEMS

RAY STURGILL & ASSOCIATES, INC.

JOB CAMP LEJEUNE, N. C.

DATE 12-20-81

DRAWING CL-811206

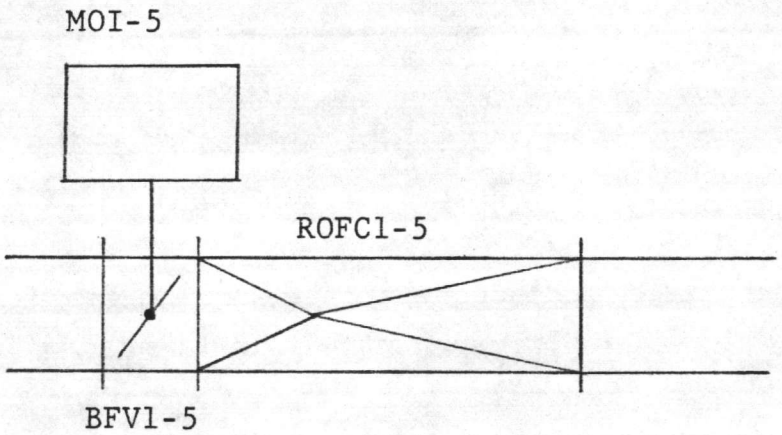


HADNOT POINT WATER TREATMENT PLANT PANEL BOXES FOR WALL LINE & SERVICE LINE FLOWMETERS

HI-RAN SYSTEMS

RAY STURGILL & ASSOCIATES, INC.

JOB	
CAMP LEJEUNE, N.C.	
DATE: 12-20-81	DRAWING: CL-811207



ROFC1-5 5 - 8" OCV #120 G Rate-of-Flow Controllers. 125# flanges, globe type, cast iron with stainless steel shaft and spring. Rated 700 GPM at 125 psi.

BFV1-5 5 - 8" Kennedy Vutterfly Valves, 125# flanges per AWWA C504 mounted to electric operators below.

MO1-5 5 - Foxboro/Jordan 5120 Electric Valve Operators for operation on 120 v., 60 Hz., single phase power.

HADNOT POINT WATER TREATMENT PLANT RATE-OF-FLOW CONTROLLERS & MOTORIZED BUTTERFLY VALVES

HI-RAN SYSTEMS

RAY STURGILL & ASSOCIATES, INC.

JOB CAMP LEJEUNE, N. C.

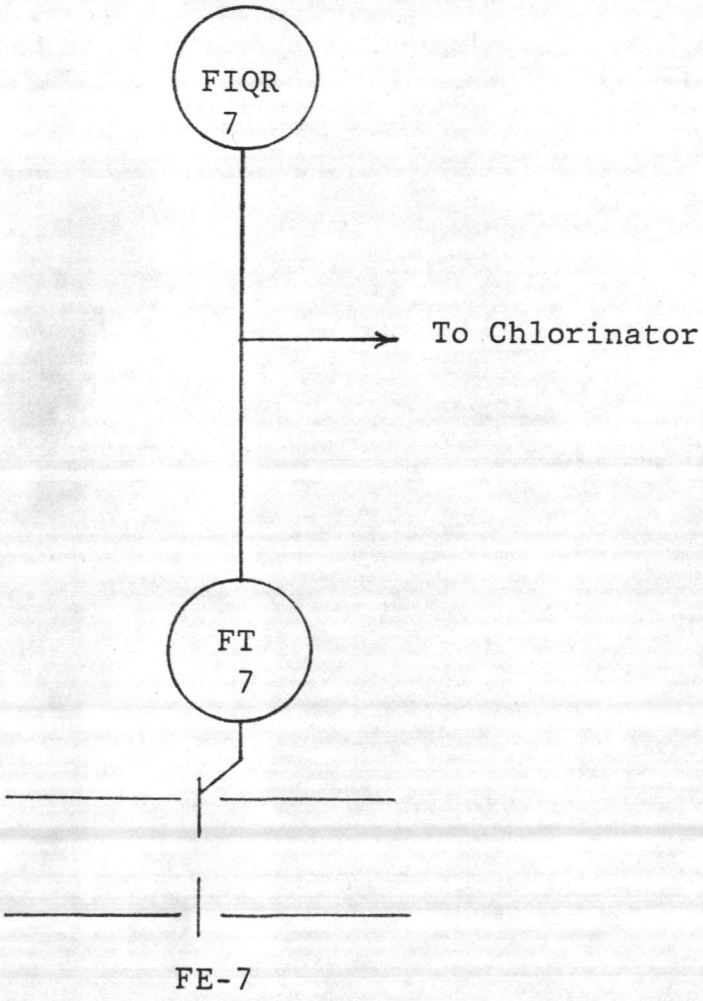
DATE 12-20-81

DRAWING CL-811209

FE-7 16" Orifice Plate with 16" weld neck orifice flanges.

FT-7 Foxboro 13A Pneumatic Flow Transmitter with 3 valve manifold and square root extractor. Range 0-6000 GPM Output 3-15 psi air to recorder and to chlorinator. Per Work Sheet 2B-1,No.5A.

FIQR-7 Foxboro 40PR Indicating and Totalizing Recorder. Output 3-15 psi air. Range 0-6000 GPM per Work Sheet 3-1, No. 1A



HADNOT POINT WATER TREATMENT PLANT RAW WATER FLOWMETER

HI-RAN SYSTEMS

RAY STURGILL & ASSOCIATES, INC.

JOB: CAMP LEJEUNE, N. C.

DATE: 12-20-81

DRAWING: CL-811208

Quote + Order Work Sheet **WS 2A-1, No. 3**

Fox. Ord No.

Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U. S. MAREIN CORPS BASE, CAMP LEJEUNE, N. C.
CUSTOMER ORDER NO. 81236

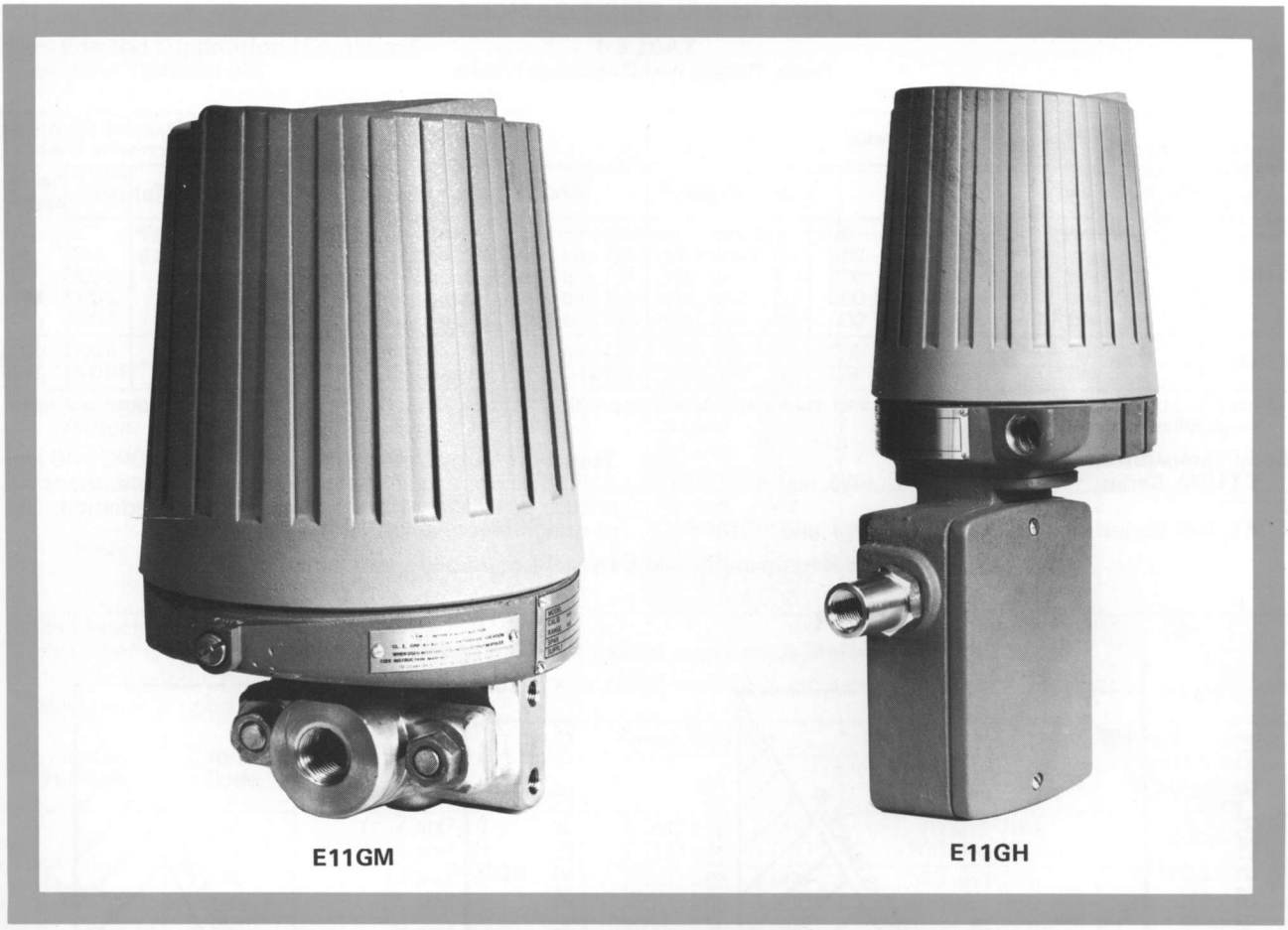
Quote Item or Sheet

Quan			
1		**FOXBORO ELECTRONIC GAUGE PRESSURE TRANSMITTER**	
		MODEL: E11GM- ISA1-ELSP-LAR	
		OUTPUT SIGNAL:	
	-H ☐	----------	10 to 50 mA dc
	-I XX	----------	4 to 20 mA dc
	S	**BODY MATERIAL:**	AISI Type 316 stainless steel
		CAPSULE MATERIAL:	
	A XX	----------	AISI Type 316 stainless steel
B Span Only	B ☐	----------	Monel Metal
		SPAN LIMITS:	
	☐	----------	0.07 and 0.56 MPa
	A XX	----------	10 and 80 psi
	☐	----------	0.7 and 5.6 bar or kg/cm^2
	☐	----------	0.14 and 1.4 MPa
	B ☐	----------	20 and 200 psi
	☐	----------	1.4 and 14 bar or kg/cm^2
	☐	----------	0.3 and 2.8 MPa
	C ☐	----------	40 and 400 psi
	☐	----------	3.0 and 28 bar or kg/cm^2
	☐	----------	0.7 and 7.0 MPa
	D ☐	----------	100 and 1000 psi
	☐	----------	7.0 and 70 bar or kg/cm^2
	☐	----------	1.4 and 14 MPa
	E ☐	----------	200 and 2000 psi
	☐	----------	14 and 140 bar or kg/cm^2
		PROCESS CONNECTION:	
	1 XX	----------	Tapped for 1/4 NPT
	2 ☐	----------	Tapped for 1/2 NPT
	3 ☐	----------	Tapped for R 1/4
	4 ☐	----------	Tapped for R 1/2
B,C,D,E, Span Only	5 ☐	----------	Machined for 9/16-18 Aminco fitting
		MOUNTING:	Bracket for both nominal 50 mm and 2 inch pipe
Must Specify	☐	**ELECTRICAL CLASSIFICATION:**	CS-E/ _____ (Refer to PS 2A-1Z1, page 1 for quotation description)
		OPTIONAL FEATURES:	
Features Continued On Sheet _____		(x) ELSP zero suppression-112 ft.water (48.5psi)	
		LAR-voltage surge protection	

SERIAL NO.	CUST. ITEM	TAG	CALIBRATED RANGE	Comp Total
	1	Elevalted Tank Level (LT-1)	0-25 ft. water	

General Specifications: ---------- GS 2A-1B3 A ☐

PRICE EACH



E11GM E11GH

E11GM AND E11GH SERIES GAUGE PRESSURE TRANSMITTERS

These transmitters measure gauge pressure and transmit proportional 4 to 20 mA or 10 to 50 mA dc signals. They are two-wire transmitters which may be installed in ordinary or hazardous locations.

PROVEN DEPENDABILITY

Foxboro gauge pressure transmitters use the same proven d/p Cell® Transmitter design which has been the standard of the process industries ever since Foxboro developed them nearly 30 years ago. Many thousands of successful, trouble-free installations have demonstrated the exceptional dependability of the E11GM and E11GH Series.

CERTIFIED WORLDWIDE AS EXPLOSION-PROOF AND INTRINSICALLY SAFE

The E11GM and E11GH Series are certified by PTB, BASEEFA, FM, CSA, LCIE, and SAA for virtually all significant electrical classifications. (See "PRODUCT SAFETY SPECIFICATIONS").

EASE OF MAINTENANCE AND COMMONALITY OF PARTS

Easy replacement of the capsule results in significant maintenance savings. Furthermore, the topworks of Foxboro electronic pressure, differential pressure, buoyancy, and target transmitters are virtually identical, minimizing spare parts inventory and simplifying maintenance routines. The replaceable capsules are identical to those used in Foxboro pneumatic gauge pressure transmitters, providing for further economy in spare parts inventory.

FOXBORO®

FUNCTIONAL SPECIFICATIONS

TABLE 1
Span, Range, and Overrange Limits

Series	Span Limit Code	Span Limits			Range-Limits (a)			Maximum Overrange Pressure Limit		
		MPa	psi	bar or kg/cm^2	MPa	psi	bar or kg/cm^2	MPa	psi	bar or kg/cm^2
E11GM	A	0.07 and 0.56	10 and 80	0.7 and 5.6	-0.1 and +0.7	-15 and +100	-1 and +7	0.7	100	7
	B	0.14 and 1.4	20 and 200	1.4 and 14	-0.1 and +2.4	-15 and +350	-1 and +24	3.5	500	35
	C	0.3 and 2.8	40 and 400	3 and 28	-0.1 and +5	-15 and +750	-1 and +50	7	1000	70
	D	0.7 and 7	100 and 1 000	7 and 70	-0.1 and +10	-15 and +1 500	-1 and +100	14	2000	140
	E	1.4 and 14	200 and 2 000	14 and 140	-0.1 and +20	-15 and +3 000	-1 and +200	28	4000	280
E11GH	M	7 and 40	1 000 and 6 000	70 and 400	-0.1 and +40	-15 and +6 000	-1 and +400	62	9000	620
	H	14 and 80	2 000 and 12 000	140 and 800	-0.1 and +80	-15 and +12 000	-1 and +800	124	18000	1 240

(a) Non-zero-based ranges may require optional zero elevation or suppression kit. See "Elevation and Suppression." Upper and lower range-values must not exceed range-limits.

Body Temperature Operative Limits

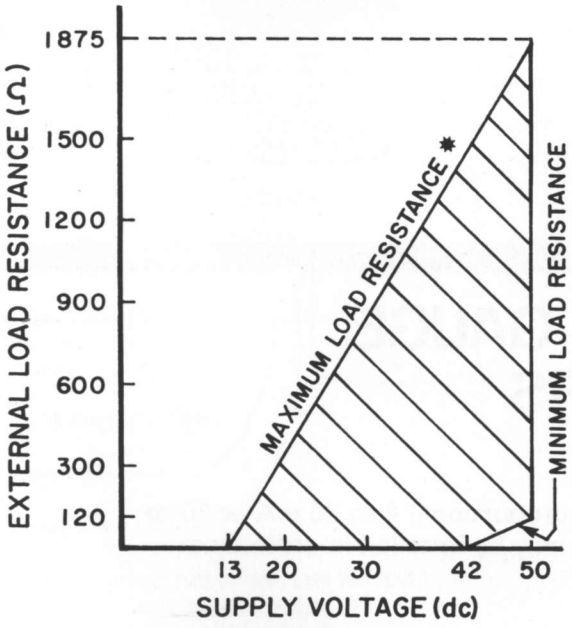
E11GM Series -40 and +190°C (-40 and +375°F)

E11GH Series -40 and +120°C (-40 and +250°F)

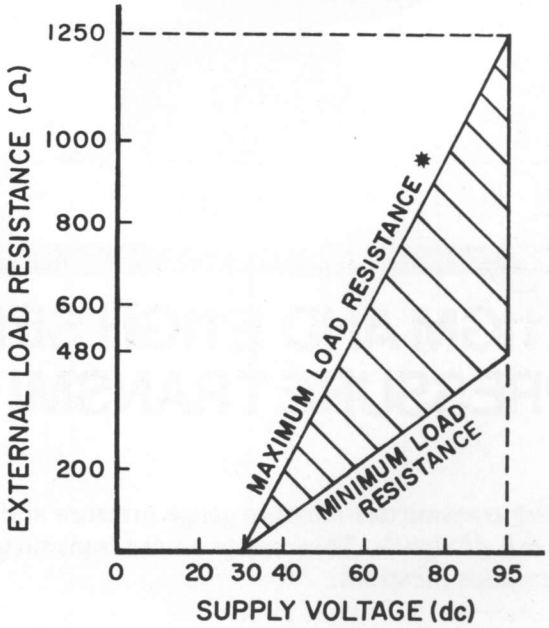
Topworks Temperature Limits -40 and +80°C (-40 and +180°F). For higher temperatures, or where the transmitter is exposed to excessive thermal radiation, use optional remote amplifier.

Supply Voltage Requirements and External Loop Load Limitations

4 TO 20 mA OUTPUT



10 TO 50 mA OUTPUT



* AT TOPWORKS TEMPERATURE OF 80° C (180° F)

Elevation and Suppression

With Optional Kit (AS Reference ELSP) By using this kit, zero may be suppressed to a maximum of 900% of capsule minimum span for the E11GM Series, and 500% of capsule minimum span for the E11GH Series. However, the sum of zero suppression plus calibrated span must not exceed the upper range-limits shown in Table 1. Zero may be elevated to the lower range-limit (full vacuum) with this kit.

Typical range for zero suppression: 0.14 to 0.7 MPa, 20 to 100 psi, or 1.4 to 7 bar or kg/cm^2.

Typical range for zero elevation: -0.07 to +0.7 MPa, -10 to +100 psi, or -0.7 to +7 bar or kg/cm^2.

FUNCTIONAL SPECIFICATIONS
(Continued)

Elevation and Suppression (Continued)

Without Optional Kit

E11GM Series: Only zero suppression is possible. The amount (limit of lower range-value in percent of span) depends upon the span.

Jumper Position (a)	Capsule Code	Spans Between			Maximum Lower Range-Value (Percent of Span) (b)
		kPa or MPa	psi	bar or kg/cm^2	
Low	A	70 and 140 kPa	10 and 20	0.7 and 1.4	200
	B	0.14 and 0.35 MPa	20 and 50	1.4 and 3.5	
	C	0.3 and 0.7 MPa	40 and 100	3 and 7	
	D	0.7 and 1.8 MPa	100 and 250	7 and 18	
	E	1.4 and 3.5 MPa	200 and 500	14 and 35	
Medium	A	140 and 280 kPa	20 and 40	1.4 and 3	100
	B	0.35 and 0.7 MPa	50 and 100	3.5 and 7	
	C	0.7 and 1.4 MPa	100 and 200	7 and 14	
	D	1.8 and 3.5 MPa	250 and 500	18 and 35	
	E	3.5 and 7.0 MPa	500 and 1 000	35 and 70	
High	A	280 and 560 kPa	40 and 80	3 and 5.6	10
	B	0.7 and 1.4 MPa	100 and 200	7 and 14	
	C	1.4 and 2.8 MPa	200 and 400	14 and 28	
	D	3.5 and 7.0 MPa	500 and 1 000	35 and 70	
	E	7.0 and 14 MPa	1 000 and 2 000	70 and 140	

(a) Electrical span selection jumper.
(b) Lower range-value plus calibrated span must not exceed upper range-limits in Table 1.

E11GH Series: Zero may be elevated to the lower range-limit (full vacuum). The amount of zero suppression available depends upon the span.

Jumper Position (c)	Capsule Code	Spans Between			Maximum Lower Range-Value (Percent of Span) (d)
		MPa	psi	bar or kg/cm^2	
Low	M	7 and 14	1 000 and 2 000	70 and 140	200
	H	14 and 28	2 000 and 4 000	140 and 280	
Medium	M	14 and 28	2 000 and 4 000	140 and 280	100
	H	28 and 56	4 000 and 8 000	280 and 560	
High	M	28 and 40	4 000 and 6 000	280 and 400	10
	H	56 and 80	8 000 and 12 000	560 and 800	

(c) Electrical span selection jumper.
(d) Lower range-value plus calibrated span must not exceed upper range-limits in Table 1.

Position These transmitters may be mounted in any orientation.

Frequency Response (Typical) A ±5% sinusoidal change superimposed on a 50% input signal is reduced by 3 dB (a magnitude ratio of 0.707) at a frequency between 1 and 3 Hz.

PERFORMANCE SPECIFICATIONS
(Under Reference Operating Conditions)

Accuracy (Includes Linearity, Hysteresis, and Repeatability)

E11GM Series . . . . . ±0.5% of span

E11GH Series

Spans Between						Accuracy (Percent of Span)
Span Code M			Span Code H			
MPa	psi	bar or kg/cm^2	MPa	psi	bar or kg/cm^2	
7 and 14	1 000 and 2 000	70 and 140	14 and 28	2 000 and 4 000	140 and 280	±0.5
14 and 21	2 000 and 3 000	140 and 210	28 and 42	4 000 and 6 000	280 and 420	±0.65
21 and 35	3 000 and 5 000	210 and 350	42 and 70	6 000 and 10 000	420 and 700	±1.0
35 and 42	5 000 and 6 000	350 and 420	70 and 84	10 000 and 12 000	700 and 840	±1.25

Dead Band . . . . . 0.05% of span

Repeatability . . . . . 0.1% of span

Hysteresis

E11GM Series

Capsule Codes A, B, C, and D . . . . . 0.1% of span
Capsule Code E . . . . . 0.2% of span

E11GH Series . . . . . 0.15% of span

PERFORMANCE SPECIFICATIONS (Continued)

Reproducibility (Includes the effects of Hysteresis, Repeatability, Dead Band, and Drift over a 1-hour period)
E11GM Series
Capsule Codes A, B, C, and D . . . . . 0.15% of span
Capsule Code E . . . . . 0.25% of span
E11GH Series . . . . . 0.20% of span

Ambient Temperature Effect

Model	Span Adjustment (Percent of Maximum Span)	Maximum Zero Shift in Percent of Span for 55°C (100°F) Change
E11GM	80 to 100 50 to 80 20 to 50	1.0 (a) 1.5 (a) 2.5 (a)
E11GH	80 to 100 50 to 80	1.5 3.0

(a) Doubles for body temperature above 120°C (250°F).

Position Effect A tilt of 90° from the vertical about the centerline of the process connection results in a maximum zero shift of 1.0%, which may be corrected with the zero adjustment screw.

PHYSICAL SPECIFICATIONS

Materials of Construction
Wetted Parts

Item	Series		
	E11GM-A	E11GM-B	E11GH
Capsule	316 ss	MONEL 404	NI-SPAN C
Connection Block	316 ss	MONEL 404	316 ss
Connector Gasket	Silicone Elastomer	ptfe	None

Nonwetted Parts
Topworks Cover and Base Die-cast low-copper aluminum alloy finished with blue textured vinyl paint. The cover is threaded and seats on a Buna-N O-ring.

Materials of Construction
Nonwetted Parts (Continued)
Case (E11GH Series). Cast iron with die-cast low-copper aluminum cover. The finish is blue textured vinyl paint.
Bolting (E11GM Series). Alloy steel per ASTM A 193 grade B7 or equivalent. See "OPTIONAL FEATURES" for 17-4 PH (b) stainless steel bolting.

Enclosure Classification Designed to meet the requirements of IP 65 (IEC 529) and to provide the environmental protection of NEMA Type 4 (NEMA IS 1.1 1975).

Mass (Approximate)
E11GM Series 9 kg (20 lb)
E11GH Series 10 kg (22 lb)
With Integral Junction Box Add 1 kg (2 lb)

PRODUCT SAFETY SPECIFICATIONS

Electrical Classification

Output (mA)	Certification Status (c)	Testing Laboratory	Types of Protection and Area Classification	Temperature Classification	CS Reference
4 to 20	A	CSA	Explosion-proof for Class I, Group D, Division 1 Dust-ignition proof for Class II, Groups E, F, and G, Division 1 and Class III. Class I, Groups B, C, and D, Division 2.	T6	CS-E/CD-A
	A	FM	Explosion-proof Class I, Groups C and D, Division 1. Dust-ignition proof Class II, Groups E, F, and G, Division 1. Nonincendive resistive for Class I, Groups A, B, C, and D, Division 2 and Class II, Groups E, F, and G, Division 2.	T6	CS-E/FD-A
	A	LCIE	Flame-proof for Class A, Group III.	T6	CS-E/LD-A
	F	Foxboro (d)	Flame-proof (Ex) d Group IIB, Zone 1.	T6	CS-E/XD-F
	A	CSA (e)	Intrinsically safe for Class I, Groups B, C, and D, Division 1.	T6	CS-E/CB-A
	A	FM (e)	Intrinsically safe for Class I, Groups A, B, C, and D, Division 1 and Class II, Groups E, F, and G, Division 1.	T6	CS-E/FB-A
	A	BASEEFA (e)	Intrinsically safe (Ex) ia IIC.	T4	CS-E/BA-A
	A	PTB (e)	Intrinsically safe (Ex) i.	G5	CS-E/PB-A
	A	SAA (e)	Intrinsically safe (Ex) is IIC.	T6	CS-E/AA-A
	A	S-COMM (e)	Intrinsically safe	G5	CS-E/YB-A
10 to 50	A	CSA	Explosion-proof Class I, Group D, Division 1 Dust-ignition proof for Class II, Groups E, F, and G, Division 1 and Class III. Class I, Groups B, C, and D, Division 2.	T6	CS-E/CD-A
	A	FM	Explosion-proof for Class I, Groups C and D, Division 1. Dust-ignition proof for Class II, Groups E, F, and G, Division 1.	T6	CS-E/FD-A
	A	LCIE	Flame-proof for Class A, Group III.	T6	CS-E/LD-A
	F	Foxboro (d)	Flame-proof (Ex) d Group IIB, Zone 1. Non-sparking (Ex) n Group IIC, Zone 2.	T6	CS-E/XD-F

(b) Trademark of Armco Steel Corporation for precipitation hardened stainless steel.
(c) A = Certification or listing received from testing laboratory.
F = Foxboro self-certified.
(d) IEC 79 terminology is used.
(e) Certification depends upon loop configuration or parameters as dictated by each testing laboratory.

OPTIONAL FEATURES

Optional Feature	Description	AS Reference
Integral Junction Boxes	With test jack across a series connected precision resistor of 1, 10, or 25 ohm value, depending on the transmission signal. (Note: This test jack is not permitted for PTB transmitter.) Available with an indicating meter visible through a glass window. Scales: 0 to 100% uniform Special legend (for example, 0 to 25 psi) Junction boxes are available to match the same electrical classification as the transmitter.	XJB XJB-A XJB-C
PG-11 Trumpet Connection	Cable connection for open cable wiring.	PG-11
Right Angle Mounting for Integral Junction Box	For E11GM Series only. Includes right angle fitting between junction box and transmitter. Specify when using O'Brien HeatPak or ViPak enclosures to provide proper clearance and orientation.	RAE
Voltage Surge Protection	A thyrector diode is placed across the power leads to protect against electrical damage due to high voltage surges. Not available for Electrical Certification Codes CS-E/AA-A, BA-A, CB-A, and FB-A.	LAR
Lower Spans	Provides for minimum span of 35 kPa, 5 psi, or 0.35 bar or kg/cm^2 with E11GM Series. The standard performance specifications and operating condition effects are reduced by factors of up to two. Maximum calibrated spans are reduced by a factor of two.	LD
Kits for Elevated-Zero and Suppressed-Zero Ranges	Permits adjustment of upper and lower range-values to the limits shown in Table 1.	ELSP
Reverse Output	20 to 4 or 50 to 10 mA dc, as specified.	TR 20-4 or TR 50-10
Steam Tracing	For E11GM Series only. One or two hollow studs may be substituted for body bolts. Steam at a maximum pressure of 1.4 MPa, 200 psi, or 14 bar or kg/cm^2 through the studs maintains the process liquid at temperatures up to 190°C (375°F) when used with an approved insulated enclosure.	Refer to Foxboro
Preparation for Oxygen Service	The transmitter is cleaned, assembled, calibrated, and packaged in a clean room, or using acceptable service alternative facilities.	OS-W
Preparation for Nuclear Service	A variety of optional constructions and preparations is available for satisfying the many applications in the nuclear power generation field. Contact any Foxboro office for further information.	Refer to Foxboro
Transmitter with Amplifier Mounted Separately	For topworks temperatures up to 120°C (250°F) the amplifier must be mounted separately in its own housing. The seven transmitter leads extend 0.5 metre (18 inches) from a hole tapped 1/2 NPT for a conduit fitting. These leads may be extended to a maximum of 150 metres (500 feet). Ambient temperature limits at the separate amplifier are -40 and +80°C (-40 and +180°F). **Amplifier Housing** **IEC Type d for Zone 1 (Division 1).** Designed for certification to Zone 1, (Ex) d IIB flameproof (Class I, Groups C and D, Division 1 explosion-proof) requirements. Temperature Classification T6. Cast aluminum case with two holes tapped 1/2 NPT for conduit fittings. Two lugs for surface mounting. **IEC Type n for Zone 2 (Division 2).** Designed for certification to Zone 2, (Ex) n IIC (Class I, Groups B, C, and D, Division 2) requirements. Temperature Classification T6. Sheet metal housing with holes for nominal 16 mm and 1/2 in conduit fitting. Four lugs for surface mounting.	RA-1 RA-2
ptfe Process Wetted Gaskets	For E11GM Series only. Connection block gasket of ptfe for chemical resistance.	DG-7
High Accuracy Calibration	For E11GM Series only. Accuracy of ±0.25% of span.	HAC
Pressure Seals	Transmitter available with field-replaceable filled pressure seal systems.	Refer to GS 3-2C1 A GS 3-2C1 B GS 3-2C2 A GS 3-2C2 B GS 3-2C2 C
Stainless Steel Bolting	For E11GM Series only. Type 17-4 PH stainless steel cap screws and nuts for the process connector.	SSB
Stainless Steel Mounting Bracket Bolting	For E11GM Series only. 316 ss bolting through the mounting brackets to the transmitter	SSB-A
Power Supplies	4 to 20 mA transmitters are normally powered directly by SPEC 200® systems, but in other systems an Acopian 32 V dc power supply or equivalent must be used. 10 to 50 mA transmitters can be powered by either single or multiple power supplies described in GS 2A-12B2 B and C.	Refer to Foxboro

® Registered Trademark

MODEL CODES

E11GM = Transmitter

Output Signal:
- -H = 10 to 50 mA dc
- -I = 4 to 20 mA dc

Body Material:
- S = AISI Type 316 stainless steel (316 ss)

Capsule Material:
- A = 316 ss
- B = MONEL (a) (Available for Span Limit Code B only)

Span Limits:
- A = 0.07 and 0.56 MPa, 10 and 80 psi, or 0.7 and 5.6 bar or kg/cm^2
- B = 0.14 and 1.4 MPa, 20 and 200 psi, or 1.4 and 14 bar or kg/cm^2
- C = 0.3 and 2.8 MPa, 40 and 400 psi, or 3 and 28 bar or kg/cm^2
- D = 0.7 and 7 MPa, 100 and 1000 psi, or 7 and 70 bar or kg/cm^2
- E = 1.4 and 14 MPa, 200 and 2000 psi, or 14 and 140 bar or kg/cm^2

Process Connection:
- 1 = 1/4 NPT
- 2 = 1/2 NPT
- 3 = R1/4
- 4 = R1/2
- 5 = Machined for 9/16-18 AMINCO (b) Fitting (Not available with Span Limit Code A).

(a) Trademark of International Nickel Company for nickel-cobalt-copper alloy.
(b) Trademark of American Instrument Company for high pressure connection.

E11GH = Transmitter

Output Signal:
- -H = 10 to 50 mA dc
- -I = 4 to 20 mA dc

Case Material (Not process wetted):
- I = Cast iron

Wetted Parts:
- N = NI-SPAN C (c) Element with 316 ss Connection.

Span Limits:
- H = 14 and 80 MPa, 2000 and 12 000 psi, or 140 and 800 bar or kg/cm^2
- M = 7 and 40 MPa, 1000 and 6000 psi, or 70 and 400 bar or kg/cm^2

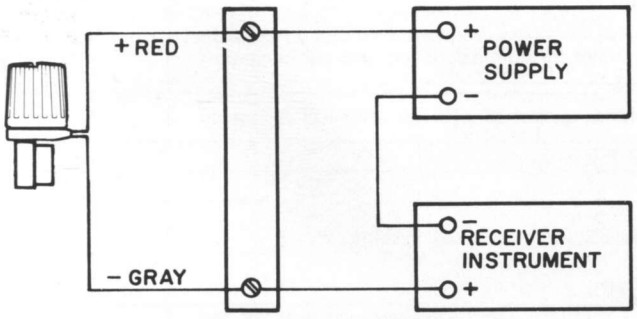
Process Connection:
- 2 = 1/2 NPT
- 4 = R1/2
- 5 = Machined for 9/16-18 AMINCO Fitting.

(c) Trademark of International Nickel Company for nickel-titanium-chromium-iron (copper-free) alloy.

ORDERING INSTRUCTIONS

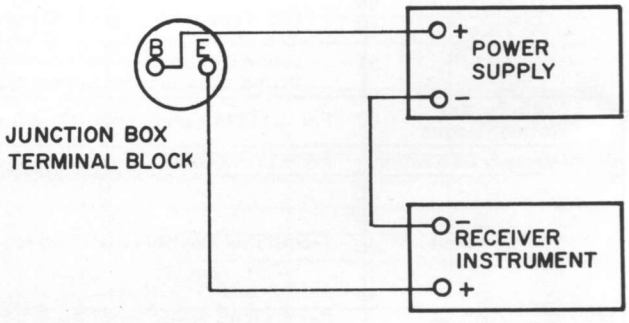
1. **Model Number**
2. **Electrical Classification**
3. **Calibrated Pressure Range**
4. **Optional Features**
5. **Tag**

WIRING CONNECTIONS



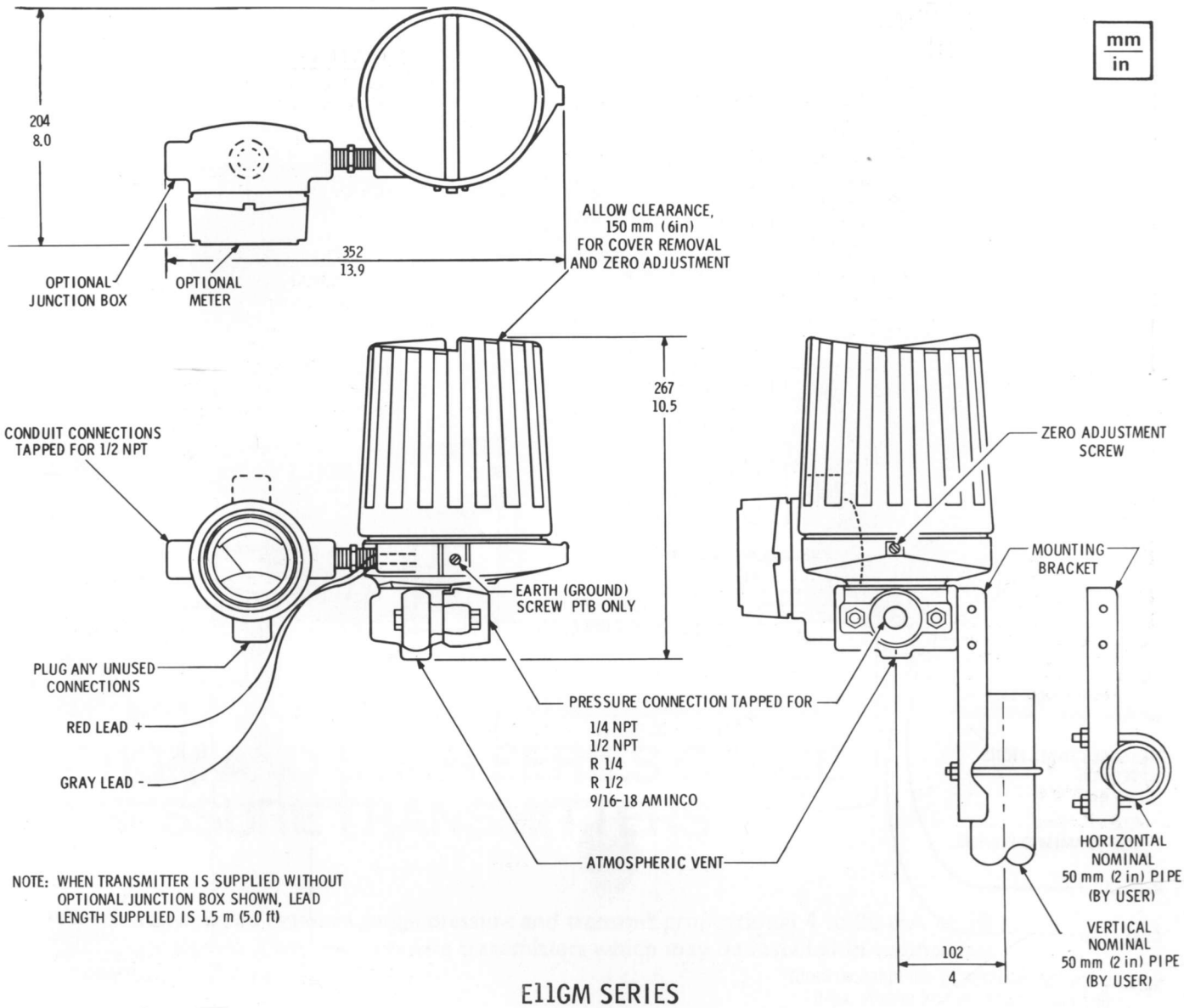
EXTERNAL CONNECTION BOX
(SUPPLIED BY USER)

WIRING FOR TRANSMITTER WITHOUT OPTIONAL JUNCTION BOX



WIRING FOR TRANSMITTER WITH OPTIONAL JUNCTION BOX

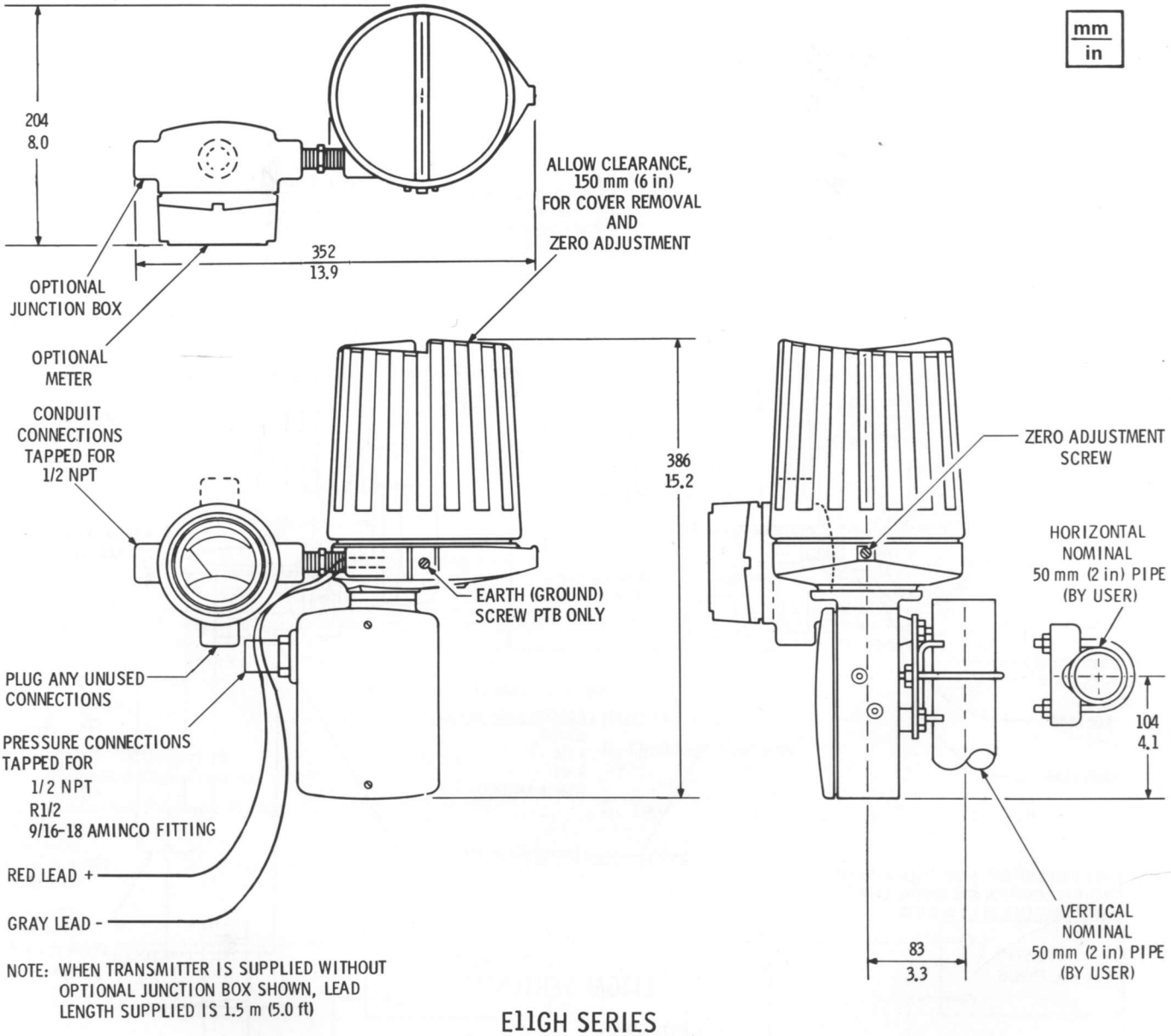
DIMENSIONS – NOMINAL



NOTE: WHEN TRANSMITTER IS SUPPLIED WITHOUT OPTIONAL JUNCTION BOX SHOWN, LEAD LENGTH SUPPLIED IS 1.5 m (5.0 ft)

EllGM SERIES

DIMENSIONS – NOMINAL
(Continued)



NOTE: WHEN TRANSMITTER IS SUPPLIED WITHOUT OPTIONAL JUNCTION BOX SHOWN, LEAD LENGTH SUPPLIED IS 1.5 m (5.0 ft)

E11GH SERIES

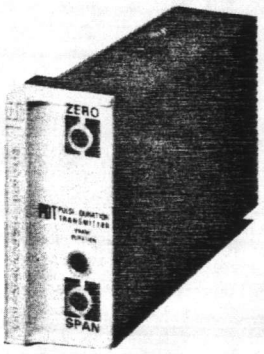
FOR TRANSMISSION OR CONTROL
TELEMETERING OR PROPORTIONAL ON-OFF

STANDARD PROCESS INPUTS
REPLACES ELECTROMECHANICAL CONVERTERS

WIDE RANGE
0.2 SEC. TO 100 SEC. DURATIONS

HIGH ACCURACY
±0.1% OF SPAN

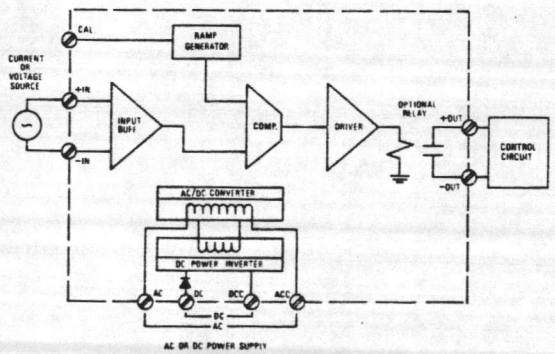
VERSATILE MOUNTING
STANDARD OR COMPACT PLUG-IN



The MII PDT, Pulse Duration Transmitter, converts any standard process signal input into an output pulse or relay closure whose duration or "on time" is linearly proportional to the input analog signal amplitude with an adjustable repetitive time over a 5:1 preselected range.

The versatile PDT may be used either as an on-off proportioning control device to operate solenoid valves or other similar final control elements, or as a transmitter for use in data transmission systems similar to the Durapulse (Honeywell), Teletax (Foxboro), or the Metameter (Bristol). In this data transmission application, a version of the PDR may be used as a receiving device to convert the "duration varying" data back to a standard analog process signal.

Control applications for this unit lie particularly in areas where regularly pulsed solenoid valves are used to inject additives into a process stream. It is especially useful in pH control work where it is desirable to have greater amounts of reagent (valve "on" longer) added to the stream as the pH increases. For control of decreasing pH applications, specifying the "reversed output" option will cause the transmitter's function to be reversed such that the maximum "on time" will occur with minimum input. Typical examples of industry applications for this type of pulsed control are:



Sugar Refining	Liming Process
Pulp and Paper	Bleaching
Food Processing	Cream and Butter Processing
Metals & Mining	Ore Flotation Process
Water Treatment	Flocculating

MOORE INDUSTRIES INCORPORATED 16650 SCHOENBORN STREET SEPULVEDA, CALIFORNIA • 91343 • 213 894-7111

INPUT:

Current:

1-5mA into 200 ohms
4-20mA into 50 ohms
10-50mA into 20 ohms

Voltage:

0-5V, 1-5V standard
10 megohms minimum input impedance
Other voltages optional

FRONT PANEL ADJUSTMENTS: With any combination of Span & Zero adjustment the output span must be greater than 50% of frame time.

Span: With full scale input (i.e. 20 M.A.), adjusts output pulse duration from 70% to 100% of any frame time within selected frame duration range.

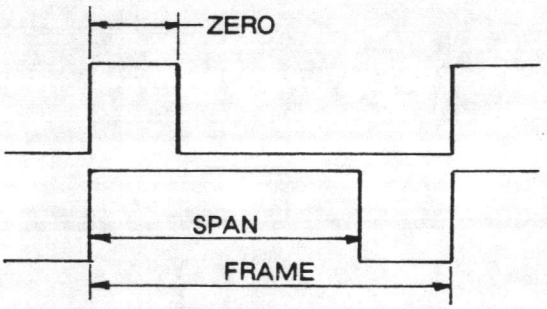
Zero: With minimum input (i.e. 4 M.A.). adjusts output pulse duration from 0% to 30% of any frame time within selected frame duration range.

Frame Duration: Adjusts pulse period over the preselected output frame duration range.

OUTPUT: 24 volt pulse whose duration is proportional to the amplitude of the input. The 50 mA maximum pulse current may be used for driving an external power relay.

Frame Duration:

0.2 thru 1 second
1 thru 5 seconds
5 thru 25 seconds
25 thru 100 seconds



PERFORMANCE:

Calibration Capability: ± 0.1% of span (linearity and repeatability)

Ambient Temperature:

Range: 0°F to + 140°F (-18°C to + 60°C)
Effect: ± 0.01%/°F over above range

Isolation: Power input isolation is maintained on both AC and DC powered models. Input to output isolation may be achieved by using the relay output option.

POWER INPUT:

24 VDC, 45 VDC, ± 10%
117 VAC, 220 VAC, 240 VAC, 50/60 Hz, ± 10%
5 watts nominal

Line Voltage Effect: AC or DC: ± 0.005%/1% line change

OPTIONS:

PR External solid-state power relay 5A at 117 VAC only inductive
RE DPDT relay externally mounted 5A at 28 VDC or 117 VAC non-inductive
For other options, see Option List

HOUSING:

Housing Options:

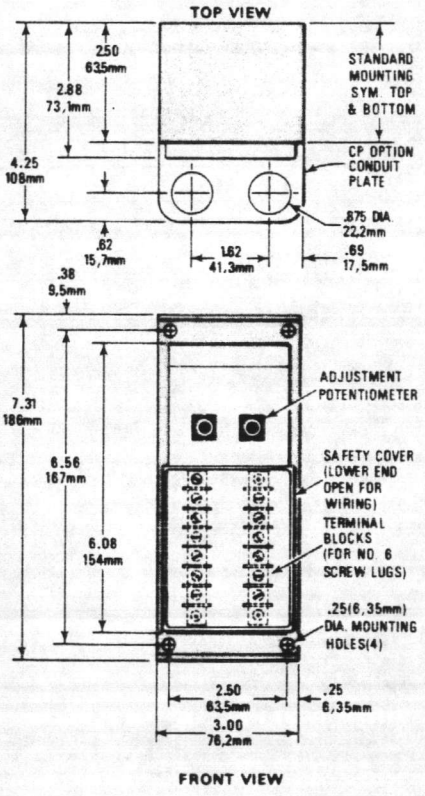
STD Standard enclosure as illustrated
AB Angle bracket mounting
CP Conduit plate for use with standard units
EX Explosion-proof enclosure, Single Unit — Div. 1
GP General-purpose enclosure, Single Unit — NEMA 1
OT Oil-tight enclosure, Single Unit — NEMA 12
PC Plug-in card
PM Panel mount enclosure
WT Water-tight enclosure, Single Unit — NEMA 4

CERTIFICATION: Canadian Standards Association
WEIGHT: Approximately 2 lbs. (908 grams)
ORDERING INFORMATION: Specify the following:

1. Input — range of voltage or current
2. Output — frame duration span as listed
3. Power input
4. Options
5. Housing

Sample Part Number:
PDT/4-20MA/5-25S/45DC/RF [STD]

STANDARD & CONDUIT PLATE MOUNTING DETAIL



MOORE INDUSTRIES INCORPORATED 16650 SCHOENBORN STREET SEPULVEDA, CALIFORNIA • 91343 • 213 894-7111

Printed in the U.S.A.

PULSE DURATION RECEIVER

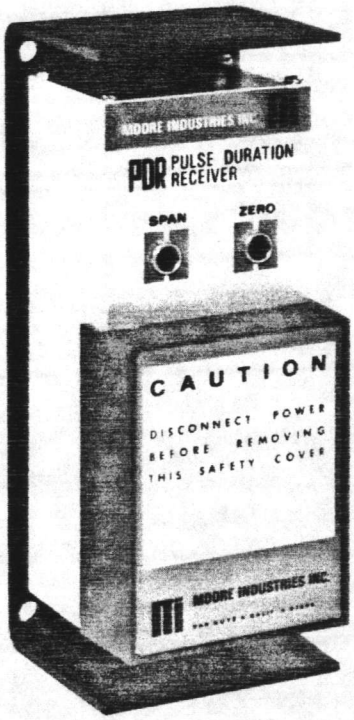
ACCEPTS PULSE DURATION SIGNALS
1-5 OR 3-12 SECOND IMPULSE CYCLES

STANDARD PROCESS OUTPUTS
1-5 mA, 4-20 mA, 10-50 mA OR VOLTAGE

DIGITAL ACCURACY
±1 PART IN 1000

FAST RESPONSE TIME
1 PERIOD RESPONSE

REPLACES ELECTROMECHANICAL UNITS
METAMETER, TELETAX OR DURAPULSE



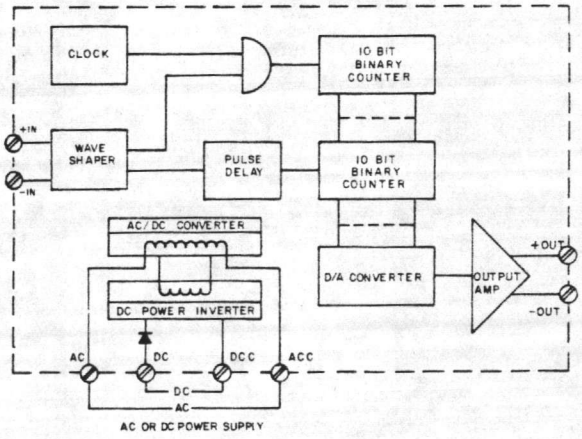
STANDARD ENCLOSURE

The Model PDR, Pulse Duration Receiver, converts time duration input pulses to 4-20 mA or any other standard process current or voltage output.

Accepting pulse-duration or impulse-cycle signals in the standard 1-5 or 3-12 second ranges, the PDR may replace electromechanical devices used in equipment with trade names like Metameter, Teletax, or Durapulse. The PDR may also be applied as a receiving unit in a telemetering or supervisory control system. As a companion receiver to the Model PDT, Pulse Duration Transmitter, the PDR may be used when standard process signals are transmitted long distances over communication lines.

The PDR's digital conversion techniques offer high accuracy and resolution of ±1 part in 1,000. Digital design also enables the PDR to respond quickly to step changes which sometimes occur in certain types of measurements. And thanks to the use of digital storage, output decay between pulses cannot occur with the PDR.

Any standard process current output may be selected in the field by specifying SC option. With input from a contact closure, the PDR supplies the voltage to produce the required input pulse level.



MOORE INDUSTRIES INCORPORATED 16650 SCHOENBORN STREET SEPULVEDA, CALIFORNIA • 91343 • 213 894-7111

PULSE DURATION RECEIVER

INPUT: 5-32 volt pulse at 5mA, or isolated contact closure (CC option)

Input Ranges;

0-2 seconds duration
1-5 seconds duration
3-12 seconds duration
0-13.33 seconds duration (Bristol)

FRONT PANEL ADJUSTMENTS: Adjustable with 22-turn potentiometer

Span: With full scale input, adjusts output to 100% ± 20% of selected output span

Zero: With minimum input, adjusts output to 0% ± 10% of selected output span

OUTPUT: Operational amplifier feedback current source; output limited to 150% of maximum output range value.

Current:

1-5 mA into 0-4800 ohm load
4-20mA into 0-1200 ohm load
10-50mA into 0-480 ohm load

Voltage: 1-5 VDC standard into 20K ohms minimum

Ripple: 10 mV P/P maximum span and maximum load resistance

Load Effect: ±0.01% of span from 0 to maximum load resistance (current output)

PERFORMANCE:

Calibration Capability: ± 0.1% of span.

Ambient Temperature:

Range: 0°F to +165°F (-18°C to 74°C)
Effect: ±0.01%/°F over above range

Isolation: Voltage output units have input negative side common to output negative side. Current output models have output negative side elevated above input negative side. Power input isolation is maintained on both AC and DC powered units.

POWER INPUT:

24 VDC, 45VDC, ±10%
117 VAC, 220 VAC, 240 VAC, 50/60 Hz, ± 10%
5 watts nominal

OPTIONS:

AT	Input attenuation for high signal voltage input specify voltage
RF	RFI filtered terminal assembly — Set of 2 per transmitter
SC	Selectable output range Current output units only

For other options, see Option List

HOUSING:

Housing Options:

STD	Standard enclosure as illustrated
AB	Angle bracket mounting
CP	Conduit plate for use with standard units
EX	Explosion-proof enclosure, Single Unit — Div. 1
GP	General purpose enclosure, Single Unit — NEMA 1
OT	Oil-tight enclosure, Single Unit — NEMA 12
PC	Plug-in card — See Data Sheet 350-710-01
PM	Panel mount enclosure
WT	Water-tight enclosure, Single Unit — NEMA 4

CERTIFICATION: Canadian Standards Association

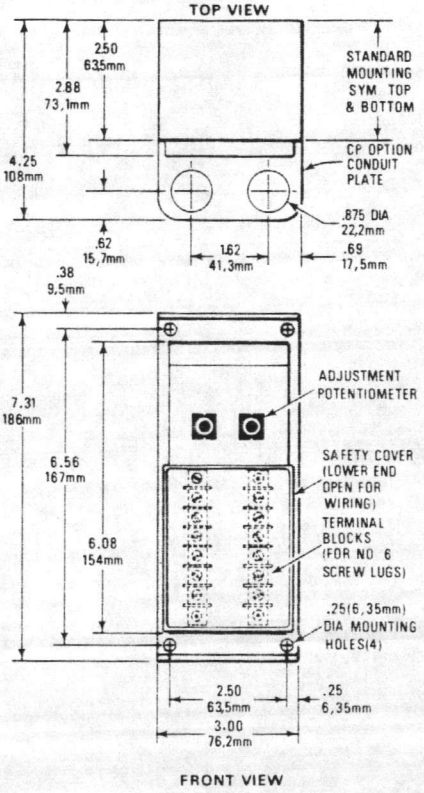
WEIGHT: Approximately 2 lbs. (908 grams)

ORDERING INFORMATION: Specify the following:

1. Input — range as listed
2. Output — span of voltage or current
3. Power input
4. Options
5. Housing

Sample Part Number: PDR/1-5S/4-20MA/45DC/RF [STD]

STANDARD & CONDUIT PLATE MOUNTING DETAIL



MOORE INDUSTRIES INCORPORATED 16650 SCHOENBORN STREET SEPULVEDA CALIFORNIA • 91343 • 213 894-7111

Printed in the U.S.A.

DATA SHEET 666-710-01D JUNE 1978

Quote + Order Work Sheet **WS 3-1, No. 1A**

Fox. Ord No.

Part

CUSTOMER
CUSTOMER ORDER NO. EAST COAST CONSTRUCTION COMPANY
U.S. MARINE CORPS, CAMP LEJEUNE
81236

Quote Item or Sheet

Quan 1

FOXBORO _____ [x] **RECORDER** [ ] **INDICATOR**

with Type 70 Contacts

MODEL: _____

CASE:

40P [X] ..... Nominal 300 mm (12 in) rectangular, glass fiber reinforced, gray polyester molding with gasketed, dust-tight door.

40M [ ] ..... Nominal 300 mm (12 in) rectangular, die-cast aluminum, black vinyl finish.

FUNCTION:

R [X] ..... Circular chart recorder
N [ ] ..... Sector indicator
K [ ] ..... Concentric indicator

INTERNAL MECHANISM:

-R [X] ..... Circular chart recording
-N [ ] ..... Sector scale indication
-K [ ] ..... Concentric scale indication
-E [ ] ..... With Type 70 contacts (Recorder or Indicator)

MOUNTING

F [X] ..... Flush
P [ ] ..... Pipe
S [ ] ..... Surface
Y [ ] ..... Yoke

[Not available with 40P Series with Type 37 Element. Pipe mounting not available with 40M Series.]

CHART DRIVE or SCALE:

Recorder only E [X] ..... Electrical, 24 h rotation. 120 V, 60 Hz
Recorder only M [ ] ..... Mechanical, 24 h rotation and wind
Indicator only N [ ] ..... Sector scale
Indicator only K [ ] ..... Concentric scale

PENS or POINTERS:

1 [X] ..... One pen [x] (Recorder) One pointer [ ] (Indicator)
2 [ ] ..... Two pens [ ] (Recorder) Two pointers [ ] (Indicator)
3 [ ] ..... Three pens (Recorder)
4 [ ] ..... Four pens (Recorder)

PEN TYPE or SCALE:

Recorder only V [X] ..... V-Type pen
Recorder only B [ ] ..... Box-Type pen
Indicator only S [ ] ..... Single Range Scale
Indicator only D [ ] ..... Dual Range Scale

ELEMENT: ([ ] See Element Work Sheet attached)

Features Continued on Sheet _____

OPTIONAL FEATURES:

(x) ESA Electronic Servo 4-20 mA contacts to control 4 pumps plus signal high level & telemetry outage

[X] **SUPPLIES:**

(x) 4 box(es) HUMITEX charts, No. _____, packaged 100 per box [ ] per instrument

(x) _____ [ ] ounce [ ] mL ink [ ] per pen

( ) _____

Comp Total

SERIAL NO.	CUST. ITEM	TAG	MEASUREMENT RANGE	CHART/SCALE
	2	Elevated Tank Level(LIRV)4-20mA		0-25 ft.

Product Specifications Sheet: 40P (fill in suffix) ..... PSS 3-1A2 __
Pressure = A Electronic = D
Temperature = B Electronic Servo = E
Flow = C
40M ..... PSS 3-1A1 A

[ ] [ ]

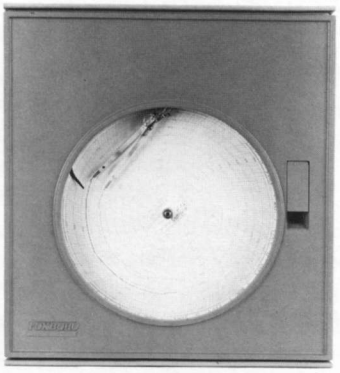
PRICE EACH

® Registered Trademark

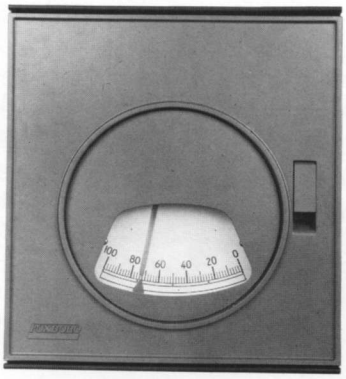
Printed in U.S.A. WS 3-1, No. 1A FOXBORO®

Effective January 1, 1981
Supersedes June 1, 1977

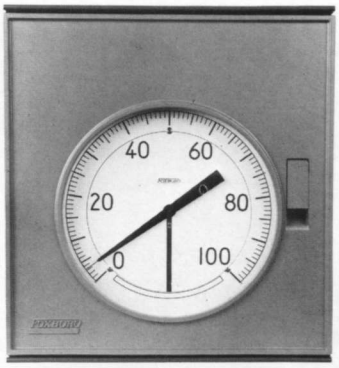
40PR
CIRCULAR CHART RECORDER



40PN
SECTOR SCALE INDICATOR



40PK
CONCENTRIC SCALE INDICATOR



40P SERIES ELECTRONIC LEVEL AND FLOW RECORDERS AND INDICATORS

These instruments are used wherever accurate chart records or precision indications are required for efficient process management. They use the simple and dependable Electronic Servo Element for signal-to-motion conversion.

ELECTRONIC SERVO ELEMENT

The Electronic Servo Element accepts electrical inputs from resistance temperature detectors (RTD's), thermocouples (TC's), or other sources of dc millivolts, and provides an output shaft position suitable for driving indicator pointers, recorder pens, or other mechanically actuated devices. The element consists of two modules which require only an appropriate electrical input signal and ac power. A servo drive module contains the feedback potentiometer and drive motor. An electronics module contains a regulated power supply, and the input signal conditioning and servo motor control electronics which are mounted on range and servo printed wiring assemblies (PWA's).

Servo Drive Module All internal components are enclosed within an aluminum housing. Motor position feedback is provided by a wiper assembly and a conductive plastic element which provides infinite resolution and long life. While slidewire maintenance should not normally be necessary, access to the element for inspection or cleaning is simply accomplished by removing two screws. The torque output of the motor is sufficient to drive any available attachment and provides rapid speed of response. The motor assembly features a minimum of moving parts for simple, trouble-free operation.

FOXBORO®

Electronics Module A radio-frequency interference (RFI) protected module is suitable for use in RFI environments which are within the normally accepted radiation limits. Over 150 calibrated standard ranges are available for measuring between –100 and +500°C or between –50 and +900°F for RTD's; between –200 and +1700°C or between –350 and +2500°F for TC's; and between –15 and +100 mV for other millivolt sources. The circuits are designed so that response is not affected by a widely varying source impedance. Field-replaceable range PWA's permit the calibration to be changed without use of special tools or soldering.

FUNCTIONAL BENEFITS OVER FILLED THERMAL SYSTEMS

The use of TC sensors permits measurement of higher temperatures, than filled thermal systems, and RTD's provide narrower spans. Instrument calibration can be conveniently performed using a resistance substitution for RTD calibrations, and a millivolt source for TC measurement instruments.

VERSATILE MOUNTING

These instruments may be mounted in a panel, on a flat surface, or on a vertical pipe, which may be continuous.

WIDE VARIETY OF CONFIGURATIONS

All of these instruments either record on a circular chart or indicate on a sector or concentric scale. The recorders are available with up to four pens. The sector scale indicator is available with one or two pointers, while the concentric scale indicator can accommodate one pointer.

WEATHERPROOF CONSTRUCTION

A glass fiber reinforced case with gasketed door provides exceptional protection against many hostile environments. This construction provides the environmental protection of IEC IP 53 and NEMA Type 3.

PERFORMANCE SPECIFICATIONS

(Under Reference Operating Conditions)

Accuracy ±0.5% of span.

Repeatability 0.25% of span.

Hysteresis 0.30% of span.

Dead Band 0.2% of span.

Speed of Response 3 seconds for a 90% step change in the input.

FUNCTIONAL SPECIFICATIONS

Operating Conditions

Influence	Reference Operating Conditions	Limits Normal Operating Conditions	Operative Limits
Ambient Temperature	25 ±2°C 77 ±3°F	–30 and +60°C –20 and +140°F	–30 and +60°C –20 and +140°F
Relative Humidity	50 ±10%	5 and 95%	5 and 95%
Supply Voltage	120 ±1 V ac 220 ±2 V ac 240 ±2 V ac	Rated +10, –15%	Rated +10, –15%
Supply Frequency	50 ±3.0 Hz or 60 ±3.0 Hz	47 and 63 Hz	47 and 63 Hz
Vibration and Shock	—	0.25 mm (0.01 in) double amplitude from 5 to 25 Hz	0.25 mm (0.01 in) double amplitude from 5 to 25 Hz

Supply Voltage Effect Maximum error will be ±0.25% of span for a +10% to −15% supply voltage change.

Supply Frequency Effect Maximum error will be less than ±0.1% of span.

Vibration Effect Zero shift due to vibration is less than ±3.0% of span at frequencies from 5 to 25 Hz with double amplitudes up to 0.25 mm (0.01 in). When vibration stops, the instrument will return to within 0.25% of its original calibration.

Shock Effect When subjected to mechanical shocks to the instrument enclosure which produces accelerations of 100 "g" at the servo drive module, momentary shifts of the output will be not more than 1%, and will return to within 0.25% of span of original reading within five seconds.

Indicator Pointer Concentric scale indicators have a black pointer and single sector scale indicators have an orange pointer. Dual sector scale indicators have one orange and one black pointer.

Indicator Scales Black markings on white background. Refer to Chart and Dial Catalog 600 for available ranges.

Sector The effective length is 175 mm (6.8 in).

Concentric The effective length is 595 mm (23.4 in).

Recorder Electrical Chart Drive The standard speed is one revolution per 24 hours for nominal 120 V ac, 60 Hz power. Refer to Optional Features Section for chart drive options.

Recorder Pens Box-type or V-type, as specified for one- and two-pen recorders. Box-type only for three- and four-pen recorders.

Recorder Expendable Accessories (Refer to Chart and Dial Catalog 600)

Charts 100 HUMITEX 300 mm (12 in) nominal circular charts, with 100 mm (4 in) nominal calibrated scale, are supplied with each instrument.

Ink 30 cm^3 (1 U.S. fl oz) is supplied for each pen.

Cardboard Nameplate A carboard nameplate is supplied for displaying the chart factor.

Electronic Servo Element

Servo Motor Direct drive torque motor with sufficient torque to drive all available attachments. Direction of angular rotation is field selectable.

Power Requirements 9 VA maximum, 8 W rms maximum.

Resistance Converter

Output Linear with equivalent temperature.

Maximum Lead Length 2300 m (7500 ft) (18 AWG conductor) (50 Ω maximum per conductor).

Lead Wire Effect Error per 30 m (100 ft) for a 1% mismatch in lead resistance. Assuming 0.64 Ω per 30 m (100 ft) (18 AWG).

Span Error Less than ±0.1% of span.

Zero Error ±0.02°C (±0.04°F) can be compensated by readjustment of linkages.

Millivolt Converter

Output Linear with millivolt input.

Burnout Indication Upscale or downscale action on open-circuit condition. Field selectable using a soldered jumper.

Temperature Sensors Platinum RTD, DIN 43760 calibration is used with resistance converter. Base metal thermocouple Types T, J, E, and K, and Noble metal thermocouple Types R, S, and B, and other millivolt signals are used with the millivolt converter. See Table 1 for the range and span limits for nonstandard ranges. See Measurement Range Code Table for standard ranges (Page 5).

Table 1. Temperature Sensor Range and Span Limits

Parameter	Platinum RTD		Thermocouple[a] and Other Millivolt
	Temperature Measurement	Temperature Difference Measurement	
Range Limits	−200 and +650°C −325 and +1200°F	−200 and +650°C −325 and +1200°F	−15 and +100 mV
Span Limits	20 and 555°C 40 and 1000°F	15 and 165°C 25 and 300°F	5 and 100 mV

[a] Includes both temperature and temperature difference measurements.

Model Code

40P = Rectangular Plastic Case

Function:
R = Circular Chart Recorder
N = Eccentric Scale Indicator
K = Concentric Scale Indicator

Internal Mechanism:
-R = Standard Recorder (40PR)
-N = Standard Eccentric Scale Indicator (40PN)
-K = Standard Concentric Scale Indicator (40PK)
-E = Recorder or Indicator with Type 70 Contacts

Mounting:
F = Flush
P = Pipe
S = Surface

Scale or Chart Drive:
E = Electric Chart Drive, 24 hour rotation, 120 V ac, 60 Hz (40PR)
N = Eccentric Scale (40PN)
K = Concentric Scale (40PK)

Pens or Pointers:
1 = One pen (40PR) or one pointer (40PN or 40PK)
2 = Two pens (40PR) or two pointers (40PN only)
3 = Three pens (40PR)
4 = Four pens (40PR)

Pen or Scale Type:
V = V-Type Pen (40PR with one or two pens only)
B = Box-Type Pen (40PR with one to four pens)
S = Single Scale (40PN or 40PK)
D = Dual Scale (40PN only)
X = Pen type per AS Reference

+E = Electronic Servo Element:
(Show complete code for each element selected)

Power Supply:
S = 120 V ac
N = 220 V ac
P = 240 V ac

Measurement - Sensor Type:
T = IEC/ISA T (Cu-CuNi) Thermocouple
C = DIN 43710-77 (Cu-CuNi) Thermocouple
J = IEC/ISA J (Fe-CuNi) Thermocouple
D = DIN 43710-77 (Fe-CuNi) Thermocouple
E = IEC/ISA E (NiCr-CuNi) Thermocouple
K = IEC/ISA K (NiCr-NiAl) Thermocouple (DIN 43710-77)
R = IEC/ISA R (Pt13Rh-Pt) Thermocouple
S = IEC/ISA S (Pt10Rh-Pt) Thermocouple (DIN 43710-77)
B = IEC/ISA B (Pt30Rh-Pt6Rh) Thermocouple
M = dc mV
Q = Platinum RTD, 100-ohm DIN Resistance
X = Nonstandard (including Temperature Difference)

Measurement Range:
XX = Select from Measurement Range Code Table, Page 5

Range Units:
C = Degree Celsius
F = Degree Fahrenheit
M = Millivolts

Burnout Feature:
U = Upscale action - Forward Range (not available with RTD)
D = Downscale action - Forward Range (not available with RTD)
N = None - Forward Range
R = Upscale action - Reverse Range (not available with RTD)
S = Downscale action - Reverse Range (not available with RTD)
T = None - Reverse Range

Examples: 40MR-RFE2V + EST15FD + EST26FD; 40PN-NSN1S + ESP37FN

Measurement Range Code Table—Standard (Consult Foxboro for ranges not shown)

Range Code	Temperature Range	Range Units—Available with Measurement/Sensor Type Code														
		mV	°C							°F						
01	0 to 5	M														
02	0 to 10	M														
03	0 to 20	M														
04	0 to 30								Q							
05	0 to 50	M							Q							Q
06	-50 to +50								Q							Q
07	-100 to +50			J*												
08	0 to 75	M							Q							
09	-20 to +80			J												
10	0 to 100	M		J					Q							Q
11	-100 to 0								Q							
12	-200 to +100			J*	E											
13	-100 to +100				E						J*	E				
14	50 to 100								Q							
15	-20 to +120															Q
16	—															
17	-25 to +125		T													
18	0 to 150			J					Q							Q
19	-50 to +150			J*	E											
20	50 to 150															Q
21	—															
22	—															
23	0 to 200		T	J		K			Q		J					Q
24	-100 to +200				E						J*	E				
25	100 to 200								Q							Q
26	0 to 250		T	J					Q	T		E				Q
27	-50 to +250		T								J*					
28	50 to 250								Q		J					Q
29	0 to 300			J		K			Q	T	J					Q
30	-350 to +300									T		E*				
31	100 to 300			J					Q		J					Q
32	0 to 400			J		K			Q	T	J		K			Q
33	100 to 400												K			Q
34	200 to 400			J					Q							Q
35	0 to 500			J		K			Q	T	J		K			Q
36	-150 to +500									T		E				
37	200 to 500					K										Q
38	300 to 500			J												
39	0 to 600					K				T	J					Q
40	—															
41	200 to 600										J					
42	300 to 600			J						T						
43	0 to 700			J												Q
44	200 to 700			J							J					
45	0 to 750			J		K							K			
46	0 to 800						R				J					Q
47	100 to 800										J		K			
48	300 to 800					K					J		K			
49	0 to 900										J					Q
50	500 to 900					K					J					
51	700 to 900					K					J					
52	0 to 1000					K		S			J		K			
53	500 to 1000							S			J		K			
54	0 to 1200										J		K			
55	200 to 1200										J		K			
56	400 to 1200										J		K			
57	0 to 1300						R									
58	—															
59	800 to 1400						R									
60	900 to 1400							S								
61	0 to 1500						R*				J*					
62	500 to 1500										J*		K			
63	0 to 1600												K			
64	1100 to 1600							S*			J*					
65	1200 to 1600												K			
66	500 to 1700						R*						K			
67	0 to 1800										J*		K			
68	0 to 2000												K			
69	1000 to 2000										J*			R		
70	1200 to 2000													R		
71	0 to 2400												K*			
72	1200 to 2400												K*			
73	0 to 2500															
74	1000 to 2500												K*	R		
75	1500 to 2500												K*		S	
76	1700 to 2500												K*		S	
XX	Nonstandard (Including temperature difference)															

*These ranges exceed the ISA recommended temperature limits for protected wire type thermocouples for the largest wire sizes shown. Consult ANSI publication MC 96.1, ASTM SPECIAL TECHNICAL PUBLICATION (STP) 470A, or SPECIFIC vendor thermocouple application data for guidance as to the maximum working temperature of the thermocouple assembly selected.

PHYSICAL SPECIFICATIONS

Enclosure The case and door are glass fiber reinforced polyester moldings, compounded for superior corrosion resistance. The door has a shatterproof glass window. The overall construction provides the environmental protection of IEC IP53 and NEMA Type 3 (NEMA IS 1.1 1977).

Mounting Standard mounting is flush in a panel up to 16 mm (0.6 in) thick or on a surface. A kit of parts is available for vertical mounting on a nominal 50 mm (2 in) diameter pipe.

Flammability Rating The case and door meet Type V-0 of UL94.

Color Case is gray, door is textured blue vinyl paint.

Blow-out Plug Located in the bottom of the case.

Electrical Connections Two nominal 22 mm (0.9 in) diameter holes are provided for a nominal 20 mm (CEE 23), PG16, or 1/2 in conduit fitting, one each for power and measurement.

Approximate Mass 12 to 18 kg (25 to 40 lb), depending on options.

OPTIONAL FEATURES

Flush Door Lock With 2 keys (AS Reference FDL).

Inlet Purge Restrictor Connection tapped for 1/4 NPT fittings (AS Reference IPR).

Alternative Color Any standard Foxboro color per GS 5-1D1 A or color reference provided by the user. Textured finish only (Designation Color).

Nameplate Laminated plastic nameplates 38 x 76 mm (1.5 x 3 in) with white characters on a black background. Maximum of 5 lines with 28 characters or spaces 3 mm (0.13 in) high or 24 characters or spaces 4 mm (0.16 in) high per line (AS Reference N/P)

Internal Illumination An incandescent lamp is available for operation from a nominal 120 or 240 V ac power source, as specified. General Purpose electrical classification only (AS Reference II-I).

Type 70 Electric Contacts A variety of contact systems is available to provide a wide range of switching functions to actuate external control or alarm circuits. General Purpose electrical classification only. Select internal mechanism code -E and refer to Foxboro.

Recorder Chart Drives Electrical, single speed, one revolution in 30 seconds; 1,2,4,6,7.5,12,15,24,30, or 96 minutes; 1,2,3,4,6,8, or 12 hours; or 2,3,4, or 7 days; 120 or 220/240 V ac, 50 or 60 Hz (refer to Foxboro for others).

Pens Front loading capillary type with 3 cm^3 (0.1 U.S. fl oz) capacity disposable cartridge or V-type fine line for a recorded line 0.25 mm (0.010 in) wide. AS Reference PN-CC/1, PN-CC/2, PN-CC/3, or PN-CC/4 for capillary type pens (first to fourth pen respectively); ES Reference PN-VF for V-type fine line pen.

PRODUCT SAFETY SPECIFICATIONS

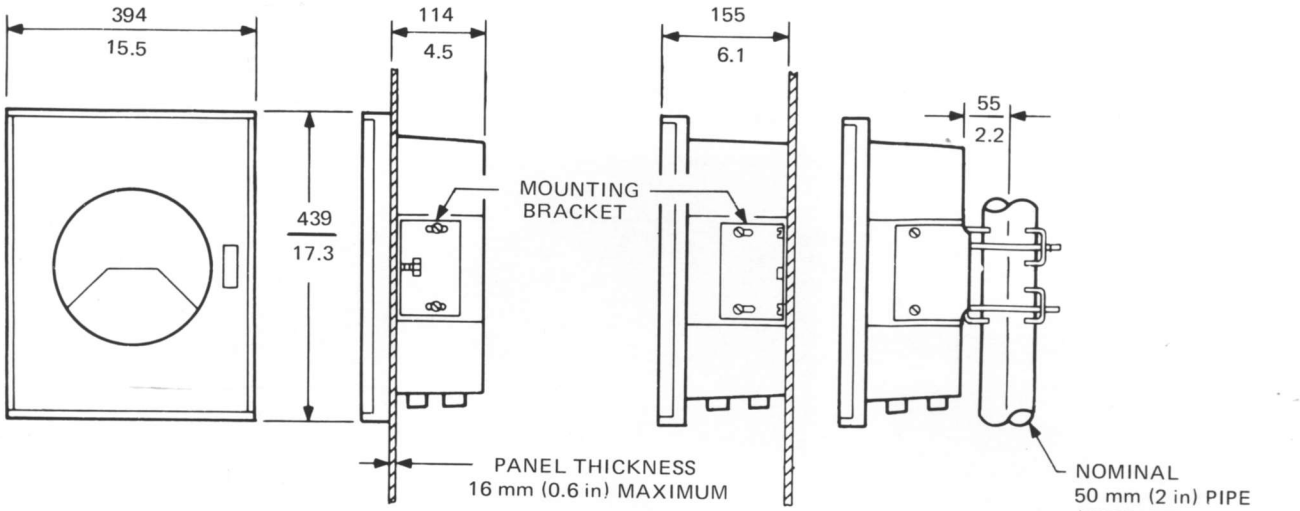
These instruments have been designed to meet the requirements of the Occupational Safety and Health Act (OSHA). When properly installed, they can be used in General Purpose Ordinary Locations, and are suitable (without internal illumination or Type 70 contact options) for Class I, Groups A, B, C, and D, Division 2 Hazardous Locations.

ORDERING INSTRUCTIONS

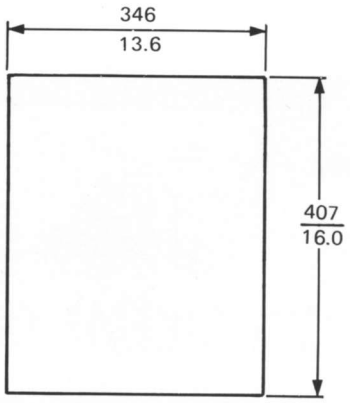
1. **Model Code**
2. **Type of Pen(s)**
3. **Optional Features**
4. **Tag and Application**

DIMENSIONS—NOMINAL

mm / in



FLUSH MOUNTING SURFACE MOUNTING PIPE MOUNTING



PANEL CUTOUT

NOTE

FOR HORIZONTAL MULTIPLE PANEL MOUNTING, A MINIMUM DISTANCE OF 445 mm (17.5 in) FROM CENTER LINE TO CENTER LINE IS REQUIRED.

T66 TRANSMITTER

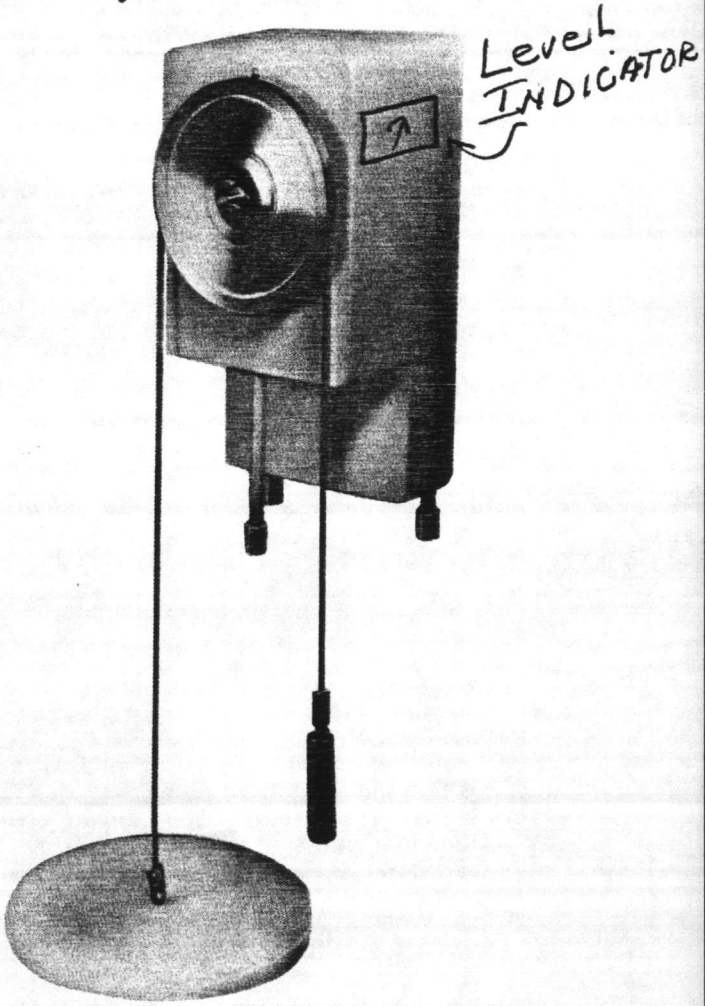
DESCRIPTION

The T66 Liquid Level and Position Transmitter is a sensitive, accurate and reliable transducer that converts linear or rotary motion into an electrical analog or digital quantity. The built-in flexibility of the T66 allows for single or dual ranges, using one or a combination of output devices. Typical outputs are: 0-5000 ohms; 0-10VDC; 4-20mA; telemetry signals; digital codes.

Optimum sensitivity is provided by anti-backlash gears and precision stainless steel bearings. Non-corrosive materials are used throughout for best performance in adverse ambient conditions. The all-weather enclosure is NEMA 4 cast aluminum with tripod mountings, leveling adjustments, and separate connection box with input-output terminals.

The T66 with a 7775 flow computer board can be programmed with your flow equation. The accurate 4-20mA output will represent flow. A contact output is provided to operate your flow totalizer scaled to your range.

The T66 with a 7774 control board can provide two-mode level control (proportional plus integral). Contact output is provided to drive motorized valves or gates. The non-indicating controller has differential gap adjustment to eliminate level cycling. Set point pot and auto-manual switch can be remote mounted for operator interface. NEMA 4 integrity is otherwise maintained by mounting the set point pot and switch within the T66 enclosure.



APPLICATIONS

Level: Water (or other liquid) level measurements in: streams, lakes, reservoirs, canals, tanks and vessels.

Flow: Flow measurement for weir, flume and other float sensed applications.

Position: Position measurement of control gates, dampers, valves and floating covers on tanks.

PROCESS CONTROL EQUIPMENT COMPANY

SPECIFICATIONS

Input:
(a) Float, tape and counterweight
(b) 0-180 degrees to 0-25 revolutions full range
(c) Gears, chain or direct coupled

Output: Standard
(a) Potentiometer: 5000 ohms nominal for full range
Optional
(b) Voltage: 0-10VDC. 120VAC or a minimum of 12VDC required
(c) Current: 4-20mA DC. Excitation Voltage 24 Volts. Loop Resistance 200-500 ohms.
(d) Contacts: Mechanical snap-action SPDT switches adjustable over 100% of range. Rated 1A at 120VAC or .25A at 125VDC.
(e) Telemetry: Digital FSK encoded signal for transmission over phone lines or radio. 120VAC or + 24VDC required.
(f) Digital encoders: Logic voltage levels.

Ranges:
Level Measurement: 2.5,5,10,20,30,40,50,70 feet full scale. Other ranges, consult factory.
Rotary Input: .5,1,1.5,2.5,5,10,20,25 turns full scale.

Accuracy:
± .2% of range standard; + .1% of range optional.

Sensitivity: ± .05%
Input Torque: Approximately 2-4 in.-oz.

Construction:
(a) Housing: Cast aluminum NEMA 4
(b) Shafts: Stainless steel - input shaft ⅜" diameter
(c) Bearings: Stainless steel lubricated and sealed
(d) Gears: Stainless steel and aluminum
(e) Tape: Stainless steel .375" wide x .005" thick, perforated .101" diameter.
(f) Counterweight: Stainless steel, 1 inch diameter.
(g) Fasteners: Stainless steel.
(h) Floats: Extruded polymer. Standard sizes 5,6,8,10 and 12 inch diameter.
(i) Standard Tape Wheel: 2.00 ft. circumference. Aluminum with stainless steel indexing pins spaced .50 ft. apart. Other sizes consult factory.
(j) Idler Wheels: 2 inch diameter with .250 inch stainless steel bearings.

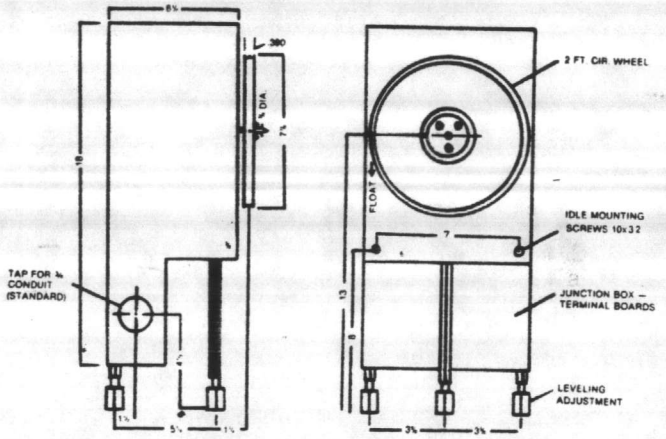
Tripod with leveling adjustments with three ¼ x 20 x 3 inch studs and nuts.

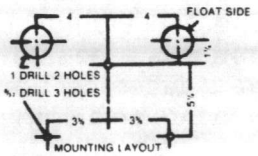
OPTIONS (also see above output options)

Heater: Approximately 5W. Standard Voltages 12,24,48, and 125 VDC and 120 VAC.

Heavy Duty Cover: ¼" Welded Steel plate with lift off handles and two-2" square bolt-down tabs centered on bottom side edge with ½" centered holes. Unit is dip-galvanized after fabrication. Dimensions: Approx. 12W x 20H x 12D inches.

T66 Transmitter
Range: Float Size:
Input: Output:
Options:
Flow Equation:
Totalizer Scale: Count & Units:
Control: Specify tank size or mass involved. Set point and auto-manual switch shipped separate if remote is specified.





Dimensions:
9W. x 18H. x 9D. inches
Weight:
Approximately 20 pounds

Type: Solid State Electronic
Input: T66 5000 ohm potentiometer or 4-20mA or 0-10VDC
Analog Output:
Volts 0-10VDC @ 20mA
Current 4-20mA sourcing 500 ohms max.
Accuracy: .5% of reading from 2 to 100% of range
Totalizer Output:
One form C contact rated 120V @ 1 amp
Scaled as specified, i.e., 100 gal/count, 1000 gal/count, etc.
Totalizer Accuracy:
.1% of computed flow at analog output
Reference Voltage:
Adjustable 10.00 to 13.00 VDC for T66 potentiometer
Full Scale Response:
1 second full scale
Power:
120V-60Hz @ .5 amp
Temperature:
-30° to 60°C
Humidity:
To 95% non condensing
Package:
4.5W x 9 (inches) printed circuit board
Mounted inside T66 housing
Computer Computation:
$Q = KH^m$ Q = Flow H = Head
K = Constant m = Exponent .5 to 5

Type: Solid State Electronic
Input: T66 5000 ohm potentiometer
Output: Contact, 24VDC, 4PDT, 3 amp.
Accuracy: + .5% **Temperature:** -30 to 60°C.
Power: 120V-60Hz @ .5 amp.
Humidity: To 95% non-condensing.
Package: 4.5 x 9 (inches) printed circuit board. Mounted inside T66 housing.

Process Control Equipment Co. warrants to you that the T66 will be free from defects in material and workmanship for a period of one year from date of shipment. PCEC will correct any defect within the warranty period by repairing or replacing any defective part or parts which are returned freight prepaid. Our liability to you arising out of supplying of equipment, or its use, whether on warranty, contract or negligence will not in any case exceed the cost of correcting the defect in the PCEC equipment, as herein provided, and upon the expiration of the warranty period, all liability shall terminate. The foregoing will constitute your sole remedy and our sole liability.

Process Control Equipment Company 14494 Wicks Blvd., San Leandro, Calif. 94577 (415) 352-0669

Quote + Order Work Sheet **WS 3-1, No. 1A** | Fox. Ord No. | Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U. S. MARINE CORPS, CAMP LEJEUNE, N. C.
CUSTOMER ORDER NO. 81236

Quote Item or Sheet

Quan: 1

FOXBORO _____ [X] **RECORDER** [ ] **INDICATOR**
with _____
MODEL: _____

CASE:

40P	[X]	Nominal 300 mm (12 in) rectangular, glass fiber reinforced, gray polyester molding with gasketed, dust-tight door.
40M	[ ]	Nominal 300 mm (12 in) rectangular, die-cast aluminum, black vinyl finish.

FUNCTION:

R	[X]	Circular chart recorder
N	[ ]	Sector indicator
K	[ ]	Concentric indicator

INTERNAL MECHANISM:

-R	[X]	Circular chart recording
-N	[ ]	Sector scale indication
-K	[ ]	Concentric scale indication
-E	[ ]	With Type 70 contacts (Recorder or Indicator)

MOUNTING

F	[X]	Flush
P	[ ]	Pipe
S	[ ]	Surface
Y	[ ]	Yoke

Not available with 40P Series with Type 37 Element. Pipe mounting not available with 40M Series.

CHART DRIVE or SCALE:

Recorder only E	[X]	Electrical, 24 h rotation. 120 V, 60 Hz
Recorder only M	[ ]	Mechanical, 24 h rotation and wind
Indicator only N	[ ]	Sector scale
Indicator only K	[ ]	Concentric scale

PENS or POINTERS:

1	[X]	One pen	[X] (Recorder)	One pointer	[ ] (Indicator)
2	[ ]	Two pens	[ ] (Recorder)	Two pointers	[ ] (Indicator)
3	[ ]	Three pens (Recorder)			
4	[ ]	Four pens (Recorder)			

PEN TYPE or SCALE:

Recorder only V	[X]	V-Type pen
Recorder only B	[ ]	Box-Type pen
Indicator only S	[ ]	Single Range Scale
Indicator only D	[ ]	Dual Range Scale

ELEMENT: ([ ] See Element Work Sheet attached)

Features Continued on Sheet _____

OPTIONAL FEATURES:
(x) ESA-electronic Servo- 4-20 mA

[XX] **SUPPLIES:**
(x) 4 box(es) HUMITEX charts, No. _____, packaged
100 per box [ ] per instrument
(X) _____ [ ] ounce [ ] mL ink [ ] per pen
( ) _____

Comp Total

SERIAL NO.	CUST. ITEM	TAG	MEASUREMENT RANGE	CHART/SCALE
	2	LIR-2 Reservoir Level	4-20 mA	0-12 Ft.

Product Specifications Sheet: 40P (fill in suffix) . . . . . PSS 3-1A2 __
Pressure = A Electronic = D
Temperature = B Electronic Servo = E
Flow = C
40M . . . . . PSS 3-1A1 A

[ ] [ ]

PRICE — EACH

® Registered Trademark

Printed in U.S.A. **WS 3-1, No. 1A** FOXBORO®

Effective January 1, 1981
Supersedes June 1, 1977

Quote + Order Work Sheet **WS 2A-1, No. 5A** | Fox. Ord No. | Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U.S. MARINE CORPS, CAMP LEJEUNE, N. C.
CUSTOMER ORDER NO. 81236 | Quote Item or Sheet

Quan: 4

FOXBORO ELECTRONIC d/p CELL TRANSMITTER

MODEL: E13DM -IKAM1

OUTPUT SIGNAL:

-H		10 to 50 mA dc
-I	X	4 to 20 mA dc

BODY MATERIAL:

K	X	Cadmium-plated carbon steel
S		AISI type 316 stainless steel
M		Monel metal
C		Hastelloy C (must be used with connection code 0)

CAPSULE WETTED PARTS:

A	X	AISI type 316 stainless steel
B		Monel metal
D		Hastelloy C 276
M Span only E		Tantalum diaphragms and Hastelloy C 276 connection parts
F		Duranickel diaphragms, monel backup plate and connection parts

SPAN LIMITS:

M		5 and 51 kPa
	XXX	20 and 205 inches of water
		50 and 510 mbar
H		50 and 210 kPa
		200 and 850 inches of water
		500 and 2100 mbar

PROCESS CONNECTIONS:

1	XX	1/4 NPT
2		1/2 NPT
3		R 1/4
4		R 1/2
6		Welding neck for 14 x 21 mm tube or 1/2 inch Schedule 80 pipe
0		None-body tapped for 1/4 NPT

MOUNTING: Direct to process, or by bracket for both nominal 50 mm and 2-inch pipe

Must Specify

ELECTRICAL CLASSIFICATION: CS-E/_____ (Refer to PS 2A-1Z1, Page 1 for quotation description)

Features Continued On Sheet _____

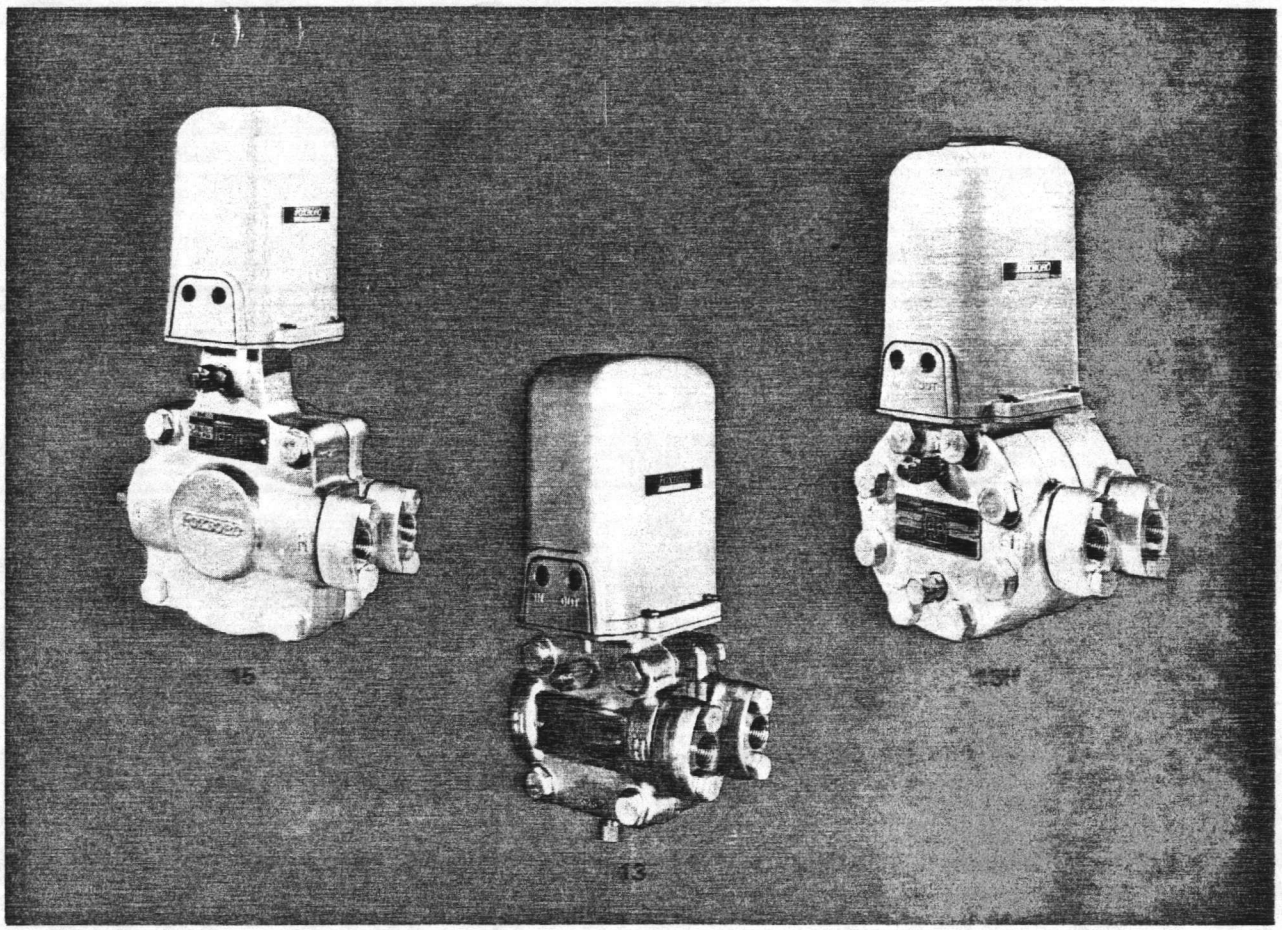
OPTIONAL FEATURES:

(x) Integral Square Root extractor per ECEP11083
Integral 3-valve Manifold

SERIAL NO.	CUST. ITEM	TAG	CALIBRATED RANGE		Comp Total
	3	FT-3 Service Water Flow	0-86"	0-2500 GPM	
	3	FT-4 Raw Water Flow	LATER	0-2500 GPM	
	3	FT-5 Well Line Flow	LATER	0-6000 GPM	
	3	FT-6 Service Line Flow	LATER	0-6000 GPM	

General Specifications ---------- GS 2A-1C1 D ☐

PRICE EACH



15, 13, AND 13H SERIES PNEUMATIC d/p Cell TRANSMITTERS

These transmitters measure differential pressure and transmit a standard pneumatic signal to receivers which may be several hundred metres or yards distant.

PROVEN DEPENDABILITY

Foxboro d/p Cell Transmitters have been the standard of the process industry ever since Foxboro developed them nearly 30 years ago. Many thousands of successful, trouble-free installations have demonstrated the exceptional dependability of these outstanding transmitters.

APPLICATION VERSATILITY

These transmitters are used in flow, liquid level, density, and low pressure measurement applications. They offer wide span adjustability and broad zero suppression and zero elevation capabilities within the range limits for each series. They are ideal for the most demanding applications.

EASE OF MAINTENANCE

The simple design of the topworks and of the field-replaceable capsule makes servicing these transmitters exceptionally easy and economical. Interchangeability of most topworks parts with other Foxboro pneumatic force balance transmitters, provides further savings to the user by minimizing spare parts inventory.

FOXBORO®

FUNCTIONAL SPECIFICATIONS

Model Codes

15A = Transmitter AISI Type 316 stainless steel (316 ss) body
15A1 = Transmitter Cadmium-plated carbon steel (cs) body

Span Limits
-L = 1.3 and 6 kPa (5 and 25 inH_2O, 13 and 60 mbar) ΔP

Body Material
K = Cadmium-plated cs (15A1 only)
S = 316 ss (15A only)

Process Connectors
1 = Tapped for 1/4 NPT
2 = Tapped for 1/2 NPT
3 = Tapped for R1/4
4 = Tapped for R1/2
6 = Weld neck for 14 x 21 mm tube (1/2 in Schedule 80 pipe)
0 = None. Body tapped for 1/4 NPT.

Optional Suffix
-L = Zero Elevation Kit
-R = Zero Suppression Kit

13HA = Transmitter 316 ss body
13HA1 = Transmitter Cadmium-plated cs body

Span Limits
-M = 5 and 62 kPa (20 and 250 inH_2O, 50 and 620 mbar) ΔP
-H = 50 and 210 kPa (200 and 850 inH_2O, 0.5 and 2.1 bar) ΔP

Body Material
K = Cadmium-plated cs (13HA1 only)
S = 316 ss (13HA only)

Process Connectors
1 = Tapped for 1/4 NPT
2 = Tapped for 1/2 NPT
3 = Tapped for R1/4
4 = Tapped for R1/2
5 = Machined for 9/16-18 Aminco(c) fitting

Optional Suffix
-L = Zero Elevation Kit
-R = Zero Suppression Kit

13A = Transmitter 316 ss body
13A1 = Transmitter Cadmium-plated cs body
13A4 = Transmitter Monel (a) body
13A5 = Transmitter Hastelloy C (b) body

Span Limits
-M = 5 and 62 kPa (20 and 250 inH_2O, 50 and 620 mbar) ΔP
-H = 50 and 210 kPa (200 and 850 inH_2O, 0.5 and 2.1 bar) ΔP

Body Material
K = Cadmium-plated cs (13A1 only)
S = 316 ss (13A only)
M = Monel (13A4 only)
C = Hastelloy C (13A5 only)

Process Connectors
1 = Tapped for 1/4 NPT*
2 = Tapped for 1/2 NPT*
3 = Tapped for R1/4*
4 = Tapped for R1/2*
6 = Weld neck for 14 x 21 mm tube (1/2 in Schedule 80 pipe)
0 = None. Body tapped for 1/4 NPT.
*Not available with 13A5.

Optional Suffix
-L = Zero Elevation Kit
-R = Zero Suppression Kit

Static Pressure, Span, and Range-Limits

Series	Static Pressure Limit			Capsule Code	Span Limits (d)			Range Limits (e)		
	MPa	psi	bar or kg/cm^2		kPa ΔP	inH_2O ΔP	mbar ΔP	kPa ΔP	inH_2O ΔP	mbar ΔP
15	3.5	500	35	L	1.3 and 6	5 and 25	13 and 60	±12.5	±50	±125
13	10	1500	100	M	5 and 62	20 and 250	50 and 620	±62	±250	±620
				H	50 and 210	200 and 850	500 and 2100	±210	±850	±2100
13H	40	6000	400	M	5 and 62	20 and 250	50 and 620	±62	±250	±620
				H	50 and 210	200 and 850	500 and 2100	±210	±850	±2100

(a) Trademark of Huntington Alloys, Incorporated.
(b) Trademark of Stellite Division of Cabot Corporation.
(c) Trademark of American Instrument Company.
(d) See "Optional Capsule Materials (13 Series Only)" for span limits of 13A4 (Monel capsule construction).
(e) Nonzero-based ranges require an optional zero elevation or suppression kit. See "Elevation and Suppression." Upper and lower range-values must not exceed range-limits. Negative numbers indicate a higher pressure on the normal "low side" of the transmitter.

FUNCTIONAL SPECIFICATIONS
(Continued)

Ambient Temperature Limits -40 and +120°C (-40 and +250°F)

Body Temperature Limits -40 and +120°C (-40 and +250°F). See "Optional Features" for operation at higher process temperatures.

Mounting Direct to the process or on a nominal 50 mm (2 in) diameter pipe. A bracket for pipe mounting is always supplied.

Air Connections The supply and output connections are tapped for 1/4 NPT.

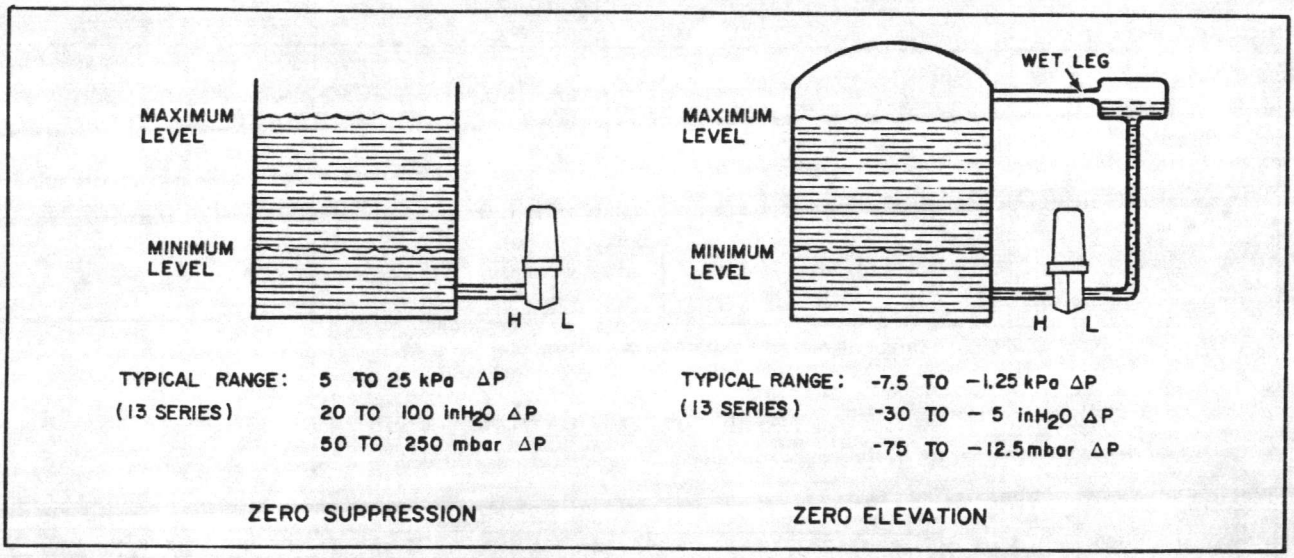
Supply Pressure 120 to 150 kPa (18 to 22 psi, or 1.2 to 1.5 bar or kg/cm^2).

Output Signal 20 to 100 kPa, 3 to 15 psi, or 0.2 to 1.0 bar or kg/cm^2, as specified.

Air Consumption under Normal Operation 0.5 m^3/h at standard conditions (0.3 scfm).

Elevation and Suppression The optional kits (Model Code Suffix -L or -R) allow adjustment of the measured pressure range within the full range-limits of the capsule. These kits may be added in the field.

Examples of Zero Suppression and Zero Elevation



PERFORMANCE SPECIFICATIONS
(Under Reference Operating Conditions)

Accuracy (Includes Linearity, Hysteresis, and Repeatability)

15 Series . . . . . ±0.5% of span

13 and 13H Series

Spans between 5 and 130 kPa, 20 and 525 inH$_2$O, or 50 and 1300 mbar differential pressure (ΔP) . . . ±0.5% of span

Spans between 130 and 210 kPa, 525 and 850 inH$_2$O, or 1300 and 2100 mbar ΔP . . . . . ±0.75% of span

Dead Band . . . . . 0.05% of span

Repeatability . . . . . 0.1% of span

Hysteresis

15 Series 0.0025 kPa, 0.01 in H$_2$O, or 0.025 mbar ΔP, or 0.10% of span, whichever is greater.

13 and 13H Series 0.012 kPa, 0.05 inH$_2$O, or 0.12 mbar ΔP, or 0.10% of span, whichever is greater.

Reproducibility (Includes effects of hysteresis, repeatability, dead band, and drift over a one-hour period)

15 Series . . . . . 0.2% of span

13 and 13H Series . . . . . 0.15% of span

Vibration Effect Zero shift is less than 1.5% of span for vibrations at frequencies between 1 and 100 Hz with amplitudes up to 6 mm (0.25 in) peak-to-peak or for acceleration up to 10 m/s^2 (1 g), whichever is smaller.

Supply Pressure Effect The maximum zero shift is 0.05% of span for a 1 kPa (0.01 bar or kg/cm^2) change in supply pressure. A 1 psi change in supply pressure results in a maximum zero shift of 0.35% of span.

Position Effect The 15 Series must be operated with the capsule in the vertical plane. The 13 and 13H Series may be mounted up to 90° from vertical and the zero shift may be corrected with the zero adjustment screw.

PERFORMANCE SPECIFICATIONS
(Under Reference Operating Conditions)
(Continued)

Ambient Temperature and Static Pressure Effects

Item	15 Series	13 Series	13H Series
Ambient Temperature Effect [Maximum zero shift in percent of span for a change of 50°C (100°F)].	1.0% at 6 kPa (25 inH_2O, 60 mbar) ΔP span. 2.5% at 1.3 kPa (5 inH_2O, 13 mbar) ΔP span.	**M Capsule** 1% for spans from 12.5 up to 62 kPa (50 up to 250 inH_2O or 125 up to 620 mbar) ΔP. 2.5% for spans from 6.2 up to 12.5 kPa (25 up to 50 inH_2O or 62 up to 125 mbar) ΔP. **H Capsule** 2% for all spans.	Same as 13 Series
Static Pressure Effect (Zero shift in percent of span for any change up to static pressure limit)	0.5%	0.5% for spans greater than 12.5 kPa (50 inH_2O, 125 mbar) ΔP. 1% for spans from 5 up to 12.5 kPa (20 up to 50 inH_2O, 50 up to 125 mbar) ΔP.	1.5% for spans greater than 12.5 kPa (50 inH_2O, 125 mbar) ΔP (a). 2% for spans from 5 up to 12.5 kPa (20 up to 50 inH_2O, 50 up to 125 mbar) ΔP (a).

(a) If the process pressure pulsates, refer to the nearest Foxboro Sales Office.

PHYSICAL SPECIFICATIONS

Materials of Construction, Wetted Parts

Item	Series			
	15A1, 13A1, 13HA1	15A, 13A, 13HA	13A4	13A5
Body	cs	316 ss	Monel	Hastelloy C
Capsule Diaphragm	316L ss (a)	316L ss	Monel 400 (b), (c)	Hastelloy C 276 (d)
Other Capsule Parts	316 ss	316 ss	Monel	Hastelloy C
Force Bar	316 ss	316 ss	Monel	Hastelloy C
Force Bar Seal	cobalt-nickel-chrome	cobalt-nickel-chrome	cobalt-nickel-chrome	cobalt-nickel-chrome
Force Bar Gasket	Silicone elastomer (e)	Silicone elastomer (e)	Viton A (f)	Viton A
Capsule Gaskets	316 ss	316 ss	Monel	ptfe (g)
Process Connection Gaskets	ptfe (h)	ptfe (h)	ptfe	

(a) AISI Type 316 low carbon stainless steel.
(b) Trademark of Huntington Alloys, Incorporated.
(c) Duranickel (b) capsule diaphragm material is supplied when Span-Limit Code -H is specified.
(d) Trademark of Stellite Division of Cabot Corporation.
(e) Buna-N is standard in the 13H Series.
(f) Trademark of E. I. duPont de Nemours and Company.
(g) Hastelloy C bodies are supplied without process connectors.
(h) Glass-filled ptfe is standard in the 13H Series.

PHYSICAL SPECIFICATIONS
(Continued)

Materials of Construction, Nonwetted Parts

Cover Blue, high-impact, glass-filled polycarbonate.

Cover Gasket Silicone rubber and cork composition.

Body Bolts and Nuts Cadmium-plated alloy steel per ASTM A 193 grade B7 and ASTM A 194 grade 2H, respectively, or equivalent. 17-4 PH (a) if Hastelloy C body is specified. See "Optional Features" for Monel or 17-4 PH stainless steel bolting.

Capsule Fill Material Dow Corning dimethylsiloxane (DC-200) with a viscosity of 500 mm^2/s (centistrokes) at 25°C (77°F). Some options require other fill materials. See "Optional Features."

Environmental Protection The transmitter housing is weatherproof. It is dust-protected as defined in IEC IP53 and, with its constant air purging, provides the environmental protection of NEMA 3.

Mass (Approximate)

15 Series 13.6 kg (30 lb)

13 Series 8.6 kg (19 lb)

13H Series 13 kg (29 lb)

OPTIONAL FEATURES

Optional Capsule Materials (13 Series Only)

Diaphragm Material	Span Limits			Other Wetted Capsule Parts	AS Reference (b)
	kPa ΔP	inH_20 ΔP	mbar ΔP		
Hastelloy C276	5 and 62 50 and 210	20 and 250 200 and 850	50 and 620 500 and 2100	Hastelloy C276	D-CSC
Monel 400	5 and 25 25 and 99	20 and 250 200 and 400	50 and 250 250 and 990	Monel	D-MMM (c)
Duranickel	5 and 62 50 and 210	20 and 250 200 and 850	50 and 620 500 and 2100	Monel	D-DMM
Tantalum	5 and 62	20 and 250	50 and 620	Hastelloy C276	D-TSC

Optional Feature	Description	AS Reference
Preparation for Oxygen Service	Transmitter is cleaned, assembled, calibrated, and packaged in a clean room, or using acceptable alternative facilities. Includes Fluorolube (d) fill for capsules. Available for instruments with 316 ss body and capsule material.	OS-FC
Special Degreasing	Transmitter is cleaned and packaged same as above, but the capsule has standard fill. **NOT FOR USE ON OXYGEN, CHLORINE, OR OTHER FLUIDS THAT MAY REACT WITH SILICONE OIL.**	OS-W
HF Alkylation Service	Supplied with carbon steel body, Monel force bar and plugs, Viton A O-rings at force bar seal, and Monel medium range capsule with DC-200 silicone oil fill. Construction provides maximum life with economical materials. The ambient temperature effects are double.	D-MMM-3-HF

(a) Trademark of Armco Steel Corporation.

(b) When ordering optional capsule (or any option) add AS Reference to Model Code.
Example: 13A-MS1, AS Reference D-CSC

(c) The ambient temperature effects are double.

(d) Trademark of Hooker Chemical Corporation.

OPTIONAL FEATURES
(Continued)

Optional Feature	Description	AS Reference
Preparation for Chlorine Service	Transmitter is cleaned, assembled, calibrated, and packaged in a clean room, or using acceptable alternative facilities. Only Fluorolube-filled Hastelloy C capsules are used. Includes 17-4 PH stainless steel body bolts, ptfe gaskets, a dashpot kit, and tantalum sheath over the force bar diaphragm. Available with body materials 316 ss, Monel, or Hastelloy C. The ambient temperature limits are -20 and +120°C (0 and 250°F). Available with 13 Series only.	CLS
Nuclear Service Cleaning	Transmitter is cleaned, assembled, calibrated, and packaged in a clean room or using acceptable alternative facilities.	NS-C
High Damping	Low and medium range capsules are available filled with high viscosity silicone fluid which increases the damping. Note: corner frequency 3 dB down at 0.3 to 0.4 Hz. The damping is greatly increased below 25°C (75°F). The lower ambient temperature limit is -20°C (0°F).	D-SSS-2H
Optional Output Signal	Output signal is 20.7 to 186 kPa (3 to 27 psi, or 0.21 to 1.86 bar or kg/cm^2).	TR 3-27
Reverse Output	100 to 20 kPa, 15 to 3 psi, or 1.0 to 0.2 bar or kg/cm^2, as specified. Accomplished by adding Zero Elevation kit and reversing high and low process connections.	TR 15-3
Electrical Heating	Two body bolts are replaced by two studs; one containing a heating element, the other a thermostat switch. Available with set points of 10 or 40°C (50 or 100°F). Recommended for use with an approved insulated enclosure (O'Brien HeatPak or equivalent) only. The maximum working pressure (MWP) of the 13H Series is reduced to 20 MPa (3000 psi, 200 bar or kg/cm^2).	Refer to Foxboro
Steam Tracing	One or two hollow studs may be substituted for body bolts with glass reinforced ptfe gaskets fitted at the process connections. Steam at a maximum pressure of 1.4 MPa (200 psi, 14 bar or kg/cm^2) through the studs maintains the process liquid at temperatures up to 190°C (375°F) when used with an approved insultated enclosure. The MWP of the 13H Series is reduced to 20 MPa (3000 psi, 200 bar or kg/cm^2). Multiply operating condition effects by 2 for body temperature above 120°C (250°F).	Refer to Foxboro
Lower Differential Spans	Provides for minimum span of 2.5 kPa, 10 inH_2O, or 25 mbar ΔP in the 13 and 13H Series; 0.65 kPa, 2.5 inH_2O, or 6.5 mbar ΔP in the 15 Series. The maximum calibrated spans are reduced by a factor of 2. The performance specifications and operating conditions effects are reduced by factors of up to 3. This option is not available with the Optional Output Signal feature (AS Reference TR 3-27).	LD
High Process Temperature	Glass reinforced process connector gaskets are fitted for operation at process temperatures up to 190°C (375°F). Multiply operating condition effects by 2 for body temperature above 120°C (250°F).	DG-5
Hydrogen Service	Transmitter is supplied with gold plated 316 ss capsule to retard hydrogen penetration. Not for corrosion protection.	D-SSS-G
ptfe Process Wetted Gaskets	Capsule and force bar gaskets of ptfe for chemical resistance.	DG-7

OPTIONAL FEATURES
(Continued)

Optional Feature	Description	AS Reference
ptfe Capsule Gaskets	Capsule gaskets made of ptfe for chemical resistance.	DG-7A
Tantalum Force Bar Seal Protection	Tantalum sheath protection over cobalt-nickel-chrome alloy force bar diaphragm.	FBP-T
Monel Force Bar	Available with Monel, Hastelloy C, or Duranickel diaphragm capsules. Standard with transmitters having Monel body and capsule.	Add Suffix -3 to AS Reference for capsule
Monel Bolting	K-Monel (a) studs and Monel nuts for both body and process connectors. This option is not available for the 15 and 13H Series.	MMB
Stainless Steel Bolting	Type 17-4 PH stainless steel cap screws for the process connectors and cap screws and nuts of the same material for the body bolting.	SSB
Stainless Steel Mounting Bracket Bolting	316 ss bolting through mounting brackets to transmitter.	SSB-A
Integral Orifice	For the measurement of extremely low flow rates. Selection of six standard orifice bores are available.	Refer to GS 2B-1Z3 A
Bypass Manifolds for Integral Mounting	A variety of 1, 3, and 5 valve manifolds are available. Some manifold valves are not rated to the full MWP of the 13H Series.	Refer to Foxboro
Air Supply Sets	A wide selection of air supply sets are available to provide filtered, regulated air supply to the transmitter.	Refer to Foxboro
R1/4 Air Connections	Air connections tapped for R1/4.	ACR
Aluminum Cover	Cover is cast low copper aluminum alloy per ASTM B85 with textured gray vinyl finish.	ALC
Test Tee	A T-connector tapped for 1/4 NPT and fitted with a shut-off valve is mounted on the transmitter for monitoring the output signal.	OTT
Insulated Enclosure	A custom-made enclosure which insulates the body for more effective use of the Electrical Heating or Steam Tracing options.	Refer to Foxboro
Lloyd's Approval for Marine Use	A version of the 13A Series approved by Lloyd's Register of Shipping.	Refer to Foxboro

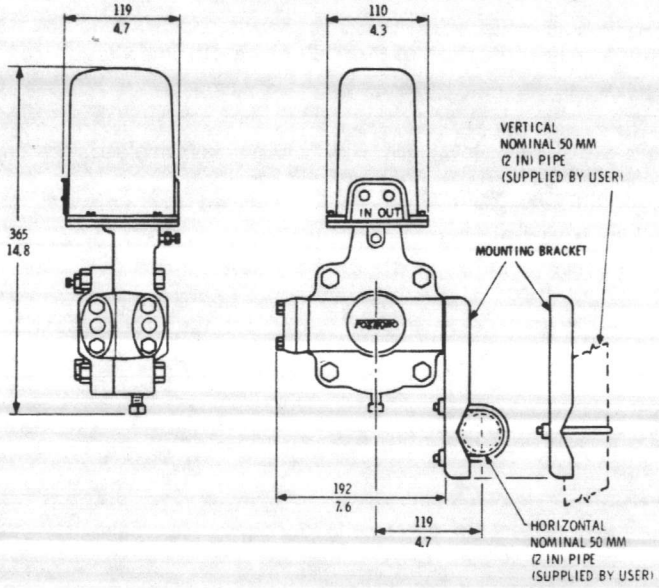
ORDERING INSTRUCTIONS

1. **Model**
2. **Output Signal**
3. **Calibrated Differential Pressure Range**
4. **Optional Features**
5. **Tag**

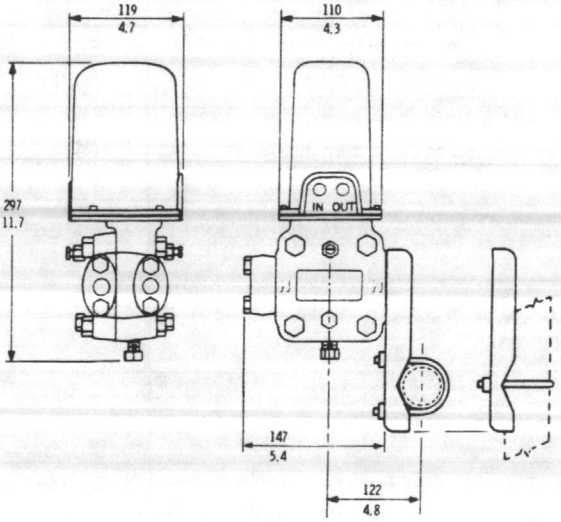
(a) Trademark of Huntington Alloys, Incorporated.

DIMENSIONS – NOMINAL

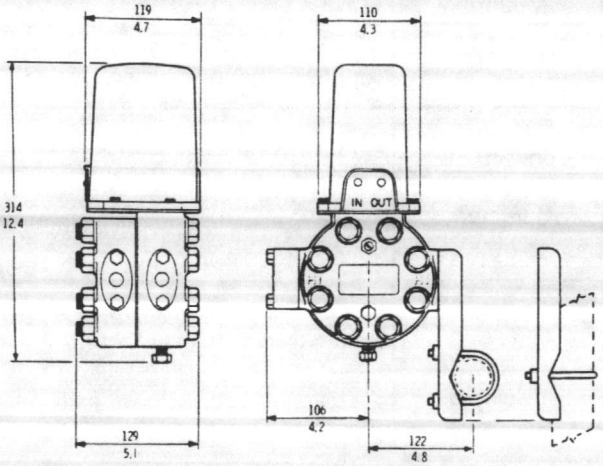
mm
in



I5 SERIES



I3 SERIES



I3H SERIES

Quote + Order Work Sheet **WS 3-1, No. 1A**

Fox. Ord No.

Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U. S. MARINE CORPS, CAMP LEJEUNE, N. C.
CUSTOMER ORDER NO. 81236

Quote Item or Sheet

Quan 4

FOXBORO _____ [XX] **RECORDER** [ ] **INDICATOR**

with _____

MODEL: _____

CASE:

40P [X] . . . . . Nominal 300 mm (12 in) rectangular, glass fiber reinforced, gray polyester molding with gasketed, dust-tight door.

40M [ ] . . . . . Nominal 300 mm (12 in) rectangular, die-cast aluminum, black vinyl finish.

FUNCTION:

R [X] . . . . . Circular chart recorder
N [ ] . . . . . Sector indicator
K [ ] . . . . . Concentric indicator

INTERNAL MECHANISM:

-R [XX] . . . . . Circular chart recording
-N [ ] . . . . . Sector scale indication
-K [ ] . . . . . Concentric scale indication
-E [ ] . . . . . With Type 70 contacts (Recorder or Indicator)

MOUNTING

F [XX] . . . . . Flush
P [ ] . . . . . Pipe
S [ ] . . . . . Surface
Y [ ] . . . . . Yoke

[Not available with 40P Series with Type 37 Element. Pipe mounting not available with 40M Series.]

CHART DRIVE or SCALE:

Recorder only E [XX] . . . . . Electrical, 24 h rotation. 120 V, 60 Hz
Recorder only M [ ] . . . . . Mechanical, 24 h rotation and wind
Indicator only N [ ] . . . . . Sector scale
Indicator only K [ ] . . . . . Concentric scale

PENS or POINTERS:

1 [XX] . . . . . One pen [ ](Recorder) One pointer [ ](Indicator)
2 [ ] . . . . . Two pens [ ](Recorder) Two pointers [ ](Indicator)
3 [ ] . . . . . Three pens (Recorder)
4 [ ] . . . . . Four pens (Recorder)

PEN TYPE or SCALE:

Recorder only V [XX] . . . . . V-Type pen
Recorder only B [ ] . . . . . Box-Type pen
Indicator only S [ ] . . . . . Single Range Scale
Indicator only D [ ] . . . . . Dual Range Scale

ELEMENT: ([ ] See Element Work Sheet attached)

Features Continued on Sheet _____

OPTIONAL FEATURES:

(x) ESA-electronic Servo 4-20 mA
24 volt power supply per ECEP 11402
24 MB integrator and totalizer

[X] **SUPPLIES:**

(x) 4 box(es) HUMITEX charts, No. _____, packaged
100 per box [ ] per instrument
(x) _____ [ ] ounce [ ] mL ink [ ] per pen
( ) _____

Comp Total

SERIAL NO.	CUST. ITEM	TAG	MEASUREMENT RANGE	CHART/SCALE
	2	FIQR-3 Service Water Flow	4-20 mA	0-2500 GPM
	2	FIQR-4 Raw Water Flow	4-20 mA	0-2500 GPM
	2	FIQR-5 Well Line Flow	4-20 mA	0-6000 GPM
	2	FIQR-6 Service Line Flow	4-20 mA	0-6000 GPM

Product Specifications Sheet: 40P (fill in suffix) . . . . . PSS 3-1A2 __
Pressure = A Electronic = D
Temperature = B Electronic Servo = E
Flow = C
40M . . . . . PSS 3-1A1 A

[ ] [ ]

PRICE EACH

® Registered Trademark

Printed in U.S.A. **WS 3-1, No. 1A** FOXBORO®

Effective January 1, 1981
Supersedes June 1, 1977

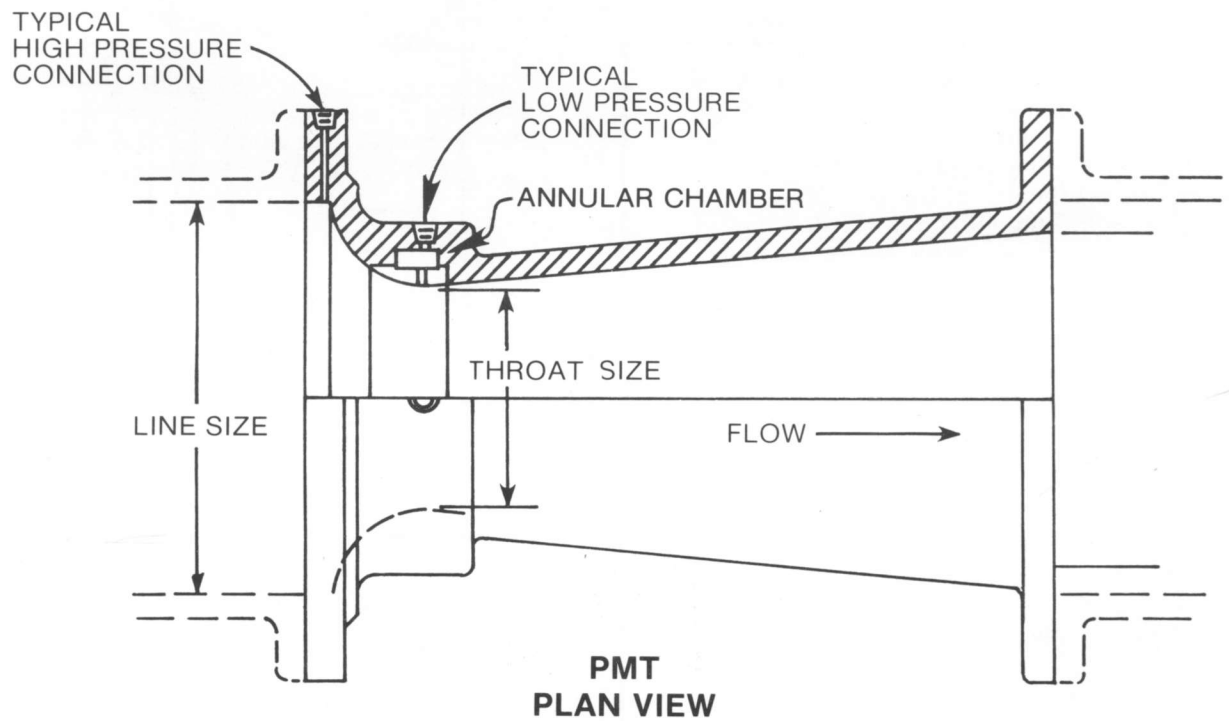
Technical Brief

Lo-Loss®
Cast Iron Flow Element

Description
The cast iron series of the Badger Meter Lo-Loss® is a modified Venturi flow element that provides increased rangeability at lower permanent pressure loss than any other differential producing primary device.

Applications
The cast iron Lo-Loss is designed to measure full pipe gases, water, wastewater and sludge or slurry flows. The cast iron Lo-Loss is furnished in four models depending on the application.

1. **PMT:** The PMT Lo-Loss is a full flanged cast iron flow element **designed for clean water or clean gas service.** The PMT has either a bronze or a stainless steel throat, precisely machined with the body. An annular chamber located in the throat is provided to enhance a stable low pressure reading. The Lo-Loss can be supplied with either a 125 or 250 lb. flange.

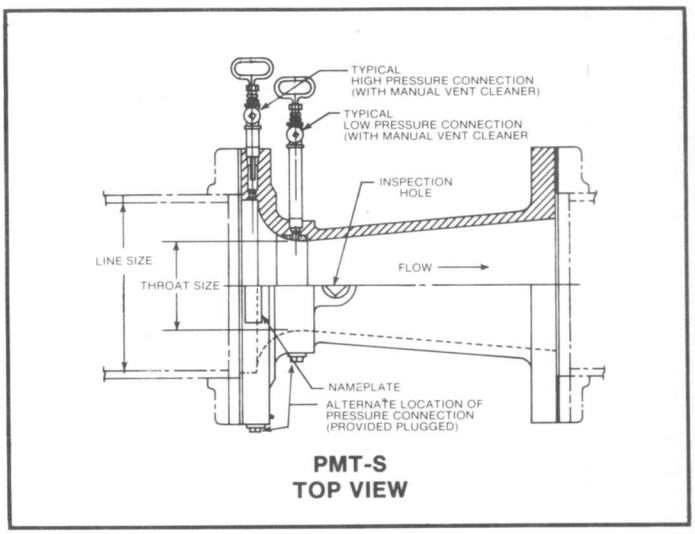


PMT
PLAN VIEW

Badger Meter, Inc. Precision Products Division

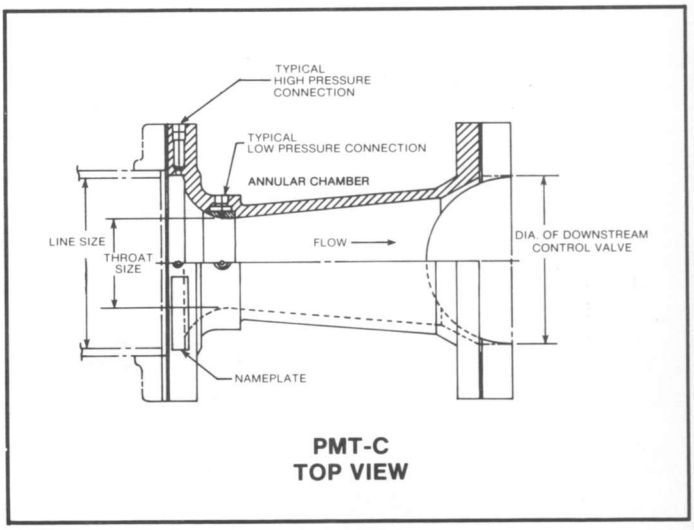
6116 East 15th Street
Tulsa, Oklahoma 74112
(918) 836-8411
Telex: 49-2365

2. **PMT-S:** The PMT-S is a full flanged (125 or 250 lb.) primary element designed for wastewater, sludge, slurry or other fluids with suspended solids. A single low pressure tap design has been incorporated in the PMT-S to eliminate solids build up from the fluid. Manual vent cleaners are standard, but hydraulic vent cleaners or a continuous water purge system are available options. Please consult the factory.



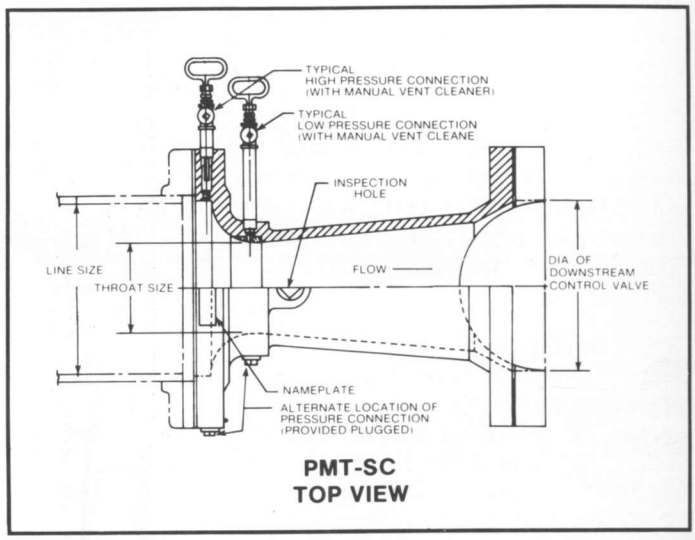
PMT-S
TOP VIEW

3. The **PMT-C** is a full flanged (125 or 150 lb.) primary element **designed for clean water or clean gas service.** The construction accommodates either a bronze or stainless steel throat, precisely machined with the body, with an annular chamber to provide a stable low pressure reading. The primary element is also constructed to accept a butterfly valve bolted directly to the downstream flange, thus allowing the PMT-C and the valve to become a vital component in a rate-of-flow controller. The butterfly valve in no way affects the discharge coefficient of the primary element, which means accuracy is maintained. In most cases the flange can be made one nominal pipe size smaller than the main pipe run, and in special cases larger reductions can be made. This type of valve engineering can significantly lower the project costs.



PMT-C
TOP VIEW

4. The **PMT-SC** is a full-flanged (125 or 250 lb.) primary element designed with no annular chamber and is intended to be used in applications where the fluid contains solids. The primary element will accept a butterfly valve or elbow bolted directly to the downstream flange, thus allowing the PMT-SC to be used in many applications where other Venturi or flow tubes could not be used.



PMT-SC
TOP VIEW

Piping Requirements

The Lo-Loss flowmeters may be either horizontally or vertically mounted. A well-developed symmetrical velocity profile is required. General practice requires the pipe be maintained full and the upstream piping be sufficient to assure profile conditioning. Refer to ASME Fluid Meters, 6th Edition, Page 180, for general conditions. The Lo-Loss requires one (1) pipe diameter less than the classical Venturi.

General Specifications

ACCURACY:
Within the specified flow range and piping configurations the Lo-Loss flowmeters produce accurate measurements of

±0.5 % of value uncalibrated
±0.25% of value calibrated

PRESSURE LOSS:
The permanent pressure loss of the Lo-Loss is expressed as a percentage of the differential produced as given in the following table and is the lowest of any differential-producing primary element. See Figure 1.

BETA RATIO:
Badger Meter is the only manufacturer of differential pressure producing devices that can furnish beta ratios for the Lo-Loss from .35 to .85. By custom computer designing a Lo-Loss to the exact flow conditions with the proper beta ratio, only Badger can guarantee the most accurate, reliable and lowest permanent pressure loss of any primary element.

Operating Conditions

The cast iron series can handle temperature ranges from -20°F to 400°F with pressure not to exceed 250 PSI up to and including 24 inches. For cast iron sizes, above 24 inches the pressures should not exceed 125 PSI.

Energy Concerns

Figure 1 compares the Lo-Loss with other primary flow elements and Figure 2 displays the annual power costs of these devices in a typical example. The significant pressure recovery of the Lo-Loss means dollar savings in reduced pumping costs. The Lo-Loss will recover up to 97.5% of the differential produced at a 0.85 Beta. This is 3 to 4 times better than a conventional Venturi and twice as good as the modified Venturi's.

Cost Savings

Figure 2 shows comparative operating costs of several commonly used primary elements. The data clearly demonstrates that the Lo-Loss flow tube is at least 50% more economical than its nearest rival and 1500% more economical than the most commonly used device.

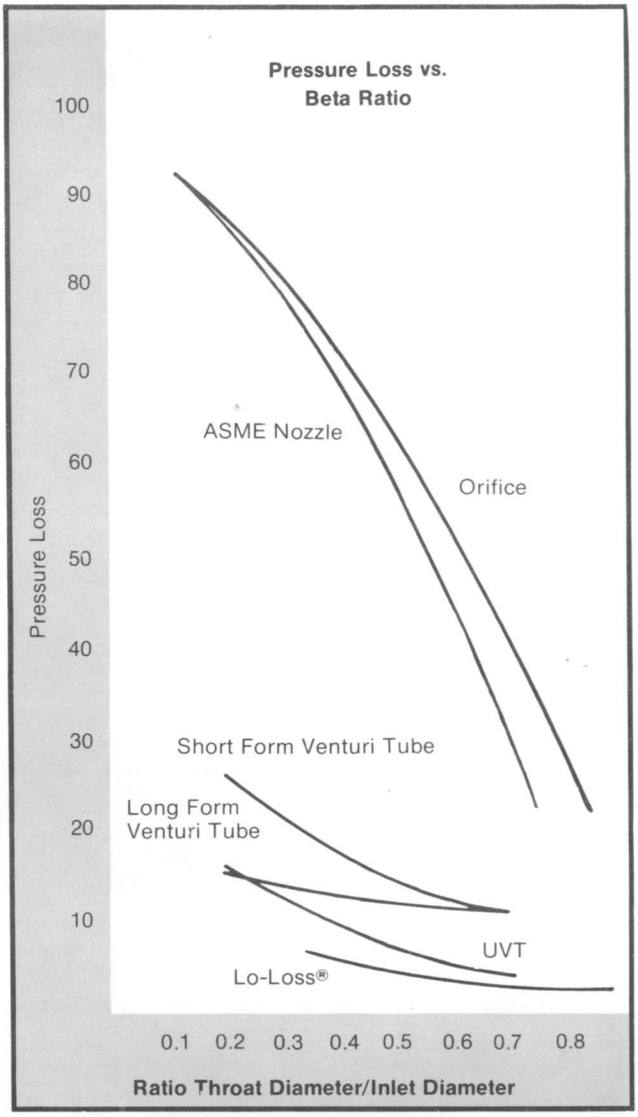


FIGURE 1

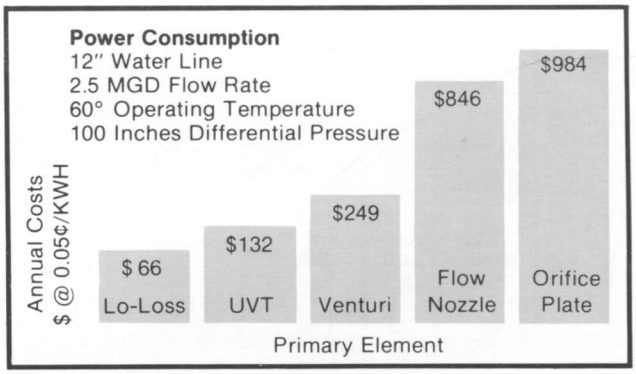


FIGURE 2

Many engineers have already realized the savings possible by using Venturi tubes instead or orifice plates. The next logical step is to realize the further significant savings possible by using the Lo-Loss instead of the Venturi tube. For 21 years many engineers have done just that and given their clients the benefits of maximum efficiency and accuracy.

CAST IRON SERIES
LO-LOSS FLOW TUBE CAPACITIES
(Water at 60° F.)

Pipe Size Inches	Throat Diameter	% Head Loss	Approx. Laying Length Inches Flanged	APPROXIMATE CAPACITIES (Maximum Differential in Inches of Water) Million Gallons per Day 42.39"	75.36"	117.75"	301.44"	Gallons per Minute 42.39"	75.36"	117.75"	301.44"
3	1.609	4.0	7 1/4	.120	.160	.200	.320	83.3	111.1	138.8	222.2
	1.798	3.3	6 1/2	.150	.200	.250	.400	104.2	138.8	173.6	277.7
	2.171	2.9	5 1/4	.225	.300	.375	.600	156.3	208.3	260.4	416.6
	2.434	2.5	5 1/4	.300	.400	.500	.800	208.3	277.7	347.2	555.5
4	2.203	4.0	9 1/4	.225	.300	.375	.600	156.3	208.3	260.4	416.6
	2.814	3.0	7	.375	.500	.625	1.000	260.4	347.2	434	694.4
6	2.529	5.3	16 1/4	.300	.400	.500	.800	208.3	277.7	347.2	555.5
	3.114	4.2	14	.450	.600	.750	1.200	312.5	416.6	520.8	833.3
	4.000	3.3	9 3/4	.750	1.000	1.250	2.000	520.8	694.4	868	1389
	4.428	2.8	9 1/4	.9375	1.250	1.5625	2.500	651	868	1085	1736
8	3.466	5.0	20 7/8	.562	.750	.937	1.500	390.3	520.8	650.7	1041
	4.018	4.3	18 7/8	.750	1.000	1.250	2.000	520.8	694.4	868	1389
	4.919	3.7	15 1/2	1.125	1.500	1.875	3.000	781.3	1041	1302	2083
	5.978	2.8	11 5/8	1.725	2.300	2.875	4.600	1198	1597	1996	3194
10	3.991	5.7	27	.750	1.000	1.250	2.000	520.8	694.4	868	1389
	4.919	4.4	23 3/4	1.125	1.500	1.875	3.000	781.3	1041	1302	2083
	6.343	3.5	17	1.875	2.500	3.125	5.000	1302	1736	2170	3472
	6.907	3.1	13 3/4	2.250	3.000	3.750	6.000	1563	2083	2604	4167
	7.710	2.6	17 1/4	2.906	3.875	4.844	7.750	2018	2691	3364	5381
12	4.892	5.7	32	1.125	1.500	1.875	3.000	781.3	1041	1302	2083
	5.675	4.6	29 1/4	1.500	2.000	2.500	4.000	1042	1389	1736	2778
	6.966	4.0	24 1/4	2.250	3.000	3.750	6.000	1563	2083	2604	4167
	8.000	3.4	18 1/4	3.000	4.000	5.000	8.000	2083	2778	3472	5556
	9.507	2.5	16 1/2	4.500	6.000	7.500	12.000	3125	4167	5208	8333
14	4.900[1]	7.0	40 1/2	1.14	1.52	1.9	3.04	792	1056	1319	2111
	6.958	4.4	31 1/2	2.250	3.000	3.750	6.000	1563	2083	2604	4167
	8.044	3.9	28 1/2	3.000	4.000	5.000	8.000	2083	2778	3472	5556
	9.757	3.1	23 13/16	4.500	6.000	7.500	12.000	3125	4167	5208	8333
	10.328	2.8	19 3/4	5.250	7.000	8.750	14.000	3646	4861	6076	9722
16	6.932	5.1	40 1/4	2.250	3.000	3.750	6.000	1563	2083	2604	4167
	8.036	4.3	36 3/4	3.000	4.000	5.000	8.000	2083	2778	3472	5556
	9.838	3.6	25 7/8	4.500	6.000	7.500	12.000	3125	4167	5208	8333
	11.255	3.0	22 7/8	6.000	8.000	10.000	16.000	4167	5556	6944	11111
	12.365	2.6	27	7.500	10.000	12.500	20.000	5208	6944	8681	13889
18	8.011	4.9	45	3.000	4.000	5.000	8.000	2083	2778	3472	5556
	8.984	4.3	41 1/2	3.750	5.000	6.250	10.000	2604	3472	4340	6944
	9.849	3.9	38 1/2	4.500	6.000	7.500	12.000	3125	4167	5208	8333
	11.350	3.6	27 3/8	6.000	8.000	10.000	16.000	4167	5556	6944	11111
	12.592	3.0	32 1/2	7.500	10.000	12.500	20.000	5208	6944	8681	13889
	13.618	2.7	32	9.000	12.000	15.000	24.000	6250	8333	10417	16667
20	7.00[2]	7.0	57	2.32	3.09	3.87	6.19	1612	2147	2689	4300
	8.959	4.8	49 3/4	3.750	5.000	6.250	10.000	2604	3472	4340	6944
	9.839	4.4	46 1/2	4.500	6.000	7.500	12.000	3125	4167	5208	8333
	11.377	3.9	41	6.000	8.000	10.000	16.000	4167	5556	6944	11111
	13.813	3.1	31 1/2	9.000	12.000	15.500	24.000	6250	8333	10417	16667
	15.602	2.5	25	12.000	16.000	20.000	32.000	8333	11111	13888	22222
	15.804	2.5	31 3/4	12.750	17.000	21.250	34.000	8854	11805	14757	23611
24	9.783	5.7	63	4.500	6.000	7.500	12.000	3125	4167	5208	8333
	11.349	4.6	57 1/2	6.000	8.000	10.000	16.000	4167	5556	6944	11111
	13.931	3.9	45 1/2	9.000	12.000	15.000	24.000	6250	8333	10417	16667
	16.000	3.3	33 1/2	12.000	16.000	20.000	32.000	8333	11111	13888	22222
	17.677	2.8	33 1/2	15.000	20.000	25.000	40.000	10417	13889	17361	27778
	19.014	2.5	37 3/4	18.000	24.000	30.000	48.000	12500	16667	20833	33333
30	11.265	6.2	82	6.000	8.000	10.000	16.000	4167	5556	6944	11111
	12.645	5.2	77	7.500	10.000	12.500	20.000	5208	6944	8681	13889
	16.086	4.0	64 1/2	12.000	16.000	20.000	32.000	8333	11111	13888	22222
	17.975	3.8	57 1/2	15.000	20.000	25.000	40.000	10417	13889	17361	27778
	21.711	2.9	43	22.500	30.000	37.500	60.000	15625	20833	26042	41667
	24.341	2.5	43 1/2	30.000	40.000	50.000	80.000	20833	27778	34722	55556
36	13.806	6.0	97	9.000	12.000	15.000	24.000	6250	8333	10417	16667
	16.022	4.9	89	12.000	16.000	20.000	32.000	8333	11111	13889	22222
	19.705	4.0	76	18.000	24.000	30.000	48.000	12500	16667	20833	33333
	22.004	3.7	67	22.500	30.000	37.500	60.000	15625	20833	26042	41667
	25.183	3.1	55	30.000	40.000	50.000	80.000	20833	27778	34722	55556
	27.687	2.6	61	37.500	50.000	62.500	100.000	26042	34722	43403	69444
	29.636	2.5	50	45.000	60.000	75.000	120.000	31250	41667	52083	83333

FOR LARGER SIZES OR SPECIALS CONSULT THE FACTORY

Quote + Order Work Sheet **WS 3-5, No. 1**

Fox. Ord No.

Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY

CUSTOMER ORDER NO. U. S. MARINE CORPS, CAMP LEJEUNE, N. C.

Quote Item or Sheet

Quan 1

ORIFICE FLANGE UNION

DESIGNATION: _____

TYPE:

FU-T	[X]	----------	Threaded
FU-S	[ ]	----------	Slip-on
FU-W	[ ]	----------	Welding neck

FLANGE FACING:

RF	[ ]	----------	Raised face
RJ	[ ]	----------	Ring type joint

MATERIAL:

-CS	[X]	----------	Carbon steel
-304	[ ]	----------	AISI Type 304 stainless steel
-316	[ ]	----------	AISI Type 316 stainless steel

ANSI RATING:

-300	[X]	----------	Class 300
-400	[ ]	----------	Class 400
-600	[ ]	----------	Class 600
-900	[ ]	----------	Class 900
-1500	[ ]	----------	Class 1500

CUST. ITEM	TAG	SIZE	PIPE I.D. (Welding neck only)	Comp Total
	FE-7 Raw Water Flow	16"		

Quan 1

ORIFICE PLATE

DESIGNATION: _____

TYPE:

OP-FTT	[X]	----------	Tab
OP-UT	[ ]	----------	Universal, for RTJ flanges and orifice fittings

MATERIAL:

-304	[X]	----------	AISI Type 304 stainless steel
-316	[ ]	----------	AISI Type 316 stainless steel
OP-FTT Only-MM	[ ]	----------	Monel Metal

OUTSIDE DIAMETER:

OP-FTT Only-150	[ ]	----------	For ANSI Class 150 flange
-300	[ ]	----------	For ANSI Class 300 flange
OP-FTT Only-400	[ ]	----------	For ANSI Class 400 flange
-600	[ ]	----------	For ANSI Class 600 flange
OP-UT Only -900	[ ]	----------	For ANSI Class 900 flange
OP-UT Only -1500	[ ]	----------	For ANSI Class 1500 flange
OP-UT Only -2500	[ ]	----------	For ANSI Class 2500 flange

BORING:

[ ] Blank [ ] _____ [ ] In accordance with Flow Data attached

TAP ARRANGEMENT:

[ ] Flange [ ] _____

OPTIONAL FEATURES:

( ) [ ] Drain Hole [ ] Vent Hole

( ) _____

_____

CUST. ITEM	TAG	SIZE	Comp Total
	FE-7 Raw Water Flow	16"	

General Specifications: Tab Type Orifice Plates ----- GS 3-5A1 A [ ]

PRICE EACH

General Specifications

GS
3-5A1 A
July 1976

ORIFICE PLATES – TAB TYPE

The Orifice Plate is a primary device which introduces a restriction in the pipeline causing a change in pressure. The quantity of fluid flowing may be determined from the measurement of the differential pressure by computation using appropriate formulae.

Conformity to Specifications The dimensions of Foxboro Orifice Plates meet the intent of the applicable portions of ASME Fluid Meters - 6th Edition; AGA3-1969; ISO/R541-1967; BS 1042; and related reference documents such as Spink's "Principles and Practice of Flowmeter Engineering" - 9th Edition; ISA RP3.2-1960; and the Shell "Flowmeter Handbook" - 1968.

Quality of Finish The plate is grained longitudinally and free from scratches. The surface finish on both sides is 1.2 micrometre (45 microinch) or better.

Variations in Plate Bore

Concentric Bore Used in a majority of applications involving clean low viscosity fluids with minimum vapor or liquid entrainment.

Eccentric Bore Used for liquids containing vapors or for vapors containing liquids. The orifice hole is arranged so that its edge is not more than 1% of the line diameter from the wall.

Segmental Bore Used for dirty fluids in preference to concentric or eccentric bores. The diameter of the concentric portion of the hole is 98% of the line diameter.

STANDARD SPECIFICATIONS

Nominal Line Size 25 to 600 mm and 1 to 24 in. Refer to Tables 1 and 2.

Materials of Construction The standard material for Orifice Plates is AISI Type 304 stainless steel (304 ss). Other materials are listed under Optional Features.

Plate Thickness Not less than 0.025D' or greater than 0.05D' where D' is the unsupported diameter (the nominal pipe diameter). [Based on a maximum differential pressure of 50 kPa (200 inH_2O, 0.5 bar or kg/cm^2) and a maximum temperature of 200°C (400°F)].

Outside Diameter Suitable for PN(ND)10, 16, 25, and 40 or ANSI Class 150, 300, 400, and 600 raised face flanges. Refer to Tables 1 and 2.

Bore The standard bore is concentric with the sharp and square inlet edge.

Orifice Computation When an Orifice Plate is purchased with a measuring instrument, Foxboro calculates the orifice size based on "Principles and Practice of Flowmeter Engineering" - 9th Edition, and finishes the orifice plate accordingly.

Tab Handle Width Foxboro Orifice Plates manufactured in the U.K. have a tab handle width of 32 mm (1.25 in) for all sizes. Orifice Plates made in the U.S. have tab handle widths of 25 or 38 mm (1 or 1.5 in), depending on the size.

Legend The upstream side of the tab handle is indelibly marked "INLET" along with the bore size, flange size, and pressure rating. The downstream side of the tab handle is stamped with the Foxboro logo and indelibly marked with the plate material, tag number, or other specific identification.

Tab Handle Hole Size (Refer to Dimensions section for location.)

Nominal Line Size		Hole Diameter	
mm	in	mm	in
25 to 50	1 to 2	6	0.25
65 to 300	2.5 to 12	9	0.37
350 to 600	14 to 24	13	0.50

FOXBORO

Printed in U.S.A.

OPTIONAL FEATURES

Reverse Flow For reverse flow applications, the plate is bored and finished equally on both faces and the bore is not beveled. The plate must be used with symmetrical taps.

Preparation for Nuclear, Oxygen, or Chlorine Service The Orifice Plate is degreased prior to packaging in a Class 10 000 clean room which meets all the requirements set out in U.S. Federal Standard 209a, or using acceptable alternative facilities, following procedures established to meet the strict user requirements for such service.

Optional Orifice Bores Eccentric, segmental, or quadrant edge bore.

Blank Orifice Plate For boring by user.

Alternative Materials of Construction AISI Type 316 stainless steel or Monel*, as specified.

Drain or Vent Hole Plate drilled with recommended maximum diameter hole to applicable standard. (See table below.)

Nominal Diameter of Drain or Vent Hole

Nominal Orifice Bore		Nominal Diameter of Drain or Vent Hole	
mm	in	mm	in
25 to 90	1.00 to 3.50	2.4	0.09
90 to 105	3.50 to 4.13	3.2	0.13
105 to 125	4.13 to 5.00	4.0	0.16
125 to 150	5.00 to 6.00	4.8	0.19
150 to 170	6.00 to 6.75	5.6	0.22
170 to 190	6.75 to 7.50	6.3	0.25
190 to 210	7.50 to 8.38	7.1	0.28
210 to 230	8.38 to 9.25	7.9	0.31
230 to 250	9.25 to 10.00	8.7	0.34
250 to 275	10.00 to 10.88	9.5	0.38
275 to 295	10.88 to 11.63	10.3	0.40
295 to 315	11.63 to 12.50	11.1	0.44
315 to 335	12.50 to 13.25	11.9	0.47
335 or larger	13.25 or larger	12.7	0.50

Refer to Dimensions section for location.

Legend Legends to suit specific requirements can be supplied. Refer to Foxboro.

Correction Curves Available for temperature, pressure, or specific gravity variations from original design conditions. Refer to Foxboro.

High Temperature and High Differential Pressure Operation The Orifice Plate may bend if the temperature of the process fluid exceeds 200°C (400°F) and the differential pressure is greater than 50 kPa (200 inH_2O; 0.5 bar or kg/cm^2) ΔP. Refer to Foxboro for determination of the plate thickness.

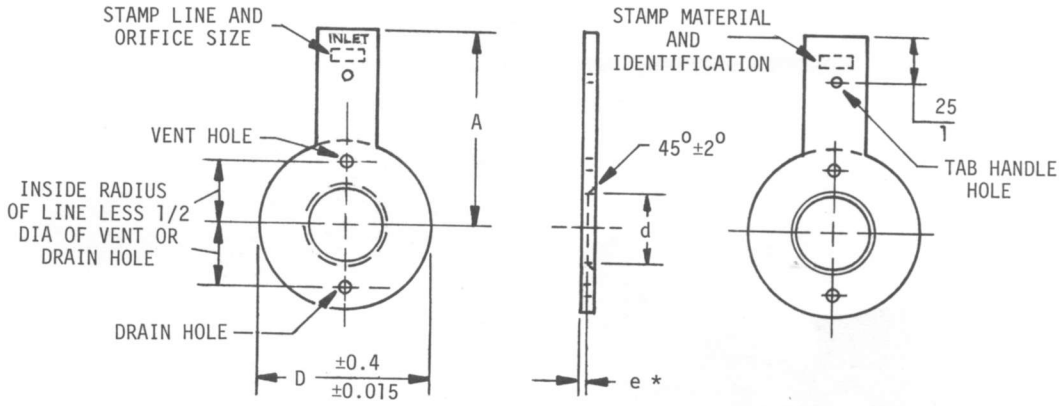
ORDERING INSTRUCTIONS – SPECIFY

1. **Foxboro Tab Type Orifice Plate**
2. **Line Size. (Exact details if calculation is required.)**
3. **Flange Rating or Designation**
4. **Dimensions for Concentric Bore or Operating Conditions for Bore Calculation.**
5. **Material of Construction**
6. **Legend**
7. **Optional Features**

*Trademark of International Nickel Company for nickel-cobalt-copper alloy.

DIMENSIONS

FIGURES EXPRESSED IN MILLIMETRES AND INCHES



* e = 0.1d or 0.02D' whichever is Less minimum 0.005D'.

(D' = Unsupported diameter)

TABLE 1 DIN OR BS 4504 FLANGES

ALL FIGURES ARE IN MILLIMETRES

Nominal Line Size	Thickness of Plate	Rating PN10		Rating PN16		Rating PN25		Rating PN40	
		A	D	A	D	A	D	A	D
25	4	107	73	107	73	107	73	107	73
32		120	84	120	84	120	84	120	84
40		125	94	125	94	125	94	125	94
50		132	109	132	109	132	109	132	109
65		143	129	143	129	143	129	143	129
80		140	144	150	144	150	144	150	144
100		160	164	160	164	167	170	167	170
125		175	194	175	194	185	196	185	196
150		192	220	192	220	200	226	200	226
200		220	275	220	275	230	286	236	293
250	6	247	330	252	331	262	343	275	355
300		272	380	280	386	292	403	307	420
350		303	440	310	446	—	—	—	—
400		332	491	340	498	—	—	—	—
500	10	387	596	407	620	—	—	—	—
600		440	698	470	737	—	—	—	—

TABLE 2 ANSI FLANGES

ALL FIGURES ARE IN INCHES

Nominal Line Size	Thickness of Plate	Class 150		Class 300		Class 400		Class 600	
		A	D	A	D	A	D	A	D
1	0.125	4.13	2.69	4.43	2.94	4.43	2.94	4.43	2.94
1.25		4.31	3.06	4.63	3.31	4.63	3.31	4.63	3.31
1.5		4.50	3.44	5.06	3.81	5.06	3.81	5.06	3.81
2		5.00	4.19	5.25	4.44	5.25	4.44	5.25	4.44
2.5		5.50	4.88	5.75	5.13	5.75	5.13	5.75	5.13
3		5.75	5.38	6.13	5.88	6.13	5.88	6.13	5.88
3.5		6.25	6.38	6.50	6.50	6.50	6.38	6.50	6.38
4		6.50	6.88	7.00	7.13	7.00	7.00	7.38	7.63
5		7.00	7.75	7.50	8.44	7.50	8.38	8.50	9.50
6		7.50	8.75	8.25	9.81	8.25	9.75	9.00	10.50
8		8.75	11.00	9.50	12.13	9.50	12.00	10.50	12.63
10		10.00	13.38	10.75	14.25	10.75	14.13	12.00	15.75
12		11.50	16.13	12.25	16.63	12.25	16.50	13.00	18.00
14		12.50	17.75	13.50	19.13	—	—	—	—
16	0.25	13.75	20.25	14.75	21.25	—	—	—	—
18		14.50	21.63	16.00	23.50	—	—	—	—
20		15.75	23.88	17.25	25.75	—	—	—	—
24		18.00	28.25	20.00	30.50	—	—	—	—

Quote + Order Work Sheet **WS 2B-1, No. 5A**

Fox. Ord No.

Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U. S. MARINE CORPS, CAMP LEJEUNE, N. C.
CUSTOMER ORDER NO. 81236

Quote Item or Sheet

Quan	
1	**FOXBORO PNEUMATIC d/p CELL TRANSMITTER**

MODEL: [X] 13HA _____ [ ] 13HA1 _____

SPAN LIMITS:

-M	[ ]	----------	5 and 62 kPa
	[XX]	----------	20 and 250 inches of water
	[ ]	----------	50 and 620 mbar
-H	[ ]	----------	50 and 210 kPa
	[ ]	----------	200 and 850 inches of water
	[ ]	----------	0.5 and 2.1 bar

BODY MATERIAL:

13HA1 only K	[X]	----------	Cadmium plated carbon steel
13HA only S	[ ]	----------	AISI Type 316 stainless steel

PROCESS CONNECTIONS:

1	[XX]	----------	1/4 NPT
2	[ ]	----------	1/2 NPT
3	[ ]	----------	R 1/4
4	[ ]	----------	R 1/2
5	[ ]	----------	Machined for 9/16-18 Aminco filling

OUTPUT SIGNAL:

Output			
[illegible] to 100 kPa	[ ]	----------	20 to 100 kPa
3 to 15 psi	[XX]	----------	3 to 15 psi
0.2 to 1.0 bar	[ ]	----------	0.2 to 1.0 bar
0.2 to 1.0 kg/cm^2	[ ]	----------	0.2 to 1.0 kg/cm^2

MOUNTING: Direct to process, or by bracket for both nominal 50 mm and 2-inch pipe

OPTIONAL FEATURES:

-L [ ] ( ) Zero Elevation (Span Suppression)

-R [ ] ( ) Zero Suppression (Span Elevation)

( ) [ ] [IAS] Integrally mounted Air Supply Set
[-F] [ ] Fixed Pressure Regulator [-A] [ ] Adjustable Pressure Regulator
[E] [ ] with 2 inch, 0 to 30 psi gauge [P] [ ] with 50 mm, 200 kPa gauge
[M] [ ] with 50 mm, 0 to 2 kg/cm^2 gauge

Features Continued On Sheet _____

(x) Integrally mounted 3 valve manifold

SERIAL NO.	CUST. ITEM	TAG	CALIBRATED RANGE	Comp Total
	4	FT-7 Raw Water Flow	LATER 0-6000 GPM	

General Specifications: ---------- GS 2B-1C1 A [ ]

PRICE EACH

FOXBORO

E13DL, E13DM AND E13DH SERIES ELECTRONIC d/p CELL TRANSMITTERS

General Specification

The Electronic Series d/p Cell Transmitters measure differential pressure in ranges of 0-5 to 0-850 inches (0-127 to 0-21590 mm) of water at static pressures up to 6000 psi (420 kg/cm^2). They transmit a proportional 10 to 50 or 4 to 20 mA d-c signal, over ordinary unshielded leads, to receivers located up to several thousand feet from the point of measurement.

FEATURES

Time-Proven Design

Trouble-Free Construction

High Performance — Excellent Reproducibility

Ease of Calibration Adjustment — Wide Range Capability

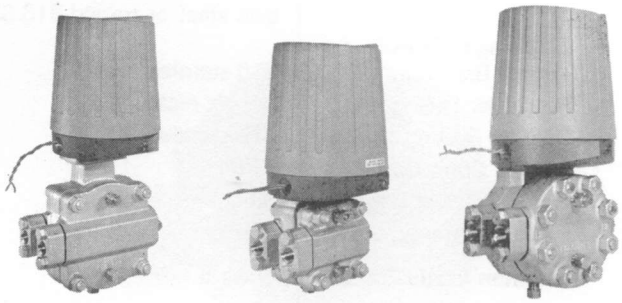
Stable Force Balance System

Positive Overrange Protection

Transmitter Housing Watertight and Moistureproof

Application Versatility

Explosionproof/Intrinsically Safe



E13DL E13DM E13DH

PERFORMANCE

Accuracy
5 to 525-inch (127 to 13335 mm) ..... ±0.5% of span
526 to 850-inch (13360 to 21590 mm) ..... ±0.75% of span
Dead Band ..... 0.05% of span
Repeatability: E13DL Series ..... 0.15% of span
E13DM, E13DH Series ..... 0.10% of span
Hysteresis ..... 0.10% of span
Reproducibility: E13DL Series ..... 0.20% of span
E13DM, E13DH Series ..... 0.15% of span
(Includes effects of Hysteresis, Repeatability, Dead Band and Drift over 1-hr period)

BASE TRANSMITTER STANDARD SPECIFICATIONS
Style B

Span Fully adjustable between range limits of capsule.

Maximum Process Temperature 250 F (120 C) at capsule

Ambient Temperature Limits -40 to +180 F (-40 to +82 C). With remote amplifier, -40 to +250 F (-40 to +120 C).

Bolting Steel cap screws and nuts through body and process connectors

Cover Threaded cast aluminum seated on Buna-N O-ring seal. Blue textured vinyl finish.

Enclosure Classification NEMA 4 watertight

Electronic Transmitter and Amplifier Solid state

Electrical Connections Two 5-foot leads from 1/2-inch female conduit connections

Output Signal

Output Signal (mA d-c)	External Loop Load (ohms)		Nominal Supply Voltage from Separate Unit
	Minimum	Maximum	
4 to 20	0	660	24 V d-c
10 to 50	480 (a)	660	80 V d-c

(a) Foxboro power supplies or distribution panels include a calibrated 0 to 500 ohm load adjustment potentiometer.

Supply Voltage Limits 24 to 60 volts d-c with 4 to 20 mA output and 63 to 100 volts d-c with 10 to 50 mA output from separate power supply unit.

Supply Voltage Effect Zero shift will be less than 0.1% of span for a 10% change in voltage within stated limits.

Electric Classification Explosionproof Class I, Groups C and D, Division 1.

Mounting Direct to process with bracket for 2-inch horizontal or vertical pipe.

Specifications	E13DL Series	E13DM Series	E13DH Series
Range Limits			
Low Range Capsule	0-5 to 0-25" water (0-127 to 0-635 mm)		
Medium Range Capsule	—	0-20 to 0-205" water (0-508 to 0-5207 mm)	0-20 to 0-205" water (0-508 to 0-5207 mm)
High Range Capsule	—	0-200 to 0-850" water (0-5080 to 0-21590 mm)	0-200 to 0-850" water (0-5080 to 0-21590 mm)

GS 2A-1C1 E
November 1971

Printed in U.S.A.

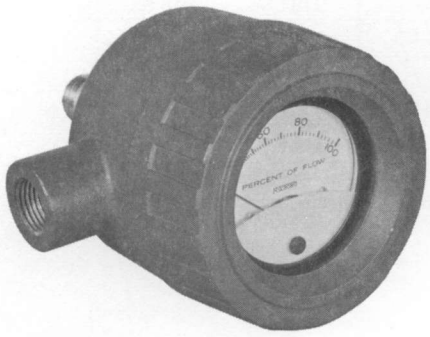
STANDARD SPECIFICATIONS
(Continued)

Specification	E13DL Series	E13DM Series	E13DH Series
Wetted Parts:			
Body and Process Conn	Cadmium plated forged carbon steel or forged 316 SS	Cadmium plated forged carbon steel or forged 316 SS	Cadmium plated forged carbon steel or forged 316 SS
Diaphragm Capsule and Force Bar	316 stainless steel	316 stainless steel	316 stainless steel
Force Bar Seal	Cobalt nickel alloy	Cobalt nickel alloy	Cobalt nickel alloy
Capsule Gasket	316 stainless steel	316 stainless steel	316 stainless steel
Process Conn Gasket	TFE	TFE	Glass filled TFE
Force Bar Seal Gasket	Silicone elastomer	Silicone elastomer	Buna-N
Backup Plate	316 stainless steel	316 stainless steel	316 stainless steel
Maximum Static Pressure	500 psi (35 kg/cm^2)	2000 psi (140 kg/cm^2)	6000 psi (420 kg/cm^2)
Process Connections	1/4 or 1/2 NPT female or 1/2 inch Sch 80 welding neck, as specified.	1/4 or 1/2 NPT female or 1/2 inch Sch 80 welding neck, as specified.	1/4 or 1/2 NPT or body machined to accept 9/16-18 Aminco fittings, as specified.
Ambient Temperature Effect (Zero shift in percent of span)	±1.0% per 100 F (55 C) change at 25" (635 mm) water; ±1.0% per 40 F (22 C) change at 5" (127 mm) water.	Medium Range Capsule: ±1.0% per 100 F (55 C) change at 100" (2540 mm) water; ±1.0% per 125 F (69 C) at 205" (5207 mm) water; ±1.0% per 40 F (22 C) at 25" (635 mm) water. High Range Capsule: Less than ±1% per 50 F (28 C) change for any span between 200 to 850" (5080 to 21590 mm) water.	Medium Range Capsule: ±1.0% per 100 F (55 C) change at 100" (2540 mm) water; ±1.0% per 125 F (69 C) at 205" (5207 mm) water; ±1.0% per 40 F (22 C) at 25" (635 mm) water. High Range Capsule: Less than ±1% per 50 F (28 C) change for any span between 200 to 850" (5080 to 21590 mm) water.
Position	Transmitter should be mounted with capsule in vertical position.	–	–
Position Effect	–	Maximum of less than 3% zero shift for 90 degree tilt of instrument in any plane	Maximum of less than 3% zero shift for 90 degree tilt of instrument in any plane
Vibration	Less than 1.5% zero shift for vibration to 1.5G in any plane, at frequencies less than 80 Hz.	Less than 1% zero shift for vibration to 2G in any plane.	Less than 1% zero shift for vibration to 2G in any plane.
Static Pressure Effect	Maximum zero shift less than 0.5% of span for 500 psi (35 kg/cm^2) change.	Zero shift less than 0.5% span for 2000 psi (140 kg/cm^2) change at 50 to 850" (1270 to 21590 mm) water; 1.0% span for 1000 psi (70 kg/cm^2) change at 20 to 50" (508 to 1270 mm) water.	Zero shift less than 1.5% span for 0-6000 psi (0-420 kg/cm^2) change at 50 to 850" (1270 to 21590 mm) water or 0.5% span for any 2000 psi (140 kg/cm^2) change; 2.0% span for 0 to 6000 psi (0 to 420 kg/cm^2) change at 20 to 50" (508 to 1270 mm) water or 1.0% span for any 2000 psi (140 kg/cm^2) change*.
Overall Dimensions	16 1/8" (410 mm) H x 6 7/8" (175 mm) W.	13 1/4" (337 mm) H x 6 7/8" (175 mm) W.	14 1/2" (368 mm) H x 6 7/8" (175 mm) W.
Approximate Weight	32 lb (15 kg)	25 lb (11 kg)	40 lb (18 kg)

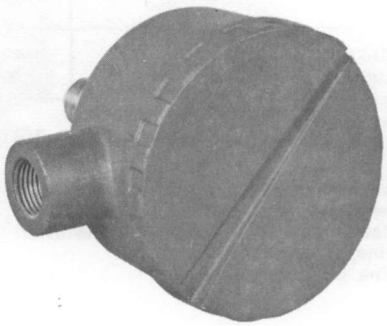
*If pressure varies cyclically, refer to your nearest Foxboro Sales Office.

OPTIONAL EXTRA FEATURES

Integral Junction Box with Indicator For use with remote or integral amplifier. Indicator consists of plug-in millivolt meter with 0 to 100% flow (square root) or 0 to 100% of output (uniform), as specified. Other dial ranges available, as specified. Meets Class I, Groups C and D, Division 1 requirements.



Integral Junction Box with Test Jack For use with remote or integral amplifier. Furnished with test jacks across precision resistor in line. Meets Class I, Groups C and D, Division 1 requirements.



Right Angle Mounting for Integral Junction Box Includes right angle fitting between junction box and transmitter with junction box parallel to zero screw unless otherwise specified.

Transmitter with Remote Amplifier (Maximum 500 feet) For ambient temperature over 180 F (+82 C) or for excessive thermal radiation. Seven transmitter leads to remote amplifier. 18-inch leads extending from 1/2-inch female threaded conduit connection.

Remote Amplifier Housing

Class I, Groups C and D, Division 2 Sheet metal housing with 1/2-inch electrical connections and four lugs for surface mounting.

Explosionproof Class I, Groups C and D, Division 1 Cast aluminum with two 1/2-inch female conduit connections, with two lugs for surface mounting.

Cleaning for Nuclear Service Cleaned, assembled, calibrated and packaged in a Class 10,000 Clean Room which meets both mandatory and non-mandatory requirements as established by Federal Standard 209a.

Oxygen Service Preparation Cleaned, assembled, calibrated and packaged in a Class 10,000 Clean Room which meets both mandatory and non-mandatory requirements as established by Federal Standard 209a. Furnished with 316 stainless diaphragm capsule filled with standard silicone or optional fluorolube fill (temperature limits 0 to 100 F (-18 to +38 C).

Stainless Steel Bolting 17-4PH stainless steel cap screws and nuts through body and process connectors.

High Damping Available with high viscosity (2200 centistoke) silicone capsule fill providing up to 4 times damping available on standard capsule.

High Process Temperature Operation to 375 F (190 C) Construction with glass filled TFE gasketing permits process temperatures to 375 F (190 C).

Intrinsic Safety 10 to 50 mA transmitters are available with Underwriters' Laboratories, Inc. listing for Class I, Groups C and D, Division 1 locations when combined with other listed instruments to form an intrinsically safe system. For Class I, Group B, Division 1 locations, transmitters must be used with a Foxboro 66P Series Barrier Repeater. See GS 2A-12D1 A.

Internal Steam Tracing To maintain process fluid at temperatures up to 375 F (190 C). Hollow tracing studs substituted for body bolts with glass filled TFE gaskets at process connection. Maximum working pressure 300 psi (21 kg/cm^2) for E13DL Series, 1100 psi (77 kg/cm^2) for E13DM Series and 2000 psi (140 kg/cm^2) for E13DH Series.

Span Elevation-Suppression Kit Permits span elevation or suppression to 1000% of span. Elevation plus span must not exceed range limits of capsule and suppression must not exceed range limits of capsule.

Reverse Output 50 to 10 or 20 to 4 mA d-c, as specified.

Power Supply Unit For single 10 to 50 mA transmitter-receiver loop, see GS 2A-12B2 C. For multiple 10 to 50 mA transmitter-receiver loops, see GS 2A-12B2 B.

OPTIONAL EXTRA FEATURES
(Continued)

Bypass Manifolds for Integral Mounting (a)

Maximum Static Pressure (b)	Manifold Type	Process Connection	Body and Bonnet	Stem	Seat	Stem Packing
1500 psi (105 kg/cm^2)	Foxboro 1-Valve	1/2 NPTF	Cadmium Plated CS	316 SS	316 SS	Asbestos with Copper Wire Insertion
			316 SS			
	Foxboro 3-Valve	1/4 NPTF	Cadmium Plated CS	416 SS	440 SS	TFE
			316 SS	316 SS	316 SS	
6000 psi (420 kg/cm^2)	Anderson, Greenwood 1 or 3-Valve	1/4 or 1/2 NPTF	Cadmium Plated CS	303 SS	316 SS	TFE
			316 SS	316 SS		
3000 psi (210 kg/cm^2) (c)	Anderson, Greenwood 5-Valve	1/2 NPTF	Cadmium Plated CS	303 SS	(d)	TFE
			316 SS	316 SS	(e)	

(a) When used with integral junction box, specify right angle junction box mounting to avoid interference with junction box.
(b) Maximum static pressure of manifold must be equal to or greater than operating static pressure of transmitter.
(c) Not available integrally mounted to transmitter.
(d) Penton line, nylon equalizer.
(e) Penton line, CTFE equalizer.

FOR E13DL SERIES ONLY

Low Spans 2.0 to 4.9 inches (51 to 124 mm) of water. Performance specifications are twice those specified for standard transmitter.

FOR E13DM SERIES ONLY

Wetted Parts

Body Monel

Force Bar and Plug Monel

Capsule Materials – Medium Range Capsule

Diaphragm	Capsule Gasket	Backup Plate (Not Wetted)	Other Wetted Parts
Monel 400 Hast C-276	Monel TFE	Monel 316 SS	Monel Hast C

ORDERING INSTRUCTIONS – SPECIFY

1. Foxboro E13 Series Electronic d/p Cell Transmitter
2. Body and Process Connector Material
3. Process Connections
4. Output Signal
5. Medium or High Range Diaphragm Capsule (E13DM, DH Series Only)
6. Calibrated Range
7. Optional Extra Features
8. Tag and Application

Quote + Order Work Sheet **WS 2B-5, No. 5**

Fox. Ord No.

Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY

CUSTOMER U. S. MARINE CORPS., CAMP LEJEUNE, N. C.

CUSTOMER ORDER NO. 81236

Quote Item or Sheet

Quan 1

FOXBORO PNEUMATIC ANALOG COMPUTER

MODEL: ☐ 556 _____ ☒ 557

FUNCTION:

556	-8	☐	Multiplying two variables
	-8E	☐	Multiplying two variables where one input and/or output is representative of a suppressed range
	-9	☐	Dividing one variable by a second variable
	-9E	☐	Dividing two variables where the numerator and/or output is representative of a suppressed range
	-10	☐	Extracting square root of one variable
	-11	☐	Squaring of one variable
557		☒	Square Root Extractor

Signal Level

SIGNAL LEVEL:

20 to 100 kPa	☐	20 to 100 kPa
3 to 15 psi	☒	3 to 15 psi
0.2 to 1.0 bar	☐	0.2 to 1.0 bar
0.2 to 1.0 kg/cm^2	☐	0.2 to 1.0 kg/cm^2

MOUNTING: Bracket for vertical mounting on strut or mounting to both nominal 50 mm or 2-inch pipe

OPTIONAL FEATURES:

( ) _____

_____

_____

_____

Features Continued On Sheet _____

CALIBRATION DATA
(For Multiplier or Divider)

Scaling constant (f): _____ Span constant (s): _____

Zero constant (z): _____ Bias constant (K_a): _____

Bias constant (K_b): _____

SERIAL NO.	CUST. ITEM	TAG	Comp Total
	5	FT-7 Raw Water Flow	

General Specifications:

556 ---------- GS 2B-5E1 A ☐

557 ---------- GS 2B-5E1 B ☐

PRICE EACH

Printed in U.S.A. **WS 2B-5, No. 5**

FOXBORO

Effective September 15, 1976

General Specifications

GS
2B-5E1 A
November 1975

556 SERIES PNEUMATIC ANALOG COMPUTER

The 556 Series Pneumatic Analog Computer multiplies, divides, squares, and extracts square roots of pneumatic analog signals.

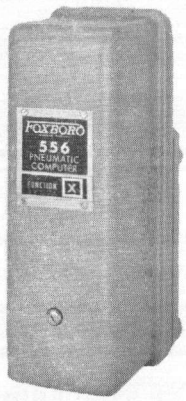
High Accuracy These instruments meet the precise requirements of analog computing systems.

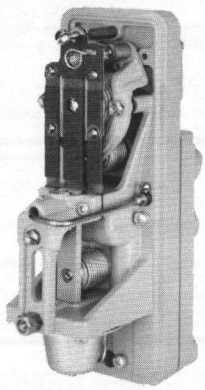
Versatility A switch plate, included in the instrument, may be set so that the instrument performs any one of the four computing functions. Since conversion can be made readily in the field, one standby unit can back up many computers in service.

Wide Range Scaling Ability Wide scaling flexibility for multiplier and divider functions permits the use of different numerical input ranges. Particularly useful for pressure and temperature compensation of gas flows, and for ratio and product computation.

Flexure Design Precision-milled 17-4 PH* stainless steel flexures, instead of rotating pivots, eliminates frictional errors and ensures highest accuracy.

Weatherproof and Corrosion Resistant Cover is provided with a gasket and is continuously purged by bleed air from the instrument nozzles. Gray textured vinyl finish is resistant to corrosive atmospheres.





PERFORMANCE

(Expressed as % of output span)

Accuracy

Multiplier (a)	±0.5%
Divider (a)	±0.5% from 10% to 100% of denominator input
Square	±0.25%
Square Root	±0.25% from 1% to 100% of input
Repeatability	0.1%
Dead Band	0.02%

(a) Accuracy is shown based on factor (f) being 1.0. For other values of (f) accuracy varies proportionally.

STANDARD SPECIFICATIONS

Function	Formula
Multiplying	$A = fB(Z + SC)$
Dividing	$B = \frac{A}{f(Z + SC)}$
Squaring	$A = C^2$
Square Root Extracting	$B = \sqrt{A}$

f = Scaling Factor represents the maximum numerical value of the C input. Limits are 0.75 and 3.50.
S = Span Factor represents the numerical span of the C input. Limits are 0.05 and 1.00.
Z = Zero Factor is the numerical zero of the C input and equals 1 minus S.

Input and Output Signals 20 to 100 kPa, 3 to 15 psi, or 0.2 to 1.0 bar or kg/cm^2, as specified.

Connections Tapped for 1/4 NPT

Supply Pressure Limits 130 and 150 kPa, 19 and 22 psi, or 1.30 and 1.50 bar or kg/cm^2.

Supply Pressure Effect The effect of a variation of 10 kPa, 1.5 psi, or 1.0 bar or kg/cm^2 within specified limits for supply pressure and expressed in percent of output span is as follows:

Multiplying	0.3 f (for f greater than 1.0)
Dividing	0.3/C (C expressed as a decimal)
Squaring	0.3 maximum
Square Root Extracting	$0.3/\sqrt{A}$ (A expressed as a decimal)

Air Consumption 0.5 m^3/h at standard conditions (0.3 scfm) for steady state operation.

Ambient Temperature Limits -40 and +80°C (-40 and +180°F).

*Trademark of Armco Steel Corporation for precipitation hardened stainless steel

Printed in U.S.A.

FOXBORO

STANDARD SPECIFICATIONS
(Continued)

Ambient Temperature Effect The span and zero shift, as a result of a change in ambient temperature of 50°C (100°F) is expressed in percent of output span.

Function	Zero Shift	Span Shift
Multiplying	1.5 f	1.0 f
	for f greater than 1.0	
Dividing	1.5/C	1.0/C
	C is expressed as a decimal	
Squaring	1.5	1.0
Square Root Extracting	Combined error is $\frac{A + 1.5}{\sqrt{A}}$	
	A is expressed as a decimal	

Construction Manifold is diecast aluminum alloy with aluminum/epoxy resin finish. Elements A and C bellows are brass. B diaphragm is copper alloy. Cover is drawn steel fitted with a cork composition gasket and finished with textured gray vinyl paint. Meets the requirements of IP53 (IEC 144) and provides protection of NEMA Type 3.

Mounting Bracket supplied for mounting computer vertically on a strut or on a nominal 50 mm (2 in) pipe.

Approximate Overall Dimensions 215 mm high x 75 mm wide x 125 mm deep (8.4 in high x 3.0 in wide x 4.9 in deep).

Approximate Mass 2.0 kg (4.5 lb)

ORDERING INSTRUCTIONS – SPECIFY

1. **556 Series Pneumatic Analog Computer**
2. **Function**
3. **Input and Output Signals in Process and Signal Units**
4. **For Multiplying and Dividing Only Values of Scaling Factor (f) and Span Factor (S) to at least Three Significant Figures, or Table of Input/Output Values.**
5. **Tag and Application**

Quote + Order Work Sheet **WS 3-1, No. 1A** | Fox. Ord No. | Part

CUSTOMER EAST COAST CONSTRUCTION COMPANY
CUSTOMER U. S. MARINE CORPS, CAMP LEJEUNE, N.C.
CUSTOMER ORDER NO. 81236

Quote Item or Sheet

Quan 1

FOXBORO _____ [XX] **RECORDER** [ ] **INDICATOR**

with _____

MODEL: _____

CASE:

40P	[XX]	Nominal 300 mm (12 in) rectangular, glass fiber reinforced, gray polyester molding with gasketed, dust-tight door.
40M	[ ]	Nominal 300 mm (12 in) rectangular, die-cast aluminum, black vinyl finish.

FUNCTION:

R	[XX]	Circular chart recorder
N	[ ]	Sector indicator
K	[ ]	Concentric indicator

INTERNAL MECHANISM:

-R	[XX]	Circular chart recording
-N	[ ]	Sector scale indication
-K	[ ]	Concentric scale indication
-E	[ ]	With Type 70 contacts (Recorder or Indicator)

MOUNTING

F	[ ]	Flush
P	[ ]	Pipe
S	[XX]	Surface
Y	[ ]	Yoke

[Not available with 40P Series with Type 37 Element. Pipe mounting not available with 40M Series.]

CHART DRIVE or SCALE:

Recorder only E	[XX]	Electrical, 24 h rotation. 120 V, 60 Hz
Recorder only M	[ ]	Mechanical, 24 h rotation and wind
Indicator only N	[ ]	Sector scale
Indicator only K	[ ]	Concentric scale

PENS or POINTERS:

1	[XX]	One pen	[XX] (Recorder)	One pointer	[ ] (Indicator)
2	[ ]	Two pens	[ ] (Recorder)	Two pointers	[ ] (Indicator)
3	[ ]	Three pens (Recorder)			
4	[ ]	Four pens (Recorder)			

PEN TYPE or SCALE:

Recorder only V	[XX]	V-Type pen
Recorder only B	[ ]	Box-Type pen
Indicator only S	[ ]	Single Range Scale
Indicator only D	[ ]	Dual Range Scale

ELEMENT: ([ ] See Element Work Sheet attached)

Features Continued on Sheet _____

OPTIONAL FEATURES:

(x) Element PC to receive 3-15 psi pneumatic signal
24 MB integrator and totalizer

[XX] **SUPPLIES:**

(x) 4 box(es) HUMITEX charts, No. _____, packaged
100 per box [ ] per instrument

(x) _____ [ ] ounce [ ] mL ink [ ] per pen

( ) _____

Comp Total

SERIAL NO.	CUST. ITEM	TAG	MEASUREMENT RANGE	CHART/SCALE
	2	FIQR-7 Raw Water Flow	3-15 psi	0-6000 GPM

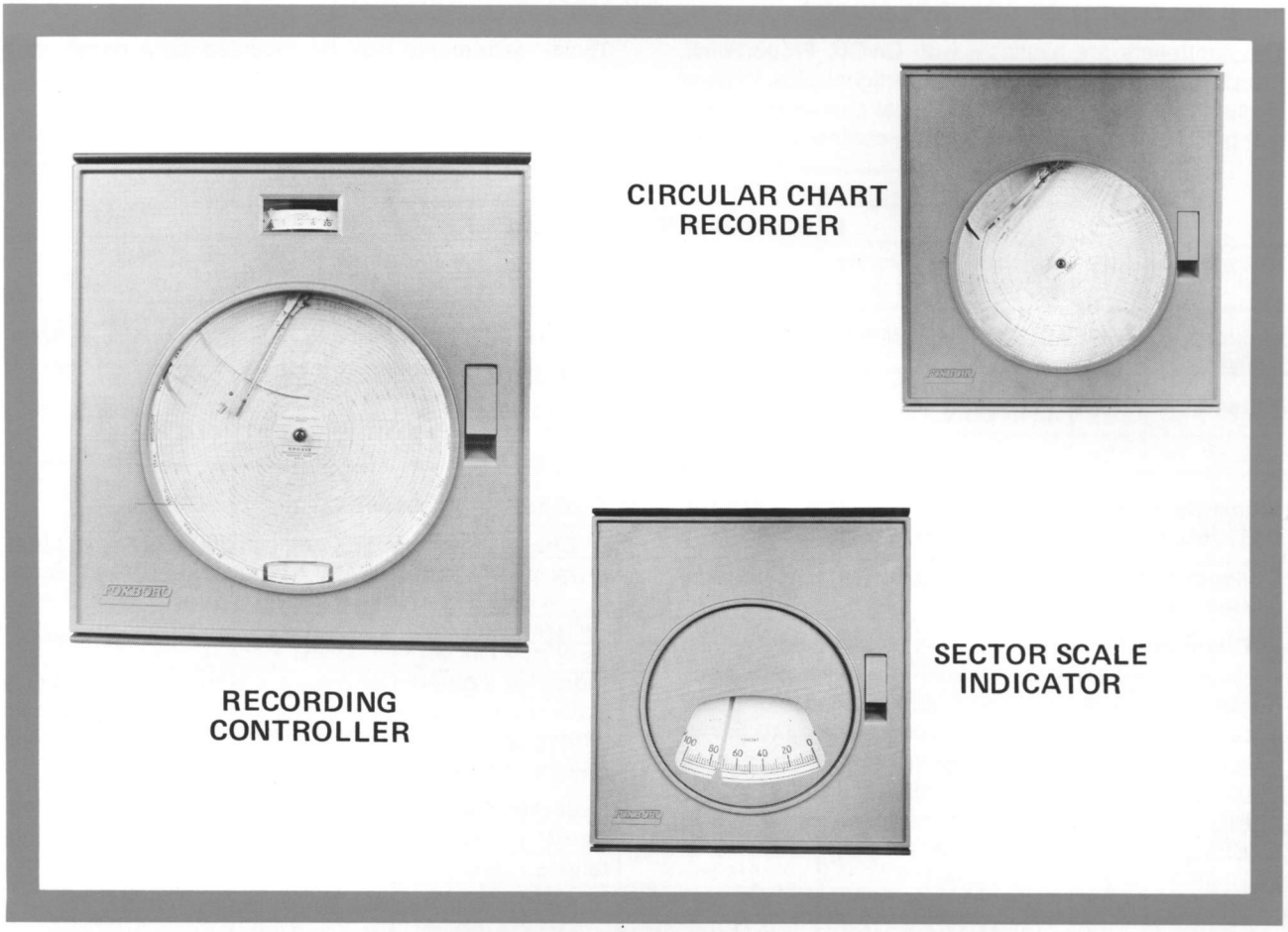
Product Specifications Sheet: 40P (fill in suffix) . . . . . PSS 3-1A2 __
Pressure = A Electronic = D
Temperature = B Electronic Servo = E
Flow = C
40M . . . . . PSS 3-1A1 A

® Registered Trademark

Printed in U.S.A. **WS 3-1, No. 1A** FOXBORO®

Effective January 1, 1981
Supersedes June 1, 1977

PRICE EACH



40P SERIES PRESSURE RECORDERS, INDICATORS, AND RECORDING OR INDICATING CONTROLLERS

These instruments are used wherever precise chart records, indication, or control of pressure measurement is required for efficient process management.

All of these instruments either record on a circular chart or indicate on a sector scale or a concentric scale. The recorders and sector scale indicators are available with up to four pens and two pointers, respectively. One pointer only is available for concentric scale indicators.

The controllers control one or two measurements and either record or indicate the variable. The control elements transmit a standard pneumatic signal to a final operator that may be as far as one hundred metres (three hundred feet) distant.

WIDE VARIETY OF RANGES

Metal diaphragm bellows or spiral or helical bourdon tube measuring elements are available for operation from full vacuum up to 210 MPa (30 000 psi, or 2100 bar or kg/cm²). Spans may be as narrow as 2 kPa (8 inH_20, or 20 mbar or g/cm²), and elevated-zero (compound) or suppressed-zero ranges are also available. These elements can be selected from a variety of materials to suit many process requirements.

WEATHERPROOF CONSTRUCTION

A glass fiber reinforced case and gasketed door with a shatterproof glass window provide the environmental protection of IEC IP53 and NEMA Type 3.

FOXBORO®

WIDE SELECTION OF CONTROL MODES

The controllers are available with On-Off, Proportional, Proportional plus Derivative, Proportional plus Integral (Reset) (STABILOG), and Proportional plus Integral (Reset) plus Derivative (HYPER-RESET) control functions.

VERSATILE MOUNTING

These instruments may be mounted on a panel, on a wall, or on a vertical pipe.

PERFORMANCE SPECIFICATIONS

(Under Reference Operating Conditions)

Accuracy (See **MEASURING ELEMENT SPECIFICATIONS)**

Repeatability 0.25% of span

Dead Band (Recorders and Indicators) 0.20% of span

Dead Band (Controllers) 0.1% of span

FUNCTIONAL SPECIFICATIONS

Elements Refer to **MEASURING ELEMENT SPECIFICATIONS** for types, materials, and ranges.

Connections All connections are located in the bottom of the case.

Elements For upper range values up to 14 MPa (2000 psi, or 140 bar or kg/cm²) the connections are tapped for R1/4 or 1/4 NPT, as specified. For upper range values from 14 MPa (2000 psi, or 140 bar or kg/cm²) up to 70 MPa (10 000 psi, or 700 bar or kg/cm²) the connections are threaded for R1/2 or 1/2 NPT, as specified. For upper range values above 70 MPa (10 000 psi, or 700 bar or kg/cm²) a 9/16-18 Aminco fitting is used.

Electrical A nominal 22 mm (0.9 in) diameter hole is provided for a nominal 20 mm (CEE 23), PG16, or 1/2 in conduit fitting.

Pneumatic The supply and output connections for the controllers are tapped for 1/4 NPT.

Mounting Standard mounting is flush in a panel up to 16 mm (0.6 in) thick or on a wall. (Wall mounting is not available for units fitted with heavy duty helical elements). A kit of parts for vertical mounting on a nominal 50 mm (2 in) pipe is available as an option.

Ambient Temperature Limits −30 and +60°C (−20 and +140°F).

Recorder Chart Drives

Electrical The standard speed is one revolution per 24 hours for nominal 120 V or 240 V, 50 or 60 Hz, as specified.

Mechanical The standard speed is one revolution per 24 hours with a 24 hour movement.

Recorder Pens Box-type or V-type, as specified. Box-type only for three- and four-pen recorders.

Expendable Accessories

Charts 100 HUMITEX nominal 300 mm (12 in) circular charts [nominal 100 mm (4 in) calibrated scale] are supplied with each instrument.

Ink 30 cm³ (1 U.S. fl oz) is supplied for each pen.

Indicator Pointer Concentric scale indicators have a black pointer and single sector scale indicators have an orange pointer. Dual sector scale indicators have one orange and one black pointer.

Indicator Scales Black markings on white background. Refer to Chart and Dial Catalog 600 for available ranges.

Sector The effective length is 175 mm (6.8 in).

Concentric The effective length is 595 mm (23.4 in).

Blow-out Plug Located in the bottom of the case.

Cardboard Nameplate A cardboard nameplate is supplied for displaying the chart factor.

Controllers Only

Controller Action The output signal either increases or decreases with increasing measurement, as specified. The action is reversible in the field.

Supply Pressure 140 kPa (20 psi, or 1.4 bar or kg/cm²).

Output Signal 20 to 100 kPa, 3 to 15 psi, or 0.2 to 1.0 bar or kg/cm², as specified.

Air Consumption (under Normal Operation) 0.5 m³/h at standard conditions (0.3 scfm).

Dual Indicating Gauge Visible through a window near the top of the door. The output signal is indicated on the upper scale and the supply pressure on the lower scale. Both are expressed in kPa, psi, bar, or kg/cm², as specified.

Index Pointer The setting index in sector scale indicating controllers has a bright orange tip. The setting index in recording controllers is silver color.

MEASURING ELEMENT SPECIFICATIONS (a)

Type	Material	Spans Available Between			Performance (b)		
		kPa or MPa	bar or kg/cm²	Other	Accuracy	Hysteresis	Linearity
Nominal 50 mm (2 in) Diaphragm	Cu-Ni-Mn Alloy	10 and 35 kPa vac or 10 and 70 kPa	0.1 and 0.35 vac or 0.1 and 0.7	40 and 140 inH_2O vac or 40 inH_2O and 10 psi	±0.3	—	±0.5
Nominal 75 mm (3 in) Diaphragm	Cu-Ni-Mn Alloy	2.5 and 10 kPa	0.025 and 0.10	10 and 40 inH_2O	±0.3	—	±0.75
Bellows	Brass	34 and 100 kPa vac or 25 and 170 kPa	0.34 and 1.00 vac or 0.25 and 1.7	10 and 30 inHg vac or 100 inH_2O and 25 psi	±0.5	—	±0.75
	316 ss	31 and 200 kPa	0.31 and 2	4.5 and 29 psi	±0.5	—	±0.75
Receiver-Bellows	Brass	20 and 100 kPa	0.2 and 1	3 and 15 psi	±0.4	±0.15	±0.5
		20 and 120 kPa	0.2 and 1.2	3 and 18 psi			
		20 and 190 kPa	0.2 and 1.9	3 and 27 psi			
Spiral	Bronze, Be-Cu, Ni-Span C	90 and 1400 kPa	0.9 and 14	13 and 200 psi	±0.25	±0.25	±0.5
	316 ss	100 and 1400 kPa	1 and 14	15 and 200 psi			
	K-Monel	100 and 1400 kPa	1 and 14	15 and 200 psi			
Double Spiral	Bronze	70 and 350 kPa	0.7 and 3.5	10 and 50 psi	±0.25	±0.25	±0.25
Helical	Bronze	1400 and 2700 kPa	14 and 27	200 and 400 psi	±0.25	±0.2	±0.5
	Be-Cu, 316 ss, Ni-Span C	1.4 and 21 MPa	14 and 210	200 and 3000 psi	±0.25	±0.2	±0.5
		21 and 42 MPa	210 and 420	3000 and 6000 psi	±0.4	±0.3	±0.75
	K-Monel	1.7 and 14 MPa	17 and 140	250 and 2000 psi	±0.25	±0.2	±0.5
Heavy-Duty Helical (c)	316 ss	0.5 and 21 MPa	5 and 210	75 and 3000 psi	±0.25	±0.2	±0.5
		21 and 42 MPa	210 and 420	3000 and 6000 psi	±0.4	±0.3	±0.75
		42 and 210 MPa	420 and 2100	6000 and 30 000 psi	±0.5	±0.5	±1.0
Absolute Bellows	316 ss	17 and 240 kPa abs	0.17 and 2.4 abs	125 mmHg and 35 psia	—	—	±0.5
Absolute Double Spiral	316 ss	140 and 700 kPa abs	1.4 and 7 abs	20 and 100 psia	—	—	±0.5

(a) For recorder, sector scale indicator, and controller.
(b) Performance specifications are in percent of span.
(c) This element extends through the back of the case.

PHYSICAL SPECIFICATIONS

Enclosure The case and door are glass fiber reinforced polyester moldings, compounded for superior corrosion resistance. The door has a shatterproof glass window. The overall construction provides the environmental protection of IEC IP53 and NEMA Type 3.

Flammability Rating The case and door meet Type V-0 of UL 94.*

Finish

Case Grey

Door Blue textured

Approximate Mass

Recorders and Indicators 11 kg (24 lb)

Controllers 13 kg (28 lb)

*Underwriters Laboratory Incorporated Standard for Test Flammability of Plastic Materials, UL 94.

OPTIONAL FEATURES

Flush Door Lock with 2 keys

Inlet Purge Restrictor Connection tapped for 1/4 NPT fittings.

Alternative Color Any standard Foxboro color per GS 5-1D1 A or color reference provided by the user. Textured finish only.

Nameplate Laminated plastic nameplates 38 x 76 mm (1.5 x 3 in) with white characters on a black background. Maximum of 5 lines with 28 characters or spaces 3 mm (0.13 in) high or 24 characters or spaces 4 mm (0.16 in) high per line.

Internal Illumination An incandescent lamp is available for operation from a nominal 120 or 240 V ac power source, as specified.

Pipe Mounting A bracket is available for mounting on a nominal 50 mm (2 in) vertical pipe.

Type 70 Electric Contacts A variety of contact systems is available to provide a wide range of switching functions to actuate external control or alarm circuits. Refer to TI 33-10a.

Recorder Chart Drives

Pneumatic, Single Speed One revolution in 24 hours.

Electrical, Single Speed One revolution in 30 seconds; 1, 2, 4, 6, 7.5, 12, 15, 24, 30, or 96 minutes; 1, 2, 3, 4, 6, 8, or 12 hours; or 2, 3, 4, or 7 days.

Electrical, Two Speed Any combination of two of the following speeds: One revolution in 30 seconds; 1, 4, 5, 6, 12, 24, or 30 minutes; 1, 2, 4, 8, 12, or 24 hours; or 2, 3, or 7 days.

Mechanical, Single Speed One revolution in 8 or 12 hours with 24 hour movement; 24 or 48 hours with 7 day movement; or 8 days with 8 day movement.

Mechanical, Two Speed One revolution in 7 days/24 hours with 7 day movement; or 8 days/24 hours with 8 day movement.

Pens Front loading capillary type with 3 cm^3 (0.1 U.S. fl oz) capacity disposable cartridge, or V-type fine line for a recorded line 0.25 mm (0.010 in) wide.

Overrange Protection Overrange protection against damage to the instrument linkage, pens, or pointers is a standard feature for diaphragm bellows and absolute bellows, but is available as an optional feature for spiral, double-spiral, helical, and heavy duty helical elements.

Preparation for Special Service The elements are cleaned, assembled, calibrated, and packaged in a Class 10 000 clean room which meets both mandatory and non-mandatory requirements established by U.S. Federal Standard 209a, or using acceptable alternative facilities following procedures established to meet strict user requirements for each specific type of service.

For oxygen service, this preparation is available for AISI Type 316 stainless steel (316 ss) spiral and helical elements only. Copper bearing alloys, used to braze the cleanout tube to the tip of stainless steel spirals, are in contact with the process.

For nuclear service, only stainless steel helical elements are used.

Pressure Seals A range of pressure seals in a variety of materials of construction are available for use with 316 ss spiral and helical elements. Refer to GS 3-2C1 A, 3-2C1 B, 3-2C2 A, and 3-2C2 C.

40P Series Controllers Only

Transfer Switch and Supply Regulator Arrangements Four basic arrangements are available: internal supply regulator only; two-position nozzle seal switch only; internal supply regulator with two-position nozzle seal switch; and internal subpanel with an output regulator and a balance indicator and two position A/M switch.

External Manual Set Knob A knob which engages with the set-point adjustment mechanism is fitted on the door.

External Connection to Integral (Reset) Bellows Used when an external feedback signal must be applied to prevent integral "windup".

"Batch" Function Attachment For processes involving discontinuous control, the integral function is modified to prevent overshoot and to initiate immediate corrective action when control is resumed.

Pneumaticset Attachment Enables the set point to be positioned pneumatically. Available over the full span or part of the span.

Ratio Attachment Provides manual means for setting the ratio between an uncontrolled variable (primary) and a controlled variable (secondary). The ratio is adjustable between 0.5:1 and 1.7:1 for square root scales, or between 0.3:1 and 3:1 for uniform scales.

Relation Attachment Maintains a fixed manually adjustable difference between an uncontrolled variable (primary) and a controlled variable (secondary). The relation is adjustable between 0 and ±50% of span.

MODEL CODES

Recorders and Indicators

40P = Rectangular Polyester Case

Function:
R = Circular Chart Recorder
N = Eccentric Scale Indicator
K = Concentric Scale Indicator

Internal Mechanism:
-R = Standard Recorder (40PR)
-N = Standard Eccentric Scale Indicator (40PN)
-K = Standard Concentric Scale Indicator (40PK)
-E = Recorder or Indicator with Type 70 Contacts

Mounting:
F = Flush
P = Pipe
S = Surface

Scale or Chart Drive:
M = Mechanical Chart Drive
E = Electric Chart Drive, 24 hour rotation, 120 V ac, 60 Hz (40PR)
N = Eccentric Scale (40PN)
K = Concentric Scale (40PK)

Pens or Pointers:
1 = One pen (40PR) or one pointer (40PN or 40PK)
2 = Two pens (40PR) or two pointers (40PN only)
3 = Three pens (40PR)
4 = Four pens (40PR)

Pen or Scale Type:
V = V-Type Pen (40PR with one or two pens only)
B = Box-Type Pen (40PR with one to four pens)
S = Single Scale (40PN or 40PK)
D = Dual Scale (40PN only)
X = Pen Type per AS Reference

	Element
/PA-CA	= Absolute pressure bellows
/PC	= Receiver
/PA-MA	= Absolute pressure double spiral
/PB-MC	= Double spiral
/PB-AA,AB,AC,AE	= Pressure helical
/PB-BA,BB,BC,BE	= Pressure spiral
/PB-CA, CC	= Pressure bellows
/PB-DF, PF	= Diaphragm
/PB-GA	= Stainless long helical

MODEL CODES
(Continued)

Single Action Controller

40P = Rectangular Polyester Case

Function:
- R = Recording
- N = Indicating with eccentric scale

Action:
- -A = Single (Control unit actuated by the first listed element)

Control:
- 1 = On-Off
- 2 = Full Proportional
- 3 = Full Proportional plus Derivative
- 4 = Full Proportional plus Integral (Reset)
- 5 = Full Proportional plus Integral (Reset) plus Derivative
- 6 = Narrow Band Proportional

Internal Relays:
- J = W/o internal regulator, w/o transfer switch (A1 only)
- K = Internal regulator, w/o transfer switch (A1 only)
- L = Two-position nozzle seal switch (A2, A3, A4, A5, and A6)
- M = Two-position nozzle seal switch plus internal regulator (A2, A3, A4, A5, and A6)
- N = Balanceable automatic/manual unit - right (A2, A3, A4, A5, and A6)
- P = Balanceable automatic/manual unit - left (A2, A3, A4, A5, and A6)

Output Signal and Gauge:
- 2 = 3 to 15 psi signal, 22 psi gauge
- 4 = 0.2 to 1.0 kg/cm² signal, 1.5 kg/cm² gauge
- 5 = 20 to 100 kPa signal, 150 kPa gauge
- 6 = 0.2 to 1.0 bar signal, 1.5 bar gauge

Mounting:
- -F = Flush
- -P = Pipe
- -S = Surface

Chart Drive or Scale:
- M = Mechanical Chart Drive
- E = Electrical, 24 hour rotation, 120 V ac, 60 Hz (40PR)
- X = Optional Chart Drive (40PR)
- N = Eccentric Scale (40PN)

Pens or Pointers:
- 1 = One pen (40PR) or one pointer (40PN)
- 2 = Two pens (40PR) or two pointers (40PN)
- 3 = Three pens (40PR only)

Pen or Scale Type:
- V = V-Type Pen (40PR with one or two pens only)
- B = Box-Type Pen (40PR with one to three pens)
- S = Single Scale (40PN)
- D = Double Scale (40PN)
- X = Pen Type per AS Reference

Element	
/PA-CA	= Absolute pressure bellows
/PC	= Receiver
/PA-MA	= Absolute pressure double spiral
/PB-MC	= Double spiral
/PB-AA,AB,AC,AE	= Pressure helical
/PB-BA,BB,BC,BE	= Pressure spiral
/PB-CA,CC	= Pressure bellows
/PB-DF,PF	= Diaphragm
/PB-GA	= Stainless long helical

MODEL CODES
(Continued)

Duplex, Dual, and Auto-Selector Controller

40P = Rectangular Polyester Case

Function:
R = Recording
N = Indicating with eccentric scale

Action:
-B = Duplex (one element actuates one measurement pen or pointer and two control units)
-C = Dual (two elements each actuate one pen or pointer and one control unit)
-H = Auto-Selector

1st Control (Right Hand):
1 = On-Off
2 = Full Proportional
3 = Full Proportional plus Derivative (-C, -H only)
4 = Full Proportional plus Integral (Reset) (-C, -H only)
5 = Full Proportional plus Integral (Reset) plus Derivative (-C, -H only)
6 = Narrow Band Proportional

2nd Control (Left Hand):
1 = On-Off
2 = Full Proportional
3 = Full Proportional plus Derivative (-C, -H only)
4 = Full Proportional plus Integral (Reset) (-C, -H only)
5 = Full Proportional plus Integral (Reset) plus Derivative (-C, -H only)
6 = Narrow Band Proportional

Internal Relays (1st Control - Right Hand):
J = W/o internal regulator, w/o transfer switch (1 only)
K = Internal regulator, w/o transfer switch (1 only)
L = Two-position nozzle seal switch (2, 3, 4, 5, and 6)
M = Two-position nozzle seal switch plus internal regulator (2, 3, 4, 5, and 6)
N = Balanceable automatic/manual unit (2, 3, 4, 5, and 6)

Internal Relay (2nd Control - Left Hand):
J = W/o internal regulator, w/o transfer switch (-B, -C) (1)
K = Internal regulator, w/o transfer switch (-B, -C) (1)
L = Two-position nozzle seal switch (-B, -C) (2, 3, 4, 5, and 6)
M = Two-position nozzle seal switch plus integral regulator (-B, -C) (2, 3, 4, 5, and 6)
N = Balanceable automatic/manual unit (-B, -C) (2, 3, 4, 5, and 6)
T = Auto-Selector (-H only)

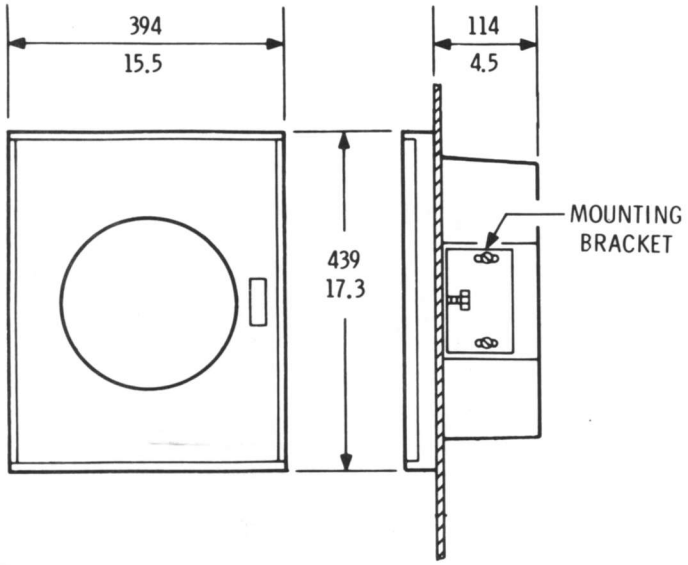
Output Signal and Gauge:
2 = 3 to 15 psi signal, 22 psi gauge
4 = 0.2 to 1.0 kg/cm² signal, 1.5 kg/cm² gauge
5 = 20 to 100 kPa signal, 150 kPa gauge
6 = 0.2 to 1.0 bar signal, 1.5 bar gauge

Mounting:
-F = Flush
-P = Pipe
-S = Surface

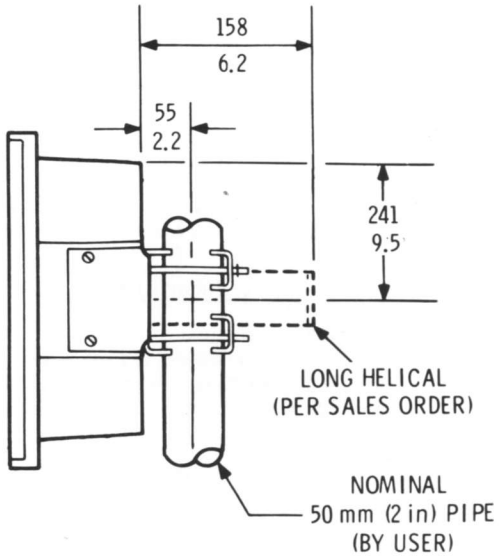
Chart Drive or Scale:
M = Mechanical Chart Drive
E = Electrical, 24 hour rotation, 120 V ac, 60 Hz (40PR)
X = Optional Chart Drive (40PR)
S = Single Scale (40PN)
D = Double Scale (40PN)

	Element
/PA-CA	= Absolute pressure bellows
/PC	= Receiver
/PA-MA	= Absolute pressure double spiral
/PB-MC	= Double spiral
/PB-AA,AB,AC,AE	= Pressure helical
/PB-BA,BB,BC,BE	= Pressure spiral
/PB-CA,CC	= Pressure bellows
/PB-DF,PF	= Diaphragm
/PB-GA	= Stainless long helical

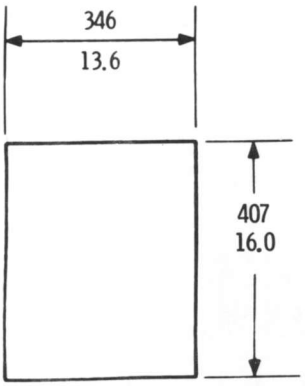
DIMENSIONS — NOMINAL



PANEL MOUNTING



PIPE MOUNTING



PANEL CUTOUT

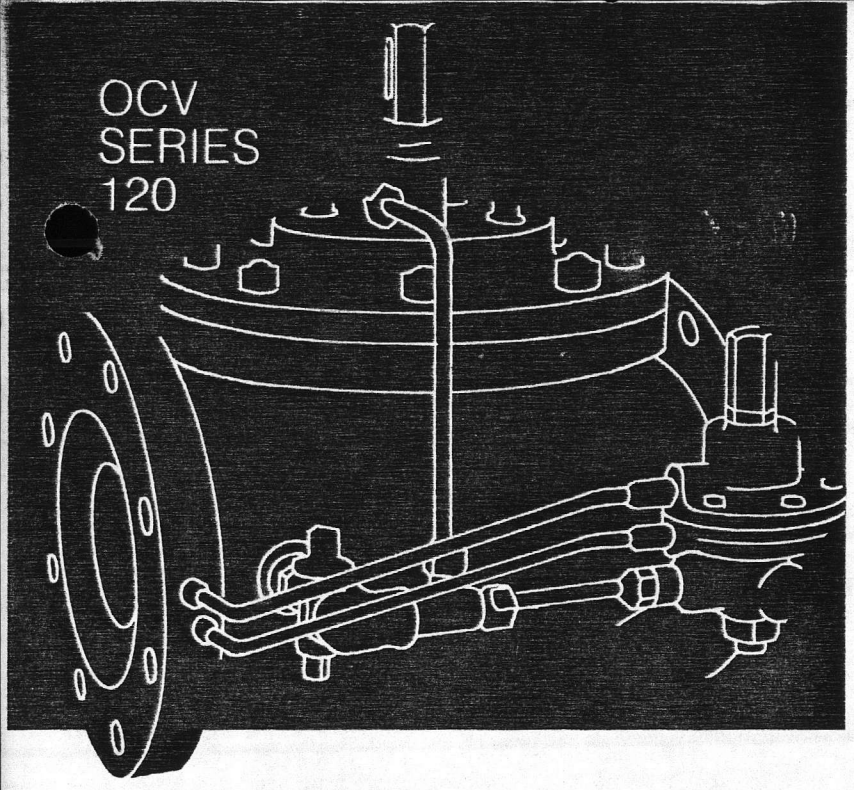
mm
in

NOTE

FOR HORIZONTAL MULTIPLE PANEL MOUNTING, A MINIMUM DISTANCE OF 445 mm (17.5in) FROM CENTER LINE TO CENTER LINE IS REQUIRED.

ORDERING INSTRUCTIONS

1. **Model Number**
2. **Mounting**
3. **Element Type, Material, and Range**
4. **Measurement Range**
5. **Measurement Connection**
6. **Chart or Scale Range**
7. **For Recorder: Chart Drive and Pen Type**
8. **For Indicator: Select Sector or Concentric Scale**
9. **For Controller: Controller Action**
10. **For Controller: Supply Pressure and Output Signal**
11. **Optional Features**
12. **Tag and Application**



SPECSHEET 12079-1

RATE OF FLOW VALVES

general description (MODEL NO. 120-G STANDARD)

The OCV Series 120-G Rate of Flow Valve is a hydraulically operated, pilot controlled diaphragm type globe or angle valve with an integral orifice plate mounted on the inlet side. Actuated by the differential pressure across the plate, the valve maintains a constant, preset rate of flow regardless of pressure fluctuations on either the upstream or downstream side of the valve.

product features

- Compact design and mechanical simplicity of the basic valve and controls minimizes field maintenance. All field repairs can be made without removing main valve from the line.
- Double acting diaphragm type (normally open) pilot has adjustable spring for presetting desired rate of flow.
- No packing glands or lubrication required.
- Easily set to maintain maximum flow rate allowable.
- Single adjusting screw for rate of flow setting is protected by cap to discourage tampering.
- Soft seat construction assures drip-tight closure.

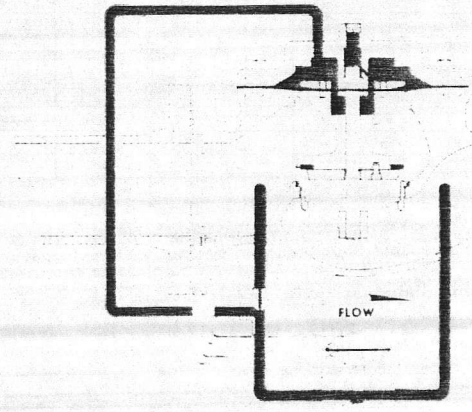
combinations available

120-G1 RATE OF FLOW/SOLENOID CONTROLLED-Operates identically to the Model 120-G but is additionally equipped with a solenoid on/off for remote control. Solenoids are available for normally open (de-energize to open) or normally closed (energize to open) and may be interlocked with such triggering devices as clocks, timers, relays, probes, pressure or temperature sensors. (For more information ask for Specsheet 11574-1)

120-G2 RATE OF FLOW/PRESSURE REDUCING—With the addition of a pressure reducing pilot, the Model 120-G2 maintains a consistent delivery pressure as long as the flow rate is at or below set point. The valve prevents excessive flow yet maintains constant flow at the desired maximum rate.

ordering information needed

1. Size, figure number and description.
2. Pressure and flow rate setting when applicable.
3. Main valve material (iron, steel, etc.)
4. Type of end connections.
5. Fluid to be controlled.
6. Maximum working pressure and temperature.
7. Electrical characteristics when applicable.
8. Additional accessories desired (indicators, manual operators, etc.)
9. For special applications and for Class 250 lbs. C. I. and 300 lbs. ANSI Cast Steel, contact factory.



Model 120-G
Rate of
Flow Valve

OCV Rate of Flow Valves

specifications

SIZES
Globe - 1-¼" thru 3" Screwed Ends
2" thru 12" & 16" Flanged Ends
14" Consult Factory
Angle- 2" Screwed Ends
2" thru 8" Flanged Ends

END DETAIL
Flanged - Cast Iron 125 & 250 ANSI B16.1
Cast Steel 150 & 300 ANSI B16.5
Cast Bronze 150 & 300 ANSI B16.24
Cast Aluminum 150 ANSI B16.5

PRESSURE RATINGS
Cast Iron: 125 Class - 175 psi max.
250 Class - 400 psi max.
Cast Steel: 150 Class - 285 psi max.
300 Class - 740 psi max.
Cast Bronze: 150 Class - 225 psi max.
300 Class - 500 psi max.
Cast Aluminum: 150 Class - 285 psi max.
Note: Maximum differential pressure across diaphragm of basic valve & pilots is not to exceed 300 psi.

TEMPERATURE RATINGS

	Min.	Max.
Light petrol products	-40°F	+180°F
All water products	+32°F	+180°F

MATERIALS (Main Valve & Bonnet)
Cast Iron - ASTM A 126
Cast Steel - ASTM A 216-WCB
Cast Aluminum - 356-T6*
Cast Bronze - ASTM B61 or B62*
*Not carried in stock. Consult factory.

TRIM (Standard on all valves)
Stem or Shaft & Spring - Stainless Steel
Spool, Seat (disc) Retainer, Diaphragm Plate - Ductile or Bronze*
Seat (ring) & Upper Stem Bushing - Bronze
•Diaphragms - Buna-N , Nylon reinforced
"O" Rings - Buna-N
* 2" & smaller only.

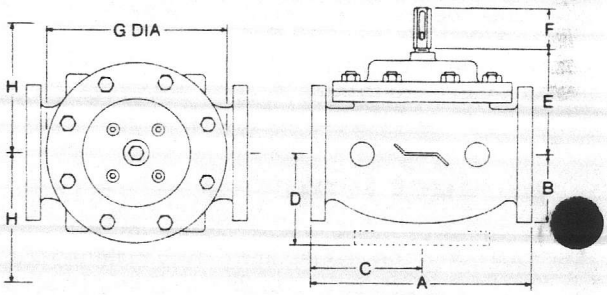
VALVE CONTROL PILOTS
Standard Bronze or Stainless Steel with Stainless Steel and Buna-N internal parts. Pilots can be supplied in Aluminum and with Viton elastomers.

OTHER MATERIALS
Stainless Steel seats* and Viton elastomers available on customer specification.
*Glass filled Teflon bushings supplied.

Note: Vendor supplied accessories will be in accordance with suppliers' specifications and will be so shown in the installation and operation manual supplied

dimensions

Dimension	ANSI/PSI	Valve Size 2"†	3"††	4"	6"	8"	10"	12"	14"	16"
A	125/150	9⅜"	10½"	13½"	17¾"	21⅜"	26½"	34"	39"	40⅜"
	250/300	9⅞"	11¼"	14⅛"	18⅝"	22⅜"	27⅞"	35½"	40½"	42"
B	125/150	3"	3¾"	4½"	5½"	6¾"	8"	9½"	10⅝"	11¾"
	250/300	3¼"	4¼"	5"	6¼"	7½"	8¾"	10¼"	11½"	12¾"
C	125/150	4¾"	6"	7½"	10"	12¾"				
	250/300	4⅞"	6⅜"	7 13/16"	10½"	13¼"				
D	125/150	3⅞"	4"	4 15/16"	6"	8"				
	250/300	4"	4⅝"	5¼"	6½"	8½"				
E**	ALL	6"	7"	8"	10"	11"	14"	17"	18"	19"
F	ALL	1⅛"	1 1/16"	1 1/16"	1⅞"	2 3/16"	2 3/16"	3¾"	3¾"	3¾"
G	ALL	6¾"	7 11/16"	10"	12½"	17¾"	21⅝"	28"	31¼"	34½"
H**	ALL	11"	11"	12"	13"	14"	17"	18"	20"	20"



**Allow for clearance

NOTE: †Applies also to 1¼, 1½ and 2" screwed end valves.
††Applies also to 2½ and 3" screwed end valves.

flow chart — basic valve

Flow of Water — Gallons Per Minute — Thru Globe Type Valve*

Valve Size	Cv Factor	10	15	20	30	40	50	60	80	100	150	200	300	400	600	800	1,000	2,000	3,000	4,000	6,000	8,000	10,000
2"	47		.1	.18	.4	.7	1.1	1.6	2.8	4.5	9.8	18											
3"	96				.1	.18	.27	.4	.7	1.2	2.5	4.2	10	17.3									
4"	200						.1	.1	.16	.25	.56	1.0	2.2	4.0	9.0								
6"	450									.1	.1	.19	.44	.8	1.8	3.1	5.0	19.8					
8"	760										.1	.1	.15	.27	.62	1.1	1.7	7.0	15.5				
10"	1,100												.13	.2	.3	.52	.82	3.3	7.4	13.2			
12"	1,700														.13	.23	.35	1.4	3.1	5.5	12.5		
14"	2,151															.14	.22	.85	1.9	3.5	7.8	13.8	22.1
16"	2,850																.12	.49	1.2	2	4.5	7.9	12.3

*Table is supplied for information and guide for sizing only. Figures are based on fully open valve flowing water. Modulating valves (pressure regulating, throttling, etc.) rarely reach full open position. Flow rates and pressure drop may be interpolated in such instances.

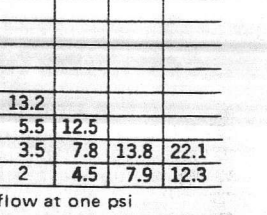
Cv Factor = Number of gallons of water that will flow at one psi pressure differential.

$$GPM = Cv \times \sqrt{\frac{\text{Pressure Loss thru valve}}{\text{Specific Gravity of fluid}}}$$

flow chart—ocv series 120

VALVE SIZE	2"	3"	4"	6"	8"	10"	12"	16"
MAX. FLOW	210	460	800	1,800	4,900	7,000	8,450	11,000
MIN. FLOW	50	115	200	450	1,250	1,750	2,150	2,750

The above figure should be used as a reference for sizing the control valve. For any orifice bore the valve flow rate can be adjusted over a 4:1 range. If other flow rates are desired consult factory.



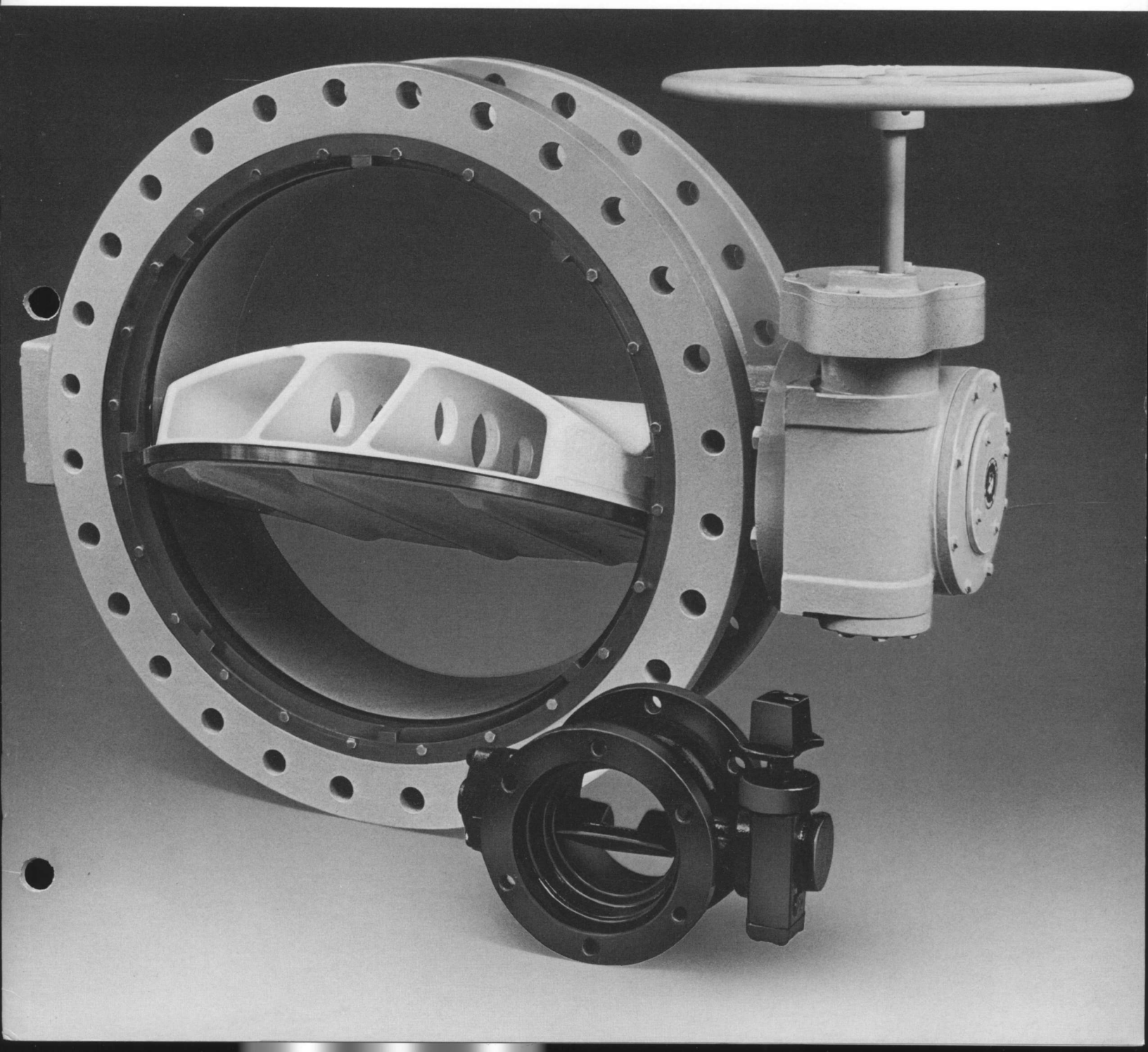
OCV Control Valves
7400 EAST 42 PLACE
TULSA, OKLAHOMA 74145
918 627-1942
TWX 910-845-2227

Printed in U.S.A.

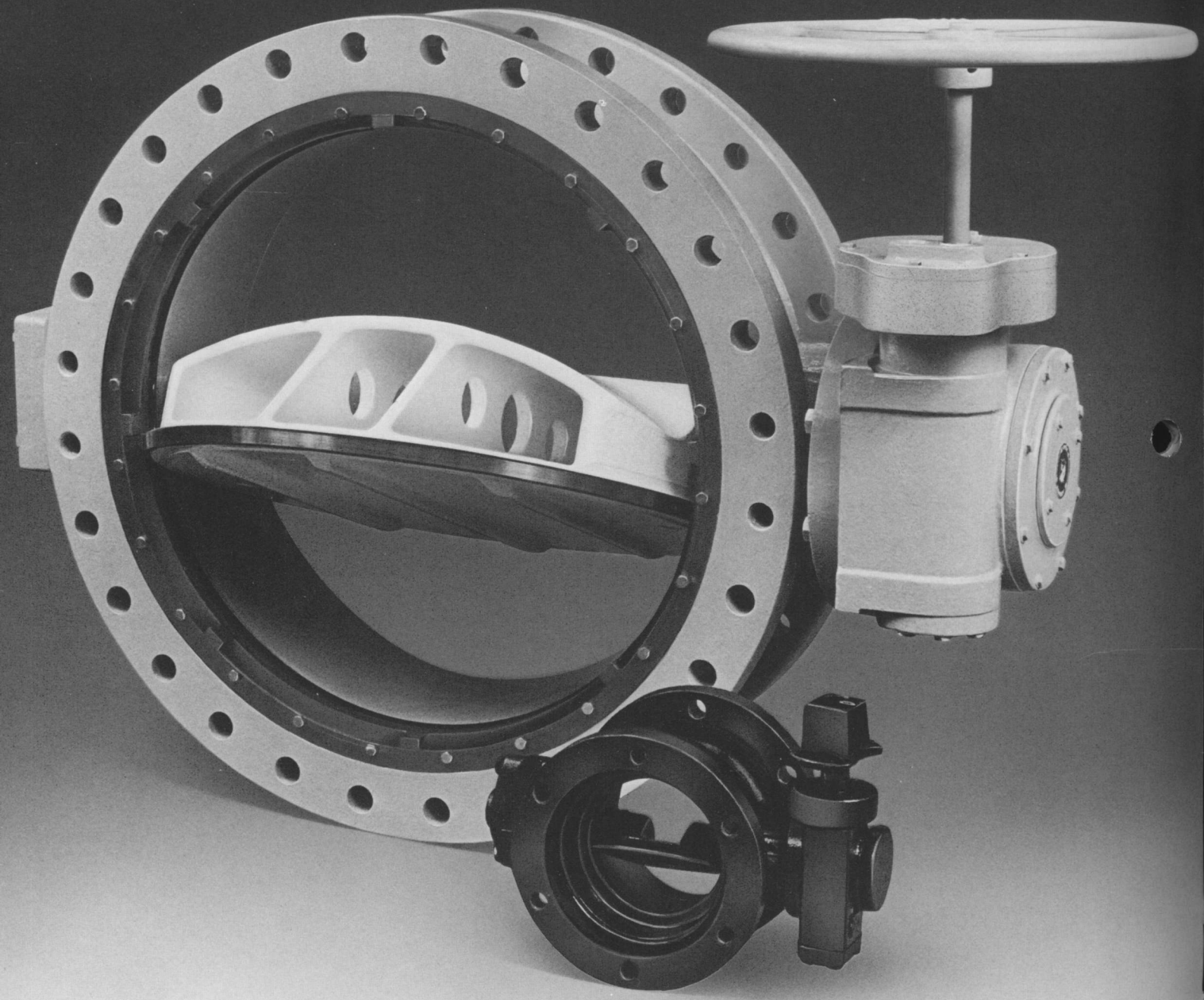
KENNEDY VALVE

4″ Thru 48″ ADAP-TORQ AWWA BUTTERFLY VALVES

CATALOG BFV-80



Index



The Butterfly Valve Story

Rubber-seated butterfly valves have been used successfully for approximately 35 years. The American Water Works Association's Standard for rubber-seated butterfly valves was first published in 1954 and accepted as Standard C-504 in 1958. The Standard has since been regularly reviewed and revised.

Butterfly valves, in accordance with A.W.W.A. C-504, provide the answer for precise flow control in a full range of water and wastewater applications from open-close, buried, distribution line service to a widely varying modulating service on filter influent and effluent.

A.W.W.A. butterfly valves provide bubble tight shutoff at rated pressure every time with frequent operation and with a minimum of input torque and retain these highly desirable features:

- Low cost
- Light weight
- Ease of automation
- Narrow face to face dimensions

Kennedy Valve's ADAP TORQ butterfly valves have been manufactured in strict accordance with the latest edition of A.W.W.A. C-504 and have been used successfully for over seven (7) years.

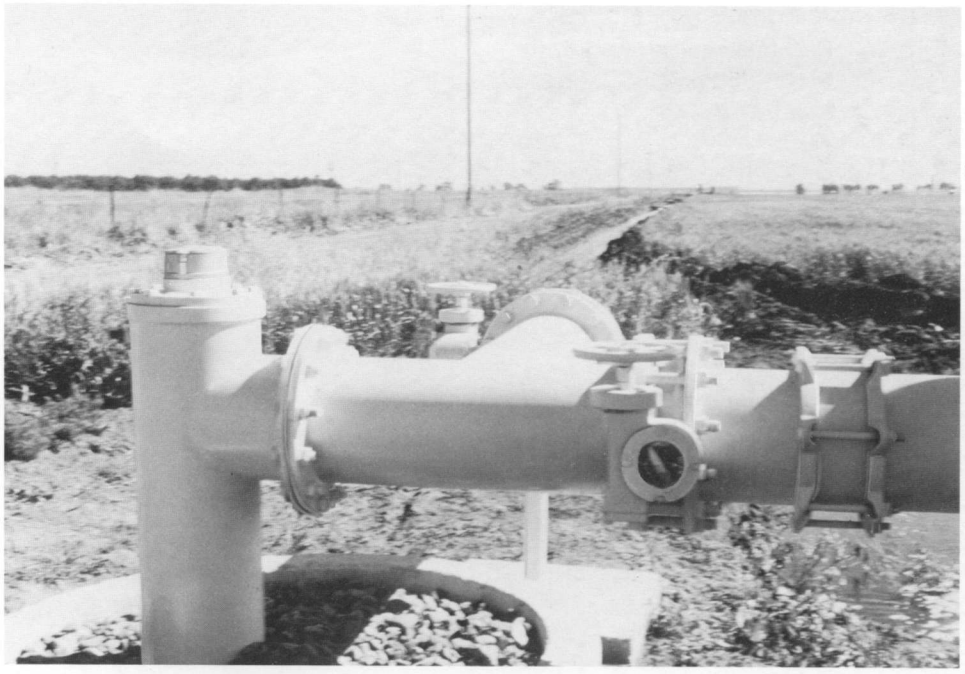
Kennedy achieves bubble tight shutoff with a Buna N seat in the body and type 304 stainless steel ring on the disc.

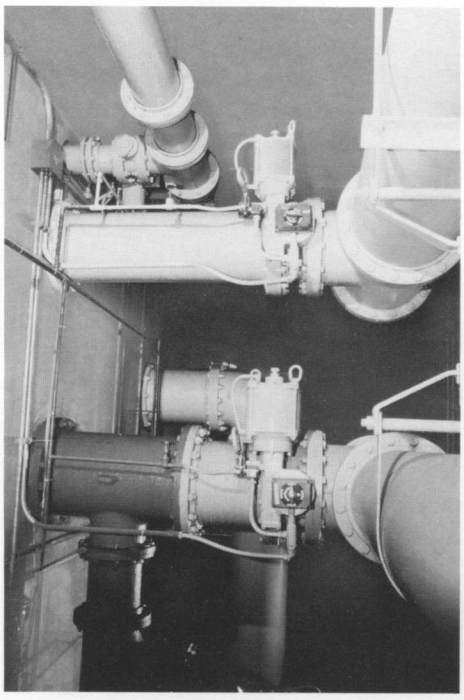
All Kennedy Valve butterfly valves are rated at 150 PSI and operate within the maximum input torque called out by C-504. This ease of operation is accomplished with rack and pinion actuator on 4″ - 24″ valves and a worm gear actuator on 30″ - 48″. The actuators are designed for and have proven themselves in both open-close and modulating service — totally play free and able to hold the disc in any position at full flow conditions without fluttering.

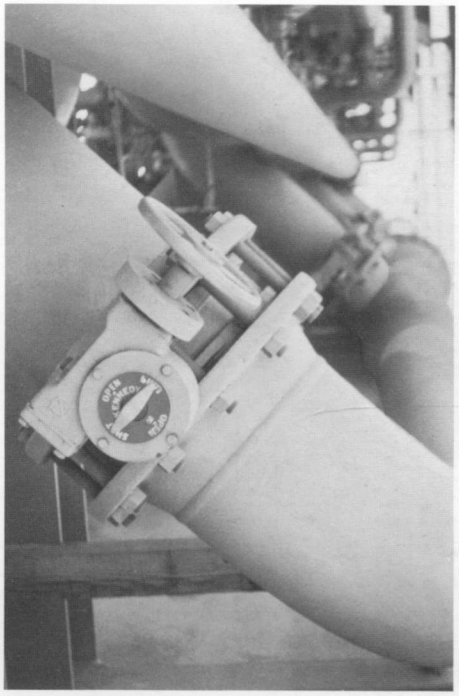
Kennedy Valve supplies a full range of power operated butterfly valves and accessories to meet all water/ wastewater flow control conditions.

This along with the following products gives Kennedy the capability to meet all of your valve requirements:

- A.W.W.A double disc gate valves
- A.W.W.A. swing check valves
- Knife Gate Valves
- Backflow Prevention Devices
- A.W.W.A. Fire Hydrants
- A full line of UL/FM Products
- Tapping sleeves and valves





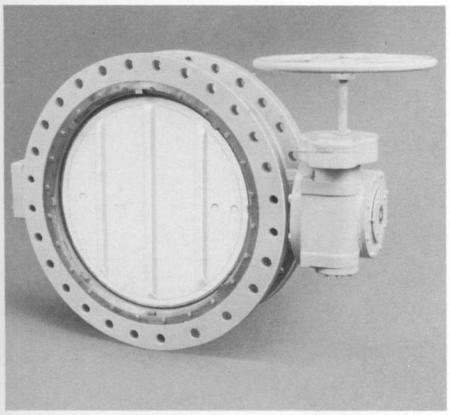


4″ Thru 48″ ADAP-TORQ AWWA Butterfly Valves

Mechanical Features

Size & Body End Configurations

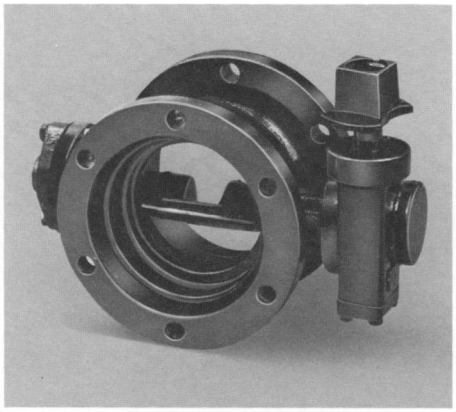
4″ to 48″ Flanged × Flanged ends
6″ to 36″ Mechanical Joint × Mechanical Joint
4″ to 20″ Wafer Body
4″ to 12″ Asbestos Cement × Asbestos Cement
6″ & 8″ Flanged × Mechanical Joint
6″ & 8″ Flanged × Asbestos Cement



Seats

Buna N
4″-24″ epoxy bonded in the body
30″ - 48″ mechanically retained and adjustable

Offers uninterrupted 360° Seating Seat is not penetrated by the shaft



Disc

Ductile iron ASTM A536 Grade 65-45-12

4″ - 24″ — smallest profile possible consistent with the structural requirements of the pressure class.

30″ - 48″ — flow through disc — large waterway opening, low pressure drop, meets structural requirements

18 - 8 Type 304 stainless steel seating edge

Valve Shafts

18 - 8 Type 304 stainless steel stub shafts for strength and excellent flow characteristics

18 - 8 Type 304 stainless steel pins for play free disc to shaft connection.

Pins mechanically held on 4″-24″ valves.

Pins retained by bolts on 30″ - 48″ valves

Seals

Fail safe double O ring retained in an easily removable Delrin® cartridge.

Actuators

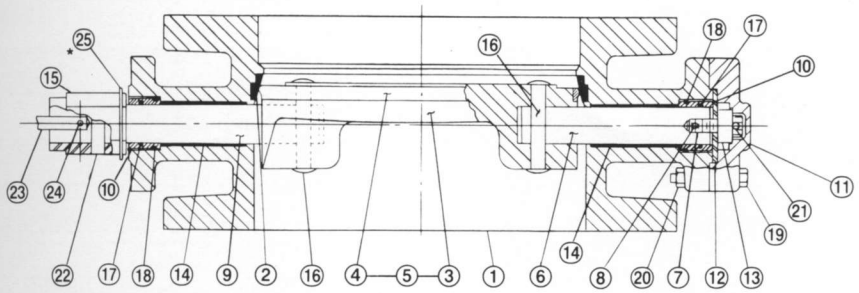
Manual
- Buried or in plant
- Nut, handwheel, chainwheel
- In strict accordance with the requirements of A.W.W.A. C-504-80

Electric

Cylinder
- Hydraulic
- Pneumatic

4″ Thru 24″ Parts and Materials Information

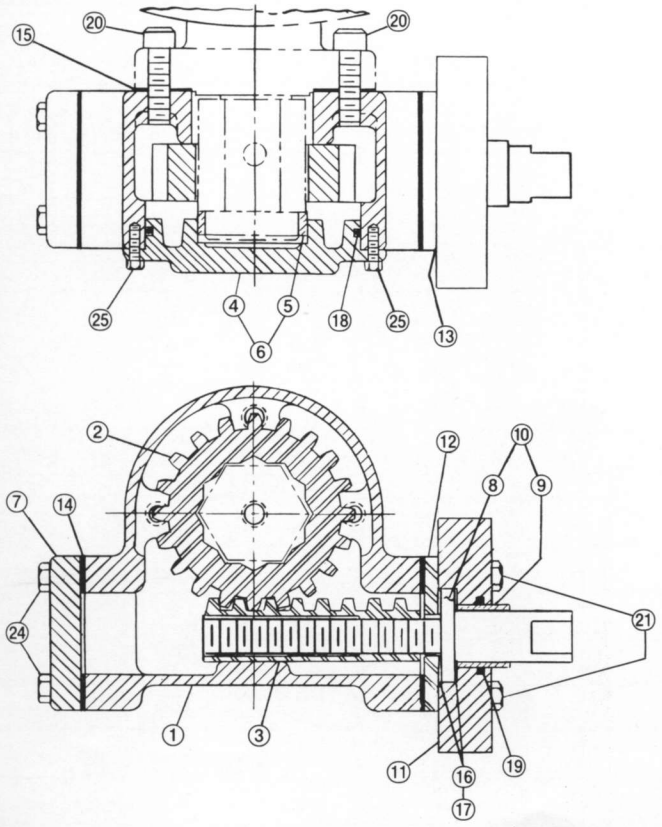
Cross Sectional Assembly of Valve



*NOTE: USED ON 4″, 6″ & 8″ VALVES ONLY

Standard Materials of Construction
BODIES — High strength cast iron ASTM A126 Class B
DISCS — Ductile iron ASTM A536 Grade 65-45-12
DISC EDGE — 18-8 Type 304 stainless steel
VALVE SHAFTS — 18-8 Type 304 stainless steel
BEARINGS — Molybdenum disulphide filled nylon
SEAL CARTRIDGES — Delrin® Cartridge with o-rings
SEATS — Synthetic rubber (Buna N)

Cross Sectional Assembly of Actuator



NOTE — Handwheel and 2″ AWWA nut actuators have same materials of construction

Sizes, Gear Ratio and Turns to Open

Actuator Size	Will Operate Valve Sizes	Gear Ratio	Turns to Open
1	4″, 6″ & 8″	72:1	18
2	10″ & 12″	112:1	28
3	14″, 16″ & 18″	152:1	38
4	20″ & 24″	176:1	44

Parts Table for Valve

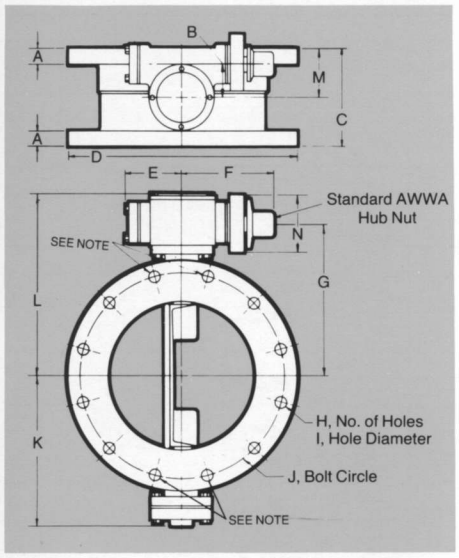
ITEM	DESCRIPTION	MATERIALS
1.	Body	Cast Iron
2.	Rubber Seat	Buna N
3.	Disc	Ductile Iron
4.	Disc Ring	Type 304 S.S.
5.	Disc & Ring Assembly	
6.	Lower Shaft	Type 304 S.S.
7.	Thrust Stud	Plated Steel
8.	Spirol Pin	Steel
9.	Upper Shaft	Type 304 S.S.
10.	Seal Cartridge	Delrin®
11.	Bottom Cover	Cast Iron
12.	Thrust Plate	Steel
13.	Thrust Nut	Bronze
14.	Bearing	Filled Nylon
15.	Hex Driver	C.R. Steel
16.	Pin	Type 304 S.S.
17.	O Ring	Buna N
18.	O Ring	Buna N
19.	Hex Hd. Cap Screw	Steel
20.	Hex Nut	Steel
21.	Spirol Pin	Steel
22.	Spirol Pin	Steel
23.	Indicator Stud	Type 304 S.S.
24.	Indicator Stud Pin	Type 304 S.S.
*25.	Snap Ring (4″, 6″ & 8″ Valves Only)	Steel

Parts Table for Actuator

ITEM	DESCRIPTION	MATERIALS
1.	Housing	Cast Iron
2.	Gear	Steel
3.	Rack	Ductile Iron
4.	Access Cover	Cast Iron
5.	Bushing	Bronze
6.	Access Cover & Bushing Assembly	
7.	End Plate	Cast Iron
8.	Drive Screw	Steel
9.	Sleeve	Bronze
10.	Drive Screw & Sleeve Assembly	
11.	Input Cover	Cast Iron
12.	Thrust Plate	Steel
13.	Shim	Victorite "B"
14.	Shim	Victorite "B"
15.	Housing Gasket	Victorite "B"
16.	Needle Bearing	Steel
17.	Races	Steel
18.	O Ring	Buna N
19.	O Ring	Buna N
20.	Cap Screw	Steel
21.	Cap Screw	Steel
24.	Cap Screw	R.P. Steel
25.	Cap Screw	R.P. Steel

4" Thru 24" Valve Dimensions

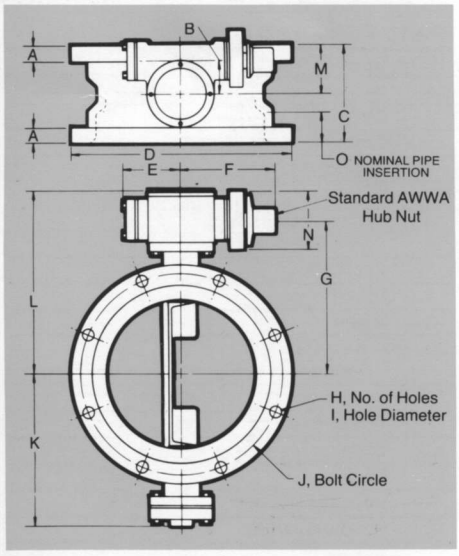
Flanged End Butterfly Valve with Nut Input Actuator



NOTE: 20" & 24" VALVES HAVE 4 TAPPED HOLES ON EACH FACE.
TAP, 20"-1⅛-7 UNC, 24"-1¼-7 UNC.

Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)
A	15/16 (24)	1 (25)	1 1/8 (28)	1 3/16 (30)	1 1/4 (32)	1 3/8 (35)	1 7/16 (36)	1 9/16 (40)	1 11/16 (43)	1 7/8 (48)
B	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	2 3/4 (70)	2 3/4 (70)	3 7/8 (98)	3 7/8 (98)	3 7/8 (98)	5 1/4 (133)	5 1/4 (133)
C	5 (127)	5 (127)	6 (152)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)
D	9 (229)	11 (279)	13 1/2 (343)	16 (406)	19 (483)	21 (533)	23 1/2 (597)	25 (635)	27 1/2 (698)	32 (813)
E	3 3/8 (86)	3 3/8 (86)	3 3/8 (86)	4 5/8 (117)	4 5/8 (117)	6 5/8 (168)	6 5/8 (168)	6 5/8 (168)	8 1/4 (210)	8 1/4 (210)
F	7 (178)	7 (178)	7 (178)	8 1/4 (210)	8 1/4 (210)	10 1/4 (261)	10 1/4 (261)	10 1/4 (261)	12 1/4 (312)	12 1/4 (312)
G	6 3/4 (171)	7 3/4 (197)	9 1/4 (235)	11 1/4 (286)	12 5/16 (313)	13 7/8 (352)	14 5/8 (371)	15 11/16 (398)	17 3/4 (451)	20 (509)
H	8	8	8	12	12	12	16	16	20	20
I	3/4 (19)	7/8 (22)	7/8 (22)	1 (25)	1 (25)	1 1/8 (28)	1 1/8 (28)	1 1/4 (32)	1 1/4 (32)	1 3/8 (35)
J	7 1/2 (190)	9 1/2 (241)	11 3/4 (298)	14 1/4 (362)	17 (432)	18 3/4 (476)	21 1/4 (540)	22 3/4 (578)	25 (635)	29 1/2 (749)
K	7 1/8 (181)	8 1/8 (206)	9 5/8 (244)	11 1/8 (282)	12 1/16 (307)	13 13/16 (351)	14 7/8 (378)	16 (406)	17 1/2 (445)	19 3/4 (503)
L	8 1/2 (216)	9 1/2 (241)	11 (279)	13 15/16 (354)	14 13/16 (376)	16 3/4 (425)	17 1/2 (444)	18 9/16 (471)	21 5/8 (549)	23 13/16 (605)
M	2 1/2 (64)	2 1/2 (64)	3 (76)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)
N	3 1/2 (89)	3 1/2 (89)	3 1/2 (89)	5 (127)	5 (127)	5 3/4 (146)	5 3/4 (146)	5 3/4 (146)	7 3/4 (197)	7 3/4 (197)

Mechanical Joint Butterfly Valve with Nut Input Actuator

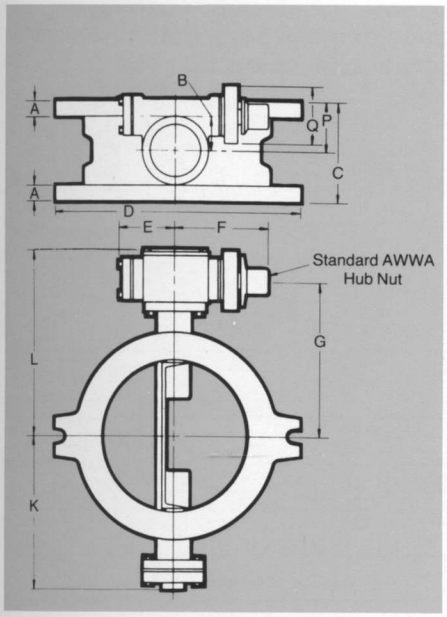


Valve Size Inches (mm)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)
A	1 1/16 (27)	1 1/8 (28)	1 3/16 (30)	1 1/4 (32)	1 5/16 (33)	1 3/8 (35)	1 7/16 (36)	1 1/2 (38)	1 5/8 (41)
B	1 7/8 (48)	1 7/8 (48)	2 3/4 (70)	2 3/4 (70)	3 7/8 (98)	3 7/8 (98)	3 7/8 (98)	5 1/4 (133)	5 1/4 (133)
C	8 (203)	8 13/32 (214)	9 3/8 (238)	9 11/16 (246)	10 3/8 (264)	10 5/8 (270)	11 (279)	11 9/32 (286)	12 3/16 (310)
D	11 1/16 (281)	13 5/16 (338)	15 5/8 (397)	17 7/8 (454)	20 1/4 (514)	22 1/2 (572)	24 3/4 (629)	27 (686)	31 1/2 (800)
E	3 3/8 (86)	3 3/8 (86)	4 5/8 (117)	4 5/8 (117)	6 5/8 (168)	6 5/8 (168)	6 5/8 (168)	8 1/4 (210)	8 1/4 (210)
F	7 (178)	7 (178)	8 1/4 (210)	8 1/4 (210)	10 1/4 (261)	10 1/4 (261)	10 1/4 (261)	12 1/4 (312)	12 1/4 (312)
G	7 3/4 (197)	9 1/4 (235)	11 1/4 (286)	12 5/16 (313)	13 7/8 (352)	14 5/8 (371)	15 11/16 (398)	17 3/4 (451)	20 (509)
H	6	6	8	8	10	12	12	14	16
I	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)
J	9 1/2 (241)	11 3/4 (298)	14 (356)	16 1/4 (356)	18 3/4 (476)	21 (533)	23 1/4 (590)	25 1/2 (648)	30 (762)
K	8 1/8 (206)	9 5/8 (244)	11 1/8 (282)	12 1/16 (307)	13 13/16 (351)	14 7/8 (378)	16 (406)	17 1/2 (445)	19 3/4 (503)
L	9 1/2 (242)	11 (279)	13 15/16 (354)	14 13/16 (376)	16 3/4 (426)	17 1/2 (444)	18 9/16 (471)	21 5/8 (549)	23 13/16 (605)
M	4 (102)	4 3/16 (106)	4 11/16 (119)	4 27/32 (123)	5 3/4 (146)	5 7/8 (149)	6 1/16 (154)	6 7/32 (158)	6 5/8 (168)
N	3 1/2 (89)	3 1/2 (89)	5 (127)	5 (127)	5 3/4 (146)	5 3/4 (146)	5 3/4 (146)	7 3/4 (197)	7 3/4 (197)
O	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	3 1/2 (89)	3 1/2 (89)	3 1/2 (89)	3 1/2 (89)	3 1/2 (89)

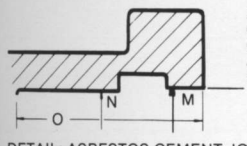
NOTE: All dimensions are for layout purposes only — for closer tolerances contact Kennedy Valve.
All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

Nut Input Actuators for 4″ Thru 24″ Valves

Asbestos Cement End Butterfly Valve with Nut Input Actuator



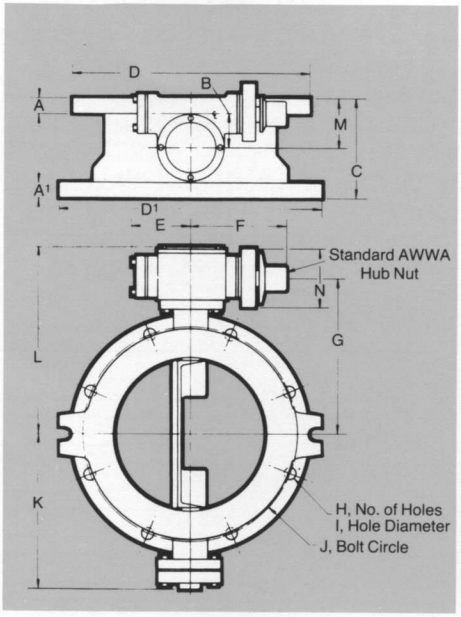
Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)
A	1¼ (32)	1½ (38)	1½ (38)	1⁹⁄₁₆ (40)	1⁹⁄₁₆ (40)
B	1⅞ (48)	1⅞ (48)	1⅞ (48)	2¾ (70)	2¾ (70)
C	9⁴¹⁄₆₄ (245)	10¹³⁄₃₂ (264)	10²⁹⁄₃₂ (277)	11¹³⁄₁₆ (299)	12⅝ (321)
D	9½ (241)	12³⁄₁₆ (310)	14⁵⁄₁₆ (364)	18⁹⁄₁₆ (471)	20⅞ (530)
E	3⅜ (86)	3⅜ (86)	3⅜ (86)	4⅝ (118)	4⅝ (118)
F	7 (178)	7 (178)	7 (178)	8¼ (210)	8¼ (210)
G	6¾ (171)	7¾ (197)	9¼ (235)	11¼ (286)	12⁵⁄₁₆ (313)
K	7⅛ (181)	8⅛ (206)	9⅝ (244)	11⅛ (282)	12¹⁄₁₆ (307)
L	8½ (216)	9½ (241)	11 (279)	13¹⁵⁄₁₆ (354)	14¹³⁄₁₆ (376)
M	5.10 (130)	7.20 (183)	9.40 (239)	11.95 (304)	14.21 (361)
N	4.91 (125)	7.01 (178)	9.21 (234)	11.76 (299)	14.02 (356)
O	3.50 (89)	3.50 (89)	3.50 (89)	3.50 (89)	4.00 (102)
P	4¹³⁄₁₆ (122)	5⅞₂ (132)	5¹⁵⁄₃₂ (139)	5¹⁹⁄₃₂ (142)	6⁵⁄₁₆ (160)
Q	3½ (89)	3½ (89)	3½ (89)	5 (127)	5 (127)



2 LUGS SPACED 180° ON CENTER, DIMENSIONS CONFORM TO JOHNS-MANVILLE SPECIFICATIONS.

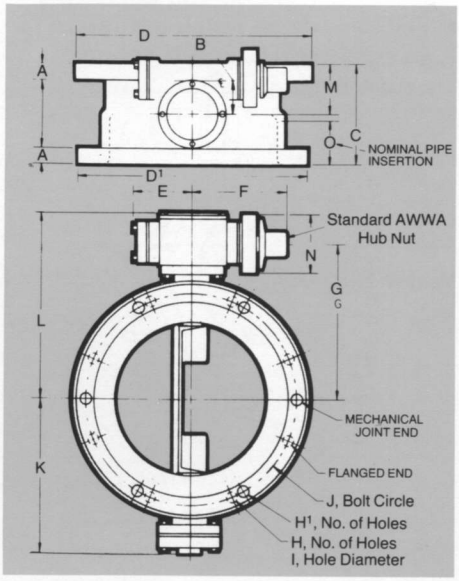
DETAIL: ASBESTOS CEMENT JOINT END

Asbestos Cement End by Flanged End Butterfly Valve with Nut Input Actuator



Valve Size Inches (mm)	6 (150)	8 (200)
A	1 (25)	1⅛ (28)
A¹	1½ (38)	1½ (38)
B	1⅞ (48)	1⅞ (48)
C	7¹¹⁄₁₆ (195)	7¹⁵⁄₁₆ (202)
D	11 (279)	13½ (343)
D¹	12³⁄₁₆ (310)	14⁵⁄₁₆ (364)
E	3⅜ (86)	3⅜ (86)
F	7 (178)	7 (178)
G	7¾ (197)	9¼ (235)
H	8	8
I	⅞ (22)	⅞ (22)
J	9½ (241)	11¾ (298)
K	8⅛ (206)	9⅝ (244)
L	9½ (241)	11 (279)
M	2½ (64)	2½ (64)
N	3½ (89)	3½ (89)

Flanged End by Mechanical Joint End Butterfly Valve with Nut Input Actuator



Valve Size Inches (mm)	6 (150)	8 (200)
A	1 (25)	1⅛ (28)
B	1⅞ (48)	1⅞ (48)
C	6½ (165)	6²³⁄₃₂ (171)
D	11 (279)	13½ (343)
D¹	11¹⁄₁₆ (281)	13⁵⁄₁₆ (338)
E	3⅜ (86)	3⅜ (86)
F	7 (178)	7 (178)
G	7¾ (197)	9¼ (235)
H	8	8
H¹	6	6
I	⅞ (22)	⅞ (22)
J	9½ (241)	11¾ (298)
K	8⅛ (206)	9⅝ (244)
L	9½ (241)	11 (279)
M	2½ (64)	2½ (64)
N	3½ (89)	3½ (89)
O	2½ (64)	2½ (64)

NOTE: D¹ & H¹ PERTAIN TO MECHANICAL JOINT. SEAT IS ON FLANGED END SIDE OF VALVE —

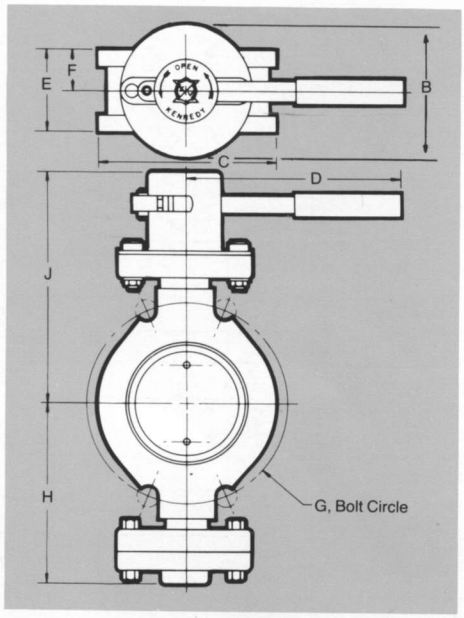
NOTE: All dimensions are for layout purposes only — for closer tolerances contact Kennedy Valve.
All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

Handlever Actuators for 4″ Thru 8″ Valves

- **Available for 4″, 6″ & 8″ valves**
- **Designed for one hand operation**
- **All actuators have infinite increment postioning capability**
- **For use where quick actuation is an asset and where it cannot cause damage to the system**

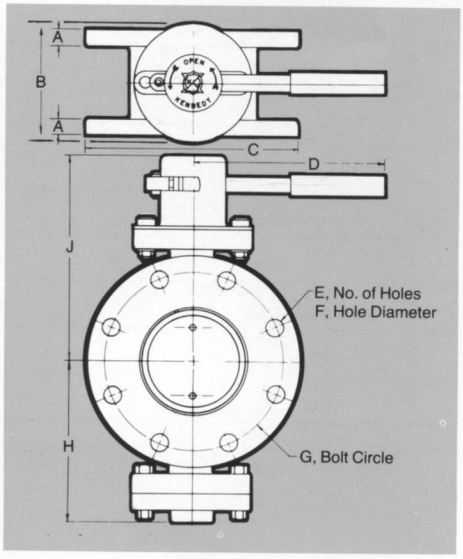
Kennedy cautions users to carefully examine their systems before using this type of actuator.
The rate of opening or closing is at operator discretion and can be extremely rapid. If there is any possibility of generating dangerous overpressures due to water hammer in the system, if the valve is opened or closed very quickly, this type actuator should not be used. Further, the fluid dynamic forces on a butterfly disc tend to drive it closed presenting a possible hazard to a careless operator or one unfamiliar with butterfly valve operational characteristics.

Wafer Butterfly Valve with Hand Lever Input Actuator



Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)
B	5 (127)	5 (127)	5 (127)
C	6 7/16 (164)	8 1/2 (216)	10 1/2 (267)
D	8 (204)	10 (254)	12 (305)
E	2 5/16 (59)	2 7/8 (73)	3 (76)
F	1 5/16 (33)	1 1/2 (38)	1 5/8 (41)
G	7 1/2 (190)	9 1/2 (241)	11 3/4 (298)
H	7 1/8 (181)	8 1/8 (206)	9 5/8 (244)
J	9 1/4 (235)	10 1/4 (261)	11 1/4 (286)

Flanged End Butterfly Valve with Hand Lever Input Actuator

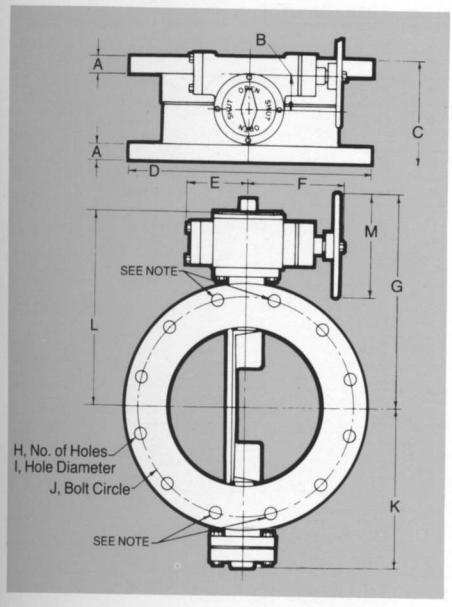


Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)
A	15/16 (24)	1 (25)	1 1/8 (28)
B	5 (127)	5 (127)	5 (127)
C	9 (229)	11 (279)	13 1/2 (343)
D	8 (204)	10 (254)	12 (305)
E	8	8	8
F	3/4 (19)	7/8 (22)	7/8 (22)
G	7 1/2 (190)	9 1/2 (241)	11 3/4 (298)
H	7 1/8 (181)	8 1/8 (206)	9 5/8 (244)
J	9 1/4 (235)	10 1/4 (261)	11 3/4 (299)

NOTE: All dimensions are for layout purposes only — for closer tolerances contact Kennedy Valve.
All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

Hand Wheel Actuators for 4" Thru 24" Valves

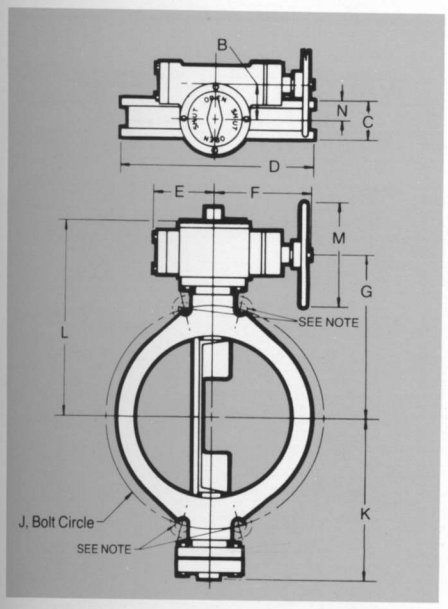
Flanged End Butterfly Valve with Handwheel Input Actuator



NOTE: 20" & 24" VALVES HAVE 4 TAPPED HOLES ON EACH FLANGE.
THRU TAP, 20"-1⅛-7 UNC, 24"-1¼-7 UNC.

Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)
A	15/16 (24)	1 (25)	1 1/8 (28)	1 3/16 (30)	1 1/4 (32)	1 3/8 (35)	1 7/16 (36)	1 9/16 (40)	1 11/16 (43)	1 7/8 (48)
B	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	2 3/4 (70)	2 3/4 (70)	3 7/8 (98)	3 7/8 (98)	3 7/8 (98)	5 1/4 (133)	5 1/4 (133)
C	5 (127)	5 (127)	6 (152)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)
D	9 (229)	11 (279)	13 1/2 (343)	16 (406)	19 (483)	21 (533)	23 1/2 (597)	25 (635)	27 1/2 (698)	32 (813)
E	3 3/8 (86)	3 3/8 (86)	3 3/8 (86)	4 5/8 (117)	4 5/8 (117)	6 5/8 (168)	6 5/8 (168)	6 5/8 (168)	8 1/4 (210)	8 1/4 (210)
F	7 (178)	7 (178)	7 (178)	8 1/4 (210)	8 1/4 (210)	10 1/4 (261)	10 1/4 (261)	10 1/4 (261)	10 1/4 (261)	12 1/4 (312)
G	10 3/4 (273)	11 3/4 (298)	13 1/4 (336)	15 1/4 (388)	16 5/16 (415)	18 7/8 (480)	19 5/8 (499)	20 11/16 (526)	24 3/4 (630)	27 (687)
H	8	8	8	12	12	12	16	16	20	20
I	3/4 (19)	7/8 (22)	7/8 (22)	1 (25)	1 (25)	1 1/8 (28)	1 1/8 (28)	1 1/4 (32)	1 1/4 (32)	1 3/8 (35)
J	7 1/2 (190)	9 1/2 (241)	11 3/4 (298)	14 1/4 (362)	17 (432)	18 3/4 (476)	21 1/4 (540)	22 3/4 (578)	25 (635)	29 1/2 (749)
K	7 1/8 (181)	8 1/8 (206)	9 5/8 (244)	11 1/8 (282)	12 1/16 (307)	13 13/16 (351)	14 7/8 (378)	16 (406)	17 1/2 (445)	19 3/4 (503)
L	8 1/2 (216)	9 1/2 (241)	11 (279)	13 15/16 (354)	14 13/16 (376)	16 3/4 (425)	17 1/2 (444)	18 9/16 (471)	21 5/8 (549)	23 13/16 (605)
M	8 (203)	8 (203)	8 (203)	8 (204)	8 (204)	10 (254)	10 (254)	10 (254)	14 (356)	14 (356)

Wafer Butterfly Valve with Handwheel Input Actuator



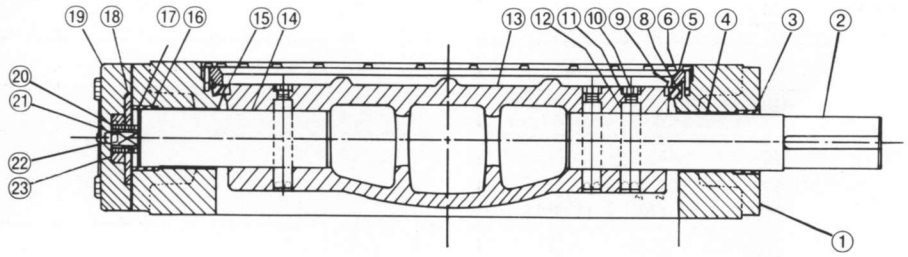
NOTE: 20" VALVES HAVE 4 TAPPED HOLES ON EACH FLANGE. TAP, 20"-1¼-7 UNC.

Valve Size Inches (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)
B	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	2 3/4 (70)	2 3/4 (70)	3 7/8 (98)	3 7/8 (98)	3 7/8 (98)	5 1/4 (134)
C	2 5/16 (59)	2 7/8 (73)	3 (76)	3 3/16 (81)	3 1/2 (89)	3 7/8 (98)	4 1/4 (108)	4 3/4 (121)	5 1/4 (133)
D	6 7/16 (164)	8 1/2 (216)	10 1/2 (267)	12 3/4 (324)	15 (381)	16 1/2 (419)	19 (483)	21 (533)	23 1/2 (597)
E	3 3/8 (86)	3 3/8 (86)	3 3/8 (86)	4 5/8 (117)	4 5/8 (117)	6 5/8 (168)	6 5/8 (168)	6 5/8 (168)	8 1/4 (210)
F	7 (178)	7 (178)	7 (178)	8 1/4 (210)	8 1/4 (210)	10 1/4 (260)	10 1/4 (260)	10 1/4 (260)	12 1/4 (311)
G	6 3/4 (171)	7 3/4 (197)	9 1/4 (235)	11 1/4 (286)	12 5/16 (313)	13 7/8 (352)	14 5/8 (371)	15 11/16 (398)	17 3/4 (451)
J	7 1/2 (190)	9 1/2 (241)	11 3/4 (298)	14 1/4 (362)	17 (432)	18 3/4 (476)	21 1/4 (540)	22 3/4 (578)	25 (635)
K	7 1/8 (181)	8 1/8 (206)	9 5/8 (244)	11 1/8 (282)	12 1/16 (307)	13 13/16 (351)	14 7/8 (378)	16 (406)	17 1/2 (445)
L	8 1/2 (216)	9 1/2 (241)	11 (279)	13 15/16 (354)	14 13/16 (376)	16 3/4 (425)	17 1/2 (444)	18 9/16 (471)	21 5/8 (549)
M	8 (203)	8 (203)	8 (203)	8 (204)	8 (204)	10 (254)	10 (254)	10 (254)	14 (356)
N	1 5/16 (33)	1 1/2 (38)	1 5/8 (41)	1 27/32 (47)	2 3/16 (56)	2 1/4 (57)	2 3/8 (60)	2 15/32 (63)	2 9/16 (65)

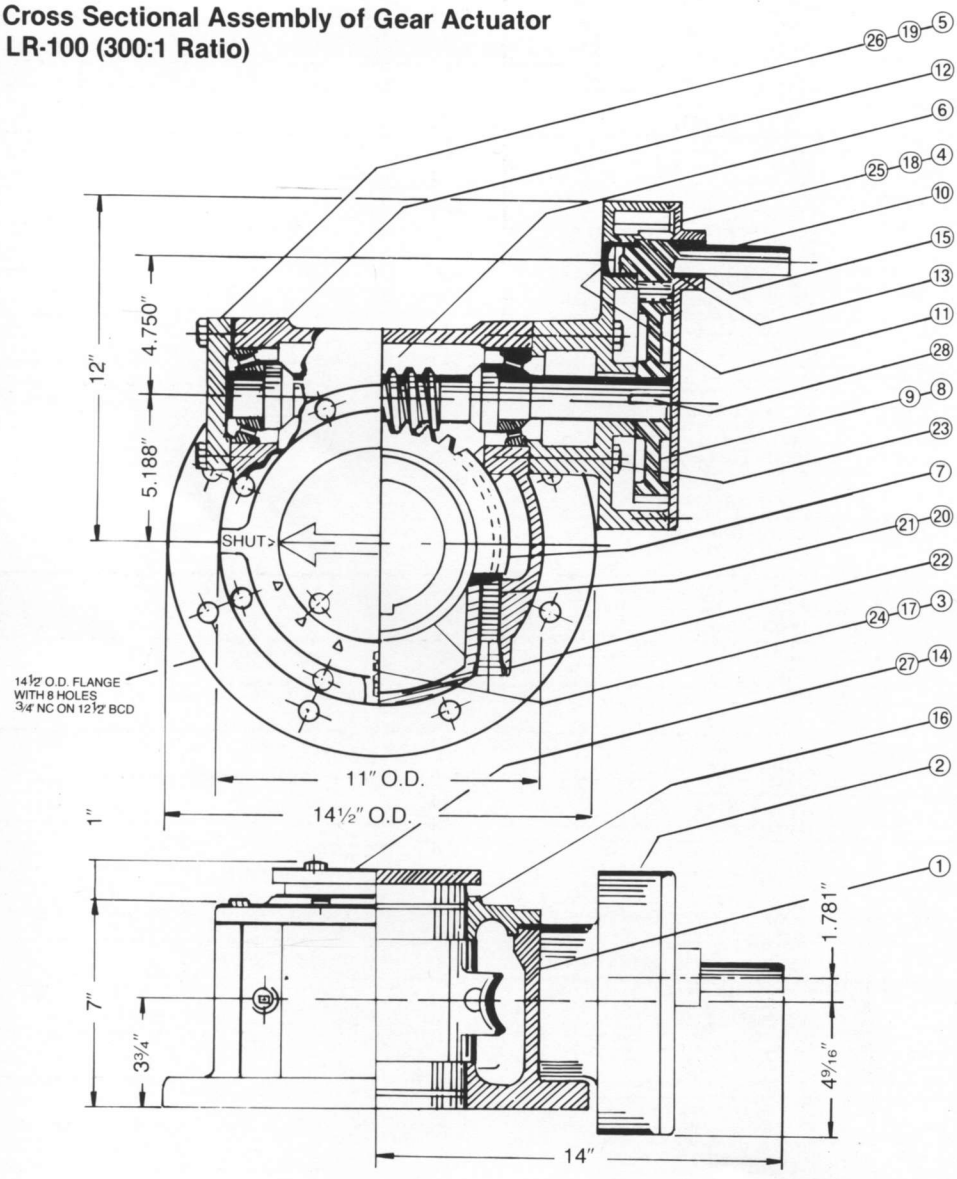
NOTE: All dimensions are for layout purposes only — for closer tolerances contact Kennedy Valve.
All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

30″ Thru 48″ Parts and Materials Information

Cross Sectional Assembly of Valve



Cross Sectional Assembly of Gear Actuator LR-100 (300:1 Ratio)



Parts Table for Valve

ITEM	DESCRIPTION	MATERIAL
1	Body	Cast Iron
2	Upper Shaft	Type 304 S.S.
3	Seal Cartridge	Delrin
4	Bearing	Steel Backed-Lead TFE-Bronze
5	Retaining Ring	Bronze
6	Cap Screw	Type 304 S.S.
8	Seat	Buna-N (Duro 70)
9	Disc Ring	Type 304 S.S.
10	Cap Screw	Type 304 S.S.
11	Thread Seal	Buna-N
12	Disc Pins	Type 304 S.S.
13	Disc	Ductile Iron
14	Lower Shaft	Type 304 S.S.
15	O-Ring	Buna-N
16	Parker O-Ring	Buna-N
17	Parker O-Ring	Buna-N
18	Thrust Plate	C.R. Steel
19	Trunion Cover	Cast Iron
20	Set Screw	R.P. Steel
21	Flat Washer	R.P. Steel
22	Cap Screw	R.P. Steel
23	Thrust Bearing	Bronze
24	Cap Screw	R.P. Steel
25	Lock Washer	R.P. Steel
26	Button Screw	R.P. Steel
27	Trunion Cover Plate	C.R. Steel

Parts Table for Gear Actuator

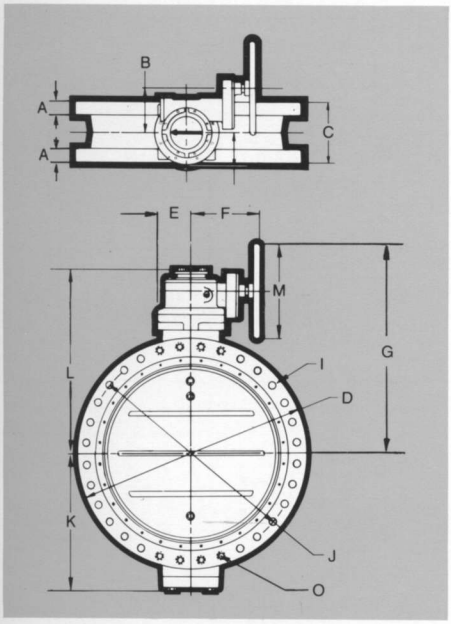
ITEM	DESCRIPTION	MATERIAL
1	Housing (Worm)	Cast Iron
2	Housing (Spur)	Cast Iron
3	Cover	Cast Iron
4	Cover	Cast Iron
5	Cover Plate	Cast Iron
6	Worm Gear	Stl. (Ht Alloy)
7	Segment Gear	Bronze
8	Spur Gear (72 T)	Stl. (Ht Alloy)
9	Idler Gear (23 T)	Stl. (Ht Alloy)
10	Pinion (12 T)	Stl. (Ht Alloy)
11	Expan. Plug	Steel
12	Bearing	Timken Stl.
13	Bearing	Sint. Brz.
14	Indicator	Cast Iron
15	Seal (Spring TP)	
16	'O' Ring	Buna N
17	Gasket	Fibre
18	Gasket	Fibre
19	Gasket Shim	Clr. Acetate
20	Adj. Scr.	Stl. ¾″ NC.
21	Lock. Scr.	Stl. ¾″ NC.
22	Pipe Plug	M I ½″ NPT.
23	Mtg. Scr.	Stl. ½″ NC.
24	Cover Scr.	Stl. ⅜″ NC.
25	Cover Scr.	Stl. 5/16″ NC.
26	Cover Scr.	Stl. ½″ NC.
27	Mtg. Scr.	Stl. ¼″ NC.
28	Key ⅜″ Sq.	Stl.

NOTE: 48″ valve uses a Limitorque HBC Actuator or equal (not illustrated)

All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

30″ Thru 48″ Valve Dimensions

Flanged End Butterfly Valve with LR-100 Gear Actuator*



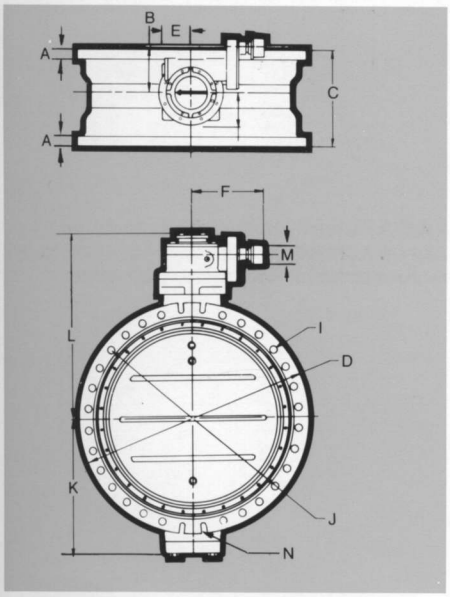
BUTTERFLY VALVES COMPLY WITH AWWAC 504-80 CLASS 150B.

*NOTE: 48″ to have Limitorque HBC Actuator or equal

Valve Size Inches (mm)	30 (750)	36 (900)	42 (1050)	48 (1200)
A	2 1/8 (54)	2 3/8 (60)	2 5/8 (66)	2 3/4 (70)
B	9 15/16 (252)	9 15/16 (252)	9 15/16 (252)	11 3/4 (288)
C	12 (305)	12 (305)	12 (305)	15 (381)
D	38 3/4 (984)	46 (1168)	53 (1346)	59 1/2 (1511)
E	7 1/4 (184)	7 1/4 (184)	7 1/4 (184)	11 1/2 (292)
F	14 (356)	14 (356)	14 (356)	22 3/4 (578)
G	37 5/16 (948)	40 (1016)	48 3/16 (1224)	50 9/16 (1283)
H	28	32	36	44
I	1 3/8 (35)	1 5/8 (41)	1 5/8 (41)	1 5/8 (41)
J	36 (914)	42 3/4 (1086)	49 1/2 (1257)	56 (1422)
K	23 1/2 (597)	27 7/8 (708)	31 11/16 (805)	35 (889)
L	29 13/16 (757)	36 1/2 (927)	40 11/16 (1033)	47 9/16 (1206)
M	20 (508)	20 (508)	20 (508)	18 (457)
O	1 1/4-7UNC x 2 Dp.	1 1/2-6UNC x 2 1/4 Dp.	1 1/2-6UNC x 2 1/4 Dp.	1 1/2-6UNC x 2 1/4 Dp.
P	4	8	8	8

NOTE: H is number of holes
O is tapped hole specification
P is number of tapped holes per flange face

Mechanical Joint Butterfly Valve with LR-100 Gear Actuator



BUTTERFLY VALVES COMPLY WITH AWWAC 504-80 CLASS 150 B.

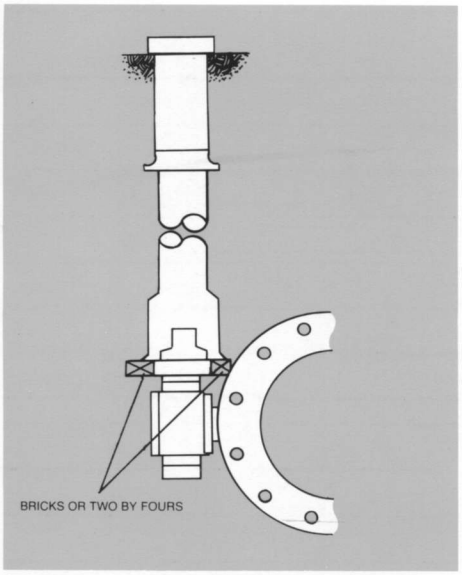
Valve Size Inches (mm)	30 (750)	36 (900)
A	1 13/16 (46)	2 (51)
B	9 15/16 (252)	9 15/16 (252)
C	18 (457)	20 (508)
D	39 1/8 (994)	46 (1168)
E	7 1/4 (184)	7 1/4 (184)
F	14 (356)	14 (356)
H	20	24
I	1 1/8 (28)	1 1/8 (28)
J	36 7/8 (937)	43 3/4 (1111)
K	23 1/2 (597)	27 7/8 (708)
L	29 13/16 (757)	36 1/2 (927)
M	2 sq.	2 sq.
N	4	4

NOTE: H is number of holes
N is number of slot/flange face
P is number of tapped holes per flange face

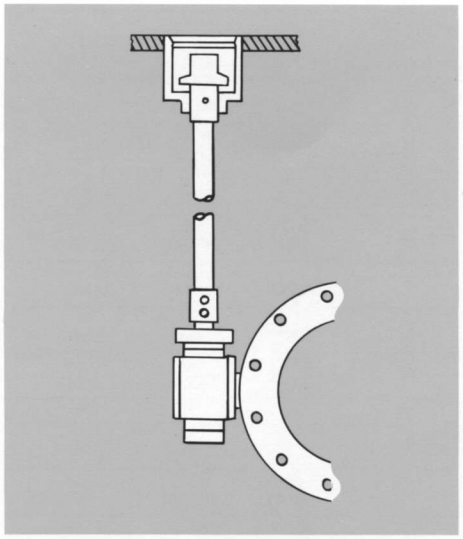
NOTE: All dimensions are for layout purposes only — for closer tolerances contact Kennedy Valve.
All the Kennedy butterfly valves have provisions for and have been designed for use with automatic actuating devices. See pages 12 and 13 for examples.

Options and Accessories

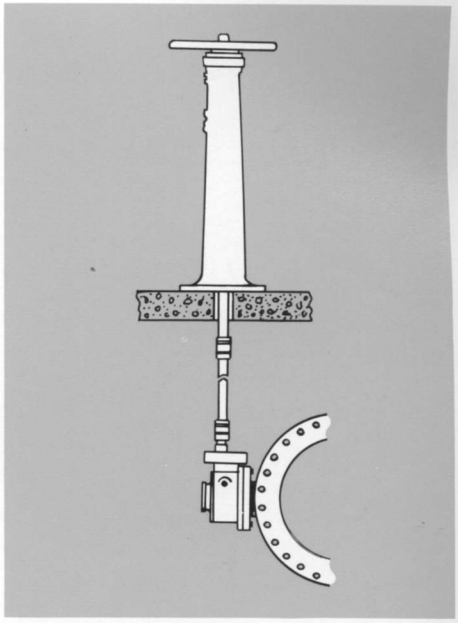
Extensions



Buried Butterfly Valve with rack and pinion actuator, 2″ square nut and ground box.

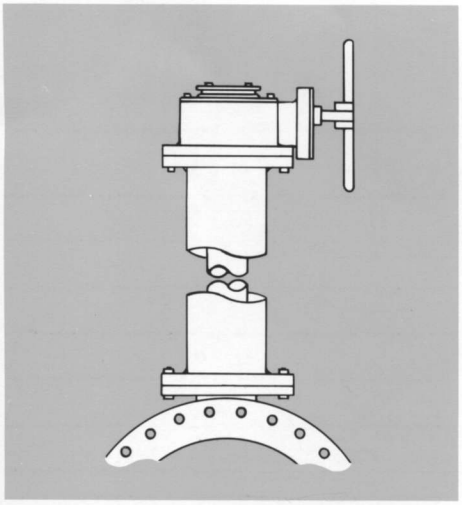


Butterfly Valve with quarter turn actuator, extension stem and floor box.

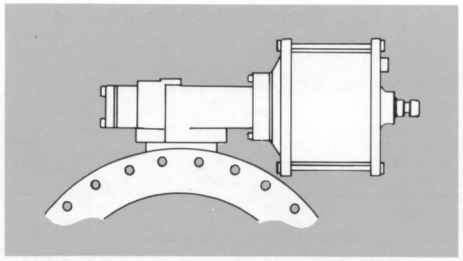


Butterfly Valve with quarter turn actuator, extension stem and floor stand.

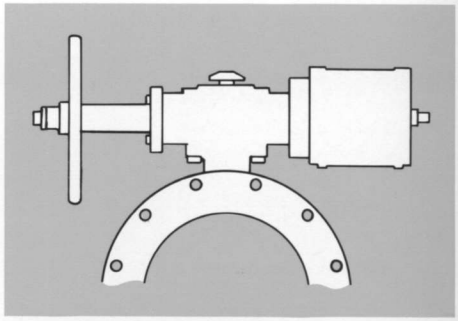
Actuators



AWWA Butterfly Valve with LR 100 quarter turn actuator with handwheel mounted on extended bonnet. Recommended for manually operated 30″-48″ Butterfly Valve when valve is submerged.



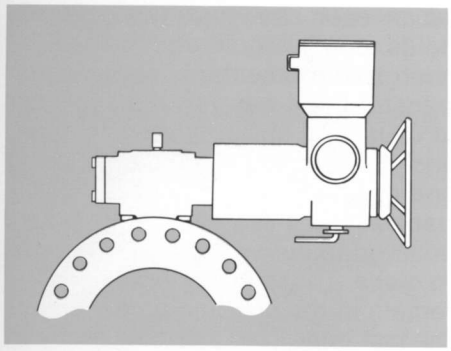
AWWA Butterfly Valve with cylinder operator on Kennedy Valve rack and pinion quarter turn actuator.



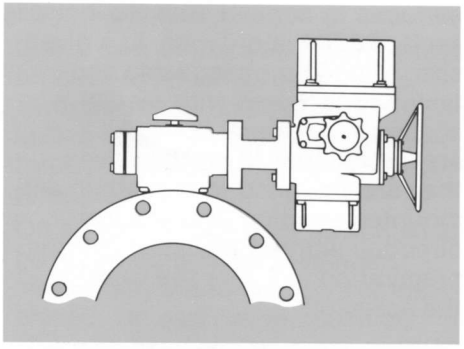
AWWA Butterfly Valve with cylinder operator on Kennedy Valve rack and pinion quarter turn actuator with manual override.

Options and Accessories

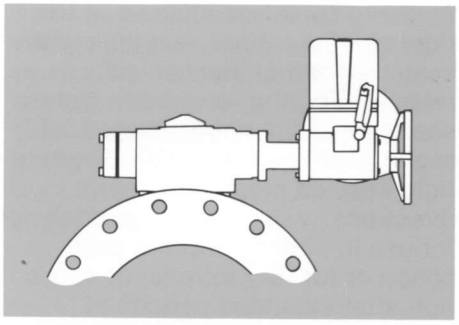
Actuators cont.



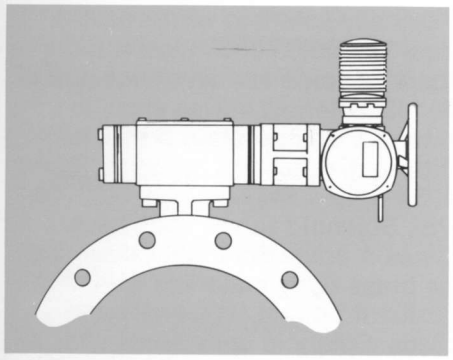
AWWA Butterfly Valve with Kennedy Valve rack and pinion quarter turn actuator and Rotork electric operator



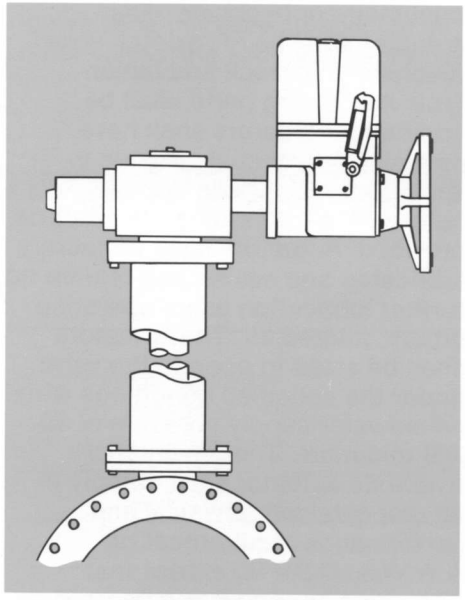
AWWA Butterfly Valve with Kennedy Valve rack and pinion quarter turn actuator and Limitorque SMC electric operator.



AWWA Butterfly Valve with Kennedy Valve rack and pinion quarter turn actuator and Limitorque SMB electric operator.



AWWA Butterfly Valve with Kennedy Valve rack and pinion quarter turn actuator and Auma SA electric operator.



AWWA Butterfly Valve with Limitorque HBC quarter turn actuator and SMB electric operator on extended bonnet. Recommended for electrically operated butterfly valve when valve is submerged.

Butterfly Valve Suggested Specifications

Manual

All Butterfly valves shall be of the tight closing rubber seat type with seats bonded or mechanically retained into the valve body. Valves shall have a full uninterrupted 360° sealing surface and shall be bubble tight at rated pressure in both directions. Valves shall be designed for use in either throttling application or for very infrequent operation after extended periods of inactivity. Valves shall be in full compliance with A.W.W.A. specification C-504-80 Class 150 B, as specified herein.

Valve Bodies

All valve bodies shall be of cast iron conforming to ASTM A-126 Class B or equal and with integral cast ends as required to meet application requirements.

Valve Disc

All valve discs shall be streamlined and present the smallest profile possible consistent with the structural requirements of the pressure class. They shall be of offset design and material composition being ductile iron. Disc sealing edge shall have a continuous uninterrupted 360° sealing surface of Type 304 stainless steel.

Valve Shafts

Valve shafts shall be of Type 304 stainless steel. Shaft design shall be of thru or stub type construction with at least 1½ shaft diameter engagement into the disc. Shaft to disc connection shall be a rigid, non slip type connection.

Valve Seats

Valve seats shall be Buna N material bonded or mechanically retained to the valve body.

Valve Bearings

Valve bearings shall be self-lubricating and non-corrosive and shall have a significant difference in hardness from the valve shaft.

Valve Actuators General

All valve actuators shall be designed as an integral part of the valve and shall meet or exceed all the requirements of A.W.W.A. C-504-80. Actuators shall be of rack and pinion or traveling nut design. All moving penetrations into the actuator shall have corrosion resistant surfaces in contact with the housing seals. All actuator types, in a given size, to be interchangeable and fastened to valves with readily accessible external bolts. All actuators must fit on the valves they are designed to operate in any mounted position or rotational direction without any special prior preparation to either the valve or the actuator.

Cylinder

Cylinder Actuators for Butterfly Valves

Cylinders shall be double acting, pneumatic or hydraulic. Gear actuator shall be of "Scotch-yoke" mechanism or rack and pinion type. All moving parts shall be enclosed. Actuators shall have provision for manual override in case of pressure loss or power failure. Position indicators shall be provided. Actuators shall be factory lubricated and sealed and require no further lubrication when operating on dry, filtered air. The actuators shall be sized to operate the valve under the specified conditions with an air/water supply pressure of 60 PSI minimum. The pneumatic/hydraulic actuator shall comply in all respects with physical and performance requirement of A.W.W.A. C-504-80 except that "Amalgon" or equal can be used as a cylinder wall material in lieu of brass specified in the standard. Cylinder actuators shall be furnished for butterfly valves where shown on the Plans. Extension bonnets for cylinder actuators shall be furnished where shown on Plans and shall be as recommended by actuator manufacturer.

Cylinder actuators with adjustable stops to allow adjustment of valve opening to any position between 10 degrees and 90 degrees shall be furnished for butterfly valves where shown on the Plans.

Cylinder actuators with positioners shall be furnished for butterfly valves where shown on the Plans.

Solenoid Valves (Cylinder Actuators)

Valves having cylinder actuators without positioners each shall be controlled by a single 4-way solenoid valve. The 4-way solenoid valves each shall have two solenoids, one solenoid after being energized momentarily shall transfer the 4-way valve to a position to cause the butterfly valve to open, and the second solenoid after being energized momentarily shall transfer the 4-way valve to its other position to cause the butterfly valve to close. These 4-way valves shall remain in the position produced by the last energized solenoid, even after that solenoid has been de-energized, so that the butterfly valve shall not change position during an outage of electrical power.

Four-way solenoid valves having dual solenoids shall have fittings for ⅜" ID pipe and an orifice size of 3/16" ID Solenoid valves shall be rated for an operating pressure differential ranging between 10 and 125 PSI and shall be tested to 300 PSI. Solenoid valves shall have Class A coils. Solenoid valves shall be brass body materials with resilient poppet type seats and discs. Solenoid enclosures shall be for general purpose use unless otherwise specified. Solenoid valves shall have a manual operator override. Solenoid valves shall be provided with a metering device.

Valves to be controlled by positioners where shown on Plans shall have a 3-way override solenoid valve. Each solenoid valve shall be connected in the 3-15 PSI signal air connection to the positioner and shall have one side open to the atmosphere. Each 3-way solenoid valve shall be arranged to shut off the 3-15 PSI signal and to vent the positioner's signal air connection when the solenoid is deenergized to cause the main valve to close and to permit the main valve to reopen in response to the 3-15 PSI signal when the solenoid is energized.

Three-way solenoid valves for 3-15 PSI signal air applications shall have fittings for ¼" ID pipe and an orifice size of 11/64" ID. Solenoid valves shall be rated for an operating pressure differential ranging between 0 and 20 PSI. Solenoid valves shall be brass body material with resilient poppet type seats and discs. Solenoid valves shall be

Butterfly Valve Suggested Specifications

ASCO, Clayton, Jackes, Skinner, or equal.

Positioners

Positioners shall be double acting feed-back type with enclosed helical stainless steel springs. Input signals shall be 3-15 PSI (pneumatic) or 4-20 M.A. (electric). Arrange positioner so that the Butterfly Valve is closed at 3 PSI or 4 M.A. Positioners shall be MOORE or equal.

Speed Control Valves

Install an adjustable speed control valve on each cylinder port of the cylinder actuated valves to restrict outflow and permit unrestricted inflow.

Limit Switches

Install two adjustable limit switches on each cylinder actuated valve. Switches shall be single-acting, spring-return, single-pole, double-throw, roller-lever type in a NEMA IV enclosure.

On all valves, one limit switch shall be actuated to close a contact circuit only when the valve is fully closed. On each valve specified above to have either an adjustable open limit stop or a positioner to control the actuator, the second limit switch shall be actuated to close a contact circuit only when the valve is not fully closed. On all other valves, the second limit switch shall be actuated to close a contact circuit only when the valve is fully open. The limit switches shall be adjusted in the field after installation of each actuated valve is complete, to verify that the above specified contact actions are produced.

Check List for Power Operated Valves

Cylinder

Hydraulic or Pneumatic _____

Cylinder operating pressure _____ PSI

Manual Override _____ YES _____ NO

Limit Switches _____ YES _____ NO

Open-close OR Modulating Service _____

Special provisions _____

_____

Speed Control Valves

Line Pressure _____ PSI

Electric

Open-close or Modulating Service _____

Power requirement _____voltage _____ phase

Motor Starters required _____

Options - controls, buttons, lights, extra limit switches, potentiometers, etc. _____

_____

_____

Other

Mounting position

Accessories - bonnets, chainwheels, etc.

Total Kennedy Capability/Product Listing

Flow Control Total Package from Kennedy Valve

Double Disc Gate Valves — A.W.W.A. C-500
2″-12″ 200 PSI
14″-36″ 150 PSI
Pump isolation
Tank isolation
Tank drains
Open-Close, bi-directional service
Network isolation
Manual or power operation

Swing Check Valves — A.W.W.A. C-508
2″-24″ 200 PSI
Pump discharge
Prevent water hammer and backflow
Lever and spring or lever and weight

Knife Gate Valves
2″-24″ 150 PSI
Perfect for solids handling
Short face to face
Bubble tight shutoff available
One way flow
Manual or power actuation

Gruvlok Butterfly Valves
(For Grooved-End piping systems)
2″–12″ 175 PSI

Fire Hydrants — A.W.W.A. C-502

Backflow Prevention
Reduced pressure devices
Double check backflow preventers

Butterfly Valves — A.W.W.A. C-504
4″-48″ 150 PSI
Bubble tight shutoff — bi-directional
Modulating or open-close services
Manual or power actuation
Isolation valves
Filter regulating valves — influent, effluent, backwash
Buried or in-plant service

Tapping Sleeves

Tapping Valves

UL/FM Products

Iron Body Gate Valves
for Indicator Posts

Iron Body Gate Valves
Outside-Screw-and-Yoke

Indicator Posts

Bronze Gate Valves

Bronze Hose Gate Valves

Bronze Angle Hose Valves

Iron Body Swing Check Valves

Iron Body Hose Gate Valves

Bronze Globe and Angle Valves

Wafer Check Valves

Butterfly Valves

KENNEDY VALVE

Division of ITT Grinnell Valve Co., Inc.
Elmira, New York 14901
(607) 734-2211 Telex 932 474
Sales representatives in principal cities

OFFICES — WAREHOUSES

West: Los Angeles
8433 Chetle Ave., Santa Fe Springs, CA 90670
(213) 698-8063 Telex 698 189

Midwest: Chicago
1010 Jorie, Suite 370, Oak Brook, IL 60521
(312) 920-9010 Telex 283 572

Canada: Toronto
10 North Queen St., Toronto, ONT M8Z 2C5
(416) 251-2247 Telex 06 967 792

Southwest: Houston
10555 Northwest Freeway
Houston, TX 77092 (Suite 211)
(713) 688-1313 Telex 791 016

Northeast: New York
P.O. Box 306, Lincoln Park, NJ 07035
(201) 628-8070

Southeast: Atlanta
645 Northside Dr. N.W., Atlanta, GA 30302
(404) 524-3833 Telex 542 573

PRINTED IN U.S.A.

BULLETIN NO. J 497

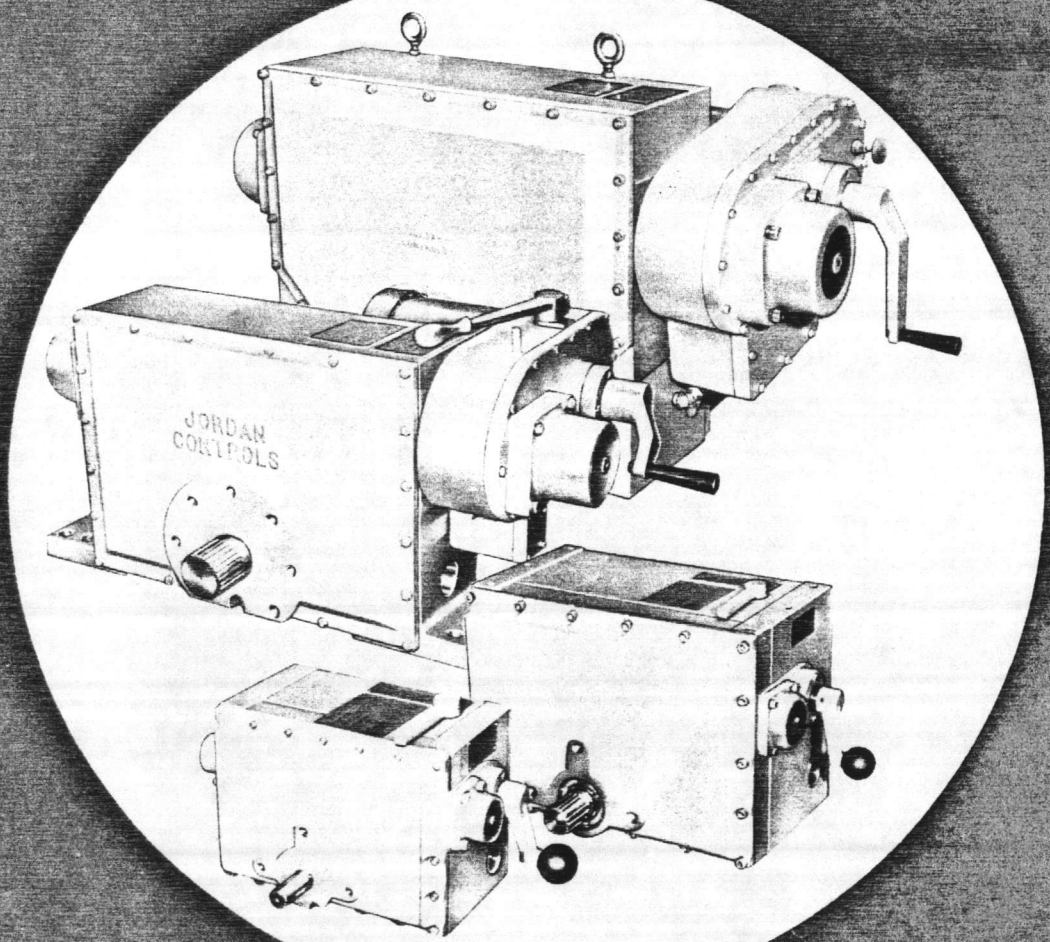
FOXBORO/JORDAN, INC.

SM-5000 SERIES

90° ROTARY ACTUATOR

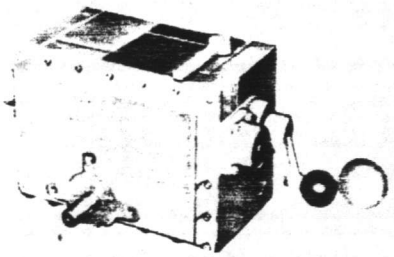
PROCESS CONTROL
MODULATING DUTY

TORQUE RATINGS
150 TO 12,500 FT. LBS.



THIS BULLETIN COVERS
MODEL SERIES
SM-5100 SM-5300
SM-5200 SM-5400

SM-5100 SERIES — 150 to 300 ft. lbs.



SM-5110
MOTOR - 115 VAC, 50/60 Hz, 1 PH., modulating duty, 3 wire plug reversible
CONTROL COMPATIBILITY - Jordan MT-6220, AA or D-8200, AD-8810 or bi-directional contacts.

SM-5120
MOTOR - 115 VAC, 50/60 Hz, 1 PH., 20% duty cycle w/5 min. max. on time, 3 wire, plug reversible.
CONTROL COMPATIBILITY - same as model SM-5110.

SM-5140
MOTOR - 24V, DC, P.M., modulating duty, capable of plug reversing and speed control with proper input.
CONTROL COMPATIBILITY - Jordan AD-7540 or any 24V, DC servo amplifier compatible with P.M. motors.

SM-5160
MOTOR - 90V, DC, P.M., modulating duty, capable of plug reversing and speed control with proper input.
CONTROL COMPATIBILITY - Jordan AD-7310 or any 90V, DC servo amplifier compatible with P.M. motors.

MAKE ONE CHOICE IN EACH BOX

BASIC UNIT (Select one of the following)

	SM-5110	Modulating duty motor, 115 VAC, 1 phase
✓	SM-5120	Intermittent duty motor, 115 VAC, 1 phase
	SM-5140	Modulating duty motor, 24 VDC
	SM-5160	Modulating duty motor, 90 VDC

TIME (full travel) (Sec.) / (Ft. Lbs.) **TORQUE**
Select one combination for your basic

TIME (Sec.) / TORQUE (Ft. Lbs.)	5110	5120	5140	5160
		17.5 / 150	20 / 150	13 / 150
	72 / 150	36 / *300	33 / *300	26 / *300
		60.5 ✓ / *300		44 / *300
	Z Special			

*NOTE: The 300 ft/lb version of the 5100 is to be used for on-off service only. It is not to be used for modulating duty.

ENCLOSURE (Select one of the following)

	E	Water Tight/Explosion Proof — NEMA 4 & 9

MOUNTING (Select one of the following)

✓	S	Standard Tapped Holes
	F	Foot Mount

OUTPUT SHAFT (Select one of the following)

✓	K	1/4 Inch Square Keyway
	SPL	20 Tooth Splined Shaft-Drive Arm Required
	Z	Special (Specify requirements)

LIMIT SWITCHES (Select one of the following)

	0	None Required
✓	2	2 Heavy Duty 20 AMP Rated
	4	4 Heavy Duty 20 AMP Rated
	Z	Special (Specify requirements)

FEEDBACK POTENTIOMETER (Select one of the following)

✓	0	None Required
	IP	IK OHM Precision
	ICC	IK OHM Characterized Cam
	Z	Special (Specify requirements)

MOTOR (Select one of the following)

✓	S	Standard
	Z	Special (Specify requirements)

BRAKE (Select one of the following)

✓	0	None Required
	B	Consult Factory For Brake Requirements

MANUAL OVERRIDE (Select one of the following)

✓	0	None Required
	M	Manual Override With Auto Preference

HEATER (Select one of the following)

✓	0	None Required
	H	Heater (required in freezing areas)

SPLINED DRIVE ARM (Required on Splined Shaft)

✓	0	Not Required
	SA	Splined Drive Arm

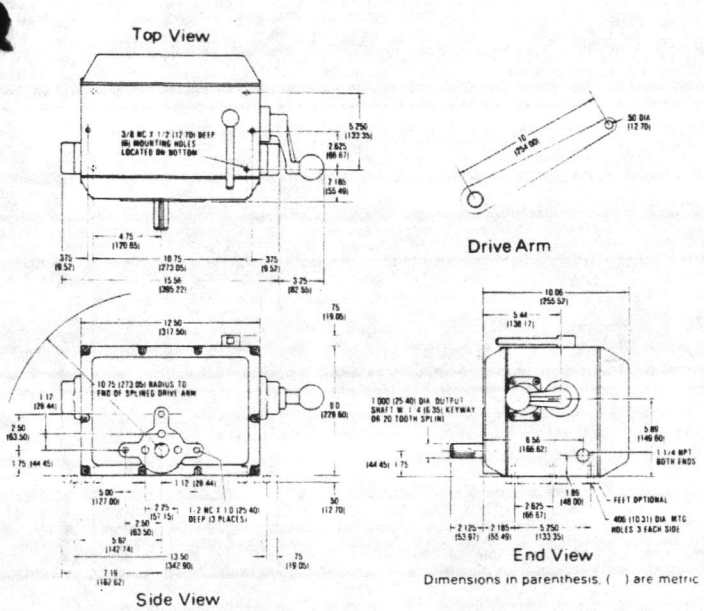
DRIVEN ARM (Used with Drive Arm)

✓	0	Not Required
	DA	Driven Arm (Specify Bore Diameter & Location)

ADAPTER/CLEVIS KIT (Used with SA & DA Linkage)

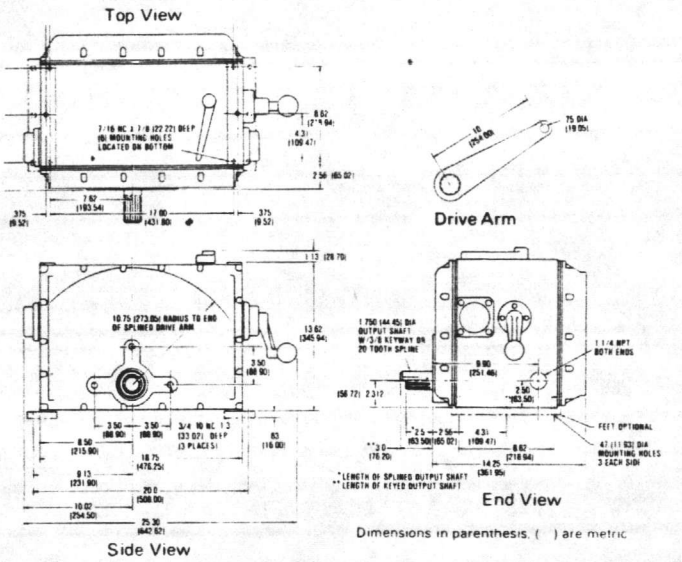
✓	0	Not Required
	AK	Adapter/Clevis Kit

SM-5100 (300 ft.-lbs. maximum)



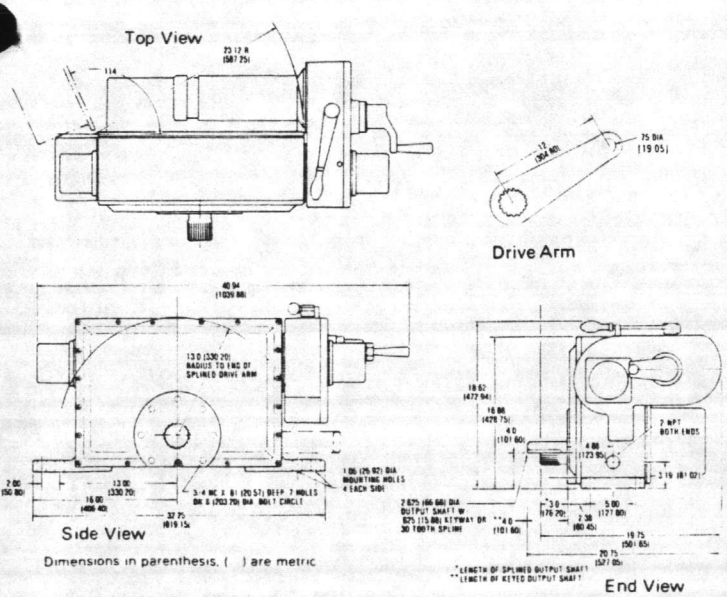
Dimensions in parenthesis, ( ) are metric

SM-5200 (1000 ft.-lbs. maximum)



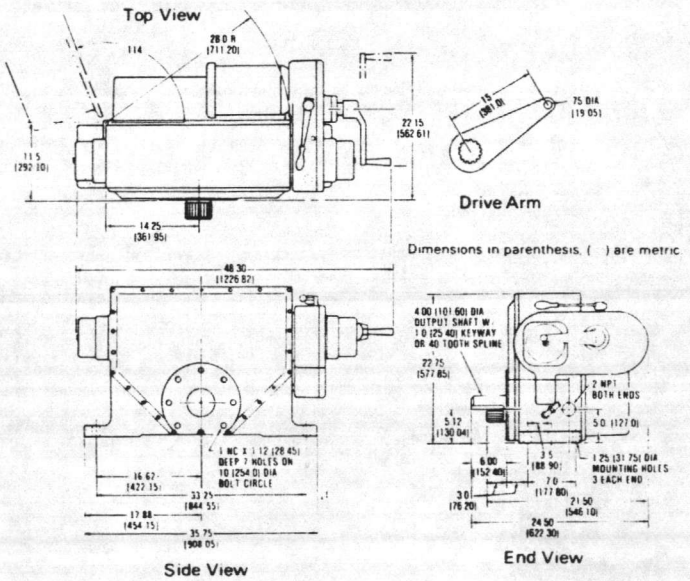
Dimensions in parenthesis, ( ) are metric

SM-5300 Series (3200 ft.-lbs. maximum)



Dimensions in parenthesis, ( ) are metric

SM-5400 Series (12,500 ft.-lbs. maximum)



Dimensions in parenthesis, ( ) are metric

WEIGHTS (POUNDS) (INCLUDING DRIVE ARM)

MODEL	BASIC WT.	WT. ON SKID	WT. IN CRATE
SM-5100	70	(80 LBS. IN STANDARD BOX)	
SM-5200	185	210	240
SM-5300	320	350	385
SM-5400	525	565	610

FOXBORO/JORDAN, INC.
5607 W. Douglas Avenue
Milwaukee, WI 53218
Tel: (414) 461-9200
Telex: 26-829

Bulletin J-497:10:79

FOXBORO®