00022532
2 of 2

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

100% SUBMITTAL
CALCULATIONS AND CUT SHEETS

VOLUME II OF II

FOR

PROJECT B-680H
PFP LIQUID LOW LEVEL WASTE SYSTEM MODIFICATION

HANFORD, WASHINGTON

FOR

WESTINGHOUSE HANFORD COMPANY

BY
KAISER ENGINEERS HANFORD COMPANY

MARCH 18, 1992

B-680 H

ICF
Kaiser Engineers

DESIGN CALCULATION INDEX

CALC. NO.	SHEET NO.
	1 of 1

JOB NUMBER	AREA OR BUILDING	CALCULATION DESCRIPTION	DISCIPLINE
91044-003		DESIGN LOAD CALCULATIONS AND EQUIPMENT SELECTION	MECH
JOB TITLE: Low Level Liq. Wst. Fac.			

CALCULATIONS APPLY TO DRAWINGS AND REVISIONS SHOWN

DRAWING	REV	DRAWING	REV	DRAWING	REV	DRAWING	REV

DESIGN ENGINEER	(SIGNATURE)	1-21-91 (DATE)	JOB ENGINEER	(SIGNATURE)	(DATE)
CALCULATIONS CHECKED	(SIGNATURE)	3/13/92 (DATE)	DESIGN SUPERVISOR	(SIGNATURE)	(DATE)
CALCULATIONS AGREE WITH DESIGN CRITERIA	(SIGNATURE)	(DATE)	CALCULATIONS AGREE WITH APPVD. VENDOR DWGS.	(SIGNATURE)	(DATE)

CALCULATION REVS	△	DATES	△	DATES	△	DATES	△	DATES
REVISION DESCRIPTION								
DESIGN ENGINEER								
CHECKER								
DESIGN SUPERVISOR								

STATUS:	PRELIMINARY	FINAL	CHECK	VOID	HOLD	OTHER

REASON FOR VOID OR HOLD:

INDEX

SHEET NO.	DESCRIPTION
1 Thru 4	DESIGN CONDITIONS
5 Thru 15	DESIGN CALCULATIONS
16 Thru 25	AIR CLEAN UP TRAIN
26 Thru 28	AIR CLEAN UP TRAIN EXHAUST FAN
29 Thru 34	UNIT HEATER SELECTION
35 THRU 39	A/C UNIT - PROCESS AREA & CHANGE ROOM
40 THRU 40	STACK HEIGHT CALCULATIONS
41A Thru 57	O.A. TRAIN FOR PROCESS AREA
58 Thru 61	AIR FLOW STATIONS & CONSTANT VOLUME CONTROLLER
62 THRU 69	PLUMBING CALCS AND CATALOG DATA.
70 THRU 86	ENERGY REPORT AND ANALYSIS
87 THRU 87	DRUM TURNING EXHAUST HOOD SIZE

ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 1 of 87

DESIGN CRITERIA

DESIGNED BY F. Lopez DATE 1-21-9

CHECKED BY TJJ DATE 1/21

DESIGN FACTORS

SUMMER[1]: 98°F DB, 66°F WB
WINTER[1]: 12°F DB
ELEVATION[1]: 392

AIR FACTOR: 1.08

INSIDE CONDITIONS

SUMMER: 80°F DB
WINTER: 45°F DB ALL AREAS EXCEPT CHANGING ROOM, 70°F DB CHANGING ROOM

OCCUPANTS

HEAVY WORK
SENSIBLE: 580 BTUH / person [2]
LATENT: 870 BTUH / person [2]

LIGHT BENCH WORK
SENSIBLE: 275 BTUH / PERSON [2]
LATENT: 475 BTUH / PERSON [2]

REF: [1] HANFORD PLANT STANDARDS - DESIGN CRITERIA
[2] 1989 ASHRAE FUNDAMENTALS

ICF KAISER ENGINEERS

JOB No. 91044-003

SHEET 2 OF 87

BUILDING "U" VALUES

DESIGNED BY F. Lopez DATE 1-11-9

CHECKED BY DT DATE 1/21/

WALL #1

	"R" VALUE
1. OUTSIDE AIR	0.17
2. METAL SKIN	0.00
3. 6" BATT INSUL	19.00
4. 5/8" GYPSUM BD	0.56
5. 3/8" PLYWOOD	0.47
6. INSIDE AIR	0.68
"R" TOTAL =	20.88

"U" VALUE = 1/"R" TOTAL

= 1/20.88

= 0.05 BTU/h·ft²°F

ROOF #1

	"R" VALUE
1. OUTSIDE AIR	0.17
2. METAL SKIN	0.00
3. 8" BATT INSUL	22.00
4. SUSPENDED CLG	1.25
5. INSIDE AIR	0.61
"R" TOTAL =	24.03

"U" VALUE = 1/"R" TOTAL

= 1/24.03

= 0.04 BTU/h·ft²°F

DOOR #1

1 3/4 INSULATED METAL DOOR W/ 2'x3' WIRE GLASS INSERT

GLASS 29%

	PERCENTAGE	"U" VALUE
FRAME	11%	1.26
EDGE	17%	1.11
CENTER	72%	1.11

"U" VALE = .11(1.26) + .17(1.11) + .72(1.11)

= 1.13 BTU/h·ft²°F

(CONTINUED)

CALCULATIONS KE Form No. E-6 Rev. 12-89

BUILDING "U" VALUES

DESIGNED BY F. Lopez DATE 1-11-9
CHECKED BY JT DATE 1/21/

DOOR #1

METAL DOOR 71%

"U" VALUE = 0.40 BTU/h·ft²°F

"U" VALUE = .71(.40) + .29(1.13) =
= 0.61 BTU/h·ft²°F

DOOR #2

METAL ROLL-UP DOOR (INSULATED)

R VALUE = 7

"U" VALUE
= 0.14 BTU/h·ft²°F

WALL #1 / DOOR #2

WALL = 104 ft² - 48 ft² = 56 ft² or 53.8%
DOOR = 6×8 = 48 ft² or 46.2%

0.538(0.05) + 0.462(0.14) = 0.09 BTU/h·ft²°F

REFERENCE
1989 ASHRAE FUNDAMENTALS

ICF KAISER ENGINEERS

Job No. 71044-003

Sheet 4 of 87

DESIGN REQUIREMENTS

DESIGNED BY F. Lopez DATE 1-17-9

CHECKED BY [illegible] DATE 1/21/

OUTSIDE AIR CONDITIONS

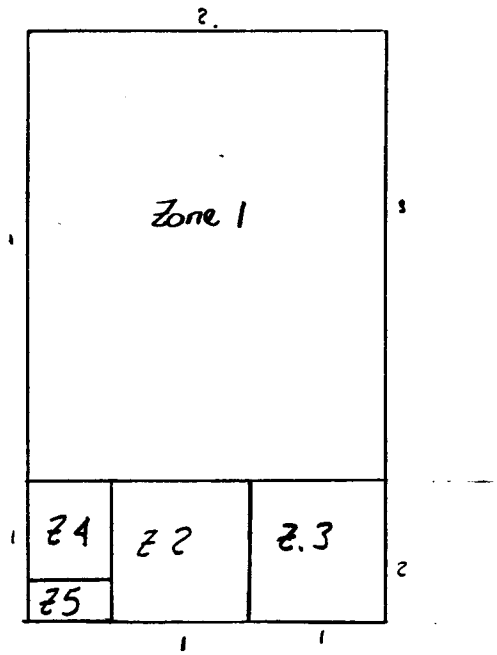
SUMMER - 98°F DB, 66°F WB
WINTER - 12°F DB

BUILDING CONDITIONS

ZONES #1,2,3,5 - 80°F COOLING, 45°F HEATING

ZONE #4 - 80°F COOLING, 70°F HEATING
ZONE #5 - NO HEATING, NO COOLING

N



CALCULATIONS KE Form No. E-6 Rev. 12-89

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***                                                               ***
***          L O A D   D E S I G N   A N A L Y S I S              ***
***                                                               ***
***                 by KAISER ENGINEERS INC.                      ***
***                                                               ***
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LOW LEVEL LIQUID WASTE FACILITY
HANFORD, WASHINGTON
U.S. DEPARTMENT OF ENERGY
FRANK LOPEZ

Weather File Code:	HANFORD
Location:	Richland,Washington
Created by:	Trane Co.
Latitude:	46.0 deg
Longitude:	119.0 deg
Time Zone:	8
Elevation:	392
*Summer Clearness No:	1.20
*Winter Clearness No:	.90
*Summer Design Dry Bulb:	98
*Summer Design Wet Bulb:	66
*Winter Design Dry Bulb:	12

(* = Entered by user)

Summer Ground Reflect	.20
Winter Ground Reflect	.20

Cooling Months Simulated: Apr through Sep
Cooling Load Method 1: 1972 ASHRAE TETD/TA

Time/Date Program Run:	11:48:56	4/22/91
Dataset Name:	H03LLLW	

6/87

SYSTEM SUMMARY

Syst #		OACfm	Air Quantities Cooling	Air Quantities Heating	Tons	Heating Mbh Extrnl	Heating Mbh Vent	Heating Mbh Reheat	Heating Mbh Total
1	PTAC	0	744	744	1.4	-16.6	.0	.0	-16.6
2	PTAC	0	126	126	.3	-1.3	.0	.0	-1.3
3	PTAC	0	148	148	.3	-2.0	.0	.0	-2.0
4	PTAC	0	203	203	.4	-1.4	.0	.0	-1.4
5	PTAC	0	21	21	.0	-.5	.0	.0	-.5
Totals		0	1242	1242	2.4	-21.7	.0	.0	-21.7

The building peaked at hour 16 month 7 with a capacity of 2.0 tons

ENGINEERING CHECKS

Syst #		% OA Cfm	Cooling Cfm/ Sq Ft	Cooling Cfm/ Ton	Cooling Sq Ft /Ton	Cooling Btuh /Sq Ft	Heating Cfm /Sq Ft	Heating Btuh /Sq Ft	Floor Sq Ft
1	PTAC	.0	.44	542.1	1225.7	9.79	.44	-9.86	1683
2	PTAC	.0	.59	472.3	798.3	15.03	.59	-6.01	214
3	PTAC	.0	.69	481.6	697.4	17.21	.69	-9.26	214
4	PTAC	.0	3.77	457.1	121.2	98.99	3.77	-25.12	54
5	PTAC	.0	.89	546.0	611.0	19.64	.89	-21.03	24
Av/Tot		.0	.57	511.3	899.3	13.34	.57	-9.92	2189

ZONE SUMMARY

Zone #	Description	Cooling ZnCfm	Cooling SADB	Cooling Cfm/ Sqft	Cooling Coil Mbh	Heating ZnCfm	Heating SADB	Heating Cfm/ Sqft	Heating Total Mbh
1	PROCESS PLANT	744	60.0	.44	16.5	744	65.3	.44	-16.6
Sys 1 Totals ------->		744			16.5	744			-16.6
2	DRUM WASHING	126	60.0	.59	3.2	126	54.2	.59	-1.3
Sys 2 Totals ------->		126			3.2	126			-1.3
3	DRUM TURNING	148	60.0	.69	3.7	148	57.2	.69	-2.0
Sys 3 Totals ------->		148			3.7	148			-2.0
4	CHANGING ROOM	203	60.0	3.76	5.3	203	76.1	3.76	-1.4
Sys 4 Totals ------->		203			5.3	203			-1.4
5	VESTIBULE	21	60.0	.88	.5	21	66.4	.88	-.5
Sys 5 Totals ------->		21			.5	21			-.5

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PEAK SPACE CLG LOADS

Zone #	Description	Time of Pk Mo/Hr	OA Condition DB/WB/OAW	Room DB	Zone Totals Sens & Lat	Zone Totals Btuh/ Sq Ft	Zone Totals Space Sens	Zone Totals Total Latent
1	PROCESS PLANT	7/16	97/66/ 50	80	16477	9.8	16361	116
Sys 1	Sum-of-the-Peaks Totals/Averages--->				16477	9.8	16361	116
	Block PTAC	7/16	97/66/ 50	80	16477	9.8	16361	116
2	DRUM WASHING	9/14	86/57/ 28	80	3224	15.0	2789	434
Sys 2	Sum-of-the-Peaks Totals/Averages--->				3224	15.0	2789	434
	Block PTAC	9/14	86/57/ 28	79	3224	15.0	2789	434
3	DRUM TURNING	7/14	97/66/ 51	80	3691	17.2	3256	434
Sys 3	Sum-of-the-Peaks Totals/Averages--->				3691	17.2	3256	434
	Block PTAC	7/14	97/66/ 51	80	3691	17.2	3256	434
4	CHANGING ROOM	4/ 6	41/34/ 19	80	5345	99.0	4475	869
Sys 4	Sum-of-the-Peaks Totals/Averages--->				5345	99.0	4475	869
	Block PTAC	4/ 6	41/34/ 19	80	5345	99.0	4475	869
5	VESTIBULE	7/16	97/66/ 50	80	471	19.6	471	0
Sys 5	Sum-of-the-Peaks Totals/Averages--->				471	19.6	471	0
	Block PTAC	7/16	97/66/ 50	80	471	19.6	471	0

Building Envelope

Zone #	Roof Space Sens	Roof RA Sens	Roof CLTD	Skylt Solar Sens	Skylt Solar CLF	Skylt Cond Sens	Skylt Cond CLTD	Part Sens	Part CLTD
1	1915	0	21.3	0	.000	0	.0	0	.0
Pk 1	1915	0	21.3	0	.000	0	.0	0	.0
Bk 1	1915	0	21.3	0	.000	0	.0	0	.0
2	26	0	3.1	0	.000	0	.0	0	.0
Pk 2	26	0	3.1	0	.000	0	.0	0	.0
Bk 2	26	0	3.1	0	.000	0	.0	0	.0
3	139	0	16.3	0	.000	0	.0	0	.0
Pk 3	139	0	16.3	0	.000	0	.0	0	.0
Bk 3	139	0	16.3	0	.000	0	.0	0	.0
4	-84	0	-39.0	0	.000	0	.0	3533	175.3
Pk 4	-84	0	-39.0	0	.000	0	.0	3533	175.3
Bk 4	-84	0	-39.0	0	.000	0	.0	3533	175.3
5	20	0	21.3	0	.000	0	.0	0	.0
Pk 5	20	0	21.3	0	.000	0	.0	0	.0
Bk 5	20	0	21.3	0	.000	0	.0	0	.0

Building Envelope

Zone #	Wall Space Sens	Wall RA Sens	Wall CLTD	Glass Solar Sens	Glass Solar CLF	Glass Cond Sens	Glass Cond CLTD	Xflr Sens	Xflr CLTD
1	4286	0	43.8	0	.000	0	.0	0	.0
Pk 1	4286	0	43.8	0	.000	0	.0	0	.0
Bk 1	4286	0	43.8	0	.000	0	.0	0	.0

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Building Envelope

Zone #	Wall Space Sens	Wall RA Sens	Wall CLTD	Glass Solar Sens	Glass Solar CLF	Glass Cond Sens	Glass Cond CLTD	Xflr Sens	Xflr CLTD
2	915	0	58.0	0	.000	0	.0	0	.0
Pk 2	915	0	58.0	0	.000	0	.0	0	.0
Bk 2	915	0	58.0	0	.000	0	.0	0	.0
3	1269	0	35.4	0	.000	0	.0	0	.0
Pk 3	1269	0	35.4	0	.000	0	.0	0	.0
Bk 3	1269	0	35.4	0	.000	0	.0	0	.0
4	-141	0	-39.2	0	.000	0	.0	0	.0
Pk 4	-141	0	-39.2	0	.000	0	.0	0	.0
Bk 4	-141	0	-39.2	0	.000	0	.0	0	.0
5	211	0	53.0	0	.000	0	.0	0	.0
Pk 5	211	0	53.0	0	.000	0	.0	0	.0
Bk 5	211	0	53.0	0	.000	0	.0	0	.0

Internal Loads

Zone #	Lites Space Sens	Lites RA Sens	Lites CLF	Peop Lat	Peop Sens	Peop CLF	Misc Equip Lat	Misc Equip Sens	Misc Equip CLF
1	5733	0	1.000	870	690	1.000	0	0	.000
Pk 1	5733	0	1.000	870	690	1.000	0	0	.000
Bk 1	5733	0	1.000	870	690	1.000	0	0	.000
2	1501	0	1.000	435	345	1.000	0	0	.000
Pk 2	1501	0	1.000	435	345	1.000	0	0	.000
Bk 2	1501	0	1.000	435	345	1.000	0	0	.000
3	1501	0	1.000	435	345	1.000	0	0	.000
Pk 3	1501	0	1.000	435	345	1.000	0	0	.000
Bk 3	1501	0	1.000	435	345	1.000	0	0	.000
4	477	0	1.000	870	690	1.000	0	0	.000
Pk 4	477	0	1.000	870	690	1.000	0	0	.000
Bk 4	477	0	1.000	870	690	1.000	0	0	.000
5	238	0	1.000	0	0	.000	0	0	.000
Pk 5	238	0	1.000	0	0	.000	0	0	.000
Bk 5	238	0	1.000	0	0	.000	0	0	.000

Zone #	Ventilation Cfm	Ventilation Sens	Ventilation Latent	Ventilation TD	Infiltration Cfm	Infiltration Sens	Infiltration Latent	Infiltration TD	Pulldown Sens	Pulldown TD
1	0	0	0	.0	200	3736	-753	17.0	0	.0
Pk 1	0	0	0	.0	200	3736	-753	17.0	0	.0
Bk 1	0	0	0	.0	200	3736	-753	17.0	0	.0
2	0	0	0	.0	0	0	0	.0	0	.0
Pk 2	0	0	0	.0	0	0	0	.0	0	.0
Bk 2	0	0	0	.0	0	0	0	.0	0	.0

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Zone #	Ventilation Cfm	Ventilation Sens	Ventilation Latent	Ventilation TD	Infiltration Cfm	Infiltration Sens	Infiltration Latent	Infiltration TD	Pulldown Sens	Pulldown TD
3	0	0	0	.0	0	0	0	.0	0	.0
Pk 3	0	0	0	.0	0	0	0	.0	0	.0
Bk 3	0	0	0	.0	0	0	0	.0	0	.0
4	0	0	0	.0	0	0	0	.0	0	.0
Pk 4	0	0	0	.0	0	0	0	.0	0	.0
Bk 4	0	0	0	.0	0	0	0	.0	0	.0
5	0	0	0	.0	0	0	0	.0	0	.0
Pk 5	0	0	0	.0	0	0	0	.0	0	.0
Bk 5	0	0	0	.0	0	0	0	.0	0	.0

10/87

PEAK HEATING LOADS

Zone #	Description	Time of Pk Mo/Hr	OA Condition DB/WB/OAW	Room DB	Zone Totals Sens & Lat	Btuh/ Sq Ft	Space Sens	Total Latent
1	PROCESS PLANT	13/24	12/ 0/ 0	45	-16593	-9.9	-16593	0
Sys 1	Sum-of-the-Peaks Totals/Averages--->				-16593	-9.9	-16593	0
2	DRUM WASHING	13/24	12/ 0/ 0	45	-1285	-6.0	-1285	0
Sys 2	Sum-of-the-Peaks Totals/Averages--->				-1285	-6.0	-1285	0
3	DRUM TURNING	13/24	12/ 0/ 0	45	-1981	-9.2	-1981	0
Sys 3	Sum-of-the-Peaks Totals/Averages--->				-1981	-9.2	-1981	0
4	CHANGING ROOM	13/24	12/ 0/ 0	70	-1356	-25.1	-1356	0
Sys 4	Sum-of-the-Peaks Totals/Averages--->				-1356	-25.1	-1356	0
5	VESTIBULE	13/24	12/ 0/ 0	45	-504	-21.0	-504	0
Sys 5	Sum-of-the-Peaks Totals/Averages--->				-504	-21.0	-504	0

Building Envelope

Zone #	Roof Space Sens	Roof RA Sens	Roof CLTD	Skylt Solar Sens	Skylt Solar CLF	Skylt Cond Sens	Skylt Cond CLTD	Part Sens	Part CLTD
1	-2962	0	-33.0	0	.000	0	.0	0	.0
Pk 1	-2962	0	-33.0	0	.000	0	.0	0	.0
2	-283	0	-33.0	0	.000	0	.0	0	.0
Pk 2	-283	0	-33.0	0	.000	0	.0	0	.0
3	-283	0	-33.0	0	.000	0	.0	0	.0
Pk 3	-283	0	-33.0	0	.000	0	.0	0	.0
4	-125	0	-58.0	0	.000	0	.0	-745	-37.0
Pk 4	-125	0	-58.0	0	.000	0	.0	-745	-37.0
5	-31	0	-33.0	0	.000	0	.0	0	.0
Pk 5	-31	0	-33.0	0	.000	0	.0	0	.0

Building Envelope

Zone #	Wall Space Sens	Wall RA Sens	Wall CLTD	Glass Solar Sens	Glass Solar CLF	Glass Cond Sens	Glass Cond CLTD	Xflr Sens	Xflr CLTD
1	-3229	0	-33.0	0	.000	0	.0	-3148	.0
Pk 1	-3229	0	-33.0	0	.000	0	.0	-3148	.0
2	-521	0	-33.0	0	.000	0	.0	-480	.0
Pk 2	-521	0	-33.0	0	.000	0	.0	-480	.0
3	-1182	0	-33.0	0	.000	0	.0	-515	.0
Pk 3	-1182	0	-33.0	0	.000	0	.0	-515	.0
4	-208	0	-58.0	0	.000	0	.0	-276	.0
Pk 4	-208	0	-58.0	0	.000	0	.0	-276	.0

11/87

Building Envelope

Zone #	Wall Space Sens	Wall RA Sens	Wall CLTD	Glass Solar Sens	Glass Solar CLF	Glass Cond Sens	Glass Cond CLTD	Xflr Sens	Xflr CLTD
5	-132	0	-33.0	0	.000	0	.0	-341	.0
Pk 5	-132	0	-33.0	0	.000	0	.0	-341	.0

Internal Loads

Zone #	Lites Space Sens	Lites RA Sens	Lites CLF	Peop Lat	Peop Sens	Peop CLF	Misc Equip Lat	Misc Equip Sens	Misc Equip CLF
1	0	0	.000	0	0	.000	0	0	.000
Pk 1	0	0	.000	0	0	.000	0	0	.000
2	0	0	.000	0	0	.000	0	0	.000
Pk 2	0	0	.000	0	0	.000	0	0	.000
3	0	0	.000	0	0	.000	0	0	.000
Pk 3	0	0	.000	0	0	.000	0	0	.000
4	0	0	.000	0	0	.000	0	0	.000
Pk 4	0	0	.000	0	0	.000	0	0	.000
5	0	0	.000	0	0	.000	0	0	.000
Pk 5	0	0	.000	0	0	.000	0	0	.000

Zone #	Ventilation Cfm	Ventilation Sens	Ventilation Latent	Ventilation TD	Infiltration Cfm	Infiltration Sens	Infiltration Latent	Infiltration TD	Pickup Sens	Pickup TD
1	0	0	0	.0	200	-7252	0	-33.0	0	.0
Pk 1	0	0	0	.0	200	-7252	0	-33.0	0	.0
2	0	0	0	.0	0	0	0	.0	0	.0
Pk 2	0	0	0	.0	0	0	0	.0	0	.0
3	0	0	0	.0	0	0	0	.0	0	.0
Pk 3	0	0	0	.0	0	0	0	.0	0	.0
4	0	0	0	.0	0	0	0	.0	0	.0
Pk 4	0	0	0	.0	0	0	0	.0	0	.0
5	0	0	0	.0	0	0	0	.0	0	.0
Pk 5	0	0	0	.0	0	0	0	.0	0	.0

12/87

SYSTEM 1 PTAC CLG SPACE LOAD PEAK CHECKSUMS

Envelope	Space Sens	Space Latent	Space Sen+Lat	Tot RA Sens	Exh RA Sens	Net Total	% of Total
Sksolr	0		0			0	.00
Skcond	0		0	0	0	0	.00
Rfcond	1915		1915	0	0	1915	11.62
Glsolr	0		0			0	.00
Glcond	0		0			0	.00
Wlcond	4286		4286	0	0	4286	26.01
Xfcond	0		0			0	.00
Infil	3736	-753	2983			2983	18.10
Total	9937	-753	9184	0	0	9184	55.74
Internal							
Lights	5733		5733	0	0	5733	34.79
People	690	870	1560			1560	9.47
Misc	0	0	0			0	.00
Part	0		0			0	.00
Total	6423	870	7293	0	0	7293	44.26
Pulldown	0		0			0	.00
OA Load	0	0	0			0	.00
SFan Heat						0	.00
RFan Heat				0	0	0	.00
Duct Heat				0	0	0	.00
Sizing	0		0			0	.00
TOTALS	16360	117	16477	0	0	16477	100.00

SYSTEM 2 PTAC CLG SPACE LOAD PEAK CHECKSUMS

Envelope	Space Sens	Space Latent	Space Sen+Lat	Tot RA Sens	Exh RA Sens	Net Total	% of Total
Sksolr	0		0			0	.00
Skcond	0		0	0	0	0	.00
Rfcond	26		26	0	0	26	.81
Glsolr	0		0			0	.00
Glcond	0		0			0	.00
Wlcond	915		915	0	0	915	28.40
Xfcond	0		0			0	.00
Infil	0	0	0			0	.00
Total	941	0	941	0	0	941	29.21
Internal							
Lights	1501		1501	0	0	1501	46.59
People	345	435	780			780	24.21
Misc	0	0	0			0	.00
Part	0		0			0	.00
Total	1846	435	2281	0	0	2281	70.79
Pulldown	0		0			0	.00
OA Load	0	0	0			0	.00
SFan Heat						0	.00
RFan Heat				0	0	0	.00
Duct Heat				0	0	0	.00
Sizing	0		0			0	.00
TOTALS	2787	435	3222	0	0	3222	100.00

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SYSTEM 3 PTAC CLG SPACE LOAD PEAK CHECKSUMS

Envelope	Space Sens	Space Latent	Space Sen+Lat	Tot RA Sens	Exh RA Sens	Net Total	% of Total
Sksolr	0		0			0	.00
Skcond	0		0	0	0	0	.00
Rfcond	139		139	0	0	139	3.77
Glsolr	0		0			0	.00
Glcond	0		0			0	.00
Wlcond	1269		1269	0	0	1269	34.40
Xfcond	0		0			0	.00
Infil	0	0	0			0	.00
Total	1408	0	1408	0	0	1408	38.17
Internal							
Lights	1501		1501	0	0	1501	40.69
People	345	435	780			780	21.14
Misc	0	0	0			0	.00
Part	0		0			0	.00
Total	1846	435	2281	0	0	2281	61.83
Pulldown	0		0			0	.00
OA Load	0	0	0			0	.00
SFan Heat						0	.00
RFan Heat				0	0	0	.00
Duct Heat				0	0	0	.00
Sizing	0		0			0	.00
TOTALS	3254	435	3689	0	0	3689	100.00

SYSTEM 4 PTAC CLG SPACE LOAD PEAK CHECKSUMS

Envelope	Space Sens	Space Latent	Space Sen+Lat	Tot RA Sens	Exh RA Sens	Net Total	% of Total
Sksolr	0		0			0	.00
Skcond	0		0	0	0	0	.00
Rfcond	-84		-84	0	0	-84	-1.57
Glsolr	0		0			0	.00
Glcond	0		0			0	.00
Wlcond	-141		-141	0	0	-141	-2.64
Xfcond	0		0			0	.00
Infil	0	0	0			0	.00
Total	-225	0	-225	0	0	-225	-4.21
Internal							
Lights	477		477	0	0	477	8.92
People	690	870	1560			1560	29.19
Misc	0	0	0			0	.00
Part	3533		3533			3533	66.10
Total	4700	870	5570	0	0	5570	104.21
Pulldown	0		0			0	.00
OA Load	0	0	0			0	.00
SFan Heat						0	.00
RFan Heat				0	0	0	.00
Duct Heat				0	0	0	.00
Sizing	0		0			0	.00
TOTALS	4475	870	5345	0	0	5345	100.00

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SYSTEM 5 PTAC CLG SPACE LOAD PEAK CHECKSUMS

Envelope	Space Sens	Space Latent	Space Sen+Lat	Tot RA Sens	Exh RA Sens	Net Total	% of Total
Sksolr	0		0			0	.00
Skcond	0		0	0	0	0	.00
Rfcond	20		20	0	0	20	4.26
Glsolr	0		0			0	.00
Glcond	0		0			0	.00
Wlcond	211		211	0	0	211	44.99
Xfcond	0		0			0	.00
Infil	0	0	0			0	.00
Total	231	0	231	0	0	231	49.25
Internal							
Lights	238		238	0	0	238	50.75
People	0	0	0			0	.00
Misc	0	0	0			0	.00
Part	0		0			0	.00
Total	238	0	238	0	0	238	50.75
Pulldown	0		0			0	.00
OA Load	0	0	0			0	.00
SFan Heat						0	.00
RFan Heat				0	0	0	.00
Duct Heat				0	0	0	.00
Sizing	0		0			0	.00
TOTALS	469	0	469	0	0	469	100.00

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BUILDING U-VALUES/AREAS

Zone #	Description	U-Values Part	Xflr	Skyl	Roof	Glas	Wall	%Wall to-RA	Zone Mass	Zone Capac
1	PROCESS PLANT	.000	.000	.000	.040	.000	.050	.0	26.3	9.4
Sys 1	PTAC	.000	.000	.000	.040	.000	.050	.0	26.3	9.4
2	DRUM WASHING	.000	.000	.000	.040	.000	.090	.0	20.8	7.8
Sys 2	PTAC	.000	.000	.000	.040	.000	.090	.0	20.8	7.8
3	DRUM TURNING	.000	.000	.000	.040	.000	.090	.0	29.0	10.1
Sys 3	PTAC	.000	.000	.000	.040	.000	.090	.0	29.0	10.1
4	CHANGING ROOM	.420	.000	.000	.040	.000	.050	.0	39.0	11.8
Sys 4	PTAC	.420	.000	.000	.040	.000	.050	.0	39.0	11.8
5	VESTIBULE	.000	.000	.000	.040	.000	.050	.0	40.6	13.4
Sys 5	PTAC	.000	.000	.000	.040	.000	.050	.0	40.6	13.4
Tot/Av		.420	.000	.000	.040	.000	.059	.0	26.5	9.4

Zone #	#Duplic Flr	Zn	Flr/Zn	TotFlr	Areas Part	Xflr	Skyl	%Sk	Roof	Glass	%Gl	Wall
1	1	1	1683	1683	0	0	0	0	2244	0	0	1957
Sys 1				1683	0	0	0	0	2244	0	0	1957
2	1	1	214	214	0	0	0	0	214	0	0	175
Sys 2				214	0	0	0	0	214	0	0	175
3	1	1	214	214	0	0	0	0	214	0	0	398
Sys 3				214	0	0	0	0	214	0	0	398
4	1	1	54	54	48	0	0	0	54	0	0	72
Sys 4				54	48	0	0	0	54	0	0	72
5	1	1	24	24	0	0	0	0	24	0	0	80
Sys 5				24	0	0	0	0	24	0	0	80
Tot/Av				2190	48	0	0	0	2751	0	0	2683

VENTILATION REQUIREMENTS

DESIGNED BY F. Lopez DATE 1-14-9
CHECKED BY TJT DATE 1/21/9

DESIGN CRITERIA (EXISTING)

VENTILATION CFM = 1200

BUILDING VOLUME = 40965 CU FT.

VOLUME X AIR CHANGES = CFM

40965 X A.C = 1200

A.C = 1200/40965

A.C. = 0.03 X 60 min.

A.C = 1.8 AIR CHANGES PER HOUR (A.C/HR)

USE 3.0 AC/HR

NEW BUILDING

BUILDING VOLUME = 28,944 CUFT

A.C/hr = CFM/VOL.

3.0/60 = CFM/28,944

.05 X 28,944 CFM

CFM = 1447 USE 1600 CFM

BLDG. VOLUME (NEW)

ZONE #1 - 51' X 33' X 13.5 = 22720.5 CU/FT
ZONE #2 - 13' X 16.5' X 13.5 = 2895.8 CU/FT
ZONE #3 - 13' X 16.5' X 13.5 = 2895.8 CU/FT
ZONE #4 - 6' X 9' X 8 = 432 CU/FT
ZONE #5 - Ø = Ø CU/FT

TOTAL = 28,944 CU/FT

TOTAL AIRFLOW = 1600 CFM

1) HEPA FILTER PLENUM

E-5 1X2 GG-F2 (304) TYPE 1

FILTER HOUSING 1X2: ONE HIGH BY TWO WIDE BY 12" THICK FILTERS

(A). FILTER CFM CAPACITY: 1000 CFM

(B) PROVIDE WITH PREFILTER & HEPA SECTIONS

2) HEPA FILTER: FLANDERS MODEL 007-8-03-007-8-03-05-NU, GG-F, GASKET UPSTREAM ONLY. FRAME FOR FLUID SEAL. 24"x24" X 11½" DEEP, 1000 CFM CAPACITY W/A MAXIMUM STATIC PRES. DROP OF 1.0" W.G.

GFI 9/23/91 TJ

3. PREFILTER: FLANDERS MODEL J-2 24-24 2C2 PLEATED MEDIA FILTER WITH A PRESSURE DROP OF 0.1" WG.

4. FILTER TRAIN PRESSURE DROP

PREFILTER	0.10
HEPA FILTER (1" WG CLEAN) DIRTY	2.00
	2.10" WG

CALCULATIONS KE Form No. E-6 Rev. 12-89

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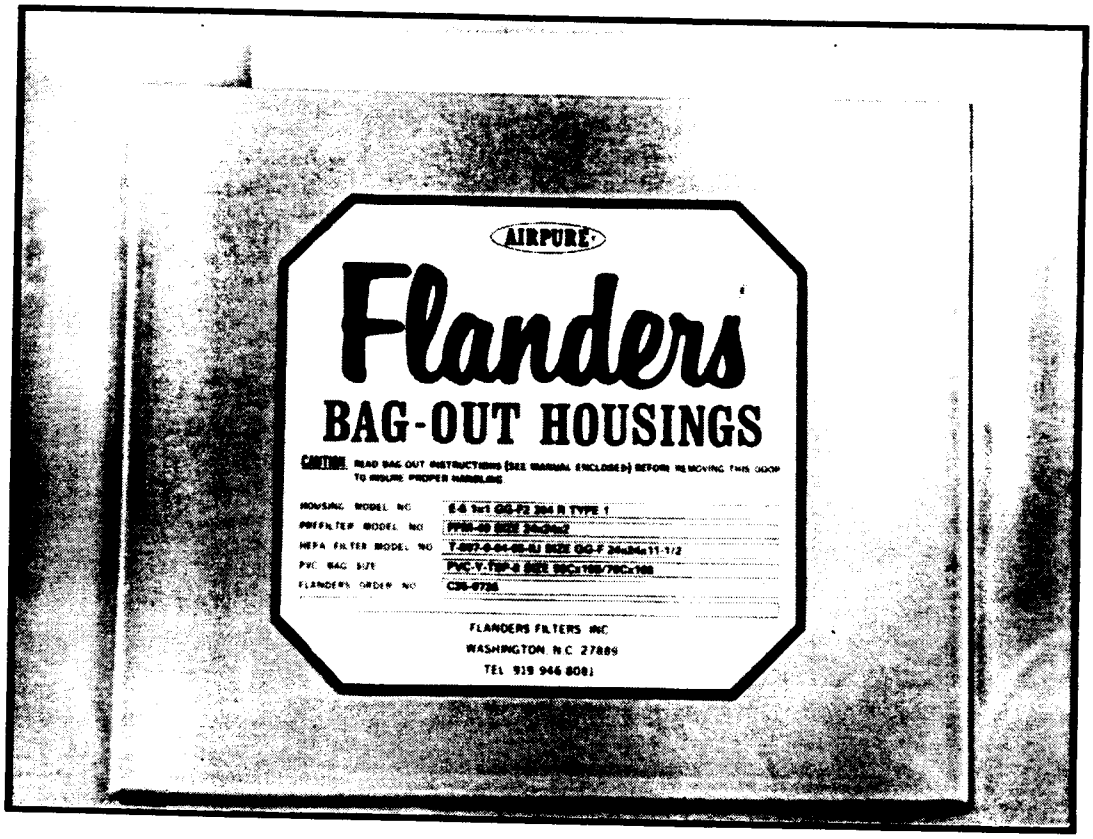
Flanders®



E-5 Bag-Out Containment Housings

(Hepa Filters, Prefilters and Adsorbers)

- ***Bag-In/Bag-Out Side Access Filter Housings***
- ***Prevents Direct Operator Contact with Contaminated Filters***
- ***Replaceable Stainless-Steel Filter Locking Mechanism***
- ***Generic Seismic Qualification***

Bulletin No. 866A

Fluid Seal

sample and a 2" half-coupling with plug for the DOP inlet (to be installed by others). All connections shall be type 304 stainless steel.

NOTE: The downstream sample port and the DOP inlet shall be located (unobstructed) ten duct diameters down and upstream (respectively) of the filter bank.*

7. Lifting Lugs

Lifting lugs shall be located on the top of each housing. They shall be 3/16" thick, type 304 stainless steel with a 2" diameter lifting eye.

8. Drilled Flanges

Drilled flanges shall be provided in the Flanders' standard pattern or according to owner's requirements **(owner to specify pattern)**. The bolt holes shall be 7/16" diameter drilled in the housing flanges on the air-entering and air-exiting sides of the housing. The flanges shall be reinforced with flat stock of the same type material as the housing so that the housing and the reinforcement have a combined minimum thickness of 1/4". The spacing shall be the manufacturer's standard bolt-hole pattern, not to exceed 4" between bolt holes on center (per ERDA 76-21, Section 4.5.3).

***See Test Housing Information, Page 31**

9. Custom-Engraved Plates

Standard housings include the housing model number, the prefilter model number and the original Flanders order number. If specified there is room for the owner's system number. Where additional information is needed the owner or his design engineer can furnish the information to Flanders and custom-engraved plates can be furnished.

Custom-engraved plates shall be made from polished stainless steel and shall be permanently welded to the housing. Lettering height shall be 1/8"

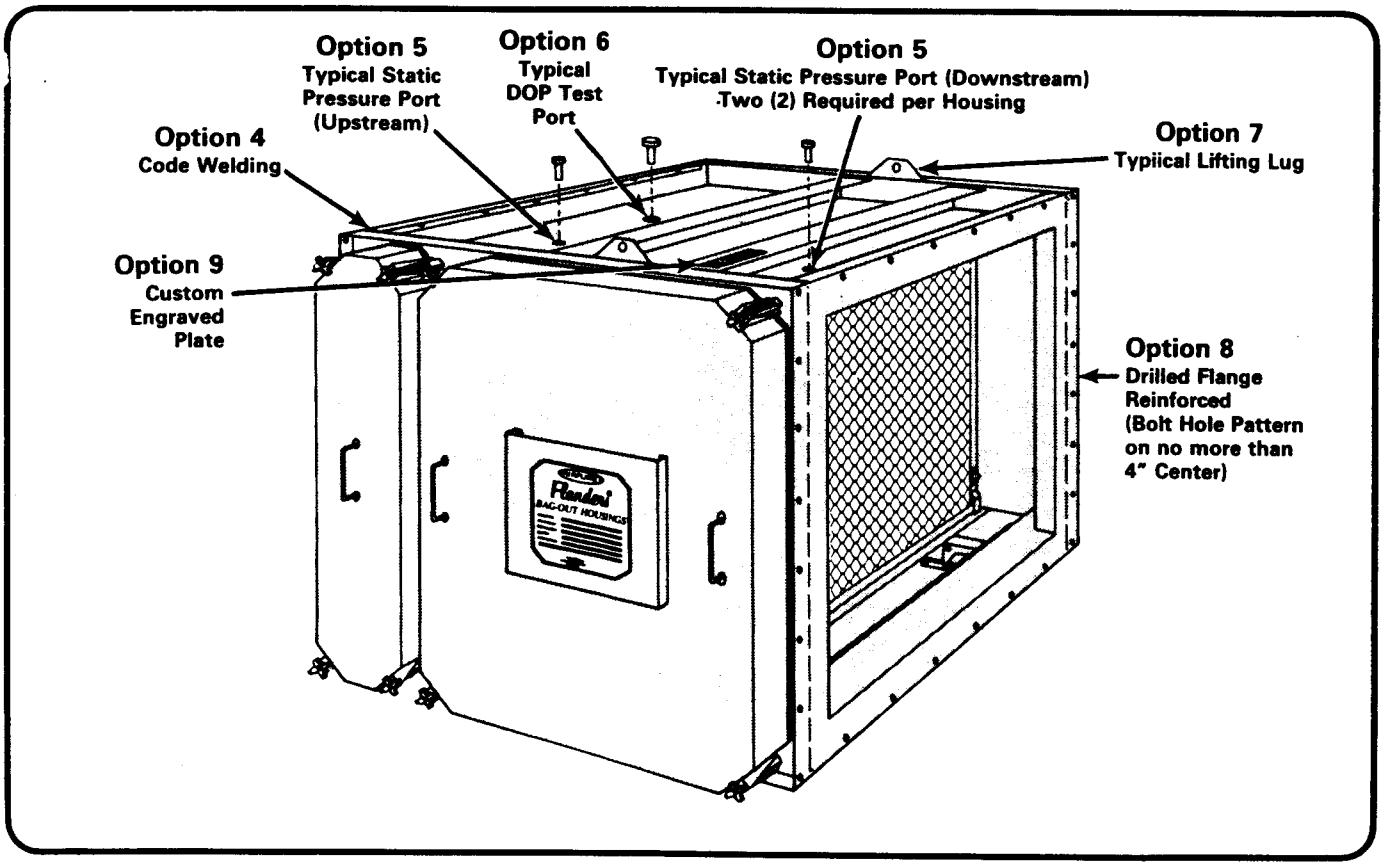


Figure 13 - Options 4 - 9

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E-5 Housing Component and Designating Code

Housing Model Number	Housing Size Designator* (Filters High x Wide)	Height A	Width B	Depth C: Standard Filters Only GG-F	Depth C: Standard Filters With Prefilters GG-F2, 4 or 6**	Housing Material	Left or Right-Hand Access	Type of Housing
E-5	1 x 1	30"	27-¼"	24"	36-1/2"	11 & 14-Gauge Type (304 & 304L) Stainless Steel [11 & 14-Gauge Type (316 & 316L) Stainless Steel Also Available Upon Special Request]	L or R	Type 1 or Type 3
	1 x 2		51-¼"					
	1 x 3		75-¼"					
	2 x 1	60"	27-¼"					
	2 x 2		51-¼"					
	2 x 3		75-¼"					
	3 x 1	90"	27-¼"					
	3 x 2		51-¼"					
	3 x 3		75-¼"					
	4 x 1	120"	27-¼"					
	4 x 2		51-¼"					
	4 x 3		75-¼"					

How to Order

Example: E-5 2x2 GG-F2 (304) L Type 1

*Special sizes are available upon special request.

**NOTE: 6" deep prefilters gasketed downstream only, 2" and 4" prefilters are not gasketed.

- **E-5** — Housing Model Number
- **2 x 2** — Two Filters High by Two Filters Wide
- **GG-F2** — Standard Filters and 2" Prefilters
- **(304)** — 14-Gauge, Type 304 Stainless Steel (Housing Material)
- **L** — Left-Hand Access
- **Type 1** — Type of Door Arrangement

Additional E-5 Information

Housing Size Designator (Filters High x Wide)	Based on 1000 CFM Per Filter	Based on 1200 CFM Per Filter	Based on 1500 CFM Per Filter
1 x 1	1000	1200	1500
1 x 2	2000	2400	3000
1 x 3	3000	3600	4500
2 x 1	2000	2400	3000
2 x 2	4000	4800	6000
2 x 3	6000	7200	9000
3 x 1	3000	3600	4500
3 x 2	6000	7200	9000
3 x 3	9000	10800	13500
4 x 1	4000	4800	6000
4 x 2	8000	9600	12000
4 x 3	12000	14400	18000

Type 1 Housing: The standard E-5 Housing has an access door on one side and a flanged plate on the other. The owner must specify left or right-hand access.

Type 3 Housing: This housing consists of two side-by-side housings in parallel. Access to the filters and operation of the filter removal rod is from both sides of the parallel housings (see page 8).

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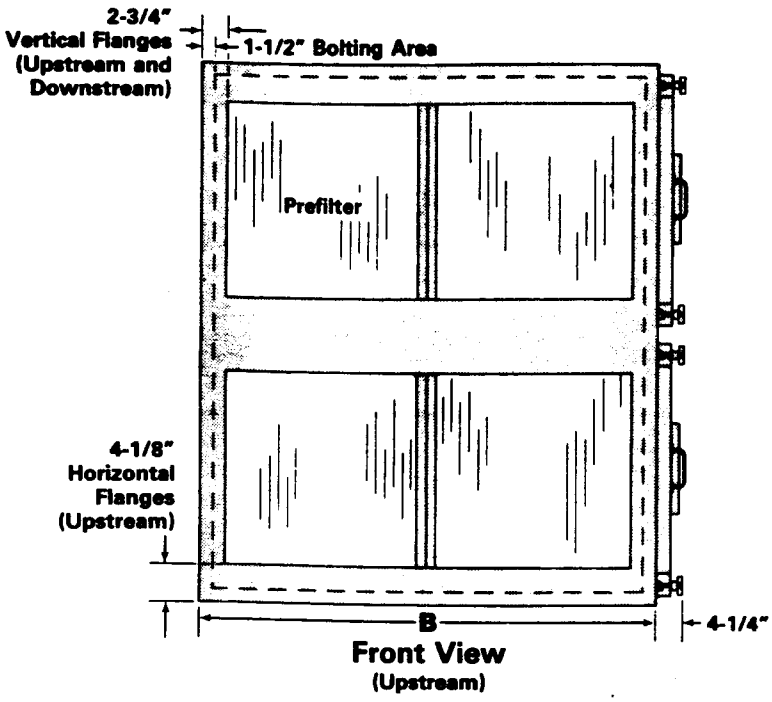
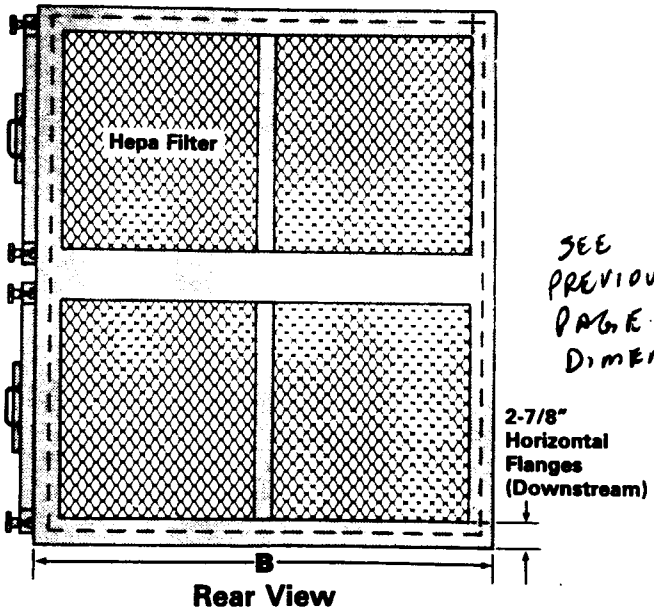
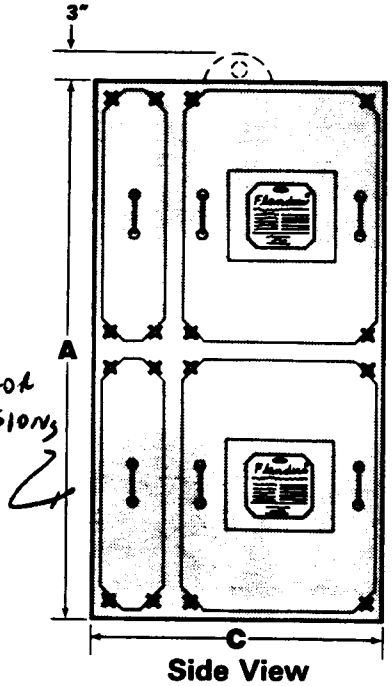


Approximate Weight in Pounds

Housing Size Designator Filters High x Wide	GG-F Without Prefilter Track	GG-F2, 4 or 6 With Prefilter Track
1 x 1	180	300
1 x 2	270	375
1 x 3	335	480
2 x 1	360	600
2 x 2	540	750
2 x 3	670	960
3 x 1	540	900
3 x 2	810	1125
3 x 3	1005	1400
4 x 1	720	1200
4 x 2	1080	1500
4 x 3	1340	1920



SEE PREVIOUS PAGE FOR DIMENSIONS



NOTE: A clearance of five feet is suggested for filter change-out

Figure 20 - E-5 1 x 2 Filter Housing

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The filter-to-housing seal shall be effected by means of a continuous knife edge on the sealing frame of the housing that mates to a continuous perimerter channel on the face of the filter which has been filled with a viscous, no-drying fluid.

Prior to shipment from the factory each housing shall be blanked off at the inlet and the outlet and shall be tested by the pressure decay method in accordance with ANSI-N510-1980 to 10" w.g. as specified in ANSI-N509-1980, Table 4-4. Following this test, each filter position shall be fitted with a plug and the filter-to-housing seal shall be tested by the pressure decay method in accordance with ANSI-N510-1980 to 10" w.g. as specified in ANSI-N509-1980, Table 4-4.

The prefilters, filters, bags, straps and instruction manual shall be shipped in separate containers from the housing.

Suggested Specifications for Standards Options

(E-5 and E-5C Housings)

Alternate Door Arrangements

The housing shall be **(specify one) Type 1 or Type 3.**

Type 1 Housing: The standard E-5 Housing has an access door on one side and a flanged plate on the other. The owner must specify left or right-hand access.

Type 3 Housinng: This housing consist of two side-by-side housings in parallel. Access to the filters and operation of the filter removal rod is from both sides of the parallel housings. This arrangement is used when there are more than three filters wide in the bank. Housings are welded together at the factory.

Weather Cap

For outdoor service, a weather cap shall be provided and shall be welded (and sealed with silastic) to the top of each housing. It shall be fabricated of the same materials and shall have the same finish as the housing.

ZD-Series Low-Leak Damper

The ZD-Series Low-Leak Damper shall be designed to porvide virtually leak-free performance by utilizing two sets of expanding blades. Each blade shall have its own drive shaft and shall be manually operated. A cam device shall be provided on the drive shaft to maintain blade pressure against the sealing surface. The damper shall be designed to mount to the flange of the 1 x 1, 1 x 2 and 1 x 3 housings for shut off of one or more tiers during filter change. The tight shut off feature shall allow the filter change to take place without the operator being hampered by the negative pressure usually present inside the system, which causes the bag to collapse. (Contact factory representative for design details).

Code Welding

All welding shall be performed by qualified welders and procedures shall be in accordance with ASME Section IX as specified in ANSI-N509-1980, Paragraph 7.3.

Static-Pressure Ports

Static-pressure ports shall be located on the top of the housing upstream and downstream of the prefilters and hepa filters. Connections shall be 1/4", IPS pipe nipple with cap, type 304 stainless steel. **(Specify quantity and arrangement)**

DOP Test Ports

An upstream sample port, 1/2" IPS pipe nipple with cap, shall be welded to the top of the housing upstream of the first hepa filter. Flanders shall also supply a second 1/2" half-coupling with plug for the downstream

(Continued)

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Suggested Specifications

(E-5 and E-5C Housings)

The filter housing shall be Flanders Model E-5 or E-5C as manufactured by Flanders Filters, Inc., Washington, NC. It shall be constructed from 11- and 14-gauge Type 304 and 304L stainless steel. (11- and 14-gauge Type 316 and 316L stainless steel shall also be available upon special request.) The housing shall be a side-servicing bank type arrangement that does not require the air to change direction through the housing as it enters or exits the housing. The housing shall be 100% seam-welded on all joints across the pressure boundaries and shall be reinforced to withstand up to 20" w.g. positive or negative pressure. All joints and seams shall be welded airtight and free of all burrs and sharp edges (where applicable). All mechanical components and filter slide plates shall be Type 304 stainless steel.

The housing shall have a removable access door for each tier of filters and, where prefilters are required, a separate access door for the prefilters. Both the removal rod and locking arm shall be operated through the door opening. A rubber lip on the perimeter of the door shall effect a seal between the housing and the access door. There shall be four tie down latches per access door and they shall be spring loaded in such a manner that they pivot away from the bag-out port after release so that they do not impede the bag-out process. The filter locking mechanism and access door shall interface in such a manner that the door cannot be closed until the filters are correctly seated in the housing and sealed on the knife edge. Each door shall be equipped with a metal pocket for the housing instruction manual which shall be provided with the housing and shall contain complete, detailed and separate instructions on the one, two or three filter wide arrangements including installation, operation, maintenance and spare parts. The manual shall be contained in a weatherproof bag. Each metal pocket on the access door shall have a painted aluminum label with the manufacturer's name, the housing model number, prefilter model number, filter model number, PVC bag number(s), manufacturer's order number and (where specified) the owner's ventilation system number permanently engraved on the label to facilitate re-ordering of critical replacement components and parts.

On the upstream side of each prefilter and filter position there shall be a smooth inlet design that provides a minimum 3/4" depth recess around the upstream perimeter of the prefilter or filter to limit the buildup of contaminants in crevices or fillets that would have been caused by the junction of the filter's integral frame and the housing wall. All flanges of the housing that connect to the system shall turn to the outside and bolt connections to the ductwork shall be in accordance with the manufacturer's instructions.

The filter locking mechanism in the housing shall be a replaceable locking tray. All components of the filter locking mechanism shall be type 300 series stainless steel. All housings shall have a locking arm in each tier to operate the mechanism which engages and disengages the filters on the internal sealing frame. Housings with two or more filters in a tier shall have a removal rod in each tier to draw the filters to the changeout position. The rod is part of the filter locking mechanism and shall be replaceable.

Each tier shall have a bag-out port inside the access door which shall be hemmed on its outer edges to prevent tearing of the bag. There shall be two continuous ribs on the outside of the port to hold the bag's elastic shock cord and the safety strap during the bag-out operation. Each E-5 and E-5C Housing is provided with a durable, 8 mil, transparent yellow PVC bag. The bag shall have an elastic shock cord hemmed into the opening for a firm fit when stretched around the bag-out port. Mittens are incorporated into the bag for added convenience and safety. Each bag shall have its stock number rolled into the hem for easy identification when reordering. The bag shall have a smooth finish and shall not stick together. A nylon safety strap shall be provided with each bag-out port to prevent the bag from slipping off during the bag-out procedure. A cinching strap shall also be provided with each bag-out port to tie off the slack in the bag while the ventilation system is operating.

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sample and a 2" half-coupling with plug for the DOP inlet (to be installed by others). All connections shall be type 304 stainless steel.

NOTE: The downstream sample port and the DOP inlet should be located (unobstructed) ten duct diameters down and upstream (respectively) of the filter bank.

Lifting Lugs

Lifting lugs shall be provided for the top of each housing. They are 3/16" thick, type 304 stainless steel with a 2" diameter lifting eye.

Drilled Flanges

Flanges shall be drilled in the Flanders' standard pattern or according to owner's requirements **(owner to specify pattern).** The bolt holes shall be 7/16" diameter drilled in the housing flanges on the air-entering and air-exiting sides of the housing. The flanges shall be reinforced with flat stock of the same type material as the housing so that the housing and the reinforcement shall have a minimum thickness of 1/4". The spacing is the manufacturer's standard bolt-hole pattern, not to exceed 4" between bolt holes on center (per ERDA 76-21, Section 4.5.3).

Custom-Engraved Plates

Standard housings include the housing model number, the prefilter model number and the original Flanders order number. If specified there is room for the owner's system number. Where additional information is needed the owner or his design engineer can furnish the information to Flanders and custom-engraved plates shall be furnished.

Custom-engraved plates shall be made from polished stainless steel and shall be permanently welded to the housing. Lettering height shall be 1/8".

Generic Seismic Qualification

The housing shall have passed a generic seismic test during which the hepa filters have been installed in the housing and have been continuously tested for efficiency per ANSI-N510-1975, Section 10 or Section 12 concurrent with the seismic shake table test. The manufacturer shall provide evidence that the filters and housings have passed both seismic and in-place DOP testing as specified and these results shall be compared with the seismic loading requirements for the owner's facility and plant site to assure that the seismic qualification requirements are satisfied. Filter housing model numbers shall be identified by the prefix, "SEISMIC"

Welding Housings Together

Housings shall be joined together vertically, in parallel and/or in series to make up larger systems and/or filter trains. All joints are welded airtight and conform to standard welding procedures.

NOTE: Housings to be welded together at the factory are to be within the limitations of shipping vehicles and access to owner's facilities.

Filter Removal Tray

A removable bag-out tray shall be provided to support the filter that is being removed from the housing and the replacement filter during the change-out procedure. The shelf shall be fastened to the housing by means of the door latches following the removal of the door.

Low Leak Test

The pressure decay leak test of both the housing and of the filter-to-housing seal at each filter position shall be performed in two separate tests in accordance with ANSI-N510-1980 and the Nuclear Air Cleaning Handbook, ERDA 76-21, Table 4-5. The leak rate shall not be greater than 0.2% of the volume of the housing per hour at 10" w.g.

NOTE: This low leak test is offered as an alternate to the leak test described in the Construction Details and Specifications, e.g. the pressure-decay method per ANSI-N510-1980 which is considerably less stringent than the leak test required in the Nuclear Air Cleaning Handbook, ERDA 76-21, Table 4.5 for all welded, man entry steel housings. (There is no category for multiple filter, side-servicing housings.) The comparison of the respective permissable leak rates is 1:651.

Banding Kit No. 1A

Flanders' Banding Kit No. 1A shall be provided to facilitate in the secure clamping off of the bag between the housing and the spent filter.

NOTE: Flanders developed this banding kit as an alternative to heat sealing which is difficult to execute. The banding procedure is described in detail in the **Installation, Operation, Maintenance and Spare Parts Manual.**

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ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 25 of 87

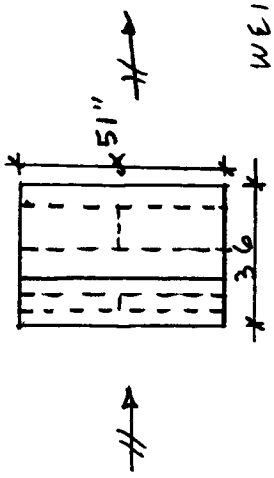
HEPA FILTER

FILTER LAYOUT.

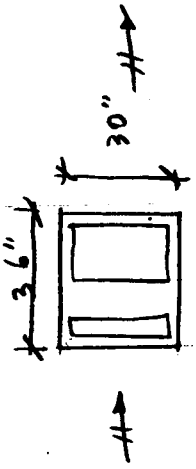
DESIGNED BY TJT DATE 4/23/9

CHECKED BY F.Lopez DATE 5/21/

WEIGHT = 450 LBS
WITH FILTERS



PLAN



SIDE

ICF KAISER ENGINEERS

JOB NO. 91044-003

SHEET 26 OF 87

AIR CLEAN UP TRAIN
EXHAUST FAN

DESIGNED BY F. Lopez DATE 1-21-9

CHECKED BY TJ DATE 1/21/9

STATIC PRESSURE

ITEM	S.P. IN INCHES WATER
EXHAUST GRILLE	0.22
DUCTWORK (125 FEET) 125 * .5/100	0.625
CLEAN-UP TRAIN (SEE CALCULATIONS, SHT 19)	2.10
O.A. INTAKE (SEE CALCS SHT 41	0.78
HOOD ENTRY LOSS (.25x.25)	0.063
EXHAUST FAN ENTRY LOSS	0.66
EXHAUST FAN DISCHARGE LOSS $K(VP) = .5(.25)$	0.125
DISCHARGE STACK LOSS $K(VP_0 - VP_1) = .25(.64 - .25) = .1$	0.100
SUBTOTAL =	4.673
10% S.F =	.467
TOTAL =	5.140

USE = 5.25 W.G

SELECT:

MAN. : GREENHECK

MODEL: BISW CLASS I

SIZE: 12

RPM: 3164

TIP SPEED: 10,156

BHP: 2.5

HP: 3 HP

AIR FLOW = 1600 cfm AT W.G.

1.2463

CALCULATIONS KE Form No. E-6 Rev. 12-89

SHT. 27/8
CK BY JT 11/21/91

12 BISW

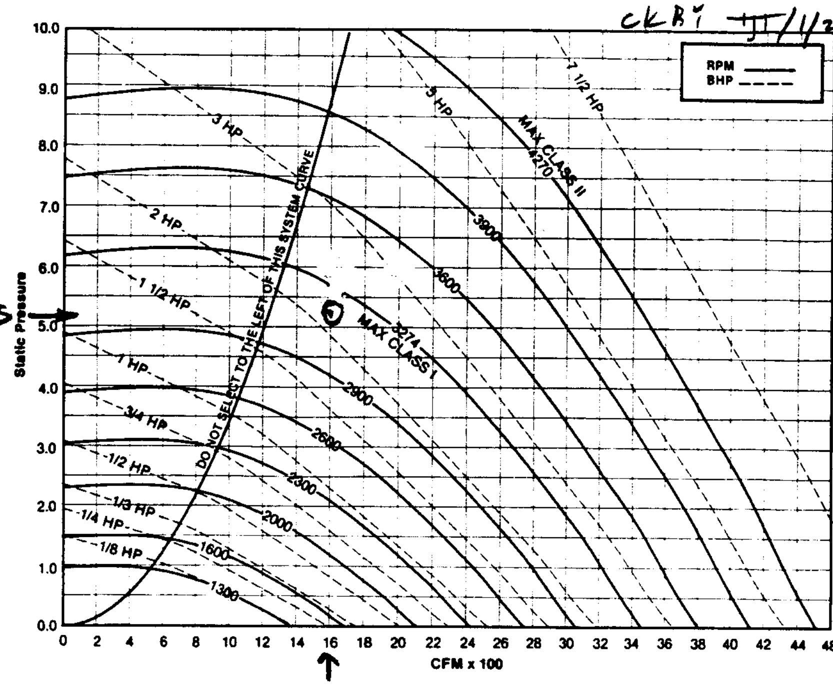
Performance Data

Wheel Diameter = 12¼ inches
Outlet Area = 0.86 Square Feet
Tip Speed, FPM = 3.21 X RPM
Maximum BHP = (RPM/2347)³

Pressure Class Limits

Class	Max. RPM
I	3274
II	4270

Arrangement 9 and 10 fans only
Maximum Motor Frame Sizes
Arr. 9 = 145T, Arr. 10 = 145T



STATIC PRESSURE

CFM	OV	¼" RPM	¼" BHP	½" RPM	½" BHP	¾" RPM	¾" BHP	1" RPM	1" BHP	1¼" RPM	1¼" BHP
600	698	[illegible]	0.04	1022	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
700	814	[illegible]	0.05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
800	930	[illegible]	0.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
900	1047	1040	0.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000	1163	1119	0.11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.32
1100	1279	1200	0.13	1340	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.38
1200	1395	[illegible]	0.16	1415	0.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1300	1512	[illegible]	0.19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.46
1400	1628	1461	0.23	1571	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.51
1500	1744	1539	0.27	1651	0.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.57
1600	1860	1628	0.32	1733	0.40	[illegible]	[illegible]	[illegible]	0.55	2017	0.64
1700	1977	1717	0.38	1816	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.71
1800	2093	1807	0.44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.78
1900	2209	1897	0.51	1984	[illegible]	2074	[illegible]	[illegible]	0.77	[illegible]	0.87
2000	2326	1988	0.58	[illegible]	0.67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.96
2100	2442	2079	0.67	2158	0.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.06
2200	2558	2170	0.76	2247	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.16
2300	2674	2262	0.86	2335	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.28
2400	2791	2354	0.97	2425	1.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.40
2500	2907	2446	1.08	2514	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.53
2600	3023	[illegible]	1.21	[illegible]	[illegible]	[illegible]	1.43	[illegible]	[illegible]	[illegible]	1.67
2700	3140	[illegible]	1.34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2800	3256	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2900	3372	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3000	3488	[illegible]	1.81	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CFM	OV	1½" RPM	1½" BHP	1¾" RPM	1¾" BHP	2" RPM	2" BHP	2¼" RPM	2¼" BHP	2½" RPM	2½" BHP	2¾" RPM	2¾" BHP	3" RPM	3" BHP
600	698														
700	814	1641	0.29												
800	930	1669	0.31	1783	0.37	[illegible]	0.44								
900	1047	1710	0.35	1817	0.41	1918	0.47	2020	0.54	2118	0.61	2211	0.69		
1000	1163	1751	0.38	1858	0.45	1958	0.52	2052	0.58	2142	0.65	2235	0.73	2323	0.81
1100	1279	1802	0.43	1900	0.49	1999	0.56	2093	0.64	2182	0.71	2267	0.78	2348	0.86
1200	1395	1856	0.48	1952	0.55	2043	0.62	2134	0.69	2223	0.77	2307	0.85	2388	0.93
1300	1512	1910	0.53	2006	0.60	2096	0.68	2182	0.75	2264	0.83	2348	0.92	2429	1.00
1400	1628	1971	0.58	2060	0.66	2150	0.74	2235	0.82	2315	0.91	2392	0.99	2470	1.08
1500	1744	2037	0.65	2121	0.73	2205	0.81	2288	0.90	2368	0.98	2445	1.07	2518	1.16
1600	1860	2105	0.72	2187	0.80	2286	0.89	2343	0.97	2423	1.07	2498	1.16	2571	1.25
1700	1977	2173	0.79	2254	0.88	2331	0.97	2404	1.06	2477	1.15	2553	1.25	2625	1.35
1800	2093	2244	0.87	2323	0.97	2398	1.06	2470	1.15	2539	1.25	2608	1.35	2680	1.45
1900	2209	2318	0.98	2392	1.06	2466	1.16	2537	1.25	2606	1.35	2671	1.46	2735	1.56
2000	2326	2392	1.06	2465	1.16	2535	1.26	2605	1.36	2673	1.47	2738	1.57	2800	1.66
2100	2442	2467	1.16	2539	1.27	2607	1.37	2674	1.48	2741	1.59	2805	1.69	2867	1.81
2200	2558	2544	1.27	2614	1.38	2681	1.49	2745	1.60	2810	1.71	2873	1.83	2934	1.94
2300	2674	2623	1.39	2689	1.50	2755	1.62	2819	1.73	2880	1.85	2942	1.97	3002	2.08
2400	2791	2702	1.52	2767	1.63	2830	1.75	2893	1.87	2953	1.99	3012	2.11	3071	2.24
2500	2907	2782	1.65	2845	1.77	2907	1.90	2968	2.02	3027	2.15	3085	2.27	3141	2.40
2600	3023	2862	1.80	2924	1.92	2985	2.05	3043	2.18	3102	2.31	3159	2.44	3214	2.57
2700	3140	2943	1.95	3004	2.08	3063	2.21	3121	2.35	3177	2.48	3233	2.61	3287	2.75
2800	3256	3025	2.11	3085	2.25	3143	2.39	3199	2.52	3254	2.66	3308	2.80	3362	2.94
2900	3372	3108	2.29	3166	2.43	3222	2.57	3278	2.71	3332	2.85	3384	3.00	3437	3.14
3000	3488	3192	2.47	3246	2.62	3303	2.76	3357	2.91	3410	3.05	3462	3.20	3512	3.35

5.25"

STATIC PRESSURE

CFM	OV	3" RPM	3" BHP	3½" RPM	3½" BHP	4" RPM	4" BHP	4½" RPM	4½" BHP	5" RPM	5" BHP	5½" RPM	5½" BHP
1200	1395	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
1300	1512	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1400	1628	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1500	1744	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1600	1860	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1700	1977	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1800	2093	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3305	2.54
1900	2209	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3347	2.68
2000	2326	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3285	2.59	3394	2.83
2100	2442	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3338	2.75	3446	2.99
2200	2558	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3279	2.66	3392	2.91	3500	3.16
2300	2674	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3334	2.82	3446	3.08	3553	3.34
2400	2791	[illegible]	[illegible]	[illegible]	[illegible]	3294	2.74	3397	2.99	3501	3.25	3608	3.53
2500	2907	[illegible]	[illegible]	[illegible]	[illegible]	3361	2.91	3463	3.18	3561	3.44	3663	3.72
2600	3023	[illegible]	[illegible]	3322	2.83	3428	3.10	3530	3.37	3627	3.65	3721	3.93
2700	3140	3287	2.75	3392	3.02	3497	3.30	3597	3.58	3693	3.86	3786	4.15
2800	3256	3362	2.94	3465	3.22	3566	3.50	3665	3.79	3761	4.08	3853	4.38
2900	3372	3437	3.14	3539	3.43	3636	3.72	3734	4.02	3828	4.32	3919	4.62
3000	3488	3512	3.35	3613	3.65	3709	3.95	3803	4.25	3897	4.56	3987	4.87
3100	3605	3590	3.57	3688	3.88	3783	4.19	3874	4.50	3965	4.81	4055	5.13
3200	3721	3668	3.80	3763	4.12	3857	4.44	3948	4.76	4035	5.06	4124	5.41
3300	3837	3746	4.05	3840	4.37	3932	4.70	4021	5.03	4108	5.36	4193	5.70
3400	3953	3826	4.31	3917	4.64	4007	4.96	4096	5.31	4181	5.65	4264	5.99
3500	4070	3905	4.57	3996	4.92	4083	5.26	4170	5.61	4255	5.96		
3600	4186	3985	4.86	4075	5.21	4161	5.56	4245	5.92				

CFM	OV	6" RPM	6" BHP	6½" RPM	6½" BHP	7" RPM	7" BHP	7½" RPM	7½" BHP	8" RPM	8" BHP	8½" RPM	8½" BHP
1200	1395												
1300	1512												
1400	1628	3282	2.29	3403	2.52								
1500	1744	3306	2.38	3427	2.62	3542	2.87	3654	3.12				
1600	1860	3338	2.50	3450	2.72	3566	2.98	3678	3.23	3786	3.50	3891	3.77
1700	1977	3379	2.63	3489	2.86	3595	3.10	3702	3.35	3810	3.62	3915	3.90
1800	2093	3419	2.78	3529	3.02	3635	3.26	3737	3.51	3836	3.76	3939	4.03
1900	2209	3461	2.92	3570	3.17	3675	3.42	3777	3.68	3876	3.94	3972	4.20
2000	2326	3502	3.08	3611	3.33	3716	3.59	3818	3.86	3916	4.12	4012	4.39
2100	2442	3550	3.25	3653	3.50	3758	3.77	3859	4.04	3957	4.32	4053	4.59
2200	2558	3603	3.42	3703	3.69	3799	3.95	3900	4.23	3998	4.51	4094	4.80
2300	2674	3656	3.61	3756	3.88	3852	4.15	3944	4.43	4040	4.72	4135	5.01
2400	2791	3710	3.80	3809	4.08	3904	4.37	3997	4.65	4087	4.94	4176	5.23
2500	2907	3765	4.01	3863	4.29	3958	4.58	4050	4.88	4139	5.17	4226	5.47
2600	3023	3819	4.22	3917	4.51	4012	4.81	4103	5.11	4192	5.42		
2700	3140	3876	4.44	3972	4.74	4066	5.05	4157	5.36	4246	5.67		
2800	3256	3941	4.68	4027	4.98	4121	5.29	4212	5.61				
2900	3372	4008	4.92	4093	5.23	4176	5.55	4266	5.87				
3000	3488	4074	5.19	4159	5.50	4241	5.82						
3100	3605	4142	5.46	4226	5.78								
3200	3721	4209	5.74										
3300	3837												
3400	3953												
3500	4070												
3600	4186												

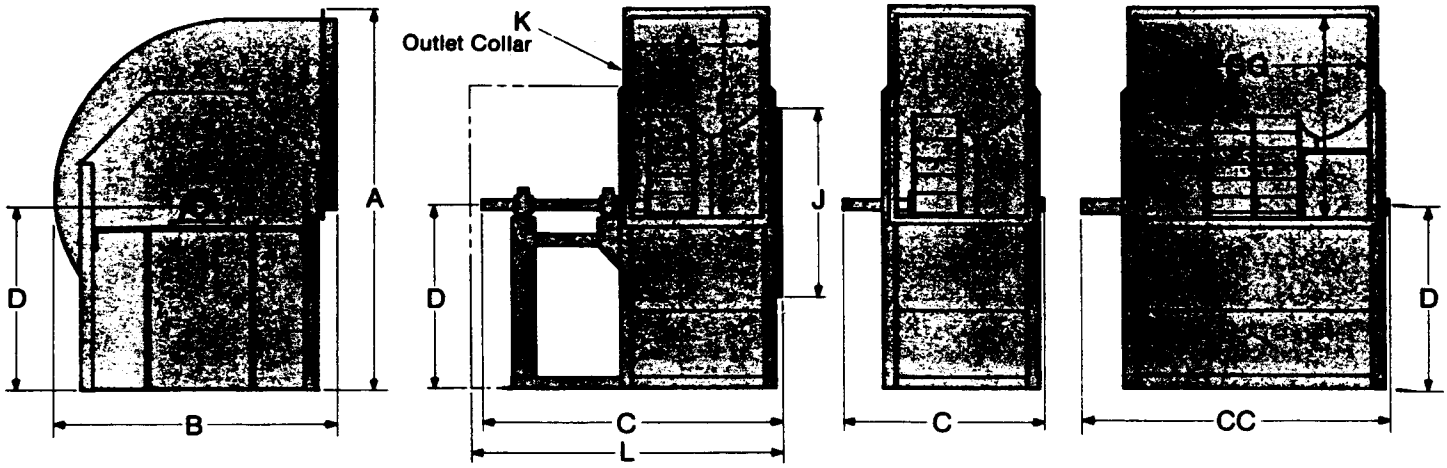
Performance shown is for Model BISW arrangement 1 with outlet duct.
BHP does not include drive losses.

GREENHECK

SHT. 28 /87

DIMENSIONAL DATA

Sizes 18-30 Single and Double Width



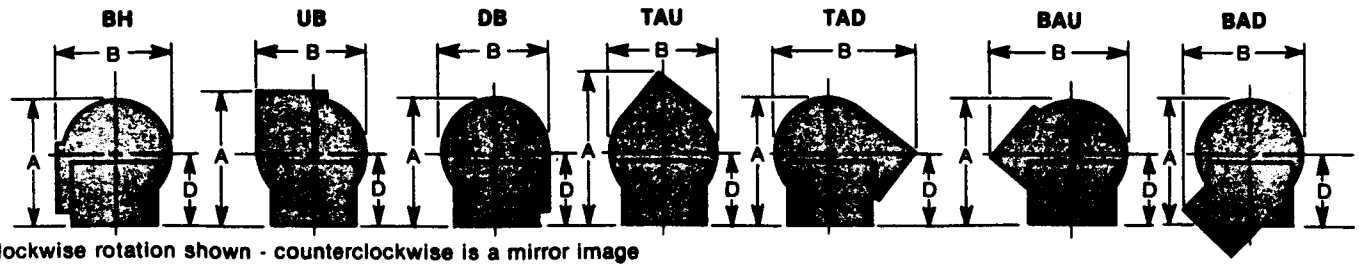
TH Discharge | Arrangements 1, 9 & 10 | Arrangement 3 | Arrangement 3 (Double Width)

Fan Size	(Height) TH	BH	UB	DB	TAU	TAD	BAU	BAD	B (Length) TH	BH	UB	DB	TAU	TAD	BAU	BAD	C (Width) 3	1,9,10	CC CL I	CL II	D
12	28	24 11/16	25 15/16	26 5/16	31 7/8	27 3/16	23 13/16	25 1/2	22	22	22 7/16	22 7/16	20 3/4	29 3/8	27 1/8	24 3/4	19	27 1/4	28	28	15 1/8
13	30 11/16	27	28 1/8	28 7/8	34 3/4	29 3/4	26 1/16	27 15/16	23 15/16	23 15/16	24 11/16	24 11/16	22 7/8	31 7/8	29 5/8	26 15/16	20	29 3/16	29 1/2	30	16 1/2
15	34 1/4	30 9/16	31 1/16	32 9/16	38 1/2	33 1/4	29 1/8	31 3/16	26 1/4	26 1/4	27 7/16	27 7/16	25 3/8	35 1/8	32 11/16	29 7/8	21 1/2	32 7/8	32 1/2	33	18 1/2
16	37 11/16	33 1/4	33 7/8	35 7/16	42 9/16	36 9/16	32 1/16	34 5/16	28 9/16	28 9/16	30 9/16	30 9/16	27 7/8	38 3/8	35 3/4	32 11/16	23	35 1/16	34 1/2	35	20 3/8
18	43 1/8	36 5/8	38	39 1/8	48 1/8	40 3/8	35 3/8	37 7/8	32 3/8	32 3/8	34 7/8	34 7/8	30 7/8	45 3/8	41 1/8	38 1/8	27 1/8	38 5/8	37 3/4	38 1/4	22 3/8
20	47	40 1/8	41 1/4	42 3/4	52 1/4	44 1/8	38 3/4	41 1/2	35	35	38 1/8	38 1/8	33 7/8	49 1/8	44 5/8	41 3/8	28 1/2	42	38 3/4	40 1/2	24 1/2
22	53 1/2	46	46 7/8	49	59 1/8	50 1/2	44 1/2	47 1/2	38 1/2	38 1/2	42 1/8	42 1/8	37 5/8	53 5/8	49 1/4	46 1/8	31	45 1/8	44 3/4	45 3/4	28 5/8
24	58 3/4	50 1/2	51 1/8	53 7/8	64 5/8	55 5/8	48 7/8	52 1/4	42	42	46 1/4	46 1/4	41 3/8	59 1/4	53 3/4	50 3/4	33 3/8	47 3/8	48 1/2	49 1/2	31 1/2
27	62 7/8	54	54 1/4	57 5/8	69 1/8	59 1/2	52 1/8	55 7/8	45 7/8	45 7/8	50 3/4	50 3/4	45 5/8	64 1/4	58 7/8	54 1/2	35 7/8	51 7/8	53 1/4	53 3/4	33
30	69 5/8	60	59 3/4	64	76 3/8	66 1/8	57 7/8	62	50 1/2	50 1/2	56 1/4	56 1/4	50 3/4	70 5/8	65	60 1/8	38 3/4	54 7/8	58 1/4	59 1/4	36 5/8

Fan Size	F	G	GG	J O.D.	K	L	Single Width: Bearing & Shaft Dia. Arr. 1, 3, 9, 10 CL I	CL II	Weight (Approx.) Class I 1, 9	3	10	Class II 1, 9	3	10	Max. Motor Frame Sizes Arr. 9	Arr. 10	Double Width: Shaft Dia. Class I	II	Bearing Dia. Class I	II	Weight (Approx.) Class I	II
12	13 1/16	9 3/4	17 1/2	13	—	28 1/4	1	1	75	70	85	80	75	95	145T	145T	1 3/16	1 7/16	1 3/16	1 7/16	110	120
13	14 3/8	10 3/4	19 1/4	14	—	30 9/16	1	1	85	80	100	90	90	115	184T	145T	1 3/16	1 11/16	1 3/16	1 11/16	130	140
15	15 15/16	11 15/16	21 3/8	15 7/8	—	33 7/8	1	1 3/16	100	90	125	110	105	140	184T	184T	1 7/16	1 11/16	1 7/16	1 11/16	175	190
16	17 9/16	13 1/8	23 1/2	17 1/2	—	36 1/16	1 3/16	1 3/16	130	120	150	145	140	170	215T	184T	1 7/16	1 15/16	1 7/16	1 15/16	210	225
18	19 5/8	14 5/8	26	19 1/4	1 1/2	39 1/8	1 3/16	1 7/16	175	185	205	190	220	230	215T	215T	1 11/16	1 15/16	1 11/16	1 15/16	315	350
20	21 1/4	16	28 1/2	21 1/8	1 1/2	41 3/4	1 3/16	1 7/16	205	235	245	235	275	285	245T	215T	1 11/16	2 3/16	1 11/16	2 3/16	350	400
22	23 5/8	17 3/4	31 3/4	23	1 1/2	44 1/4	1 7/16	1 7/16	285	285	315	305	335	315	256T	215T	1 15/16	2 7/16	1 15/16	2 7/16	430	490
24	26	19 1/2	34 7/8	25 7/8	1 1/2	47	1 7/16	1 11/16	385	375	445	430	460	500	256T	254T	2 3/16	2 7/16	2 3/16	2 7/16	570	660
27	28 5/8	21 1/2	38 5/8	28 1/2	1 1/2	51	1 11/16	1 11/16	445	445	515	510	560	590	284T	254T	2 3/16	2 11/16	2 3/16	2 11/16	700	790
30	31 7/8	23 7/8	42 3/4	31 3/4	1 1/2	51	1 15/16	1 15/16	570	550	650	650	680	740	286T	256T	2 7/16	2 15/16	2 7/16	2 7/16	910	1050

Due to Greenheck Fan Corporation's policy of continuous product improvement, dimensions are subject to change. For complete dimensional information refer to the applicable Greenheck submittal drawing.

ANGULAR DISCHARGE DIMENSIONS



Clockwise rotation shown - counterclockwise is a mirror image

PROCESS PLANT UH-01 & UH-02

PEAK HEATING LOAD 16593 BTUH OR 5.0 KW

SELECT:

CHROMALOX MODEL LUH-04-03 4 KW CAPACITY,
280 V, 3 PH, 11 AMP, 13,700 BTUH CAPACITY,
1000 RPM, 1/50 HP, 310 CFM, 42° T. RISE
(PROVIDE TWO FOR AIR CIRCULATION)

DRUM WASHING UH-03 & DRUM TURNING UH-04 UH-05

PEAK HEATING LOAD - 1285 BTUH DRUM WASHING
PEAK HEATING LOAD - 1981 BTUH DRUM TURNING

SELECT:

CHROMALOX MODEL LUH-02-71, 2.6 KW CAP.
208 V., 1 PH, 13 AMP, 8,900 BTUH CAPACITY,
1000 RPM, 1/50 HP, 310 CFM, 27°F T. RISE

SHT. 30/8
CKBY: JJT
1/21/91
SHT 34 THRU 38

Horizontal unit heater

2.6 to 45 kW

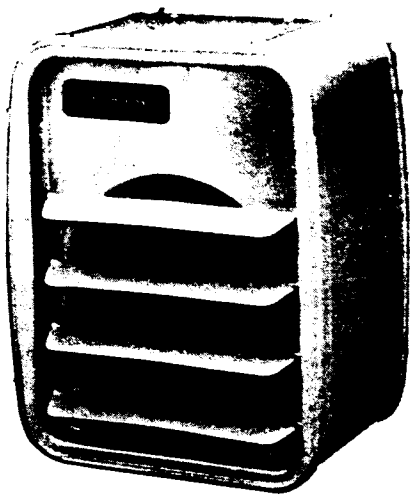
208, 240, 277, 480V, 1 & 3 ph.

8,900 to 153,600 Btuh

Wall or ceiling mounting

Meets U.L., NEC & OSHA requirements

Type LUH



Applications

- ☐ Primary heating
- ☐ Supplementary heating
- ☐ Dual system heaters
- ☐ Spot heating
- ☐ Entryway air curtain heating

Features

Stylized, efficient, flameless fan-forced heater.

No venting necessary.

Built-in power controls.

Heavy gauge steel cabinet; neutral grey baked-on enamel.

Electric heat bank consists of patented Chromalox spiral metal sheath Fintube electric heating elements with built-in overheat protection.

Individually adjustable discharge louvers direct air flow.

Heavy duty magnetic control contactors are standard on all models except single-phase 2.6 thru 5 kW models, which are standard without contactors for control by external line voltage thermostat. Optional contactors are also available for these models.

To eliminate remote thermostat wiring, LUH unit heaters can be field equipped with an optional integral comfort thermostat kit complete with an external control knob on the front face of the heater or if preferred, a remote wall-mounted pilot-duty type thermostat such as WR-80 can be used to control room comfort level.

When total heater capacity exceeds 48 amps, built-in fusing is provided behind a hinged and latched door in the side which allows easy access.

Notes:

1. All heaters have built-in contactors except LUH-02, LUH-04, LUH-05 1 phase 208, 240, 277 volt models. Optional contactors are available in these models with 208/240, 120 and 24 volt holding coils (with or without built-in control transformer).

2. All other 277 volt and stock 480 volt models have built-in control transformers and contactor with 120 volt holding coils. All stock 208 and 240 volt models with built-in contactors have 208/240 volt holding coils.

3. Fan only option is available for either internal control via built-in switch, or external control. When supplied for external control, motor voltage is isolated through motor relay. Control is pilot-duty 120 volt circuits.

4. Factory built-in thermostat optional on all models. Non-stock, made to order.

5. LUH-30, -35, -40 and -45 heaters are equipped as standard with two integral relays for two-stage control. Contactor control terminals may be jumpered in field for single-stage control, if desired.

SHT. 31/6

VH-03, VH-04, VH-05

Horizontal unit heater

Electrical Data (60 Hz)					Fan Motor							Mtg. Data					
kW	Volts	Phase	Amps	Btuh	Volts	Phase	RPM	HP	Fan Dia.	Air Velo. CFM	Temp. Rise °F	Max. Ht.	Hor. Throw	Catalog No.	Status	PCN	Wt. lbs.
2.6	208	1	13	8,900	208	1	1000	1/50	9"	310	27°	8'	12'	LUH-02-81	$	300011	32
2.6	240	1	11	8,900	240	1	1000	1/50	9"	310	27°	8'	12'	LUH-02-21	$	300020	32
2.6	277	1	10	8,900	277	1	1000	1/50	9"	310	27°	8'	12'	LUH-02-71	$	300038	32
4	208	1	19	13,700	208	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-81	$	300046	32
4	208	3	11	13,700	208	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-83	$	300054	32
4	240	1	17	13,700	240	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-21	$	300062	32
4	240	3	10	13,700	240	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-23	NS	300070	32
4	277	1	15	13,700	277	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-71	NS	300089	32
4	480	3	5	13,700	480	1	1000	1/50	9"	310	42°	8'	12'	LUH-04-43	$	300097	32
5	208	1	24	17,100	208	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-81	$	300118	32
5	208	3	14	17,100	208	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-83	$	300126	32
5	240	1	21	17,100	240	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-21	$	300134	32
5	240	3	12	17,100	240	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-23	$	300142	32
5	277	1	18	17,100	277	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-71	$	300150	32
5	480	3	6	17,100	480	1	1050	1/50	9"	420	42°	8'	18'	LUH-05-43	$	300169	32
7.5	208	1	36	25,600	208	1	1550	1/10	12"	670	40°	8'	20'	LUH-07-81	NS	300185	50
7.5	208	3	21	25,600	208	1	1550	1/10	12"	670	40°	8'	20'	LUH-07-83	$	300193	50
7.5	240	1	31	25,600	240	1	1550	1/10	12"	670	40°	8'	20'	LUH-07-21	$	300206	50
7.5	240	3	18	25,600	240	1	1550	1/10	12"	670	40°	8'	20'	LUH-07-23	$	300214	50
7.5	277	1	27	25,600	277	1	1550	1/10	12"	670	40°	8'	20'	LUH-07-71	$	300222	50
7.5	480	3	9	25,600	480	3	1550	1/10	12"	670	40°	8'	20'	LUH-07-43	$	300230	50
10	208	1	48	34,100	208	1	1550	1/10	12"	750	47°	9'	27'	LUH-10-81	NS	300257	50
10	208	3	28	34,100	208	1	1550	1/10	12"	750	47°	9'	27'	LUH-10-83	$	300265	50
10	240	1	42	34,100	240	1	1550	1/10	12"	750	47°	9'	27'	LUH-10-21	$	300273	50
10	240	3	24	34,100	240	1	1550	1/10	12"	750	47°	9'	27'	LUH-10-23	$	300281	50
10	480	3	12	34,100	480	3	1550	1/10	12"	750	47°	9'	27'	LUH-10-43	$	300290	50
12.5	208	3	35	42,700	208	1	1550	1/10	12"	750	55°	9'	27'	LUH-12-83	$	300302	50
12.5	240	3	30	42,700	240	1	1550	1/10	12"	750	55°	9'	27'	LUH-12-23	$	300310	50
12.5	480	3	15	42,700	480	3	1550	1/10	12"	750	55°	9'	27'	LUH-12-43	$	300329	50
15	208	3	42	51,200	208	1	1550	1/10	12"	750	61°	10'	27'	LUH-15-83	$	300337	50
15	240	3	36	51,200	240	1	1550	1/10	12"	750	61°	10'	27'	LUH-15-23	$	300345	50
15	480	3	18	51,200	480	3	1550	1/10	12"	750	61°	10'	27'	LUH-15-43	$	300353	50
20	240	3	48	68,500	240	3	1550	1/10	14"	1240	53°	11'	31'	LUH-20-23	$	300361	73
20	480	3	24	68,500	480	3	1550	1/10	14"	1240	53°	11'	31'	LUH-20-43	$	300370	73
25	480	3	30	85,500	480	3	1550	1/10	14"	1350	60°	12'	31'	LUH-25-43	$	300388	73
30	208	3	83	102,400	208	3	1725	.454	14"	1555	64°	13'	46'	LUH-30-83	NS	300396	106
30	240	3	72	102,400	240	3	1725	.454	14"	1555	64°	13'	46'	LUH-30-23	$	300409	106
30	480	3	36	102,400	480	3	1725	.424	14"	1555	64°	13'	46'	LUH-30-43	$	300417	106
35	240	3	84	119,500	240	3	1725	.454	14"	1555	71°	14'	45'	LUH-35-23	$	300425	106
35	480	3	42	119,500	480	3	1725	.424	14"	1555	71°	14'	45'	LUH-35-43	$	300433	106
40	240	3	96	136,500	240	3	1725	.454	14"	1555	84°	15'	44'	LUH-40-23	NS	300441	106
40	480	3	48	136,500	480	3	1725	.424	14"	1555	84°	15'	44'	LUH-40-43	$	300450	106
45	480	3	54	153,600	480	3	1725	.424	14"	1555	94°	17'	42'	LUH-45-43	$	300468	106

UH-01
UH02

Specify: Quantity, catalog no., PCN, kW, volts, phase unit heaters.

SHT. 32
1/4

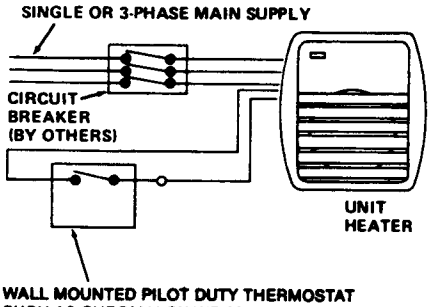
Horizontal unit heater

Thermostat kits (field-installed)

Type	*Use With	Cat. No.
DPST	LUH-02 thru LUH-05 (without contactor)	LUH-TK2
SPST	LUH-02 thru LUH-25 (with contactor)	LUH-TK1

*All LUH heaters have contactors except LUH-02, LUH-04 and LUH-05 (single phase).
Temperature Range: 40°F to 90°F
differential: 5°F

Wiring



Mounting limitations

Hazardous atmosphere — Unit heaters should not be used in potentially explosive atmospheres.

Corrosive atmosphere — The finish is not intended for direct salt spray exposure in marine applications or the highly corrosive atmospheres of greenhouses, swimming pools, chemical storage bins, etc.

Mounting height — Do not install unit heaters above recommended maximum mounting height.

Obstructions must not block unit heater air inlet or discharge.

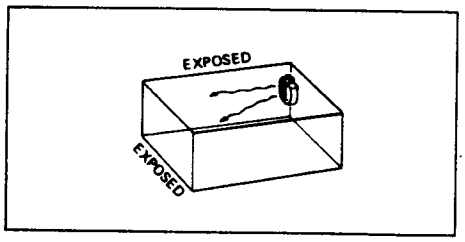
Dimensions—Inches

Cat. No.	A	B	C	D	Welded Fasteners	E	F	G	H	I	J	K
LUH-02 thru -05	16	13⅛	8⅞	11¼	5/16-18	10¼	9¾	5	4 1/16	4⅝	4½	6⅝
LUH-07, 10, 12, 15	20½	17¼	11½	15	⅜-16	13⅞	13	8¼	4½	6⅝	6¼	8⅝
LUH-20, 25	24	20⅛	11½	17¾	⅜-16	16¼	16	8¼	6	8¼	6¼	10
LUH-30, 35, 40, 45	24	20⅛	17¼	24⅜	⅜-16	16¼	16	8¼	6	10¼	11¾	10

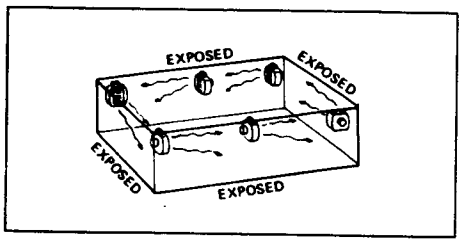
Horizontal unit heater

Application tips

Small rooms can be heated by one unit heater. Where two walls are exposed, heater should be mounted as shown.



Larger rooms require multi-unit installations. Number and capacity of units will be determined by volume of building and square feet of floor area to be heated. Arrange units to provide perimeter air circulation.

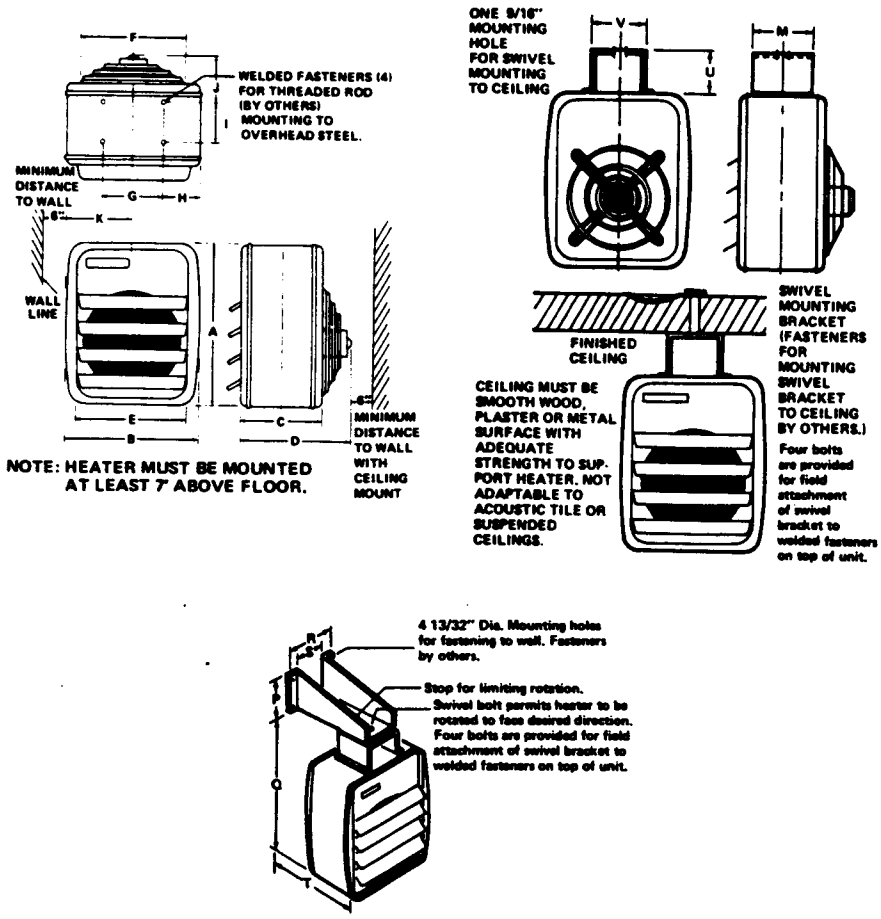


To prevent air stratification, the total CFM capacity of all units should circulate the room air volume at least 3 times per hour.

Unit heaters should be located so their air streams wipe exposed walls without blowing directly at them. In multiple unit heater installations, it is good practice to locate units so each unit supports the air stream from another, thus setting up a circulatory air movement within the space. In warehouse type applications, where maintaining minimum temperature is the basic requirement, then one or more large unit heaters can be used in order to reduce initial installation expense.

Individual spaces. For individual spaces, total heating capacity is calculated in the conventional way, using formulas in the ASHRAE "Guide" or those found in the National Electric Manufacturer's Assn. (NEMA) handbook.

Pedestrian entryways. When heating capacity for a pedestrian entry is not known, a "rule of thumb" of 3000-5000 watts per door is often applied. The smaller figure is applied to a low traffic single-door entry or a large multiple-door entry, and the larger figure to a high traffic single-door entry.



Mounting Brackets

Wall

Use With	Dimensions—Inches P	Q	R	S	T	Cat. No.
LUH-02 thru -05	3 9/16	20 5/8	6 3/4	4	14 1/2	WUH-01
LUH-07 thru -25	4 3/16	31	9 1/2	7	19 5/8	WUH-02
LUH-30 thru -45	7	28 1/2	5	—	32 9/16	WUH-03

Ceiling

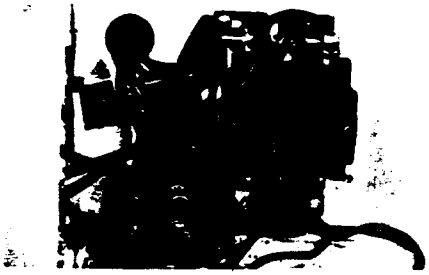
Use With	Dimensions—In. M	U	V	Cat. No.
LUH-02 thru -05	6	4	4 1/4	WUH-04
LUH-07 thru -25	8	6	7 1/4	WUH-05
LUH-30 thru -45	13 3/4	6	7 1/4	WUH-06

Unit heaters are frequently used to combat cold air inrush when loading dock doors are opened. For such applications, one or more units should be arranged to blow warm air across the opening, not toward it.

Comfort

SHT. 34/87

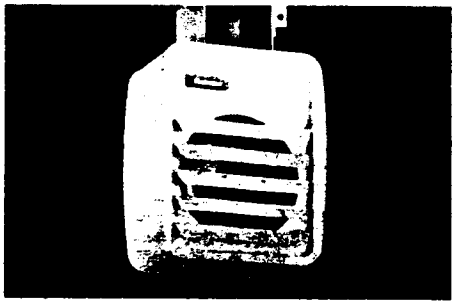
Horizontal unit heater



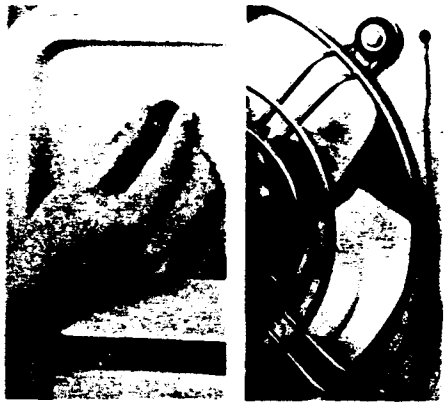
No external contactors are necessary No external contactors are needed; integral, heavy-duty, 3-pole, magnetic contactors are standard on all heaters with the exception of the 2.6 kW, 4 kW and 5 kW single-phase models (they're optional on these heaters). The 5 kW and smaller units can be remotely controlled direct by a Chromalox line voltage wall thermostat such as Type WR-80.

Built-in fuse protection . . . no need for external fusing. All Horizontal Unit Heaters having a total draw of 48 amperes or more have electrically balanced, sub-divided circuits, each with fuse protection (no external fusing is necessary; reduces installation costs). Fuse compartment is located on the left side of the heater unit. A latched hinged door affords easy access.

Internal 24V or 120V control transformer. All models can be equipped with low voltage control transformer to eliminate the need for an external control source. These transformers are standard on all 277 and 480 volt models, supplying 120 volt contactor holding coils.

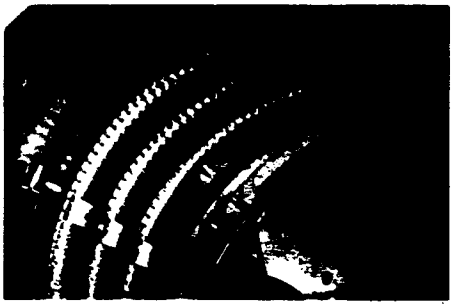


Die-formed cabinet. Cabinet is heavy, 18 gauge steel; die-formed and welded. No sharp edges. It's given a phosphate undercoat for corrosion resistance in industrial atmospheres. Finish is neutral grey, baked enamel.



Self-contained thermostats eliminate installation of wall thermostats. Any model (through 25 kW) can be equipped with a "built-in" field installed Thermostat Kit, LUH-TK, to eliminate the use of a wall type thermostat and thermostat wiring. (Internal thermostats can be factory installed on any size unit.) LUH self-contained thermostats have a temperature range of 40°F to 90°F. If wall thermostats are desired, Chromalox Type WR-80 is recommended.

Fan only operation. A fan only operation (optional) is available by means of a built-in switch or by external control.



Chromalox metal sheath fintube® heating elements. The electric Heat Bank — Chromalox patented metal sheath Fintube® heating elements. They are shock proof! Heat radiation fins are corrosion-resistant steel, furnace brazed to the tubular heating elements for good heat transfer. They don't come loose! Wide spacing prevents clogging. You can almost expect Chromalox elements to last more than a life-time. With any type heater, this is, indeed, a good start.

Totally enclosed, continuous duty, fan motor. It's a totally enclosed, continuous duty unit, with built-in automatic reset overload protection. Operates on same voltages as line power supply. There's no need for a stepdown transformer or separate motor circuit. Combination fan guard and motor mount is attached to housing of heater with rubber vibration isolators. They prevent vibration; make for quieter operation.

Dynamically balanced fan. Dynamically balanced for smooth, quiet running. Blade pitch is carefully selected so that the volume of air moved results in the optimum discharge air temperature.

Built-in thermal overload protection. Thermal overload cutouts open the control circuit and cutoff power to the heating elements should over-heating occur. Cutouts are the automatic reset type. When temperature falls to normal, they reclose the control circuit and power is restored. Automatic protection makes for safety. Also, longlife.

ICF KAISER ENGINEERS

JOB NO. 91044-003

SHEET 35 OF 87

PROCESS AREA & MEZZANINE A/C UNIT

DESIGNED BY F. Lopez DATE 1-21-91

CHECKED BY JJ DATE 1/24/91

PROCESS AREA TOTAL COOLING LOAD = 16361 BTUH w/200CFM INFIL.

O.A. HEAT GAIN

1400 CFM x (98°F - 80°F) x 1.08 = 27,216 BTUH

Total - 43,577 BTUH

SELECT: AC-1, AC-2

MANUF. : CARRIER

MAKE : WEATHERMASTER

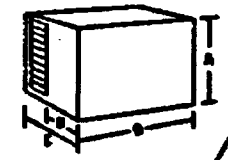
MODEL : HKB2293

CAPACITY: 28,800 BTUH COOLING

ELEC. : 208 V., 15.7 AMPS, SINGLE PHASE, 60 HZ,

CALCULATIONS KE Form No. E-6 Rev. 12-89

SHT. 40



MODEL NAME	MODEL NUMBER	CAPACITY BTUH*	EER	VOLTS	WATTS	AMPERES	FUSE SIZE**	RECEPTACLE TYPE	FAN SPEED	MOISTURE REMOVAL, PTS/HR	AIR DELIVERY, CFM	AIR THROW, FT.	AIR FLOW CONTROL	VENTILATION	EXHAUST	A	B	C	D	GRILL PROJECTS	CHASSIS TYPE	INSTALLATION KIT	WEIGHT (NET/SHIP)
International Series™ ZM	ZMB7051	5400	9.0	115	600	5.6	15	1	3	1.8	175/125	27	4-Way	X	X	14 7/8	20 9/16	17 7/8	5 1/4	1	Slide Out	Ready	74/79
	ZMB7061	6200	9.4	115	660	6.0	15	1	3	2.0	175/125	27	4-Way	X	X	14 7/8	20 1/16	17 1/8	5 1/4	1	Slide Out	Ready	75/80
International Series™ AG	AGA1081	8000	9.0	115	830	7.5	15	1	3	2.7	210/150	30	4-Way		X	14 13/16	20 5/8	16 3/4	4 7/8	2	Slide Out	Ready	70/75
International Series™ CM	CMB1091	8800	9.5	115	925	8.6	15	1	3	2.4	300/200	34	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	104/116
	CME1121	12300	9.2	115	1340	11.7	15	1	3	3.4	350/240	43	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	124/134
	CMED123	12000/ 11800	9.2/ 9.2	230/ 208	1300/ 1280	6.0/ 6.3	15	3	3	3.2	395/265	44	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	124/134
	CMA1153	15000/ 14800	9.2/ 9.2	230/ 208	1630/ 1610	7.5/ 7.9	15	3	3	3.9	380/270	42	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	126/138
International Series™ GM	GMB0091	9000	12.0	115	750	7.1	15	1	3	1.3	400/290	40	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	119/131
	GMC1141	13800	10.0	115	1380	12.0	15	1	3	2.4	500/340	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	134/146
	GMA1183	18000/ 17700	9.2/ 9.2	230/ 208	1950/ 1920	8.7/ 9.2	15	3	3	5.8	500/350	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	145/157
	GMA1213	20500/ 20000	9.2/ 9.2	230/ 208	2220/ 2165	10.3/ 11.0	15	3	3	6.7	485/370	49	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	160/172
	GMA1243	23500/ 23000	9.2/ 9.2	230/ 208	2550/ 2500	11.3/ 12.0	15	3	3	8.5	500/385	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	161/173
	GMA2283	27500/ 27000	8.2/ 8.2	230/ 208	3350/ 3290	15.2/ 16.0	20	4	3	10.2	520/400	52	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	170/182
Super Weathermaker, HK	HKB2293	29200/ 28800	8.7/ 8.7	230/ 208	3360/ 3310	15.1/ 15.7	20	4	3	10.9	700/540	57	4-Way		X	22 3/8	27 1/2	32 1/4	12 1/2	3/4	Slide Out	Acc'y	256/268
	HKA3333	33000/ 32000	7.5/ 7.5	230/ 208	4400/ 4265	19.5/ 21.5	30	5	3	12.1	675/555	55	4-Way		X	22 3/8	27 1/2	32 1/4	12 1/2	3/4	Slide Out	Acc'y	238/250

Attn Tom Thomas

From DEBBIE

SHT 36/87

CK BY: TJT

1/21/91

ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 37 of 87

FAN COIL UNIT - (CHANGING RM)

DESIGNED BY F. Lopez DATE 1-18-91

CHECKED BY JT DATE 1/21/9

DESIGN CONDITIONS

SUMMER - 98° WB / BUILDING 80°F
WINTER - 12° WB / BUILDING 70°F

COOLING REQUIREMENTS = 5345 BTUH
COOLING O.A. = 15 CFM/PERSON x 2 PEOPLE
x 1.08 x (98°F - 80°F) = 583 BTUH

TOTAL = 5,928 BTUH

HEATING REQUIREMENTS: 954 BTUH
a.) ADDITIONAL REQ. = Q = 15 CFM O.A./PERSON x
2 PEOPLE = 30 x 1.08 x (70°F - 12°F)
= 1879 BTUH

TOTAL = 1,356 + 1,879 = 3,235 BTUH
OR 0.94 KW

SELECT: AC-3
MANUF.: CARRIER
MODEL: QCA202L
MAKE: INTERNATIONAL SERIES QC
COOLING CAP.: 8500 BTUH
HEATING CAP.: (1) 7500 BTUH HEAT PUMP
(2) 5000 BTUH ELECTRICAL HEATING
ELEC: 115V, 16 AMPS, SINGLE PHASE
60 HZ.

OUTSIDE AIR SET TO 30 CFM.

CALCULATIONS KE Form No. E-6 Rev. 12-89

38/87

Carrier®

INVESTIGATE THE DIFFERENCE

★★★★★

FIVE YEAR WARRANTY

1st Year
Full Warranty—All Parts and Labor!

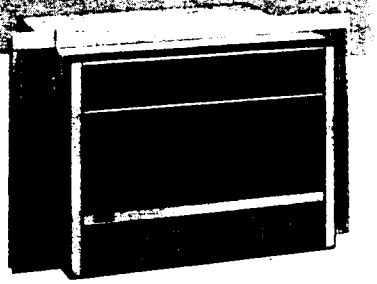
2nd thru 5th Year
Limited Warranty—All Parts with a Labor Allowance!

(See our warranty certificates 530-018 or 530-045 for complete details.)

ROOM AIR CONDITIONERS

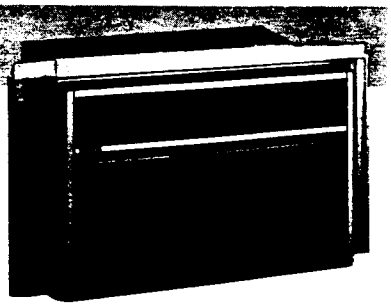
International Series™

Straight Cool
ZM 5400 & 6200 BTUH



- 24-Hour Programmable On/Off Timer
- Super-Quiet Operation
- Hi-Efficiency Rotary Compressor
- Energy Saver Fan Cycle Switch
- Independent Exhaust & Vent Controls
- Slide-Out Chassis
- Easy-Access Filter
- Ready-Mount Installation Kit
- 4-Way Air Flow Control
- 3-Speed Fan
- Sure Temp® Thermostat
- Weather Armor® Cabinet
- Concealed Control Panel
- Security Guard
- Rear Grille

Straight Cool
AC 8000 BTUH



- Super-Quiet Operation
- Hi-Efficiency Rotary Compressor
- Slide-Out Chassis
- Easy-Access Filter
- Ready-Mount Installation Kit
- Exhaust Controls
- 4-Way Air Flow Control
- 3-Speed Fan
- Sure Temp® Thermostat
- Weather Armor® Cabinet
- Concealed Control Panel
- Security Guard
- Rear Grille

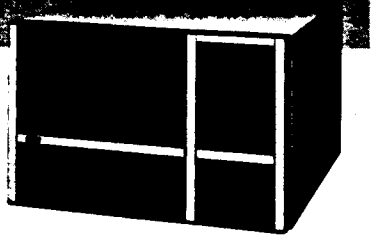
Straight Cool
CM, GM 6000-27,500 BTUH

- 24-Hour On/Off Timer
- Auto Air Circulator
- Super-Quiet Operation
- Hi-Efficiency Rotary Compressor
- Energy Saver Fan Cycle Switch
- Independent Exhaust & Vent Controls
- Slide-Out Chassis
- Easy-Access Filter
- Ready Mount Installation Kit
- 4-Way Air Flow Control
- 3-Speed Fan
- Sure Temp® Thermostat
- Weather Armor® Cabinet
- Concealed Control Panel
- Indicator Light
- Cord Compartment
- Security Guard
- Rear Grille

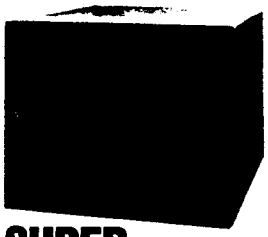
Year Round Comfort

Heat/Cool CV, GY
8000-23,500 BTUH COOLING
3000-16,500 BTUH ELECTRIC HEAT

Heat Pump QC, QG
8000-23,000 BTUH COOLING
7500-20,000 BTUH HEAT PUMP
5000-16,500 BTUH ELECTRIC HEAT



- 24-Hour Programmable On/Off Timer
- Auto Air Circulator
- Super-Quiet Operation
- Hi-Efficiency Rotary Compressor
- Energy Saver Fan Cycle Switch
- Independent Exhaust & Vent Controls
- Slide-Out Chassis
- Easy Access Filter
- Security Guard
- 4-Way Air Flow Control
- 2-speed Heating
- 3-Speed Cooling
- Sure Temp® Thermostat
- Weather Armor® Cabinet
- Concealed Control Panel
- Indicator Light
- Cord Compartment
- Rear Grille



SUPER WEATHERMAKER

Straight Cool
[illegible] BTUH

- Slide-Out Chassis
- Sure Temp® Thermostat
- 4-Way Air Flow Control
- Weather Armor® Cabinet
- Exhaust Control
- Rear Grille

WEATHERMATE
SLIDER/CASEMENT

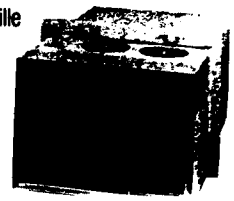
Straight Cool
[illegible]

- Weather Armor® Cabinet
- Ready Mount Installation Kit
- Hi-Efficiency Rotary Compressor
- 4-Way Air Flow Control
- Exhaust Control
- Automatic Thermostat
- Rear Grille

WEATHERMATE
CASEMENT

Straight Cool
[illegible]

- Weather Armor® Cabinet
- Ready Mount Installation Kit
- Rotary Air Flow Control
- Automatic Thermostat
- Rear Grille



Carrier ROOM AIR CONDITIONERS

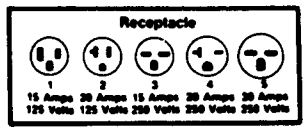
39/87

MODEL NAME	MODEL NUMBER	CAPACITY BTUH*	EER	VOLTS	WATTS	AMPERES	FUSE SIZE**	RECEPTACLE TYPE	FAN SPEED	MOISTURE REMOVAL, PTS/HR	AIR DELIVERY, CFM	AIR THROW, FT.	AIR FLOW CONTROL	VENTILATION	EXHAUST	A	B	C	D	GRILL PROJECTS	CHASSIS TYPE	INSTALLATION KIT	WEIGHT (NET/SHIP)
International Series™ ZM	ZMB7051	5400	9.0	115	600	5.6	15	1	3	1.8	175/125	27	4-Way	X	X	14 7/8	20 1/16	17 1/8	5 1/4	1	Slide Out	Ready	74/79
	†ZMB7061	6200	9.4	115	660	6.0	15	1	3	2.0	175/125	27	4-Way	X	X	14 7/8	20 1/16	17 1/8	5 1/4	1	Slide Out	Ready	75/80
International Series™ AG	AGA1081	8000	9.0	115	890	7.5	15	1	3	2.7	210/150	30	4-Way		X	14 13/16	20 5/8	16 3/4	4 7/8	2	Slide Out	Ready	70/75
International Series™ CM	CMB1091	8800	9.5	115	925	8.6	15	1	3	2.4	300/200	34	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	104/116
	†CMC1121	12000	9.2	115	1305	12.0	15	1	3	3.4	350/240	43	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	116/128
	†CMD0123	12000/ 11800	9.2/ 9.2	230/ 208	1300/ 1280	6.0/ 6.3	15	3	3	3.6	395/265	44	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	116/128
	CMA1153	15000/ 14800	9.2/ 9.2	230/ 208	1630/ 1610	7.5/ 7.9	15	3	3	3.9	380/270	42	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Ready	126/138
International Series™ GM	GMB0091	9000	12.0	115	750	7.1	15	1	3	1.3	400/290	40	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	119/131
	GMB1141	14000	10.2	115	1370	12.0	15	1	3	2.0	500/340	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	134/146
	GMA1183	18000/ 17700	9.2/ 9.2	230/ 208	1950/ 1920	8.7/ 9.2	15	3	3	5.8	500/350	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	145/157
	GMA1213	20500/ 20000	9.2/ 9.2	230/ 208	2220/ 2165	10.3/ 11.0	15	3	3	6.7	485/370	49	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	160/172
	GMA1243	23500/ 23000	9.2/ 9.2	230/ 208	2550/ 2500	11.3/ 12.0	15	3	3	8.5	500/385	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	161/173
	GMA2283	27500/ 27000	8.2/ 8.2	230/ 208	3350/ 3290	15.2/ 16.0	20	4	3	10.2	520/400	52	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Ready	170/182
Super Weathermaker, HK	HKB2293	29200/ 28800	8.7/ 8.7	230/ 208	3360/ 3310	15.1/ 15.7	20	4	3	10.9	700/540	57	4-Way		X	22 3/8	27 1/2	32 1/4	12 1/2	3/4	Slide Out	Acc'y	256/268
	HKA3333	33000/ 32000	7.5/ 7.5	230/ 208	4400/ 4265	19.5/ 21.5	30	5	3	12.1	675/555	55	4-Way		X	22 3/8	27 1/2	32 1/4	12 1/2	3/4	Slide Out	Acc'y	238/250
International Series™ QC Heat Pump	†QCA2091	8600-C 7500-HP 5000-EH	9.0 2.6 COP	115	955 845 1850	8.7 7.7 16.0	20	2	3 2 2	3.4	300/200	34	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Acc'y	111/116
	†QCB2123	11700/ 11400-C 10800/ 10500-HP 10400/ 8450-EH	8.5/ 8.5 2.6/ 2.6 COP	230/ 208	1375/ 1340 1215/ 1185 3350/ 2750	6.3/ 6.8 5.6/ 6.0 15.8/ 14.6	20	4	3 2 2	3.6	395/265	44	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Acc'y	123/128
International Series™ QG Heat Pump	†QGA3153	14800/ 14500-C 13800/ 13500-HP 16500/ 13500-EH	8.5/ 8.5 2.6/ 2.6 COP	230/ 208	1740/ 1710 1555/ 1520 5300/ 4350	8.0/ 8.7 7.1/ 7.7 23.0/ 21.0	30	5	3 2 2	4.5	425/325	43	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	141/146
	†QGB3183	17800/ 17500-C 16300/ 16000-HP 16500/ 13500-EH	8.5/ 8.5 2.6/ 2.6 COP	230/ 208	2095/ 2060 1835/ 1805 5300/ 4350	9.5/ 10.2 8.4/ 9.1 23.0/ 21.0	30	5	3 2 2	5.8	500/350	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	152/157
	†QGA3233	23000/ 22700-C 20000/ 19500-HP 16500/ 13500-EH	8.5/ 8.5 2.4/ 2.4 COP	230/ 208	2710/ 2670 2445/ 2380 5300/ 4350	11.0/ 13.0 11.2/ 12.0 23.0/ 21.0	30	5	3 2 2	8.5	500/385	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	168/173
International Series™ CV Heat/Cool	CVA2091	8800-C 5000-EH	9.5	115	925 1850	8.6 16.0	20	2	3 2	3.4	300/200	34	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Acc'y	106/111
	†CVB2123	12000/ 11700-C 10400/ 8450-EH	9.0/ 9.0	230/ 208	1335/ 1300 3550/ 2750	6.1/ 6.7 15.8/ 14.6	20	4	3 2	3.6	395/265	44	Auto	X	X	15 9/16	24 7/16	27 5/16	11 1/2	1	Slide Out	Acc'y	118/123
International Series™ GY Heat/Cool	†GYA3153	15000/ 14800-C 16500/ 13500-EH	9.0/ 9.0	230/ 208	1665/ 1645 5300/ 4350	7.5/ 8.0 23.0/ 21.0	30	5	3 2	4.5	425/325	43	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	136/141
	†GYB3183	18000/ 17700-C 16500/ 13500-EH	9.2/ 9.2	230/ 208	1950/ 1920 5300/ 4350	8.7/ 9.2 23.0/ 21.0	30	5	3 2	5.8	500/350	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	147/152
	†GYB3243	23500/ 23000-C 16500/ 13500-EH	9.2/ 9.2	230/ 208	2550/ 2500 5300/ 4350	11.3/ 12.0 23.0/ 21.0	30	5	3 2	8.5	500/385	50	Auto	X	X	17 9/16	26	28 1/16	11 1/2	1	Slide Out	Acc'y	163/168
Weathermate Casement, KM	KMC0061	5800	8.1	115	700	6.2	15	1	2	1.6	210/170	28	Rotary			10 1/2	14 1/2	25 5/8	8 1/4	3/8	Fixed	Ready	72/80
Weathermate Slider, KY	KYD1101	10000	9.0	115	1110	10.1	15	1	3	3.5	250/190	27	4-Way		X	20 9/16	14 1/2	25 3/4	7 5/8	3/8	Fixed	Ready	105/111

CABINET DIMENSIONS

Before purchasing this appliance, read important energy cost and efficiency information available from your retailer.

†Preliminary rating
*For heat pump and heat/cool models—
Cooling capacities noted by –C
Heat Pump heating capacities noted by —HP
Electric Heating capacities noted by —EH
**Fuse: Time delay or equivalent
NOTE: Yellow areas indicate high EER models

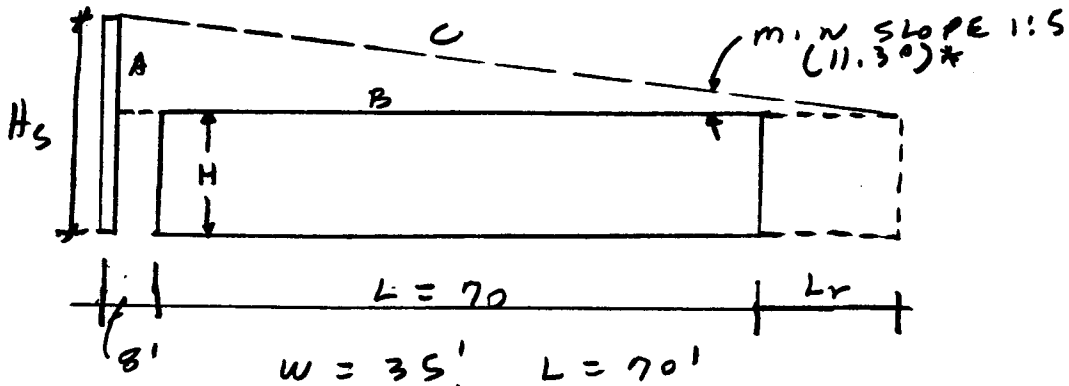


UNITED TECHNOLOGIES CARRIER

Carrier Corporation • Syracuse, NY Printed in U.S.A. 0989 851-122 SCP

STACK HEIGHT CALCULATION

DESIGNED BY TJT DATE 9/23/
CHECKED BY F. Copet DATE 9/25/



W = 35' L = 70'
H = 20'

FROM ASHRAE FUNDAMENTALS 1989
CHAPTER 14

$R = H^{0.67} \times W^{0.33}$

$R = 20^{0.67} \times 35^{0.33}$

$= 7.44 \times 3.2 = 23.81 \cong 24'$

$L_r = R(1.0) = 24'$

$B = 8' + 70' + 24' = 102'$

$C(\cos 11.3) = B$

$C = \frac{B}{\cos 11.3} = \frac{102}{.98} = 104.1'$

$C(\sin(11.3) = A$

$(104.1)(.196) = 20.4'$

$H_S = H + A$

$H_S = 20' + 20.4 = 40.4'$

USE 42' STACK HEIGHT.

* SEE ASHRAE FUNDAMENTALS

CALCULATIONS KE Form No. E-6 Rev. 12-89

ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 41A of 87

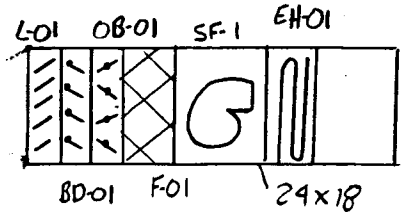
OUTSIDE AIR INTAKE
COMPONENT SELECTION
PFP LOW LEVEL LIQUID WASTE

DESIGNED BY F. Lopez DATE 11-26-

CHECKED BY TJJ DATE

TOTAL OUTSIDE AIR INTAKE : 1400 CFM (200 Infiltration) - 3 A.C/HR

LOUVER SIZE : 36" x 36"
FREE AREA : 3.75 SQ/FT
VELOCITY = CFM/FREE AREA
= 1400/3.75
= 373 FPM



WATER PENETRATION: 530 FMP = 0

7467

STATIC PRESSURE

L-01	LOUVER	0.034
BD-01	B.D. DAMPER	0.098
OB-01	O.B. DAMER	0.030
F-01	FILTER	0.560
EH-01	ELECTRIC HEAT	0.025
SR-01	SUPPLY REGISTER (24"x24")	0.03
	Total	0.78 WG

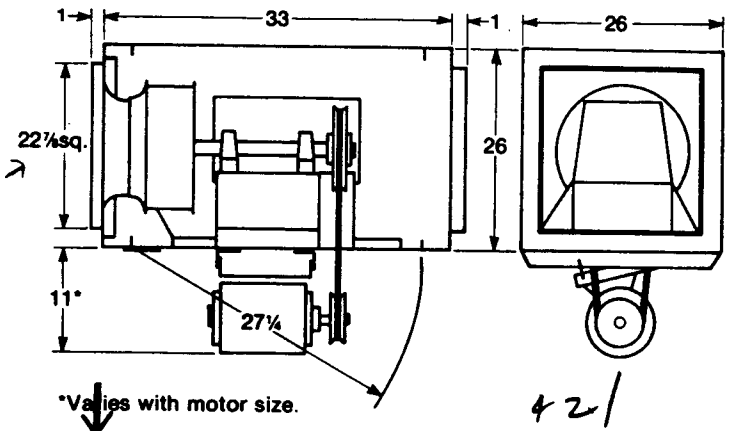
SELECT:
MAN. : GREENHECK
MODEL: BSQ-
SIZE : 16-5
RPM : 1020
TIP SPEED : 447
BHP : 0.416
HP : 1/2
VELOCITY : 445
AIR FLOW : 1400 CFM @ 0.78 W.G
ELEC. 1/2 HP , 208 V. , SINGLE Phase

CALCULATIONS KE Form No. E-6 Rev. 12-89

BSQ-16

MAXIMUM BHP AT A GIVEN RPM — $(RPM/1366)^3$
MAXIMUM RPM — 1990
(RPM above 1590 must have reinforced wheel)
MAXIMUM MOTOR FRAME SIZE — 184
(Consult factory regarding larger frame sizes)
OUTLET VELOCITY = CFM X 0.2782
TIP SPEED = RPM X 4.385

UNIT SPECIFICATIONS
HOUSING METAL THICKNESS — 18 ga.
APPROX. WEIGHT — 159 lbs.



Model	Drive Range	RPM	Static Pressure/Capacity																							
			0.125		0.250		0.375		0.500		0.625		0.750		1.000		1.250		1.500		1.750		2.000		2.250	
			Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP	Sone	BHP
BSQ 16-4 ¼HP	R-1	720	1899		1672		1334																			
			7.6	0.13	7.6	0.14	7.4	0.14																		
		795	2133		1944		1699																			
			8.2	0.18	8.0	0.19	7.8	0.20																		
		870	2363		2199		2003		1743																	
			8.9	0.23	8.7	0.24	8.5	0.26	8.3	0.25																
BSQ 16-3 ⅓HP	R-2	920	2516		2366		2187		1970		1672															
			9.5	0.27	9.3	0.29	9.1	0.30	8.9	0.30	8.7	0.29														
		970	2667		2530		2367		2184		1935															
			10.2	0.32	9.9	0.33	9.7	0.35	9.5	0.36	9.4	0.35														
BSQ 16-5 ½HP	R-3	1020	2818		2692		2539		2370		2165		1896													
			11.0	0.37	10.7	0.38	10.4	0.40	10.2	0.41	10.1	0.41	10.0	0.40												
		1075	2984		2863		2725		2571		2402		2184													
			11.9	0.43	11.5	0.44	11.3	0.46	11.1	0.48	11.0	0.49	10.9	0.48												
		1125	3133		3018		2891		2751		2593		2405		1830											
			12.8	0.49	12.4	0.51	12.2	0.52	12.0	0.54	11.9	0.55	11.8	0.56	11.6	0.51										
BSQ 16-7 ¾HP	R-4	1190	3327		3219		3105		2974		2832		2683		2254											
			14.0	0.57	13.7	0.59	13.5	0.61	13.3	0.63	13.2	0.65	13.1	0.66	12.5	0.64										
		1250	3506		3402		3299		3176		3048		2906		2563											
			15.3	0.66	14.9	0.69	14.7	0.70	14.5	0.72	14.4	0.74	14.3	0.76	13.5	0.76										
BSQ 16-10 1HP	R-5	1300	3654		3555		3455		3342		3221		3089		2782		2358									
			16.4	0.74	16.0	0.77	15.8	0.79	15.6	0.81	15.5	0.83	15.4	0.84	14.5	0.86	12.7	0.83								
		1355	3817		3721		3626		3523		3408		3288		3018		2649									
			17.7	0.84	17.3	0.87	17.1	0.89	16.8	0.91	16.8	0.93	16.7	0.95	15.7	0.98	14.5	0.95								
		1405	3965		3873		3781		3687		3575		3464		3213		2898		2447							
			18.9	0.93	18.4	0.96	18.2	0.98	18.0	1.00	17.9	1.03	17.8	1.05	16.9	1.08	16.2	1.08	16.2	1.02						
BSQ 16-15 1½HP	R-6	1500	4245		4159		4072		3986		3890		3786		3563		3310		2984		2511					
			21.4	1.13	20.8	1.16	20.6	1.19	20.3	1.21	20.3	1.23	20.2	1.26	19.5	1.30	19.4	1.32	19.4	1.30	17.3	1.22				
		1590	4509		4428		4347		4266		4184		4086		3887		3664		3397		3065					
			23.8	1.34	23.2	1.37	22.9	1.41	22.6	1.43	22.6	1.45	22.6	1.48	22.2	1.53	22.4	1.56	22.5	1.57	20.3	1.54				
BSQ 16-20 2HP	R-7	1640	4656		4577		4499		4420		4341		4251		4060		3848		3613		3325		2958			
			25.3	1.47	24.5	1.50	24.2	1.54	23.9	1.56	23.9	1.58	24.0	1.61	23.8	1.66	24.1	1.70	24.1	1.73	22.0	1.71	20.1	1.65		
		1685	4788		4712		4635		4558		4482		4399		4213		4012		3802		3528		3199			
			26.6	1.59	25.7	1.62	25.4	1.66	25.0	1.69	25.1	1.71	25.2	1.74	25.3	1.79	25.6	1.84	25.7	1.88	23.5	1.86	21.4	1.82		
		1735	4935		4860		4786		4711		4637		4562		4381		4193		3988		3746		3460		3104	
			28.1	1.73	27.1	1.77	26.7	1.81	26.3	1.84	26.4	1.86	26.6	1.88	27.0	1.94	27.3	2.00	27.3	2.03	25.2	2.04	22.8	2.02	21.3	1.95
BSQ 16-30 3HP	R-8	1800	5125		5053		4982		4910		4838		4766		4598		4424		4228		4024		3766		3460	
			30.1	1.93	28.9	1.97	28.4	2.01	27.9	2.04	28.2	2.07	28.5	2.09	29.3	2.15	29.5	2.21	29.5	2.25	27.3	2.29	24.6	2.27	22.9	2.23
		1865	5315		5246		5177		5108		5038		4969		4814		4646		4465		4274		4048		3798	
			32.2	2.14	30.7	2.18	30.1	2.22	29.5	2.26	29.9	2.29	30.3	2.32	31.6	2.37	31.7	2.44	31.7	2.49	29.5	2.53	26.5	2.54	24.5	2.52
		1925	5491		5424		5356		5289		5222		5155		5011		4848		4681		4496		4305		4064	
			34.1	2.36	32.3	2.40	31.7	2.44	31.0	2.48	31.5	2.51	32.1	2.54	33.8	2.59	33.7	2.66	33.7	2.72	31.5	2.76	28.2	2.80	26.1	2.78
		1990	5681		5616		5551		5486		5421		5356		5224		5066		4909		4734		4555		4345	
			36.3	2.60	34.1	2.64	33.3	2.68	32.5	2.73	33.3	2.77	34.0	2.79	36.2	2.85	35.9	2.91	35.9	2.98	33.7	3.03	30.0	3.07	27.7	3.08

GREENHECK
FAN CORPORATION

Performance shown is for Model BSQ with outlet ducts.
BHP does not include drive losses.

EXTRUDED ALUMINUM, 4" DEEP, 45° FIXED DRAINABLE TYPE BLADE

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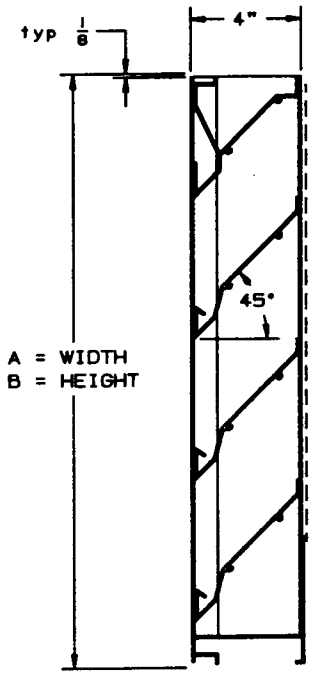
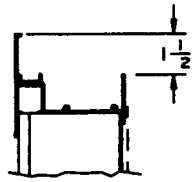
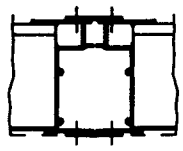


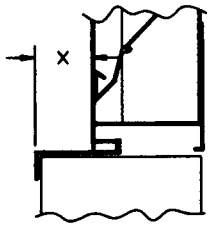
SECTION VIEW



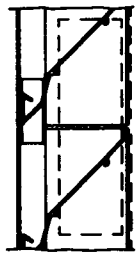
FLANGED FRAME
OPTIONAL



VERTICAL
MULLION



EXTENDED SILL
OPTIONAL



HORIZONTAL
MULLION

AWV ITEM No.	TAG	QUANTITY	"A" WIDE OPENING (IN.)	"B" HIGH OPENING (IN.)	No. OF PANELS (WIDE x HIGH)	OPTIONS: FLANGED FRAME	OPTIONS: SILL EXTENSION (X DIM.)	OPTIONS: SCREENS (EXTERIOR) INSECT SCREEN ONLY	OPTIONS: SPECIAL SCREEN	COMMENTS

SPECIAL FINISH:

MODEL LE-21
STANDARD SPECIFICATIONS

FRAME: 4" DEEP CHANNEL .081" THICK 6063-T5 EXTRUDED ALUMINUM ALLOY.

BLADES: .081" THICK. 6063-T5 EXTRUDED ALUMINUM ALLOY.

FINISH: MILL.

SCREEN: 1/2" MESH ALUMINUM REMOVABLE SCREEN, LOCATED ON INTERIOR.

MAXIMUM PANEL SIZE: 96" x 96".

MINIMUM PANEL SIZE: 12" x 12".

DIMENSIONS: "A" (WIDTH) AND "B" (HEIGHT) ARE OPENING SIZES. LOUVERS ARE MADE 1/4" UNDERSIZE.

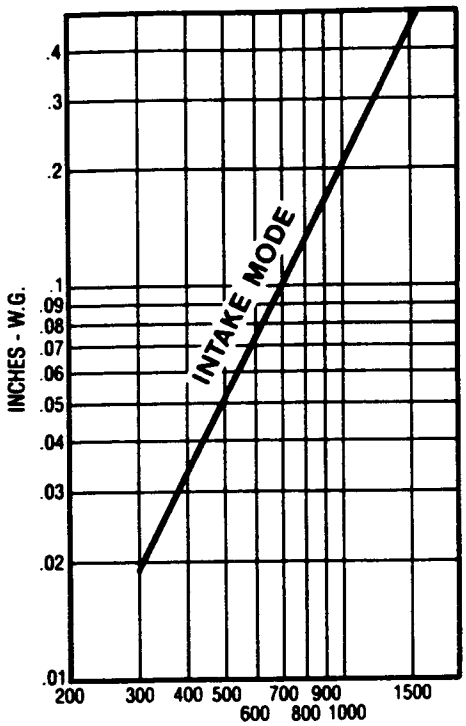
DATE :	AWV PROD. # :
PROJECT :	
CUSTOMER / ORDER # :	
ARCH. / ENGR. :	
AGENT / ORDER # :	

american warming and ventilating inc.
1310 INDIAN WOOD CIRCLE MAUMEE, OHIO

LE-21 STATIONARY LOUVER

DRN. BY JTS	DWG. NO.	REV.
DATE 4-1-86	LE-21-1	

PRESSURE DROP



VELOCITY THRU FREE AREA
(FPM)
STANDARD AIR - .075 LB. PER CU. FT.
Test Fig. 5.5

FREE AREA IN SQUARE FEET

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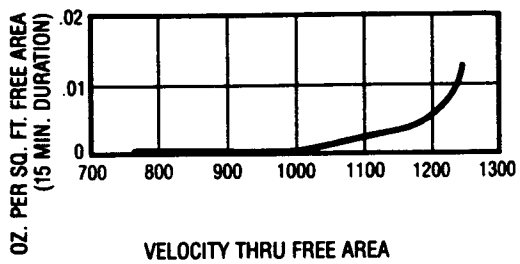
HEIGHT \ WIDTH	12	24	36	48	60	72	84	96	108	120	132	144
12	0.23	0.59	0.95	1.32	1.68	2.00	2.37	2.73	3.10	3.46	3.78	4.14
24	0.54	1.42	2.30	3.19	4.07	4.84	5.72	6.60	7.48	8.36	9.13	10.01
36	0.91	2.39	3.87	5.35	6.83	8.13	9.60	11.08	12.56	14.04	15.34	16.82
48	1.24	3.24	5.24	7.24	9.24	10.99	12.99	14.99	16.99	18.99	20.74	22.74
60	1.62	4.24	6.86	9.48	12.10	14.39	17.01	19.63	22.25	24.87	27.16	29.78
72	2.00	5.24	8.48	11.72	14.96	17.80	21.04	24.28	27.51	30.75	33.59	36.83
84	2.32	6.08	9.83	13.59	17.34	20.63	24.38	28.14	31.89	35.65	38.94	42.69
96	2.69	7.05	11.40	15.75	20.11	23.92	28.27	32.63	36.98	41.34	45.15	49.50
108	3.01	7.89	12.76	17.64	22.51	26.78	31.66	36.53	41.41	46.28	50.55	55.42
120	3.40	8.89	14.39	19.88	25.38	30.18	35.68	41.17	46.67	52.16	56.97	62.47
132	3.78	9.90	16.01	22.12	28.24	33.59	39.70	45.82	51.93	58.05	63.40	69.51
144	4.10	10.73	17.36	23.99	30.62	36.42	43.05	49.68	56.31	62.94	68.74	75.37

WATER PENETRATION



VELOCITY THRU FREE AREA
(FPM)
STANDARD AIR - .075 LB. PER CU. FT.
MAXIMUM RECOMMENDED
FREE AREA
VELOCITY 1000 F.P.M.

amca CERTIFIED RATINGS
WATER PENETRATION
AIR PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION, INC.

AWV certifies that the model LE-21 louver shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests made in accordance with AMCA Standard 500 and comply with the requirements of the AMCA Certified Ratings Program.
The AMCA Certified Ratings Seal applies to air performance ratings and water penetration ratings.

LE-21

Openings that require multiple louver panels in both width and height will require internal structural supports. It is recommended that large openings be divided with structural members so that the louvers will span either width or height with a single panel. Unusually high wind loading may require structural supports on non-multiple wide and multiple high assemblies. Structural supports and mounting accessories not supplied as standard.

AWV is proud to be among the first manufacturers licensed to bear both the AMCA Air Performance and Water Penetration Certified Ratings Seals. Below is an explanation of how to use this information.

LE-21

To determine minimum free area required for the louver:

Step #1: Divide the required CFM flow by the maximum recommended free area velocity.

Step #2: Select the most desirable louver size, from the free area table, that meets the minimum free area requirement.

Step #3: Compare specified performance to the certified water penetration and pressure drop ratings.

Example: Given 12,000 CFM flow

Step #1:

$$\text{min. free area} = \frac{\text{Design CFM}}{\text{Max. Recommended Velocity}}$$

$$= \frac{12{,}000}{1{,}000} = 12 \text{ FT.}^2$$

Step #2: from the free area table the approximate louver size is 60" × 60" (12.10 Ft.^{2}).

SHT. 45/18

BD-10 & 12 Backdraft Dampers — Commercial — 1" wg, 1000 fpm

PRIMARY FUNCTION
The BD-10 vertically-mounted backdraft damper with drop-in frame is designed to prevent air flow reversal in low pressure, low velocity systems. Unit construction consists of extruded aluminum frame and aluminum blades. The BD-12 is identical, but with the addition of an expanded aluminum grille, and is furnished with a flanged frame.

American Warming and Ventilating has been engaged exclusively in the design, development and manufacture of air control equipment for over 75 years.

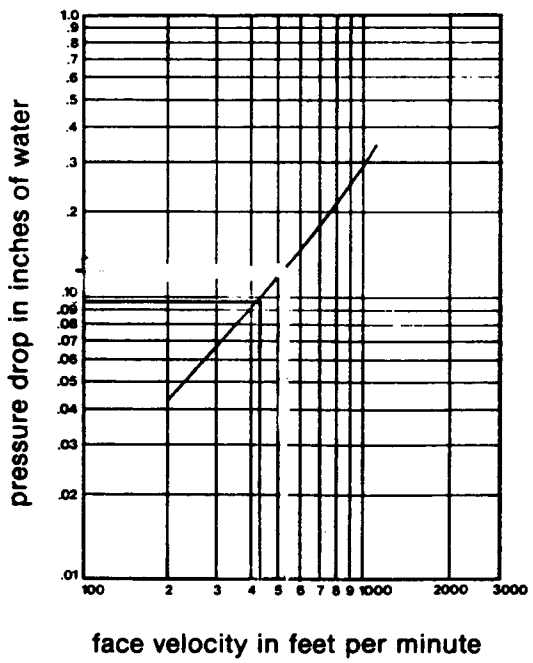
No damper or louver is too large or too small for AWV's engineering and fabrication facilities. Nuclear and fossil-fired power plants, high temperature industrial applications, guillotines and slide-gates, and variations of commercial dampers are just a sampling of the equipment furnished by AWV, through our worldwide network of capable representatives.

AWV's AMCA certified testing laboratory, also dedicated to research and development of new products, is the largest and most complete in the damper/louver industry, worldwide.

SUGGESTED SPECIFICATIONS
Furnish and install where shown, AWV model BD-10 and/or BD-12 backdraft dampers. BD-10 frames shall be .050" through 16 square feet and .063" above, drop-in style. BD-12 frames shall be .063", flanged. All frames shall be 6063-T5 extruded aluminum alloy. Blades through 30" in length, shall be 26 gauge with single stiffening brake; from 30"+ through 38" in length, blades shall be 26 gauge with double stiffening brakes; material shall be aluminum. Axles shall be 3/16" diameter full length galvanized steel rod, turning in self lubricating heavy duty nylon bearings. There shall be felt seals on the blade edges and polyurethane sponge on the sill stop. BD-12 shall have integral 1/2" x .051" expanded aluminum grille.

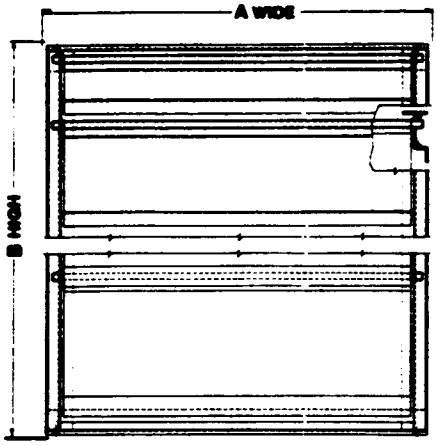
The products shown or described herein may or may not be covered by one or more of the following patent numbers: 3191241, 3286732, 3287870, 3426667, 3650069, 3668999, 3826179, 3963070, 3894481, 38357268 and 4046670. Other patents pending.

PERFORMANCE

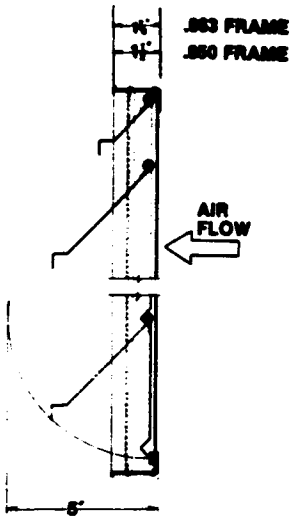


TYPICAL PERFORMANCE FOR BD-10 (BD-12) DAMPERS PER AMCA 500, FIG. 5.4 TESTED SIZE 24" x 24"

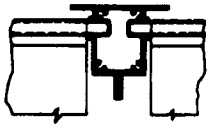
SHT. 46/87



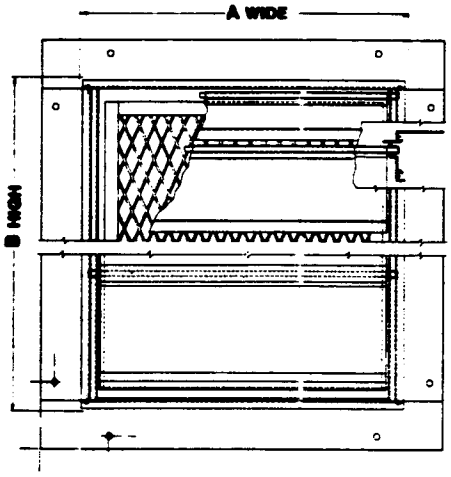
BD-10
FACE VIEW



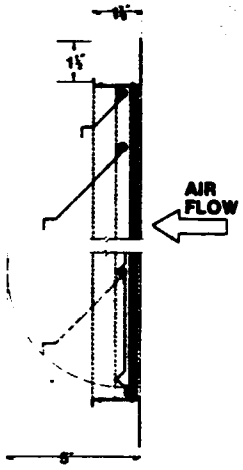
BD-10
VERTICAL SECTION
(DROP-IN FRAME)



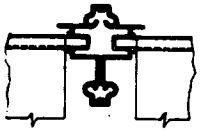
BD-10 MULLION



BD-12
FACE VIEW



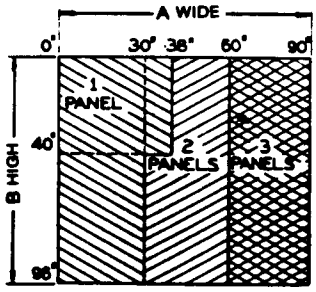
BD-12
VERTICAL SECTION
(FLANGED FRAME)



BD-12 MULLION

SPECIFICATIONS

Maximum Face Velocity: 1000 fpm/5 m/s
Maximum Differential Pressure: 1" wg/250 N/m²
Maximum Temperature: 200°F/95°C
Dimensions:
Maximum panel sizes — See sizing chart.
Minimum panel size — 6"w x 6"h
"A" & "B" dimensions are opening sizes. Dampers will be fabricated 1/8" undersize.
Frame:
BD-10 — .050" 6063-T5 extruded aluminum alloy thru 16 square feet, drop-in style.
.063" 6063-T5 extruded aluminum alloy above 16 square feet, drop-in style.
BD-12 — .063" 6063-T5 extruded aluminum alloy, flanged.
Blades:
Panel widths:
Up to 30"w — 26 gauge aluminum with a single stiffening brake.
30"+ to 38"w — 26 gauge aluminum with double stiffening brakes.
Axles: 3/16" diameter galvanized steel
Bearings: Self-lubricating heavy duty nylon
Seals: Polyurethane sponge on the sill and felt between adjacent blades.
Finish: Mill
Grille: BD-12: 1/2" x .051" expanded aluminum



MAXIMUM FACTORY
ASSEMBLED SIZE

NOTES

1. Drawings are subject to change without notice. Specific information for any component part or construction detail will be furnished upon request.
2. Any variations from the standard specifications must be indicated on the purchase order and on the damper schedule (if used).
3. Contact your AWV representative for dampers exceeding 90"w x 96"h.

American Warming and Ventilating, Inc.
1310 Indian Wood Circle
Maumee, Ohio 43537
Telex No. 286442 Tel. (419) 893-5011

REG TRADE MARK
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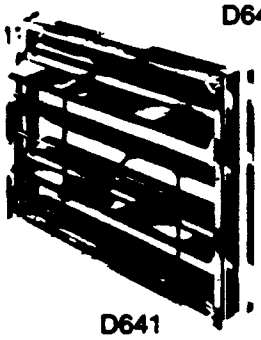
SHT. 47/87
CHKD: TJ
1/21/91

D640, D641 Low Leakage Dampers

D640



D641

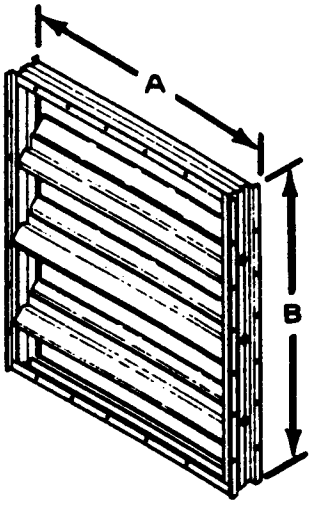
Control volume of circulating air in heating, cooling, economizer, or ventilating systems; modulating or 2-position motor operates dampers.

D640 dampers have parallel acting blades—all blades rotate in the same direction. D641 dampers have opposed acting blades—adjacent blades rotate in opposite directions. Order damper closest to size of duct and maximum desired cfm [m³/hr] capacity to provide good flow control. If an application calls for a damper with 4,000 cfm [6,800 m³/hr], choose a damper rated at 4,000 cfm [6,800 m³/hr] that most closely corresponds to duct dimensions.

SPECIFICATIONS—Custom-built D640 and D641 dampers:

Model Number	Minimum Dimensions A in.	Minimum Dimensions A mm	Minimum Dimensions B in.	Minimum Dimensions B mm	Included Accessories	Options Available
D640	8	203	8	203	Drive axles, vertical drive linkage	Oilite bearings, vertical blades, neoprene blade edging
D641	12	305	14	356		

D640 parallel horizontal blades.



Both D640 and D641 are available in 2 in. [51 mm] increments from the minimum up to 48 in. [1219 mm]. Larger duct dimensions require using multiple dampers, which are field connected vertically and horizontally. Specify internal motor mounting if needed. Other specifications are the same as D640 Standard models. TO ORDER CUSTOM BUILT D640 AND D641 DAMPERS, CONTACT YOUR HONEYWELL REPRESENTATIVE.

SPECIFICATIONS—D640 Standard models. Also see Order Table, page 189.

Blades: 6 or 8 in. [152 or 203 mm], or combination of both, 16 gauge. Drive blades 36 in. [914 mm] or longer are reinforced. Blades mounted horizontally.

Frame Construction: 13-gauge roll formed galvanized steel channel—horizontal, 5/8 x 3 x 3/32 in. [16 x 76 x 2 mm]; vertical, 13/16 x 4-1/2 x 3/32 in. [21 x 114 x 2 mm]. Spring-loaded stainless steel side seals.

Bearings: Nylon.

Motor Mounting: 4 in. [102 mm] long, 1/2 in. [13 mm] diameter extendable axles for use with externally mounted motor. Right-hand drive ear for internally mounted motor is factory installed.

Max. Pressure Differential: 3 in. wc [0.75 kPa].

Max. Approach Velocity: 1500 fpm [7.6 m/s].

Ambient Temperature Range: −40 F to +200 F [−40 C to +93 C].

Leakage: 1% leakage in normal economizer applications.

Q605 Linkages: See page 190 for specifications.

ACCESSORIES: See page 191.

continued next page

D640, D641 continued

Available only through Authorized Honeywell Distributors.

**TRADELINE models.*

SHT. 48/

Order Number	Approximate Dimensions A[b] Top/Bottom in.	A[b] mm	B[b] Sides in.	B[b] mm	sq ft	m²	Capacity cfm at 1000 fpm at 0.03 in. wc Press. Diff.[a]	Capacity m³/hr at 18,300 m/hr at 7.5 Pa Press. Diff.[a]
*D640A9009	12	305	12	305	1.0	0.09	1,000	1,700
D640A9017	12	305	18	457	1.5	0.14	1,500	2,550
D640A9025	12	305	24	610	2.0	0.19	2,000	3,400
D640A9033	12	305	30	762	2.5	0.23	2,500	4,250
D640A9041	12	305	36	914	3.0	0.28	3,000	5,100
*D640A9058	12	305	42	1067	3.5	0.33	3,500	5,950
D640A9066	12	305	48	1219	4.0	0.37	4,000	6,800
*D640A9074	18	457	12	305	1.5	0.14	1,500	2,550
*D640A9082	18	457	18	457	2.3	0.21	2,250	3,825
*D640A9090	18	457	24	610	3.0	0.28	3,000	5,100
D640A9108	18	457	30	762	3.8	0.35	3,750	6,375
D640A9116	18	457	36	914	4.5	0.42	4,500	7,650
D640A9124	18	457	42	1067	5.3	0.49	5,250	8,925
D640A9132	18	457	48	1219	6.0	0.56	6,000	10,200
*D640A9140	24	610	12	305	2.0	0.19	2,000	3,400
*D640A9157	24	610	18	457	3.0	0.28	3,000	5,100
*D640A9165	24	610	24	610	4.0	0.37	4,000	6,800
*D640A9173	24	610	30	762	5.0	0.46	5,000	8,500
*D640A9181	24	610	36	914	6.0	0.56	6,000	10,200
D640A9199	24	610	42	1067	7.0	0.65	7,000	11,900
D640A9207	24	610	48	1219	8.0	0.74	8,000	13,600
*D640A9215	30	762	12	305	2.5	0.23	2,500	4,250
*D640A9223	30	762	18	457	3.8	0.35	3,750	6,375
*D640A9231	30	762	24	610	5.0	0.46	5,000	8,500
*D640A9249	30	762	30	762	6.3	0.59	6,225	10,583
D640A9256	30	762	36	914	7.5	0.70	7,500	12,750
D640A9264	30	762	42	1067	8.8	0.82	8,750	14,875
*D640A9280	36	914	12	305	3.0	0.28	3,000	5,100
*D640A9298	36	914	18	457	4.5	0.42	4,500	7,650
*D640A9306	36	914	24	610	6.0	0.56	6,000	10,200
*D640A9314	36	914	30	762	7.5	0.70	7,500	12,750
*D640A9322	36	914	36	914	9.0	0.84	9,000	15,300
D640A9355	42	1067	12	305	3.5	0.33	3,500	5,950
D640A9363	42	1067	18	457	5.3	0.50	5,250	8,925
D640A9371	42	1067	24	610	7.0	0.65	7,000	11,900
D640A9389	42	1067	30	762	8.8	0.82	8,750	14,875
D640A9421	48	1219	12	305	4.0	0.37	4,000	6,800
*D640A9439	48	1219	18	457	6.0	0.56	6,000	10,200
*D640A9447	48	1219	24	610	8.0	0.74	8,000	13,600
*D640A9470	48	1219	48	1219	16.0	1.49	16,000	27,200
*D640A9488	14	356	14	356	1.4	0.13	1,360	2,312
*D640A9496	16	406	16	406	1.8	0.17	1,780	3,026
*D640A9504	20	508	20	508	2.8	0.26	2,780	4,726

[a]To find capacity in systems with fpm [m/hr] different from 1000 fpm [18,300 m/hr], use this conversion formula:

$$\text{cfm} = \frac{\text{cfm from chart x fpm}}{1000\ \text{fpm}} \qquad \text{m}^3/\text{hr} = \frac{\text{m}^3/\text{hr from chart x m/hr}}{18{,}300\ \text{m/hr}}.$$

[b]See drawing on page 188.

BUILDING CONTROLS

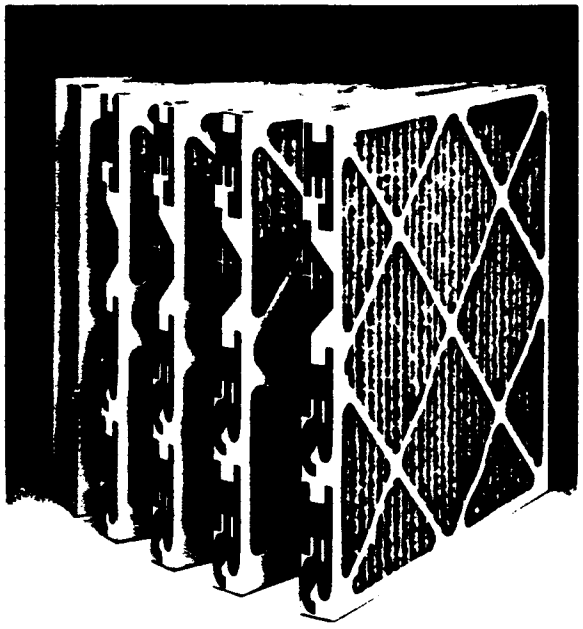
SHT 49/6

Bulletin No. A-1305-6B

SELECTION GUIDE

30/30® FILTERS

FARR 30/30 EXTENDED AREA FILTERS have established a new air filtration standard in a wide variety of commercial, industrial and residential applications. High efficiency ratings, extended service life and ease of handling have made them the accepted choice where both performance and economy are required.



NEW OR EXISTING SYSTEMS can be upgraded by incorporating he Farr 30/30. Its greater dust holding capacity not only extends replacement intervals, but considerably lengthens the service life of any other secondary filters in the system.

Farr 30/30 filters may be installed in built-up banks, Farr Glide/Pack side access housings and OEM air handling units. A wide range of conversion fasteners and clips are available to adapt the Farr 30/30 to almost any existing built-up filter bank.

FILTER MEDIA shall be of the non-woven cotton fabric type. The filter media shall have an average efficiency of 25-30% on ASHRAE Test Standard 52-76. It shall have an average arrestance of 90-92% in accordance with that test standard.

The Farr 30/30 is categorized as a 30% efficiency filter. Average efficiencies may vary 5 points. These variances are typical of filters in the medium efficiency category when tested in accordance with the ASHRAE 52-76 standard.

MEDIA SUPPORT GRID shall be a welded wire grid with an effective open area of not less than 96%.

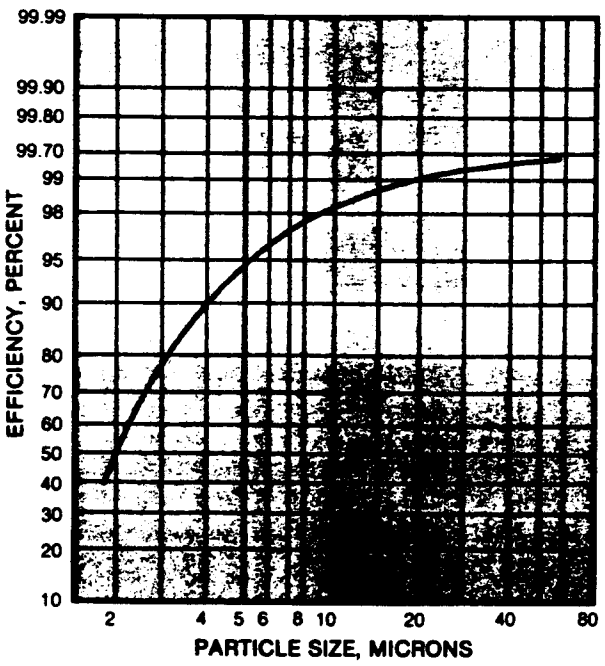
The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away.

The media support grid shall be formed in such a manner that it affects a radial pleat design, allowing total use of filter media.

ENCLOSING FRAME shall be constructed of a rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and air exit side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.

HOLDING FRAMES shall be Farr Type 8, factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and four spring-type positive sealing fasteners. Fasteners shall be capable of being attached or removed without the use of tools.

EFFECTIVE PARTICLE SIZE EFFICIENCY



A COMPLETE LIST OF AVAILABLE SIZES IS SHOWN ON REVERSE SIDE.

FARR

SHT 50
87

NOMINAL FILTER DEPTH	NOMINAL SIZE (inches) (mm)	ACTUAL SIZE (inches) (mm) WIDTH	HEIGHT	DEPTH	CAPACITIES (CFM) (m^3/h) MEDIUM	HIGH	RESISTANCE AT CAPACITY (inches WG) (kPa) MEDIUM	HIGH	FINAL**	MEDIA AREA (ft^2) (m^2) TOTAL	MEDIA AREA PER SQUARE FOOT FACE AREA
4"	12 x 24	11.38	23.38	3.88	600	1200	.12	.35	.90	13.8	7.0 ft² 11 pleats per linear foot. .65 m² 36 pleats per linear meter.
	305 x 610	289	594	98.4	1020	2040	.03	.09	.22	1.28	
	16 x 20	15.38	19.38	3.88	665	1325	.12	.35	.90	15.6	
	406 x 508	391	492	98.4	1130	2250	.03	.09	.22	1.45	
	16 x 25	15.38	24.38	3.88	835	1670	.12	.35	.90	19.6	
	406 x 635	391	619	98.4	1420	2840	.03	.09	.22	1.82	
	18 x 24	17.38	23.38	3.88	900	1800	.12	.35	.90	20.6	
	457 x 610	441	594	98.4	1530	3060	.03	.09	.22	1.91	
	20 x 20	19.38	19.38	3.88	835	1670	.12	.35	.90	18.6	
	508 x 508	492	492	98.4	1420	2840	.03	.09	.22	1.73	
	20 x 24	19.38	23.38	3.88	1000	2000	.12	.35	.90	22.5	
	508 x 610	492	594	98.4	1700	3400	.03	.09	.22	2.09	
	20 x 25	19.38	24.38	3.88	1050	2100	.12	.35	.90	23.5	
	508 x 635	492	619	98.4	1785	3570	.03	.09	.22	2.18	
	24 x 24	23.38	23.38	3.88	1200	2400	.12	.35	.90	27.5	
	610 x 610	594	594	98.4	2040	4080	.03	.09	.22	2.55	
	29 x 25	28.38	24.38	3.88	1540	3075	.12	.35	.90	35.2	
	737 x 635	721	619	98.4	2615	5225	.03	.09	.22	3.27	
2"	10 x 20*	9.50	19.50	1.88	350	695	.08	.28	.90	5.9	4.6 ft² 15 pleats per linear foot. .43 m² 49 pleats per linear meter.
	254 x 508	241	495	47.6	595	1180	.02	.07	.22	.55	
	12 x 20	11.88	19.50	1.88	420	835	.08	.28	.90	7.5	
	305 x 508	302	495	47.6	715	1420	.02	.07	.22	.70	
	12 x 24	11.38	23.38	1.88	500	1000	.08	.28	.90	8.5	
	305 x 610	289	594	47.6	850	1700	.02	.07	.22	.79	
	14 x 20*	13.50	19.50	1.88	485	970	.08	.28	.90	8.4	
	356 x 508	343	495	47.6	825	1650	.02	.07	.22	.78	
	14 x 25*	13.50	24.50	1.88	610	1215	.08	.28	.90	10.6	
	356 x 635	343	622	47.6	1035	2065	.02	.07	.22	.98	
	15 x 20*	14.50	19.50	1.88	520	1040	.08	.28	.90	9.0	
	381 x 508	368	495	47.6	885	1765	.02	.07	.22	.84	
	16 x 20	15.50	19.50	1.88	550	1100	.08	.28	.90	10.1	
	406 x 508	394	495	47.6	935	1870	.02	.07	.22	.94	
	16 x 25	15.50	24.50	1.88	695	1390	.08	.28	.90	12.7	
	406 x 635	394	622	47.6	1180	2360	.02	.07	.22	1.18	
	18 x 20	17.50	19.50	1.88	625	1250	.08	.28	.90	10.9	
	457 x 508	445	495	47.6	1060	2125	.02	.07	.22	1.01	
(2) →	18 x 24	17.50	23.50	1.88	750	1500	.08	.28	.90	13.3	
	457 x 610	445	597	47.6	1274	2548	.02	.07	.22	1.24	
	18 x 25	17.50	24.50	1.88	780	1560	.08	.28	.90	13.7	
	457 x 635	445	622	47.6	1325	2650	.02	.07	.22	1.27	
	20 x 20	19.50	19.50	1.88	695	1390	.08	.28	.90	12.1	
	508 x 508	495	495	47.6	1180	2360	.02	.07	.22	1.12	
	20 x 24*	19.50	23.50	1.88	835	1670	.08	.28	.90	14.6	
	508 x 610	495	597	47.6	1420	2840	.02	.07	.22	1.36	
	20 x 25	19.50	24.50	1.88	870	1740	.08	.28	.90	15.3	
	508 x 635	495	622	47.6	1480	2955	.02	.07	.22	1.42	
	24 x 24	23.38	23.38	1.88	1000	2000	.08	.28	.90	17.6	
	610 x 610	594	594	47.6	1700	3400	.02	.07	.22	1.64	
1"	14 x 20	13.50	19.50	.88	485	970	.14	.45	.90	4.2	2.3 ft² 16 pleats per linear foot. .21 m² 52 pleats per linear meter.
	356 x 508	343	495	22.4	825	1650	.03	.11	.22	.39	
	14 x 25	13.50	24.50	.88	605	1210	.14	.45	.90	5.2	
	356 x 635	343	622	22.4	1030	2055	.03	.11	.22	.48	
	15 x 20	14.50	19.50	.88	520	1040	.14	.45	.90	4.6	
	381 x 508	368	495	22.4	885	1765	.03	.11	.22	.43	
	16 x 20	15.50	19.50	.88	555	1110	.14	.45	.90	4.8	
	406 x 508	394	495	22.4	945	1885	.03	.11	.22	.45	
	16 x 25	15.50	24.50	.88	695	1390	.14	.45	.90	6.1	
	406 x 635	394	622	22.4	1180	2360	.03	.11	.22	.57	
	20 x 20	19.50	19.50	.88	695	1390	.14	.45	.90	6.0	
	508 x 508	495	495	22.4	1180	2360	.03	.11	.22	.56	
	20 x 25	19.50	24.50	.88	870	1740	.14	.45	.90	7.6	
	508 x 635	495	622	22.4	1480	2955	.03	.11	.22	.71	
	24 x 24	23.50	23.50	.88	1000	2000	.14	.45	.90	8.9	
	610 x 610	597	597	22.4	1700	3400	.03	.11	.22	.83	

* These are custom sizes, fabricated to order. Framework is not constructed of die-cut stock. Performance is similiar to other standard sizes.
** Recommended final resistance. System design may dictate a lower change-out point.

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Farr Company has a policy of uninterrupted research, development and product improvement and reserves the right to change design and specifications without notice. Metric equivalents have been rounded for convenience.

LITHO IN U.S.A. 5/89

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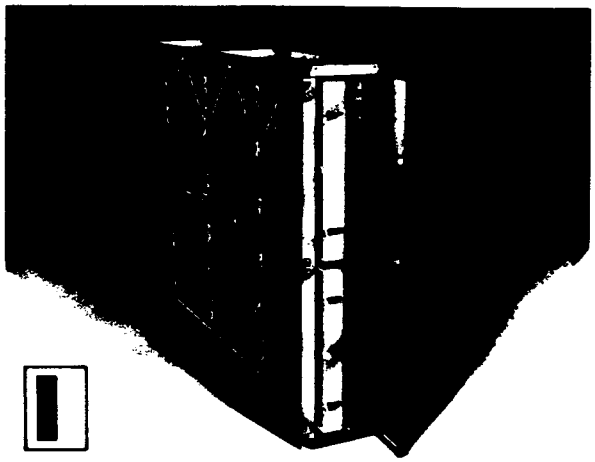
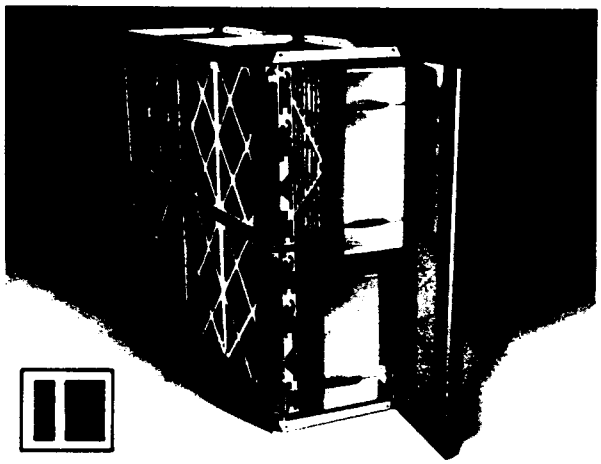
4542-370 — 10M — L

SHT. 51 1/4
CKB4: TJT
1/21/91

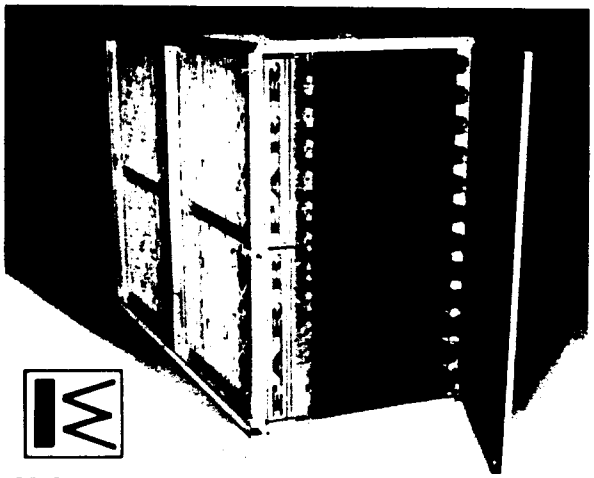
Six Choices Meet Many Design Options



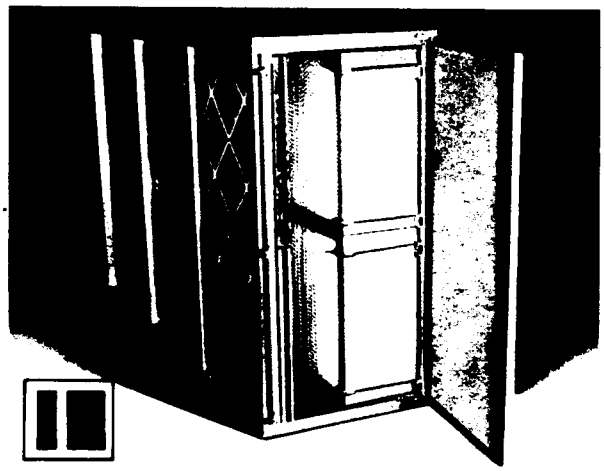
4P GLIDE/PACK — *Single-stage, holds 2", 4", or 6" deep filters from 25%-95%, ASHRAE Standard 52-76. Lowest industry leakage rate. In-line depth is just 12".*



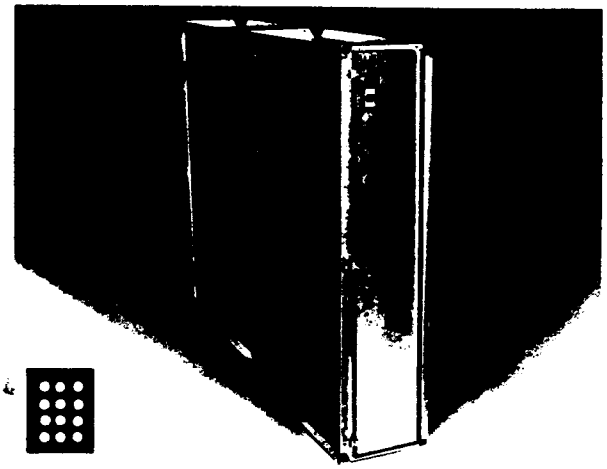
3P GLIDE/PACK — *Incorporates an integral static tap, two stages for 2" deep prefilters and a wide choice of final filters. Lowest industry leakage rate. In-line depth is just 21"*



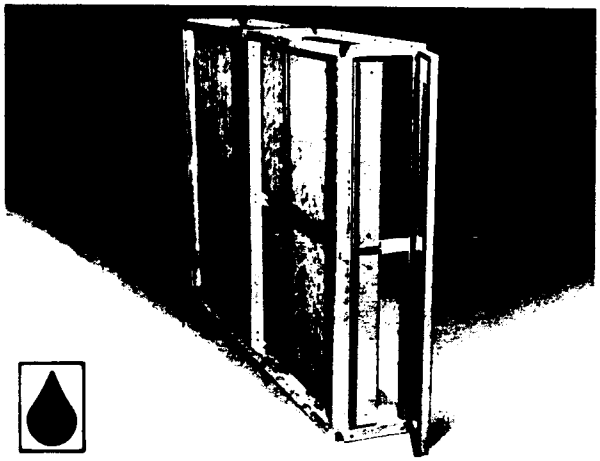
3CF GLIDE/PACK — *Two-stage housing accommodates a 4" prefilter and 90 lbs. of carbon for each 2,000 CFM. Airflow may be in either direction. 33.75" deep.*



MAGNA/PACK — *14-gauge housing for HEPA filters, with or without prefilter section. Includes DOP port. See Magna-Series Bulletin No. B-1304-6. 27" deep.*



DIFFUSER/PACK — *Perforated plate has 51% open area, with a pressure drop of only 0.1" w.g. at 500 fpm. For use on positive side of fan. In-line depth is just 12".*



MOISTURE/PACK — *Single-stage system for oil and water mist removal. Built-in drain mechanism for liquid run-out. In-line depth is just 12".*

SHT. 52/10.
CKD BY TJ
1/21/81

GLIDE/PACK LAYOUT GUIDE

APPLICATION	ARRANGEMENTS	TOTAL DEPTH‡ (without fan)
[illegible]		
[illegible]		
[illegible]		
SATURATED AIR*		4'9"
COMMERCIAL		[illegible]
INDUSTRIAL		[illegible]
FOG, OIL OR WATER MISTS		[illegible]

‡ DEPTH OF HOUSING	
	1'0"
3P GLIDE/PACK (Particulates)	
	2'9¾"
DIFFUSER/ PACK	
MOISTURE/ PACK (Mists)	1'0"
FAN	

TOP VIEW

* Design dictates Diffuser/Pack and Moisture/Pack @ 500 fpm, final filters @ 400 fpm.
** For source-capture, see Farr Model TM-33 Bulletin No. B-1000-14.

HOUSING DIMENSIONS AND AIRFLOW CAPACITIES*

(Airflow rated at 500 fpm...filters may be operated at up to 625 fpm)

NUMBER OF FILTERS HIGH	HEIGHT	NUMBER OF FILTERS WIDE											
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6
½	1'3¾"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	2'3¼"	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000
1½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	4'3½"	2,000	4,000	6,000	8,000	10,000	12,000	14,000	16,000	18,000	20,000	22,000	24,000
2½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	6'3¾"	—	6,000	9,000	12,000	15,000	18,000	21,000	24,000	27,000	30,000	33,000	36,000
3½	7'4"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	8'4"	—	8,000	12,000	16,000	20,000	24,000	28,000	32,000	36,000	40,000	44,000	48,000
WIDTH		[illegible]	2'0"	3'0"	4'0"	5'0"	[illegible]	7'0"	8'0"	9'0"	10'0"	11'0"	12'0"

* 3CF Glide/Pack not available in half-widths.
Magna/Pack dimensions and capacities can be found in Magna-Series Bulletin No. B-1304-6.

SHT. 53/8
CKBY: TJ
1/21/91

FILTER REFERENCE

FILTER DEPTH	FILTER (Nominal — 24" x 24")	RATED AIRFLOW (CFM)‡	INITIAL RESISTANCE (ins. w.g.)	MEDIA AREA FILTER (ft²)	EFFICIENCY (%) ASHRAE 52-76	EFFICIENCY (%) @ ONE MICRON*	ARRESTANCE (%) ASHRAE 52-76
12"	RIGA-FLO 15	2,000	.29	58.0	60-65	58	97
	RIGA-FLO 200	2,000	.68	58.0	90-95	97	99
6"	RIGA-FLO 15	1,500	.32	29.0	60-65	58	97
	RIGA-FLO 200	1,200	.56	29.0	90-95	97	99
4"							
2"	30/30	2,000	.28	17.6	25-30	23	92
4"	MOISTURE SEPARATOR	2,000					

‡ *Filters may be operated up to 625 fpm except Moisture Separators. Refer to Farr performance graphs available through your local Farr representative.*
* *Clean efficiency shown...efficiency increases with dirt load. Efficiency versus Micron Size graphs available upon request.*

INSTALLED WEIGHTS — LBS.

SIZE HIGH	SIZE WIDE	FULL SIZE GLIDE/PACK HOUSING 4P	BIFF/PACK	MOIST/PACK	3P	3CF*
1	1	45	60	65	120	315
	2	65	90	95	175	530
	3	95	125	135	230	750
	4	115	150	175	280	955
	5	140	185	215	325	1,170
	6	160	210	250	375	[illegible]
2	1	70	90	105	180	545
	2	100	125	170	265	920
	3	140	170	240	330	1,310
	4	170	205	310	405	1,685
	5	210	250	380	480	2,075
	6	240	285	440	545	2,430
3	1	100	155	155	235	765
	2	145	190	250	325	1,305
	3	195	245	350	430	1,870
	4	240	300	450	520	2,400
	5	290	350	550	620	2,970
	6	[illegible]	[illegible]	645	700	[illegible]
4	1	130	140	200	300	990
	2	[illegible]	[illegible]	325	405	[illegible]
	3	245	265	460	540	2,435
	4	[illegible]	[illegible]	590	645	[illegible]
	5	365	395	730	775	3,880
	6	420	465	850	865	4,560

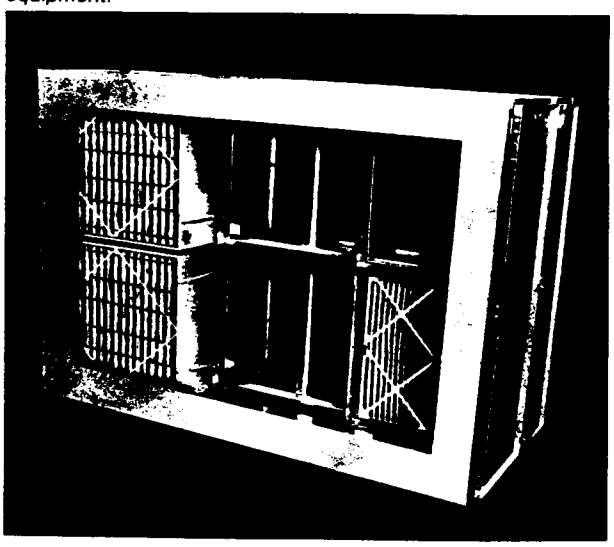
Add 20% for shipping weights to all housings.
Add 9% for insulated doors only.
Add 12% for insulated doors, top and bottom panels.

* *3CF not available in half-widths.*
NOTE: Weights shown include filters.

METRIC CONVERSIONS

CONVERSION	FORMULA
[illegible]	[illegible]
Lbs. to kgs.	Lbs. X .455
[illegible]	[illegible]
CFM to m³/h	CFM X 1.6992
[illegible]	[illegible]

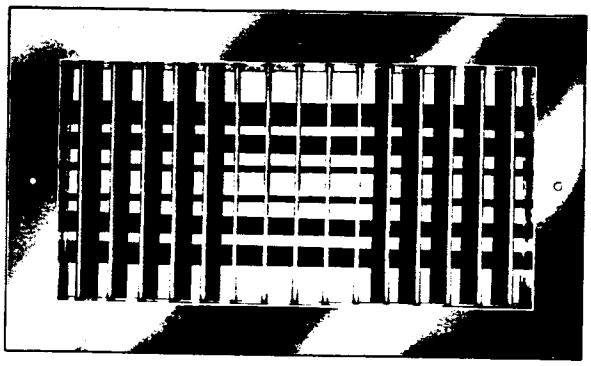
Transition plates, on one or both sides, are available to allow direct connection to most major manufacturer's air handling equipment.



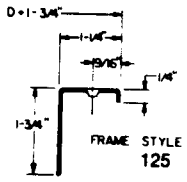
SHT. 54/E
CK RT: TJ 1/21/9

880 H or V

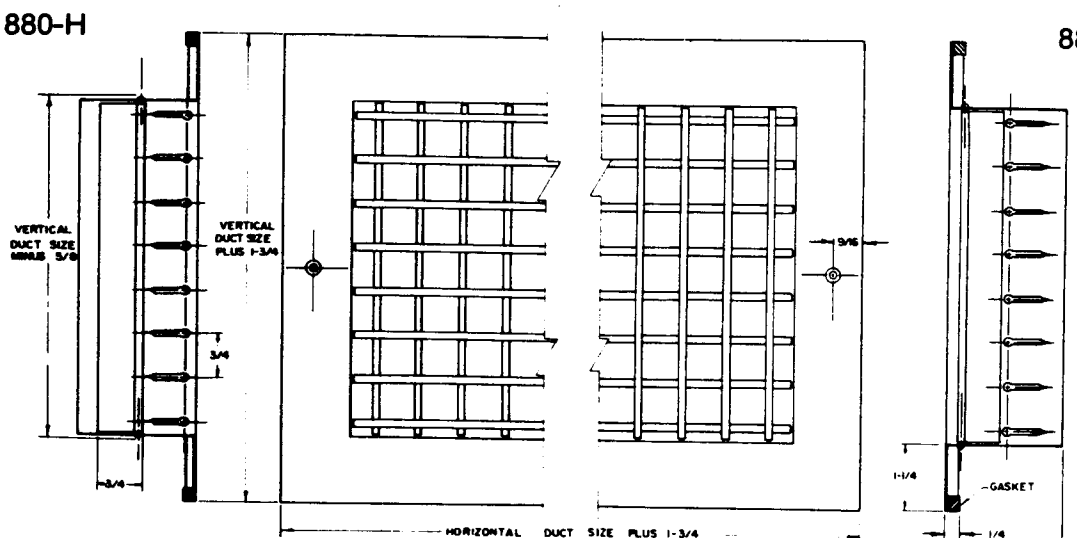
- 880H — Horizontal front with vertical rear deflection vanes.
- 880V — Vertical front with horizontal rear deflection vanes.
- Sturdy deflection vanes, spaced on ¾" centers are adjustable front and rear or standard..
- 885 H or V — ½" Spacing available upon request.
- Optional Opposed Blade Damper (OBD) operator is easily adjusted through face with screwdriver or allen wrench.
- Narrow depth of OBD design allows Grille-OBD combination to be used in stackheads of minimum depth.
- Construction — Steel.
- A phosphate coating followed by a 49 White Finish is standard.
- Large sizes manufactured in multiple sections.
- A sponge rubber gasket prevents streaking.
- Optional — Model 8PF Plaster Frame.
  (Use on standard frame #125 only)
- Specify horizontal dimension followed by vertical dimension.



STANDARD FRAME

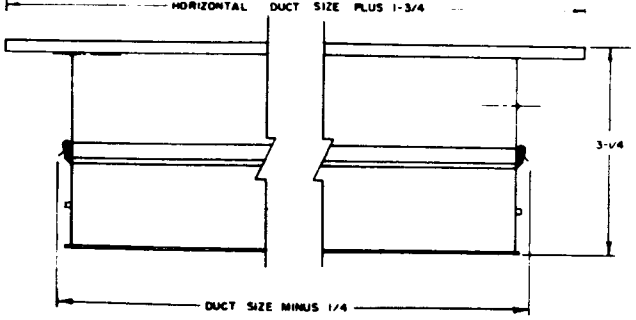


880-H



880-V

880-H-OBD



880-V-OBD

CLEAN ITT 1/25/91

SHT. 55/8

PREFERRED SIZES

CFM	SIZE		24 x 12									24 x 24		
	DEFLECTION	0	22	45	0	22	45	0	22	45	0	22	45	0	22	45	0	22	45
600	VELOCITY	[illegible]	[illegible]	600	480	505	550	425	430	475	330	360	390						
	TOTAL PRESS.	[illegible]	[illegible]	[illegible]	[illegible]	.020	.026	.012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
	THROW	[illegible]	[illegible]	[illegible]	[illegible]	26	28	24	[illegible]	18	30	[illegible]	[illegible]						
	DROP	[illegible]	[illegible]	[illegible]	[illegible]	12	9.5	14.5	[illegible]	9.5	14.5	12	9.5						
650	VELOCITY	[illegible]	585	650	535	545	595	460	475	515	380	395	415						
	TOTAL PRESS.	[illegible]	[illegible]	.037	.021	.024	.031	.016	[illegible]	.022	.010	.011	.014						
	THROW	32	28	23	30	27	21	26	22	17	22	19	13						
	DROP	14.5	11.5	9.0	14.5	12	9.5	15	12.5	9.5	15	12.5	9.5						
700	VELOCITY	625	640	700	575	590	640	495	510	555	390	410	445	320	325	355			
	TOTAL PRESS.	.029	.033	.043	.025	.028	.036	.018	.020	.024	.011	.013	.016	.007	.008	.010			
	THROW	34	30	25	33	29	22	29	24	18	25	21	14	19	16	11			
	DROP	14.5	12.5	9.5	14.5	13	10	15	13	10	15	13.5	10	15	14	10			
750	VELOCITY	670	685	750	615	630	685	530	545	595	415	440	475	340	350	385			
	TOTAL PRESS.	.034	.038	.050	.028	.032	.042	.021	.023	.029	.013	.014	.019	.008	.010	.017			
	THROW	36	32	26	34	30	23	32	27	20	29	23	17	21	18	13			
	DROP	16	13	9.5	16.5	13.5	10.5	17	14.5	11	16.5	14.5	11	16.5	14.5	11			
800	VELOCITY	715	735		655	670	735	565	580	635	455	470	510	385	370	410	290	325	365
	TOTAL PRESS.	.039	.043		[illegible]	.036	.048	.023	.026	.034	.015	.017	.022	.010	.011	.013	.007	.008	.010
	THROW	[illegible]	34		[illegible]	32	24	33	28	21	31	26	19	23	20	16	19	16	13
	DROP	[illegible]	[illegible]		19.5	14	10.5	15	14.5	11	18.5	15	11.5	18.5	15	11.5	18.5	15	11.5
900	VELOCITY				740	755		635	650	715	515	525	575	410	420	460	325	365	400
	TOTAL PRESS.				.041	.046		.029	.033	.043	.018	.021	.028	.012	.014	.018	.009	.010	.013
	THROW				[illegible]	36		37	31	23	33	28	21	25	22	19	21	17	15
	DROP				[illegible]	14.5		18.5	14.5	11.5	19	15	11.5	20	15.5	12	20	15.5	12
1000	VELOCITY							785	725		570	585	640	455	465	510	360	405	445
	TOTAL PRESS.							.037	.041		.023	.026	.034	.015	.017	.021	.011	.012	.016
	THROW							39	34		35	30	23	28	25	21	24	20	17
	DROP							19.5	[illegible]		20	16	12	20.5	16	12.5	20.5	16.5	13
1100	VELOCITY										630	645	705	500	510	560	395	450	489
	TOTAL PRESS.										.028	.031	.040	.018	.020	.025	.013	.015	.019
	THROW										40	32	25	31	28	23	27	24	21
	DROP										20.5	16.5	12.5	21	17.5	13	21.5	17.5	13
1200	VELOCITY										685	700		545	560	610	475	490	535
	TOTAL PRESS.										.033	.037		.021	.024	.030	.016	.018	.023
	THROW										43	35		34	30	25	29	26	22
	DROP										21	17		21.5	17.5	13	22	17.5	13
1300	VELOCITY										740			590	605	665	515	530	580
	TOTAL PRESS.										.039			.025	.028	.035	.018	.022	.027
	THROW										48			38	32	26	32	29	24
	DROP										22			22	18	13.5	22.5	18	13.5
1400	VELOCITY			1405										635	650	715	555	570	625
	TOTAL PRESS.			.170										.029	.032	.041	.021	.025	.031
	THROW			39										42	35	28	35	31	26
	DROP			14										23	18.5	14.5	23	18.5	14.5
1500	VELOCITY						1375							680	695		595	610	670
	TOTAL PRESS.						.170							.033	.037		.025	.029	.036
	THROW						38							46	38		38	33	27
	DROP						14.5							22	19		23	19.5	14.5
1600	VELOCITY				1610	1345	1465							730			635	690	715
	TOTAL PRESS.				[illegible]	.143	.196							[illegible]			.028	.033	.041
	THROW				[illegible]	36	41							[illegible]			40	35	28
	DROP				23	19	16							25.5			24	20	16
1700	VELOCITY				1395	1430	1560			1350							675	690	
	TOTAL PRESS.				.147	.160	.224			.152							.032	.037	
	THROW				61	50	43			37							42	38	
	DROP				23.5	19.5	16.5			18.5							24.5	20.5	
1800	VELOCITY								1305	1430							715		
	TOTAL PRESS.								.139	.170							.035		
	THROW								57	40							46		
	DROP								20.5	16							24.5		
1900	VELOCITY																		
	TOTAL PRESS.																		
	THROW																		
	DROP																		
2000	VELOCITY																		
	TOTAL PRESS.																		
	THROW																		
	DROP																		
2400	VELOCITY																		
	TOTAL PRESS.																		
	THROW																		
	DROP																		
2800	VELOCITY																		1280
	TOTAL PRESS.																		.125
	THROW																		44
	DROP																		17.5
3200	VELOCITY																1270	1300	1425
	TOTAL PRESS.																.113	.126	.163
	THROW																72	[illegible]	[illegible]
	DROP																26.5	23	[illegible]

NC SOUND DATA COLOR CODE

- NC LEVEL LESS THAN 20
- NC LEVEL LESS THAN 30
- NC LEVEL LESS THAN 35
- NC LEVEL LESS THAN 40
- NC LEVEL LESS THAN 50
- NC LEVEL MORE THAN 50

DATA BASED ON 8 db ROOM ATTENUATION

NOTE: PREFERRED SIZES SHOWN IN BOLD PRINT.

ICF KAISER ENGINEERS

JOB NO. 91044-003

SHEET 56 OF 87

DUCT HEATER FOR O.A. INTAKE

DESIGNED BY F. Lopez DATE 1-18-91

CHECKED BY [illegible] DATE 1/21/91

OUTSIDE AIR REQUIREMENTS = 1400 CFM

TEMPERATURE DIFFERENCE = 33°F (45°F - 12°F)

$Q = CFM \times 1.08 \times \Delta T$

$Q = 1800 \times 1.08 \times 33°$

Q = 49896 BTUH OR 14.6KW X 1.10 SF = 16 KW USE 20KW

FACE AREA = (24-2.5)(18-.75)/144 DUCT SIZE 24"x18"

= 2.5 SQ FT

KW/FT² = KW/2.5 = 15/2.5

= 8 KW/FT²

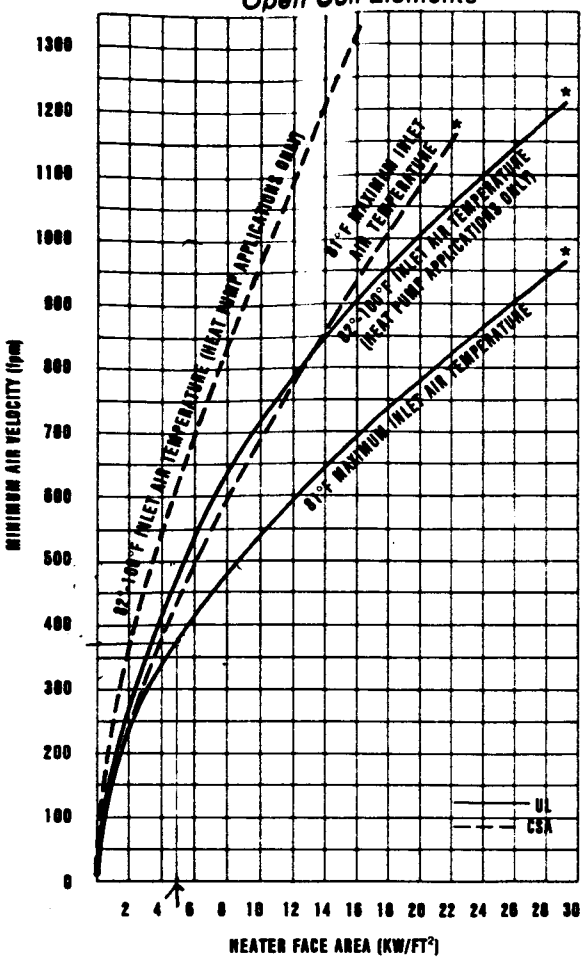
AT MAXIMUM OF 81°F, A MINIMUM AIR VELOCITY OF 475 FPM NEEDED AT 8 KW/FT²

FPM OF SYSTEM: 560 FPM THROUGH DUCT HTR. (1400 CFM / 2.5 SQ FT)

CALCULATIONS KE Form No. E-6 Rev. 12-89

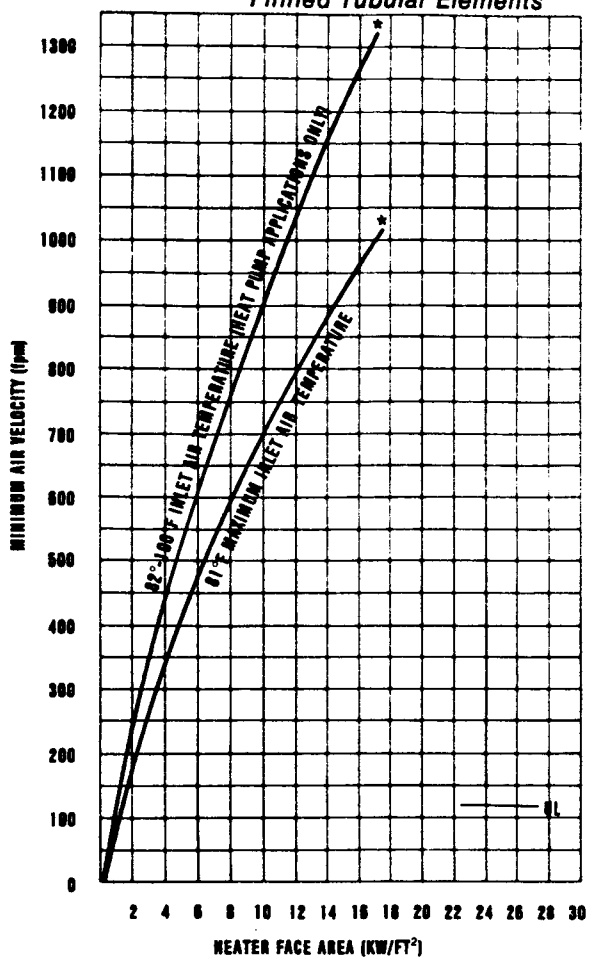
SHT. 57/8
CKD BY: JT
1/21/91

Figure 44 *Minimum Air Velocity - Open Coil Elements*



*Maximum allowed watt density.

Figure 45 *Minimum Air Velocity - Finned Tubular Elements*



*Maximum allowed watt density.

$$\text{Face Area} = \frac{(H\text{-}2\tfrac{1}{2}")\ (W\text{-}\tfrac{3}{4}")}{144}$$

$$KW/Ft^2 = \frac{KW}{\text{Face Area}}$$

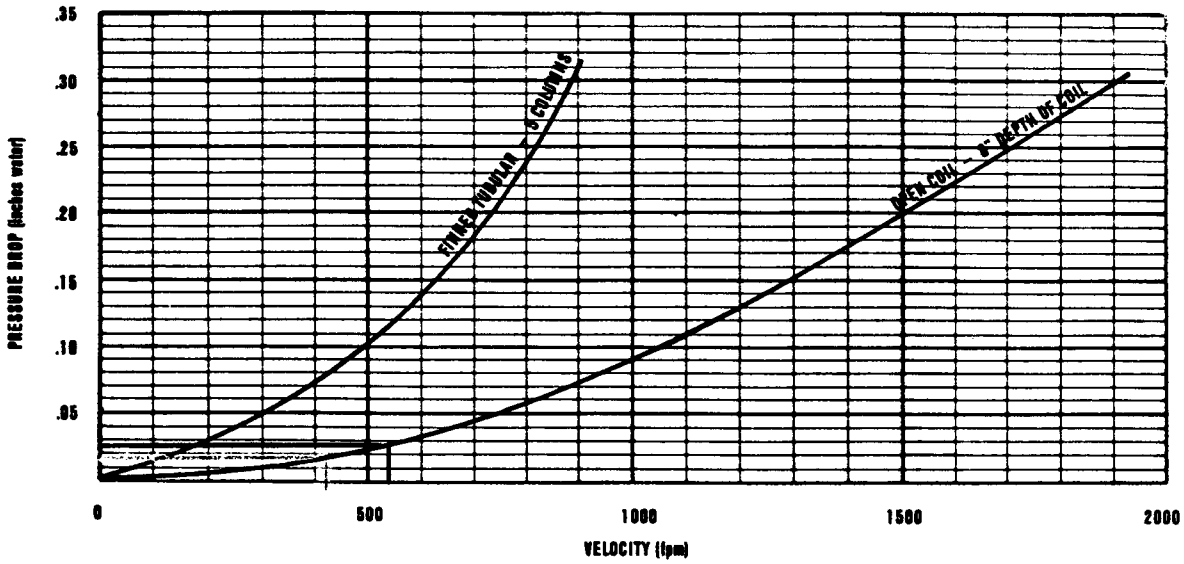
Example: 25 KW UL Heater, Inlet 75°F
12" H x 24" W, Open Coil Elements

$$\text{Face Area} = \frac{(12\text{-}2\tfrac{1}{2})\ (24\text{-}\tfrac{3}{4})}{144} = 1.53\ Ft^2$$

$$KW/Ft^2 = \frac{25}{1.53} = 16.3$$

Using Figure 44, 16.3 KW/Ft^2 = 700 fpm

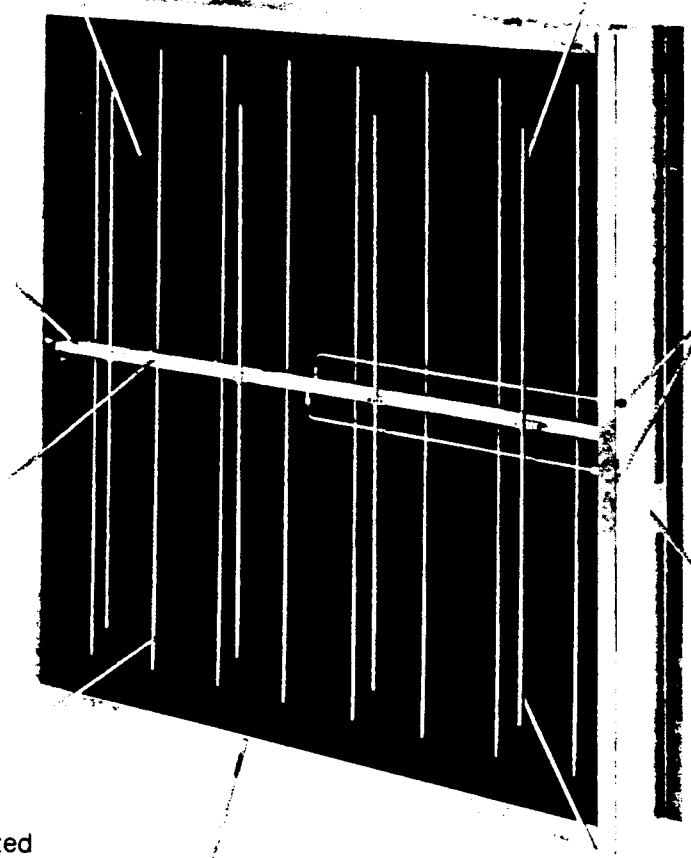
Figure 46 *Pressure Drop-Through Heater (inches water)*



The FAN-Evaluator AIRFLOW MEASURING STATION

a combination of airflow straightener-equalizer and self-averaging Pitot traverse array

Application: Measuring ducted airflow rates under conditions of severe turbulence



NOTE: Commercial HVAC construction is indicated above. See special construction for industrial HVAC and process control applications.

Special construction FAN-E and D.A.M.D. stations for industrial HVAC and process control applications

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The FAN-E and D.A.M.D. airflow measuring stations can be fabricated with special materials and coatings to meet nearly any airflow operating condition of temperature, contamination, or corrosion. Listed below are the special materials and coatings available.

AIR STRAIGHTENER

Standard construction:

a. 3/4" cell, .003", type 3003 alum., expanded

Special construction:

b. 3/4" cell, .0045", type 5052M alum., expanded
c. 3/4" cell, .003", type 316 SST, expanded
d. 3/4" cell, .003", type 316 SST, welded
e. 1" cell, .008", type 304 or 316 SST, welded

AIR EQUALIZER

Standard construction:

a. 3/8" cell, .003", type 3003 alum., expanded

Special construction:

b. 3/8" cell, .0045", type 5052M alum., expanded
c. 3/8" cell, .003", type 316 SST, expanded
d. 3/8" cell, .003", type 316 SST, welded
e. 1/2" cell, .008", type 304 or 316 SST, welded

VELOCITY SENSING (PITOT) ARRAY

Standard construction:

a. Copper tubing, soldered; brass fittings

Special construction:

b. Type 304 or 316 SST tubing, soldered; SST fittings
c. Type 304 or 316 SST tubing, welded; SST fittings
d. PVC tubing, glued; PVC fittings

CASING

Standard construction:

a. 14 ga. galv. steel, welded

Special construction:

b. 12, 10, 5, etc., ga. galv. steel, welded
c. 16, 14, 12, 10, etc., ga. type 304 or 316 SST, welded
d. 14, 12, 10, etc., ga. black steel, welded
e. 14, 12, 10, etc., ga. type 3003 alum., welded
f. PVC sheet or pipe, welded
g. Pipe sections, black and SST

COATINGS

Standard construction:

a. Cold galv. paint over casing welds

Special finishes:

b. PVC .003", 2 coats, sprayed
c. PVC, .005", 3 coats, sprayed
d. Epoxy, .003", 2 coats, sprayed
e. Epoxy, .005", 3 coats, sprayed
f. Hot dipped galv. (after casing fabrication)

FLANGES

Standard construction:

a. 90°, 1" & 1½", 14 ga. galv. steel
b. Beaded edge with 1" casing extension

Special construction:

c. 2", 2½", 3", or other sizes
d. 1/8", 3/16", 1/4" thickness
e. Black steel, aluminum, stainless steel
f. Pipe flanges
g. Bolt hole patterns

PERFORMANCE SPECIFICATION GUIDE

AIRFLOW MEASURING STATIONS

Provide where indicated, airflow measuring stations capable of continuously monitoring the fan or duct capacities (air volumes) they serve.

Each airflow measuring station shall contain multiple total and static pressure sensors positioned at the center of equal area of the station cross-section and interconnected by their respective averaging manifolds. For stations of 4 square feet or less, one total and one static pressure sensor shall be present for every 16 square inches of station area respectively. For stations of larger area, one total and one static pressure sensor shall be present for every 36 square inches of station area respectively.

The airflow measuring station shall be fabricated of a minimum of 14 ga. galvanized steel, welded casing in 8" depth with 90° connecting flanges in a configuration and size equal to that of the duct it is to be mounted into. Each station shall be complete with an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to the casing, total and static pressure sensors located on an equal area basis and connected to symmetrical averaging manifolds, internal piping, and external pressure transmitter ports. An identification label shall be placed on each station casing listing model number, size, area, and specified airflow capacity.

The maximum allowable pressure loss through the station shall not exceed .015" wc at 1000 fpm, or .085" wc at 2000 fpm. Each station shall be capable of measuring the airflow rate within an accuracy of 2 percent as determined by U.S.G.S.A. certification tests. The stations shall have a self-generated sound rating of less than NC 40, and the sound level within the duct shall not be amplified, nor shall additional sound be generated.

The airflow measuring stations shall be the FAN-Evaluator or Duct Air Monitor Device as manufactured by Air Monitor Corporation, Santa Rosa, California.

Because of ongoing product improvement, Air Monitor reserves the right to change specifications without notice

Air Monitor Corporation

P.O.Box 6358 Santa Rosa, CA 95406
(707) 544-2706 TWX 510-744-2073
AIRMONITR SARO

125-030 (3-87)

60/87

SPACE-tron/1 DEDICATED ELECTRONIC

CONSTANT VOLUME CONTROL OF FAN OR DUCT CAPACITY RESET BY SPACE PRESSURIZATION LEVEL

SPACE-tron/1

CONTROL FUNCTIONS

■ Fan or Duct Air Volume Control

The airflow rate of the supply [return, exhaust] fan or duct is sensed by a FAN-Evaluator or Duct Air Monitor Device airflow measuring station mounted in the supply [return, exhaust] duct or fan inlet [discharge] duct.

The station signals of total and static pressure are sent to the SPACE-tron/1 electronic control center. There the CARD-trol velocity pressure transmitter with the CARD-trol square root extractor and scaling multiplier extracts the square root of the resulting differential velocity pressure signal and amplifies it into a 4-20 mADC electronic signal linear, proportional, and scaled to air volume.

The signal is sent to the CARD-trol electronic air volume controller where it is compared with the air volume setpoint signal from the CARD-trol computation module. The controller issues an electronic control signal to the CARD-trol electronic-pneumatic (I/P) transducer (or to an electronic volume damper operator) to position the fan vortex damper [adjustable pitch blades] or duct volume damper to maintain the airflow rate at a constant volume.

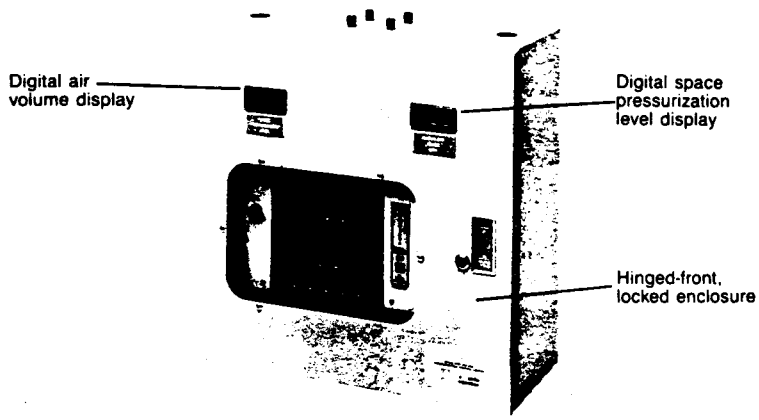
■ Reset by Space Pressurization Level

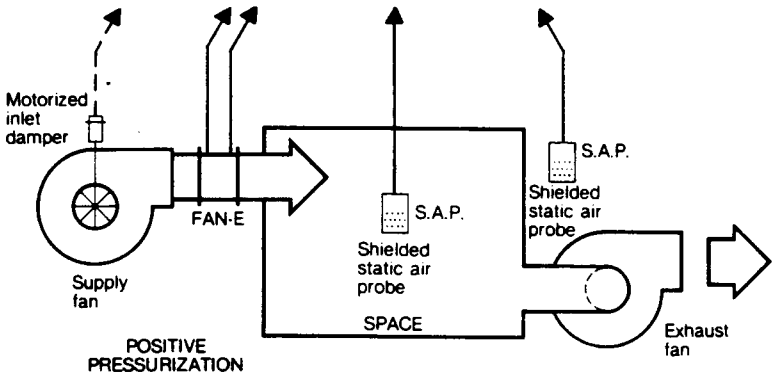
The S.A.P. shielded static air probes sense the pressure levels in the space and at the reference location. These probe signals are sent to the SPACE-tron/1 electronic control center. There the CARD-trol electronic differential (static) pressure transmitter amplifies the resulting differential static pressure signal into a 4-20 mADC electronic signal linear, proportional, and scaled to space static (differential) pressure.

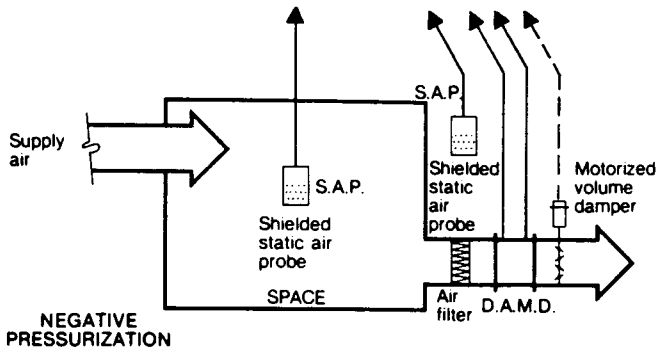
The signal is sent to the CARD-trol electronic pressurization controller where it is compared with the space static pressure setpoint signal. The controller issues an electronic control signal to the CARD-trol computation module where the air volume setpoint signal to the CARD-trol air volume controller is increased or decreased as required to maintain the space pressurization level.

■ Digital Display of Air Volume and Space Pressurization Levels

The air volume of the supply [return, exhaust] fan or duct in CFM and the space pressurization level in Inches of water column with appropriate positive or negative symbol are continuously indicated on digital LED displays on the face of the SPACE-tron/1 electronic control center.







——— Signal tubing
– – – – Wiring or control tubing

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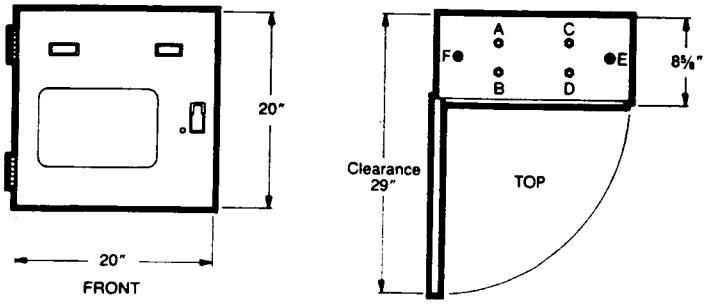
PRESSURIZATION CONTROL CENTER

SPACE REQUIREMENTS for SPACE-tron/1



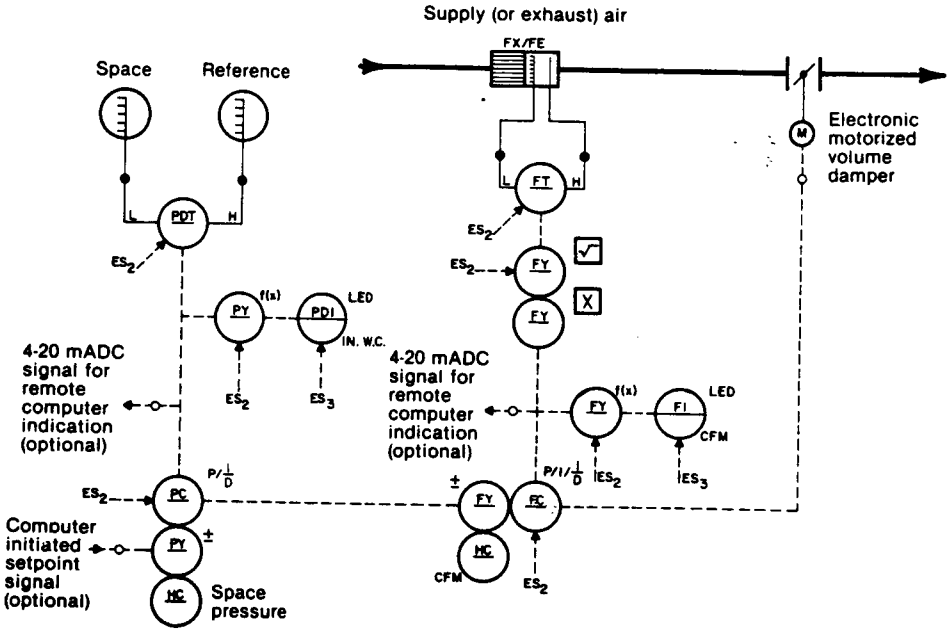
CONNECTION CODE

A. Static pressure-reference location
B. Static pressure-space
C. Static pressure-airflow measuring station
D. Total pressure-airflow measuring station
E. Power supply
F. Electronic output control signal

POWER REQUIREMENTS for SPACE-tron/1

The SPACE-tron/1 electronic control center is available for operation on a 24 VAC or 20 to 40 VDC power supply. Also available are centers for operation on 110 VAC, 230 VAC, etc. The power consumption of the SPACE-tron/1 control center is minimal, being rated at 12.5 watts. When electronic damper operators are powered by the center, an additional 5 watts per operator should be added to the above power requirements. Power consumption may vary with options selected.

CONTROL SCHEMATIC for SPACE-tron/1



NEGATIVE PRESSURIZATION SHOWN

GUIDE SPECIFICATION for SPACE-tron/1

See *Specification Writers' Guide for Electronic Airflow Control (and Pressurization) Systems* published by Air Monitor Corporation.

ICF KAISER ENGINEERS

Job No. 91044-003

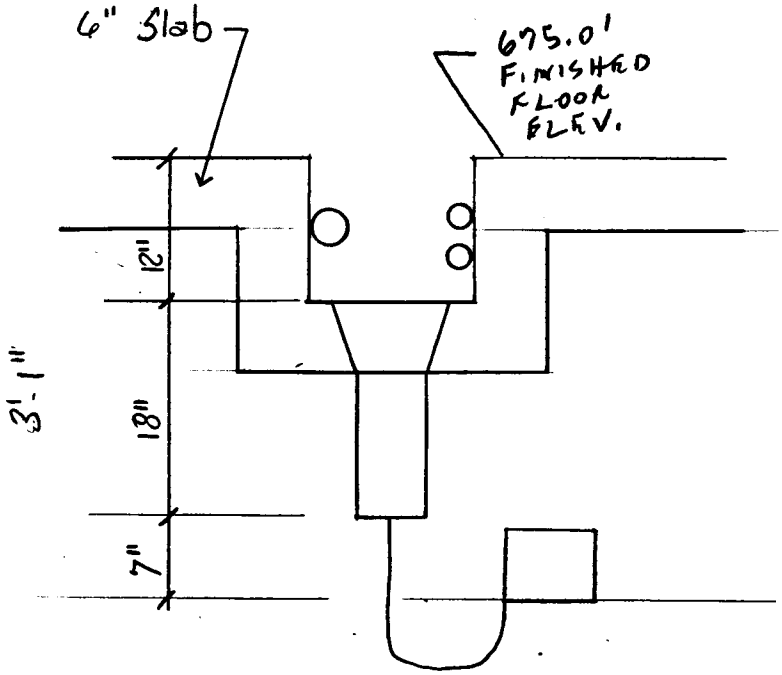
Sheet 62 of 87

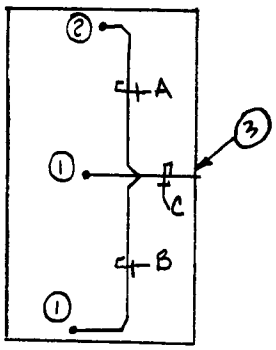
Drain Invert

DESIGNED BY F. Lopez DATE 4-23

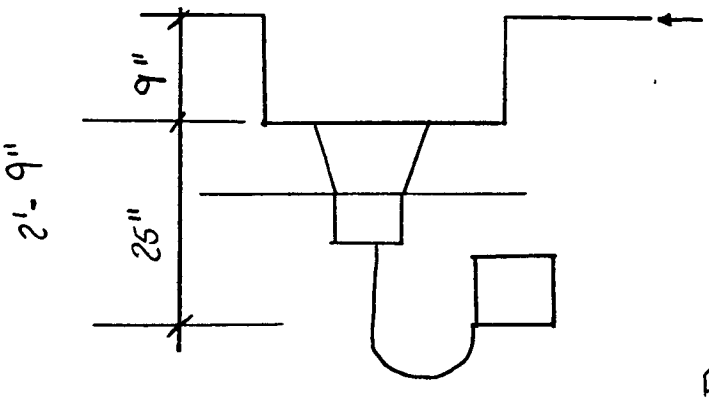
CHECKED BY TJJ DATE 9/23/

(1)





(2)



A) 37' @ 1/8" per ft.
= 4.625"

B.) 55' @ 1/8" per ft.
= 6.875"

C.) 8'-8" @ 1/8" per ft
= 1.083"

2'-9"
+ 4.625"
3'-1"

3'-1"
+ -7"
3'-8"

+ -1"
3'-9"

675.0'
- 3.75'

INVERT AT BLDG PENETRATION = 671.25' min. (3)

CALCULATIONS KE Form No. E-6 Rev. 12-89

ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 63 of 87

WATER REQUIREMENTS
POTABLE & NON-POTABLE

DESIGNED BY F. Lopez DATE 4-5-

CHECKED BY TJ DATE 1/23

POTABLE	FIXTURE UNITS	GPM RATE	SUPPLY SIZE
1. EMERGENCY SHOWER	57.0	32.0 (40 PSI)	
& EYE WASH	8.0	6.6 (40 PSI)	
	65.0	38.6	

NON-POTABLE			
1. DRUM WASHING	52	30	
2. TRAIN A, B SINGLE POINT OPERATION	52	30	
3. WALL HYDRANTS (4 x 5 F.U.)	20	15	
	124	75	
BLDG TOTAL	189	113.6	

MINIMUM FLOW RATE USE 68.6 (40 PSI) 2" BLDG MAIN

PRESSURE AVAILABLE FOR FRICTION LOSS

Bldg PSI - [Allowable PSI + (HGHT ABOVE PRV x CONSTANT)] =

60 - [40 + (3 x 0.43)] = 18.71 PSI

FRICTION LOSS PER 100 FT

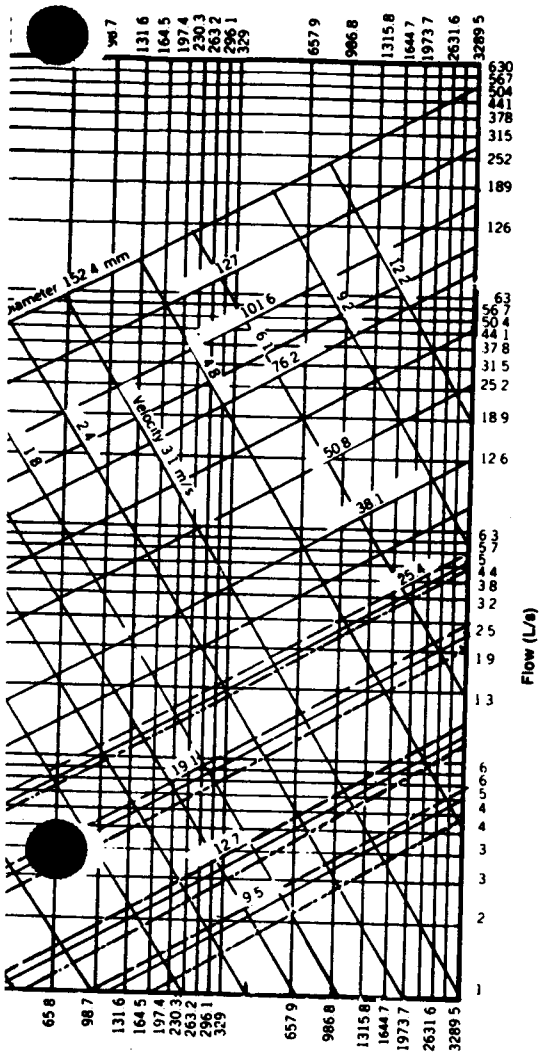
CONSTANT x PRESSURE AVAILABLE ÷ TOTAL LENGTH PIPE

100 x 18.71 ÷ 110 = 17 psi

REFERENCE 1988 UPC

CALCULATIONS KE Form No. E-6 Rev. 12-89

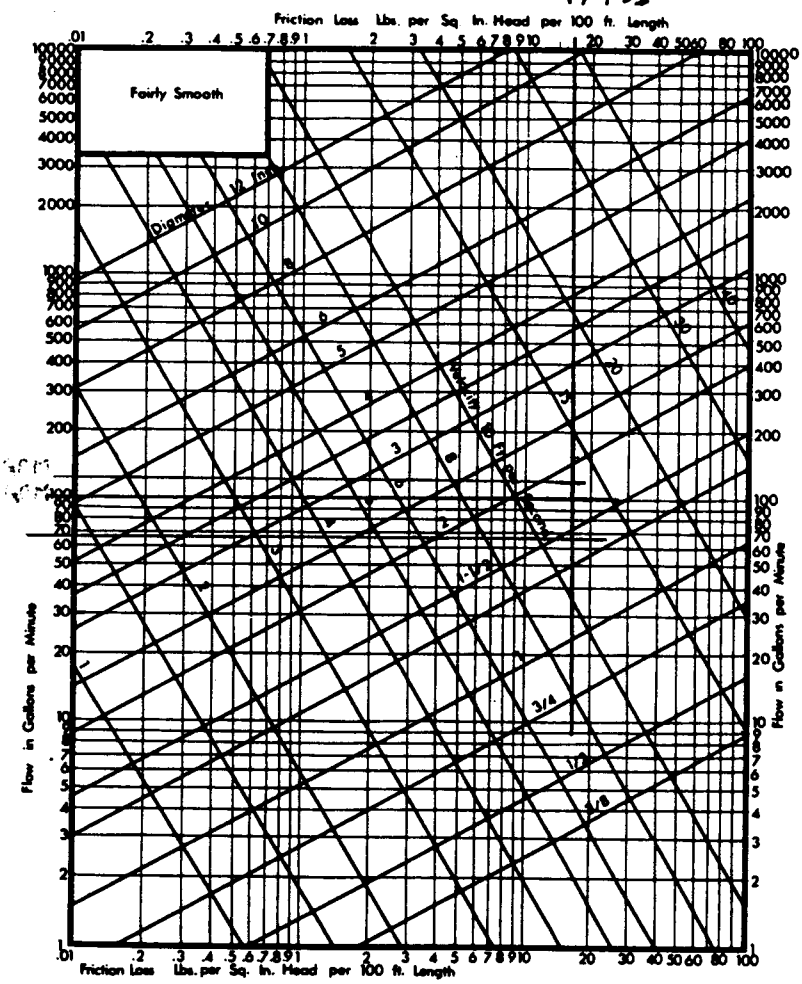
CHART A-4
(metric)



64/87

CHART A-5

17 PSI



6 5/87

FLOW DATA

One of the most important considerations when installing water bearing emergency equipment is assuring an adequate supply of water is available to the unit. You should never install piping smaller than the inlet size of this unit. At least 20 psi flowing pressure should be available to the unit. The ideal flowing pressure for shower or eye wash is between 40 and 60 psi. The following chart shows some representative flow data for various Western emergency units.

MODEL 823V	Flow pressure (PSI)	10	20	30	40	50
	Flow rate (GPM)	66	93	106	131	147
MODEL 863H	Flow pressure (PSI)	10	20	30	40	50
	Flow rate (GPM)	66	93	106	131	147
MODEL 9301 (Shower only)	Flow pressure (PSI)	10	20	30	40	50
	Flow rate (GPM)	47	65	74	92	104
MODEL 9201 (Shower only)	Flow pressure (PSI)	10	20	30	40	50
	Flow rate (GPM)	47	65	74	92	104

170 series eye wash – 1.5 gpm
900 series eye/face wash – 6 gpm
700 series eye/face wash – 3 gpm
400 series eye wash – 1.5 gpm
200 series eye/face wash – 6 gpm

SOLD BY

WESTERN DRINKING FOUNTAINS

EMERGENCY EQUIPMENT DIVISION

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CATALOG A-9400

Form No. A-9400 (2/87)

GUARDIAN EQUIPMENT

6/87

PERFORMANCE DATA

One concern is preeminent in selecting eye wash and shower equipment: In an emergency, how effective will the unit be in rinsing the user's eyes, face or body? Performance is dictated by two factors: first, how much water does the unit deliver and second, how wide an area will be covered by the water flow? In order to compare Guardian units to those of other manufacturers, set forth below is information regarding the volume and pattern of flow delivered by Guardian emergency eye and eye/face wash units.

1. Volume of Flow

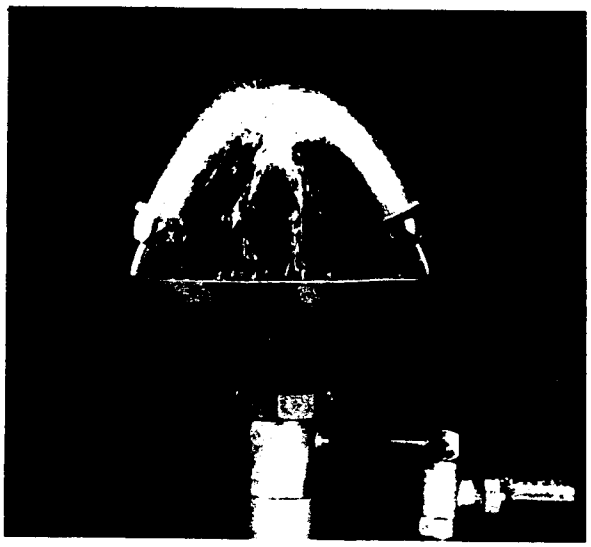
When harmful acids or chemicals come in contact with a person's eyes, face or body, common sense demands that the contaminant be rinsed away as quickly and as completely as possible. While the flow of water should be gentle enough not to injure the user, as much water as possible should be delivered to the affected area. The more water delivered, the more effective will be the rinsing action. Consequently, Guardian emergency units are engineered to deliver a high volume of water, as shown below:

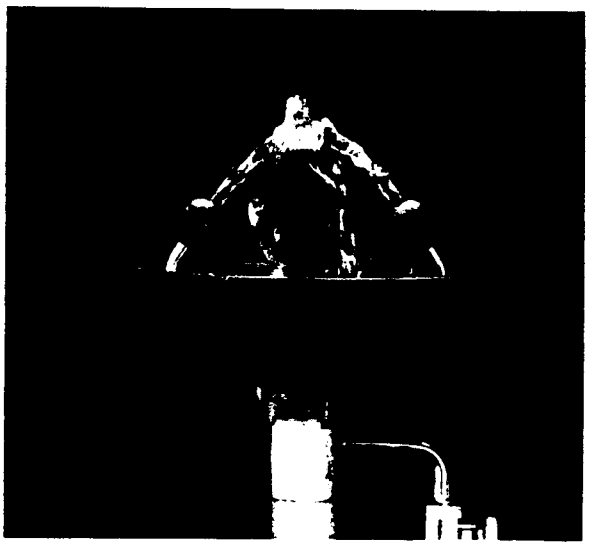
	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI
Four-Head Eye/Face Wash					
with Self-Regulating Volume Controls	5.8	6.8	8.0	8.5	8.9
with Adjustable Volume Controls	6.0	6.9	8.3	8.7	9.4
Two-Head Eye/Face Wash					
with Self-Regulating Volume Controls	5.4	6.0	6.6	7.3	8.3
with Adjustable Volume Controls	6.0	6.3	6.9	7.7	8.6
Two-Head Eye Wash					
with Self-Regulating Volume Controls	3.3	3.9	4.4	4.8	5.1
with Adjustable Volume Controls	3.3	4.4	4.7	5.0	5.3

Note: Water pressures listed above refer to flow rather than static pressure. Flow rates for units with adjustable volume controls will vary depending upon the particular setting of the controls.

2. Pattern of Flow

The pattern in which water is delivered to the user's eyes and face is critical in two respects. First, the water flow must be gentle enough not to be injurious to the user. A forceful stream of water may drive foreign matter into the user's eyes rather than remove it. Use of the eye wash will then aggravate, rather than relieve, the user's condition. Second, the water flow should be dispersed over a wide area of coverage. Wide coverage will speed the rinsing action and make the water flow more accessible to the user. For these reasons, a soft, wide spray of water is preferable to a solid, narrow stream. The photographs below illustrate the advantages of the Guardian Gentle Spray outlet head over typical solid stream type outlet heads:





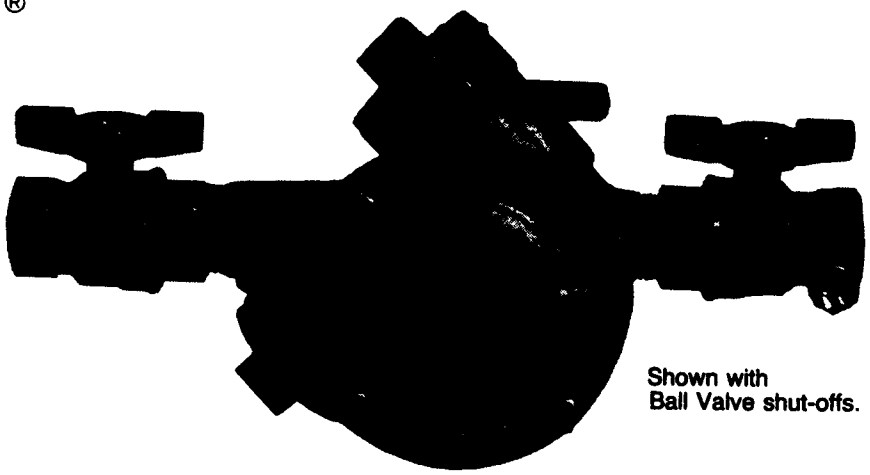
After comparing Guardian products to those of other manufacturers, we trust you will agree that Guardian units rinse contaminants away more quickly, more gently and more completely than any others. In an emergency, you can rely on "the Guardian difference."

67A/87

FEBCO®

SPECIFICATION SHEET NO. 825Y (¾" – 2")

Model 825Y (3/4" through 2") Reduced Pressure Backflow Preventer For High Hazard Service



Shown with Ball Valve shut-offs.

Features

- Ultimate mechanical protection of potable water, against hazards of cross connection contamination.
- Meets all specifications of AWWA, ASSE and USC Foundation for Cross Connection Control and Hydraulic Research.
- **Documented flow curves established by University of Southern California Foundation for Cross Connection Control and Hydraulic Research.**
- Modular relief valve for ease of maintenance.
- Simple Service procedures. All internal parts serviceable in line.
- **Low head loss.**
- Spring loaded "Y" type check valves.
- Internal relief valve pressure sensing passages.
- Replaceable relief valve seat ring on ¾", 1", 1½" and 2".

Operation

In a flow condition the check valves are open with the pressure between the checks, called the zone, being maintained at least 5.0 PSI lower than the inlet pressure and the relief valve is maintained closed.

Should abnormal conditions arise under no flow or reversal of flow, the differential relief valve will open and discharge to maintain the zone at least 2 PSI lower than the supply.

In resumption of normal flow, the zone's differential pressure will resume and the relief valve will close.

Typical Specifications

The reduced pressure backflow preventer shall consist of two independently operating, spring loaded, "Y" pattern check valves and one hydraulically dependent differential relief valve. The assembly shall automatically reduce the pressure in the "zone" between the check valves to at least 5 PSI lower than inlet pressure. Should the differential between the upstream and the zone of the unit drop to 2 PSI, the differential relief valve shall open and maintain the proper differential.

Mainline valve body and caps including relief valve body and cover shall by bronze. Check valve moving member shall be center stem guided. All hydraulic sensing passages shall by internally located within the mainline and relief valve bodies and relief valve cover. Diaphragm to seat area ratio shall be 10:1 minimum. Relief valve shall have removable seat ring. Check valve and relief valve components shall be constructed so they may be serviced without removing the valve body from the line. All seat discs shall by reversible. Shut-off valves and test cocks shall be full ported ball valves.

The assembly shall be rated to 175 PSI water working pressure and water temperature range from 32°F to 140°F

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C506-78; and USC Foundation of Cross Connection Control and Hydraulic Hydraulic Research, Sixth Edition.

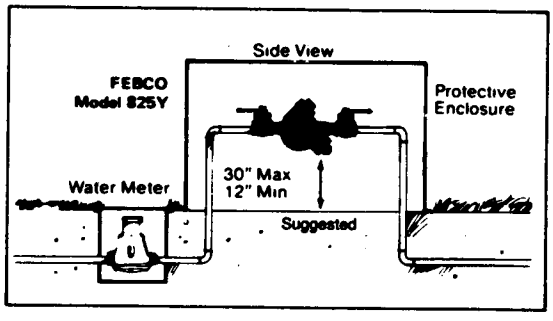
Typical Applications

Reduced Pressure assemblies are used to protect against high hazard (toxic) fluids in water services to industrial plants, hospitals, morgues, mortuaries, and chemical plants. They are also used in irrigation systems, boiler feed, water lines and other installations requiring maximum protection.

Installation

Reduced Pressure Backflow preventers should be installed with minimum clearance of 12" between port and floor or grade. They must be installed where discharge will not be objectionable and can be positively drained away. They should be installed where easily accessible for testing and maintenance and must be protected from freezing. Thermal water expansion and/or water hammer downstream of the backflow preventer can cause excessive pressure. Excessive pressure situations should be eliminated to avoid possible damage to the system and assembly.

Refer to local codes for specific installation requirements. Some codes may prohibit vertical installation.



Characteristics and Materials

Maximum working pressure	175 PSI
Hydrostatic test pressure	350 PSI
Temperature range	32°F to 180F*
Fluid	Water
End detail	Threaded ANSI B2.1
Main valve body	Bronze ASTM B584-78
Relief valve body	Bronze ASTM B584-78
Elastomers	Nitrile ASTM D-2000 Seat Discs.† Diaphragms: Nitrile, fabric reinforced
Springs	Stainless Steel, 300 series

* On water systems that experience an excess of a constant 140°F, device must be ordered with HW (825Y 1" HW).
† Can be supplied with optional silicone seat disc.

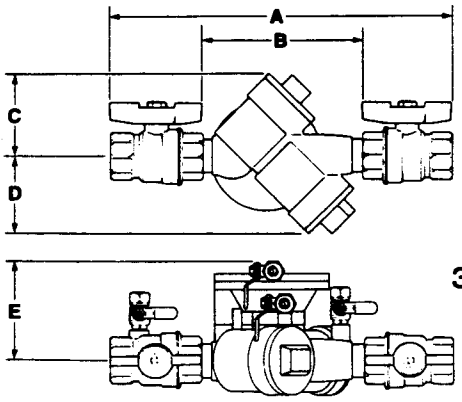
Dimensions and Weights (U.S.-Inches) 678/85

SIZE	A* BV.	A* GV.	B	C	D	E	NET WT.(Lbs.)
¾	12 ¼	11 ¼	7 ¾	4 ⅛	3 ¼	4 ⅛	11 ½
1	13 ⅝	11 ⅝	7 ¾	4 ⅛	3 ¼	4 ⅛	12 ½
1 ¼	14 ¼	11 ¾	7 ¾	4 ⅛	3 ¼	4 ⅛	14
1 ½	18 ¼	15 ¼	10 ⅝	5 ¼	4 ½	5	26 ½
2	19	15 ½	10 ⅝	5 ¼	4 ½	5	29

(Metric-mm.)

SIZE	A* BV.	A* GV.	B	C	D	E	NET WT.(Kgs.)
20	311.2	285.8	196.9	104.8	82.6	104.8	5.2
25	346.1	295.3	196.9	104.8	82.6	104.8	5.7
30	362.0	298.5	196.9	104.8	82.6	104.8	6.4
40	463.6	387.4	269.9	133.4	114.3	127.0	12.0
50	482.6	393.7	269.9	133.4	114.3	127.0	13.0

A* BV. is approximate length with Ball Valve shut-offs.
A* GV. is approximate length with Gate Valve shut-offs.
All dimensions are approximate.

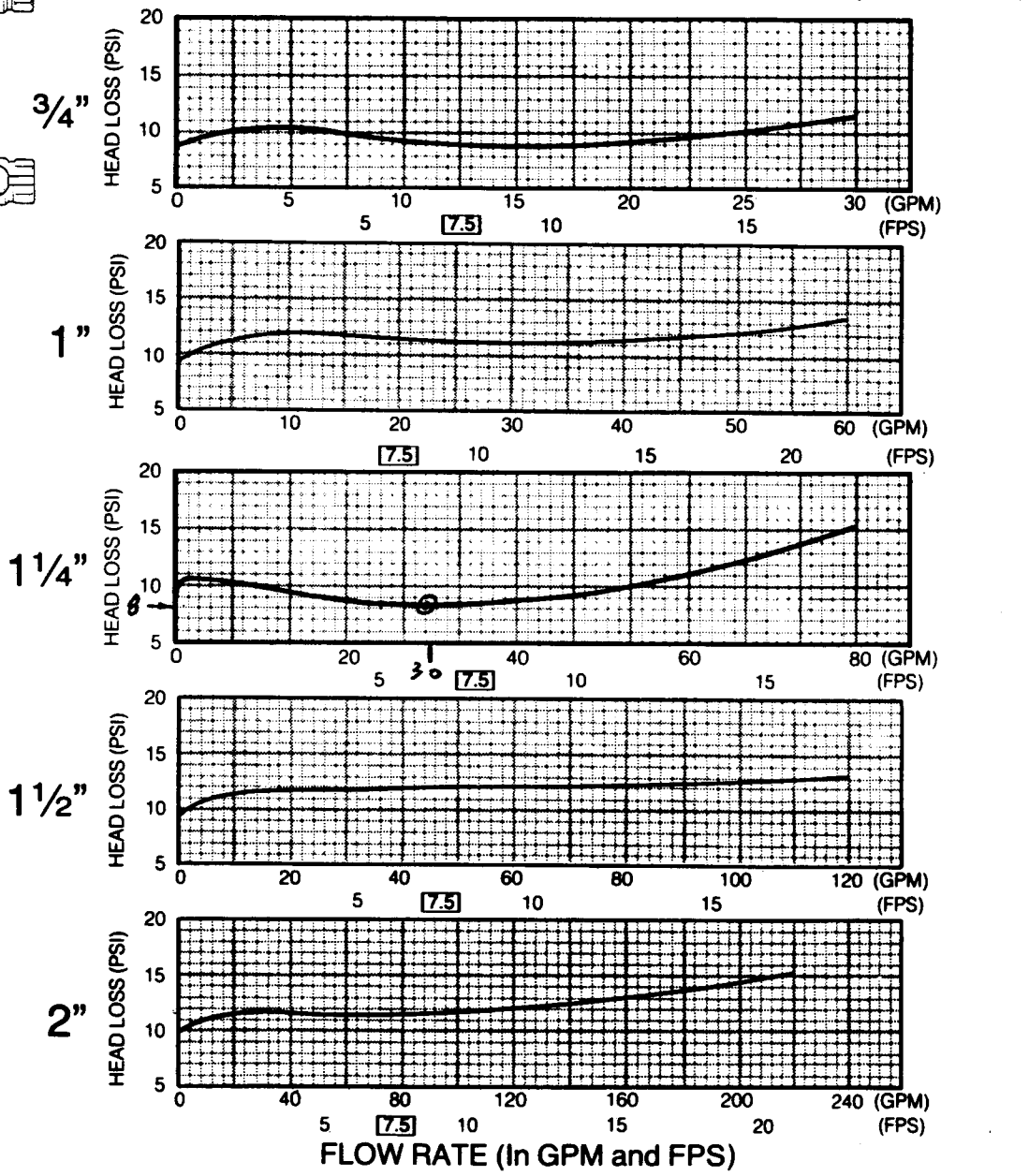


USC FCCC & HR, *Approved
AWWA C506 Conformance
*SSE Listed 1013
CSA B64.4 Certified
IAPMO® Listed

* Valves must be supplied with ball valve/resilient seated shut-off valves and test cocks for USC FCCC & HR approval to be effective.

Model 825Y Flow Curves

(Flow Curves as Established by the USC Foundation for Cross Connection Control and Hydraulic Research)



NOTES: 1. Velocities are calulated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons

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67c/87

KECKLEY

TYPE AA, AR PRESSURE REGULATORS

Bronze Body
Steam — Stainless Steel Trim (Max. 300 psi Inlet)
Air — Nylon Trim (Max. 600 psi Inlet)
Internal Unit Pilot Valve

The Keckley Precision Pressure Regulator has for its greatest advantages simplicity in design, Unit Pilot Valve construction, and the use of stainless steel for parts subject to the most wear, which can be renewed at a nominal cost.

The main valve seat of stainless steel is inserted from the bottom of the body. The piston above the valve, where dirt and sediment will not affect its operation, rides in a cylinder liner which can be easily replaced. The pilot valve cage is screwed into the top cap as a complete unit, with valve and spring. Directly above the pilot valve is the diaphragm held down by the adjusting spring case.

The main valve is opened by high pressure acting on the large piston directly above it. The pilot valve, working in conjunction with the diaphragm, actuated by any unbalanced effect of the adjusting spring and low pressure beneath it, controls accurately the necessary pressure to the piston. Thus the pilot valve, extremely sensitive to the secondary pressure, opens and closes the main valve in a proportionate degree to maintain the desired constant low pressure at all times.

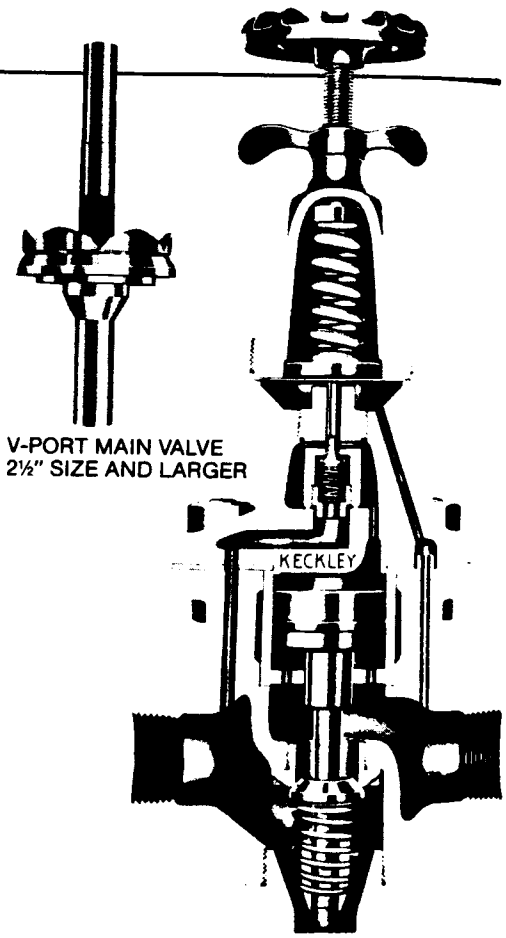
Sudden fluctuations in initial pressure are prevented from reaching the secondary side by the expansion chamber effect of the piston cylinder.

The Keckley Regulator is made of the finest materials with precision workmanship and is thoroughly tested under all operating conditions. This Regulator, therefore, offers maximum efficiency not only as to close regulation but also as to dependability through years of service.

Type AA for reduced steam or air pressures above 40 psi: Type AA Regulators are recommended for reduction of pressures from the maximum pressure in one step to pressure above 40 psi. For pressures below 40 psi, we recommend the Type AR Precision Pressure Regulator as described below. It is necessary to have a minimum difference of 15 psi between initial pressure and reduced pressure for proper valve operation.

Type AR for reduced pressures from 1 to 40 psi: For reduction of pressures to 40 psi or less, the top cap of the Regulator is furnished with larger diaphragm and provided with remote control connection, and is designated as Type AR and listed at the same price as the Type AA. Remote control connection should be installed in the line to be controlled on the reduced pressure side of the regulator.

Operation: Remove all tension from the adjusting spring by turning handwheel to the left which closes pilot valve and main valve of the Regulator. Then open wide the stop valve on the high pressure side of the line. Increase tension slowly on the adjusting spring by turning handwheel to the right until the desired low pressure is reached, after which the stop valve in the low pressure side can be opened. When the Regulator is in operation, keep both stop valves fully open and locknut on adjusting screw tight.



V-PORT MAIN VALVE
2½" SIZE AND LARGER

TYPE AA REGULATING VALVE
SIZES ½" to 6"
SCREWED OR FLANGED

The Keckley Precision Pressure Regulator can be adjusted to any desired pressure within the range of the regulating spring and diaphragm by merely turning the handwheel at the top of the Regulator to the right for higher secondary pressure, and to the left for lower secondary pressure.

See pages 50-51 for recommended sizes at various capacities.

TYPE	Size	INLET PRESSURE RANGE Steam	REDUCED PRESSURE RANGE Minimum	Maximum	Approx. Variation in Reduced Pressure Setting
Type AA	½"-2½"	60—300 psi	40 psi	275 psi	3% of inlet Press. over 100 psi
	3"-6"	60—300 psi	40 psi	275 psi	5% of inlet Press. over 100 psi
Type AR	½"-2½"	20—300 psi	2 psi	40 psi	2% of inlet Press. over 100 psi
	3"-6"	25—300 psi	5 psi	40 psi	5% of inlet Press. over 100 psi

For Air service with nylon trim to 600# inlet, same Minimum Reduced Pressure % factors apply. Must have at least 20 psi initial pressure (see Type 115 for initial pressure under 20 psi.)

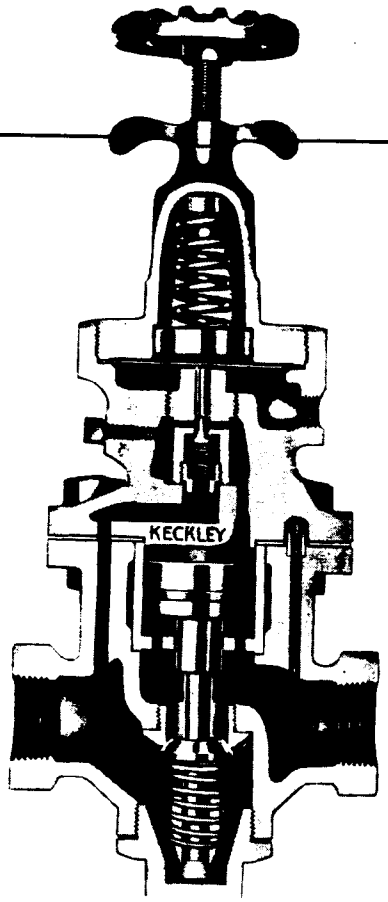
	INITIAL PRESSURE RANGE Steam	Air	SECONDARY PRESSURE RANGE Steam	Air
Type AA	60—300 psi	60—600 psi	20—285 psi	20—585 psi
Type AR	20—300 psi	20—600 psi	2— 40 psi	2— 40 psi

Must have at least 20 psi initial pressure (see Type 115 for initial pressure under 20 psi.)

670/87

KECKLEY

TYPE AA, AR PRESSURE REGULATORS



TYPE AR REGULATING VALVE
SIZES ½" to 6"
SCREWED OR FLANGED

Specifications:

BODY CASTINGS: Bronze.

MAIN VALVE: Stainless steel, accurately machined, ground and polished.

MAIN VALVE SEAT: Stainless steel with seat ground and polished. Screwed into body. Readily removable and renewable.

DIAPHRAGM: Phosphor Bronze rolled to accurate thickness.

SPRINGS: Stainless steel, impervious to tension changes due to temperature variations. Accurately wound. Ends ground square.

PISTON: Government bronze, accurately machined and readily removable. Carries piston ring of high resiliency and sealing characteristics.

PISTON CYLINDER: Renewable cylinder liner with integral head of Government bronze or stainless steel.

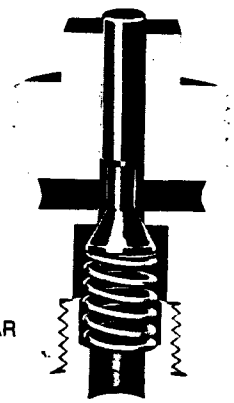
GASKETS: Copper asbestos gaskets, both under main valve cap and between body and body cap offer maximum resistance to leakage.

PILOT VALVE: The Pilot Valve, spring and cage is of course the "HEART OF THE REGULATING VALVE." For this reason we have designed this portion of the Keckley Regulating Valve so that it is removable as a unit. Compare this unit construction with other types where the various component parts of the pilot valve must be removed individually. Valve and cage are stainless steel, accurately ground and polished.

NYLON is used for both the pilot valve and main valve, guaranteeing positive shut-off on air and gas service, available at slight additional cost which we recommend.

STELLITED SEAT RINGS for the main valve and main valve seat can be furnished for extreme operating conditions where high pressure and temperature is a major factor. Available at slight additional cost.

Capacity table, see pages 50 and 51.



UNIT PILOT
VALVE OF
TYPE AA AND AR
REGULATORS

DIMENSIONS • BRONZE—300# • 300# ASA FLANGES (approximate)

Size	Face to Face		Center To Bottom	Center To Top	Total Height	Diam. of Flanges	Thick. of Flanges	Bolt Circle	No. of Bolts	Size of Bolts	Diam. of Bolt Hole	Net Weight		Ship. Weight	
	Screwed	Flanged										Screwed	Flanged	Screwed	Flanged
½	5¾	6⅝	2 11/16	11 3/16	13⅞	3¾	½	2⅝	4	½	⅝	18	25	22	29
¾	5¾	6 11/16	2 11/16	11 3/16	13⅞	4⅝	17/32	3¼	4	⅝	¾	18	25	22	29
1	5¾	6 13/16	2 11/16	11 3/16	13⅞	4⅞	19/32	3½	4	⅝	¾	18	25	22	29
1¼	6	7⅛	2⅞	11½	14⅜	5¼	⅝	3⅞	4	⅝	¾	21	28	23	32
1½	6¼	7⅞	3 3/16	11¾	14 15/16	6⅛	11/16	4½	4	¾	⅞	25	35	27	39
2	7½	9	3½	12 1/16	15 9/16	6½	¾	5	8	⅝	¾	38	50	42	54
2½		10	4⅝	13⅛	17¾	7½	13/16	5⅞	8	¾	⅞		65		75
3		11 5/16	5 11/16	13⅝	19 5/16	8¼	29/32	6⅝	8	¾	⅞		100		115
4		13 3/16	7⅛	15 9/16	22 11/16	10	1 1/16	7⅞	8	¾	⅞		200		221
5		14⅜	9 5/16	16⅞	26 3/16	11	1⅛	9¼	8	¾	⅞		250		300
6		15⅞	9 13/16	18 9/16	28⅜	12½	1 3/16	10⅝	12	¾	⅞		325		400

DATA REQUIRED WHEN ORDERING:
Initial Pressure
Final Pressure
Media
Capacity

67E/87

KECKLEY

TYPE 40 — A.S.M.E. STANDARD — STEAM OR AIR
TYPE 41 — A.S.M.E. STANDARD — STEAM OR AIR
TYPE 42, 43, 44 — LIQUIDS • SAFETY AND RELIEF VALVES

Bronze Body
Bronze or Stainless Steel Trim

A.S.M.E. Standard —
A.S.M.E. Tested

Type 40 (side outlet) and Type 41 (top outlet) Bronze Pop Safety Valves

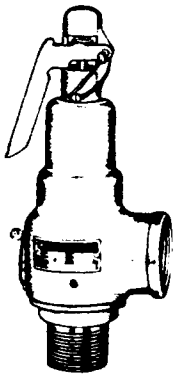
Pressure Settings:
Steam to 250 psi 406° F.
Air/Gas to 300 psi 300° F.

Standard valves have bronze body and bronze trim. Consult factory regarding stainless steel trim for higher pressure settings. These valves meet A.S.M.E. requirements and are NB Certified. Regulators and pressure adjustment screws are both sealed after final tests before shipment.

Recommended for installation on, or protection of steam boilers, generators, unfired pressure vessels, line pressure reducing valves, etc. Sizes ½" through 2½". For larger sizes consult factory.

When ordering specify:
Size • orifice • set pressure • capacity • 3% or 10% accumulation.

SAFETY VALVES

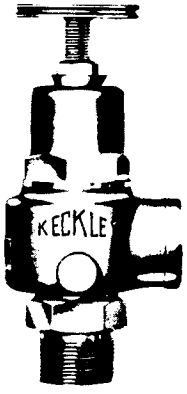


TYPE 40

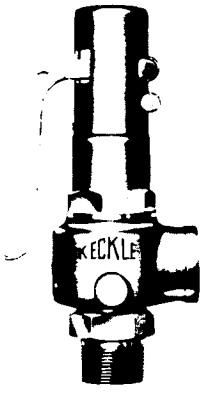
TYPE 41

RELIEF VALVES

TYPE 42



TYPE 43



TYPE 44

Type 42, 43, 44
Bronze Relief Valves
These RELIEF VALVES are furnished for any service where the pressure media does not attack bronze and the temperature is not higher than 406° F. and maximum pressure not higher than 300 psi designed for protection against overpressure in pumps, pipe lines, tanks, etc.

Constructed of bronze, with stainless steel spindle and Long-Life Springs, all parts machined to close tolerances, these Valves will be found to give faithful service under most severe conditions.

Type 42 is standard for use where set pressure is fairly constant. Special locking caps are available at additional cost.

Type 43 is standard with hand-wheel for ease in changing the set pressure. Adjustment range varies with size of valve and pressure setting. Consult factory.

Type 44 has lifting lever required for some applications where inspection tests are advisable to show valve is operative.

In all the designs the outlet opening is in the base casting. This makes it unnecessary to break the connection to take valve apart for cleaning. Size ½" through 2½".

For larger sizes consult factory.

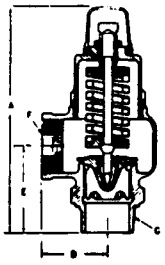
CAPACITIES IN GALLONS OF WATER PER MINUTE AT 25% OVERPRESSURE

TYPES 42, 43, 44 RELIEF VALVES

Set Lbs Gage	½	¾	1	1¼	1½	2	2½	3
25	8	11	16	37	58	95	160	220
50	11	14.5	22.5	51	75	109	187.5	315
75	13	16	27	60	83	120	210	385
100	16	20	32.5	68	90	131	230	445
125	18	22.5	36	76	98	142	247	500
150	20	25	39	81	105	151.5	263	545
175	21.5	27	42	87	111.5	158	276	585
200	23	31	45	92	117	165	288	630
225	24	34	48	96	124	171.5	300	665
250	25	36.5	50.5	100	130	177	311	706
275	25.5	39	53	104	135.5	183	332	749
300	26	42	55	107.5	142	189	330	785

DIMENSIONS (approximate)

C & F	A Type 42-43	A Type 44	D All Styles	E	Weight
½	5	5 1/16	1⅛	1 15/16	1
¾	6 9/16	7⅝	1 11/16	2¼	1¼
1	7¼	8⅝	2 1/16	2 11/16	4
1¼	8¾	9¾	2 9/16	3	5¾
1½	9½	10 9/16	2½	3⅜	7¾
2	9 13/16	10⅞	2 13/16	3 11/16	11
2½	12 1/16	13 3/16	3¾	4 9/16	18¼
3	12¾	14	3⅞	4⅝	26



TYPE 42

KECKLEY

67F/87

TYPE 40, 41
SAFETY AND RELIEF VALVES

Capacity Table
Dimensions

1/2 = 40 $100
1/2" A2 WATER

CAPACITY FOR TYPE 40 SAFETY VALVE (A.S.M.E.)
(TYPE 41 — CONSULT FACTORY)

CAPACITY IN POUNDS OF SATURATED STEAM PER HOUR

ORIFICE	D		E		F		G		H		J	
AREA	.121 sq. in.		.216 sq. in.		.338 sq. in.		.554 sq. in.		.863 sq. in.		1.414 sq. in.	
Set Pressure PSIG	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.	Lbs./Hour Steam 3% Acc.	Lbs./Hour Steam 10% Acc.
5	99	110	176	196	275	306	450	504	703	786	1153	1289
10	124	140	221	250	347	391	568	641	886	1001	1453	1640
15	150	170	267	303	418	475	685	778	1069	1215	1752	1991
20	175	200	312	357	489	558	802	916	1251	1429	2051	2342
25	201	230	358	410	561	642	919	1053	1434	1644	2350	2693
30	226	260	404	464	632	725	1036	1191	1616	1858	2650	3045
35	252	290	449	517	703	809	1152	1328	1799	2072	2949	3396
40	278	320	495	571	775	893	1269	1465	1981	2286	3248	3747
45	303	350	540	625	846	977	1386	1602	2164	2500	3547	4098
50	329	380	586	678	918	1061	1503	1739	2347	2714	3846	4449
55	354	410	631	732	989	1145	1620	1876	2529	2928	4146	4800
60	386	440	677	785	1060	1229	1737	2014	2711	3142	4445	5151
65	405	470	723	839	1132	1312	1854	2151	2894	3356	4744	5503
70	431	500	768	892	1203	1396	1971	2289	3076	3570	5043	5854
75	457	530	814	946	1274	1479	2088	2426	3259	3784	5343	6205
80	482	560	860	1000	1346	1563	2205	2563	3441	3999	5642	6556
85	508	590	905	1053	1417	1647	2322	2700	3624	4213	5941	6907
90	533	620	950	1106	1489	1731	2439	2837	3806	4427	6240	7258
95	559	650	996	1159	1560	1815	2556	2974	3989	4641	6540	7609
100	586	680	1042	1212	1631	1899	2673	3111	4171	4855	6839	7960
105	610	710	1087	1265	1703	1983	2790	3248	4354	5069	7138	8311
110	636	740	1133	1319	1774	2067	2907	3385	4536	5283	7437	8662
115	661	770	1178	1372	1845	2151	3024	3522	4719	5497	7736	9013
120	687	800	1224	1425	1917	2235	3141	3660	4901	5711	8036	9365
125	712	830	1269	1479	1988	2318	3258	3797	5084	5925	8335	9716
130	738	860	1315	1532	2060	2402	3375	3935	5266	6140	8634	10067
135	764	890	1361	1586	2131	2486	3492	4072	5449	6354	8933	10418
140	789	920	1406	1640	2202	2569	3608	4209	5632	6568	9233	10769
145	815	950	1452	1694	2273	2653	3725	4346	5814	6782	9532	11120
150	840	980	1497	1747	2345	2736	3842	4483	5997	6996	9831	11471
160	891	1040	1588	1853	2488	2904	4076	4757	6362	7424	10430	12173
170	943	1100	1680	1961	2631	3071	4310	5032	6727	7832	11028	12875
180	994	1160	1771	2068	2773	3239	4544	5306	7092	8281	11627	13578
190	1045	1220	1862	2174	2916	3406	4778	5581	7457	8709	12225	14280
200	1096	1280	1953	2282	3059	3574	5012	5855	7822	9138	12824	14982
210	1147	1340	2044	2389	3202	3642	5246	6130	8187	9566	13422	15684
220	1198	1400	2135	2496	3344	3809	5480	6404	8552	9994	14021	16386
230	1249	1460	2226	2603	3487	4077	5714	6678	8917	10423	14619	17088
240	1301	1520	2318	2710	3630	4244	5948	6953	9282	10851	15218	17790
250	1352	1580	2409	2816	3773	4411	6181	7227	9647	11279	15816	18492

Lbs./Hour Steam, 90% basis
3% Accumulation

The capacities shown in these columns are for saturated steam and apply to valves for use on power boilers in accordance with current A.S.M.E. Code, Section 1.

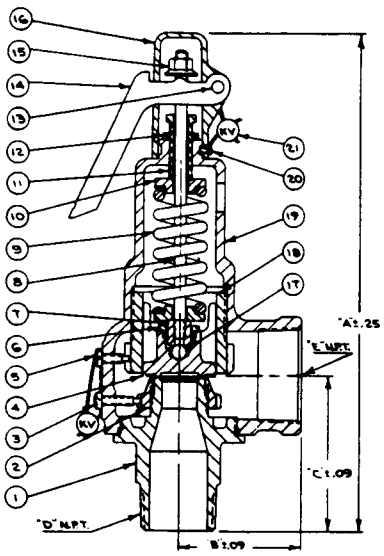
Lbs./Hour Steam, 90% basis
10% Accumulation

The capacities shown in these columns are for saturated steam and are in accordance with A.S.M.E. Unfired Pressure Vessel Code, Section VIII.

FOR AIR CAPACITY — CONSULT FACTORY.

APPLICATIONS

Steam boilers, generators, lines, unfired vessels. Compressor intercoolers, aftercoolers, receivers.



TYPE 40
41 (TOP OUTLET NOT SHOWN)

TYPE 40 DIMENSIONS (approximate)

Inlet	Orifice	Outlet	Discharge Area Sq. in.	Connections Inlet "D"	Connections Outlet "E"	A	B	C	Approx. Wt. Lbs.
½	D	¾	0.121	½"M.	¾"FE.	6⅜	1⅝	2⅛	1½
¾	D	¾	0.121	¾"M.	¾"FE.	6⅜	1⅝	2⅛	1¾
¾	E	1	0.216	¾"M.	1" FE.	7½	1¾	2⅜	2½
1	E	1	0.216	1" M.	1" FE.	7⅝	1¾	2½	2¾
1	F	1¼	0.338	1" M.	1¼"FE.	8½	2	2⅝	3½
1¼	F	1¼	0.338	1¼"M.	1¼"FE.	8⅝	2	2⅞	3¾
1¼	G	1½	0.554	1¼"M.	1½"FE.	9⅝	2⅜	3⅛	5¼
1½	G	1½	0.554	1½"M.	1½"FE.	9⅞	2⅜	3⅜	5½
1½	H	2	0.863	1½"M.	2" FE.	10⅝	2¾	3⅝	7
2	H	2	0.863	2" M.	2" FE.	11⅛	2¾	4⅛	7½
2	J	2½	1.414	2" M.	2½"FE.	13⅝	3⅜	4¼	14
2½	J	2½	1.414	2½"M.	2½"FE.	13⅞	3⅜	4½	14½

PARTS AND MATERIALS

ITEM	DESCRIPTION	MATERIAL
1	Body	Copper Alloy
2	Regulator Ring	Copper Alloy
3	Regulator Ring Set Screw	Steel/Brs. Pft.
4	Disc	Copper Alloy
5	Guide Set Screw	Steel/Brs. Pft.
6	Stem Retainer L'nut	Brass
7	Stem Retainer	Brass
8	Stem	Steel/Cad. Pft.
9	Spring	Steel/Cad. Pft.
10	Spring Plate	Steel/Cad. Pft
11	Pressure Screw	Brass
12	Press. Screw L'nut	Brass
13	Lever Pin	Steel
14	Lever	Steel/Brs. Pft.
15	Lift Nut	Steel/Cad. Pft.
16	Hood	Copper Alloy
17	Ball	S/S
18	Guide	Copper Alloy
19	Cap	Copper Alloy*
20	Hood Set Screw	Steel/Brs. Pft.
21	Seal	Lead & Wire

*Cast iron cap may be furnished at our option.

Model 8300

68/87

This unit provides a complete station for immediate first aid. It has a separate overhead drench shower and stainless steel eye bath bowl. A universal emergency sign is included with each unit. Heads are protected with dust covers that remove when water is turned on.

☐ Model 8300 (Stay Open Valve)

Shower head: ABS plastic in "safety" green (Model 8129).
Shower valve: Instant-action, stay-open until manually closed chrome plated brass ball valve (Model SP260) operated by easily located rigid stainless steel pull-rod with triangular handle.
Standard: 1¼" galvanized pipe with 9" floor flange.
Eye-wash: Corrosion-resistant stainless steel bowl with twin Buna N covered ABS plastic patented Soft Flo* anti-surge heads in "safety" green. (Model SP11).
Eye-wash valve: Easily-operated, instant-action, stay-open chrome plated brass ball valve with foot treadle or push-flag operation. Stays open until manually closed (Model SP225).
Stream control: Steady water flow under varying pressures is assured with Haws dependable dual automatic pressure compensation devices.
Supply: 1¼" IPS.
Waste: 1¼" IPS.
Shipping weight: Approx. 49 lbs.

Options:

☐ *CRP Green Coating:* For protection against corrosive atmospheres, at additional cost.
☐ *Model 9100 Dust Cover Assembly,*** at additional cost.
☐ *Shower Head:* Model 8127, stainless steel, at additional cost.
☐ *Model SP505 Self-closing Spring*† for horizontal shower valve, at additional cost.

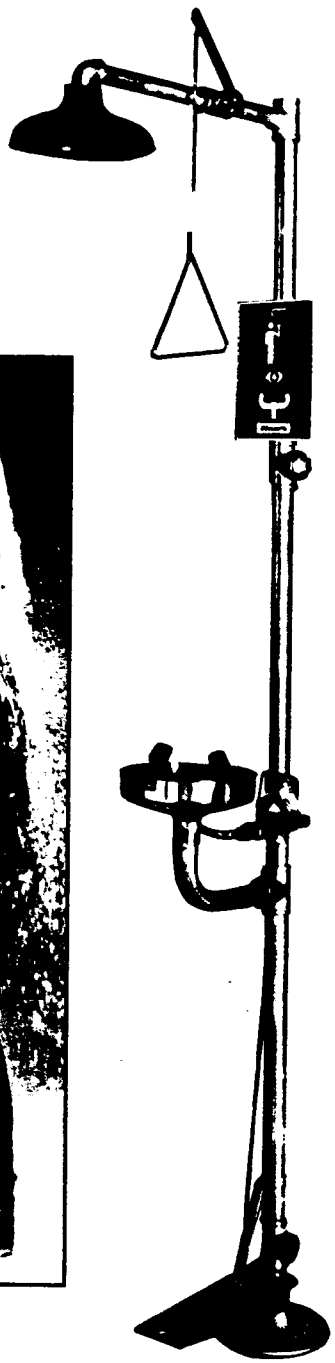
Freeze-Proof: See Model 8300FP.

*Patent No. 3,809,315
**Patent No. 3,599,251

† ANSI Standard states that valve should be stay-open type.

Model 8300 shown with Model 9000 Alarm (at additional cost).

Drain should be provided for this unit.



Model 8300

ALL EMERGENCY EQUIPMENT SHOULD BE TESTED WEEKLY.
Haws emergency products meet ANSI Standard and OSHA rules and regulations relating to this type of equipment.
***Note:** Continued product improvement makes specifications subject to change without notice.*

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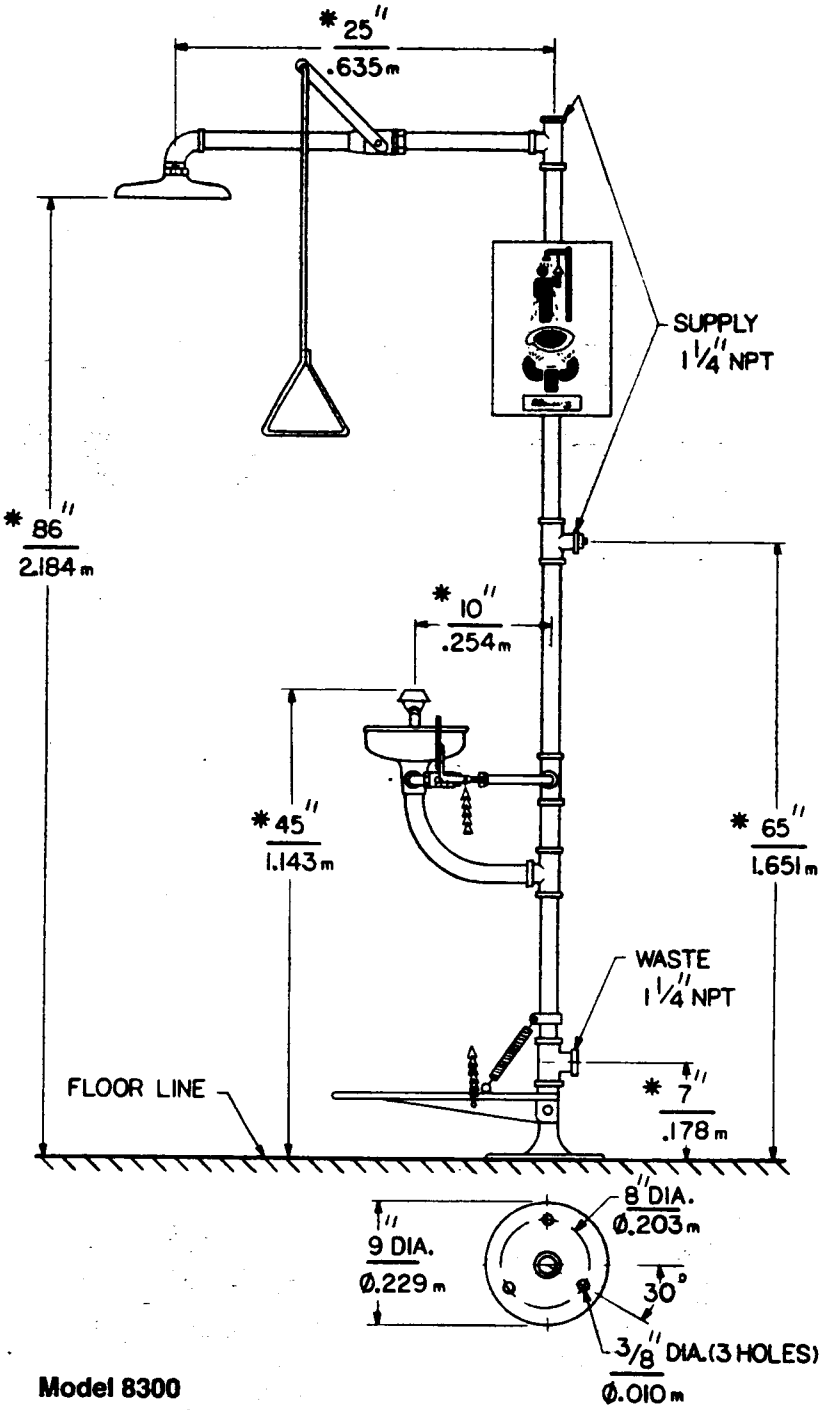
HAWS AG: Kirchberg/Bern, Switzerland

Haws®
HAWS DRINKING FAUCET COMPANY

EMERGENCY EQUIPMENT

Model 8300

69/87



Model 8300

* These dimensions may vary plus or minus ½" (.013 m).

ALL EMERGENCY EQUIPMENT SHOULD BE TESTED WEEKLY.
Haws emergency products meet ANSI Standard and OSHA rules and regulations relating to this type of equipment.

***Note:** Continued product improvement makes specifications subject to change without notice.*

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Haws®
HAWS DRINKING FAUCET COMPANY

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HAWS AG: Kirchberg/Bern, Switzerland

70/87

ENERGY CONSERVATION REPORT AND ANALYSIS

ENERGY CONSERVATION REPORT AND ANALYSIS

I. Summary

The PFP Liquid Low Level Waste System will be housed in a new building of approximately 2450 square feet. The building will be provided with a ventilation system whose primary function will be to clean up the building ambient from airborne contaminant particulates before exhausting the air outside. Energy conservation guidelines outlined in DOE Order 6430.1A "General Design Criteria," will be incorporated into the design.

II. Systems

A. Heat Recovery for Heating, Ventilating, and Air Conditioning (HVAC)

The ventilation system will be a once-through all outside air exhaust system. A run-around heat recovery system to transfer heat from the exhaust to the supply air will not be used. The volume of ventilation air for this facility is less than the 4000 cfm which is indicated in DOE Order 6430.1A as the minimum airflow that will produce a favorable payback. The building was located and oriented in an available space.

B. Solar Systems

Based on previous studies of solar systems for building heating, installation of solar equipment is not economically justifiable. Because there are no hot water requirements for the facility, installation of a solar water heating system is also not justifiable.

C. Building Envelope

The exterior walls and the roof will be insulated to provide an overall "U" value of 0.051 Btu/hr/sq ft/°F. Windows will not be required and exterior doors will be metal with insulated core equipped with perimeter seals to reduce infiltration to a minimum. Lighting levels for the facility will follow the guidelines outlined in DOE Order 6430.1A for the required application. Lights will be switched off except during periods of occupancy for inspection/maintenance purposes.

D. Building Ventilation System

The ventilation air drawn in from the outdoors will be preheated by an electric heating coil equipped with an automatic temperature control. The set point will be such as to keep the building ambient above freezing temperature to prevent damage to the process equipment. The ventilation system will draw in 100% outside air for the facility. The exhaust air will be filtered through a HEPA filter prior to being discharged to the outdoors.

E. Automatic and Supervisory Features

The building ambient will not be heated for comfort; therefore, supervisory automatic control features will not be necessary.

III. Total Annual Energy Usage

Building energy consumption is estimated to be 540 million Btu/yr. (See attached Calculation Estimates.) All guidelines for energy conservation outlined in DOE Order 6430.1A have been incorporated. No other energy conservation features will be developed. The process is for the treatment of low level radioactive liquid waste.

ICF KAISER ENGINEERS

JOB No. 91044-003

SHEET 73 OF 87

DESIGNED BY T.J. Thomas DATE 5/16

CHECKED BY F. Lopez DATE 5/21

OVERALL "U" VALUE

$$"U"_{OVERALL} = [\text{ROOF AREA} \times (U_{ROOF}) + \text{WALL AREA} \times (U_{WALL}) + \text{DOOR NO. 1 AREA} \times (U_{D1}) \text{ DOOR NO. 2 AREA} \times (U_{D2}) + \text{GLASS AREA} \times U_{GLASS}] \div \text{TOTAL AREA}$$

$$= [\overset{87.6}{2190\,FT^2}(.04) + \overset{129.6}{2592\,FT^2}(.05) + \overset{25.62}{42\,FT^2}(.61) + \overset{6.72}{48\,FT^2}(.14) + \overset{1.4}{1.25\,FT^2}(1.13)] \div 4873\,FT^2$$

$$= 250.9 / 4873\,FT^2$$

$$= 0.051\ BTUH/^{\circ}F/FT^2$$

CALCULATIONS KE Form No. E-6 Rev. 12-89

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003
ENERGY CALCULATIONS

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

DATE: 08/31/90
BY: TJT
CHK: F. Lopez 5/21/91
SHT: OF
14/87

A = BIN IN DEG. F	B = TOTAL OBS HOURS	C = BLDG H.G. OR H.L. BTUH	D = B*C BTU X10**5	E = EXHUAST AIR	F = O.A. TEMP DEG. F	G = O.A. H.L. BTUH	H = B*G ENERGY BTU X10**5	I = D+H ANNUAL ENERGY USE HTG BTU X10**5	J = D+H ANNUAL ENERGY USE CLG BTU X10**5	K = A/C UNITS ANNUAL ENERGY USE KW/YR
112	0	51200	0.00	1600	112	55296	0.00		0	0
107	0	43200	0.00	1600	107	46656	0.00		0	0
102	10	35200	3.52	1600	102	38016	3.80		7	118
97	51	27200	13.87	1600	97	29376	14.98		29	466
92	121	19200	23.23	1600	92	20736	25.09		48	781
87	197	11200	22.06	1600	87	12096	23.83		46	742
82	299	3200	9.57	1600	82	3456	10.33		20	322
77	0	0	0	1600	77	-5184	0	0		
72	0	0	0	1600	72	-13824	0	0		
67	0	0	0	1600	67	-22464	0	0		
62	0	0	0	1600	62	-31104	0	0		
57	0	0	0	1600	57	20736	0	0		
52	0	0	0	1600	52	12096	0	0		
47	0	0	0	1600	47	3456	0	0		
42	804	-1973	-15.86	1600	42	-5184	-41.68	-58		
37	809	-5261	-42.56	1600	37	-13824	-111.84	-154		
32	850	-8548	-72.66	1600	32	-22464	-190.94	-264		
27	495	-11836	-58.59	1600	27	-31104	-153.96	-213		
22	252	-15124	-38.11	1600	22	-39744	-100.15	-138		
17	129	-18412	-23.75	1600	17	-48384	-62.42	-86		
12	72	-21700	-15.62	1600	12	-57024	-41.06	-57		
7	43	-24988	-10.74	1600	7	-65664	-28.24	-39		
2	20	-28276	-5.66	1600	2	-74304	-14.86	-21		
-3	11	-31564	-3.47	1600	-3	-82944	-9.12	-13		
-8	4	-34852	-1.39	1600	-8	-91584	-3.66	-5		
-13	1	-38139	-0.38	1600	-13	-100224	-1.00	-1		
-18	1	-41427	-0.41	1600	-18	-108864	-1.09	-2		
TOTAL	4159							-1049		2311

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003
ENERGY CALCULATIONS

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

DATE: 08/31/90
BY: TJT
CHK: F. Lopez 5/21/91
SHT OF
75 / 87

ENERGY CALC. FOR PROCESS SYSTEM

M =	N = ND. FROM BAL RPT	O = BHP	P = WATTS	Q = VOLTS	R = HRS/YR	S = ANNUAL ENERGY USE KW
PUMP	P-102A	2.5	1865	460	8760	16337
PUMP	P-202	2.5	1865	460	8760	16337
PUMP	P-101A	2.5	1865	460	8760	16337
PUMP	P-301	2.5	1865	460	0	0
INSTRU.		-	3600	120	8760	31536
SAMPLERS(2)		-	1200	120	17520	21024

PROCESS ANNUAL ENERGY USE 101572
=========

ENERGY CALC. FOR HVAC FAN SYSTEM

EXH. FAN EF-01	2.5	1865	460	8760	16337

HVAC FAN ANNUAL ENERGY USE 16337
=========

ENERGY CALC. FOR LIGHTS

OUTSIDE LIGHTS	-	350	208	2920	1022
LIGHTS	-	3195	120	1460	4665

LIGHTING ANNUAL ENERGY USE 5687
=========

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003
ENERGY CALCULATIONS
PROPOSED

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

DATE: 08/31/90
BY: TJT
CHK: F Lopez 5/21/91
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A = BIN IN DEG. F

B = TOTAL HOURS OBSERVED - DATA FROM AIR FORCE MANUAL 88-29
C = HEAT GAIN (28800/(98-80))*(A-80) BTUH
HEAT LOSS (21,700/(45-12))*(A-45) BTUH
D = HEAT GAIN OR HEAT LOSS PER YEAR AT BIN TEMP.
E = TOTAL EXHAUST AIR FLOW RATE CFM
F = OUTSIDE AIR DRY BULB TEMP.
G = OUTSIDE AIR HEAT LOSS - FOR CLG E*1.08*(80-F)
FOR HTG E*1.08*(F-45)
(a) AIR FACTROR = 1.08 BTU/CFM/DEG. F
H = OUTSIDE AIR HEAT GAIN OR HEAT LOSS PER YEAR AT BIN TEMP.
B*G BTU
I = TOTAL ANNUAL ENERGY USE, HEATING BTU PER YEAR AT BIN TEMP. X 10**5
D+H BTU
J = TOTAL ANNUAL ENERGY USE, COOLING BTU PER YEAR AT BIN TEMP. X 10**5
D+H BTU
K = A/C UNIT ENERGY USE (KW) (J/12000)(1.64+.30)
(a) ESTIMATE ELECTRICAL ENERGY FOR A/C UNITS.DATA FROM ASHRAE 1985 FUNDAMENTIALS PG. 28.7, TABLE 2. APPROXIMATE POWER INPUTS ARE 1.94 KW/TON(1.64+.3)
L = NOT USED.
M = EQUIPMENT
N = EQUIPMENT NO.
O = BRAKE HORSE POWER FROM FAN
P = WATTS = HP X 746 WATTS/HP
Q = VOLTS
R = ANNUAL HOURS OF OPERATION
(a) Pumps P-102A, P-202, P-101A, instrumentation, samplers and exhaust fan operate 24 hours per day.
(b) Pump P-301 is for emergency use only.
(c) Outside lights operate 8 hours per day and lights in building operate approximately 4 hours per day.
S = ANNUAL ENERGY USE KW/YR P*R/1000 KW

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003
ENERGY CALCULATIONS FOR HEAT TAPE

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

DATE: 08/31/90
BY: TJT
CHK: F. Lopez 5/21/91
SHT OF
77/87

A = BIN IN DEG. F	B = TOTAL OBS HOURS	C = BLDG H.G. OR H.L. BTUH	D = B*C ANNUAL ENERGY USE HTG BTU X10**5
112	0	0	0
107	0	0	0
102	0	0	0
97	0	0	0
92	0	0	0
87	0	0	0
82	0	0	0
77	0	0	0
72	0	0	0
67	0	0	0
62	0	0	0
57	0	0	0
52	0	0	0
47	0	0	0
42	804	-950	-7.64
37	809	-2534	-20.50
32	850	-4117	-35.00
27	495	-5701	-28.22
22	252	-7284	-18.36
17	129	-8868	-11.44
12	72	-10451	-7.52
7	43	-12034	-5.17
2	20	-13618	-2.72
-3	11	-15201	-1.67
-8	4	-16785	-0.67
-13	1	-18368	-0.18
-18	1	-19952	-0.20
TOTAL	3491		-139

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

0
BY: TJT
CHK: F. Lyper 5/21/91
SHT OF
78/87

HEAT TAPE

A = BIN IN DEG. F

B = TOTAL HOURS OBSERVED - DATA FROM AIR FORCE MANUAL 88-29
C = HEAT LOSS (10,451/(45-12))*(A-45) BTUH

D = HEAT LOSS PER YEAR AT BIN TEMP.
E = TOTAL ANNUAL ENERGY USE, HEATING BTU PER YEAR AT BIN TEMP. X 10**5

PROJECT: LLWTF
HANFORD, WASH.

PN: 91044-003
ENERGY CALCULATIONS

ICF KAISER ENGINEERING INC.
6400 UPTOWNBLVD.
ALBUQUERQUE, NEW MEXICO
(505) 881-1593

DATE: 08/31/90
BY: TJT
CHK: F Lopez 5/21/91
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	BTU/YR*10**6	KW/YR
ANNUAL HVAC ENERGY USE		
HVAC HEATING =	105	
EXHAUST FAN =		16,337
ANNUAL LIGHTING ENERGY USE		
LIGHTING ENERGY USE =		5,687
TOTAL ANNUAL BUILDING ENERGY USE =	105	22,024
ANNUAL PROCESS ENERGY USE		
PROCESS EQUIP. =		101,572
HEAT TAPE =	14	
TOTAL ANNUAL ENERGY USE FOR HVAC =	119	123,596
CONVERT PROCESS POWER KW TO BTU =	421	
TOTAL ANNUAL ENERGY USE IN BTU/YR =	540	

AREA OF BUILDING = 2450 SQFT

TOTAL BTU PER GROSS-SQFT PER YEAR FOR HVAC = 48,512 BTU/SQFT/YR

TOTAL BTU PER GROSS-SQFT PER YEAR FOR PROCESS = 172,026 BTU/SQFT/YR

TOTAL BTU PER GROSS-SQFT PER YEAR FOR ENTIRE BUILDING = 220,538 BTU/SQFT/YR

JOB No. 91044-003
SHEET 80 OF 87

ELECTRICAL LOAD CALCULATIONS for LLWTF

DESIGNED BY DB DATE 4/24
CHECKED BY T. Thomas DATE 5/20/9

	DESCRIPTION	QUANTITY	HP	VOLTAGE	AMP.	PHASE	HP x 746 WATTS	QUANTITY x WATTS TOTAL WATTS	LOCATION
1.	MOTORS (P102A, P102B P202A, P202B) P101A, P10B	6	5	480	7.6	3Ø	3730	22380	TANK FARM
2.	EXHAUST FAN	1	3	480	4.8	3Ø	2238	2238	OUTSIDE LLWT
3.	P301 MOTOR	1	7.5	480	11	3Ø	5595	5595	TANK FARM
4.	LIGHTS LPS	6	-	208	0.168	1Ø	35	210	TANK FARM
5.	RECEPTICLES	3	-	120	1.5	1Ø	180	540	
6.	HEAT TAPE	4	-	208	7.2	1Ø	1500	6000	TANK FARM
7.	INSTRUMENTATION	2	-	120	5	1Ø	600	1200	TANK FARM
8	LIGHTS LPS	4	-	208	0.168	1Ø	35	140	OUTSIDE LLWTF
	TOTAL OUTSIDE							38303	
9.	LIGHTS 3-BULB	24	-	120	1.0	1Ø	120	2880	LLWTF
10	LIGHTS 2-BULB	3	-	120	0.667	1Ø	80	240	LLWTF
11.	LIGHTS EXIT + EMER	5	-	120	0.125	1Ø	15	75	"
12	INSTRUMENTATION	4	-	120	5	1Ø	600	2400	"
13	OUTLETS	22	-	120	1.5	1Ø	180	3960	"
14	DAMPER MTRS	3	-	120	1.1	1Ø	133	400	"
15	AIR CONDITIONER	1	2 1/12	120	16	1Ø	1920	1920	"
16	AIR CONDITIONER	2	2 1/12	208	9.1	1Ø	3330	6660	"
17	HTR UH0-3, 4, 5	3	2 1/12	208	13	1Ø	2700	8100	
18	SAMPLER	4	2 1/12	120	5	1Ø	600	2400	
19	KOH PUMP	1	1/4	208	2.5	1Ø	500	500	
20	PLC	1	-	120	10	1Ø	1200	1200	
21	HTR UH01-UH02	2	2 1/12	208	11.1	3Ø	4000	8000	
22	KOH MIXER	1	3/4	480	1.4	3Ø	560	560	
23	DUCT HTR	1	2 1/12	480	24	3Ø	20000	20000	
24	GARAGE DOOR	4	1/2	480	1	3Ø	375	1500	
25	XFMR LOSS (estimate)	1	-	480/208	?	3Ø	1000	1000	
								61795	

100098 WATTS = 100.1 KW

CALCULATIONS KE Form No. E-6 Rev. 5-85

LLWTF	JOB No. 91044-003 SHEET B1 OF B7
HEAT TRACE CALCULATIONS	DESIGNED BY BORNEO DATE 5/1[illegible] CHECKED BY T.J. Thomas DATE 5/20/9[illegible]

TM - DESIRED MAIN. TEMP = 42°F
TA - MIN EXPECTED AMBIENT TEMP = -10°F
TE - MAX INTERMITTENT EXPOSURE TEMP = 80°F
PIPE SIZE - 1/2", 1 1/2", 2", 3"

QB - PIPE HEAT LOSS BASED ON IEE STANDARD 515-1983 Eqn 1
f - INSULATION COMPENSATION FACTOR = 1 (GLASS FIBER ASTM C547)

1. $\Delta T = TM - TA = 42 - (-10) = 52°F$

PIPE HEAT LOSS (IN WATTS/FT)

INSULATION THICKNESS	ΔT	PIPE DIAMETER 1/2"	1 1/2"	2"	3"
0.5"	50°	3.5 W/ft			
1"	↓		2.8 W/ft		
1 1/2"				2.4 W/ft	
2"					2.6 W/ft

CIRCUIT BREAKER CALC.
at 3 WATT/FT SRL3-2 208 VOLT 1Ø
MAX LENGTH 695' → MAX LENGTH for THIS OPERATION = 500'
@ 208 V WATTS/FT = 80% (3 WATT/FT) = 2.4

FACTOR at 0°F = .04 AMP/FT for START-UP

CIR. BREAKER CALC
$.04 \frac{A}{ft}(ft) = AMP \rightarrow .04 \frac{A}{ft}(500\ ft) = 20$ AMP BREAKER

USE 20 AMP BREAKER for EVERY 500' of TAPE

CALCULATIONS KE Form No. E-6 Rev. 5-85

MOSES LAKE/GRANT CO WASHINGTON

LAT 47 12N LONG 119 19W ELEV 1185 FT

MEAN FREQUENCY OF OCCURRENCE OF DRY BULB TEMPERATURE (DEGREES F) WITH MEAN COINCIDENT WET BULB TEMPERATURE (DEGREES F) FOR EACH DRY BULB TEMPERATURE RANGE

Temperature Range	MAY Obsn Hour Gp 01 to 08	MAY 09 to 16	MAY 17 to 24	MAY Total Obsn	MAY MCWB	JUNE Obsn Hour Gp 01 to 08	JUNE 09 to 16	JUNE 17 to 24	JUNE Total Obsn	JUNE MCWB	JULY Obsn Hour Gp 01 to 08	JULY 09 to 16	JULY 17 to 24	JULY Total Obsn	JULY MCWB	AUGUST Obsn Hour Gp 01 to 08	AUGUST 09 to 16	AUGUST 17 to 24	AUGUST Total Obsn	AUGUST MCWB	SEPTEMBER Obsn Hour Gp 01 to 08	SEPTEMBER 09 to 16	SEPTEMBER 17 to 24	SEPTEMBER Total Obsn	SEPTEMBER MCWB	OCTOBER Obsn Hour Gp 01 to 08	OCTOBER 09 to 16	OCTOBER 17 to 24	OCTOBER Total Obsn	OCTOBER MCWB
110/114																	0	0	0	70										
105/109												0	0	0	66		0	0	0	68										
100/104							1	0	1	67		4	2	6	67		2	1	3	66										
95/99		0	0	0	67		3	2	5	66		20	10	30	66		11	4	15	65		1		1	67					
90/94		3	1	4	65		9	4	13	63		38	22	60	64	0	25	13	38	63		5	1	6	64					
85/89		6	3	9	62	0	19	10	29	62	1	44	30	75	62	1	40	20	61	62		18	5	23	62		0		0	59
80/84		16	7	23	60	1	35	19	55	60	6	51	40	97	61	2	48	31	81	60		27	11	38	60		2	0	2	58
75/79	1	29	15	45	58	4	48	29	81	58	18	42	43	103	59	8	50	45	103	59	0	39	20	59	58		9	1	10	57
70/74	3	40	22	65	56	13	56	41	110	56	38	31	42	111	57	27	39	47	113	57	3	50	33	86	55		16	5	21	56
65/69	9	48	33	90	53	30	43	46	119	54	50	12	31	101	55	82	22	43	117	55	15	44	42	101	53	1	32	11	44	54
60/64	26	50	46	122	50	58	20	46	124	52	66	5	19	89	52	70	9	29	108	53	35	32	51	118	51	2	48	22	72	51
55/59	42	35	49	126	48	67	6	29	102	50	46	1	7	53	50	57	1	12	70	50	59	18	45	122	49	13	54	42	109	49
50/54	64	16	44	124	46	48	1	12	61	46	15		1	16	47	25	0	2	27	47	65	5	22	92	46	38	44	59	141	46
45/49	61	3	21	85	42	16		1	17	43	2		0	2	43	6		0	6	43	42	0	8	50	42	59	29	56	144	42
40/44	30	0	5	35	38	2		0	2	39	0			0	40	0			0	41	15		1	16	38	68	10	36	114	39
35/39	11		1	12	34	1			1	35											3		0	3	33	41	3	11	55	35
30/34	2			2	30																1			1	29	20	0	4	24	30
25/29	0			0	23																					7		1	8	26
20/24																										1		0	1	23

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MOSES LAKE/GRANT CO WASHINGTON

Temperature Range	NOVEMBER Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79					
70/74					
65/69		0		0	54
60/64	0	3	0	3	50
55/59	1	12	2	15	48
50/54	4	33	5	46	45
45/49	16	51	36	103	43
40/44	44	50	54	148	39
35/39	51	39	50	140	35
30/34	49	28	45	122	30
25/29	41	13	27	81	26
20/24	21	6	10	37	21
15/19	7	3	4	14	16
10/14	3	1	1	5	11
5/9	2	0	1	3	6
0/4	0			0	2
-5/-1					
-10/-6					
-15/-11					
-20/-16					

Temperature Range	DECEMBER Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79					
70/74					
65/69					
60/64		0		0	51
55/59		1		1	46
50/54	1	4	2	7	44
45/49	3	16	4	23	41
40/44	14	35	19	68	38
35/39	36	53	49	138	34
30/34	80	65	82	227	31
25/29	52	39	46	137	26
20/24	32	19	21	72	21
15/19	15	8	10	33	16
10/14	7	4	6	17	11
5/9	5	2	4	11	6
0/4	2	0	2	4	2
-5/-1	1	1	1	3	-4
-10/-6	0	0	0	0	-9
-15/-11	1		0	1	-12
-20/-16					

Temperature Range	JANUARY Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79					
70/74					
65/69					
60/64					
55/59	0	1	0	1	48
50/54	1	5	2	8	46
45/49	3	14	7	24	42
40/44	11	27	18	56	38
35/39	32	45	34	111	35
30/34	59	59	68	186	31
25/29	48	35	41	124	26
20/24	33	26	29	88	21
15/19	23	15	19	57	16
10/14	15	12	11	38	11
5/9	11	6	10	27	6
0/4	7	2	5	14	1
-5/-1	4	1	2	7	-3
-10/-6	2	0	1	3	-9
-15/-11	0	0	0	0	-14
-20/-16	1		0	1	-19

Temperature Range	FEBRUARY Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79					
70/74					
65/69					
60/64					
55/59		1		1	51
50/54		7	1	8	49
45/49	1	16	5	22	44
40/44	7	34	17	58	41
35/39	18	46	38	102	38
30/34	42	52	58	152	34
25/29	67	38	54	159	30
20/24	48	17	27	92	26
15/19	20	7	13	40	21
10/14	11	3	6	20	17
5/9	6	2	3	11	11
0/4	1	0	1	2	6
-5/-1	1	0	1	2	1
-10/-6	1	0	0	1	-4
-15/-11	1			1	-8
-20/-16					

Temperature Range	MARCH Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79					
70/74					
65/69		0		0	58
60/64		1	0	1	54
55/59		4	1	5	52
50/54		12	3	15	48
45/49	1	27	9	37	46
40/44	1	56	24	81	43
35/39	14	63	52	129	40
30/34	50	43	59	152	37
25/29	64	25	50	139	33
20/24	67	11	33	111	30
15/19	36	3	10	49	25
10/14	10	1	3	14	20
5/9	4	0	1	5	16
0/4	1	0	0	1	11
-5/-1	0			0	6
-10/-6					
-15/-11					
-20/-16					

Temperature Range	APRIL Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114					
105/109					
100/104					
95/99					
90/94					
85/89					
80/84					
75/79		0		0	63
70/74		2	1	3	61
65/69		4	1	5	57
60/64		14	5	19	54
55/59	0	30	12	42	52
50/54	1	51	24	76	49
45/49	9	61	42	112	46
40/44	28	51	56	135	44
35/39	50	21	56	135	41
30/34	74	5	32	111	38
25/29	48	0	10	58	34
20/24	17		1	18	29
15/19	4		0	4	26
10/14	0			0	23
5/9					
0/4					
-5/-1					
-10/-6					
-15/-11					
-20/-16					

Temperature Range	ANNUAL TOTAL Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	RCWB
110/114		0	0	0	70
105/109		0	0	0	67
100/104		7	3	10	67
95/99		35	16	51	66
90/94	0	80	41	121	64
85/89	2	127	68	197	62
80/84	9	181	109	299	60
75/79	31	221	154	406	58
70/74	84	247	195	526	56
65/69	165	235	219	619	54
60/64	257	231	240	728	51
55/59	294	224	238	756	48
50/54	291	231	238	760	45
45/49	287	231	258	776	42
40/44	326	216	262	804	38
35/39	329	217	263	809	34
30/34	362	201	287	850	30
25/29	236	107	152	495	26
20/24	117	59	76	252	21
15/19	60	29	40	129	16
10/14	32	19	21	72	11
5/9	19	8	16	43	6
0/4	10	2	8	20	1
-5/-1	6	2	3	11	-3
-10/-6	3	0	1	4	-8
-15/-11	1	0	0	1	-13
-20/-16	1		0	1	-19

83/87

STATE / Station	LOCATION Lat	LOCATION Long	Elev	WINTER DESIGN DATA HEATING Dry Bulb 99%	97.5%	Pvlg Wind	Mean Speed	DEGREE DAYS Heating	SUMMER DESIGN DATA AIR CONDITIONING Dry Bulb 1% MCWB		2.5% MCWB		Mean Daily Range	Pvlg Wind	5% MCWB		Wet Bulb 1%	2.5%	5%	SUMMER CRITERIA DATA AIR CONDITIONING Dry Bulb ≧ 93°F	≧ 88°F	Wet Bulb ≧ 73°F	≧ 67°F
	° '	° '	feet	°F	°F	dir	Knots	annual	°F	°F	°F	°F	°F	dir	°F	°F	°F	°F	°F	hrs	hrs	hrs	hrs
VIRGINIA (CONT)	N	W																					
Norfolk NAS/Chambers Field	36 56	76 18	13	20	23	NNW	11	3451	93	77	91	76	17	SSW	89	76	80	78	77	39	930	932	2212
Oceana NAS	36 49	76 02	22	19	22	N	11	3639	91	77	89	76	17	SW	87	75	79	78	77	12	708	856	2184
Portsmouth	36 51	76 18	10	20	22	NW	10	3488	93	77	91	76	19	SW	89	76	79	78	77	41	874	961	2238
Quantico MCAS	38 30	77 18	12	10	14	NW	6	4349	93	77	91	76	21	S	89	75	80	78	77	37	892	710	1884
Radford Ordnance Works	37 11	80 33	1750	9	14	NW	9	4680	91	71	89	71	24	SW	86	70	74	73	72	14	609	124	1213
Richmond/Byrd IAP	37 30	77 20	164	14	17	N	6	3939	95	76	92	76	22	SW	90	75	79	78	77	70	932	765	1973
Richmond Quartermaster Depot	37 26	77 27	122	14	17	N	6	3939	95	76	92	76	22	SW	90	75	79	78	77	70	932	765	1973
Roanoke/Woodrum Aprt	37 19	79 58	1193	12	16	NW	9	4307	93	72	91	72	24	SW	88	71	75	74	73	38	810	223	1468
Staunton/Shenandoah Valley	38 16	78 54	1201	12	16	NW	9	4307	93	72	91	72	24	SW	88	71	75	74	73	38	810	223	1468
Vint Hill Farms Station	38 45	77 41	425	7	11	NW	9	5010	93	74	90	73	23	S	88	73	77	76	75	28	749	386	1417
Williamsburg	37 16	76 42	70	17	20	N	10	3671	93	77	91	76	17	SSW	88	75	80	78	77	42	905	807	2065
Yorktown	37 14	76 31	25	17	20	NW	9	3623	92	78	90	77	17	SW	87	76	79	78	77	21	809	1010	2290
WASHINGTON	N	W																					
Aberdeen	46 59	123 49	12	25	28	ESE	6	5316	80	65	77	62	20	NNW	73	61	65	63	62	1	38	0	14
Bangor	47 43	122 43	15	21	25	E	8	5432	82	65	78	64	24	N	75	62	66	64	63	2	64	0	26
Bellingham IAP	48 48	122 32	158	10	15	NNE	15	5738	81	67	77	65	26	WSW	74	63	68	65	63	0	45	1	46
Blaine AFS	48 55	122 44	65	10	15	NNE	15	5738	81	67	77	65	26	WSW	74	63	68	65	63	0	45	1	46
Bremerton NAVSHIPYD	47 34	122 39	7	21	25	E	8	5432	82	65	78	64	24	N	75	62	66	64	63	2	64	0	26
Ephrata MAP	47 18	119 31	1272	4	8	N	8	5603	96	66	93	65	31	SSW	89	63	67	66	64	81	655	1	52
Everett use Paine AFB																							
Fairchild AFB/Spokane	47 37	117 38	2462	1	7	NNE	7	6790	93	63	90	62	29	SSW	86	61	65	63	62	32	415	0	5
Fort Lawton	47 39	122 25	225	21	25	ESE	6	5678	81	65	77	64	22	NNW	74	62	67	64	63	2	47	1	30
Fort Lewis/Gray AAF	47 05	122 35	301	19	24	S	6	5339	86	65	82	64	30	NNE	78	62	67	65	63	2	130	2	29
Four Lake Comm Sta ANG	47 33	117 33	2642	1	7	NNE	7	6806	93	63	90	62	29	SSW	86	61	65	63	62	32	415	0	5
Keyport	47 42	122 37	17	21	25	E	8	5432	82	65	78	64	24	N	75	62	66	64	63	2	64	0	26
Longview	46 10	122 56	12	19	24	ESE	9	5064	88	68	85	67	26	NW	81	65	69	67	66	9	200	4	101
Madigan Army Hospital	47 06	122 32	275	19	24	S	5	5328	86	66	82	65	32	NNE	79	63	68	66	64	4	131	0	49
Makah AFS	48 23	124 41	1430	26	29	E	24	5774	64	58	62	58	9	SW	60	57	60	59	58	0	0	0	0
Marietta	48 50	122 36	20	10	15	NNE	15	5738	81	67	77	65	26	WSW	74	63	68	65	63	0	45	1	46
McChord AFB/Tacoma	47 09	122 29	322	19	24	S	5	5287	86	66	82	65	32	NNE	79	63	68	66	64	4	131	0	49
Mica Peak AFS	47 34	117 05	5198	-1	4	SW	17	8840	77	58	74	57	20	SW	71	56	59	58	56	0	2	0	0
Moses Lake/Grant Co	47 12	119 19	1185	1	7	N	8	5809	97	66	94	65	31	SSW	90	63	67	66	64	97	675	1	52
Olympia	46 58	122 54	215	16	22	NE	4	5530	87	66	83	65	33	NE	79	64	67	66	64	5	139	0	46

STATE / Station | LOCATION Lat | Long | Elev | WINTER DESIGN DATA HEATING Dry Bulb 99% | 97.5% | Pvlg Wind | Mean Speed | DEGREE DAYS | SUMMER DESIGN DATA AIR CONDITIONING Dry Bulb | Mean Daily | Pvlg | Wet Bulb | SUMMER CRITERIA DATA AIR CONDITIONING Dry Bulb | Wet Bulb

84/87

State Station	Annual Cooling Degree Days
VIRGINIA (continued)	
Williamsburg	1345
Yorktown	1539
WASHINGTON	
Aberdeen	13
Bangor	89
Bellingham IAP	44
Blaine AFS	44
Bremerton NAVSHIPYD	89
Ephrata MAP	941
Everett	49
Fairchild AFB/Spokane	416
Fort Lawton	60
Fort Lewis/Gray AAF	110
Four Lake Comm Sta ANG	416
Keyport	89
Longview	135
Madigan Army Hospital	94
Makah AFS	0
Marietta	44
McChord AFB/Tacoma	94
Mica Peak AFS	109
Moses Lake/Grant Co	707
Olympia	101
Othello AFS	666
Paine AFB/Everett	60
Pasco/Tri-Cities Aprt	826
Seattle NSA	162
Seattle-Tacoma IAP	129
Spokane IAP	388
Tacoma	138
Tatoosh Island	0

State Station	Annual Cooling Degree Days
Walla Walla Aprt	793
Whidbey Island/Ault Fld	6
Whidbey Is/Oak Harbor	24
Yakima Firing Center	479
Yakima MAP	479
WEST VIRGINIA	
Beckley/Raleigh Co Aprt	490
Charleston/Kanawha Aprt	1055
Elkins/Randolph Co Aprt	389
Fairmont	841
Huntington	1098
Martinsburg MAP	922
Parkersburg	1045
Wheeling/Ohio Co Aprt	647
WISCONSIN	
Antigo AFS	318
Badger Ordnance Works	631
Camp McCoy	573
Green Bay/Austin-Straubel	386
La Crosse MAP	695
Madison/Truax Field	460
Milwaukee/Gen Mitchell Fld	450
Oshkosh/Wittman Field	547
Volk Field ANG/Camp Douglas	708
WYOMING	
Casper IAP	458
Cheyenne MAP	327
F E Warren AFB/Cheyenne	327
Lander/Hunt Field	383
Rock Springs	227
Sheridan	446

85/87

STATE / Station	Lat	Long	Elev	Winter Design Heating: Dry Bulb 99%	97.5%	Prvlg Wind	Mean Speed	Degree Days: Heating	Summer Design Data, Air Conditioning: Dry Bulb 1% MCWB		2.5% MCWB		Mean Daily Range	Prvlg Wind	5% MCWB		Wet Bulb 1%	2.5%	5%	Dry Bulb ≥ 93°F	≥ 80°F	≥ 73°F	≥ 67°F
	° '	° '	feet	°F	°F	dir	knots	annual	°F	°F	°F	°F	°F	dir	°F	°F	°F	°F	°F	hrs	hrs	hrs	hrs
WASHINGTON (CONT)	N	W																					
Othello AFS	46 50	119 10	1280	1	7	N	8	5809	97	66	94	65	31	SSW	90	63	67	66	64	97	675	1	52
Paine AFB/Everett	47 55	122 17	596	21	25	ESE	6	5678	80	65	76	64	22	NNW	73	62	67	64	63	1	40	1	30
Pasco/Tri-Cities Aprt	46 16	119 07	406	5	11	WNW	5	4892	99	68	96	67	30	SW	92	66	70	68	67	145	844	5	220
Seattle NSA	47 41	122 15	47	22	27	N	7	4650	85	68	82	66	24	N	78	65	69	67	65	3	120	5	93
Seattle-Tacoma IAP	47 27	122 18	400	21	26	E	9	5185	84	65	80	64	26	N	76	62	66	64	63	3	87	0	22
Spokane IAP	47 38	117 31	2366	-6	2	NE	6	6835	93	64	90	63	30	SW	87	62	65	64	62	32	428	0	12
Tacoma	47 15	122 30	100	19	24	S	5	4835	86	66	82	65	32	NNE	79	63	68	66	64	4	131	0	49
Tatoosh Island	48 23	124 44	115	26	29	E	24	5774	64	58	62	58	9	SW	60	57	60	59	58	0	0	0	0
Walla Walla Aprt	46 06	118 17	1206	0	7	W	5	5187	97	67	94	66	29	W	90	65	69	67	66	98	632	3	109
Whidbey Island/Ault Fld	48 21	122 40	47	19	24	E	4	5520	79	65	76	64	20	N	71	62	67	64	63	1	26	1	30
Whidbey Is/Oak Harbor	48 17	122 39	55	20	24	E	4	5609	82	65	78	64	22	W	74	62	67	64	63	1	53	1	30
Yakima Firing Center	46 41	120 28	1262	-3	4	W	5	6109	95	65	92	65	37	NW	88	63	68	66	65	59	504	1	63
Yakima MAP	46 34	120 32	1052	-2	5	W	5	6009	96	65	93	65	37	NW	89	63	68	66	65	73	566	1	63
WEST VIRGINIA	N	W																					
Beckley/Raleigh Co Aprt	37 47	81 07	2504	-2	4	WNW	9	5615	83	71	81	69	26	WNW	79	69	73	71	70	0	126	41	515
Charleston/Kanawha Aprt	38 22	81 36	939	7	11	SW	8	4590	92	74	90	73	25	SW	87	72	76	75	74	25	744	315	1521
Elkins/Randolph Co Aprt	38 53	79 51	1948	1	6	WNW	9	5975	86	72	84	70	26	WNW	82	70	74	72	71	1	305	64	715
Fairmont	39 28	80 08	1298	4	10	SW	7	5208	94	74	90	73	26	SW	87	72	76	75	74	40	662	258	1221
Huntington	38 25	82 30	565	5	10	N	6	4374	94	76	91	74	27	SW	89	73	78	77	75	47	797	470	1671
Martinsburg MAP	39 24	77 59	556	6	10	WNW	10	5231	93	75	90	74	26	W	88	74	77	76	75	35	684	384	1383
Parkersburg	39 16	81 34	615	7	11	WSW	7	4817	93	75	90	74	23	WSW	88	73	77	76	75	33	736	401	1528
Wheeling/Ohio Co Aprt	40 11	80 39	1196	1	5	WSW	10	5930	89	72	86	71	23	WSW	84	70	74	73	72	5	461	105	886
WISCONSIN	N	W																					
Antigo AFS	45 03	89 14	1530	-22	-15	NNE	7	8460	88	71	84	70	23	SSW	81	68	74	72	70	7	234	44	387
Badger Ordnance Works	43 22	89 45	880	-11	-7	WNW	8	7382	91	74	88	73	24	SSW	85	71	77	75	73	16	466	187	868
Camp McCoy	44 01	90 41	870	-15	-12	NW	8	7558	91	75	88	72	22	SW	85	70	76	74	72	12	482	128	721
Green Bay/Austin-Straubel	44 29	88 08	682	-13	-9	W	8	8098	88	74	85	72	23	SW	83	71	76	74	72	5	286	128	648
La Crosse MAP	43 52	91 15	651	-13	-9	NW	10	7417	91	75	88	73	22	S	85	72	77	75	74	15	469	206	896
Madison/Truax Field	43 08	89 20	858	-11	-7	NW	8	7730	91	74	88	73	24	SW	85	71	77	75	73	16	466	187	868
Milwaukee/Gen Mitchell Fld	42 57	87 54	672	-8	-4	WNW	10	7444	90	74	87	73	23	SSW	84	71	76	74	73	11	346	161	791
Oshkosh/Wittman Field	43 59	88 33	805	-14	-9	WNW	8	7602	89	74	86	72	21	SSW	83	71	76	74	72	9	309	128	648
Volk Field ANG/Camp Douglas	43 56	90 16	915	-15	-12	WNW	8	7773	91	75	88	72	22	SSW	85	70	76	74	72	12	482	128	721

86/87

ICF KAISER ENGINEERS

Job No. 91044-003

Sheet 87 of 87

DRUM TURNING EXHAUST HOOD

DESIGNED BY TJT DATE 3/6/

CHECKED BY DATE

SIZE OPENING FOR DRUM TURNING EXHAUST HOOD

EXHAUST AIR FLOW = 1400 CFM

USE 150 FPM MINIMUM.*

MAX AREA = 1400 CFM / 150 FPM

= 9.33 SQ FT.

WIDTH SIZE = 4.5 FT + 4.5 FT = 9. FT

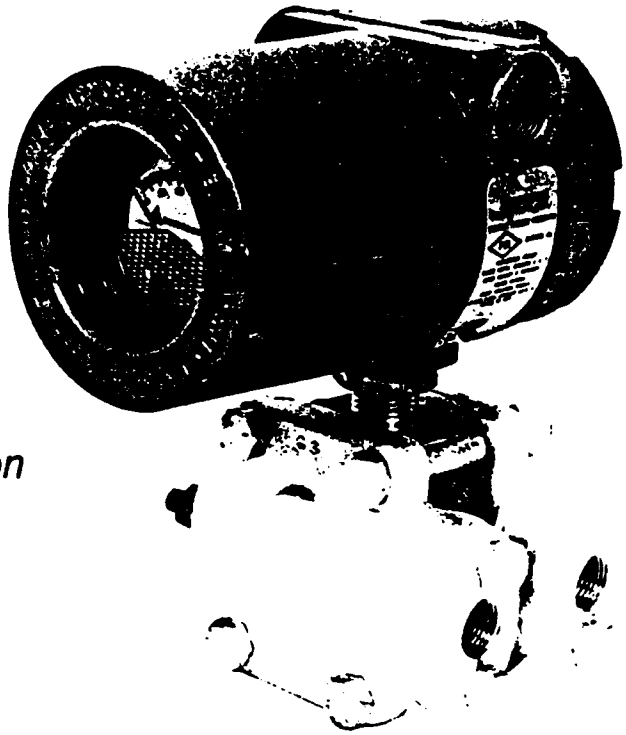
HEIGHT SIZE = 9.33 SQ FT / 9 FT

= 1.04 FT USE 1 FT

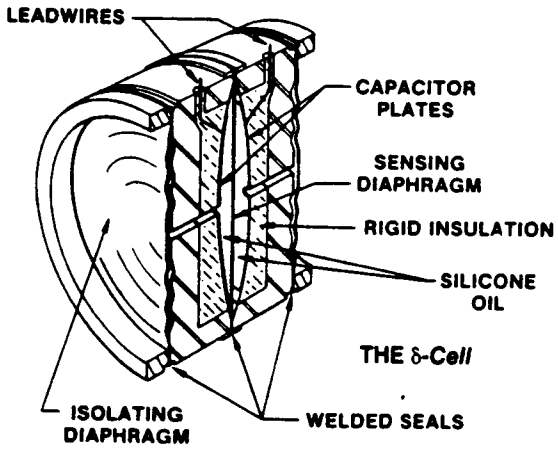
* ACGIH INDUSTRIAL VENTILATION DRAWING VS-203, 150 FPM MAX LAB. HOOD EXHAUST.

CALCULATIONS KE Form No. E-6 Rev. 12-89

MODEL 1151DP ALPHALINE® DIFFERENTIAL PRESSURE TRANSMITTER



Ranges from 0-5 inH_2O to 0-750 inH_2O
Compatible with any 2-wire system
Solid state, plug-in circuit boards
Compact, rugged, impervious to vibration
External span and zero adjustments
0.2% accuracy
Up to 600% elevation and 500% suppression
Adjustable damping



FEATURES

The *Alphaline*® Differential Pressure Transmitter* brings true precision to the measurement of flow, level, low gage pressure, vacuum, and specific gravity. Direct electronic sensing with the completely sealed δ-*Cell*™ capacitance sensing element allows significant improvement in differential pressure measurement. Because mechanical force transfer is eliminated, performance is dramatically improved and problems with shock and vibration are drastically reduced. Welded stress isolation clamping in the sensor housing prevents introduction of errors due to stresses and torques on the process flanges and minimizes effects of line pressure and overpressure to 2000 psi (13.79 MPa).

Installation, calibration, and commissioning are simplified by compact design, external span and zero adjustments, and explosion-proof, weatherproof construction with separate compartments for electronics and wiring connections. Volumetric displacement of less than 0.01 cubic in. (0.16 cm^3) prevents pumping of the process fluid and eliminates the need for condensate chambers and level pots. Tantalum, *Hastelloy C*, and *Monel* are available for corrosive service. Modular construction and plug-in printed circuit boards aid in troubleshooting and reduce parts stocking.

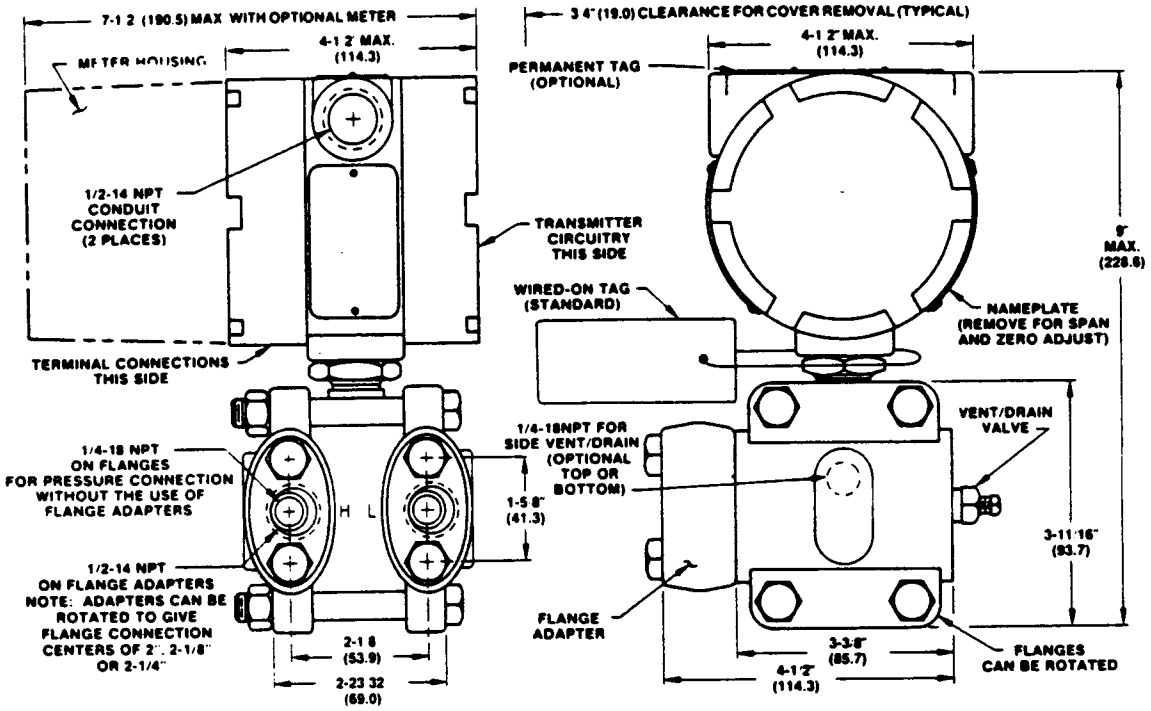
OPERATION

Process pressure is transmitted through isolating diaphragms and oil fill fluid to a sensing diaphragm in the center of the δ-*Cell*. The sensing diaphragm is a stretched spring element which deflects in response to differential pressure across it. The displacement of the sensing diaphragm, a maximum motion of 0.004 in. (0.10 mm), is proportional to the differential pressure. The position of the sensing diaphragm is detected by capacitor plates on both sides of the sensing diaphragm. The differential capacitance between the sensing diaphragm and the capacitor plates is converted electronically to a 2-wire, linear, 4-20 mA dc or 10-50 mA dc signal.

Rosemount®

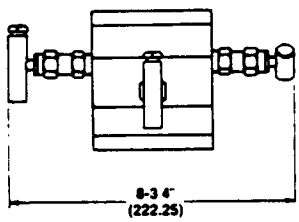
©Rosemount Inc., 1971, 1975, 1976, 1985, 1986.
May be protected by one or more of the following U.S. Patent Nos. 3,618,390; 3,646,538; 3,793,885; 3,800,413; 3,975,719; 4,339,750 and Re. 30,603. CANADA PATENTED (BREVETE) 1974, 1975, 1976 and 1979. May depend on model. Other Foreign Patents Issued and Pending.

DIMENSIONAL DRAWINGS

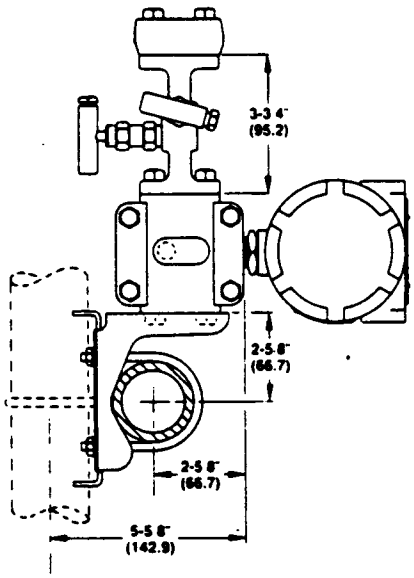


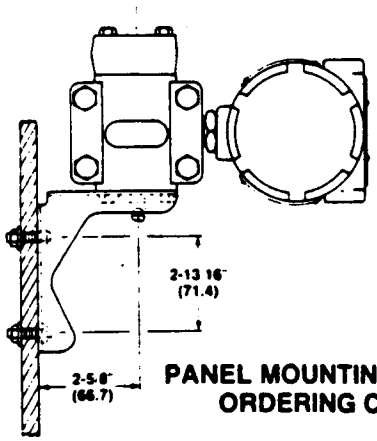
NOTE: MILLIMETERS IN PARENTHESIS

OPTIONAL MOUNTING BRACKETS
SHOWN IN TYPICAL MOUNTING CONFIGURATIONS

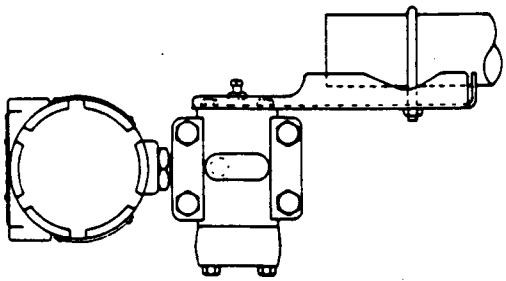


MOUNTING BRACKET ORDERING CODE B1 AND OPTIONAL 3-VALVE MANIFOLD





PANEL MOUNTING BRACKET ORDERING CODE B2



FLAT MOUNTING BRACKET ORDERING CODE B3

NOTE: MILLIMETERS IN PARENTHESIS

SPECIFICATIONS

FUNCTIONAL SPECIFICATIONS

Service

Liquid, gas, and vapor.

Ranges

0-5 to 0-30 inH_2O (0-1.24 to 0-7.46 kPa)
0-25 to 0-150 inH_2O (0-6.22 to 0-37.29 kPa)
0-125 to 0-750 inH_2O (0-31.08 to 0-186.45 kPa)

Outputs

4-20 mA dc or 10-50 mA dc.
Smart 4-20 mA dc (See PDS 2593).

Power Supply

External power supply required.
4-20 mA dc: Transmitter operates on 12 to 45 V dc with no load.
10-50 mA dc: Transmitter operates on 30 to 85 V dc with no load.

Load Limitations

See Figure 1.

Indication

Optional meter with 2.3 in. (58.5 mm) scale.
Indication accuracy is ± 2%.

Hazardous Locations

Factory Mutual (FM) Approvals
Explosion Proof: Class I, Divisions 1 and 2, Groups B, C, and D. Dust-Ignition Proof: Class II, Divisions 1 and 2, Groups E, F, and G. Suitable For Use In: Class III, Divisions 1 and 2. Indoor and outdoor use. NEMA 4X.
Canadian Standards Association (CSA) Approvals
Certified for Class I, Division 2, Groups A, B, C and D; Class I, Division 1, Groups C and D; Class II, Divisions 1 and 2, Groups E, F, and G; Class III hazardous locations; CSA enclosure 4, factory sealed.
Intrinsic Safety Approvals
FM and CSA certifications optional for specific Classes, Divisions, and Groups when connected with approved barrier systems. See summary in PDS 2360.

FM explosion proof tag is standard. Appropriate tag will be substituted if optional certification is selected.

Span and Zero

Continuously adjustable externally.

Zero Elevation and Suppression

Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit.

Maximum zero elevation is 600% of calibrated span. Maximum zero suppression is 500% of calibrated span.

Temperature Limits

−20 to +200 °F (−29 to +93 °C) Amplifier operating.
−40 to +220 °F (−40 to +104 °C) Sensing element operating with silicone fill.
+32 to +160 °F (0 to +71 °C) Sensing element operating with inert fill.
−60 to +250 °F (−51 to +121 °C) Storage.

Static Pressure and Overpressure Limits

0 psia to 2000 psig (0 to 13.79 MPa) on either side without damage to the transmitter.
Operates within specifications between static line pressures of 0.5 psia and 2000 psig (3.44 kPa to 13.79 MPa) for silicone oil transmitters, and between atmospheric and 2000 psig (13.79 MPa) for inert fill transmitters.
10,000 psig (68.95 MPa) proof pressure on the flanges.

Humidity Limits

0 to 100% relative humidity.

Volumetric Displacement

Less than 0.01 cubic in. (0.16 cm^3).

Damping

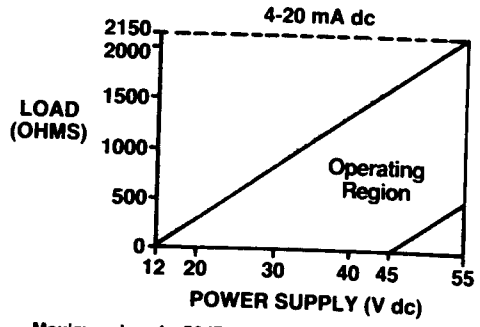
Time constant continuously adjustable between 0.2 and 1.67 seconds with silicone fill.

Inert fill: Higher time constant.

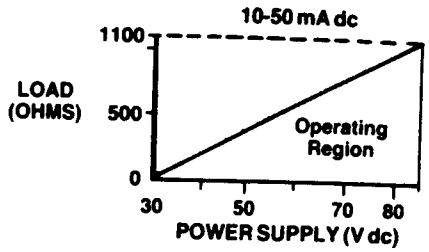
Turn-on Time

2 seconds. No warmup required.

FIGURE 1
LOAD LIMITATIONS



Maximum Load = 50 (Power Supply Voltage − 12)



Maximum Load = 20 (Power Supply Voltage − 30)

PERFORMANCE SPECIFICATIONS

(Zero based spans, reference conditions, silicone oil fill, 316 SST isolating diaphragms)

Accuracy

± 0.2% of calibrated span. Includes combined effects of linearity, hysteresis and repeatability.

Linearity

± 0.1% calibrated span.

Hysteresis

0.05% of calibrated span (0.1% for Range 5).

Dead Band

None.

Stability

± 0.2% of upper range limit for 6 months.

Temperature Effect

At maximum span: e.g., 0-150 inH_2O (0-37.29 kPa) for Range 4.
Zero Error: ± 0.5% of span per 100 °F (55 °C).
Total effect including span and zero errors: ± 1.0% of span per 100 °F (55 °C).
Note: Double the specified effect for Range 3.

At minimum span: e.g., 0-25 inH_2O (0-6.22 kPa) for Range 4.
Zero Error: ± 3.0% of span per 100 °F (55 °C).
Total effect including span and zero errors: ± 3.5% of span per 100 °F (55 °C).
Note: Double the specified effect for Range 3.

Static Pressure Effect

Zero Error: ± 0.25% of upper range limit for 2000 psi (13.79 MPa). ± 0.5% for Range 3. Correctable through rezeroing at line pressure.
Span Error: Correctable to ± 0.25% of reading per 1000 psi (6.9 MPa), or to ± 0.5% of reading per 1000 psi (6.9 MPa) for Range 3.

Vibration Effect

± 0.05% of upper range limit per g to 200 Hz in any axis.

Power Supply Effect

Less than 0.005% of output span per volt.

Load Effects

No load effect other than the change in power supplied to the transmitter.

Mounting Position Effect

Zero shift of up to 1 inH_2O (0.24 kPa) which can be calibrated out. No span effect. No effect in plane of diaphragm.

PHYSICAL SPECIFICATIONS

Materials of Construction†

Isolating Diaphragms
316L SST, *Hastelloy C-276, Monel* or tantalum.

Drain/Vent Valves
316 SST, *Hastelloy C*, or *Monel*.

Process Flanges and Adapters
Nickel or cadmium-plated carbon steel, 316 SST, *Hastelloy C*, or *Monel*.

Wetted O-rings
Viton. (Other materials also available)

Fill Fluid
Silicone oil or inert fill.

Bolts and Conduit Plug
Cadmium-plated carbon steel.

Electronics Housing
Low-copper aluminum. NEMA 4X.

Paint
Epoxy-polyester.

Process Connections

1/4 NPT on 2-1/8 in. (5.4 cm) centers on flanges. 1/2 NPT on 2 (5.08 cm), 2-1/8 (5.4 cm), or 2-1/4 in. (5.72 cm) centers with adapters.

Electrical Connections

1/2 in. conduit with screw terminals and integral test jacks compatible with miniature banana plugs (*Pomona 2944, 3690* or equal).

Weight

12 pounds (5.44 kg) excluding options.

δ-Cell, Alphaline, and Rosemount are registered trademarks of Rosemount Inc.
Terminology per SAMA Standard PMC20.1-1973.
†Monel is a trademark of International Nickel Co.
Hastelloy is a trademark of the Cabot Corp.
Viton is a trademark of E.I. Du Pont de Nemours & Co.

SP

FU

Ser
Liqu

Rar
0-5
0-2
0-1

Out
4-2
Sm

Pov
Ext
4-2
loa
10-
no l

Loa
See

Ind
Opt
Indi

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pre
or lc
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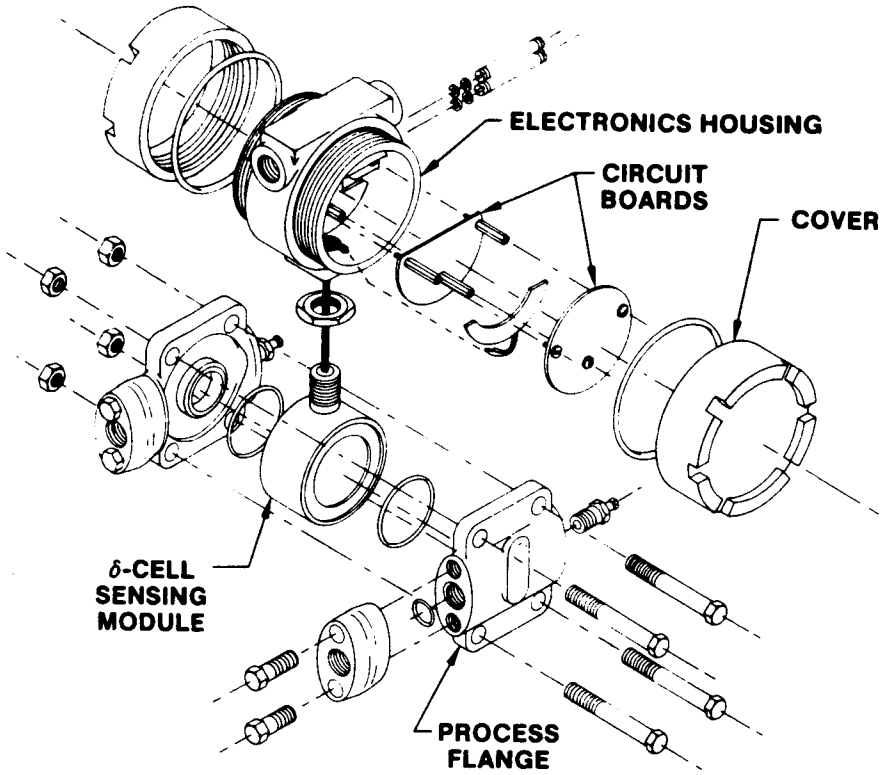
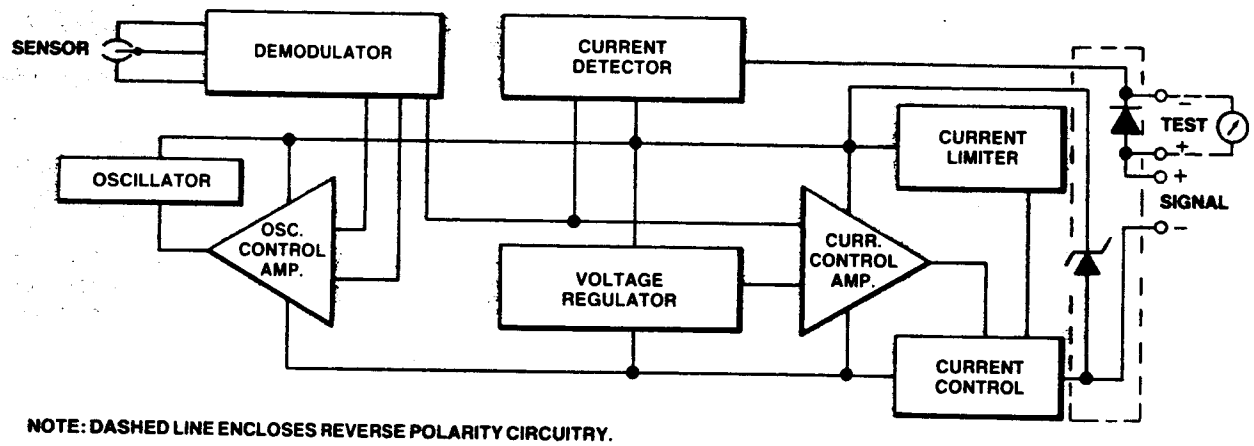
Max

TYPICAL MODEL 1151 PRESSURE TRANSMITTER ASSEMBLY

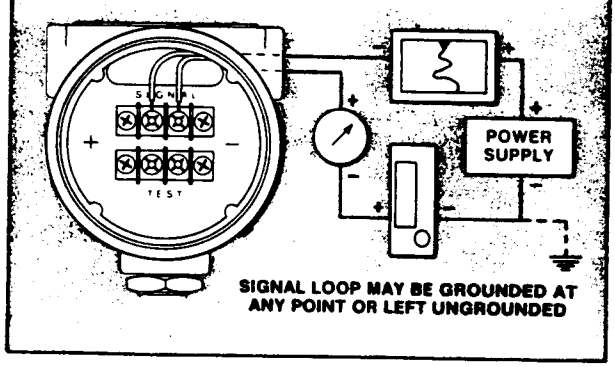


ELECTRICAL BLOCK DIAGRAM



NOTE: DASHED LINE ENCLOSES REVERSE POLARITY CIRCUITRY.

WIRING CONNECTIONS



Standard Accessories

All models are shipped with flange adapters, vent/drain valves and one instruction manual per shipment.

Tagging

*Alphaline** Differential Pressure Transmitters will be tagged in accordance with customer requirements. Customer tag is 0.018 in. (0.051 cm) thick with 0.125 in. (0.318 cm) high letters. All tags are stainless steel.

Calibration

Transmitters are factory calibrated to customer's specified range. If calibration is not specified, transmitters are calibrated at maximum range. Calibration is at ambient temperature and pressure.

ORDERING INFORMATION

MODEL 1151DP	ALPHALINE® DIFFERENTIAL PRESSURE TRANSMITTER

CODE	RANGES
3	0-5 to 0-30 inH_2O (0-1.24 to 0-7.46 kPa) 0-.18 to 0-1.08 PSI
4	0-25 to 0-150 inH_2O (0-6.22 to 0-37.29 kPa) 0-.9 to 0-5.4 PSI
5	0-125 to 0-750 inH_2O (0-31.08 to 0-186.45 kPa) 0-4.5 to 0-27.0 PSI

CODE	OUTPUT
E	4-20 mA dc with adjustable damping
G	10-50 mA dc with adjustable damping
S	1151 SMART 4-20 mA dc electronics (See 1151 PDS 2593)

CODE	MATERIALS OF CONSTRUCTION* FLANGES AND ADAPTERS	DRAIN/VENT VALVES	ISOLATING DIAPHRAGMS	FILL FLUID
12	Cadmium-Plated CS	316 SST	316L SST	Silicone
53	Nickel-Plated CS	316 SST	*Hastelloy C-276*	Silicone
54	Nickel-Plated CS	316 SST	*Monel*	Silicone
55	Nickel-Plated CS	316 SST	Tantalum	Silicone
22	316 SST	316 SST	316L SST	Silicone
23	316 SST	316 SST	*Hastelloy C-276*	Silicone
24	316 SST	316 SST	*Monel*	Silicone
25	316 SST	316 SST	Tantalum	Silicone
33	*Hastelloy C*	*Hastelloy C*	*Hastelloy C-276*	Silicone
35	*Hastelloy C*	*Hastelloy C*	Tantalum	Silicone
44	*Monel*	*Monel*	*Monel*	Silicone
83**	Nickel-Plated CS	*Hastelloy C*	*Hastelloy C-276*	Silicone
73**	316 SST	*Hastelloy C*	*Hastelloy C-276*	Silicone
1A	Cadmium-Plated CS	316 SST	316L SST	Inert Fill
2A	316 SST	316 SST	316L SST	Inert Fill
5B	Nickel-Plated CS	316 SST	*Hastelloy C-276*	Inert Fill
2B	316 SST	316 SST	*Hastelloy C-276*	Inert Fill
3B	*Hastelloy C*	*Hastelloy C*	*Hastelloy C-276*	Inert Fill
5D	Nickel-Plated CS	316 SST	Tantalum	Inert Fill
2D	316 SST	316 SST	Tantalum	Inert Fill
3D	*Hastelloy C*	*Hastelloy C*	Tantalum	Inert Fill
8B**	Nickel-Plated CS	*Hastelloy C*	*Hastelloy C-276*	Inert Fill
7B**	316 SST	*Hastelloy C*	*Hastelloy C-276*	Inert Fill

CODE	OPTIONS (See Product Data Sheet 2360 for additional options)
M1	Linear Meter, 0 to 100% scale
M2	Square Root Meter, 0 to 100% flow
M3	Special Scale Meter, specify range desired
B1	Mounting Bracket for mounting to 2 inch pipe
B2	Mounting Bracket for panel mounting
B3	Flat Mounting Bracket for mounting to 2 inch pipe
D1	Side Vent/Drain, Top
D2	Side Vent/Drain, Bottom
E6	Canadian Standards Association (CSA) Approvals. Certified for Class I, Division 2, Groups A, B, C, and D; Class I, Division 1, Groups C and D; Class II, Divisions 1 and 2, Groups E, F, and G; Class III hazardous locations; CSA enclosure 4; factory sealed.
I5	Factory Mutual (FM) Non-incendive, and Intrinsic Safety Approval (both system and entity concepts). Intrinsic safety approval requires connection with approved barrier systems in accordance with Rosemount drawing 1151-0214. See summary in PDS 2360. (Available with Output Code E only.)
I6	Canadian Standards Association (CSA) Intrinsic Safety Approval when connected with approved barrier systems. See summary in PDS 2360. (Available with Output Code E only.)
--	Other Options. Note: Insert the appropriate option codes to specify any of the additional options described in PDS 2360.

1151DP	4	E	12	M1B1	← TYPICAL MODEL NUMBER

*NOTE: Bolts and conduit plug are plated carbon steel.
**Meets NACE material recommendations per MR 01-75.

ADDITIONAL OPTIONS

All series 1151 transmitter options are described in Product Data Sheet 2360. These include optional materials, outputs, tests, etc. Any appropriate option code can be added to the basic model number.

ACCESSORY 3-VALVE MANIFOLD (Packaged Separately)

Part No. 1151-150-1: 3-Valve Manifold, Carbon Steel
(Anderson, Greenwood & Co., M4AVC).

Part No. 1151-150-2: 3-Valve Manifold, 316 SST with carbon steel bolts
(Anderson, Greenwood & Co. M4AVS).

Other Series 1151 Pressure Transmitter Product Data Sheets:

PDS2257: 1151DP High Differential Pressure
PDS2258: 1151HP High Line Pressure Differential
PDS2259: 1151DP Square Root Differential Flow
PDS2260: 1151GP Gage Pressure
PDS2261: 1151AP Absolute Pressure
PDS2262: 1151LT Liquid Level
PDS2294: 1151DR Draft Range Differential Pressure
PDS2360: 1151 Pressure Transmitter Options
PDS2394: 1151DP & 1151GP Remote Seals

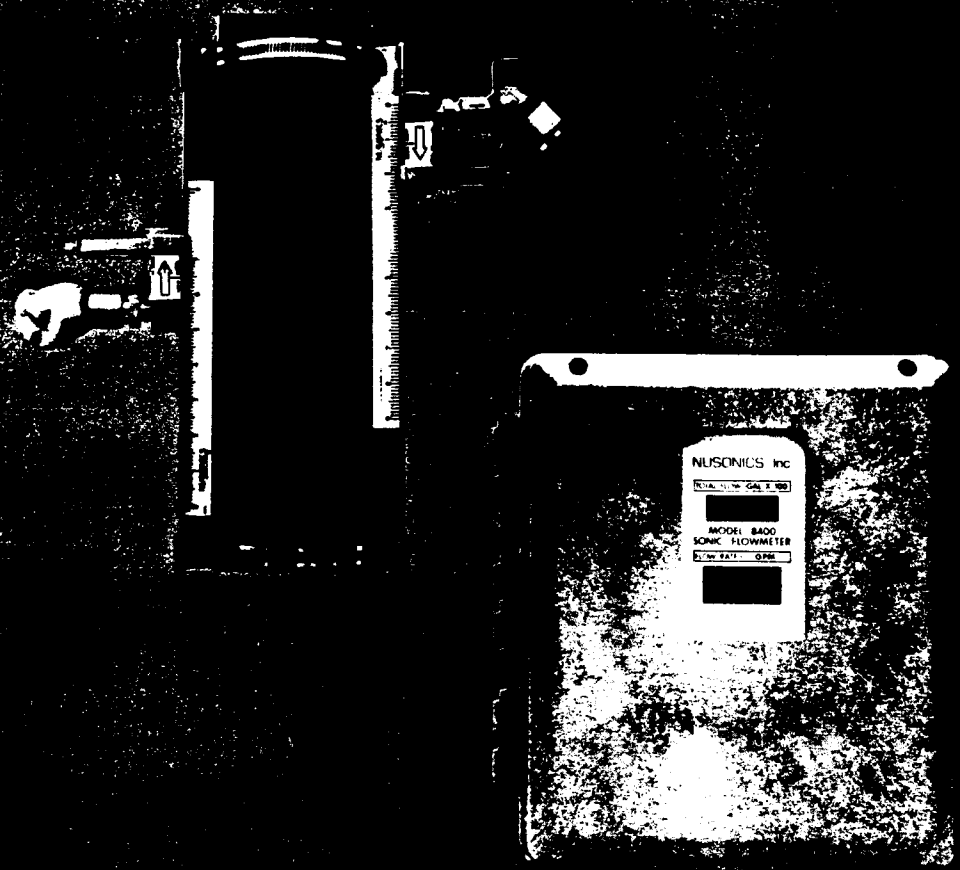
Rosemount Inc. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MINNESOTA 55344 U.S.A.

PHONE: (612) 941-5560 TELEX: 4310024, 4310012 CABLE: ROSEMOUNT

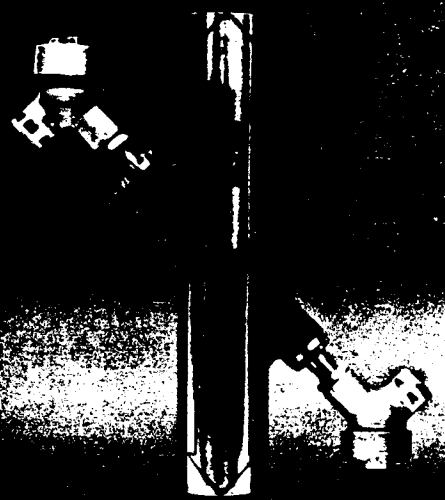
Revised 10/87

NUSONICS INC.

SFM-2016 (3/88)



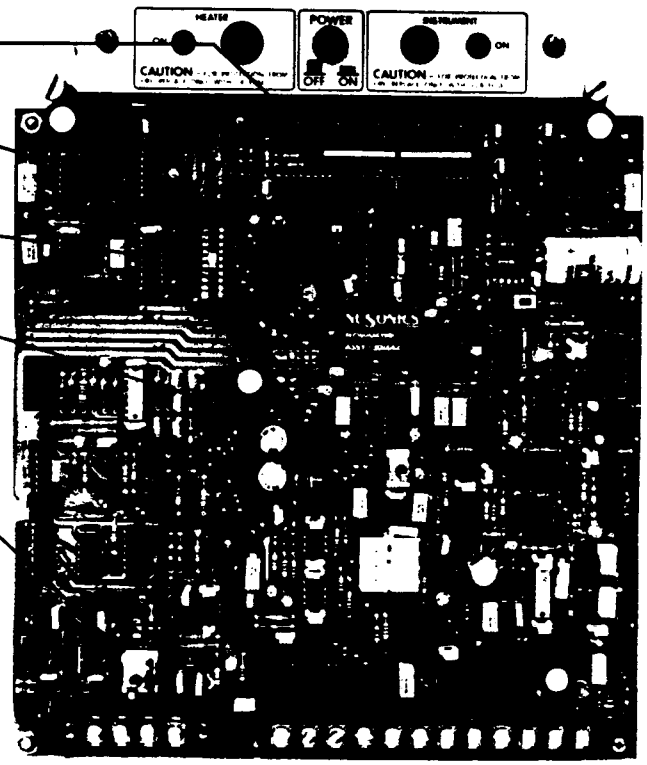
- WETTED OR STRAP-ON TRANSDUCERS
- ± 1% OF READING TYPICAL ACCURACY
- GREATER THAN 100:1 TURNDOWN
- FULL PERFORMANCE TO 0.5 FEET/SEC
- ECONOMICAL "KIT" INSTALLATION
- EASILY ZEROED UNDER FLOW CONDITIONS
- TIME-PROVEN . . . THE ECONOMICAL FLOWMETERING CHOICE

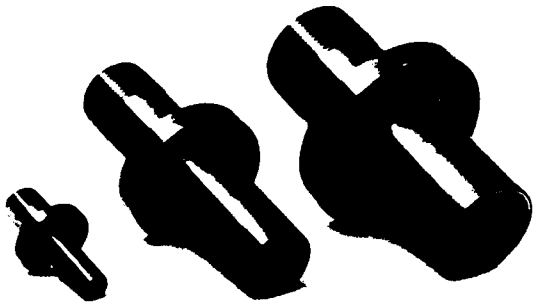


MODEL 8400
TRANSIT-TIME SONIC FLOWMETER

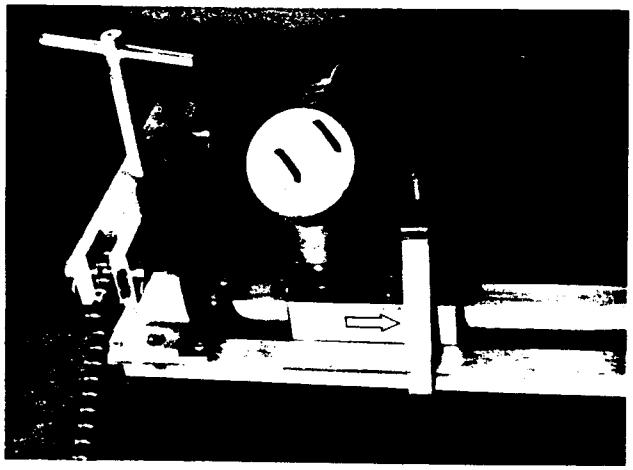
11391 E. Tecumseh St. • Tulsa, OK 74116-1602
Phone: (918) 438-1010 • Telex: 49-7592
FAX: (918) 438-6420

MODEL 8400 MAIN BOARD





STANDARD SEAL-FREE REMOVABLE TRANSDUCERS



STRAP-ON TRANSDUCERS

The latest addition to NUSONICS' family of transit-time sonic flowmeters, the Model 8400 combines the best features of its predecessors in a single package:

- **Basic flowmeter on a single printed-circuit board.**

  This design offers significant cost advantages over multiple-card designs. Multiple-card meters usually have controls located at the card edge; since the Model 8400 PCB is mounted flat in the enclosure, all controls are easily accessible and clearly labeled.

- **Extended operating range**

  The Model 8400 operates over a flow velocity range of 0.5 to 50.0 feet per second. In some applications, flow measurement may be made to as low as 0.2 ft/sec

- **Display options**

  In addition to standard pulse and current outputs, the user may specify visual displays of flowrate (scalable to any units) and totalized flow for liquid crystal displays (LCD) mounted on the enclosure door.

- **Virtually Maintenance-Free**

  Since the Model 8400 has no moving parts, there is no wear. Unlike mechanical flowmeter types, periodic maintenance is unnecessary, and the life of the flowmeter is far greater than mechanical types. Also, output drift associated with wear is

Flowmeter Components

The Model 8400 consists of two major elements: the transmitter,or electronics, housed in an enclosure, and a set of transducers mounted on the pipe. Standard transmitters are provided in NEMA 4X (thermoplastic) enclosures, with explosion-proof NEMA 7 enclosures optional. The transmitter may also be equipped with a heater/thermostat, which permits operation below -10°C (+14°F) to as low as -60°C(-76°F).

The transmitter and transducers are connected by 25 feet of signal cable, provided by NUSONICS. In some instances, cable length may be extended to 100 feet.

Flowmeter transducers are available in two configurations, strap-on or wetted. The standard transducer is the wetted style.

Wetted Transducers

NUSONICS wetted transducers are a unique, seal-free all-metal design, which minimizes the potential for transducer damage due to corrosion or environmental exposure. They are mounted via an integral flange to weld bosses which are aligned on either side of the pipe, and are available in three sizes, 1/2", 1" and 2" diameter. Generally, 1/2" transducers are provided for 2-6" pipe sizes, 1" transducers for 8-24" pipes and 2" transducers are recommended for pipes greater than 24" in diameter. In some applications such as clean water, the 1" transducer may be employed beyond 24".

Wetted transducers may be provided in factory-fabricated flowtubes, or in kit form for installation in an existing line. The latter is especially economical at larger pipe sizes, or for non-metallic pipe materials.

Our saddle plate design allows the user to employ wetted transducers on concrete pipes, where it is not possible to weld a mounting boss to the pipe wall, or to insert a factory flowtube.

Titanium is the standard material of construction for wetted transducers. Other available materials include 316 stainless steel, Hastelloys B and C, Carpenter 20, zirconium and PVC.

Strap-On Transducers

Unequalled in ease of installation and flexibility of application, Strap-on transducers are a convenient alternative to the wetted design.

Installation is accomplished in several easy steps — the entire process typically requires less then 30 minutes. Since the transducers are strapped to the outside of the pipe, the integrity of the pipe is maintained, there is no pressure loss and no possibility of corrosion damage .

Strap-on transducers are ideal for locations where conditions or code prohibit installation of wetted transducers, or in instances where the line cannot be shut down for installation. They are easily relocated to other pipes, and operate on many pipe materials, including carbon and stainless steels, ductile iron, brass, copper, PVC, glass, and some cast irons.

The transducers are mounted on a set of rails which strap to the sides of a pipe, and their locations on the rails can be changed in order to maximize the signal. Each rail includes a scale by which transducer location is determined. Installation simply involves securing the rails to the sides of the pipe, the removal of surface paint with a sanding block (provided), and the application of coupling grease to the transducer location points.

Strap-on transducers are suitable for horizontal, vertical or inclined pipes, and sense flow equally well in either forward or reverse directions.

Output and Display

The basic output of the Model 8400 transmitter is a stream of 5-volt pulses, the frequency of which is proportional to flowrate. A current output (4-20 mA or 0-20 mA) is also standard. Both outputs are isolated.

Also included are two 5-volt logic level outputs, one to indicate change in flow direction and another to indicate loss of "lock", or signal synchronization (failure indication).

Optional LCD displays of flowrate and totalized flow are available. The LCD panel mounts to the door of the transmitter enclosure.

The flowrate display is a 3 1/2-digit LCD. Typically, the LCD is factory-preset to units specified by the customer, but the display may be easily rescaled in the field.

The totalizer option includes the totalizer circuitry which resides on the main board, and a 6-digit LCD display of totalized volume in any desired units. The totalizer indication is non-volatile, battery-backed at all times. Hence, when main power is interrupted, the display is maintained. It will retain the last totalized reading for the life of the battery, typically five years or longer. Meter factor switches on the main board allow the user to change the volumetric units which are totalized.

The LCD counter may be provided integral to the transmitter (door-mounted) or separately, for remote mounting. A factored pulse output is provided in conjunction with remote mounting of the counter.

Controls

"Dynamic" Zeroing (Wetted Transducers)

The Model 8400 is provided factory calibrated and "zeroed", such that outputs indicate zero (or 4 mA) under no-flow conditions, and outputs at a given flowrate are the same regardless of direction of flow. However, when changing transducers, installing flowmeter kits, or when moving the meter to a different size flowtube, zeroing is recommended.

Under constant flow conditions, the user simulates bidirectional flow by changing positions of a forward/reverse switch on the main board. By simply observing output for each "direction", a one-step adjustment is made to zero the meter.

A zero LED (light-emitting diode) on the main board may also be used to determine when the meter is zeroed under no-flowconditions.

"Fail-Safe" Mode

When prohibitive amounts of entrained solids or gases are present, meter operation may be interrupted. When such a condition occurs, the meter will deliver the last valid flow output for 60 seconds, then drive the outputs to zero (4 mA) or to full scale (at the user's option) in order to indicate this condition.

A "lock" LED on the main board illuminates when the unit is synchronized and operating properly.

Calibration and Flowtube Size

Though provided factory-scaled to accommodate flowrate ranges specified by the user, the Model 8400 includes controls which enable the user to rescale the basic output of the Model 8400 to a different maximum flowrate, if desired.

Often, rescaling is done in conjunction with changing the location of the flowmeter. When this involves moving the meter to a different size pipe, the new size is selected with an on-board switch.

Applications and Performance

The Model 8400 is well-suited for a variety of liquid applications. Generally, entrained solids and/or gases should be minimized, although small amounts can be tolerated. For example, liquids such as sewage influent and industrial wastewater which frequently contain significant amounts of solids are normally good applications for the Model 8400 with standard transducers.

Clean liquids such as potable water, or liquids such as river or lake water that contain primarily dissolved solids are excellent applications. The strap-on transducer design is especially suited for metering in chemical plant or industrial environments, where liquids are in many cases corrosive and its non-contact design offers unique maintenance and safety advantages. Example applications include many acids and bases, and almost all organic chemicals/solvents. Either transducer design is suitable for hydrocarbons such as gasoline, kerosine, crude oil, etc.

In most applications, NUSONICS Model 8400 offers ±1% of **reading** accuracy at all flowrates greater than 1 ft/sec with the wetted transducer design. Calibration tests conducted by an independent lab have shown that this error band may apply to rates as low as 0.5 ft/sec. Error bands of ±0.5% of rate above 1 ft/sec have been recorded. The Model 8400 with strap-on transducers delivers typical accuracies of ±1 to 3% of reading, by comparison.

Some manufacturers use the term "percent of full scale" rather than percent of reading to describe flowmeter accuracy. There is a significant difference between the two; 1% of reading insures an error within plus or minus 1% of actual rate over an entire range, while, for a 10:1 turndown range, "1% of full scale" is equivalent to ±10% of reading at minimum flow!

Where meter accuracy is a primary requirement, the wetted transducer should be strongly considered. However, when ease of installation, and non-invasive design are the main considerations, strap-on transducers should be specified.

SPECIFICATIONS

OUTPUTS:

Standard	Analog, 4-20 mA (isolated) forward and reverse, into 800 ohms or less Unfactored pulse, 5-volt (isolated) from 3300 ohm source Fault relay, SPST, 0.5 amp resistive, max. switching current. 100 VDC max. switching voltage.
Optional	Factored pulse, 26-volt (non-isolated), 8.3 ms duration, 40 ohm source max. current 130 mA to drive 24 VDC counter. —OR— 5-volt (non-isolated), 8.3 ms duration from 1000 ohm source to drive TTL load

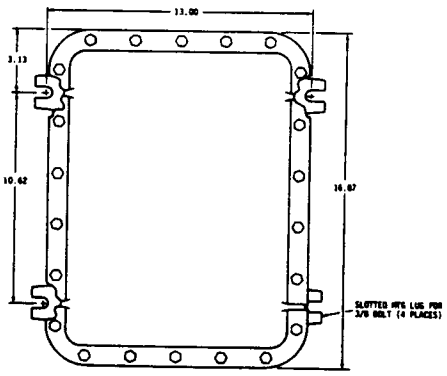
POWER:

Supply	115 or 230 (±10%)VAC, 50 to 60 Hz
Consumption	12 watts standard, 212 watts w/ optional heater

Liquid Temperature	-40°C(-40°F) to +150°C(+302°F), higher range optional
Liquid Pressure	1000 psig maximum standard, higher range optional
Ambient Temperature	-10°C(+14°F) to +60°C(+140°F) at transmitter (std.) -60°C(-76°F) to +60°C with optional heater

OPTIONAL DISPLAYS:

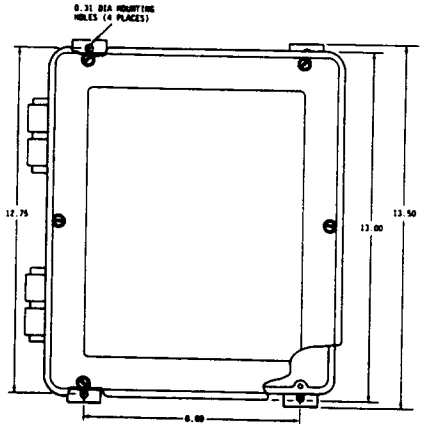
Rate	3½ digit LCD
Totalizer	6 digit LCD, resettable, nonvolatile (battery-backed)

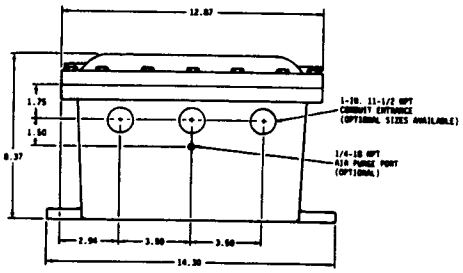


ENCLOSURE OUTLINE DRAWINGS
(Dimensions in Inches)

OPTIONAL NEMA 7 (EXPLOSION PROOF) ENCLOSURE

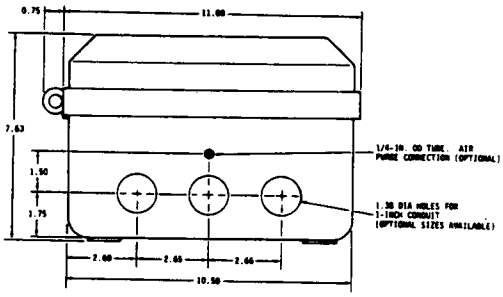
Weight: 46 lbs.





STANDARD NEMA 4X ENCLOSURE

Weight: 10 lbs.



NUSONICS INC.

ENGINEERING SPECIFICATIONS

MODEL 8400 FLOWMETER
SONIC FLOWMETER SPECIFICATIONS

8400SPEC 8/87

GENERAL REQUIREMENTS

The flowmeter shall be of the general classification SONIC FLOWMETER. It shall consist of a primary element, flowtube and transmitter. The flowmeter shall be a Model 8400 as manufactured by NUSONICS, Inc., or approved equal.

PRIMARY ELEMENT

The primary element shall employ a single pair of electroacoustic transducers mounted diagonally in a flowtube. When installed, the flowtube shall be positioned in the manner suggested by the manufacturer to achieve optimum performance and reliability.

The electroacoustic transducer elements shall be mounted within an all-metal housing, completely isolating the measured fluid from the transducer. The housing shall be of a design that is free of O-ring and gasket seals except for one at the mounting flange.

The transducer faces shall be parallel to and directly facing each other to avoid refraction of sonic pulses and the attendant error.

The transducers shall be mounted in such a way as to take advantage of natural liquid circulation to keep them relatively clean. Performance shall not be degraded by normal grease build-up.

The electroacoustic transducer elements shall be removable for service or inspection without drainage or depressurization of the pipe.

FLOWTUBE

The flowtube shall be of _____-inch diameter, with material of construction to match piping.

TRANSMITTER ELECTRONICS

The transmitter electronics shall be mounted in a NEMA 4X enclosure with optional viewing window. The electronics shall be connected to the transducers by _____ feet of cable. The electronic circuit boards shall be conformally coated for moisture and fungus protection.

The electronics shall incorporate built-in protection against AC line transients and lightning spikes.

The electronics shall have provisions to reject external electrical noise and operate satisfactorily despite momentary blockage of the acoustic path between transducers.

Two (2) output signals proportional to flow rate shall be provided as follows:

1. Isolated 5-volt DC rectangular pulses into 1000 ohms or greater.
2. Isolated 4-20 mA current for loads of up to 800 ohms.

The following shall be incorporated in the flowmeter electronics:

— Dynamic zeroing switch to permit zeroing of the meter under flow conditions.

— Flowrate calibrator and scaling frequency switches.

— Flowtube size selector switch.

— A fail-safe mode selector switch which, at the user's option, drives the meter output to zero or to full scale 60 seconds after signal interruption.

— Forward/reverse flow signal.

— Diagnostic LED's.

OPTIONS AVAILABLE

1. A 3½-digit LCD display for flowrate.
2. A 6-digit local LCD display of totalized flow. The totalizer shall be non-volatile and supplied with 5-year battery backup.
3. A 6-digit remote electromechanical totalizing counter.
4. A 24-volt DC factored pulse output.

METER ACCURACY

Meter accuracy shall be +/– 1% of actual flow for velocities over 1 foot/second, and Reynolds numbers greater than 100,000, with the meter located in straight, unobstructed piping extending at least 10 pipe diameters upstream and three diameters downstream of a "tee" or 90° elbow.

The flowmeter system shall be factory tested and calibrated. A calibration report shall be provided with the system.

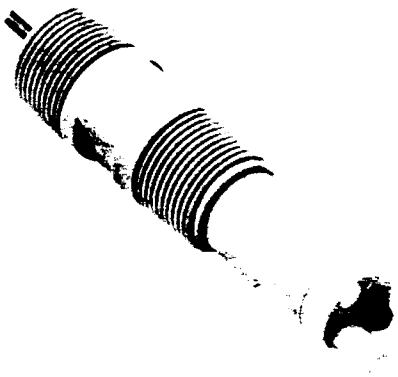
Printed in U.S.A.

11391 E. Tecumseh St., Tulsa OK 74116-1602 Phone: (918) 438-1010 Telex: 49-7592 FAX: 918-438-6420

Rosemount® Analytical

Model 399
Combination pH/ORP Sensor

- *DISPOSABLE DESIGN provides convenience and economical advantages where minimal troubleshooting and maintenance downtime are of prime importance.*
- *CHEMICALLY RUGGED "KYNAR"[1] BODY provides maximum resistance and is completely sealed to eliminate sensor leakage.*
- *DOUBLE JUNCTION REFERENCE CELL ensures longer sensor life in process solutions containing poisoning ions.*



FEATURES

The Uniloc® Model 399 Sensor measures the pH or the Oxidation Reduction Potential (ORP) of aqueous solutions in pipelines, open tanks, or ponds. It is suitable for virtually all pH/ORP applications where a low cost, disposable sensor is required. The combination electrode features a peripheral ceramic junction constructed in an annular design around the pH/ORP sensitive membrane. The double junction reference cell configuration ensures longer life in process solutions containing ammonia/chlorine, cyanides/sulfides or other poisoning ions.

The sensor is housed in a molded KYNAR (PVDF) body with Viton[2] O-rings, making it virtually indestructable and chemical resistant. Complete encapsulation eliminates leakage or high humidity problems traditionally found in other pH/ORP designs. The simplified construction, designed with user convenience in mind, does not require electrolyte (KCl) replenishment or any high maintenance troubleshooting procedures.

The Uniloc pH/ORP method features an integral preamplifier to convert the high impedance pH or ORP mV signal into a stable, noise-free signal with transmission capability of up to three miles. The Uniloc method has become the industry standard for pH/ORP measurement reliability.

Installation versatility is easily achieved through the wide variety of mounting configurations. The Model 399 features 1-inch (MNPT), front and rear facing connections for insertion, submersion or flow through pH applications.

PHYSICAL SPECIFICATIONS

Materials of Construction:
Glass filled KYNAR (PVDF), glass, ceramic and VITON

Process Connections:
1-inch MNPT

Interconnecting Cable:
5 conductor, 10 feet cable undressed

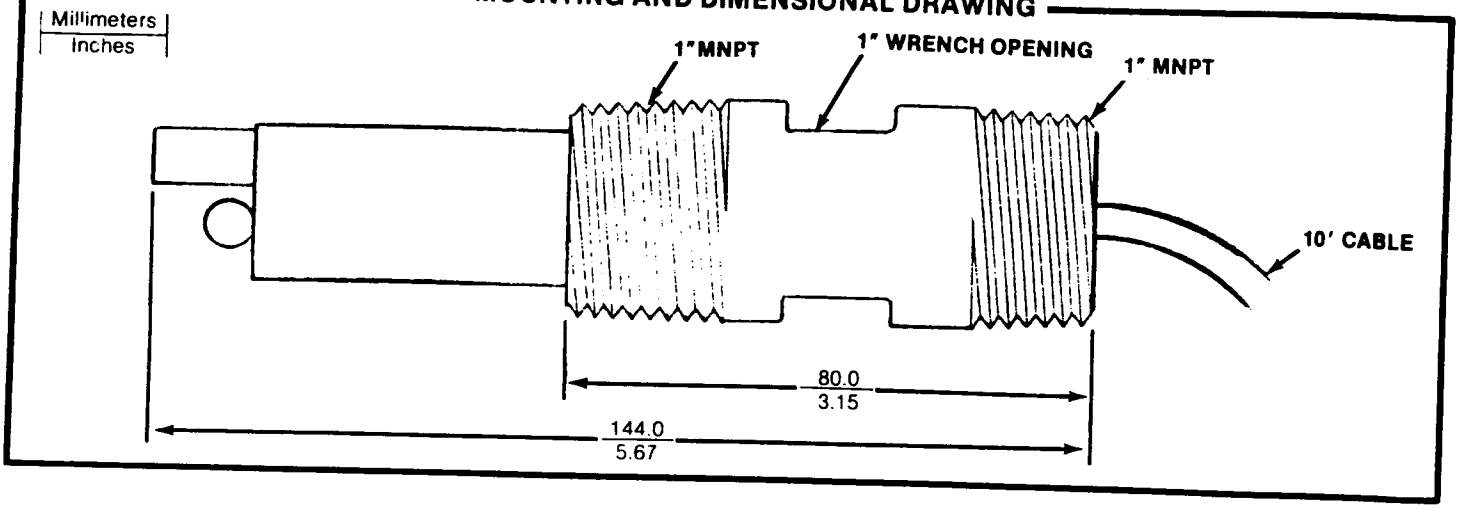
Temperature Compensation:
Automatic 0 to 85°C (32° to 185°F)
Temperature compensation is not required for 399 ORP when used with Uniloc Models 1060, 1023 or 1181ORP.

Maximum Pressure:
690 kPa (100 psig) at 65°C (see Graph A)

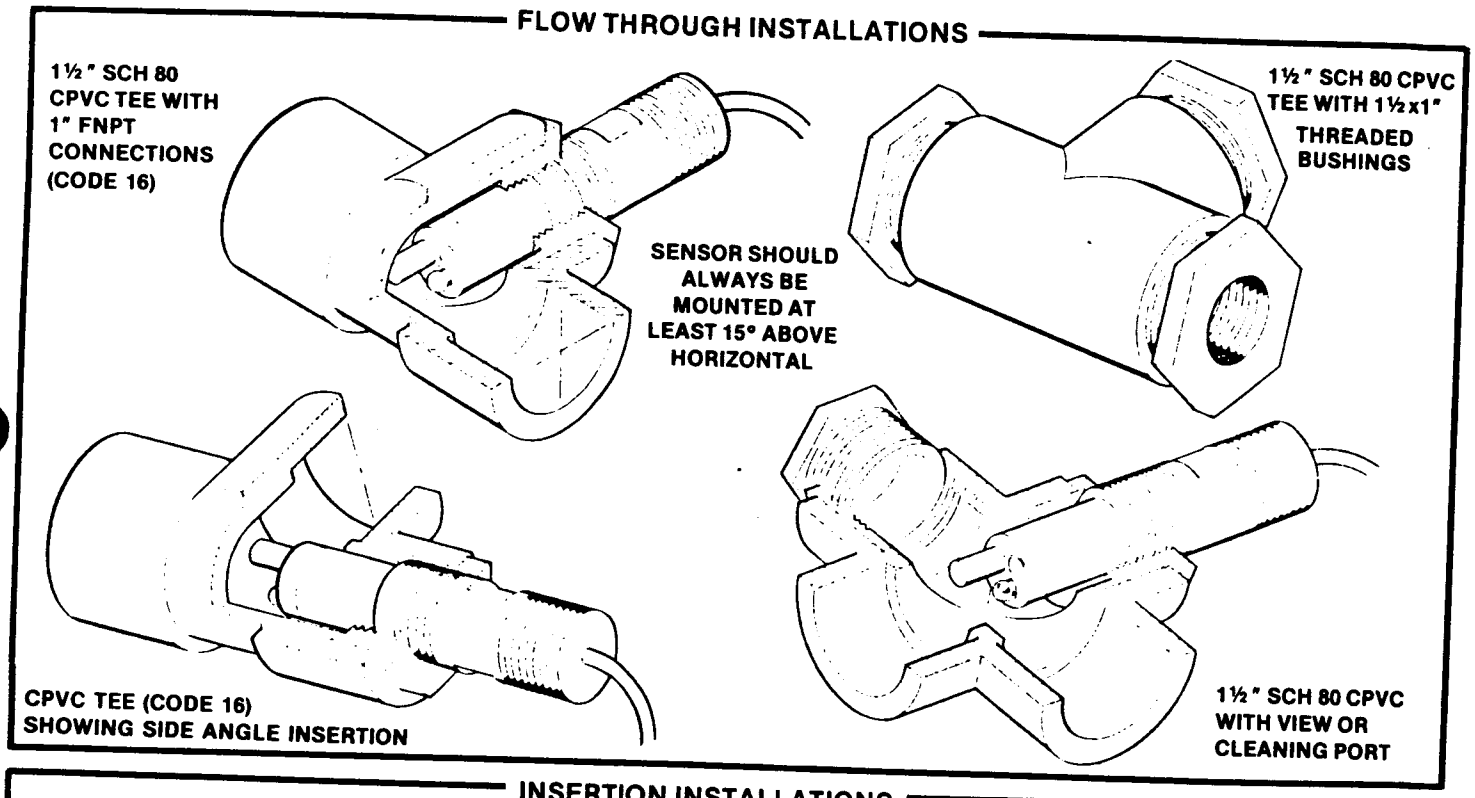
Weight/Shipping Weight:
0.45 kg/0.9 kg (1 lb./2 lbs.)

[1]Reg. U.S. Pat. Office for Pennwalt's polyvinylidene fluoride.
[2]Reg. U.S. Pat. Office for DuPont's fluoroelastomer.

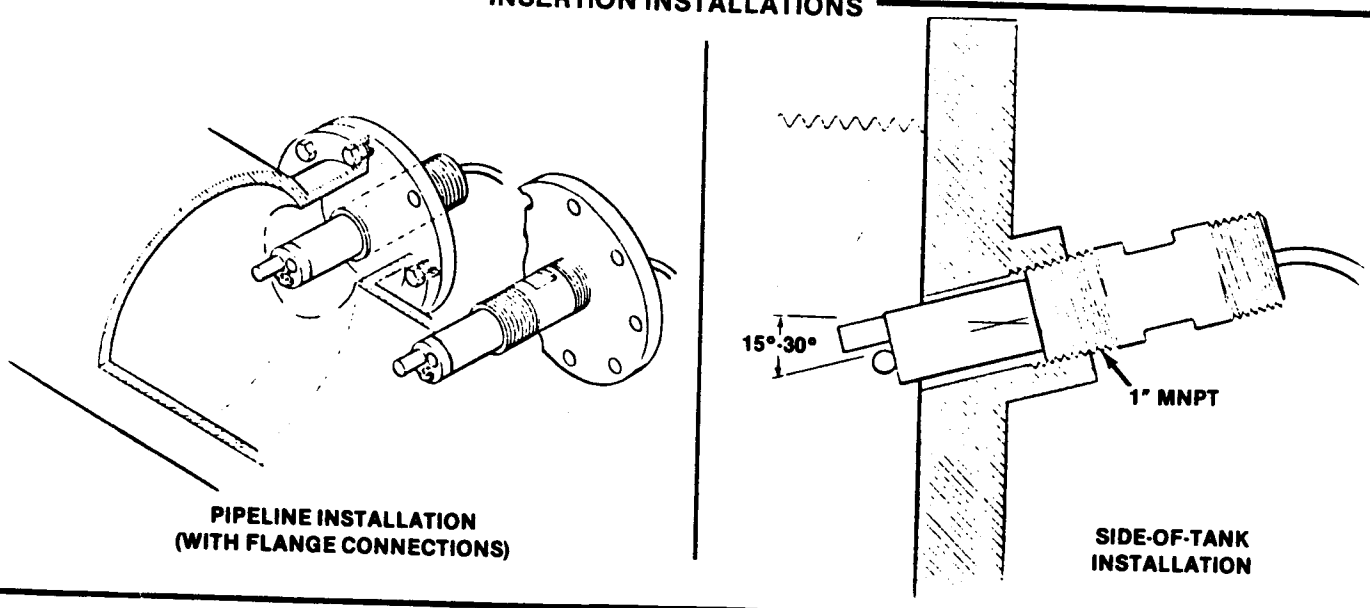
MOUNTING AND DIMENSIONAL DRAWING



FLOW THROUGH INSTALLATIONS



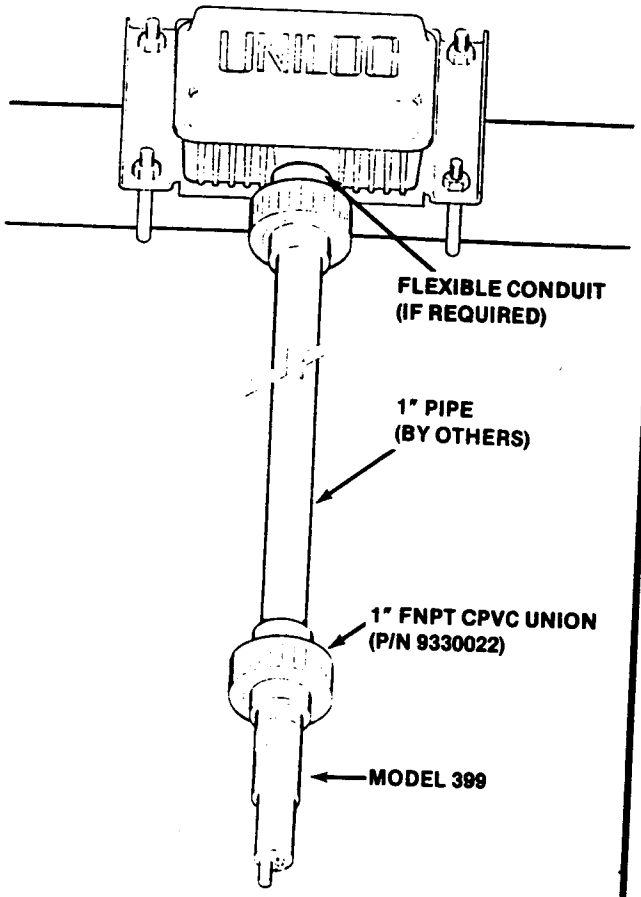
INSERTION INSTALLATIONS



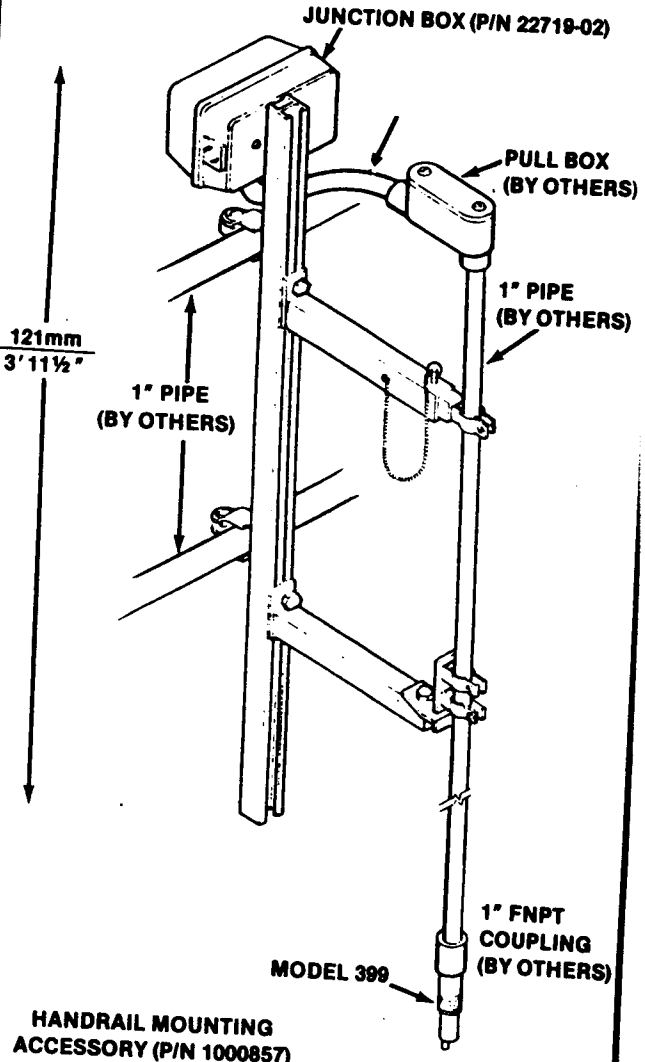
PIPELINE INSTALLATION (WITH FLANGE CONNECTIONS)

SIDE-OF-TANK INSTALLATION

SUBMERSION INSTALLATIONS



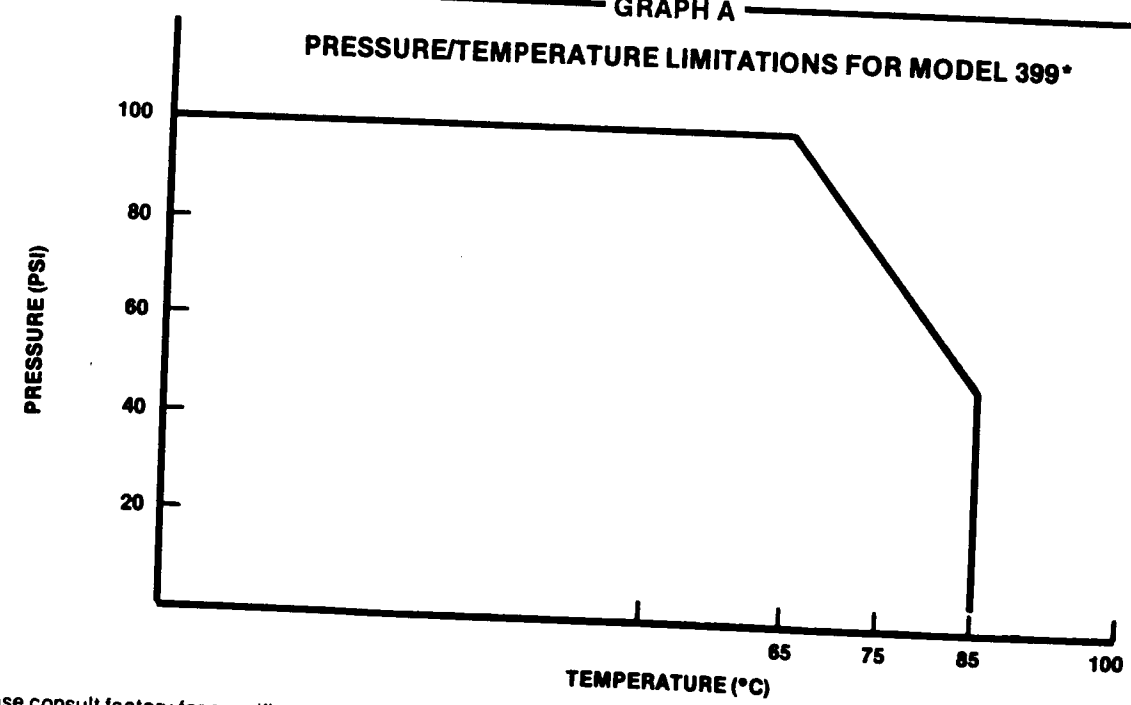
JUNCTION BOX (P/N 22719-02)
AND PIPE MOUNTING ACCESSORY



HANDRAIL MOUNTING
ACCESSORY (P/N 1000857)

GRAPH A

PRESSURE/TEMPERATURE LIMITATIONS FOR MODEL 399*



*Please consult factory for specification, pricing and delivery information on Model 399, less integral preamp.

ORDERING INFORMATION

The Model 399 pH/ORP Sensor is housed in a molded KYNAR[1] body with 1-inch MNPT threads suitable for insertion, submersion or flow through installation. The sensor includes a general purpose pH electrode or a platinum ORP electrode and a double junction gell filled reference electrode. The Model 399pH is available with or without an integral hermetically sealed preamplifier. The Model 399ORP is available only with an integral hermetically sealed preamplifier. Automatic temperature compensation is standard with the Model 399pH but is not required on the Model 399ORP (except when used with the Model 1054ORP Microprocessor Analyzer). Two cable lengths are offered for the pH sensor (3.0 m or 10 m). A 10 meter cable (32.8 feet) is available for the ORP sensor.

MODEL
399 SENSOR

CODE	FUNCTION (Must select one)
pH	Measures pH
ORP	Measures Oxidation Reduction Potential

CODE	OPTIONS — 399 pH (Must select one)
01	10 ft. cable with integral preamp for Models 1181pH & 1050
05	10 m cable with integral preamp for Models 1181pH & 1050
03	10 ft. cable with integral preamp for Model 1003
06	10 m cable with integral preamp for Model 1003
07	10 ft. cable with integral preamp for Model 1054pH
08	10 m cable with integral preamp for Model 1054pH
02	10 ft. coax cable for remote preamp, 3K ohm TC (Models 1181, 1050 & 1003)
09	10 ft. coax cable for remote preamp, PT-100 TC (Model 1054pH)

CODE	OPTIONS — 399ORP (Must select one)
30	10 m cable with integral preamp for Models 1181ORP & 1060
31	10 m cable with integral preamp for Model 1023
32	10 m cable with integral preamp for Model 1054ORP

CODE	OPTIONS
11	Stainless steel nameplate (specify marking)
16	1½-inch CPVC tee with 1-inch FNPT connections

399	**pH**	**01**	**—**	**11**	**EXAMPLE**

ACCESSORIES

UNILOC PART NUMBER	DESCRIPTION
1000856	Handrail mounting bracket for use with instruments
1000857	Handrail mounting bracket for use with J-box
22719-02	Weatherproof junction box
9322014	1-inch FNPT union of KYNAR
9330022	1-inch FNPT CPVC union

[1]Reg. U.S. Pat. Office for Pennwalt's polyvinylidene fluoride

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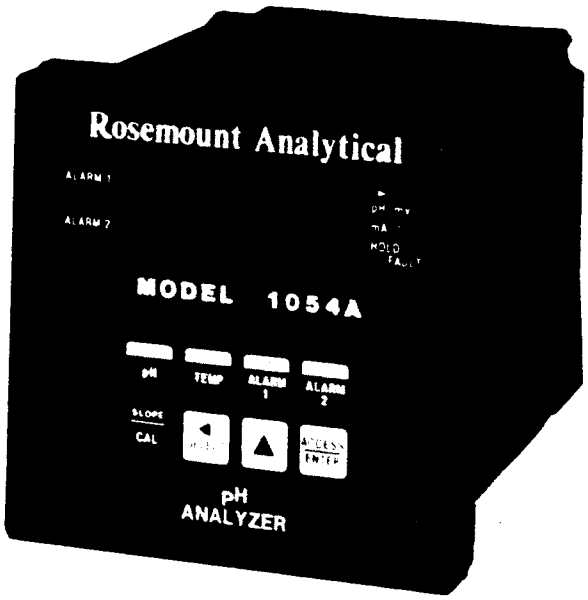
Irvine, CA 92714
Tel: (714) 863-1181
Telex: 67-8387 UNILOC IRIN
Fax: (714) 474-7250

Rosemount® Analytical

Model 1054A Series Microprocessor Analyzers



- *SELF DIAGNOSTICS with a user selectable fault alarm relay alerts operator if corrective action is required.*

- *NEMA 4X WEATHERPROOF CORROSION-RESISTANT ENCLOSURE Compact DIN size takes up less panel space and is suitable for pipe or wall mounting in most industrial environments.*

- *NO BATTERY BACK-UP REQUIRED. Non-volatile EEPROM memory permits instrument shop configuration prior to installation and information is not lost in the event of a power failure.*

- *DUAL ALARMS WITH PROGRAMMABLE LOGIC AND TIME DELAY ACTIONS with adjustable hysteresis provides greater adaptability to on/off control applications. A third relay is provided with timer functions.*

- *PROGRAMMABLE HOLD OUTPUT FUNCTION provides manual control of the isolated output to a control system during routine sensor maintenance or between batch processing. During fault conditions the hold output is programmable to default to a preset or process value.*

- *KEYBOARD SECURITY is user selectable. Data may be read but changes to calibration and set points are safe.*

MODEL 1054A MICROPROCESSOR ANALYZERS

FEATURES AND APPLICATIONS

The Model 1054A Microprocessor Analyzers, with the appropriate sensor, are designed to continuously measure and control the pH, ORP, conductivity, percent concentration and residual chlorine of industrial processes.

The Model 1054A is housed in a NEMA 4X (IP65) weatherproof corrosion-resistant flame retardant enclosure suitable for panel, pipe or wall mounting. All functions are accessed through the front panel membrane keyboard which features tactile feedback. Measurement data may be read at any time, however settings may be protected against accidental or unauthorized changes by a user selectable security code. The display indicates the measured value in engineering units as well as temperature, alarm status, hold output and fault conditions.

The 1054A transmits a user selected isolated current output is continuously expandable over the measurement range in either Direct or Reverse and can be displayed in milliamps or percent. Output dampening of 0-999 secs. is user selectable.

Hold function and fault condition defaults for the the dual alarms and current output are user selected. This feature allows manual control during sensor maintenance and instrument detected fault conditions.

Dual alarms are a standard feature on the Model 1054A and are programmable for either high or low operation. Alarm 2 may be programmed as a fault alarm. Both alarms feature independent setpoints, adjustable hysteresis and time delay action. The time delay is convenient when an alarm is used for corrective action, such as shutting down a demineralizer for regeneration. Time delay will ignore a temporary breakthrough and prevent shutting down a demineralizer unit prematurely. A dedicated interval timer with relay is also provided.

Automatic or manual temperature compensation is keyboard selectable. The process temperature is accurately measured at the sensor assembly and is read on the display. For greater accuracy, the temperature indication may be standardized to the process temperature. The temperature may be configured to read in °C or °F.

Calibration is easily accomplished by simply immersing the sensor in a known solution and entering the value With two point calibration, the Model 1054A will automatically calculate the pH electrode slope, or in the case of conductivity, the temperature slope of the solution.

The Model 1054A Microprocessor analyzer comes standard with an LCD display. An LED display is available as an option.

The Model 1054A's continuous self diagnostics alert the operator to ROM, EEPROM, temperature, measuring electrode and open wiring faults.

PHYSICAL SPECIFICATIONS - GENERAL

Enclosure: Black, ABS, NEMA 4X, IP65

Front Panel: Membrane keyboard with tactile feedback and user selectable security. Black and white on grey.

Digital Display: LCD, black on grey
Optional, red LED
Character Height: 18mm (0.7 inch)

Dimensions: 144 X 144 X 192mm
(5.7 X 5.7 X 7.6 inches)

Electrical Classification: General purpose

Power: 115 VAC, ± 10%, 50/60 Hz ± 6%, 4.0 W
230 VAC, ± 10%, 50/60 Hz ± 6%, 4.0 W

Current Output: Isolated, Direct or Reverse 0-20 mA or 4-20 mA into 600 ohms maximum load

Ambient Temperature: -20 to 65°C

Ambient Humidity: 0-95%

Alarms: Dual, field selectable High/Low, High/High, Low/Low
Alarm 2 configurable as a fault alarm
Time Delay 0 to 254 seconds
Dual Setpoints, continuously adjustable
Hysteresis is adjustable up to 2 pH units or 25% full scale for low side/High Alarm and high side/Low Alarm

Internal Timer: Interval: 10 min. to 2999 days
On Counts: 1 to 60
On Duration: 1 to 299.9 seconds
Off Duration: 1 to 299.9 seconds
Wait Duration: 1 to 299.9 seconds
Controls dedicated relay

Relay Contacts: Epoxy Sealed Form A contacts, SPST, Normally Open.

	Resistive	Inductive
28 VDC	6.0 Amps	3.0 Amps
115 VAC	6.0 Amps	3.0 Amps
230 VAC	6.0 Amps	1.5 Amps

Weight/Shipping Weight: 1.1 kg/1.6 kg (2.5 lbs./3.5 lbs.)

The **Model 1054A pH Analyzer** uses a preamplifier that converts the high impedance pH glass electrode signal to a low impedance signal. The result is that the pH signal may be reliably transmitted from the sensor to the analyzer using standard shielded 4-wire instrument cable. The preamplifier may be located in one of three areas; in the pH sensor for best performance, in a remote junction box when process temperatures exceed 80°C (176°F) in submersion applications, or in the analyzer when the distance between the pH sensor and the analyzer is 4.5 meters (15 feet) or less.

The Model 1054A pH measures over the full range of 0-14 pH. The current output may be calibrated to represent any 1 to 14 pH span. Calibration is easily accomplished by simply entering the pH value and standardizing to a grab sample or buffer. A two-point calibration is made by immersing the sensor in two different buffer solutions and entering the pH values. When two buffers are used, the microprocessor automatically calculates the electrode slope which is used for self-diagnostics. This value can be read on the LCD display to assist in manually adjusting the pH electrode efficiency for longer electrode life.

INSTRUMENT SPECIFICATIONS @ 25°C

Measurement Range: 0-14 pH

Output Scale Expansion: Zero suppression: up to 13 pH units
Span: Any pH from 1 to 14

Accuracy: ±0.01 pH

Repeatability: ±0.01 pH

Stability: ±0.01 pH/month/non-cumulative

Temperature Coefficient: Input: ±0.003 pH/°C
Output: ±0.006 pH/°C

Temperature Compensation: PT 100 RTD, Automatic or Manual
-15 to 100°C

RECOMMENDED SENSORS:

Model 300 Retractable pH Sensor
Model 320B Flow Through pH Sensor
Model 320HP High Purity pH Sensor *
Model 328 Steam Sterilizable pH Sensor
Model 381 Insertion/Submersion/Flow pH Sensor
Model 385 Retractable pH Sensor
Model 399 Disposable pH Sensor

*Model 1054A pH includes programmable temperature correction required for the presence of ammonia used in treating high purity boiler feed water.

The **Model 1054A ORP Analyzer** measures over the full range of -1500 mV to +1500 mV full scale user selectable in either the American convention (Oxidation Reduction Potential), or the European convention (Reduction Oxidation-Redox). Although temperature compensation is not required for ORP measurements, the process temperature is measured and displayed. Temperature measurement is made by a Pt 100 RTD located in the sensor assembly.

INSTRUMENT SPECIFICATIONS @ 25°C

Measurement Range: -1500 to +1500 mV

Output Scale Expansion: Zero suppression: up to ±1350 mV
Span: from ±1500 mV to ±1500 mV

Accuracy: ±1.0 mV

Repeatability: ±1.0 mV

Stability: ±1.0 mV/month, non-cumulative

Temperature Coefficient: Input: ±0.6 mV/°C
Output: ±1.2 mV/°C

Temperature Measurement: -15 to 100°C

RECOMMENDED SENSORS:

Model 300 Retractable ORP Sensor
Model 330B Flow Through ORP Sensor
Model 381 Insertion/Submersion/Flow ORP Sensor
Model 385 Retractable ORP Sensor
Model 399 Disposable ORP Sensor

MODEL 1054A MICROPROCESSOR ANALYZERS

The **Model 1054A C Conductivity Analyzer** measures over the range of 0-2 µS/cm to 0-1,000 mS/cm. Temperature slope may be adjusted anywhere between 0 and 5% to provide greater accuracy in chemical concentration control. The temperature slope is factory set at 2% as a representative value, but each conductive solution has its own set of temperature vs. concentration curves. The Model 1054A C will automatically calculate the temperature slope for any given solution, or permits manual adjustment of the temperature slope if already known. On calibration the analyzer will also automatically correct for cell constant variations for better measurement accuracy.

INSTRUMENT SPECIFICATIONS @ 25°C

Measurement Range: 0-2 µS/cm to 0-1,000 mS/cm
Auto range multipliers of X20, X200, X2,000, X20,000

Output Scale Expansion: Zero suppression: up to 90% full scale.
Span: from 10% to 100% full scale

Accuracy: ±0.5% of measured range

Repeatability: ±0.25% of output range

Stability: ±0.25% of output range/month, non-cumulative

Temperature Coefficient: Input: ±0.03%/°C of reading
Output: ±0.04%/°C of reading

Temperature Compensation: 0-200° (automatic or manual)

Temperature Slope Adjustment: 0-5%/°C

RECOMMENDED SENSORS (SEE TABLE 1):

Model 112 Insertion Conductivity Sensor
Model 140 Retractable Conductivity Sensor
Model 141 Insertion Conductivity Sensor
Model 142 Insertion Conductivity Sensor
Model 150 Insertion/Submersion Conductivity Sensor
Model 160 Insertion/Submersion Conductivity Sensor

The **Model 1054A T Toroidal Conductivity Analyzer** measures over the full range of 0-100 µS/cm to 0-2,000 mS/cm. The Model 1054A T uses an inductive principle of measurement and employs the use of toroidal (electrodeless) conductivity sensors. Toroidal conductivity sensors have no electrodes exposed to the measured solution which practically eliminates routine sensor maintenance in applications where electrode fouling may occur.

The Model 1054A T features cell constant correction and the 0-5%/°C temperature slope adjustment available on the Model 1054A C.

INSTRUMENT SPECIFICATIONS @ 25°C

Measurement Range: 0-100 µS/cm to 0-2,000 mS/cm

Output Scale Expansion: Zero suppression: up to 90% full scale.
Span: from 10% to 100 % full scale

Accuracy: ±0.5% of measured range

Repeatability: ±0.25% of output range

Zero Offset Error: 5 µS/°C for 1.0 cell constant

Stability: ±0.25% of output range/month, non-cumulative

Temperature Coefficient: Input: ±0.03%/°C of reading
Output: ±0.04%/°C of reading

Temperature Compensation: 0 to 200°C (automatic or manual)

Temperature Slope Adjustment: 0-5%/°C

RECOMMENDED TOROIDAL SENSORS:

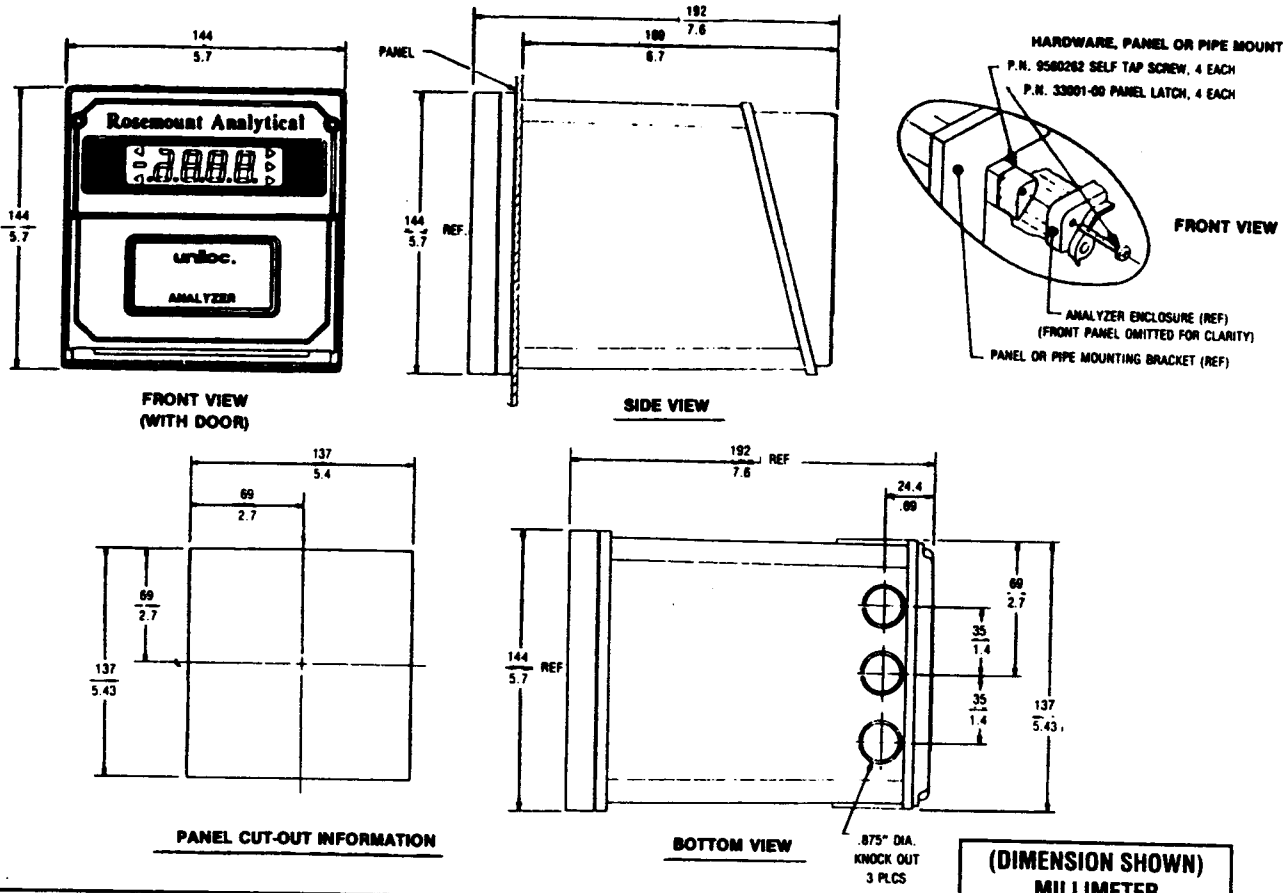
	FULL SCALE Minimum	FULL SCALE Maximum
Model 222 Sensor	0-500 µS/cm	0-2000 mS/cm
Model 224 Sensor	0-100 µS/cm	0-1000 mS/cm
Model 225 Sensor	0-250 µS/cm	0-2000 mS/cm
Model 228 Sensor	0-250 µS/cm	0-2000 mS/cm

FOR MODEL 1054AC ONLY – TABLE 1

Conductivity Sensor Model Number		142	142 150	140 141	150	140, 141 150	160	160	112 112	112
Cell Constant		0.01	0.1	0.2	0.5	1.0	2.0	5.0	20.0	50.0
Range Multiplier	X20	C/F*	2	4	10	20	40	100	400	1,000
	X200	2	20	40	100	200	400	1,000	4,000	10,000
	X2000	20	200	400	1,000	2,000	4,000	10,000	40,000	100,000
	X20000	200	2,000	4,000	10,000	20,000	40,000	100,000	400,000	1,000,000
		FULL SCALE MICROSIEMENS/cm								

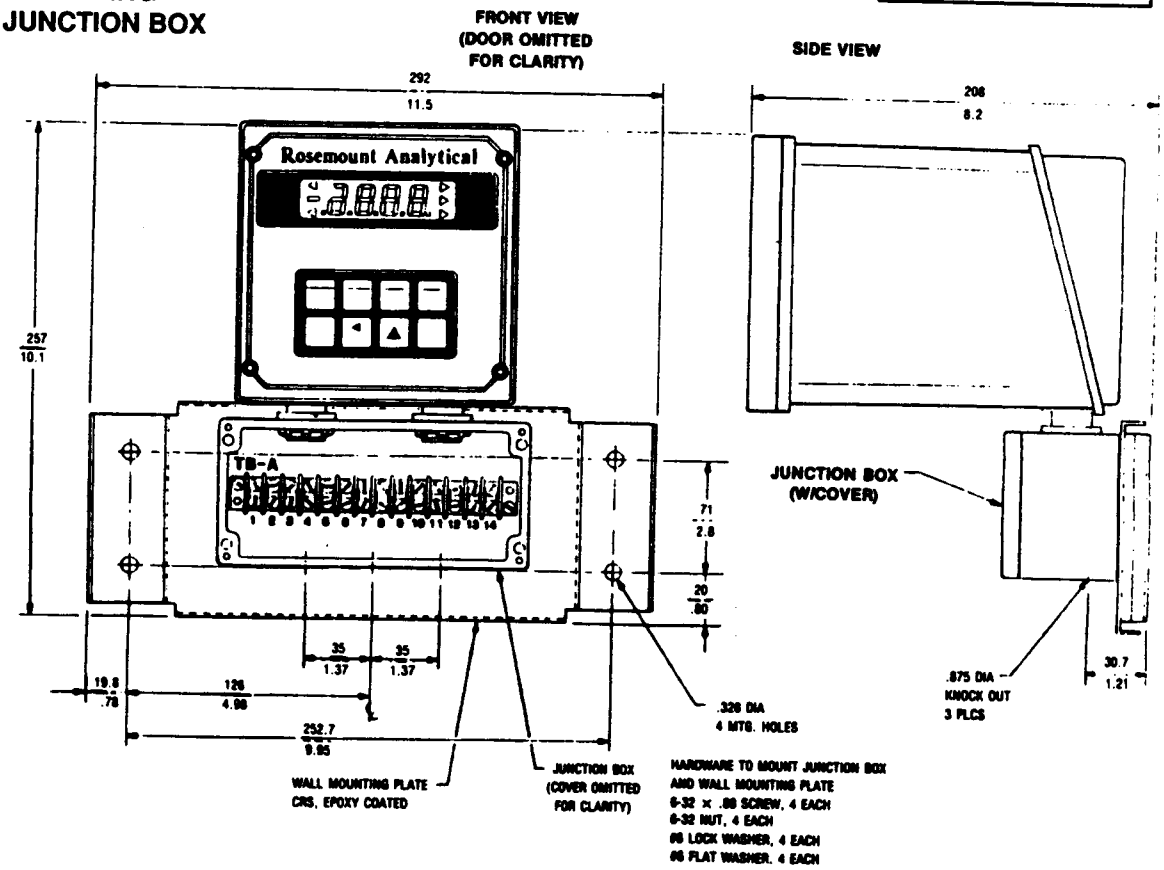
*C/F - Consult Factory

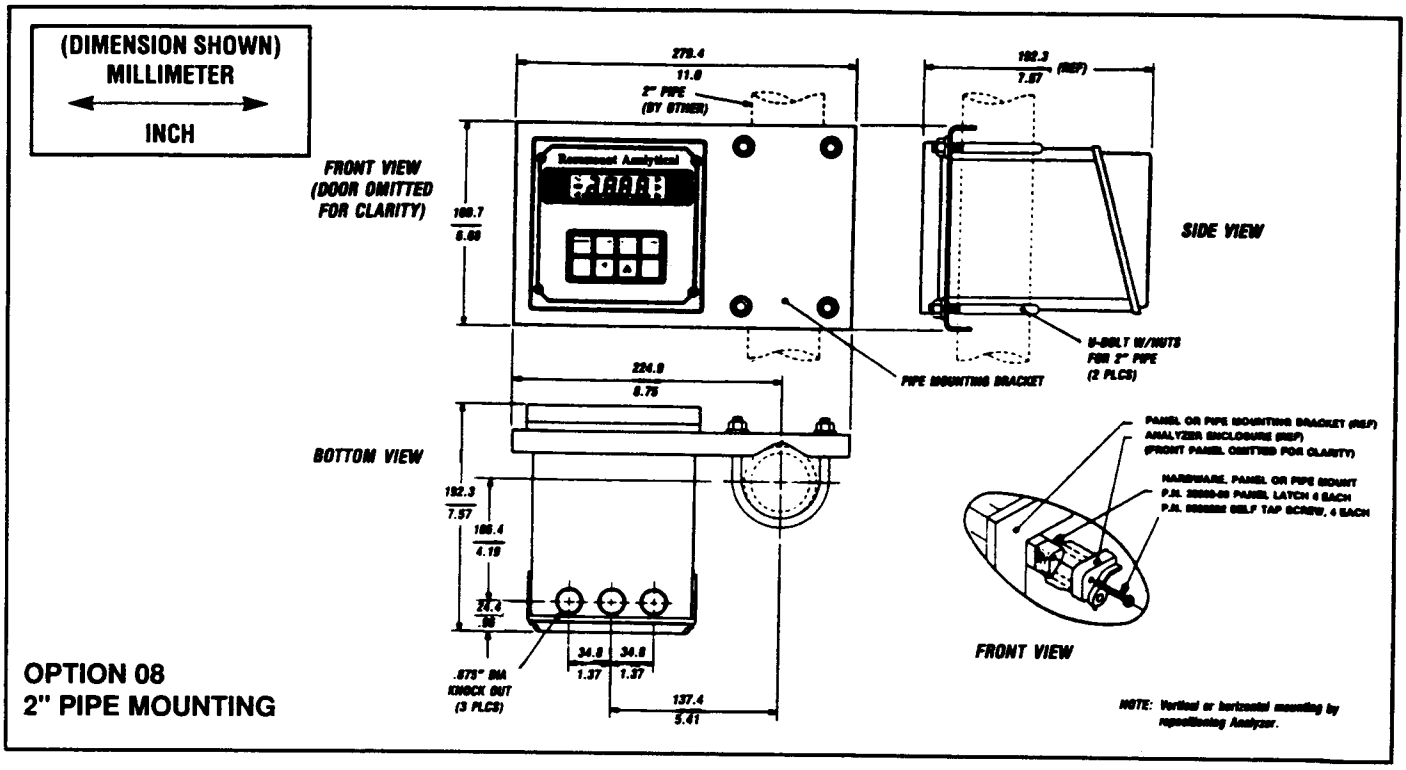
MOUNTING AND DIMENSIONAL DRAWINGS



(DIMENSION SHOWN)
MILLIMETER
INCH

OPTION 07
WALL MOUNTING
WITH JUNCTION BOX





ORDERING INFORMATION

The **Model 1054A Microprocessor Analyzer** is housed in a NEMA 4X weatherproof, corrosion-resistant housing suitable for panel, pipe or wall mounting. The analyzer operates on 115 VAC, 60 Hz unless otherwise specified. Standard features include LCD digital display, isolated current outputs, dual alarms, automatic temperature compensation.

MODEL	
1054A	MICROPROCESSOR ANALYZER

CODE	INPUT (Required Selection)
pH	pH measurement in an aqueous solution
ORP	Oxidation Reduction Potential
C	Conductivity
T	Toroidal Conductivity
%	Percent Concentration
RCl	Residual Chlorine

CODE	OPTIONS
02	LED Display
05	230 VAC, 50/60 Hz Power
07	Wall Mounting Plate with Junction Box
08	Two-inch Pipe/Wall Mounting Bracket
11	Stainless Steel Tag (specify marking)

CODE	pH/ORP OPTIONS
54	Integral Preamp

1054A	pH	07	-11-	54	EXAMPLE

Rosemount® Analytical

Model 160 Conductivity Sensor

- *SUITABLE FOR INSERTION/SUBMERSION/ FLOW-THROUGH installation.*
- *TEMPERATURE COMPENSATION is provided as integral part of sensor.*
- *OPERATES IN HIGH PRESSURE SYSTEM to 175 psig at 100°F.*
- *SENSOR CONSTANTS OF 1.0, 2.0 and 5.0 are available.*

FEATURES AND APPLICATIONS

The Rosemount Analytical Model 160 Insertion/Submersion Sensor is available in sensor constants of 1.0, 2.0 or 5.0 which cover conductivity ranges from 0 - 100 to 0 - 50,000 micromhos when used with the Uniloc Model 733, Model 750 or 1181C Analyzers/Transmitters. Conductivity ranges are from 2.0 to 100,000 micromhos when used with the Model 1054C Analyzer/Transmitters.

The KYNAR[1] housing has both rear-facing and forward-facing, one-inch, male pipe threads. The sensor can be threaded into a process line or the side of a tank, or be attached to a length of pipe for submersible installation. An integral 12-foot cable is supplied for interconnections to the analyzer/transmitter. The Model 160 is available with a 1-½ inch CPVC tee Code 16 for flow-through installation.

SPECIFICATIONS

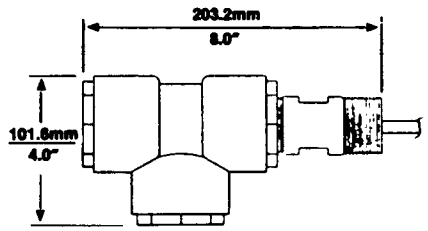
Available Sensor Constants: 1.0, 2.0, and 5.0
Process Connection: 1-inch MNPT both front and rear threads
Wetted Materials: Electrodes: Gold plated Hastelloy C[2]
Insulators: KYNAR and VITON[3]
Temperature Compensation: 0 to 121°C (32 to 250°F)
Pressure/Temperature Rating: (see graph)

Pressure	Temperature
1207 kPa (175 psig)	38°C (100°F)
345 kPa (50 psig)	121°C (250°F)

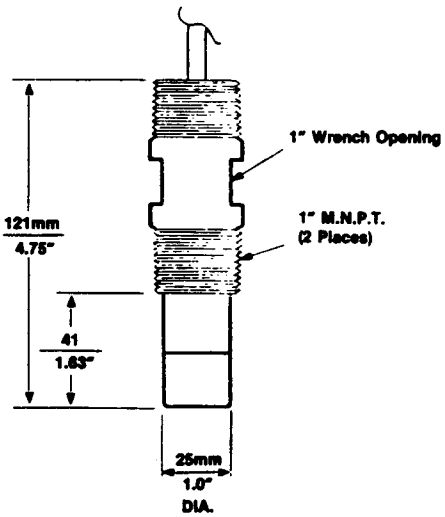
Junction Box: Code 17: ABS, meets NEMA 4X specifications
210 mm x 127 mm H x 102 mm D
(8-¼ in. x 5 in. x 4 in.)
Integral Cable: Four conductor cable with one shielded pair;
12-foot (366 cm) length provided with spade lugs.
Weight/Shipping Weight: 0.5 kg/ 0.9 kg (1 lbs/2 lbs)

[1]A registered trademark of Pennwalt Corp.
[2]A registered trademark of Cabot Corp.
[3]A registered trademark of E.I. duPont de Nemours and Co.

MOUNTING DIMENSIONS



Model 160 Sensor with optional 1½" CPVC tee adapter



ORDERING INFORMATION

The Model 160 Insertion/Submersion Conductivity Sensor is available in sensor constants of 1.0, 2.0, or 5.0 which cover conductivity ranges from 0-100 to 0-100,000 micromhos with selected instruments. The KYNAR[1] housing is supplied with both rear facing and forward facing 1-inch MNPT's. The sensor can be threaded into a process line or the side of a tank or attached to a length of pipe for submersion installations. An integral 12-foot cable is supplied for interconnection to the analyzer/transmitter. The Model 160 may be optionally supplied in a 1-inch CPVC tee for flow-through installation (Code 16).

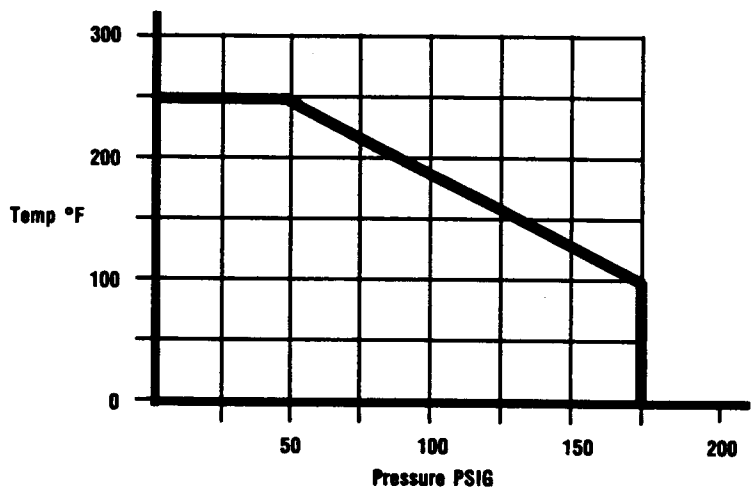
MODEL	
160	INSERTION/SUBMERSION CONDUCTIVITY SENSOR

CODE	PROBE CONSTANT (Must select one)
06	1.0
07	2.0
08	5.0

CODE	OPTIONS
16	Supplied in a 1-½ inch CPVC tee with 1-inch FNPT connections
17	Remote weatherproof junction box
19	Stainless steel nameplate (specify marking)

160	06	19	EXAMPLE

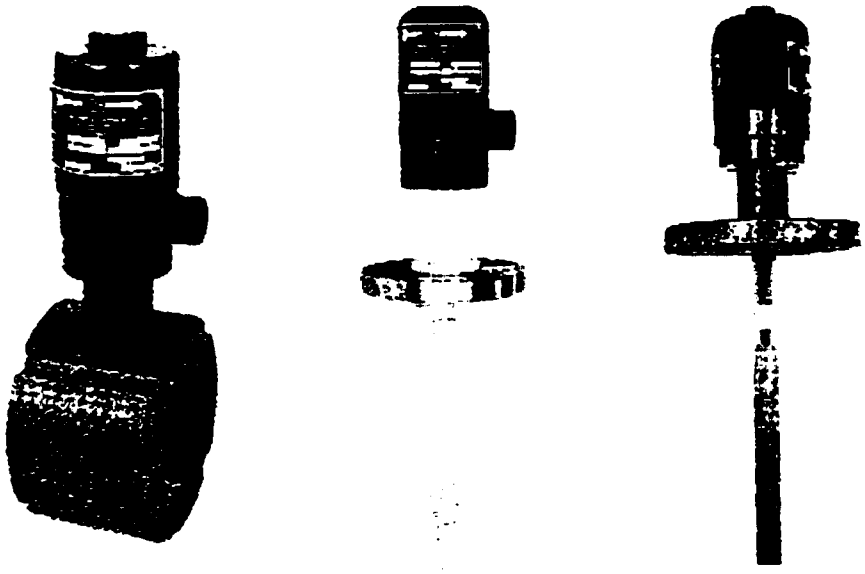
NOTE: Recommended cable from sesor to transmitter is Uniloc P/N 9200104, or equivalent, available from Uniloc. This cable is also available with spade lugs at both ends (P/N2001869). Specify length.



ROSEMOUNT®
Measurement
Control
Analytical
Valves

Rosemount Analytical Inc.
2400 Barranca Pkwy.
Irvine, CA 92714
Tel: (714) 863-1181
Telex: 67-8387 UNILOC IRIN
Fax: (714) 474-7250

Teflon®

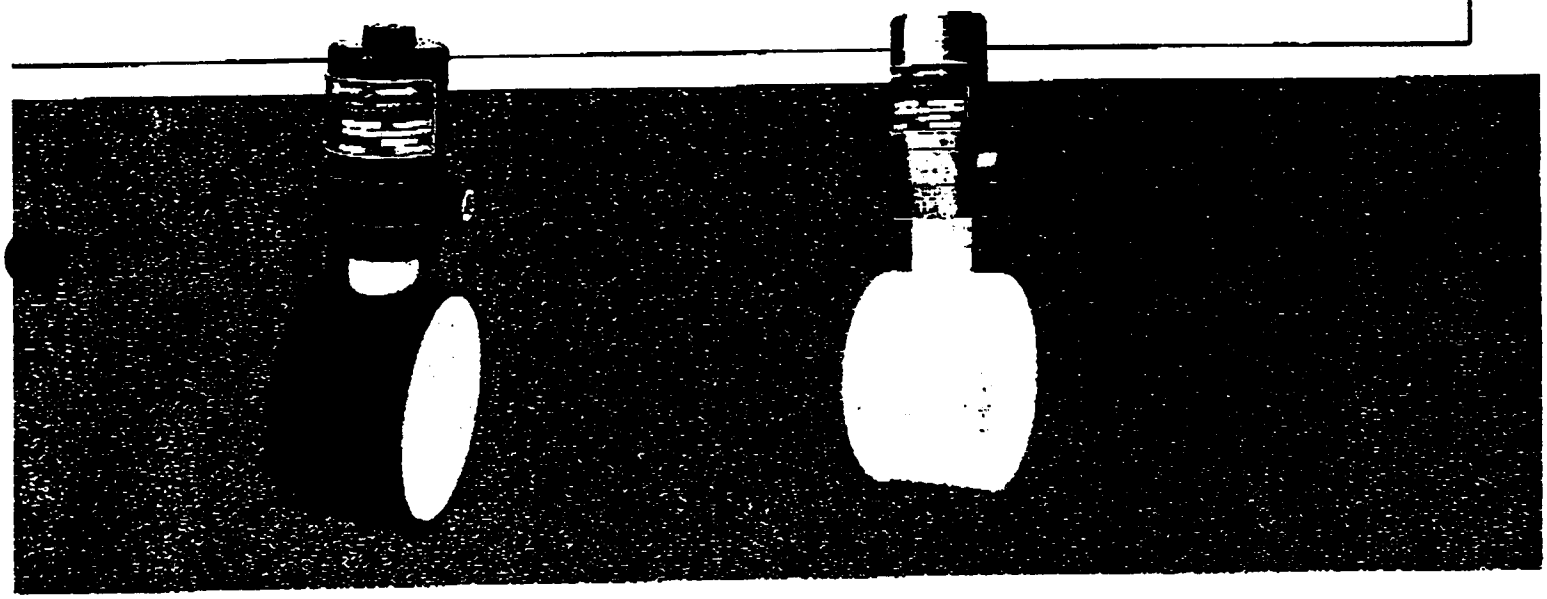


Combat the problems of corrosion and friction with all wetted parts of Teflon® or Teflon® bellows in conjunction with Polypropylene, PVC, Kynar, etc.

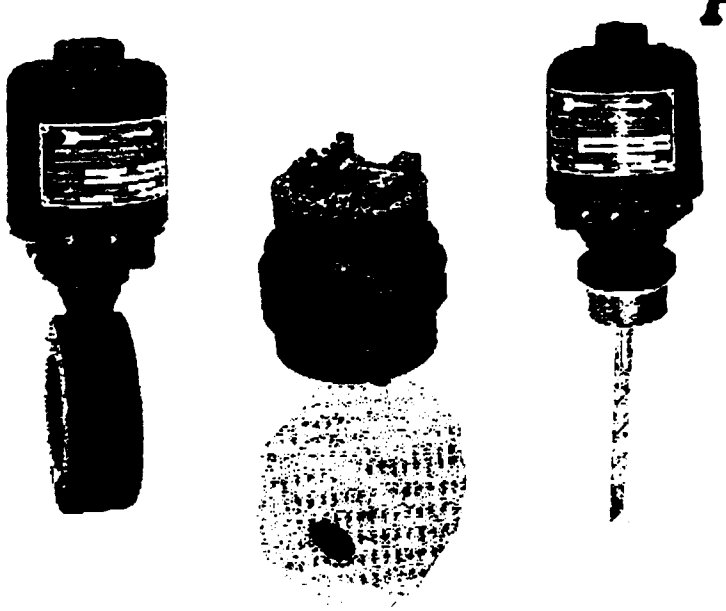
Available in both explosion proof and non-explosion proof models, any style, any line size.

Limitations: 100 psi — 450°F

Teflon® or any other coatings also available.

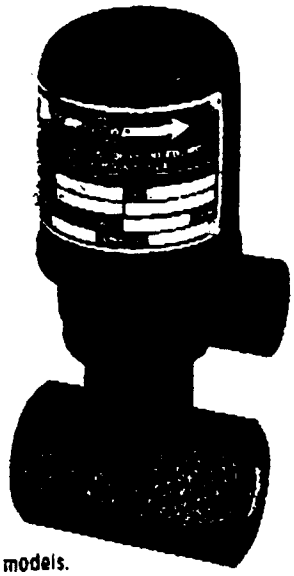


Air Operated



Where electrical contacts are not permitted or where pneumatic operation is preferred, use the PEECO AIR OPERATED FLOW SWITCH.

- Identical in function and specification to conventional PEECO units.
- Available in explosion proof models only.
- Supply pressure: 3 to 20 psi or 20 to 125 psi.
- Standard tubing connections: 1/8 — 27 NPT; 1/4 — 18 NPT optional



STYLE NT

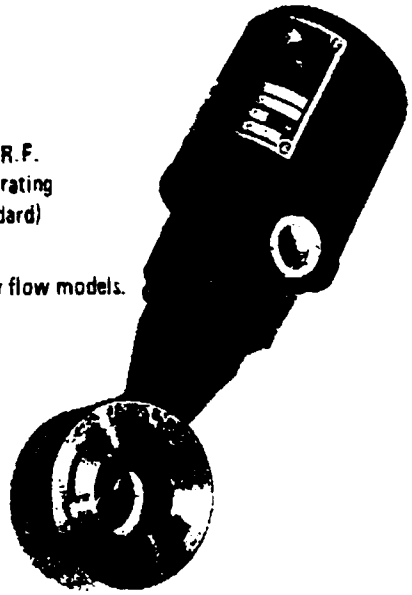
Connection: Screwed Tee
Standard: Specify size
Optional: Socket-weld, Butt-weld
Line Size: 2" and under (standard)
over 2" (optional)

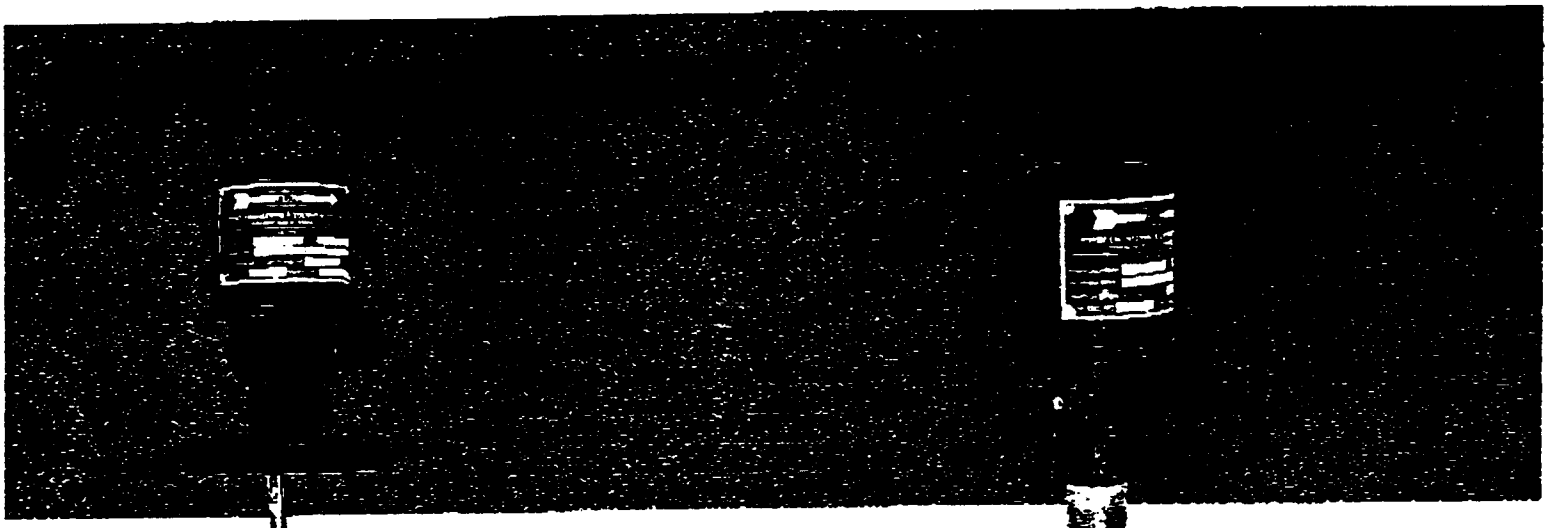
Also available in low and low-low flow models.
(see page 12)

STYLE NT-F

Connection: Wafer Tee
Standard: 2" 150# or 300# R.F.
Optional: Any size, style and rating
Line Size: 2" and under (standard)
over 2" (optional)

Also available in low and low-low flow models.
(see page 12)





STYLE NP-F

Connection: Flanged*
Standard: 2" 150# or 300# R.F.
Optional: Any size, style and rating
Line Size: 2½" and up

*Specify distance from face of mounting flange to top I.D. or C/L of pipe and pipe size.

STYLE NP-S

Connection: Screwed
Standard: 1¼" NPT
Optional: Any other size
Line Size: 2½" and up

Material Specifications

	STANDARD MATERIALS OF CONSTRUCTION		AVAILABLE MATERIALS OF CONSTRUCTION	
	EXPLOSION PROOF	NON-EXPLOSION PROOF	EXPLOSION PROOF	NON EXPLOSION PROOF
COVER & HOUSING	HEAT TREATED ALUMINUM 356-T6		[illegible]	[illegible]
BODY	STEEL		[illegible]	[illegible]
BELLOWS "E" & "B" Models	Seamless 321 Stainless Steel		[illegible]	[illegible]
FLEXURE TUBE "H" Models	316 SS	Not Applicable	Any machinable Metal	Not Applicable
STEM PADDLE	302, 303 Stainless Steel		Most Metals, Teflon, Hycar, Polypropylene, PVC	
BEARINGS	440C Stainless Steel, Micro Ball		440C Stainless Steel, Micro Ball	
NAME PLATES	Aluminum		Stainless Steel	
MICRO-SWITCH	15A 125-250-480 VAC SPDT ½A 125 VDC (1 N.O., 1 N.C., 1 Comm.)		400°F, 40A 125 VDC Hermetically sealed, Explosion proof 600 VAC 25A DPDT and many others SILVER BRAZING ALLOY: Copper – 15.5%, Silver – 50%, Zinc – 16.5%, Cadmium – 18% Cadmium free and copper free alloys available	

100% Unconditionally guaranteed as to quality of workmanship and materials.

PEECO FLOW ACTUATED ELECTRICAL SWITCHES are unique in the field of flow controls. They are **not** a standard shelf item, but are **specifically** designed to accommodate **your** application. Maintenance free in lines from 1/16" to 12 ft. or larger.

Actuated by flow — not pressure. No need to be concerned with minimum and maximum flow (pp. 7 & 8) . . . you state your requirements, PEECO will accommodate them! From −450°F to +2000°F. From high vacuum service to 10,000 psi. Fully field adjustable over the entire range (less than 10% dead band/differential between make and break). Easily accessible — but not readily tampered with. (Tamper proof see p. 15).

Explosion proof models are approved by Canadian Standards Association, City of Los Angeles, Institut National des Industries (of Belgium). French Approval I.C.I.E. and the U.S. Army Corp of Engineers. Electrical by Underwriters Laboratories.

The desired flow indication — increase, decrease, reverse — is transmitted mechanically from the line media by deflection of the paddle through the stem and bellows or flexure tube assembly, causing micro-switch actuation and resultant electrical contact for transmission of signal to whatever ultimate point desired.

Base travel of the stem is from 1/16" (H Model) to 1/4" (E Model). Standard Micro-switch travel is approximately .005". [illegible] specifications, making the PEECO switch inherently

To Ann

LEAK DETECTION FOR TANKS, SUMPS, DOUBLE-WALL PIPING

- RELIABLE LEAK DETECTION
- INTRINSICALLY SAFE SYSTEM
- UL/LISTED SENSOR
- OPTICAL SENSING PRINCIPLE
- CORROSION-RESISTANT MATERIALS

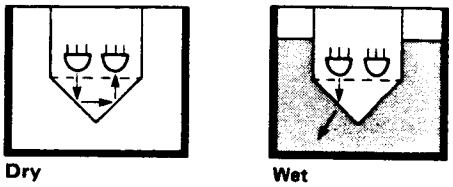
Genelco Soil Sentry Liquid-130 is the leak-monitoring system you don't spend all your time monitoring. Fully self-checking and intrinsically safe, Soil Sentry accurately monitors tanks' annular space for presence of liquid, notifying you at first sign of trouble.

Advanced optical sensors
Soil Sentry probes detect liquid, using infra-red light. In use, pulsed light beam is aimed at probe tip. If tip is dry, light is reflected off tip sides and back to an optically matched photo-transistor, completing an optical circuit and sending a "dry" signal to controller. If tip is wet, however, light is refracted out from probe, breaking the circuit with the photo-transistor, causing a "wet" signal to be relayed.

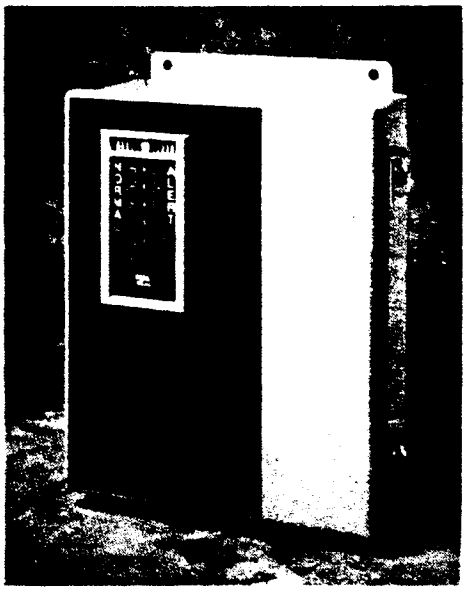
Inside the annular space of a double-wall tank or double-wall pipe, optical sensing provides immediate detection of even small accumulations of liquid at probe tip.

Soil Sentry system is designed for easy installation. Liquid sensors are placed either inside tank for product-level sensing, or in the annular space for leak detection. Two controllers are available: 130A for one or two probes and 130C for up to six.

Probe assembly



Dry Wet



Alarm Contact to cont. cab

SPECIFICATIONS:

Power:
117 Vac, 60 Hz, 15 watts.
Number of sensors:
130A, up to 2
130C, up to 6
Display and alarm:
Green "normal" lamp and red "alert" lamp for each channel. Audible alarm beeps several times an hour.
Reset button:
Disables audible tone and alert lamps if alarm condition is corrected. Initiates lamp test and diagnostic routine.
Probe dimensions:
141 A&B
Length: 2-7/8"
Both ends threaded 1/2" NPT
Removable debris shield supplied
142 A&B
Length: 3" including debris shield
Outside diameter: 3/4"
No threads

Electrical outputs:
None as shipped. Optional power and communications outputs.
Enclosure:
4 x 9 x 11-1/2 JIC box with three conduit cutouts.
Operating temperature:
Controller, 0-65°C. Sensors, 0-40°C.
Field wiring:
Up to 2000 feet between controller and sensor. Two-conductor cable. Consult manual for cable requirements.
Certification:
U.L. Listed. Sensors 141A, 141B, 142A and 142B, Division 1, Class 1, Group D locations. Controller must be installed in non-hazardous indoor area.

Controller—must be mounted in non-hazardous location.

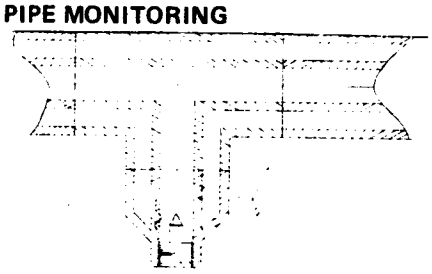
ORDER: 6926-(Size No.) PROBE

-141 Polysulfone, wet alarm	$120.00
-143 Polysulfone, dry alarm	120.00
-142 PFA, wet alarm	150.00
-144 PFA, dry alarm	150.00

ORDER: 6926-(Size No.) CONTROLLER

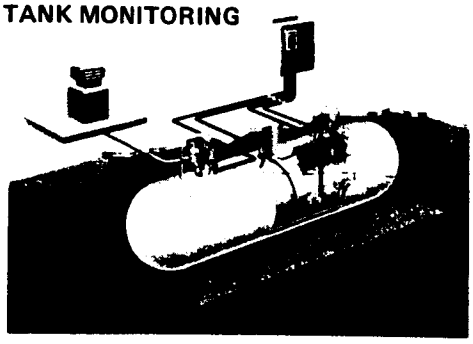
-130 2-channel	$1595.00
-131 2-channel with 2 relays	1795.00
-133 6-channel	1950.00
-134 6-channel with 6 relays	2225.00

DOUBLE-CONTAINMENT PIPE MONITORING

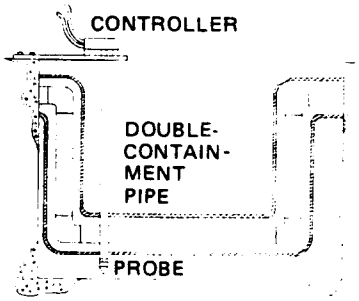


PROBE

TANK MONITORING



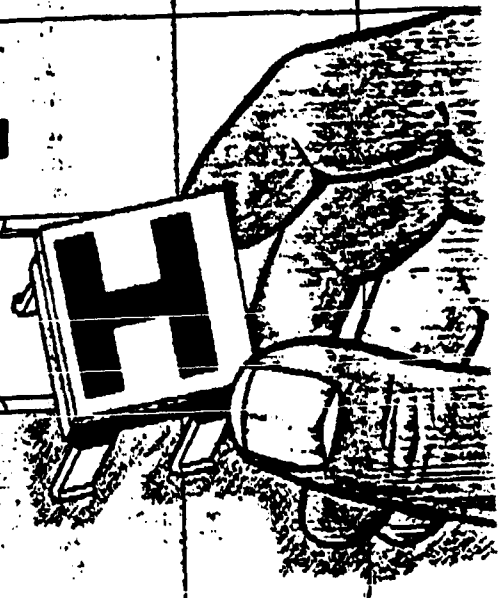
SUMP MONITORING



PANALARM

MODEL 280

MODU-GRAPH



MOSAIC TILE GRAPHIC DISPLAY

Made in USA

Based on the inch

PANALARM

MODEL 280 MODU-GRAPH

MOSAIC TILE GRAPHIC DISPLAY SYSTEM

The Modu-Graph system consists of 1" or 2" polycarbonate tiles designed to snap into openings of a thermoplastic grid matrix. The snap-in tile design allows future field modifications to be made quickly and easily without special tools or skills.

The grid matrix is supported in a black anodized extruded aluminum frame available in both wall mounting and flush panel mounting versions.

The system provides a flexible means of providing passive and active graphic panels or mapboards. Lines, symbols, maps, etc. are painted on background tiles to provide a durable, long-lasting display.

Pushbuttons, switches, lamps, meters, etc. are available for factory mounting through tiles to give a professional, finished appearance.

Lamp assemblies for backlighting translucent tiles or lens inserts are also available.

"Flow" effects can be obtained by using Panalarm Model 207 Lamp Sequencers to operate series of lamps.

At the customer's option, electrical devices may be furnished unwired or factory wired to marked, screw-type terminal blocks.

Modu-Graph applications are unlimited. Some typical uses are for monitor and/or control via:

- Area maps of water, waste, natural gas distribution systems.
- Area maps of highway, railway, airway traffic systems.
- Building floor plan layouts (Security, fire, heating/cooling systems, etc.)
- Power distribution grid layouts.
- Manufacturing operations layouts (Motor control, temperature [zone ambients, bearings, liquids, gases, etc.], process flow, product flow, etc.)

Consult Model 280 Engineering Handbook for more detailed information.

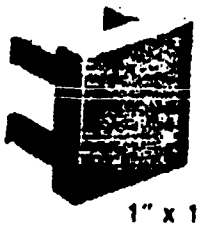
TILES

High quality polycarbonate background tiles have colors permanently molded-in to provide a stable, durable base for your custom graphic display

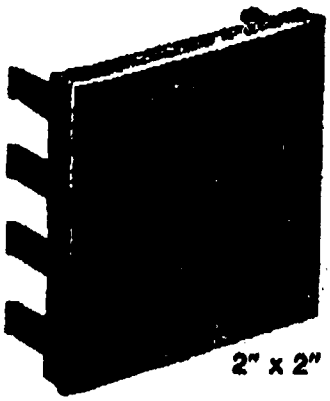
Background tile standard colors:

OPAQUE;	TRANSLUCENT;
Neutral	Milky White
Beige	
Gray	
Black	

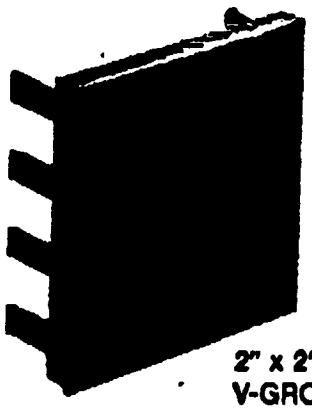
Custom tile colors are available at extra cost.



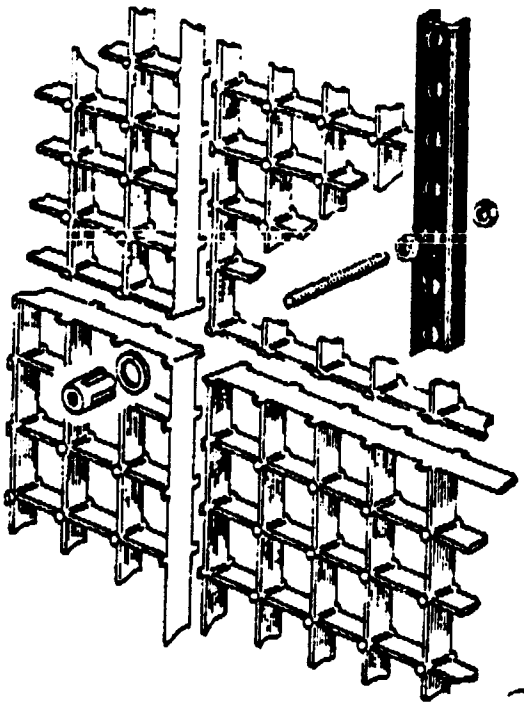
1" x 1"



2" x 2"



2" x 2",
V-GROOVED

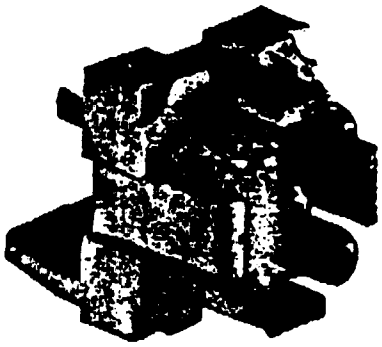


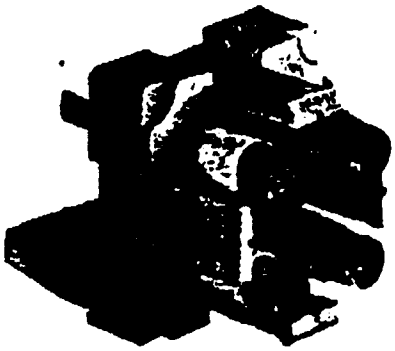
STURDY, LIGHTWEIGHT CONSTRUCTION

Thermoplastic grid sections are firmly supported at each intersection using a spacer and specially designed junction fastener (see illustration). Additionally, grid-to-grid clips are installed to insure permanently accurate alignment

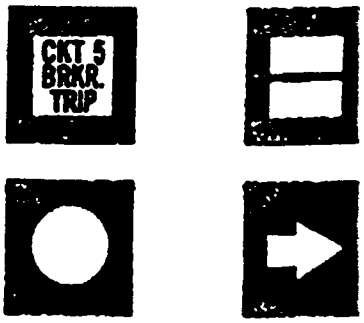
INDICATING LIGHTS

Custom molded lamp assemblies can accommodate from one to five wedge-base incandescent lamps or multi-chip LEDs in various colors. These assemblies snap-in behind translucent tiles or opaque tiles with translucent lens inserts.





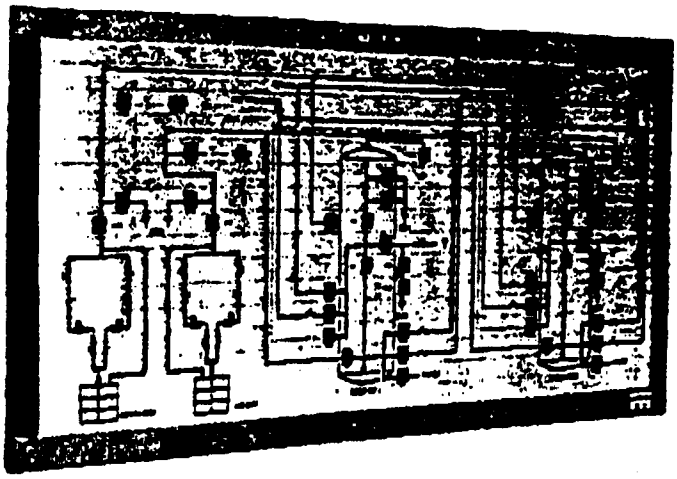
Typical opaque tile

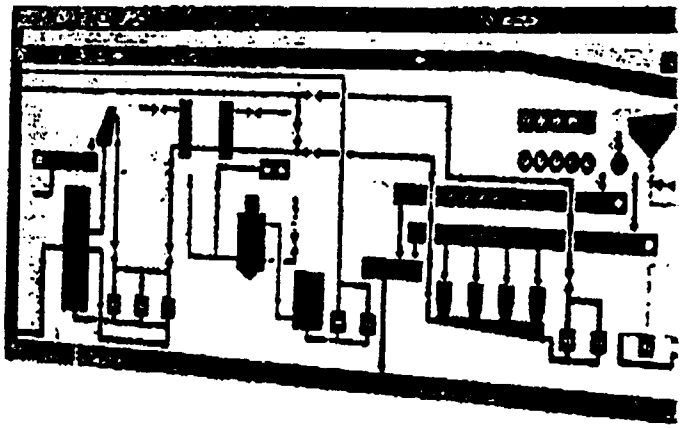


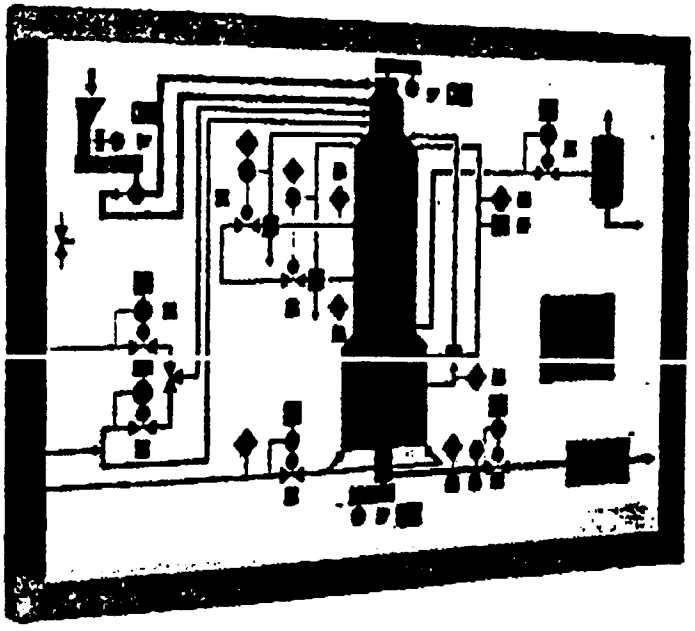
Other lens inserts available.
Custom inserts available at ex

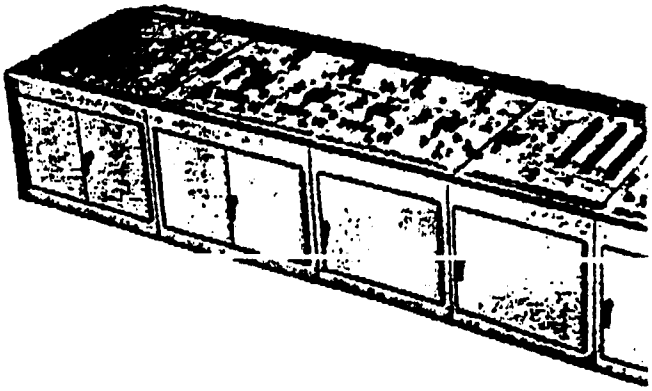
TYPICAL INSTALLATIONS

System size is practically unlimited. Curve specialists will work with you to develop a





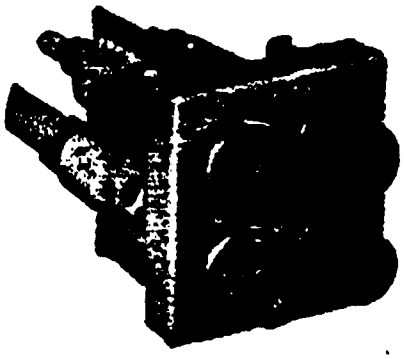


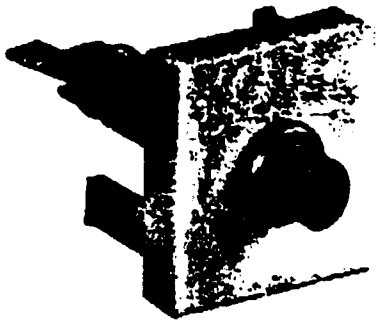


ile/translucent lens inserts

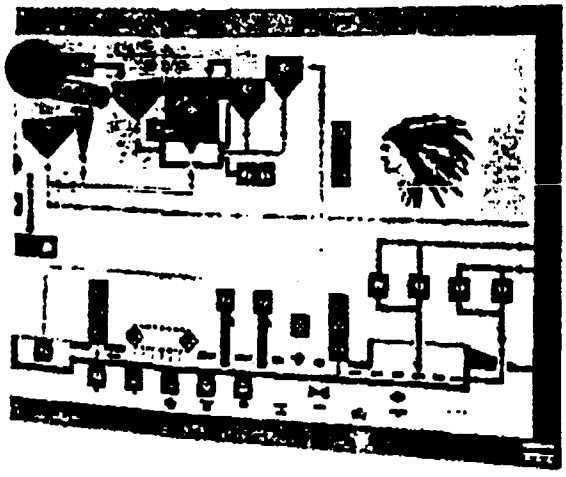
le.
at extra cost.

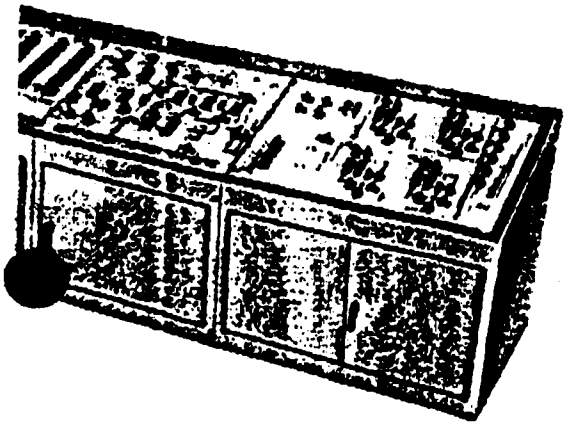
Through-tile lamp assemblies can be arranged in various configurations of from one to four indications.





urved panels are also available. Our product op a system for your application.

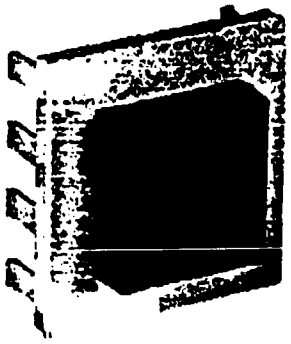


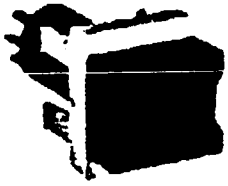


Reproduced courtesy of
Electric Control & Switch, Inc., Dallas, Texas.

PUSHBUTTONS & SWITCHES

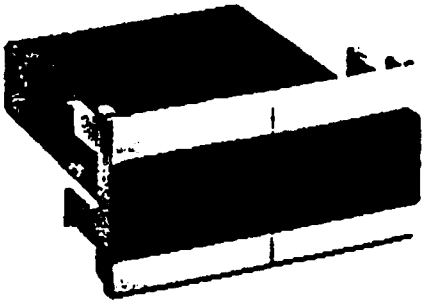
Through-tile mounted toggle, selector and pushbutton switches (lighted or unlighted) are available with various contact arrangements.





METERS & DISPLAYS

A wide variety of digital displays, meters, clocks, indicators and controllers are available for through-tile mounting. Consult the "Meters, Displays" section of the Model 280 Engineering Handbook.



SYMBOLS & LEGENDS

Symbols, lines and mapwork are painted on tile using high quality, fade-resistant paints.

Standard symbols are illustrated in the Engineering Handbook. Custom symbols, logos, etc. can be faithfully reproduced.

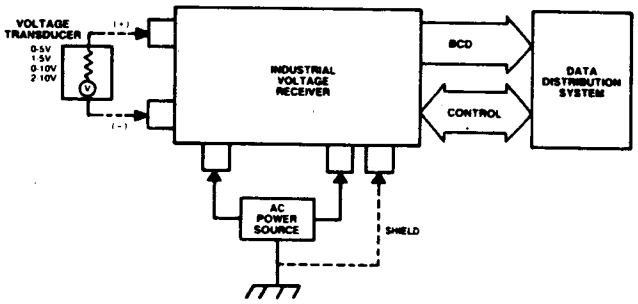
Legends to accompany and identify symbols, lamps, switches, etc., are engraved in background tiles and filled with paint (usually black or white). The result is clear, crisp lettering which enhances the appearance of the graphic display.

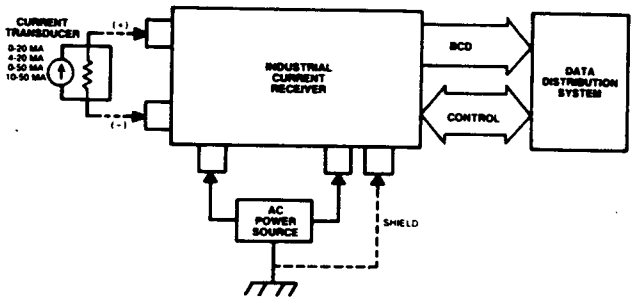
INDUSTRIAL RECEIVER

Digital panel meters

A wide range of DPMs for direct readout in engineering units from either voltage transmitter or current loop signals. All feature unique scaling and offset circuitry (per user specification), and selectable decimal point placement. Applications include temperature, power, speed, flow rate, pressure, and angular displacement measurements, when interfaced with suitable industrial transmitters.

- Choice of 4 voltage and 4 milliamp ranges.
- Display readings specified by user.





Specifications at 23°C

	All 3½ Digit Models	2470 Series	Model 2475	Model 2491
Accuracy (receiver only)	0.1% rdg ±1 digit	.015% rdg ±2 digits	.005% rdg ±2 digits	.005% rdg ±2 digits
Temperature Coefficient (span or offset)	0.012% rdg/°C	20 ppm/°C	80 ppm/°C typ.	80 ppm/°C typ.
Settling Time (typical)	<1 sec.	<1 sec.	<1 sec.	<1 sec.
Input Type	Single-ended	Single-ended	Single-ended	Single-ended
Max. Burden (current)	500mV	200mV	200mV	200mV
Resistance (voltage)	>1MΩ	>1MΩ	>1MΩ	>1MΩ
NMRR	40 dB at 60 Hz	65 dB at 60 Hz	40 dB at 60 Hz	40 dB at 60 Hz
CMRR	110 dB at 60 Hz	100 dB at 60 Hz	110 dB at 60 Hz	110 dB at 60 Hz

Industrial Receiver Catalog Numbers — Voltage

SUPPLY VOLTAGE	115 VAC				230 VAC			
Ranges	**0-5V**	**1-5V**	**0-10V**	**2-10V**	**0-5V**	**1-5V**	**0-10V**	**2-10V**
2431	0287200	0287201	0287202	0287203	0287204	0287205	0287206	0287207
2432	0287208	0287209	0287210	0287211	0287212	0287213	0287214	0287215
2435	0287216	0287217	0287218	0287219	0287220	0287221	0287222	0287223
2436	0287224	0287225	0287226	0287227	0287228	0287229	0287230	0287231
2443*	0300834	0300835	0300836	0300837				
2445	0289220	0289221	0289222	0289223	0289224	0289225	0289226	0289227
2446	0289236	0289237	0289238	0289239	0289240	0289241	0289242	0289243
2471	0289300	0289301	0289302	0289303	0289304	0289305	0289306	0289307
2472	0289312	0289313	0289314	0289315	0289316	0289317	0289318	0289319
2473	0289324	0289325	0289326	0289327	0289328	0289329	0289330	0289331
2474	0289336	0289337	0289338	0289339	0289340	0289341	0289342	0289343
2475	0289348	0289349	0289350	0289351	0289352	0289353	0289354	0289355
2491	0287160	0287161	0287162	0287163	0287164	0287165	0287166	0287167
2498	0287240	0287241	0287242	0287243	0287244	0287245	0287246	0287247
2499	0287248	0287249	0287250	0287251	0287252	0287253	0287254	0287255
SUPPLY VOLTAGE	**7-15VDC**				**5VDC**			
2443**	0300875	0300876	0300877	0300878				
2495	0287256	0287257	0287258	0287259	0287260	0287261	0287262	0287263
2496					0287268	0287269	0287270	0287271
2497					0287276	0287277	0287278	0287279

Specify both Model Number and Catalog Number when ordering.

Industrial Receiver Catalog Numbers — Current

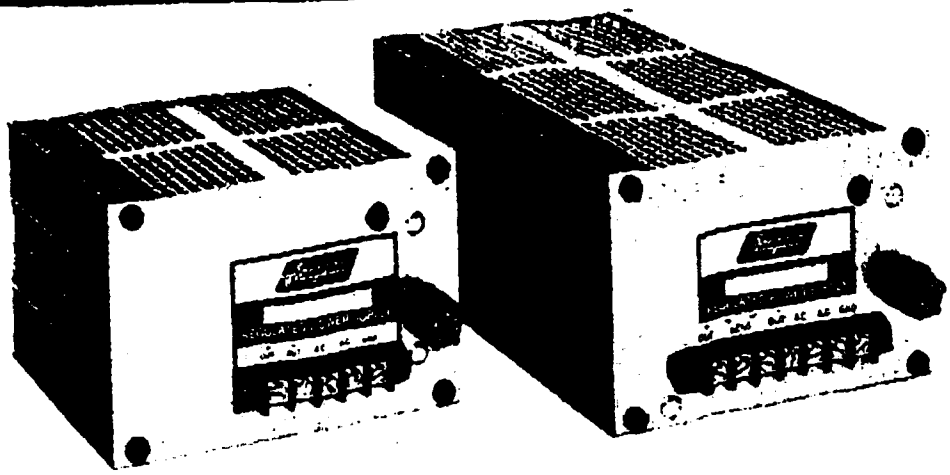
SUPPLY VOLTAGE	115VAC				230VAC			
Ranges	**0-20mA**	**4-20mA**	**0-50mA**	**10-50mA**	**0-20mA**	**4-20mA**	**0-50mA**	**10-50mA**
2431	0287280	0287281	0287282	0287283	0287284	0287285	0287286	0287287
2432	0287288	0287289	0287290	0287291	0287292	0287293	0287294	0287295
2435	0287296	0287297	0287298	0287299	0287300	0287301	0287302	0287303
2436	0287304	0287305	0287306	0287307	0287308	0287309	0287310	0287311

SUPPLY VOLTAGE	115/230 VAC*		7.5-15 VDC		24 VDC	
Ranges	**Red LED**	**Green LED**	**Red LED**	**Green LED**	**Red LED**	**Green LED**
2443:						
0-5V	0300834	0300852	0300875	0300893	0300911	0300929
1-5V	0300835	0300853	0300876	0300894	0300912	0300930
0-10V	0300836	0300854	0300877	0300895	0300913	0300931
2-10V	0300837	0300855	0300878	0300896	0300914	0300932
0-20mA	0300830	0300848	0300871	0300889	0300907	0300925
4-20mA	0300831	0300849	0300872	0300890	0300908	0300926
0-50mA	0300832	0300850	0300873	0300891	0300909	0300927
10-50mA	0300833	0300851	0300874	0300892	0300910	0300928

2445	0289228	0289229	0289230	0289231	0289232	0289233	0289234	0289235
2471	0289380	0289381	0289382	0289383	0289384	0289385	0289386	0289387
2472	0289388	0289389	0289390	0289391	0289392	0289393	0289394	0289395
2473	0289396	0289397	0289398	0289399	0289400	0289401	0289402	0289403
2474	0289404	0289405	0289406	0289407	0289408	0289409	0289410	0289411
2475	0289412	0289413	0289414	0289415	0289416	0289417	0289418	0289419
2491	0289440	0289441	0289442	0289443	0289444	0289445	0289446	0289447
2498	0287320	0287321	0287322	0287323	0287324	0287325	0287326	0287327
2499	0287328	0287329	0287330	0287331	0287332	0287333	0287334	0287335
SUPPLY VOLTAGE	**7-15VDC**				**5VDC**			
2443*	0300871	0300872	0300873	0300874				
2495	0287336	0287337	0287338	0287339	0287340	0287341	0287342	0287343
2496					0287348	0287349	0287350	0287351
2497					0287356	0287357	0287358	0287359

Specify both Model Number and Catalog Number when ordering.

** 115 and 230VAC power selectable by jumpers at rear connector.*



These versatile supplies are ideal for powering digital circuitry, test sets, instrument bridges, and process control transmitters. Many models have regulation of ±0.1% or better. All components are generously derated to insure a long and trouble-free life. And they use the same rugged construction as the Series A line. Overvoltage protection and other options are available.

SERIES B GENERAL PURPOSE POWER SUPPLIES

STANDARD FEATURES

- Short circuit proof (electronic current limiting)
- May be mounted on any of three surfaces
- Completely serviceable

SPECIFICATIONS

Input Voltage: 105-125 VAC, 50-400 Hz, single phase.

Output Specifications: See pages 16 and 17. Series B supplies have model numbers beginning with the letter B.

Remote Voltage Adjustment/Sensing: Available as an option. See below.

Floating: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient Operating Temperature: 0 to +71°C.

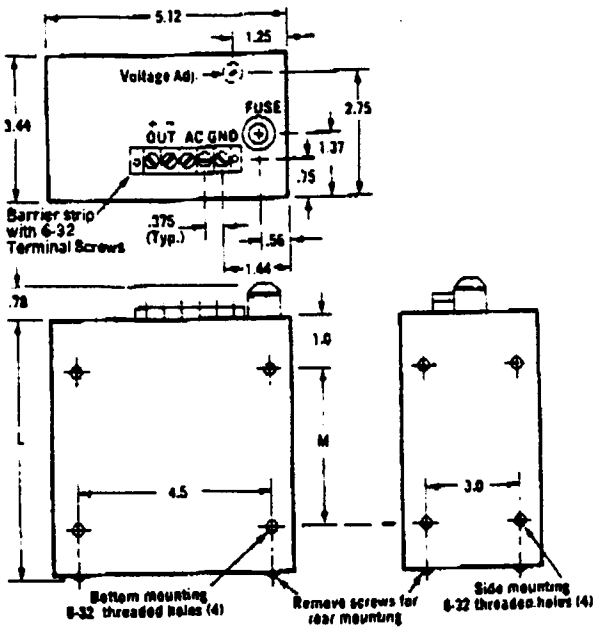
Storage Temperature: −55 to +85°C.

OPTIONS

Overvoltage Protection: An internal preset overvoltage protector is available on all models with outputs of 3 to 7volts. To order, add prefix "V" to the model number, and add $25.00 to the standard price.

Remote Voltage/Sensing: Provision for sensing the output voltage across the load, so that drops in the lead lines are compensated, is available on all models. (This option also permits the use of an externally located potentiometer to adjust output voltage.) To order, add prefix "R" to the model number. No increase in price.

230 Volt Input: All models can be alternately furnished for operation on inputs of 210-250 VAC, 50-400 Hz. To order, add suffix "-230" to model number and $25.00 to price.



Size	L	M	Approx. Weight
G3	3.71	1.62	3lb 2oz
G5	5.09	3.00	4lb 14oz
G6	6.59	4.00	5lb 8oz
G9	9.25	6.00	7lb 4oz
G13	13.25	10.00	11lb

Nominal Output Voltage	Adjust ± V	Output Current Amps at 40°C	55°C	71°C	Regulation Load ±%	Line ±%	Ripple mv RMS	Price	Model	Size
[illegible]	.5	12.0	11.5	9.5	.005	.005	.250	$305	A20H1300	H11
[illegible]	.5	16.0	14.0	12.0	.005	.005	250	440	A20H1600	H16
[illegible]	1	300	300	300	.05	.05	1	80	B24G30	G3
[illegible]	1	750	750	750	.1	.05	1	115	B24G75	G3
[illegible]	1	1.1	1.1	1.0	.1	1	1.5	130	B24G110	G5
[illegible]	1	1.7	1.7	1.5	.1	.1	1.5	145	B24G170	G5
[illegible]	.5	2.1	2.0	2.0	1	.1	1.5	160	B24G210	G5
[illegible]	.5	2.1	2.0	2.0	.005	.005	.250	185	A24MT210	M6
[illegible]	.5	3.5	3.0	2.5	.15	1	1.5	205	B24G350	G9
[illegible]	.5	3.5	3.0	2.5	.005	.005	250	245	A24MT350	M9
[illegible]	.5	5.0	5.0	5.0	.15	1	1.5	255	B24G500	G13
[illegible]	.5	6.5	6.0	4.5	.005	.005	250	280	A24MT650	M13
[illegible]	.5	8.5	7.2	5.9	.005	.005	250	335	A24H850	H8
[illegible]	.5	12.0	10.5	9.0	.005	.005	250	385	A24H1200	H11
[illegible]	.5	15.0	13.0	11.0	.005	.005	.250	440	A24H1500	H16
[illegible]	1	.300	.300	300	.05	.05	1	100	B25G30	G3
[illegible]	1	.750	.750	.750	1	.05	1	120	B25G75	G3
[illegible]	1	1.1	1.1	1.1	.1	.1	1.5	140	B25G110	G5
[illegible]	.5	1.7	1.7	1.5	.1	1	1.5	165	B25G170	G5
[illegible]	.5	2.1	2.1	2.0	.1	1	1.5	170	B25G210	G5
[illegible]	.5	3.5	3.0	2.5	.15	1	1.5	210	B25G350	G9
[illegible]	.5	5.0	5.0	5.0	.15	1	1.5	265	B25G500	G13
[illegible]	1	300	300	300	.05	.05	1	100	B28G30	G3
[illegible]	1	500	500	500	.05	.05	1	110	B28G50	G3
[illegible]	1	800	.800	800	1	.05	1	120	B28G80	G5
[illegible]	1	1.1	1.1	1.0	1	.05	1	135	B28G110	G5
[illegible]	.5	1.8	1.6	1.5	1	1	1.5	160	B28G180	G5
[illegible]	.5	2.1	2.1	2.0	1	1	1.5	170	B28G210	G5
[illegible]	.5	2.1	2.1	2.0	.005	.005	250	190	A28MT210	M6
[illegible]	.5	3.0	2.7	2.5	.15	.1	1.5	200	B28G300	G9
[illegible]	.5	3.0	2.7	2.5	.005	.005	250	225	A28MT300	M9
[illegible]	.5	5.0	5.0	5.0	.15	1	1.5	255	B28G500	G13
[illegible]	.5	5.0	5.0	5.0	.005	.005	250	250	A28MT500	M13
[illegible]	.5	8.0	6.8	5.6	.005	.005	.250	335	A28H800	H8
[illegible]	.5	11.0	9.5	8.0	.005	.005	250	385	A28H1100	H11
[illegible]	.5	14.0	12.0	10.0	.005	.005	.250	440	A28H1400	H16
[illegible]	1	300	300	300	.05	.05	1	100	B30GT30	G3
[illegible]	1	500	.500	500	.05	.05	1	115	B30GT50	G3
[illegible]	1	1.1	1.1	1.0	1	1	1	145	B30G110	G5
[illegible]	1	1.7	1.6	1.5	1	1	1.5	160	B30GT170	G5
[illegible]	.5	2.1	2.1	2.0	1	1	1.5	175	B30G210	G6
[illegible]	.5	2.1	2.1	2.0	.005	.005	.250	195	A30MT210	M6
[illegible]	.5	3.0	2.7	2.5	.005	.005	250	230	A30MT300	M9
[illegible]	.5	5.0	5.0	5.0	.15	1	1.5	260	B30GT500	G13
[illegible]	.5	5.0	5.0	5.0	.005	.005	250	280	A30MT500	M13
[illegible]	.5	7.5	6.3	5.2	.005	.005	250	340	A30H750	H8
[illegible]	.5	10.0	9.0	8.0	.005	.005	.250	395	A30H1000	H11
[illegible]	.5	14.0	12.0	10.0	.005	.005	250	455	A30H1400	H16
[illegible]	1	300	.300	.300	.05	.05	1	100	B32GT30	G3
[illegible]	1	.500	.500	.500	.05	.05	1	115	B32GT50	G3
[illegible]	1	1.0	1.0	1.0	.1	.1	1	145	B32GT100	G5
[illegible]	1	1.5	1.5	1.5	.1	.1	1.5	170	B32GT150	G5
[illegible]	.5	1.8	1.6	1.3	.005	.005	250	205	A32MT180	M6
[illegible]	.5	2.5	2.1	1.7	.005	.005	250	245	A32MT250	M9
[illegible]	.5	9.0	7.5	6.0	.005	.005	.250	410	A32HT900	H11
[illegible]	1	300	.300	.300	.05	.05	1	100	B34GT30	G3
[illegible]	1	800	.800	800	.1	1	1	145	B34GT80	G5
[illegible]	1	1.5	1.5	1.5	1	1	1.5	175	B34GT150	G5
[illegible]	1	.100	.100	.100	.05	.05	1	90	B35GT10	G3
[illegible]	1	.300	300	300	.05	.05	1	100	B35GT30	G3
[illegible]	1	500	500	.500	.05	.05	1	120	B35GT50	G3
[illegible]	1	.600	600	600	.1	.05	1	135	B35GT60	G3
[illegible]	1	800	.800	.800	1	1	1.5	145	B35GT80	G5
[illegible]	1	.100	.100	.100	.05	.05	1	90	B36GT10	G3
[illegible]	1	500	500	500	.05	.05	1	120	B36GT50	G3
[illegible]	1	.800	750	.700	.1	.05	1	145	B36GT80	G5
[illegible]	.5	1.3	1.3	1.3	1	.1	1.5	160	B36GT130	G6
[illegible]	.5	1.3	1.3	1.3	.005	.005	250	200	A36MT130	M6
[illegible]	.5	2.3	2.0	1.8	1	.1	1.5	225	B36GT230	G9
[illegible]	.5	2.3	2.0	1.8	.005	.005	.250	245	A36MT230	M9
[illegible]	.5	4.0	3.2	2.5	.005	.005	.250	290	A36MT400	M13
[illegible]	.5	8.0	6.6	5.3	.005	.005	250	410	A36HT800	H11
[illegible]	.5	11.0	9.1	7.2	.005	.005	.250	510	A36HT1100	H16
40	1	.200	.200	200	.05	.05	1	105	B40GT20	G3
40	1	400	400	400	.05	.05	1	130	B40GT40	G3
40	1	.500	.500	500	.1	.05	1	145	B40GT50	G5
40	1	1.0	1.0	1.0	1	1	1.5	165	B40GT100	G6
[illegible]	1	200	.200	.200	.05	.05	1	105	B45CT20	G3
[illegible]	1	.400	400	400	.05	.05	1	140	B45GT40	G3

Nominal Output Voltage	Adjust ± V	Output Current Amps at 40°C	55°C	71°C	Regulation Load ±%	Line ±%	Ripple mv RMS	Price	Model	Size
[illegible]	1	200	.200	200	.05	.05	1	$105	B48G120	G3
[illegible]	1	.400	400	.400	.05	.05	1	145	B48GT40	G3
[illegible]	1	.600	.600	.600	1	.1	1	175	B48CT60	G5
[illegible]	1	1.1	1.0	600	.1	.1	1.5	190	B48GT110	G6
[illegible]	1	1.2	1.0	800	.005	.005	.250	215	A48MT120	M6
[illegible]	1	1.8	1.6	1.2	.005	.005	250	250	A48MT180	M9
[illegible]	1	3.0	2.6	2.1	.005	.005	250	290	A48MT300	M13
[illegible]	1	6.0	5.0	4.0	.005	.005	250	410	A48HT600	H11
[illegible]	1	8.5	7.2	5.9	.005	.005	250	510	A48HT850	H16
[illegible]	1	.400	400	400	.05	.05	1	155	B50CT40	G3
[illegible]	1	500	500	500	.05	.05	1	180	B50CT50	G5
[illegible]	1	1.0	800	.700	.005	.005	250	225	A50MT100	M6
[illegible]	1	1.5	1.3	1.0	.005	.005	.250	265	A50MT150	M9
[illegible]	1	2.7	2.3	1.8	.005	.005	250	305	A50MT270	M13
[illegible]	1	6.0	5.0	4.0	.005	.005	250	420	A50HT600	H11
[illegible]	1	8.0	6.6	5.2	.005	.005	250	510	A50HT800	H16
[illegible]	1	.300	300	300	.05	.05	1	155	B55GT30	G3
[illegible]	1	500	.500	500	.05	.05	1	185	B55GT50	G5
[illegible]	1	200	200	.200	.05	.05	1	130	B60GT20	G3
[illegible]	1	.300	300	300	.05	.05	1	160	B60GT30	G3
[illegible]	1	.400	400	.400	.05	.05	1	185	B60GT40	G5
[illegible]	1	650	720	600	.005	.005	250	230	A60MT65	M6
[illegible]	1	1.2	1.0	800	.005	.005	.250	265	A60MT120	M9
[illegible]	1	2.5	2.1	1.7	.005	.005	250	305	A60MT250	M13
[illegible]	1	5.0	4.1	3.3	.005	.005	250	425	A60HT600	H11
[illegible]	1	7.0	5.8	4.6	.005	.005	250	515	A60HT700	H16
[illegible]	1	.300	300	300	.05	.05	1	160	B65GT30	G3
70	1	100	.100	100	.05	.05	1	120	B70GT10	G3
[illegible]	1	.300	300	300	.05	.05	1	160	B70GT30	G3
[illegible]	1	.050	.050	050	.05	.05	1	105	B75GT05	G3
[illegible]	1	.200	200	200	.05	.05	1	155	B75GT20	G3
[illegible]	1	600	500	400	.005	.005	250	230	A75MT60	M6
[illegible]	1	1.0	830	.660	.005	.005	250	270	A75MT100	M9
[illegible]	1	2.0	1.8	1.5	.005	.005	250	305	A75MT200	M13
[illegible]	1	4.0	3.3	2.6	.01	.01	1	425	A75HT400	H11
[illegible]	1	5.6	4.6	3.6	.01	.01	1	520	A75HT560	H16
[illegible]	1	.100	100	100	.05	.05	1	135	B80GT10	G3
[illegible]	1	200	200	.200	.05	.05	1	160	B80GT20	G3
[illegible]	1	.200	200	200	.05	.05	1	160	B85CT20	G3
[illegible]	1	200	.200	200	.05	.05	1	160	B90GT20	G3
[illegible]	1	.500	400	.300	.005	.005	250	230	A90MT50	M6
[illegible]	1	800	700	600	.005	.005	250	270	A90MT80	M9
[illegible]	1	1.5	1.3	1.0	.005	.005	250	305	A90MT150	M13
[illegible]	1	3.3	2.7	2.1	.01	.01	1	435	A90HT330	H11
[illegible]	1	4.4	3.6	2.9	.01	.01	1	525	A90HT440	H16
[illegible]	1	200	.200	200	.05	.05	1	165	B95GT20	G3
[illegible]	1	100	.100	.100	.05	.05	1	150	B100GT10	G3
[illegible]	1	.200	200	200	.05	.05	1	165	B100GT20	G3
[illegible]	1	.460	460	340	.1	.1	1.5	200	B100GT46	G6
[illegible]	1	650	650	650	1	1	1.5	225	B100GT65	G6
[illegible]	1	700	600	500	.005	.005	250	265	A100M70	M6
[illegible]	1	1.3	1.2	1.0	.005	.005	250	305	A100MT130	M13
[illegible]	1	3.0	2.5	2.0	.01	.01	1	435	A100HT300	H11
[illegible]	1	4.0	3.3	2.6	.01	.01	1	525	A100HT400	H16
[illegible]	1	200	200	200	.05	.05	1	170	B110GT20	G3
[illegible]	1	100	.100	100	.05	.05	1	195	B120GT10	G3
[illegible]	1	200	200	200	.05	.05	1	170	B120GT20	G3
[illegible]	1	400	400	300	.1	1	1.5	195	B120GT40	G6
[illegible]	1	550	550	.550	1	1	1.5	235	B120G55	G6
[illegible]	1	600	.500	400	.005	.006	250	275	A120M60	M6
[illegible]	1	1.2	1.1	1.0	.005	.005	250	305	A120MT120	M13
[illegible]	1	2.5	2.0	1.6	.01	.01	1	445	A120HT250	H11
[illegible]	1	3.5	2.9	2.3	.01	.01	1	535	A120HT350	H16
[illegible]	1	.200	200	200	.05	.05	1	190	B125GT20	G3
[illegible]	1	.200	.200	.200	.05	.05	1	195	B130GT20	G3
[illegible]	1	200	200	200	.05	.05	1	195	B135GT20	G3
[illegible]	1	200	200	200	.05	.05	1	195	B140GT20	G3
[illegible]	1	.100	100	100	.05	.05	1	160	B150GT10	G3
[illegible]	1	200	.200	200	.05	.05	1	190	B150GT20	G3
[illegible]	1	.320	320	.250	1	.1	1.5	210	B150GT32	G6
[illegible]	1	420	420	.420	.1	.1	1.5	225	B150GT42	G9
[illegible]	1	1.0	900	800	.005	.005	250	335	A150MT100	M13
[illegible]	1	3.0	2.6	2.0	.01	.01	1	555	A150HT300	H16
[illegible]	1	100	100	.100	.1	.05	1.5	190	B200GT10	G3

*or 2 mv, whichever is greater

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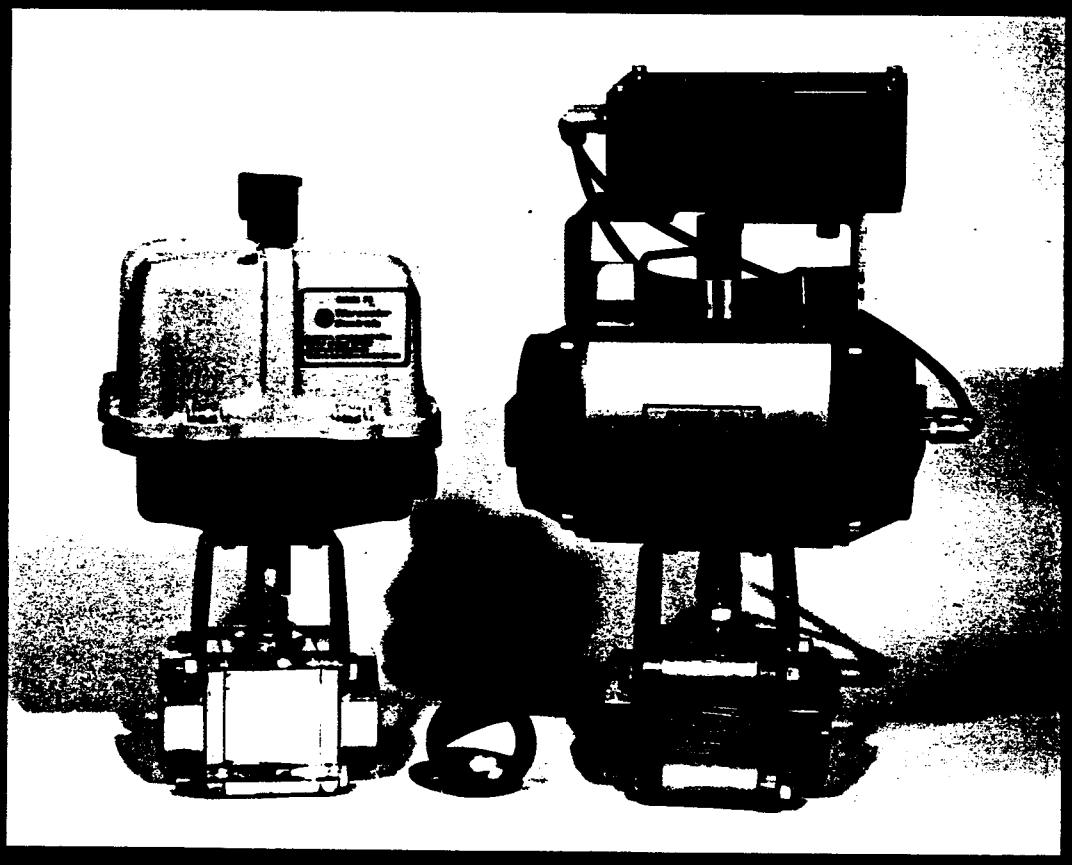
Advanced Ball Control Valves for High Performance Throttling Applications

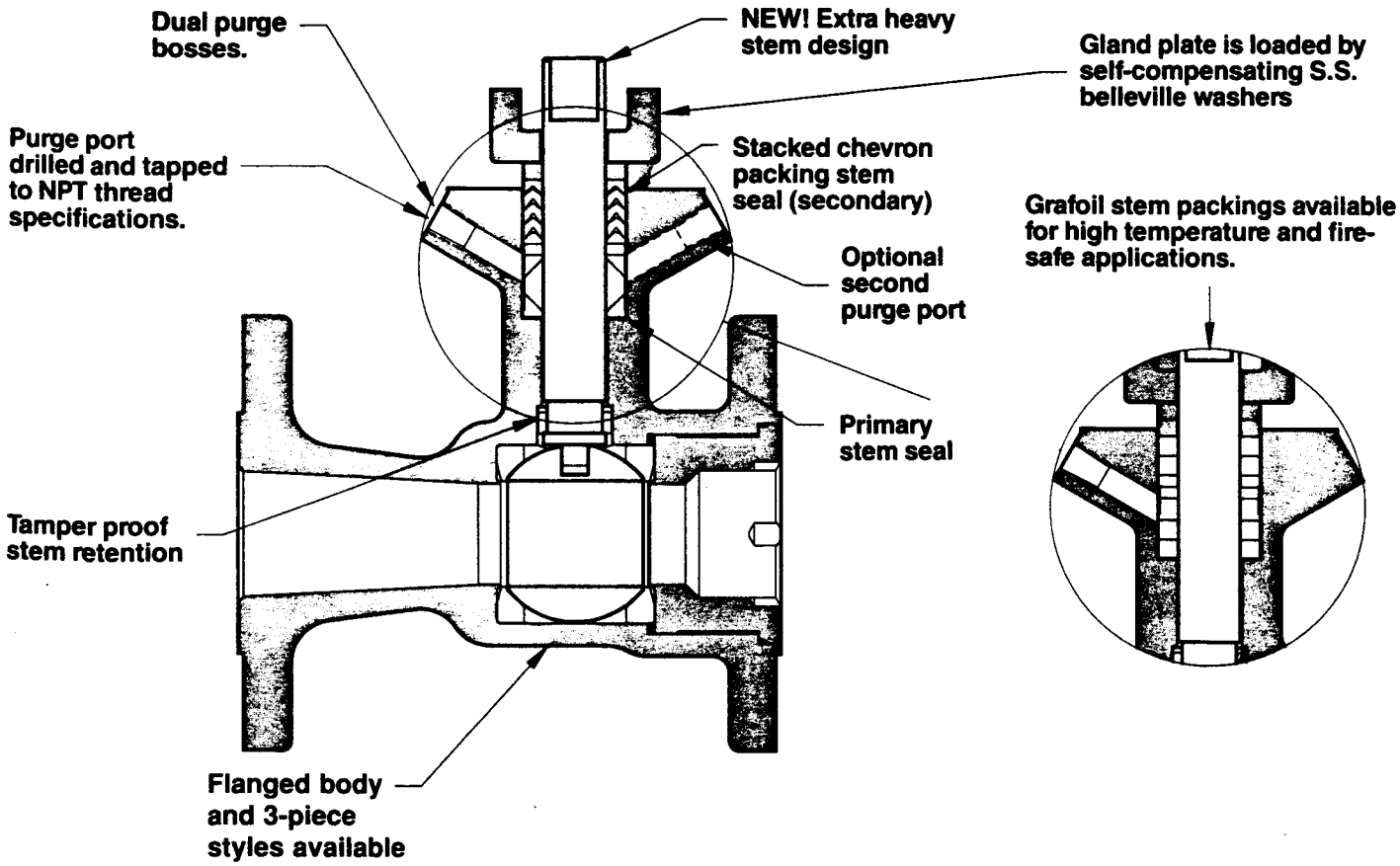
CV-3



Worcester Controls

The Series 94

Series 94 [3-Piece]
Series 94-150/300 [Flanged]

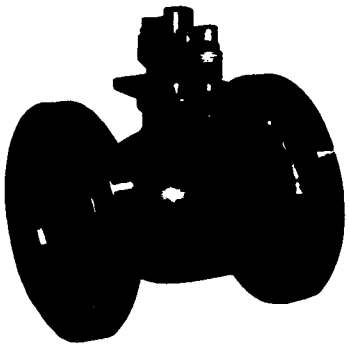


Worcester's Series 94 valve sets new performance standards for both cycle-life and leak tightness ball valves. Available in flanged body or 3 piece styles, it offers a unique combination of features:

- Dual Stem Seals – A primary seal and filler ring seal against the stem and body. Three chevron packing rings, loaded by the gland plate, form the secondary seal.
- Double "Live-Loaded"Stem Seals – Stem seals benefit from the springlike properties inherent in the chevron rings. They are further loaded by the gland plate that is under constant force from the stacked belleville washers.
- Two Stem Purge Bosses – The Series 94 comes with 2 bosses in the stem area. One is drilled & tapped to ⅛" NPT standard threads. An optional second port can be added to allow through purging between the stem seals or connection of instrumentation and sensing devices.
- The valve goes from full open to full closed with 90° operation of the stem. Dual stem seals ensure zero leakage.
- The bonnet and body are cast as a single piece. There are no welds or crevices to fracture and leak.
- The Series 94 is available with stainless steel or Hastelloy C anti-corrosion trim to meet NACE MRO 1-75.

Specifications

Series 94 Flanged (94-150 & 94-300)



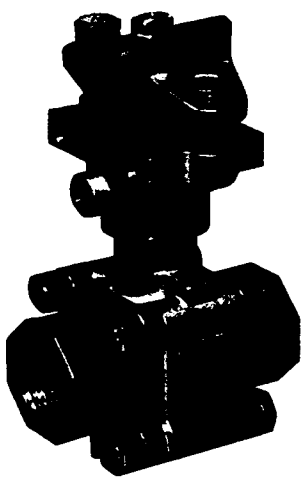
Sizes:	1", 1½", 2", 3", 4" & 6"
Flanges:	94-150 (ANSI 150# raised face) 94-300 (ANSI 300# raised face)
Body Materials:	Stainless steel, carbon steel
Stem:	316 or Hastelloy C, one-piece, tamper resistant, increased stem support for high cycling
Stem Seals:	Virgin TFE, Grafoil
Seats:	Metal "A", Metal "G", High-per Fill, TFE, Polyfill, RTFE or UHMWPE
Body Seals:	TFE or graphite coated stainless steel "S" gasket, TFE, Viton or Graph-lock
Ball:	316 or Hastelloy C (Poly Ond coated where applicable)
Options:	1 leak-off port drilled & tapped to ⅛" NPT standard. Optional 2nd port for purging.
Operation:	Lever handle, pneumatic or electric automation (on/off or proportional control)
Standards:	ANSI B16.5 (flange dimensions), B16.10 (face-to-face dimensions), B16.34, B31.1, B31.3 (including category M materials) and MSS SP-72

Series CL94, CL94-150 & CL94-300 (Chlorine Versions)

Same specifications as for non-chlorine versions but with the following exceptions:

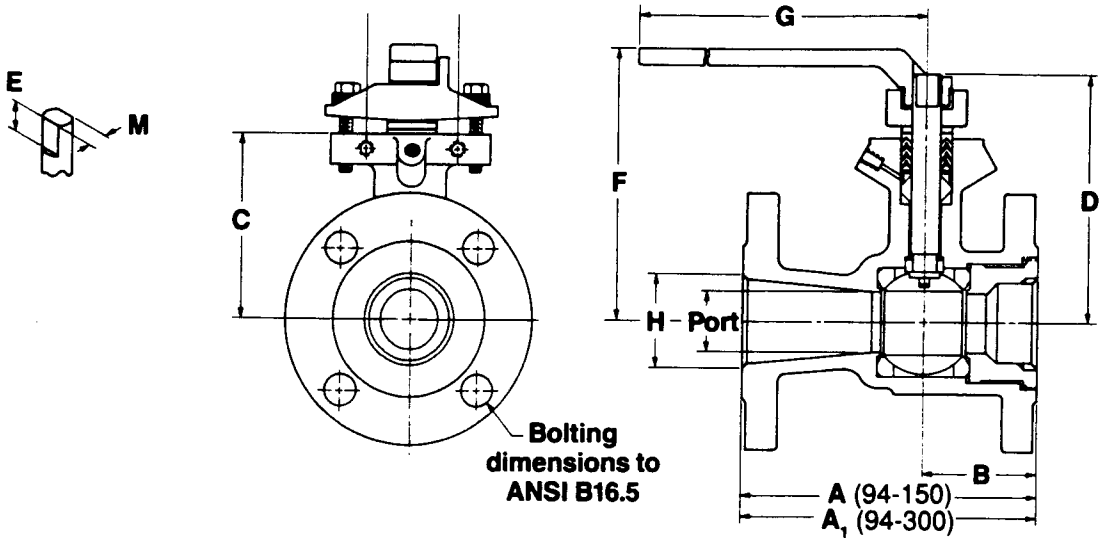
Body:	Carbon steel
Ball & Stem:	Hastelloy C (Cavity relief hole in ball)
Seat/Seals:	TFE seat & seal (combined seat/seal on 3-piece valves), allows two-way flow with a cavity relief hole in the ball
Special:	Assembled & packaged in accordance with Chlorine Institute guidelines in Pamphlet 6

Series 94 3-Piece

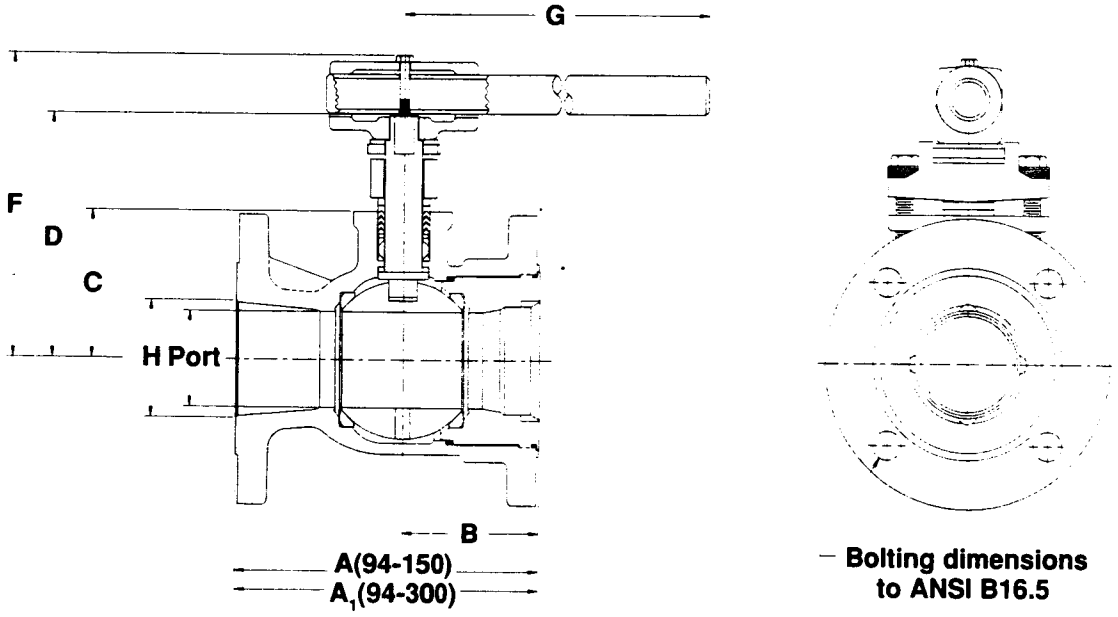


Sizes:	¼" – 2"
Ends:	Screwed Ends, Socket Weld, Butt Weld
Body Materials:	Carbon Steel, Stainless Steel
Stem:	316 or Hastelloy C® , One-piece tamper-resistant construction with increased stem support for high cycling
Stem Seals:	Virgin TFE, Grafoil®
Seats:	Metal "A", Metal "G", High-per Fill® , TFE, Polyfill® , RTFE, UHMWPE
Body Seals:	Graphite coated "S" gasket, TFE coated "S" gasket, TFE, Viton® or *Graph-lock™
Ball:	316 or Hastelloy C (Poly Ond™ coated where applicable)
Options:	1 leak-off port drilled & tapped to ⅛" NPT standard Optional second port for purging
Operation:	Lever handle, pneumatic or electric automation (on/off or proportional control)
Standards:	ANSI B1.20.1 (for SE, NPT threads) B16.11 (for SW socket dimensions only), B16.25 (for BW), B16.34, B31.1, B31.3 (including category M) and MSS SP-72 API 607 Edition 3, and Exxon EXES 3-14-1-2A fire test approvals.

Dimensions for 94-150/300 (Flanged 1″-2″)
inches (mm)



94-150/300 (Flanged 3″-6″)



Series 94-150 & 94-300 Dimensions

Valve Size	A	A_1	B	C	D	E	F	G	H	M	Port
1″	5.00 (127.0)	6.50 (165.1)	2.25 (57.2)	3.43 (87.12)	4.91 (124.71)	.70 (17.78)	5.26 (133.60)	8.00 (203.20)	.98 (24.9)	.343 (8.71)	.75 (19.05)
1½″	6.50 (165.10)	7.50 (190.50)	2.45 (62.23)	4.13 (104.90)	5.66 (143.76)	.75 (19.05)	6.14 (155.96)	10.00 (254.00)	1.57 (39.88)	.500 (12.70)	1.19 (30.23)
2″	7.00 (177.80)	8.50 (215.90)	2.67 (67.82)	4.32 (109.73)	5.85 (148.45)	.75 (19.05)	6.33 (160.78)	10.00 (254.00)	1.97 (50.04)	.500 (12.70)	1.44 (36.58)
3″	8.00 (203.20)	11.12 (282.45)	3.62 (91.95)	3.88 (98.55)	6.29 (175.51)	.65 (16.51)	7.82 (198.63)	22.00 (558.80)	3.06 (77.72)	.745 (18.92)	2.50 (63.50)
4″	9.00 (228.60)	12.00 (304.80)	4.00 (101.60)	4.48 (113.79)	6.91 (175.51)	.65 (16.51)	8.44 (214.38)	22.00 (558.80)	4.03 (102.36)	.745 (18.92)	3.25 (82.55)
6″	10.50 (26.67)	15.88 (403.35)	4.25 (107.95)	6.19 (157.23)	9.06 (230.12)	1.031 (26.19)	11.31 (287.27)	26.00 (660.4)	6.06 (153.92)	1.120 (28.45)	4.38 (111.25)

Dimensions are for layout purposes only. For tolerances contact Worcester Controls. Metric dimensions are converted from standard English.

THE CHARACTERIZED SEAT CONTROL VALVE: ACCURATE CONTROL, BETTER THAN CLASS VI OR BUBBLETIGHT SHUTOFF, AND COMPUTER COMPATIBILITY IN A SMALLER, LIGHTER, REPAIRABLE PACKAGE.

Traditional Control Valves

The most common control valves for industrial processes have been single and double ported globe valves powered by spring diaphragm or cylinder actuators with yoke type mounting brackets. Although globe valves offer good flow characteristics and can take high pressure drops, they have many features that become problems in high performance throttling applications. These include slow response to control signals, bulky actuators, sticking valve stems, leaking packing, limited flow capacity, excessive weight, poor shutoff capability, inability to function with fluids containing solids/fibers, high initial purchase price, difficult maintenance and poor interface with PLC or central computers.

Conventional throttling butterfly valves as well as segmented ball valves and cam action rotary valves have made advances but serious limitations remain; difficult maintenance, high purchase cost and high weight. They also have the function, hysteresis and low response problems associated with adapting linear actuators and positioners for rotary actuation and control.

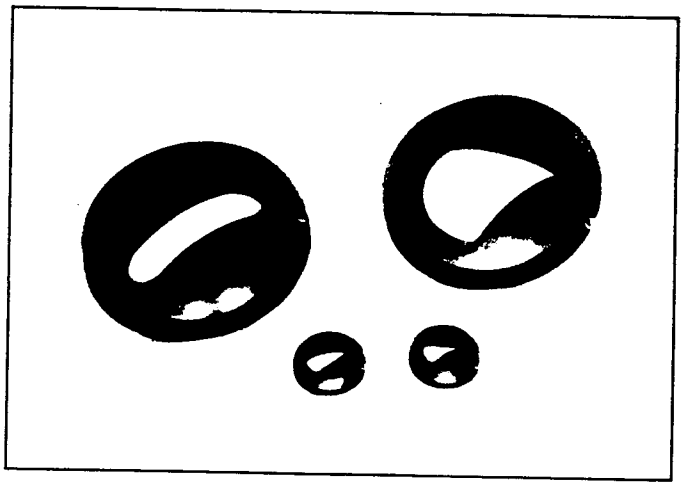
Worcester's patented metal seat technology has opened a new chapter in the history of modulating control. It combines the simplicity of ball valves with the revolutionary characterized seat concept. The combination offers state of the art modulating control valves that are specifically designed for today's automated production needs. Worcester's new generation of advanced ball control valves virtually eliminates the problems associated with traditional control valves.

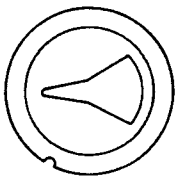
Why Rotary Valves?

Industry turned to rotary valves to get more capacity (C_V) for its dollar, to reduce bulk and weight and to solve external leakage problems associated with globe control valve stem seals. In addition, many processes involving fluids with fibers and solids could not utilize conventional globe valves. But some throttling control problems were still not solved including incompatibility with highly automated/computerized systems.

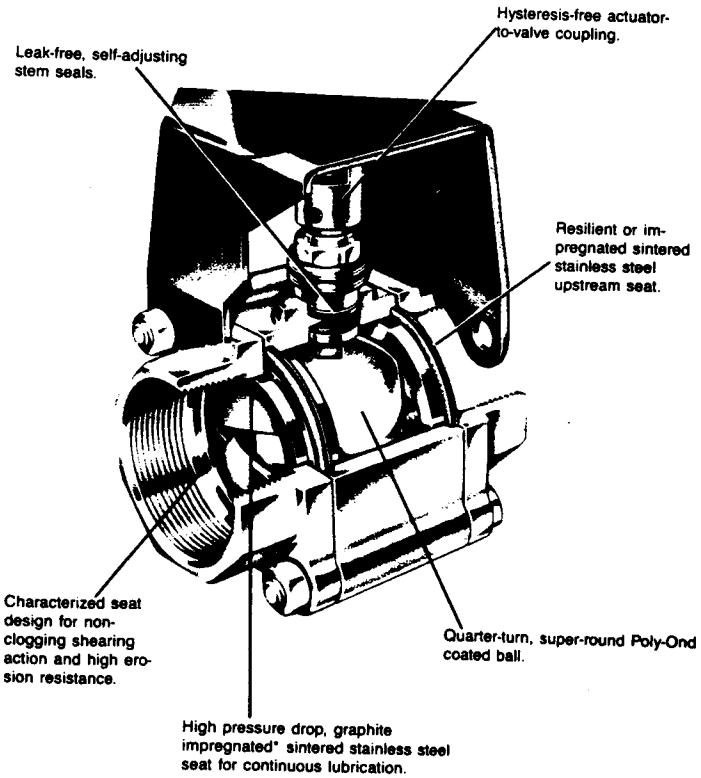
Why Worcester Characterized Seat Valves for Automatic Throttling Control?

- After years of research and evaluation of performance in actual harsh throttling applications, Worcester Controls presents a new patented and award winning seat technology. With this new technology, Worcester has brought the ball valve to a leadership position in advanced throttling control.
- Worcester's new metal seat technology has vastly increased pressure drop and temperature capabilities: pressure drops to 150 psi on steam and 500 psi with liquids; process temperatures to 1000°F.
- Worcester's new metal seat technology means tight shut-off exceeding ANSI Class VI standards. Bubbletight can be done by using the soft seat downstream.
- High Rangeability — Repeatable control through 95% travel.
- Low and High Flow Control — C_Vs from .007 to 200.





Standard characterized seat angles are 30°and 60°; slots of 1/32″ and 1/16″ standard in 1/4″ and 1/2″ valves. Custom Characterized Seats with other angles, slots, and combinations of slots and angles are available.



*TFE impregnated, available on request.

SELECTION/SIZING INFORMATION

There are many control valve sizing formulas used by the process industries, some very complicated and cumbersome, some simple. Worcester Controls has decided to provide solid, field proven sizing information separate from this brochure. If using your personal calculator, use Worcester Controls formulas found in Technical Paper #6 (TP-6). If equipped with PC compatible computer, ask for the Worcester Controls Computer Control Valve Sizing Program. Available on 5¼" or 3½" floppy disks, the program is based on ISA formulas and includes instructions.

Flow Coefficient - C_V - Characterized Seat Control Valves

Valve Size	Line Size	Percent of Rated Travel (Degree of Rotation)										
		0 (0)	10 (9)	20 (18)	30 (27)	40 (36)	50 (45)	60 (54)	70 (63)	80 (72)	90 (81)	100 (90)
¼", ½" (1/32" wideslot)	½		-	.033	.074	.115	.156	.197	.238	.279	.320	.361
	¾	0	-	.029	.066	.102	.139	.175	.212	.248	.285	.321
	1	0	-	.027	.061	.095	.129	.163	.177	.208	.265	.300
¼", ½" (1/16" wideslot)	½	0	-	.07	.20	.33	.46	.60	.73	.86	.99	1.10
	¾	0	-	.06	.18	.29	.41	.53	.65	.77	.88	.98
	1	0	-	.06	.17	.27	.38	.50	.61	.71	.82	.91
¼" ½" 30°V	½	0	.01	.10	.20	.34	.55	.83	1.11	1.59	2.08	2.50
	¾	0	.01	.09	.18	.30	.49	.74	.99	1.41	1.85	2.22
	1	0	.01	.08	.17	.28	.46	.69	.92	1.32	1.73	2.07
¼" ½" 60°V	½	0	.01	.12	.33	.49	.84	1.35	1.95	3.10	4.37	5.92
	¾	0	.01	.10	.29	.44	.75	1.20	1.74	2.76	3.90	5.27
	1	0	.01	.10	.27	.41	.70	1.12	1.62	2.57	3.63	4.91
1" 30°V	1	0	.03	.21	.56	.96	1.58	2.39	3.43	4.62	6.15	7.26
	1½	0	.02	.16	.44	.75	1.23	1.86	2.68	3.60	4.80	5.66
	2	0	.02	.15	.40	.69	1.14	1.72	2.47	3.33	4.43	5.23
1" 60°V	1	0	.03	.30	.78	1.24	2.27	3.59	5.28	8.29	11.6	15.5
	1½	0	.02	.23	.61	.97	1.77	2.80	4.12	6.47	9.05	12.1
	2	0	.02	.22	.56	.89	1.63	2.58	3.80	5.97	8.35	11.2
2" 30°V	2	0	.05	.55	1.72	3.41	5.65	8.26	12.1	16.6	22.2	26.5
	3	0	.04	.45	1.41	2.80	4.63	6.77	9.92	13.6	18.2	21.7
	4	0	.04	.41	1.27	2.52	4.18	6.11	8.95	12.3	16.4	19.6
2" 60°V	2	0	.05	.70	2.64	4.90	9.32	15.5	22.2	32.1	47.2	61.6
	3	0	.04	.57	2.16	4.02	7.64	12.7	18.2	26.3	38.7	50.5
	4	0	.04	.52	1.95	3.63	6.90	11.5	16.4	23.8	34.9	45.6
3" 30°V	3	0	.10	.75	2.68	6.00	10.2	16.9	24.5	33.9	44.8	54.2
	4	0	.07	.54	1.93	4.32	7.34	12.2	17.6	24.4	32.3	39.0
	6	0	.06	.41	1.47	3.30	5.61	9.30	13.5	18.6	24.6	29.8
3" 60°V	3	0	.10	.95	4.25	10.1	18.6	29.4	46.3	67.2	94.4	124.6
	4	0	.07	.68	3.06	7.27	13.4	21.2	33.3	48.4	68.0	89.7
	6	0	.06	.52	2.34	5.56	10.2	16.2	25.5	37.0	51.9	68.5
4" 30°V	4	0	.10	.80	3.59	8.50	16.1	26.8	40.2	56.6	72.5	89.8
	6	0	.07	.52	2.33	5.53	10.5	17.4	26.1	36.8	47.1	58.4
	8	0	.06	.44	1.97	4.68	8.86	14.7	22.1	31.1	39.9	49.4
4" 60°V	4	0	.10	.90	5.69	15.4	28.8	48.6	73.4	107.0	150.7	200.0
	6	0	.07	.59	3.70	10.0	18.7	31.6	47.7	69.6	98.0	130.0
	8	0	.06	.50	3.13	8.47	15.8	26.7	40.4	58.9	82.9	110.0

C_V is defined as the flow of liquid in gallons per minute through a valve with a pressure drop of 1 psi across the valve.

FL	0	.96	.95	.94	.93	.92	.90	.88	.86	.82	.75
X_t	0	.72	.65	.60	.54	.48	.42	.36	.28	.16	.12

FL = Liquid Pressure Recovery Factor X_t = Pressure Drop Ratio Factor (Gas)

MOUNTING KITS SELECTION MANUAL

Use the following charts to find the proper mounting kit for your actuator. To select the appropriate actuator, use valve and actuator bulletins.

Standard mounting kits all have 3 digit numbers.

Use suffix S for mounting kits with positive drive coupling.
(Positive drive coupling is necessary for control valves.)

Use suffix 6 for mounting kits with S.S. bolts.

Use suffix S6 for positive drive coupling and S.S. bolts.

Use suffix 20 for Alloy 20 bolts.

EXAMPLES

065	This mounting kit is not available as 065/6, 065/S, or 065 6/S
009/S 6	This mounting kit is available as 009, 009/6, 009/S and 009 6/S
014 6/S	This mounting kit is available as 014/6 and also 014 S/6
276 6	This kit must be ordered as listed.

VALVE SERIES CODES

S51/S52	ANSI 150 & 300 Flanged Control
59	Fullport
W59	Fullport Energy Mizer
W2 59	Fullport Thermal Fluid Mizer
PT59	Fullport High-per Mizer
C4	Cryogenic
CPT	Characterized Seat Control Valve
C4N	Non-extended 3-piece Cryogenic
4AA	Miser Alloy 20
51/52	ANSI 150 & 300 Flanged
W2 52	Thermal Fluid Mizer 300# Flanged
AF51/AF52	Anti-Static ANSI 150 & 300 Flanged
CL51/CL52	ANSI 150 & 300 Flanged Chlorine
W52	ANSI 300 Flanged Energy Mizer
PT51-52	ANSI 150 & 300 Flanged High-per Mizer
45	Large 3-piece
W2 45	Large 3-piece Thermal Fluid Mizer
W45	Energy Mizer Large 3-piece
PT45	Large 3-piece High-per Mizer
W301	Energy Mizer Wafer ANSI 300
W2 301	ANSI 300 Thermal Fluid Mizer
151/301	ANSI 150 & 300 Wafer
4	3-piece Miser Series 44
W4	Energy Mizer
W2 4	Thermal Fluid Mizer
CL44	3-piece Chlorine
D4	3-piece Diverter
T4	3-piece Three-Way
H4	3-piece Dyn-O-Miser high pressure
FZ44	3-piece Fire-Rated
S4	3-piece Control
82/83	ANSI 150 & 300 Fullport Flanged
AF82/AF83	Anti-Static ANSI 150 & 300 Fullport Flanged
WK44	Clean-Mizer
TWK44	Three-way Clean-Mizer
PT44	High-Per Mizer
MP44	Tire Press Valve
94	3-piece
94-150/300	Flanged
CL94	3-piece Chlorine
CL94-150/300	Flanged Chlorine
FZ94	3-piece Fire Rated
FZ94-150/300	Flanged Fire Rated

ACTUATOR SERIES CODES

A34, B34	Series 34 Pneumatic
05337, 15337	Series 37 Al. Pneumatic
05637, 15637	Series 37 S.S. Pneumatic
1039, 1539, 2039, 2539, 3039, 3539, 4039, 4539	Series 39 Pneumatic
10-2236	Series 36 Electric**
10-3075	Series 75 Electric
B32	Series 32 Manual* Gear Operator
SR44	Series 44 Spring Return Handle Operator

* B size 32 uses Series 34 mounting kits
C, D, E, size 32 have integral mounting kits

**Series 36 Electric Actuators cannot be used on D4, T4, CL44, CL51/52 or valves with V-3 ball option

Effective: January 1, 1990

BALL VALVES

VALVE		ACTUATOR SERIES				
SERIES	SIZE	1039 10-1275	15-2039 15-2275	2539	3039 25-3075	3539
C4 R_3 - R_5	1/4" - 1"	080/S	079/S			
	1 1/2" - 2"		083/S	169/S	117/S	
C4 R_6	1/4" - 1"	265 6/S	264 6/S			
	1 1/2" - 2"	267 6/S	266 6/S	271 6/S	280 6/S	
PT51-52	1/2"-3/4"	068/S	317/S			
	1"	071/S	070/S			
	1 1/2"-2"	075/S	074/S	170/S	078/S	
PT59	2"		283/S	284/S	285/S	286/S
PT45	2 1/2"		283/S	284/S	285/S	286/S
	1/4"-1/2"	009 6/S	318/S			
	3/4"	012 6/S	251 6/S			
PT44	1"	015 6/S	014 6/S			
	1 1/4"	019 6/S	018 6/S			
	1 1/2"	023 6/S	022 6/S	164 6/S	252 6/S	
	2"	027 6/S	026 6/S	165 6/S	030 6/S	253 6/S

SERIES 94 VALVES

VALVE		ACTUATOR SERIES						
SERIES	SIZE	1039 1075	15-2039 15-2275	2539	3039 25-3075	3539	4039	4539
94, CL94, FZ94	1/4"-3/4"	325 325/S	326 326/S					
94, CL94, FZ94, 94-150/300, FZ94-150/300, CL94-150/300	1"-1 1/4"	327 327/S	328 328/S					
94, CL94, FZ94, 94-150/300, FZ94-150/300, CL94-150/300	1 1/2"-2"	329 329/S	330 330/S	331 331/S	332 332/S			
94-150/300, FZ94-150/300, CL94-150/300	3"-4"		333	334	335	336	337	
94-150 94-300	6"				338	339	340	341

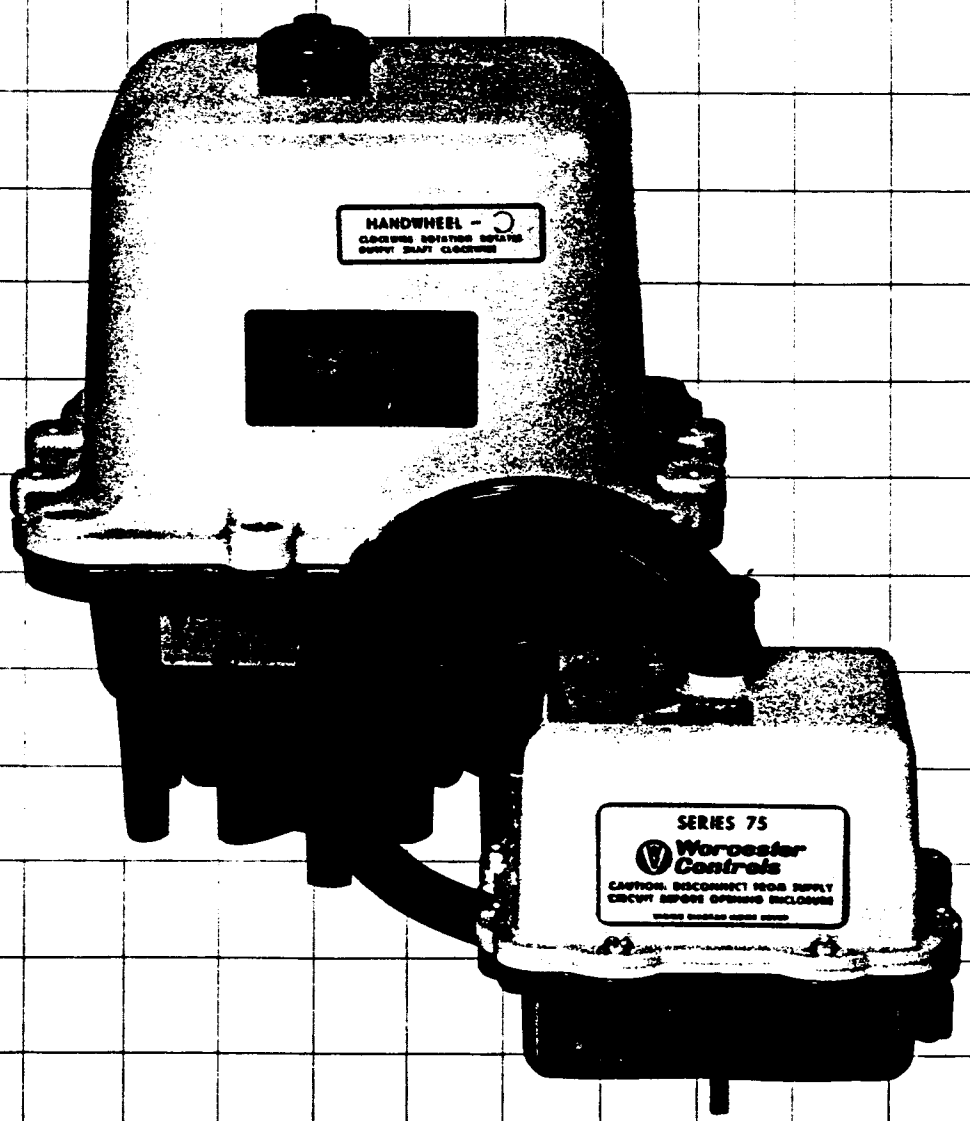
Worcester Controls
A BTR Company

Series 75 Electric Actuator

Specially designed for rotary valve applications, on/off and modulating

PB 730-20

Backed by Worcester's exclusive 2-year warranty

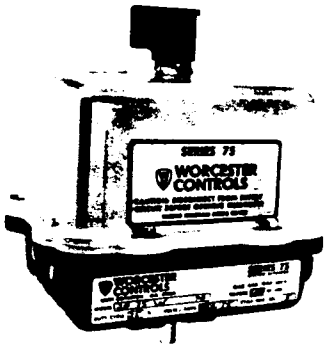


Series 75 Electric Actuators from Worcester Controls add a new dimension of operational dependability and flexibility to modern processes controlled by computers, programmable controllers and other electric control equipment. A multi-function capability permits use of the Series 75 actuator throughout the process for on/off, throttling, variable cycle and any analog or digital control. One of the most reliable electric actuators on the market, the Series 75 is lightweight, compact and powerful. Its brushless, split phase capacitor start/run reversing motor drives a valve through a sealed, permanently lubricated gear train which offers virtually lifetime maintenance-free dependable operation.

The Series 75 is available in six sizes and produces torques to 3000 in.-lbs. Housings are designed to NEMA I General Purpose, NEMA IV Watertight, and NEMA VII, Class 1, Division 1, Group C, D and NEMA IX, Class II, Division 1, Group E, F, G. A baked epoxy finish is the standard coating, but special coatings are available for extreme hazardous environment applications.

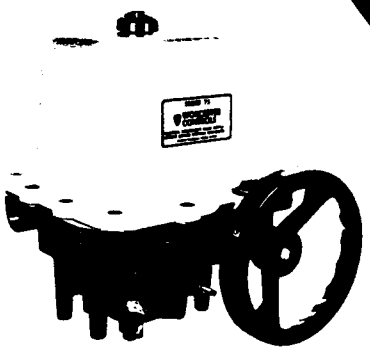
Series 75 actuators may be used on Worcester Controls complete line of ball and butterfly valves or other quarter-turn valves or devices requiring rotary operators. More-over, their ability to provide power in both directions through selected arcs from 20° through 300° makes them ideal for control of heating, ventilating and air conditioning duct systems and automatic, remotely operated equipment.

Sizes 10, 12, 15, 20, 22
NEMA I

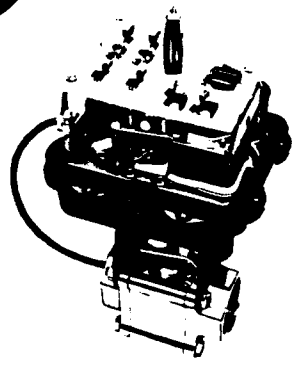


Sizes 10, 12, 15, 20, 22
NEMA IV

Sizes 10, 12, 15, 20, 22
NEMA VII & IX



Sizes 25, 30
NEMA IV, VII & IX



I-75

Options to Fit your Application

The Series 75 can be ordered with a variety of options to custom tailor it to the needs of your application. **Cycle Length Control** allow field adjustment of opening and closing cycles. **Feedback Potentiometer** or current position indicator signals the exact position of the output shaft. **Heater/Thermostat** prevents condensation from collecting inside the actuator. **180° Center-Off Kit** provides and extra position for 3-way valves and is useful for dribble feed applications in quarter-turn valves. **Additional Limit Switches** may be used to operate lights which indicate valve position or to operate other equipment. **Mechanical Brake** is used especially in butterfly valve applications to stop actuator drift due to pressure. An integral electric positioner and set point controller are available for throttling control.

Programmable Controller Interface

In operating electric actuators with devices which use solid state switches, such as programmable controllers or computers, the switching circuit must be protected from higher current and voltage than its rating.

The I-75, a solid circuit board, acts as a relay between an electric actuator and a computer or programmable controller. By driving the electric actuator with a totally separate current activated by the controller command, the I-75 solves the problem of unequal voltage between the pc and the actuator. This protects the pc from destructive feedback voltage and current. In effect, it creates a pc/computer ready actuator.

Worcester's I-75 is an option available with the Series 75 or may be used as a separate unit to fit other electric devices. It is totally enclosed in the actuator housing, and therefore applicable in any environment safe for the actuator's NEMA enclosure. Refer to bulletin PB-I75 for further information.

Specifications

Sizes:
Small: 10, 12, 15, 20, 22 Large: 25, 30

Torque:
150-3000 in.-lbs

Enclosures:
Small: NEMA I General Purpose; NEMA IV Watertight; NEMA VII, Class I, Division 1, Group C, D; NEMA IX, Class II, Division 2, Group E, F, G; Hazardous Environments.
Large: NEMA IV Watertight

Enclosure Coatings:
Corrosion resistant baked epoxy finish standard. Consult factory for special applications.

Voltages:
120V & 240V AC, 12V & 24V DC

Connection:
Male output shaft (female shaft available on request)

Gearing:
Small: Sealed, permanently lubricated spur gear module driving a final dual torque bull gear
Large: Two stage planetary gear, permanently lubricated self locking gear train

Overload Protection:
AC only. Thermal overload protector with automatic reset.

Travel Stop Limit Switches:
Two SPDT, all sizes; Internal, independent, adjustable. Actuated by cams mounted on drive shaft. Adjustable from 20° to 300°.

Manual Override:
All sizes, NEMA IV, VII and IX only.
Small: Lift position indicator and turn shaft.
Large: Turn side mounted handwheel.

Options:
All sizes, all enclosures. Cycle Length Control (CLC) Dual or single Feedback Potentiometer, 4-20 mA Position Indicator, Heater/Thermostat, Condensation Drainplug, 180° Center-Off (3 positions), Additional Limit Switches, Mecahnical Brake, I-75 Computer Interface Unit, Various Duty Cycles, Positioner, Controller.

Temperature Limits (All models):
−40°F (with heater & thermostat) to 150°F (max.)

Lubrication:
Permanently lubricated gear trim. Self-lubricated bearings.

Conduit Connection:
One ½" NPT - Two ½" Optional

Operation:
Reversing (bi-directional) for use with quarter-turn valves or rotating equipment to full rotation.

Actuator Model	Stall Torque in.-lbs.	Startup Torque in. - lbs.	VOLTAGES		Duty Cycles	90° Time Seconds	LOCKED ROTOR CURRENT - AMPS				Approx. Weight Lbs. (kg.)
			VAC	VDC			120 VAC	240 VAC	12 VDC	24 VDC	
1075	150	120	120, 240	--	10%	2.5	1.75	.62	--	--	8.2 (3.7)
			120, 240	12, 24	25%	5	.75	.42	2.8	1.5	
			120, 240	--	75%	15	.33	.17	--	--	
			120, --	--	100%	15	.27	.62	--	--	
1275	225	180	120, 240	--	10%	3.75	1.75	--	--	--	8.2 (3.7)
			120, 240	12, 24	25%	8	.75	.42	2.8	1.5	
			120, 240	--	75%	23	.33	.17	--	--	
			120, --	--	100%	23	.27	--	--	--	
1575	325	260	120	--	20%	5	.75	--	--	--	8.5 (3.83)
2075	600	480	120, 240	--	10%	2.5	3.3	1.45	--	--	9.5 (4.31)
			120, 240	12, 24	25%	5	1.6	.93	5.6	3.0	
			120, 240	--	75%	15	.50	.38	--	--	
			120, --	--	100%	23	.50	--	--	--	
2275	900	720	120, 240	--	10%	3.75	3.3	1.45	--	--	9.5 (4.31)
			120, 240	12, 24	25%	8	1.6	.93	5.6	3.0	
			120, --	--	75%	23	.80	.38	--	--	
2575	1800	1440	120, 240	--	25%	10	2.7	1.65	--	--	48.0 (21.8)
			120, 240	--	75%	15	2.5	1.55	--	--	
3075	3000	2400	120, 240	--	25%	15	2.9	1.8	--	--	48.0 (21.8)
			120, --	--	75%	23	2.7	--	--	--	

Actuator Sizing

There are a few terms associated with electric actuators that require definition. **Actuator Start-up Torque** is the amount of torque initially produced by an actuator when starting from rest. Use start-up torque when selecting an electric actuator for a ball valve that is used for either on-off or throttling service. **Actuator Stall Torque** is the amount of torque produced by the actuator just prior to the point where the motor stalls.

Select the actuator whose start-up torque output exceeds the breakaway torque requirements of the valve.

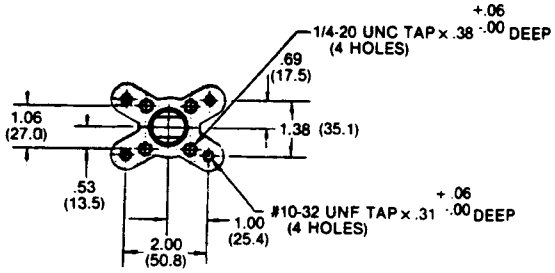
For valves other than ball valves, actuators must be selected such that start-up torque exceeds the maximum torque rating of the valve.

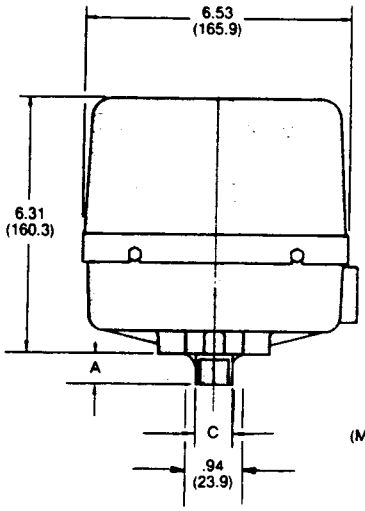
Before making a final selection, make sure that the electric actuator selected is available in the required voltage. Not all electric actuators are available in all voltages.

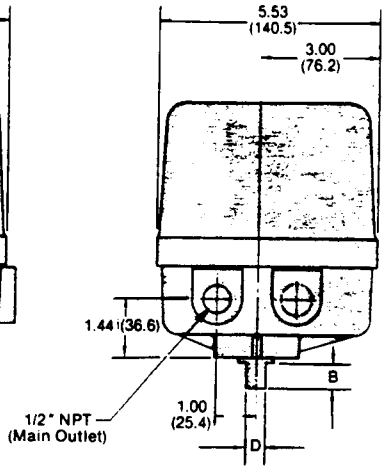
To determine torque for Worcester Controls valves for proper actuator sizing refer to the Actuator Sizing Manual for Worcester Valves, bulletin ASM.

Dimensions

Sizes 10, 12, 15, 20, 22 NEMA I (General Purpose) Enclosure

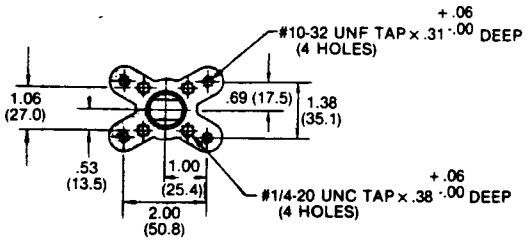


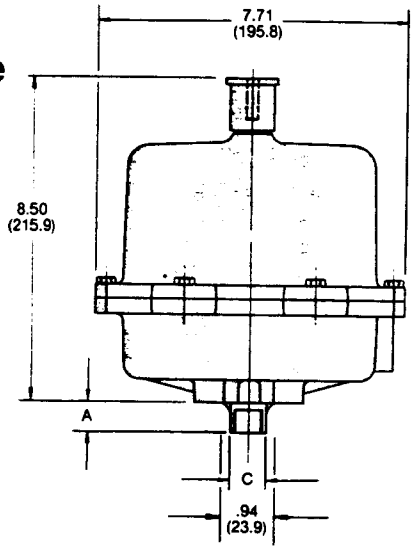


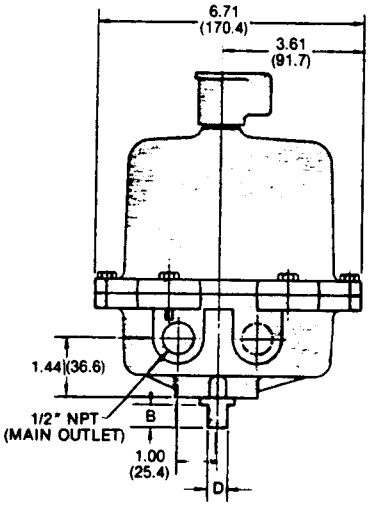


	DIMENSIONS INCHES (mm)			
SIZE	A	B	C	D
10,12	.74 (18.8)	.66 (16.7)	.59 (15.0)	.36 (9.14)
15,20,22	.90 (22.9)	.82 (20.8)	.80 (20.3)	.50 (12.7)

Sizes 10, 12, 15, 20, 22 NEMA IV (Watertight) Enclosure NEMA VII & IX (Hazardous Environment) Enclosure

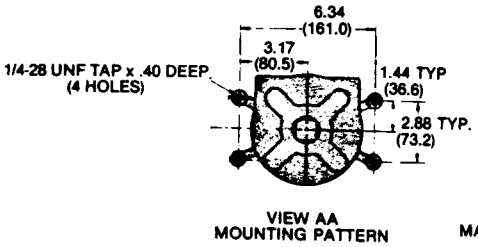


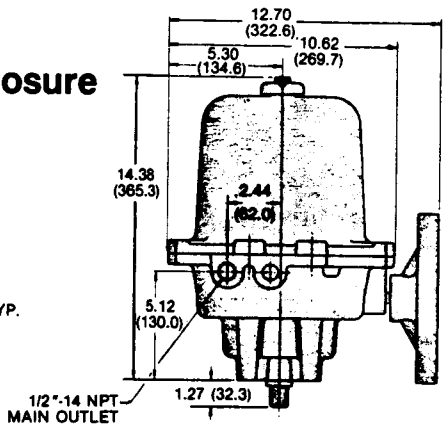


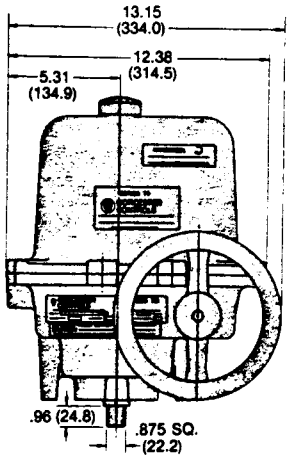


	DIMENSIONS INCHES (mm)			
SIZE	A	B	C	D
10,12	.74 (18.8)	.66 (16.7)	.59 (15.0)	.36 (9.14)
15,20,22	.90 (22.86)	.82 (20.82)	.80 (20.32)	.50 (12.7)

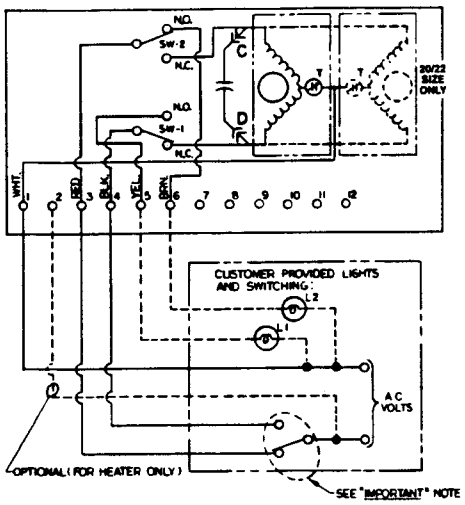
Sizes 25, 30 NEMA IV (Watertight) Enclosure NEMA VII & IX (Hazardous Environment) Enclosure







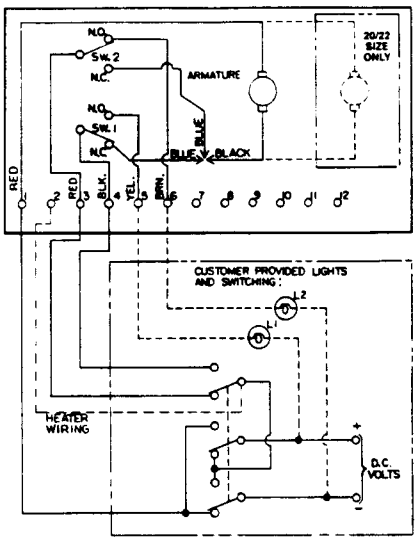
Wiring Diagrams



Sizes 10-30
AC Power

IMPORTANT!
EACH ACTUATOR SHOULD BE ELECTRICALLY POWERED THRU ITS OWN INDIVIDUAL SINGLE POLE SWITCH CONTACTS TO ISOLATE THE UNUSED WINDING.

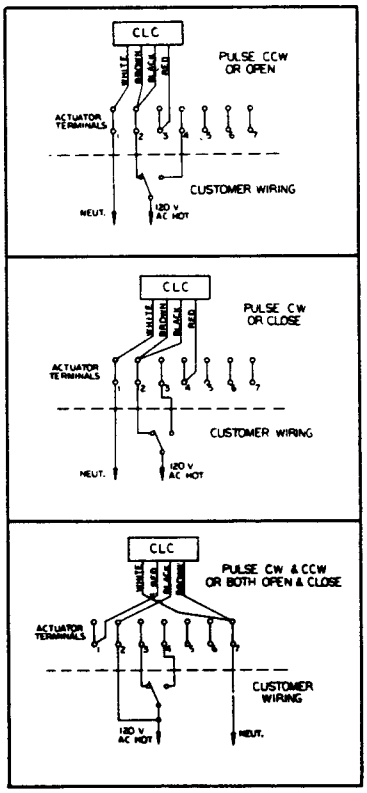
NOTE:
1. ACTUATOR SHOWN IN COUNTER-CLOCKWISE EXTREME OF TRAVEL, OR "OPEN" POSITION.



Sizes 10-22
DC Power

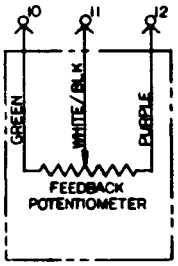
Design Options

Cycle Length Control (CLC)



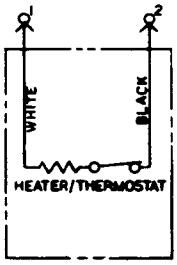
Prevents destructive pipeline shock caused by fast opening or closing valves on steam or hydraulic services. The CLC units allow field adjustment of the standard actuator's rate cycle time up to approximately 14 minutes.

Feedback Potentiometer



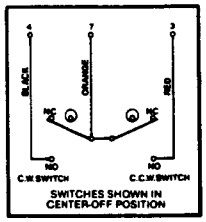
A feedback potentiometer is used when remote indication is desired. Potentiometers are available in 1000 ohms.

Heater/Thermostat



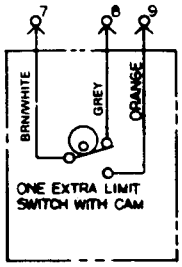
A heater/thermostat kit for cold ambient temperatures or humid environments uses a 15 watt heater and a thermostat set to close at 80°F and open at 95°F.

180° Center-off (3 positions)

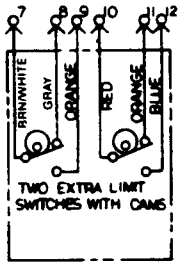


Used with 3-way valves of similar products requiring a mid-position stop capability for shut-off. May be adjusted for travel other than 180°.

Limit Switches



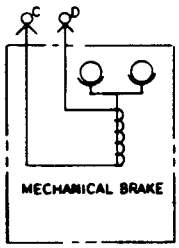
1 Limit Switch



2 Limit Switches

May be mounted to either operate lights, indicating valve position, or for operating other equipment such as pumps, compressors, mixers, etc.

Mechanical Brake



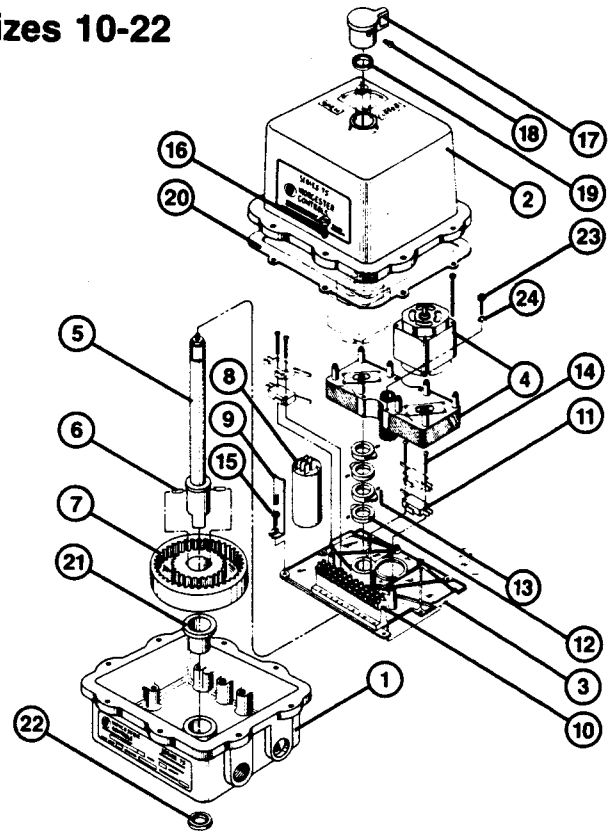
(A.C. SHOWN)

A mechanical brake is used for all butterfly valve applications or when the actuator must be stopped instantaneously and securely. (Used on 10-22 sizes only.) Available for A.C. and D.C. actuators.

Additional Options Available. Consult Factory.

Parts List & Materials of Construction

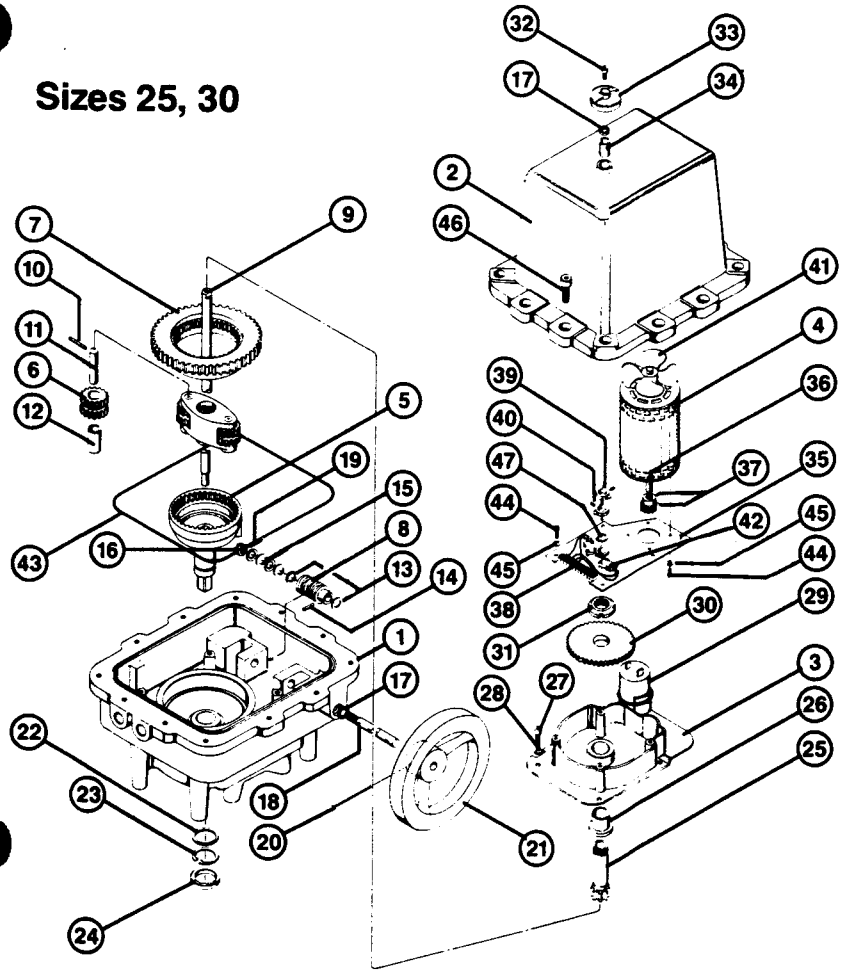
Sizes 10-22



Item	Qty.	Description	Material
1	1	Base	Aluminum Casting
2	1	Cover	Aluminum Casting
3	1	Base Plate	Zinc Casting
4	1	Motor Module	Zinc Casting
5	1	Output Shaft	Steel
6	2	Gear Drive Pin	Steel
7	1	Bull Gear	Steel
8	1	Capacitor (w/Fiber Washer if Required	Phenolic Encapsulated
9	1	Capacitor Bracket	Steel
10	1	Terminal Strip	Polyethylene Based Material
11	2	Limit Switch	Phenolic Encapsulated
12	2	Limit Switch Cam	Zinc Casting
13	1/Cam	Cam Set Screw	Steel
14	4	Limit Switch Screw	Steel
15	6	Base Plate Screw	Steel
16	8	Hex Screw (W,X)	Steel
16	4	Hex Screw (G,P)	Steel
17	1	Position Indicator (W,X)	Molded Phenolic
18	1	Indicator Set Screw (W,X)	Steel
19	1	Seal (W,X)	Reinforced Rubber
20	1	Gasket (W only)	Neoprene
21	1	Bearing	Bronze
22	1	Seal	Reinforced Nitrile
23	4	Screw	Steel
24	4	Lock Washer	Steel

NOTE: Series 75 W and X are shown. General purpose units have different bases and covers.

Sizes 25, 30



Item	Qty.	Description	Material
1	1	Base	Aluminum
2	1	Cover	Aluminum
3	1	Gear Train Support	Aluminum
4	1	Motor	
5	1	Output Gear	Steel Casting
6	2	Planet Gear	Hardened Steel
7	1	Planetary Gear	Ductile Iron
8	1	Worm Gear	Steel
9	1	Sensing Shaft	Steel
10	2	Pin, Spring	Steel
11	2	Shaft	Hardened Steel
12	2	Bushing	Bronze
13	2	Thrust Washer	Steel
14	1	Pin, Spring	Steel
15	4	Belleville Washer	Steel
16	1	Nut	Steel
17	2	Seal	Rubber, Steel
18	1	Manual Override Shaft	Steel
19	1	Pin, Cotter	Steel
20	1	Pin, Spring	Steel
21	1	Handwheel, Manual Override	Aluminum
22	1	Thrust Washer	Steel
23	1	Tru-arc Ring	Steel
24	1	Seal	Rubber, Steel
25	1	Sun Gear	Steel
26	1	Bushing	Bronze
27	4	Cap Screw	Steel
28	4	L Washer	Steel
29	1	Capacitor (w/Fiber Washer if Required)	Phenolic Encapsulated
30	1	Input Gear	Steel
31	1	Nut	Steel
32	1	Cap Screw	Steel
33	1	Position Indicator	Aluminum
34	1	Bushing	Bronze
35	1	Motor Support Plate	Aluminum
36	1	Gear, Pinion	Steel
37	2	Set Screw	Steel
38	1	Terminal Strip	Polyethylene Based Material
39	2	Limit Switch Cam	Zinc Casting
40	2	Set Screw	Steel
41	1	Fan	Plastic
42	2	Limit Switches	Phenolic Encapsulated
43	1	"O" Ring (W only)	Buna
44	9	Cap Screw	Steel
45	9	Lock Washer	Steel
46	12	Cap Screw	Steel
47	1	Sensing Shaft Ret. Ring	Steel

How to order Series 75 Electric Actuators

20 — 75 — X MI 120A

- **20** — Size
- Special Services (blank if none)
- **75** — Actuator Type
- Duty Cycle (25%)
- **X** — Enclosures: hazardous environment NEMA VII
- **MI** — Options (additional microswitch)
- **120A** — Voltage

The basic Model number contains all necessary ordering information and should be used whenever possible to avoid errors. The following is a breakdown of the variations:

Actuator Size	Special Service	Actuator Type	Duty Cycle	Enclosures	Option	Voltage	CLC Operation
10 12 15 20 22 25 30	**Blank** - No special service options **A** - AF17 (240 VAC Positioner ***C** - CLC Module for cycle length control **D** - Feedback Dual Potentiometer **H** - Heater and thermostat for low temperature and high humidity applications **I** - I-75 Interface Relay Unit **M** - Mechanical Brake **P** - Feedback Single Potentiometer **4** - Position Indicator **9** - Cross-line mount *Specify operation in CLC Operation column	75	**2—** 10% duty cycle. Sizes 10, 12, 20, 22 only. **BLANK—** 25% duty cycle **4—** 75% duty cycle. **5—** 100% duty cycle. Sizes 10, 12, 20 only. (120 AC) **Note:** All duty cycles are at 70°F Ambient Temp.	**BLANK—** General purpose NEMA I **W—** Watertight NEMA IV **X—** Hazardous environment NEMA VII, Class I, Group C, D & NEMA IX, Class II, Group E, F, G.	**BLANK—** no additional micro switches **M1—** one additional micro switch **M2—** two additional micro switches **D2—** 180° operation for 180° directional valves **D3—** Center Off	**120A—** 120 VAC - 60Hz † **240A—** 240 VAC 60Hz † **12D—** 12 VDC **24D—** 24 VDC	**BLANK—** counter-clockwise (open) and clockwise (closed) **C—** clockwise (closed) **O—** counter-clockwise (open) CLC is set to operate in direction specified.

†60 Hz. actuators will operate on 50 Hz. Torque will remain the same, cycle time will increase by a factor of 1.2, and duty cycle will be reduced by a factor of approximately 20%.

Note: UL or CSA approved units are available on request.

Due to continuous development of our product range, we reserve the right to alter the dimensions and information contained in this leaflet as required.

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Worcester Controls
A BTR Company

PB730, Supplement 1

Series 75 Electric Actuators

Product Specification

STANDARD FEATURES:

- Two year warranty.
- Permanently lubricated gear train.
- Self lubricated bearings.
- Metalic cams — adjustable.
- General Purpose, Water Proof and/or Hazardous Location housing.
- Standard 25% duty cycle motors.
- Manual override in Water Proof and Hazardous Location models.
- Mechanical position indicator in Water Proof and Hazardous Location models.
- Dry metalized polypropylene motor start capacitor — Non P.C.B.
- Thermal overload motor protection with automatic reset. (AC motors).
- Reversible rotary operation from 20° to 300°.
- No specific mounting orientation requirement.
- Available in common AC or DC voltages.
- 12 point terminal strip, #12 maximum wire size.

OPTIONAL FEATURES:

- Available in 10, 75 or 100% duty cycle motors.
- Ability to accept PLC/computer command.
- Available with solid state built in relay for pulse operation and voltage surge circuit protection.
- Fail safe capability.
- Heater and thermostat and condensation drain.
- Built in positioner for modulating applications.
- CSA, UL, and BASEEFA approvals.
- Cycle length control for one or both directions.
- Multi-position, reversible up to 5 positions.
- Built in combined positioner with set point controller.
- Remote 4-20 MA position indicator.
- Single or Dual Feedback Potentiometer.
- Hard anodized enclosure for protection against harsh environments.
- Mechanical brake.
- Telemetry operation capability.
- Two wire control — two position operation.

. . . As designed and manufactured in the U.S.A. by Worcester Controls Corporation.

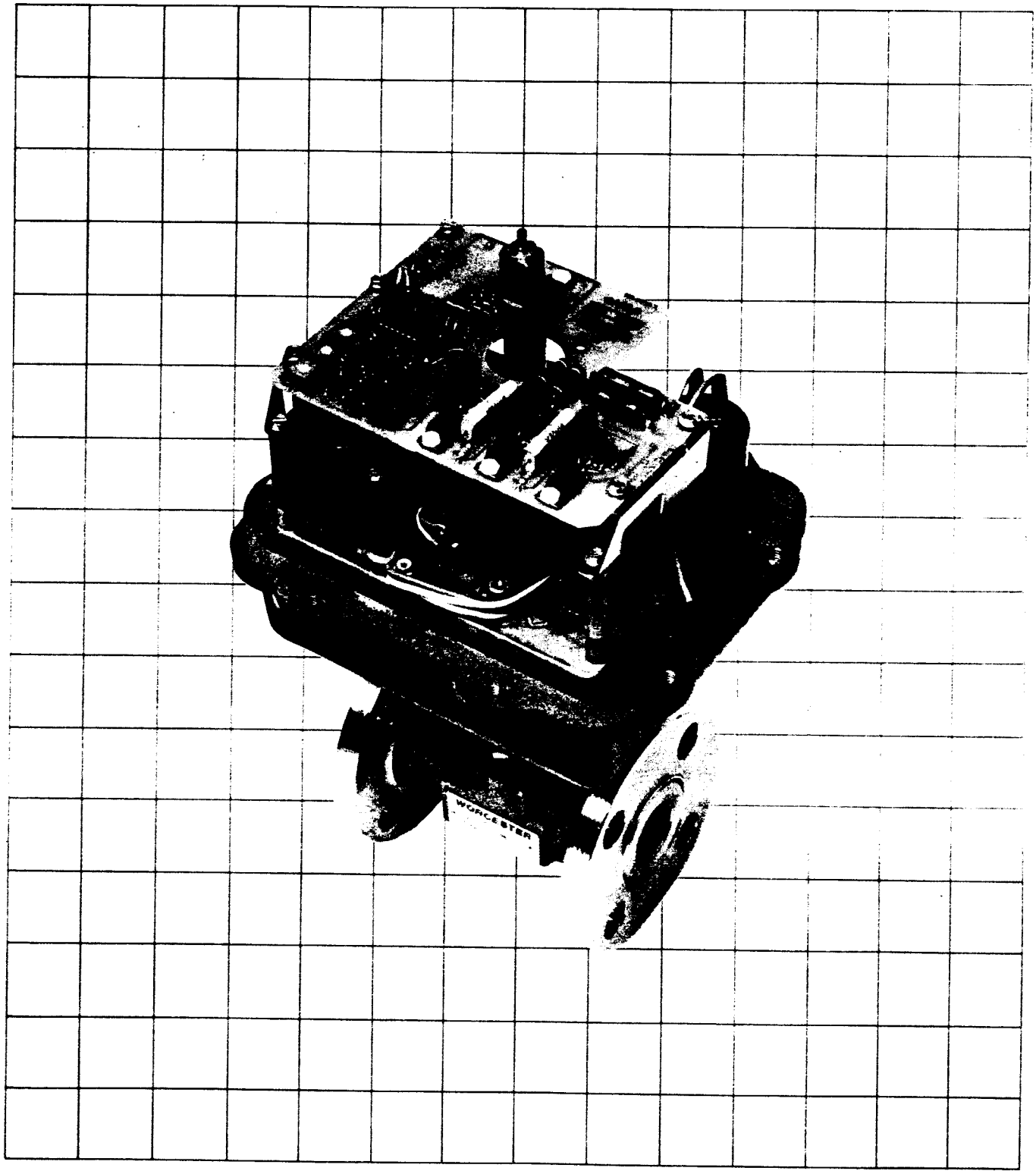
Printed in U.S.A. 12/88

Worcester Controls
A BTR Company

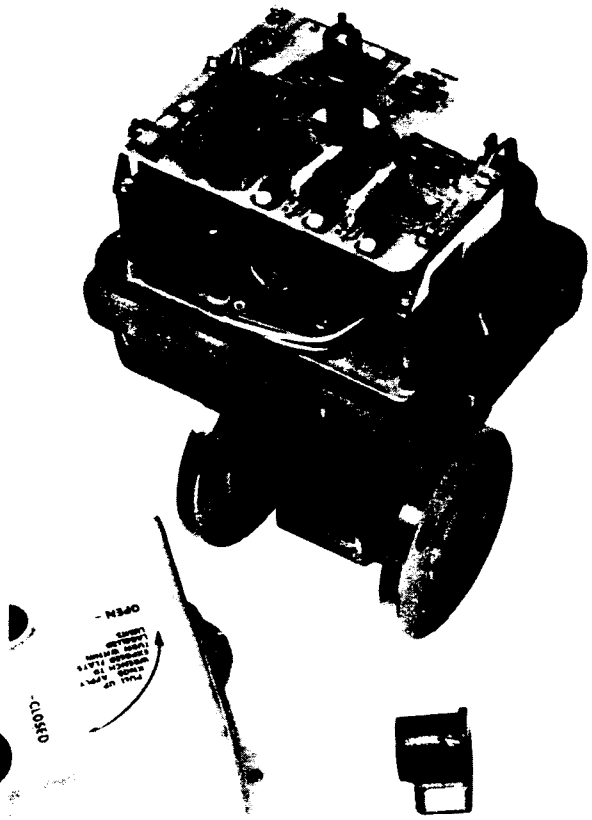
Series AF17 Electronic Positioner

100% solid state electronic positioner, precisely designed and manufactured by Worcester Controls to provide the most reliable rotary positioning.

AF 101-13



The Series AF17 Positioner



AF17 Electronic Positioner in Series 75 Actuators

- **Engineered to position rotary devices precisely, automatically.**
- **Single compact unit adapts easily and economically to valves, dampers or similar equipment.**

These Features Make Positive Position Control Possible

- **90° rotation standard** - AF17 Actuators are designed specifically for quarter turn operation - engineered to meet the needs of your application.
- **Other rotations available.**
- **Standard inputs** - 1-5, 4-20, 10-50 milliamps, 135 & 1000 ohms, 0-5 & 0-10 volts. Other inputs available upon request.
- **Output ratings** - peak voltage on load circuit, at 120 VAC - 400 VAC, and 240 VAC - 800 VAC, 24 VAC, 24 VDC. Maximum standard current - 8 A/1 minute. Maximum run current with: Resistive load - 5A, Inductive load - 3A.
- **Direct or reverse acting** - nothing additional to buy.
- **Independent zero & span adjustment** - speeds calibration time, lowers maintenance labor costs.
- **All solid state electronic circuitry** - reduces heat, saves energy, gives longer life and higher reliability.
- **Anti-hunting control built in** - facilitates balancing of positioner to dynamic characteristics of the total system - helps eliminate final element hunting.
- **Solid state relays are standard** - (on AC powered units) provide longer life and higher reliability.
- **Dynamic electronic braking** - stops actuator movement with momentary electric pulse (reverse current brake). Allows quicker and more accurate operation.
- **Electromechanical brake optional** - provides continuous holding when needed, as on dampers or butterfly valves.
- **"LED" calibration check** - indicator lights verify proper calibration "at-a-glance," makes calibrating simple and easy.
- **Standard split-range capability.**
- **Bypass for manual operation** - interrupts control signal, provides local manual position control. Consult factory.
- **Position feedback module** - 4-20 mA output.

Performance

	Positioner Mounted In Typical Actuator Series 75, 15/23 Sec. Cycle Time
Independent Linearity (The maximum deviation of the actual characteristic from a straight line)	0.5% of span
Resolution (Smallest possible change in valve position)	0.5% of span
Deadband (The maximum range through which the input signal can be varied without initiating a change in output shaft position.) Adjustable via anti-hunt control.	0.4% min. of span
Hysteresis (The maximum difference in output shaft position for a given input signal during a full range traverse in each direction.)	0.5% of span
Temperature Limits (Ambient)	-40° to + 115°F.†
Duty Cycle	Specify 75% or 100%
Current Drain	5 Watts plus actuator current drain
Characteristic (Input/Output Relationship)	Linear

†For conditions beyond these ratings, consult factory.

Specifications AF17 Positioner with Series 75 Actuator

Actuator Size	Stall Torque (in.-lbs)	Start-up Torque (in.-lbs)
10	150	120
12	225	180
15	335	280
20	600	480
22	900	720
25	1800	1440
30	3000	2400

Voltages

120 V 50/60 Hz
240 V 50/60 Hz
24 VDC

Cycle Time

15 Sec/90° Rotation, 23 Sec/90° Rotation
(Other speed and rotation options available. Consult factory.)

Inputs

1-5 mA DC	0-135 ohms	0-5 VDC
4-20 mA DC	0-1000 ohms	0-10 VDC
10-50 mA DC		

Load Resistance (for AF17)

100 ohms for 10-50 mA signal	800 ohms for 0-5 VDC
220 ohms for 4-20 mA signal	1100 ohms for 0-10 VDC
1000 ohms for 1-5 mA signal	

Enclosure Options

NEMA IV - Watertight*
NEMA VII and NEMA IX - Hazardous Locations*
*Includes Manual Override/Indicator Knob

Adjustments

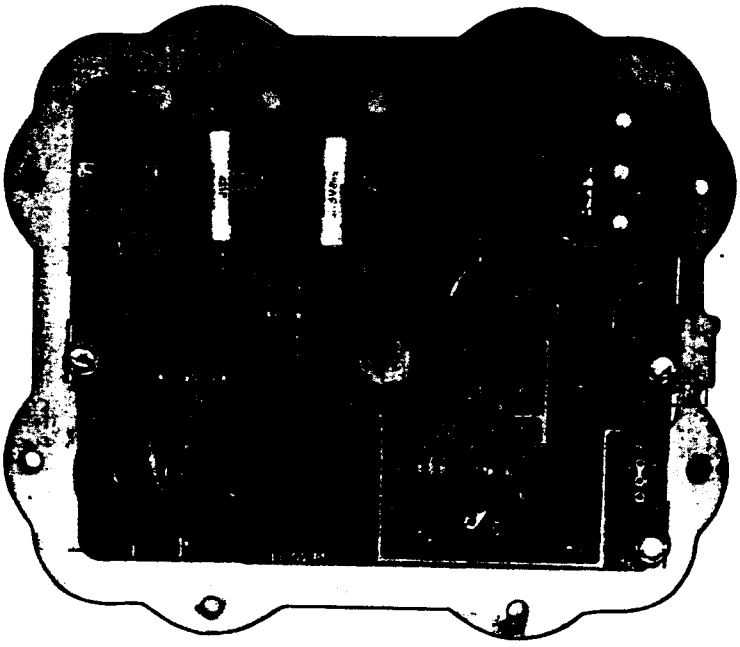
Zero - 25% of span
Range - 25% of span
Anti-hunt Control .25 to 10% of signal

Potentiometer - 1000 ohms

For feedback to the positioner circuitboard only. If remote valve position monitoring is required, order the optional Dual Potentiometer ("D" in the ordering code). With the dual potentiometer installed, one pot operates with the positioner circuitry, the other is used for external position monitoring. They are independently adjustable.

Series 75 Options

Extra Limit Switches (2)
Heater/Thermostat
Mechanical Brake - for butterfly valve and damper applications
Direct or Reverse Acting
Dual Potentiometer (for remote position monitoring)
Position Feedback Module 4-20 mA Output



1 Input Signal
2 Feedback Signal From Potentiometer
3 Power Output To Actuator Motor

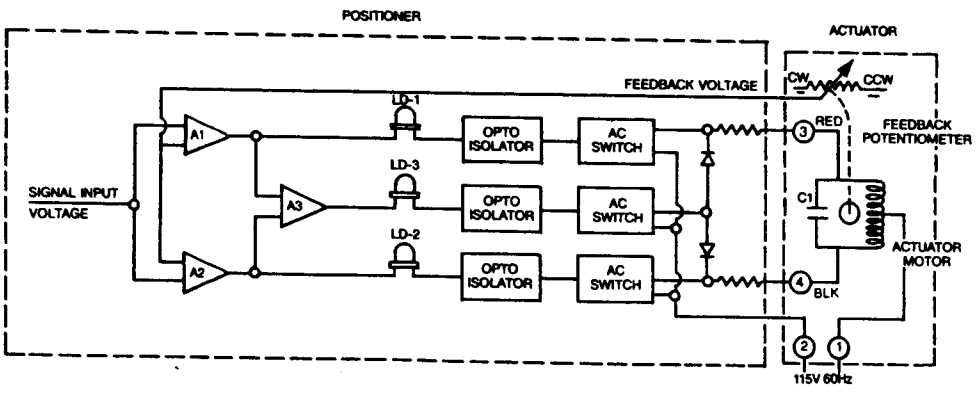
Theory of Operation

The AF17 Positioner is a unique circuit board specifically designed to provide accurate and reliable position control.

The operation of the AF17 is based on the comparison of 2 voltages — one derived from the input signal and the other from the feedback potentiometer driven by the actuator shaft.

- The signal input voltage is derived from an input signal conversion circuit (not shown) that changes the milliampere or resistance input signals to voltage.
- The signal is then compared with the voltage from the feedback potentiometer located beneath the circuit board.
- Both voltages — from the input signal and the feedback potentiometer — are fed to the two comparison amplifiers A1 and A2 (as shown in diagram below) which have been calibrated to provide the correct action. If the voltages are equal, both amplifiers will be in the "off" state and the actuator motor will not be energized.
- If there is a difference between the two voltages, either amplifier will be "on". The actuator motor will then be energized, turning the actuator shaft and the feedback potentiometer until the potentiometer's output voltage is the same as the signal input voltage. This turns the amplifier "off' and de-energizes the actuator motor.

AF17 Positioner and Actuator Block Diagram



How To Order

AF17 Positioner

20	AF17	4	—	120A
20 - 10-2075 Actuator **30** - 25-3075 Actuator	**AF17**	**1** - 1-5 mA input **4** - 4-20 mA input **10** - 10-50 mA input **13** - 135 ohm input **1K** - 1000 ohm input **5V** - 0-5 VDC input **XV** - 0-10 VDC input	**Blank** - Direct Acting **R** - Reverse Acting	**120A** -120V 50/60 Hz **240A**-240V 50/60 Hz* **24 VDC** - Optional *If using 240 VAC for AF17, order code for actuator size must use suffix A. (Example: 20A)

NOTE: Code above depicts Size 20 AF17, 4-20 mA input, direct acting 120V 60 Hz operation.

Series 75 Electric Actuators

20	HD	75	5	XM 2	120A
10 - 150 inch lbs. **12** - 225 inch lbs. **20** - 600 inch lbs. **22** - 900 inch lbs. **25** - 1800 inch lbs. **30** - 3000 inch lbs.	**A** - AF17 240 VAC only **H** - Heater/Thermostat **M** - Mechanical Brake **†D** - Dual Potentiometer †Dual pot must be ordered if 4-75 (4-20 mA) position indication is ordered OR independant feedback potentiometer is required.	**75**	**5** -100% Duty Cycle Available on sizes 10,12, 20 only **4** -75% Duty Cycle Available on sizes 25, 30 only	Must use: **W** - NEMA IV or **X** - NEMA VII, IX Additional Options: **M1** -One extra auxiliary limit switch (SPDT) with cam **M2** -Two extra auxiliary limit switches (SPDT) with cam	**120A** -120V 50/60 Hz **240A**-240V 50/60 Hz **24 VDC**

NOTE: Code above depicts Size 20 Series 75 Actuator with Heater/Thermostat and Dual Potentiometer, for Hazardous Environment with Two Auxiliary Limit Switches and 120 V 60 Hz.

Due to continuous development of our product range, we reserve the right to alter the information contained in this leaflet as required.

For additional information refer to

- **C-12** — **Corrosion Data** — For valve to media compatibility
- **ASM** — **Actuator Sizing Manual** — For seat & seal pressure/torque curves and actuator torque output charts
- **PB 730** — **Series 75 Electric Actuators** — For detailed technical information
- **CV** — **Ball Control Valve Selection Manual** — For overall envelope dimensions

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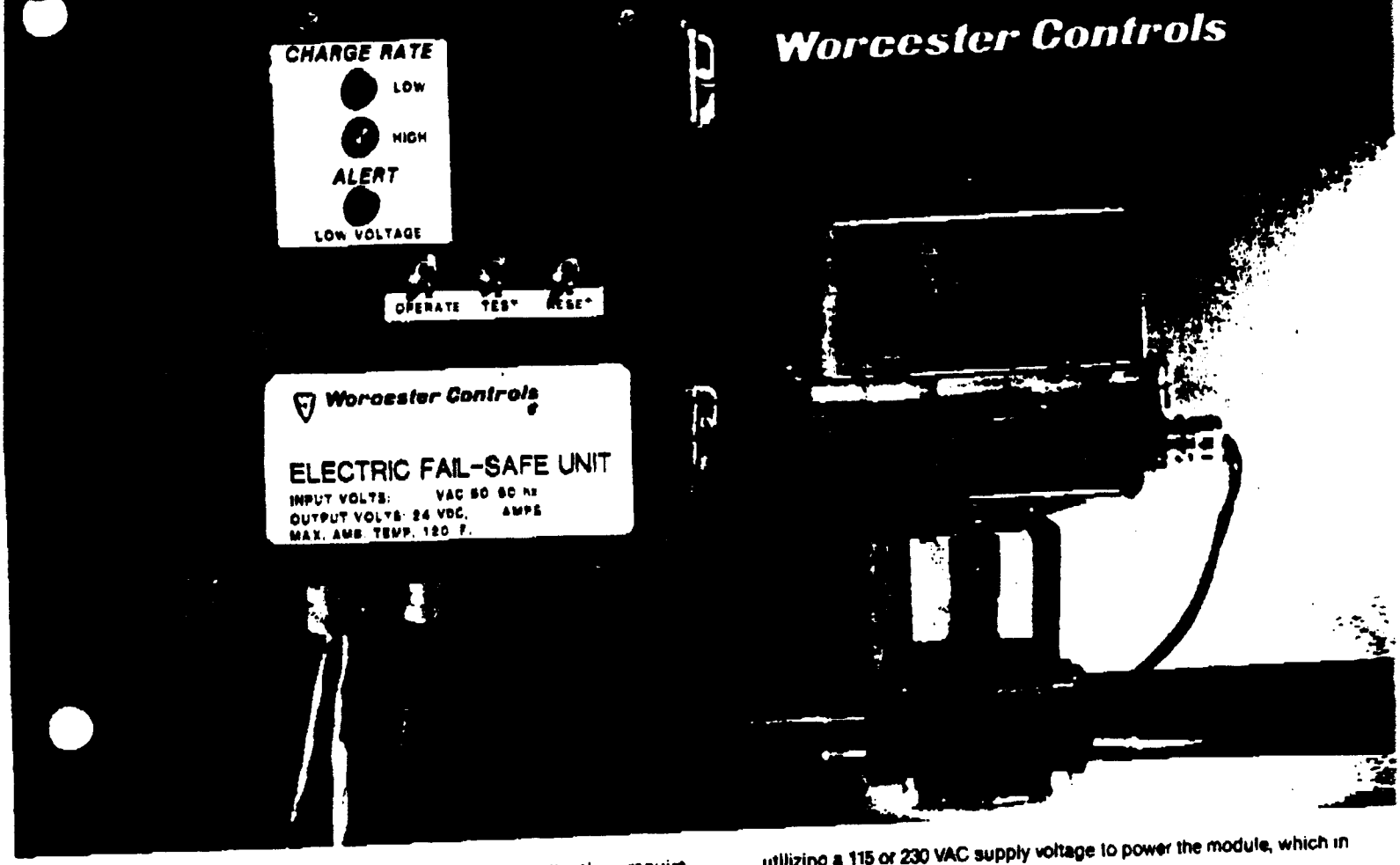
the fail-safe electric actuator

series F75

from

Worcester Controls

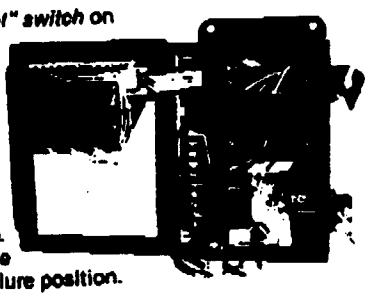


PLANT SAFETY requirements for many process applications require the security of a failure mode on process and utility valving, especially where hazardous or flammable media exists. To meet this need Worcester has designed the Fail-Safe Electric Actuator, a combination of the "Fail-Safe" module and a Series 75, Electric Actuator. In the event of an electrical power failure, the Fail-Safe module will power the actuator to the pre-determined valve position, either fail closed or fail open, whichever is preferred. Normal valve operation is accomplished utilizing a 115 or 230 VAC supply voltage to power the module, which in turn powers the 24 VDC actuator.

As a primary element in this package, the Series 75 Electric Actuator provides precise, reliable rotary valve operation in a rugged but small package. These actuators feature permanently lubricated gear trains, independently adjustable internal limit switches, manual override and position indication, corrosion resistant epoxy coated housings, and a wide variety of other options.

Principle of Operation

- **Upon loss of AC Voltage** the Fail-Safe Module automatically drives the valve to the pre-determined failure position.
- **While power is out** the valve may be operated to the non-failure position by pushing the *"Operate" switch* on the Fail-Safe Module. Releasing this button will return the valve to the "Fail-Safe" position. **For extended loss of voltage,** batteries within the Fail-Safe Module contain sufficient power to operate the valve at least 25 full cycles depending on the load.
- **When power returns** the *"Re-Set" switch* on the Fail-Safe Module must be pressed to return to normal operation. If the "Re-Set" switch is not pressed the actuator will not respond to commands from the control panel.
- **If it's just a power interruption,** the module does not automatically switch to the failure mode. There is a 2 second delay before the actuator is cycled to the failure position.



- **The Fail-Safe Module can be tested** while in the normal mode by pushing the *"Test" switch* on the Fail-Safe Module, which switches the module to battery power and cycles the actuator to the fail-safe position. The *"Re-Set" switch* must be depressed to return to normal operation.
- **Failure mode is field adjustable** to the open or closed position by a simple wiring change.
- **For hazardous or remote locations,** the Fail-Safe Module can be mounted up to 100 feet away from the actuator. For greater distances, consult factory.
- **Illuminated low voltage warning system** provides visual indication of the battery voltage. Indicator lights are powered by AC line voltage and will go out at power loss.

Indicator Lights show charge rates

Low (Green) - Full Fail-Safe power is available to the power pack. Trickle charge to the batteries is maintaining the maximum supply voltage.

High (Yellow) - Battery voltage is low. Batteries are recharging at a higher rate.

Alert, low voltage (Red) - Battery voltage is very low and may not be sufficient to power actuator. Battery replacement is required.

SPECIFICATIONS

Supply Voltage: 115 or 230 VAC, single phase 50/60 Hz.
Conduit Connections: ½" NPT

Actuator Specifications

Sizes: 10 - (150 in./lbs.)
12 - (225 in./lbs.)
20 - (600 in./lbs.)
22 - (900 in./lbs.)

Enclosures: NEMA IV - Watertight
NEMA VII & IX - Hazardous Environment

Temperature Rating: −40°F to 150°F

Lubrication: Permanently lubricated gear train. Self-lubricated bearings.

Operation: Reversing. Limit switches, cam operated. Adjustable from 0° to 300°

Options: A normal compliment of actuator options are available including:
- Position Transmitting Potentiometer
- Heater/Thermostat (An AC heater is recommended so as not to drain batteries while in failure mode. Heater should be wired directly to AC power supply.)
- Extra Limit Switches
- Mechanical Brake

Fail-Safe Module Specifications

Enclosures: NEMA III - Dust tight, Rain tight & Sleet(ice) Resistant - Metal
Other enclosures available on application.

Temperature Rating: 0°F to 120°F

Mounting: The Fail-Safe Module can be mounted with strut.

Battery Charge: The Fail-Safe Module contains float charge circuitry to maintain maximum power levels of battery pack.

ENGINEERING DATA

10F75	150	5	1.5	115 VAC 230 VAC
12F75	225	8		
20F75	600	5	3.0	
22F75	900	8		

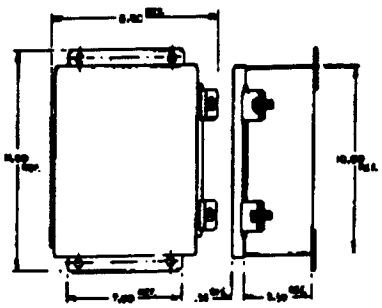
When using a Mechanical Brake, add 0.4 amps to locked rotor currents shown above.

SIZING CHART

1075 2075	1/4" - 1" 1-1/4" - 2"	1/4" - 3/4" 1" - 1-1/2"

This sizing chart is to be used as a guide only. Actuator sizing can be affected by differential pressure across the valve, media and seat material.

DIMENSIONS Inches

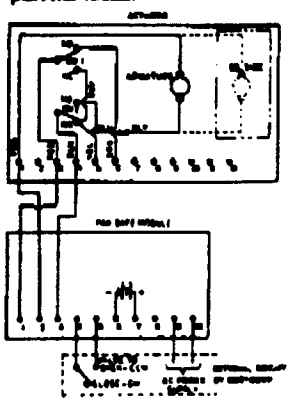


FAIL SAFE MODULE

Fail-Safe Module - approx. weight 13 lbs. For actuator dimensions, refer to Series 75 Brochure #PB-730. Dimensions are given for layout purposes only, for tolerances, consult factory.

WIRING DIAGRAM

Diagram shows fail closed mode. To accomplish other modes consult "Application and Specific Wiring" section of I.O.M. part no. 16022.



HOW TO ORDER

10 — F75 — W — 24D — F2

10 12 20 22	BLANK—No special service options H—Heater and thermostat for low temperature and high humidity applications. P—Position Transmitting Potentiometer M—Mechanical Brake	F75	BLANK—25% duty cycle	W—Watertight NEMA IV X—Hazardous environment NEMA VII & IX	BLANK—no additional micro switches M1—one additional micro switch M2—two additional micro switches D2—180° operation for 180° directional valves	24D—24 VDC	F1 - 115 VAC F2 - 230 VAC

Ordering example above: A 10 size 24 VDC Actuator with a NEMA IV actuator enclosure using a 230 VAC power supply and a Fail-Safe Module.

Due to the continuous development of our product range, we reserve the right to alter the information contained in this leaflet as required.

Distributed by:

Worcester Controls
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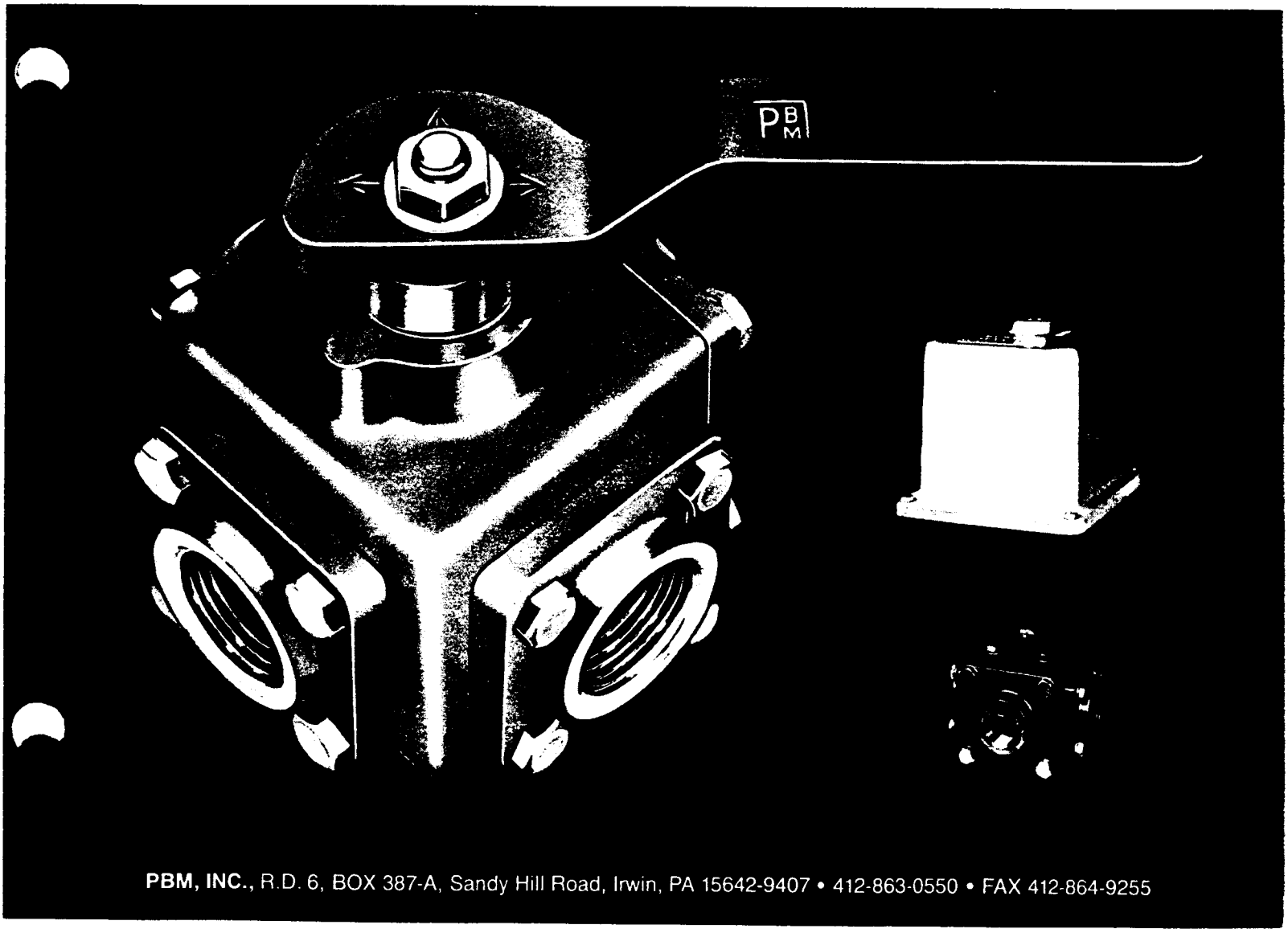
PBM® REGISTERED U S PAT AND TRADEMARK OFF

Multi-Port Ball Valves

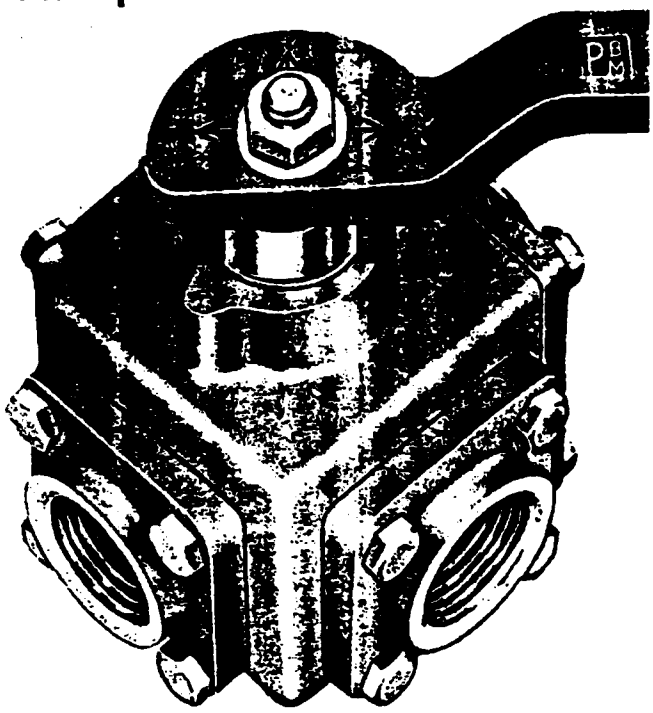
Three, Four, and Five-Way



PBM, INC., R.D. 6, BOX 387-A, Sandy Hill Road, Irwin, PA 15642-9407 • 412-863-0550 • FAX 412-864-9255

3-way

multi-ports in MP & BT series



- Low Torque Operation
- Low Pressure Drop
- Low Profile Design
- Reinforced Teflon* Seats & Seals
- Positive Shut-Off
- In-line Adjustment for normal wear (Adjust-O-Seal)®
- Easily Actuated

PBM's 3-Ways are at work throughout industry providing long term, reliable performance under toughest conditions.

Taking the place of two, three or more 2-Way Valves, with a corresponding savings in pipe runs and fittings, these 3-Ways are available with a full array of add-ons and options to meet specific requirements.

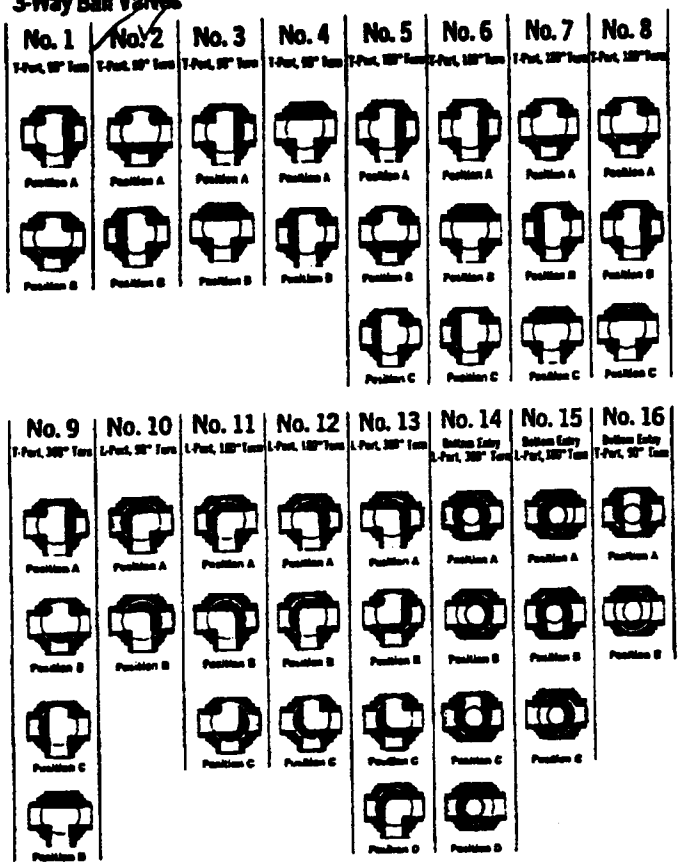
ADJUST-O-SEAL is a Registered Trademark of PBM, INC.

*Teflon is a Registered Trademark of E. I. du Pont de Nemours & Company

Flow Patterns possible with one 3-way MP

(Many more possible using manifolds of 2 or more Valves)

3-Way Ball Valves

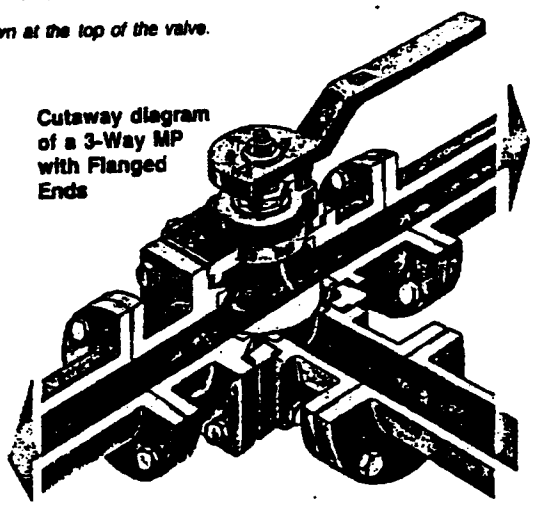


NOTE: Flow patterns are looking down at the top of the valve.

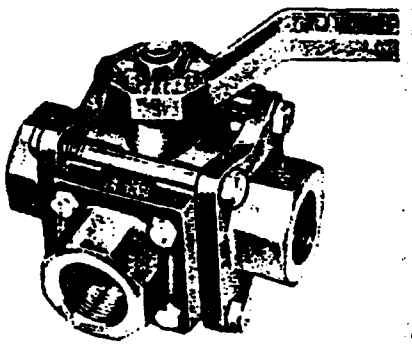
Standard Ports for 3-way MPs

Angle Port (L) Tee Port (T)

Cutaway diagram of a 3-Way MP with Flanged Ends



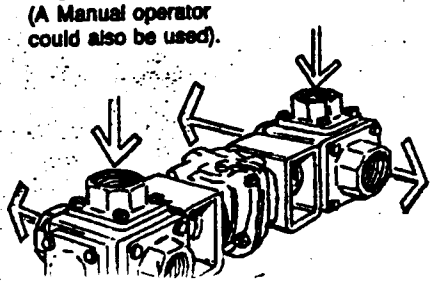
3-Way BT Pattern



The BT Pattern is used

Special Application for 3-Ways

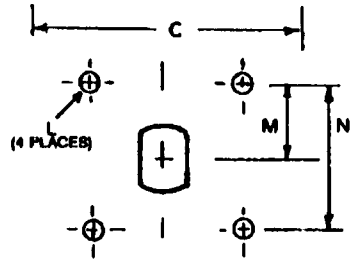
For applications requiring two pieces of equipment or two process lines to be operated simultaneously, two 3-Way Valves may be mounted in tandem and controlled with a single actuator.
(A Manual operator could also be used).

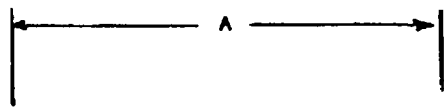


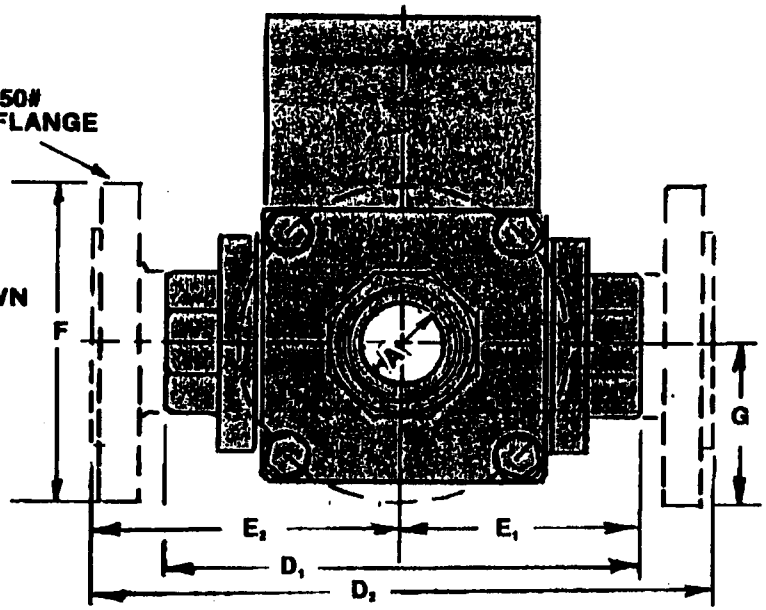
QUICK REFERENCE FOR 3-WAYS

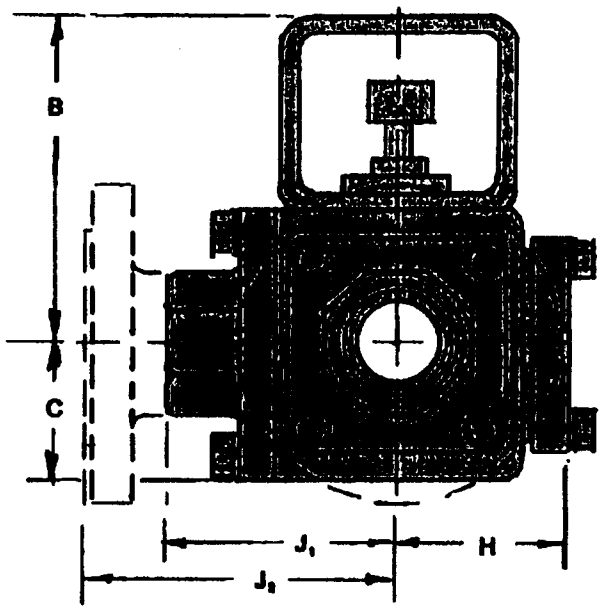
Metals Available	*Valve Sizes Available*
STAINLESS STEEL	1", 1¼", 1½", 2", 3", 4"
BRONZE	1", 1¼", 1½", 2", 3"
IRON	½", ¾", 1½", 2", 3", 4"
CARBON STEEL	1", 1¼", 1½", 2", 3", 4"

Other Metals on Special Order









MP- and BT-Series— Dimension in Inches

Valve Model No.	Pipe Size	A	B	C	D_1	D_2	E_1	E_2	F	G	H	J_1	J_2	Female N.P.T. Wgt.*	150# Flange Wgt.*
MP	½	.62	3.62	2.00	4.00	N/A	2.00	N/A	N/A	N/A	1.47	2.00	N/A	8	N/A
MP	¾	.62	3.62	2.00	4.00	N/A	2.00	N/A	N/A	N/A	1.47	2.00	N/A	8	N/A
MP	1	1.00	4.53	1.56	4.72	N/A	2.36	N/A	N/A	N/A	2.00	2.36	N/A	12	N/A
MP	1¼	1.00	4.53	1.56	4.75	N/A	2.38	N/A	N/A	N/A	2.00	2.38	N/A	12	N/A
MP	1½	1.50	5.25	2.25	6.56	10.56	3.28	5.28	5.00	2.50	2.88	3.28	5.28	28	46
MP	2	2.00	6.53	2.62	7.75	11.94	3.88	5.97	6.00	3.00	3.30	3.88	5.97	40	64
MP	3	2.25	6.94	3.75	11.06	14.56	5.53	7.28	7.50	3.75	3.75	5.53	7.28	65	105
MP	4	3.00	9.00	5.00	N/A	17.00	N/A	8.50	9.00	4.50	5.00	N/A	8.50	N/A	220
BT	1	1.06	4.62	1.78	5.88	N/A	2.94	N/A	N/A	N/A	N/A	2.75	N/A	<13‡	N/A
BT	1¼	1.06	4.62	1.78	5.88	N/A	2.94	N/A	N/A	N/A	N/A	2.75	N/A	16‡	N/A
BT	1½	1.62	5.12	2.69	7.91	9.91	3.95	4.95	5.00	2.50	2.52	3.67	5.70	30‡	46‡
BT	2	1.62	5.12	2.69	7.66	10.03	3.83	5.02	6.00	3.00	2.52	3.53	5.77	35‡	59‡

(All dimensions are for reference only ±.06)

NOTES:

1. Dimensions shown are for stainless steel valves. Please consult factory for other metal dimensions.

*2. Weights shown are for stainless steel valves and include bracket and coupling weight. To determine approximate weight for other metals:

METAL	MULTIPLY BY
Aluminum	.52
Bronze	1.10
Iron and Carbon Steel	1.02

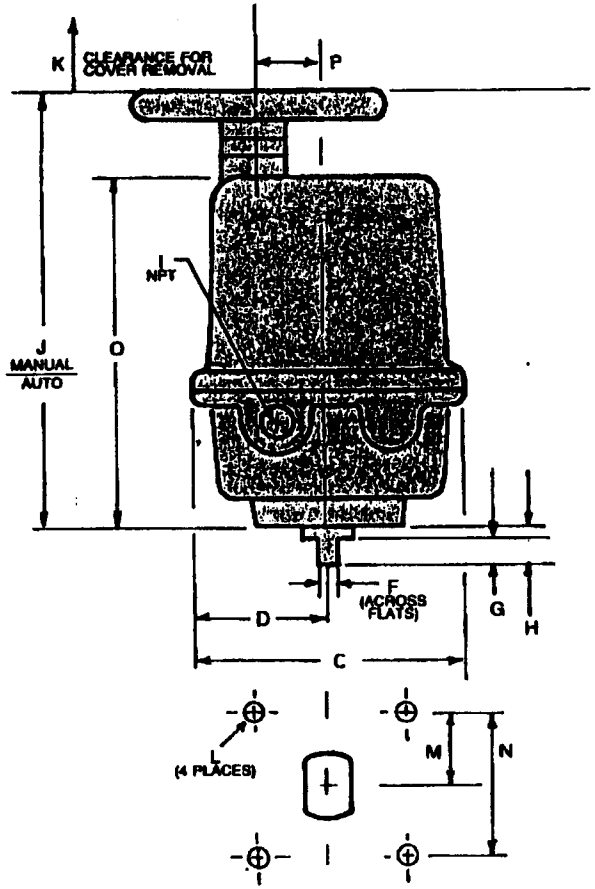
3. Please consult Reference Book IV for additional information.

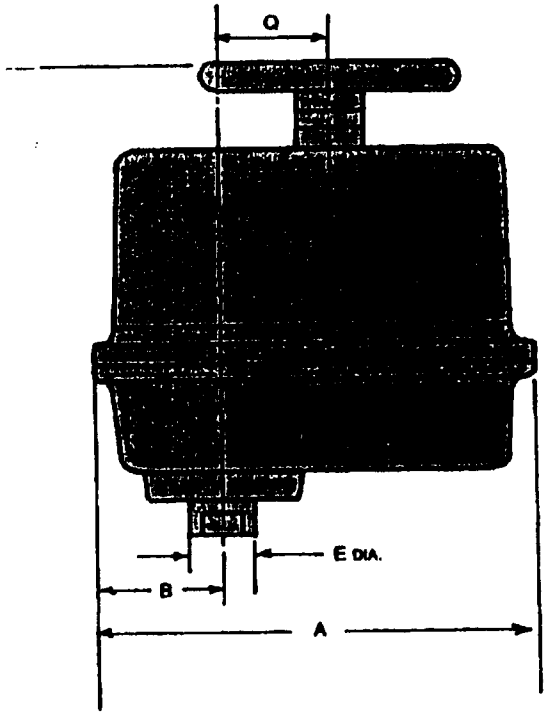
‡Indicates Bronze wgt.

ER-150 THROUGH ER-1000

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
ER-150	12.36	3.30	8.36	4.18	1.124 1.125	.874 .875	1.12	1.19	¾	13.50 13.00	10.00	⅜"-16 x¾"DP	1.500	3.00	10.44	2.14	3.33
ER-190	12.36	3.30	8.36	4.18	1.124 1.125	.874 .875	1.12	1.19	¾	13.50 13.00	10.00	⅜"-16 x¾"DP	1.500	3.00	10.44	2.14	3.33
ER-350	12.36	3.30	8.36	4.18	1.124 1.125	.874 .875	1.12	1.19	¾	13.50 13.00	10.00	⅜"-16 x¾"DP	1.500	3.00	10.44	2.14	3.33
ER-1000	12.36	3.30	8.36	4.18	1.498 1.500	1.124 1.125	1.43	1.50	¾	13.50 13.00	10.00	½"-13 x⅞"DP	1.750	3.50	10.44	2.14	3.33

ER-150 THROUGH ER-1000





STD. 150#

Kay-Ray/Sensall, Inc.

Sensall® S Series; P Series; 8100S Series Ultrasonic Transducers

General

Sensall ultrasonic transducers are available in a variety of configurations and materials to optimize your continuous level control application. All transducers are designed for ultrasonic pulse/echo use but each series differs in compensation scheme and physical configuration. Sensors are manufactured using CPVC, Kynar® or Teflon® in order to provide compatibility with broad variety of chemical vapors. Other materials have been used for special situations.

Sensall offers three basic series:

S Series

These transducers are used with our temperature/velocity compensated systems. They include a thermister buried within the transducer body which supplies the control with temperature data from the vicinity of the transducer body. Since the temperature variation of the velocity of sound is common for most gases, the control can compensate for temperature changes in the vapor space.

8100S Series

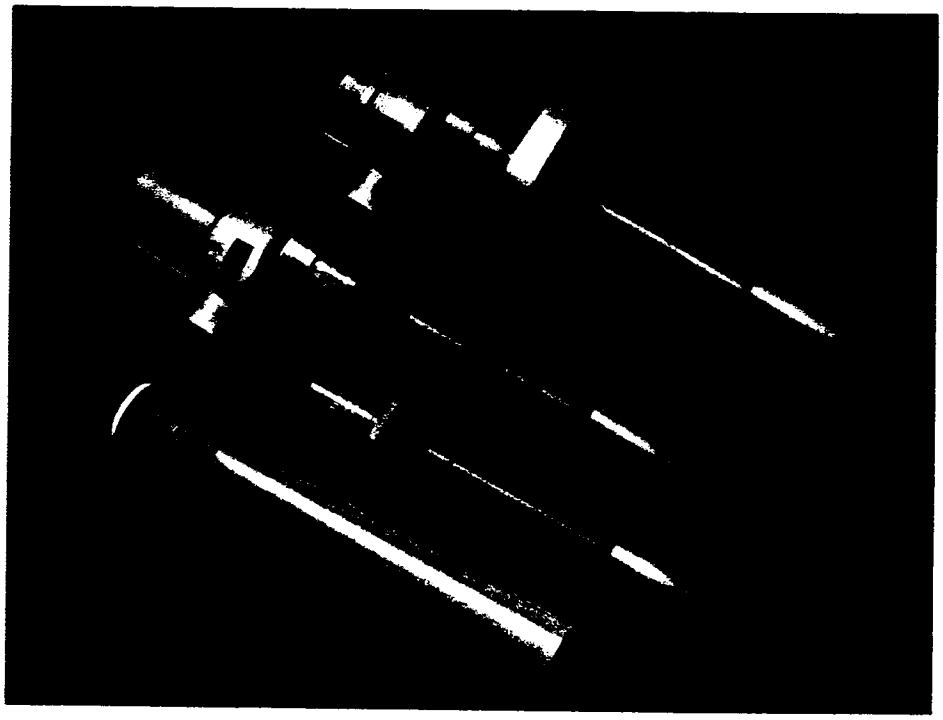
These transducers use a pin in ultrasonic path to reflect a portion of the energy. Since the pin is at a known distance, the control can use the travel time to compensate for changes in both vapor temperature and vapor composition. These transducers are used with our sound distance compensated (8100R) control systems.

P Series

These transducers are specifically designed for our non-contact point level controls.

Environmental

All transducers are rated from -22° to +158°F (-30° to +70°C). Transducers will operate effectively from -10 to +50 PSIG. In a non-operate mode the sensors will not withstand steam cleaning and should be removed from the tank during cleaning.



Application Considerations

Sensall's "Continuous Liquid Level" brochure enumerates a variety of application considerations which dictate the selection of a control system approach. Once the control system is determined, the following procedure might be helpful in determining the correct transducer.

Series

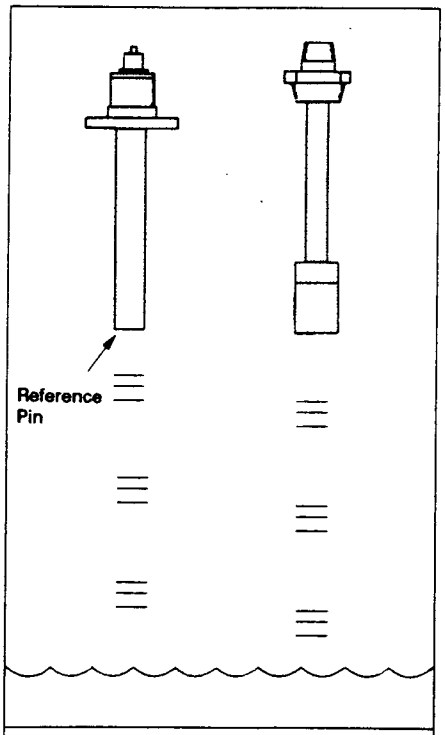
The series will generally be determined by the control approach. Each series has a beam angle specified. Consider closely whether an obstruction in the tank can intercept the beam and produce a spurious output.

Configurations

Within each series the following options may be available:

- Integral Control (– T)

  Our Model 821 (S Series) and 802 (P Series) are almost always used integrally with the transducer. The transducer should be designated by a – T. It is also possible to use these

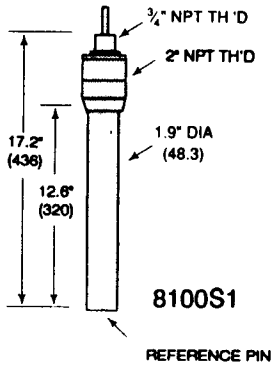


8100S Series **S & P Series**

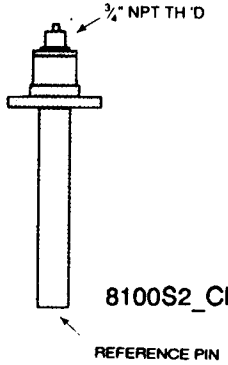
8100S Series reflects portion of ultrasound for compensation while S & P Series senses temperature to compensate for velocity changes.

TRANSDUCER DIMENSIONAL DRAWINGS

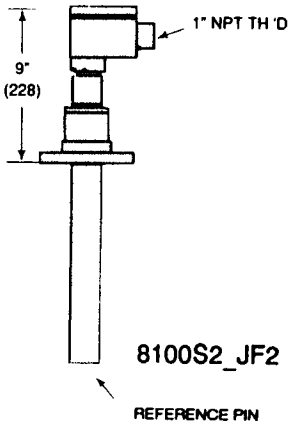
8100 SERIES



8100S1

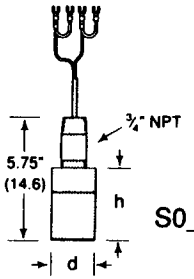


8100S2_CF2_

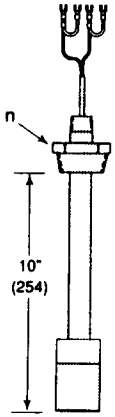


8100S2_JF2

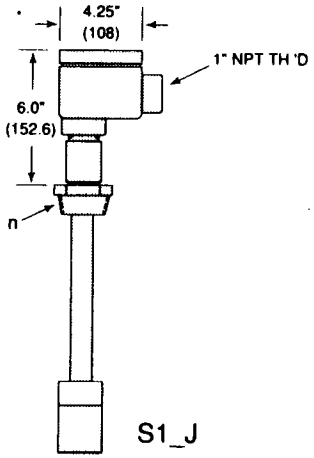
S&P SERIES



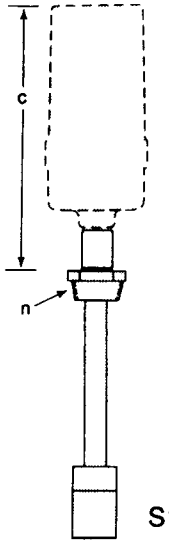
S0_C



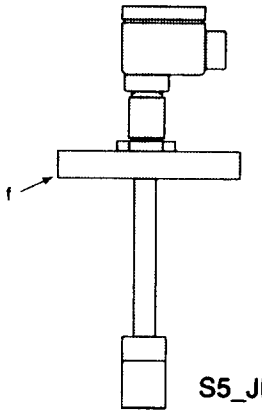
S1_C



S1_J



S1_T



S5_JF3_

Material	d	h	n	Min. f	c
CPVC & Kynar	1.9" (48.3)	3.19" (81.0)	2" NPT TH 'D	2"	See control data sheet
Teflon	2.25" (57.2)	3.0" (76.1)	2½" NPT TH 'D	3"	

controls remotely using the – J configuration.

- Integral Amplifier (– A, D)

  This special configuration provides an amplifier integral to the transducer. "A" is applicable to our 805, 807 and 809 point devices with the P Series transducer. "D" is applicable to the 895 continuous level system with the S Series transducer. The designations include the amplifier.

- Junction Box (– J)

  Sensors in this configuration are provided with an integral junction box. They are the configuration of choice when the control is mounted remotely (8120R and sometimes 821 and 802). Cable to the control is accomplished by a simple extension cable terminated at the sensor and control with spade lugs. The junction box provides a convenient anchor, allows for easy replacement should the cable be damaged and simplifies installation.

- Integral Cable (– C)

  This configuration may be required where the electronics or junction box cannot be mounted by the transducer. Sensall will splice the appropriate cable length to the transducer. Integral cable lengths should not be greater than 50 ft.

Material

Series S and Series P transducers are available in CPVC, Kynar® and Teflon®. the 8100 S Series is not available in Teflon®. It is vital to select a material compatible with the contents of the tank. Other transducer materials (and materials for the pin) are available.

Mounting Configuration

Transducers can be mounted in the tank using their standard fitting or by using a flange. Be certain that the sensor is not recessed in a nozzle! For maximum accuracy it is best to position the sensor face relatively close to the maximum height of the liquid surface (but beyond the "near" zone). In those unusual situations where the level does not rise to the top of the tank, it may be desirable to position the sensor deeper into the tank using a mechanical extension and an integral cable (– C) configuration. Basic mounting options include:

	8100S Series	S Series	P Series
Beam Angle	10°	12°	12°
Materials Available	CPVC Kynar® –	CPVC Kynar® Teflon®	CPVC Kynar® Teflon®
Configurations Available	J-Box Integral Cable – –	J-Box Integral Cable Integral Control –	J-Box Integral Cable Integral Control Integral Amplifier
Fittings	3/4" NPT (OF) 2" NPT (OF)	3/4" NPT 2" NPT (Kynar®, CPVC) 2-1/2" NPT (Teflon®)	
Minimum Flange	2"	2" Kynar®, CPVC 2-1/2" Teflon®	
Pressure	-10 to +50 PSI; operating 150 PSI; non-operating		
Temperature	-22° to 158°F; (-30° to +70°C) (1)		
Use with	8120R	820 895	802, 807 805, 809

(1) Temperature limits refer to inside the tank. – A, – D, and – T configurations may impose different limitations on ambients outside the tank. Refer to control data sheets.

Connection	Cable(1)	Use With(2)	Max Length(3)	Sensall P/N(4)
S-Series (– D Config)	#18 AWG	895	3000'	5797-(XXX)
P-Series (– A Config) (Amplifier to Control)	4 Conductor 18 Gauge	805, 807, 809	600'	4736-(XXX)
8100S (– J Config) J-Box to Control	RG58 RG63	8120R 8120R	100' 250'	3678-(XXX) C.F.

(1) Radiation resistant cable and other sizes also available

(2) Series 802 and 821 normally used integral to transducer

(3) Controls normally designated for integral mounting (821, 802) may not be operated more than 25 ft. from sensor

(4) Append cable length in feet to part number

- 3/4" NPT outside fitting (S0, P0, 8100S)

  This option is intended for applications where the transducer is to be mechanically extended or where it can be inserted from inside the tank.

- 2" and 2-1/2" NPT

  These transducers are designed to be mounted through the top of the tank and will normally be provided in – J, – D, – T or – A configurations. CPVC and Kynar® transducers require the 2" NPT fitting while the Teflon® unit requires 2-1/2" NPT. Standard transducers are 10" (254mm) in length and are designated S1 or S6 and P1 or P6.

- Flange Mounted Transducers

  Transducers are available with a variety of flanges and flange materials. The sensor should be designated by an F_ _ appended to the basic part number. The "F" indicates that the transducer is flange mounted while the next digit indicates the flange size and the following character indicates the flange material.

ORDERING GUIDE FOR NON-CONTACT TRANSDUCER PART NUMBERING SCHEME

Sound/distance Compensated Non-Contact 8100 S Series	8100S1 8100S2 8120S1 8120S2	Full-tube w/ 3/4" and 2" NPT (OF) Full-tube w/ flange [1] Coated full-tube w/ 3/4" and 2" NPT (OF) Coated full-tube with flange[1]	Use these probes with: Model 8120R Control
Temp/velocity Compensated Non-Contact S Series	S0 S1 S6 S7	5-3/4" length with 3/4" NPT (OF) 10" length with 2" NPT[2] 10" length with 2-1/2" NPT 5-3/4" length with 2" NPT	Use with: Model 895 Control (–D config) Model 821 Control (–T config)
Point Non-Contact P Series	P0 P1 P6 P7	5-3/4" length with 3/" NPT (OF) 10" length with 2" NPT [2] 10" length with 2-1/2"NPT 5-3/4" length with 2" NPT	Use with: Model 802 control (–T config) Model 805, 807, 809 Control (–A config)

TRANSDUCER MATERIALS

A	CPVC
K	Kynar®
T	Teflon® (not available for 8100S Series)

CONFIGURATIONS		Use with:
J	Junction Box	8120R
C	Integral cable[3]	8120R
T	Integral control	821, 802
D	Integral amplifier	895
A	Integral amplifier[4]	805,807, 809

F	Use only for flange mount	
2	2" 150#[2]	Flange size
3	3" 150#	
4	4" 150#	
7	2-1/2" 150#	
A	CPVC	Flange Materials
K	Kynar®	
T	Teflon®[5]	
F	Carbon steel w/ Teflon® face[5]	

S1	K	J	F	3	K	TYPICAL MODEL NUMBER

[1] Model # must include F_ _ designation to show size

[2] Use 2-1/2" NPT or 2-1/2" flange for Teflon transducer

[3] Cable length to be specified

[4] Designation includes amplifier

[5] Not available on 8100 Series

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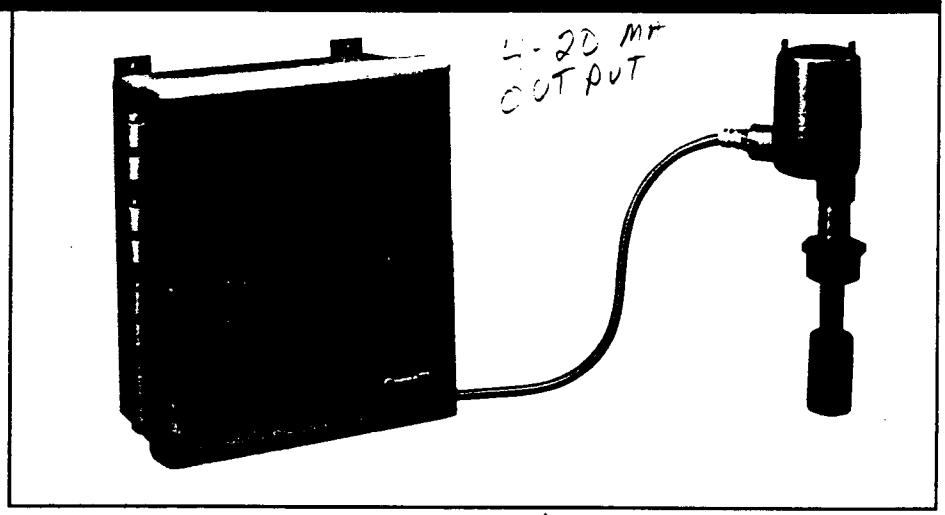
Rosemount® is a registered trademark of Rosemount, Inc.
Teflon® is a registered trademark of DuPont.
Kynar® is a registered trademark of PENNWALT.

Kay-Ray/Sensall, Inc.
1400 Business Center Drive
Mt. Prospect, IL 60056
Tel (708) 803-5100
Telex 62970165
Fax (708) 803-5466

Series 895
Non-Contact/Continuous Liquid Level Controller

Features:

- Non-contact, Low Maintenance System
- No Coaxial Cable Required
- Rugged Transducers Fit 2" NPT
- Isolated 4-20mA Output
- Versatile 3 Adjustable Setpoints
- Unique Functional Alert Relay
- Sleek NEMA 4X Enclosure
- Convenient Dial-in Calibration



General

The Model 895 is designed to offer the convenience of local indication and control using the powerful performance of ultrasonic echo technology. The integral transducer assembly is mounted safely above the liquid level and is, therefore, less susceptible to any of the harsh effects of the measured product. The rugged transducer can be fabricated in CPVC, Kynar or Teflon. The transducer has the narrowest profile of any ultrasonic transducer on the market, requiring only a 2 inch diameter vessel opening.

The Model 895 will measure ranges from 1 to 31 feet from the transducer face. The span can be set to any 2 feet over the full range. Housed within the sleek new NEMA 4X enclosure, the output package includes a large 4-1/2 digit LCD display, isolated 4-20mA proportional to the level, 3 adjustable setpoint relays and a unique functional alert relay.

Principle of Operation

The Model 895 is based on ultrasonic echo technology. Pulsed signals are transmitted from a piezoelectric transducer mounted above the liquid surface and returned as echoes. The elapsed time is proportional to the distance from the transducer to the liquid surface and back ... and inversely proportional to liquid level. By encoding the pulsed signals and discriminating the echoes through analog and digital techniques, a highly reliable level measurement is obtained.

Many of the discrimination features plus the calculation of level are performed in a microcomputer. This "micro" also makes it possible to calibrate easily by simply setting rotary switches to simulate zero and span.

Temperature compensation is implemented from a thermister imbedded in the transducer to automatically adjust for variations due to temperature effects on the speed of sound.

In addition to temperature compensation, the system performs a variety of other discrimination functions to verify that the returned echo is a true reflection of the transmitted pulse. These functions include digital filtering, moving averages and time variable gain (see brochure B-8000 for further information).

Powerful Performance

By using an integral transducer assembly directly at the tank, the 895 puts it's power directly to the application. Unlike coaxial-linked systems, the 895 supplies full amplification at the tank; there is no power loss. The gain, or strength of the beam, is automatically adjusted by the microprocessor in the controller from as far as 3000 feet away. The high degree of resolution, accuracy and performance is accomplished through the use of microprocessor based compensation techniques, elimination of coaxial cable and through the use of an integral transducer assembly.

Output Package

The 895, as a continuous level controller, provides both local readout and control capabilities. Locally it includes a large 4-1/2 digit LCD display with easily adjustable decimal point placement. Control output features include, standard, isolated 4-20mA proportional to the level, 3 fully independent SPDT setpoint relays (hermetically sealed relays are offered as an option for Class 1, Division 2 areas) and an SPDT functional alert relay. The unique functional alert relay is field selectable for near zone or lost echo or both conditions. The output package provides the user with all the requirements for the complete and safe control of his process.

Installation & Calibration

Standard 5 conductor instrument wire is used to link the transducer assembly to the controller. Multiple cable runs can be accommodated in the same tray or conduit and multiple controllers can be mounted in close proximity to one another.

The operator can bench calibrate the system before actual installation. Using the sealed BCD switches, the span, zero and setpoint relays may be set. The digital display will track and verify all settings during calibration. The system may be set for either Height (4-20mA) or Distance (20-4mA) modes.

Physical/Environmental

The Model 895 is packaged in a NEMA 4X fiberglass enclosure. It will operate within specification from +10°F to +160°F (-12°C to71°C). An optional heater is available to permit operation down to -4°F (-20°C). Reference PDS-S & P for transducer assembly specifications.

SPECIFICATIONS MODEL 895

PERFORMANCE

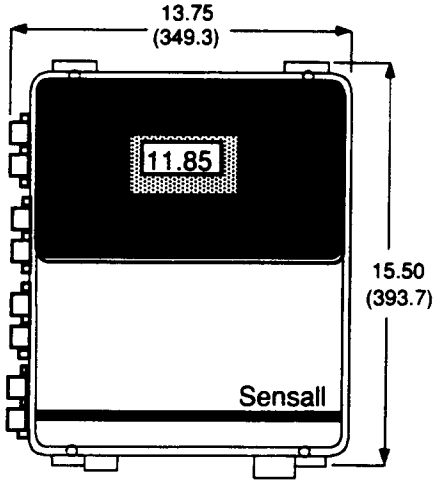
Reference Conditions	Atmospheric pressure in still air with water as liquid.
Near Zone	12 inches (0.30m) from transducer face (minimum) or to top of span.
Range	1 - 31 feet (0.3 - 9.45m) from transducer face.
Minimum Span	Any 2 feet (0.61m) over full range.
Accuracy	± 1/4% of full scale. Includes combined effects of linearity, hysteresis and repeatability at referenced conditions.
Temperature Compensation	Automatic over full range of system
Temperature Effects	± 1/2% of full range per 100°F (55.6°C) at transducer from -10°F to 160°F (-23°C to +71°C) at reference conditions.
Resolution	
Analog Output & Digital Display	1/4 inch (0.64 cm) or 1/2% of span setting (whichever is greater).
Setpoint	1/4 inch (0.64 cm).

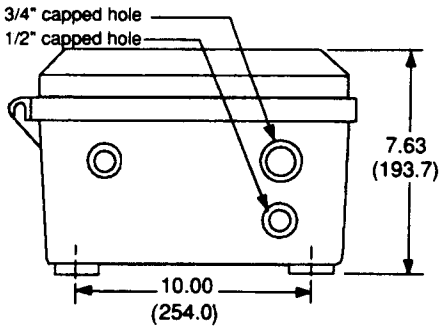
ELECTRICAL

Supply Voltage	115VAC (std.) or 230VAC (±10%; 50/60Hz)
Power Consumption	50 watts (150 watts w/ heater)
Outputs	
Current	4-20mA (isolated) into 0 - 1000 ohms
Setpoints	3 each: SPDT; 5 Amps at 115VAC (non-inductive) field selectable fail-safe operation.
Functional Alert	SPDT; 5 Amps at 115VAC (non-inductive)
Response Time	
Meter and Current	Factory set at 1 second.
Setpoints	1 - 5 seconds depending on failsafe mode.
Readouts	4 1/2 digit LCD display
Indicators	NEAR ZONE, LOST ECHO, OPERATE HI ALARM, MID ALARM, LOW ALARM
Ultrasonic Frequency	50 KHz
Calibration	Dial-in rotary switches.
Alarm Response	
Near Zone	Current and reading are maintained. Relay actuated (or deactuated).
Lost Echo (after 8 sec.)	Current and reading are maintained.

PHYSICAL

Temperature Range (Operating)	+10°F to +160°F (-12°C to +71°C); with heater (115VAC only) -4°F (-20°C).
Transducer Compatibility	CPVC, Kynar® or Teflon®
Enclosure	NEMA 4X
Weight	10 pounds (4.6 kg) approx.





ORDERING INFORMATION

Model 895 Level Control

	C	115VAC	Supply Voltage
	E	230VAC	
	T	Heater & Thermostat	Options
	C	Characterizer	
	R	Hermetic Relay Pkg.*	
	M	Special Calibration	
895	C	CT	Typical Model Number

Order Transducer Assembly as a separate line item. Reference PDS-S & P.
*Without Power Switch

Kynar® is a registered trademark of PENNWALT Corporation. Teflon® is a registered trademark of E.I. Dupont Corporation.

FOR FURTHER INFORMATION CONTACT:

Sensall®
Instruments, Inc.
a Rosemount® division

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Mt. Prospect, Illinois 60056
Tel: (312) 803-5102
Fax: (312) 803-5466

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ICF KAISER ENGINEERS
1900 Diamond Drive
Los Alamos, New Mexico 87544

DESIGN CALCULATION INDEX

CALC. NO.	SHEET NO.

JOB NUMBER	AREA OR BUILDING	CALCULATION DESCRIPTION	DISCIPLINE
JOB TITLE LLWTF B680H	HANFORD WASH	ELECTRICAL	

CALCULATIONS APPLY TO DRAWINGS AND REVISIONS SHOWN

DRAWING	REV	DRAWING	REV	DRAWING	REV	DRAWING	REV

DESIGN ENGINEER	[signature] (SIGNATURE)	5/10/91 (DATE)	JOB ENGINEER	(SIGNATURE)	(DATE)
CALCULATIONS CHECKED	Ross Krayer (SIGNATURE)	5/20/91 (DATE)	DESIGN SUPERVISOR	(SIGNATURE)	(DATE)
CALCULATIONS AGREE WITH DESIGN CRITERIA	(SIGNATURE)	(DATE)	CALCULATIONS AGREE WITH APPVD. VENDOR DWGS.	(SIGNATURE)	(DATE)

CALCULATION KEYS		DATES		DATES		DATES		DATES
REVISION DESCRIPTION								
DESIGN ENGINEER								
DESIGN SUPERVISOR								

STATUS	PRELIMINARY	FINAL	CHECK	VOID	HOLD	OTHER

REASON FOR VOID OR HOLD

INDEX

SHEET NO.	DESCRIPTION
1	LIGHTING CALCULATIONS
2	CONDUCTOR DERATING TO TANK FARM
3	VOLTAGE DROP
4	HEAT TAPE
5	DRY TYPE TRANSFORMER SIZING

91044-003 Hanford Lowlevel Waste Treatment Facility - Lighting Calcs Designed By: BaRNEO Date: 12-Apr-91 Checked By:

Room Designation	Length	Width	Height	Floor Cavity	Ceiling Cavity	Desired Foot Candles	Lamp Lumen	LLD	LDD	Rho Floor	Rho Ceiling	Rho Walls	Filname	A/I	Number Of Lamps	RCR	CU	Required Quantity Fixtures	Actual FC
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt440	A	4	2.629120879	0.535961538	13	30.93298038
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt340	A	3	2.629120879	0.56967033	16	30.34936685
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt240	A	2	2.629120879	0.623379121	22	30.44315971
Plant	52	35	13.5	2.5	0	30	22000	0.827	0.88	0.2	0.7	0.5	ths250s	A	1	2.629120879	0.752252747	5	33.09621107
Plant	52	35	13.5	2.5	0	30	8800	0.827	0.88	0.2	0.7	0.5	ah100s6b	A	1	2.629120879	0.554459707	16	31.22442545
Drum & Wash room	17	14	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.7	0.5	2gt340	A	3	7.163865546	0.554459707	3	42.35373635
Drum & Wash room	17	14	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.7	0.5	2gt240	A	3	7.163865546	0.554459707	3	42.35373635

91044-003 Hanford Lowlevel Waste Treatment Facility - Lighting Calcs Designed By: Date: 12-Apr-91 Checked By:

Room Designation	Length	Width	Height	Floor Cavity	Ceiling Cavity	Desired Foot Candles	Lamp Lumen	LLD	LDD	Rho Floor	Rho Ceiling	Rho Walls	Filname	A/I	Number Of Lamps	RCR	CU	Required Quantity Fixtures	Actual FC
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt440	A	4	2.629120879	0.535961538	13	30.93298038
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt340	A	3	2.629120879	0.56967033	16	30.34936685
Plant	52	35	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.8	0.5	2gt240	A	2	2.629120879	0.623379121	22	30.44315971
Plant	52	35	13.5	2.5	0	30	22000	0.827	0.88	0.2	0.7	0.5	ths250s	A	1	2.629120879	0.752252747	5	33.09621107
Plant	52	35	13.5	2.5	0	30	8800	0.827	0.88	0.2	0.7	0.5	ah100s6b	A	1	2.629120879	0.554459707	16	31.22442545
Drum & Wash room	17	14	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.7	0.5	2gt340	A	3	7.163865546	0.554459707	3	42.35373635
Drum & Wash room	17	14	13.5	2.5	0	30	2775	0.827	0.88	0.2	0.7	0.5	2gt240	A	3	7.163865546	0.554459707	3	42.35373635

DESIGNED BY BARNEO
CHECKED BY R. KRAYER
RK

LLWTF

CONDUCTOR DERATING

MAJOR WIRING TO TANK FARM

DESIGNED BY BORNEO DATE 5/10

CHECKED BY R. K. DATE 5/20/9

MOTORS - 6 - 5 HP 480 3Ø
1 - 7.5 HP 480 3Ø

CONDUIT - 1 1/2"

12-#12 → 3 for 4 ea. 5 HP MTR
6 - #8 → 3 for 1 ea 7.5 HP MTR
3 for 2 ea. 5 HP MTR

Ampacity Limit

$$A_2 = \sqrt{0.5\left(\frac{N}{E}\right)}\ A_1$$

where A_2 - Ampacity Limit of Energized Conductors
N - # of conductors
E - # of Energized conductors
A_1 - Ampacity Factor (TAB 8 K) ART 310

#12

$$A_2 = \sqrt{0.5\left(\frac{12}{12}\right)}\ (25(.7)) = 12.37 \text{ AMP} \checkmark$$

5 HP 480 3Ø → 7.6 AMPS ✓ NEC TABLE 430-150

8

$$A_2 = \sqrt{0.5\left(\frac{6}{6}\right)}\ (.7(50)) = 24.75 \text{ AMPS} \checkmark$$

7.5 HP 480 3Ø → 11 AMP ✓ NEC TABLE 430-150
2 ea 5 HP = 10 HP 480 3Ø → 14 AMP ✓ NEC TABLE 430-150

CALCULATIONS KE Form No. E-6 Rev. 5-85

LLWTF

Motor AT Tank Farm

Voltage Drops

DESIGNED BY Borneo DATE 5/10

CHECKED BY R.K. DATE 5/20/9

5 HP MTR. 480 3Ø 7.6 AMP. NEC TABLE 430-150

#12CU ⇒ 1.93 Ω/1000 ft NEC TABLE 8

REF - STD HDBK FOR EE - 11TH ED, PG 18-10 para 33.

$VD = \frac{L\ R\ I\ \sqrt{3}}{1000}$ L - Length = 200 FT ✓

R - Ω/1000 = 1.93Ω/1000 ✓

$VD = 200\,(1.93)(7.6)\sqrt{3}/1000 = 5.1$ Volt Drop ✓

3% VD @ 480 V ⇒ 480(.03) = 14.4 V ✓

7.5 HP MTR 480 3Ø 11.0 AMP ✓ NEC TABLE 430-150

#8 ⇒ 0.764Ω/1000 ft ✓ NEC TABLE 8

$VD = 200\,(.764)\,(11)\sqrt{3}/1000 = 2.9$ Volts ✓

---

10 HP

#8 ⇒ .764 Ω/1000 ft

$VD = 200\,(.764)(14)\sqrt{3}/1000 = 3.7$ Volts ✓

CALCULATIONS KE Form No. E-6 Rev. 5-85

LLWTF

HEAT TRACE CALCULATIONS

DESIGNED BY JORNPO DATE 5/10

CHECKED BY R.K. DATE 5/20/91

TM - DESIRED MAINT TEMP = 42°F
TA - MIN EXPECTED AMBIENT TEMP = -10°F
TE - MAX INTERMITTENT EXPOSURE TEMP = 80°F
PIPE SIZE - 1/2", 1 1/2", 2", 3"

QB - PIPE HEAT LOSS BASED ON IEE STANDARD 515-1983 Eqn 1
f - INSULATION COMPENSATION FACTOR = 1 (GLASS FIBER ASTM C547)

1. $\Delta T = TM - TA = 42 - (-10) = 52°F$

PIPE HEAT LOSS (IN WATTS/FT)

INSULATION THICKNESS	ΔT	PIPE DIAMETER 1/2"	1 1/2"	2"	3"
0.5"	50°	2.5 W/FT			
1"			2.8 W/FT		
1 1/2"				2.4 W/FT	
2"					2.6 W/FT

CIRCUIT BREAKER CALC
at 3 WATT/FT SRL3-2 208 VOLT 1Ø
MAX LENGTH 695' → MAX LENGTH FOR THIS OPERATION = 500'
@ 208 V WATTS/FT = 80% (3 WATT/FT) = 2.4

FACTOR at 0°F = .04 AMP/FT for START-UP

CIR. BREAKER CALC
$.04 \frac{A}{ft}(ft) = AMP \rightarrow .04 \frac{A}{ft}(500\ ft) = 20$ AMP BREAKER

USE 20 AMP BREAKER for every 500' of TAPE ✓

CALCULATIONS KE Form No. E-6 Rev. 5-85

LLWTF

XFm SIZING

DESIGNED BY Bornoo DATE 5/10

CHECKED BY R.K DATE 5/20/9

75 kVA, 480V/208Y/120, DRY TYPE TRANSFORMER

pri $\frac{75 kVA}{480V\sqrt{3}} = 90. A$ ✓ Fused at 100A ✓

sec. $\frac{75 kVA}{208\sqrt{3}} = 208. A$ ✓

150 Amp PANEL LLWTF ✓
+ 60 Amp Panel Tank PAD ✓
210 Am

CALCULATIONS KE Form No. E-6 Rev. 5-85

LLWTF

SHEET OF

DESIGNED BY Boenoo DATE 5/10

CHECKED BY RK DATE 9/18

150 Amp PNL.

62.91 kw TOTAL CONNECTED
- 10.00 kw RC UNITS
52.91 kw

$\frac{52\ kw}{208\sqrt{3}}$ = 144 AMPS

Use → 150 Amp PNL.

60 Amp PNL

13.3 kw TOT CONNECTED

$\frac{13.3\ kw}{208\ \sqrt{3}}$ = 37 Amp

Use 60 Amp

MCC CAL

53.25 HP @ 746w = 53.25 kva .75PF
20 kw HTR = 20 kva Unity
75 kva XFMR = 75 kva
148.25 kva

$\frac{148.25\ kva}{480\sqrt{3}}$ = 178.3 A @ 1.25 = 222 A

Use 225 Amp Breaker.

CALCULATIONS KE Form No. E-6 Rev. 5-85

SC-I PROGRAM

VERTICAL SECTION PRICING - 20" WIDE x 15" DEEP

AXIMUM SHIPPING BLOCK - 3 VERTICAL SECTIONS

nd closing plates are supplied on each end of the shipping blocks that contain incoming line or main breaker ctions.

ICE INCLUDES DOOR AND UNIT SUPPORT PAN FOR FRAME MOUNTED UNIT SUPPLIED WITH THE SECTION.

Device	Catalog Number		Description	Available Space Factors For Plug-In Units	Price NEMA Type 1 ■
	Position	Character			
Basic ection		1 (UL)	20" wide standard section with full 6 S.F., available for unit inserts. Include standard features indicated in table on opposite page.	6	$ 1373
coming Line ection ■		F (UL)	Incoming line section, 600A, top entry, 1 S.F.	5	1666
		G (UL)	Incoming line section, 600A, bottom entry, 1.5 S.F.	4.5	1684
		H (UL)	Incoming line section, 600A, top entry with 12" pull box with lug pad in horizontal wireway (pull box shipped separately)	6	1950
		5 (UL)	Incoming line section, 800A, top entry, 1 S.F. with 12" pull box (pull box shipped separately)	5	2334
		T (UL)	Incoming line section, 800A, top entry, 1.5 S.F.	4.5	2032
		6 (UL)	Incoming line section, 800A, bottom entry, 1.5 S.F.	4.5	2032
		3 (UL)	Incoming line section, 1200A, top entry, 2 S.F.	4	2440
Main rcuit eaker ction ■	Ninth ■	B (UL)	Main CB section, 225A (JDB), top entry, 1.5 S.F., #4-350 MCM, 1/phase	4.5	3049
		Q (UL)	Main CB section, 400A (KDB), top entry, 2 S.F., #3/0-250 MCM, 2/phase	4	4345
		R (UL)	Main CB section, 600A (LC), top entry, 2 S.F., 250-500 MCM, 2/phase	4	6351
		S (UL)	Main CB section, 800A (MC), top entry, 2.5 S.F., #3/0-300 MCM, 3/phase	3.5	7762
		4 (UL)	Main CB section, 1200A (NC), top entry, 3 S.F., #3/0-400 MCM, 4/phase	3	12095
ans- mer ction		K (UL)	Transformer section, 7.5KVA, single phase, 1.5 S.F. bottom, 240/480V primary, 120/240V sec., no tap (secondary fused for 240 volts)	4.5	3218
		L (UL)	Transformer section, 15KVA, single phase, 2 S.F. bottom, 240/480V primary, 120/240V sec., with (2) 2.5% taps FCAN, (4) 2.5% taps FCBN (secondary fused for 240V)	4	4173
		M (UL)	Transformer section, 25KVA, single phase, 2 S.F. bottom, 240/480V primary, 120/240V sec., with (2) 2.5% taps FCAN, (4) 2.5% taps FCBN (secondary fused for 240V)	4	5245
		N (UL)	Transformer section, 15KVA, three phase, 2 S.F. bottom, 480V primary, 208/120V sec., with (2) 2.5% taps FCAN, (4) 2.5% taps FCBN (secondary fused for 208V)	4	5677
		P (UL)	Transformer section, 30KVA, three phase, 2 S.F. bottom, 480V primary, 208/120V sec., with (2) 2.5% taps FCAN, (4) 2.5% taps FCBN (secondary fused for 208V)	4	6736
mer tion		7 (UL) ■	Corner section for a 15" deep enclosure (25-1/8" wide by 25-1/8" wide) or a 20" deep enclosure (30-1/8" wide by 30-1/8" wide), without lugs	–	1766
c.		X	No cabinet in this location	–	N/C

e page 8 for SC-I adder prices.
rizontal ground bus must be specified in order to obtain (UL) Listing.
e page 16 for optional lug selection. List and price lugs separately.
e Appendix for circuit breaker Interrupting Capacity Ratings.
gle section shipping split only.

BASIC SECTION & STRUCTURE MODIFICATIONS FOR ASSEMBLED MOTOR CONTROL CENTERS

NOTE: SHADING INDICATES PE PROGRAM.

	Description	Price Per Basic Section, NEMA Type 1, 15" Deep
Basic 20" Wide Section (UL) ■	Includes standard features indicated in the table below. (Maximum three (3) 20" wide sections per shipping block.)	$ 1373
25", 30", 35" Wide Sections (UL) ■	Sections requiring extra width are priced the same as the basic 20" wide section. The adder for the additional width for the section and associated modifications has been included in the price for the factory mounted unit.	1373
Back-to-Back Section (UL) ■	There is no additional charge for assembling 15" or 20" deep sections back-to-back. This construction consists of two (2) separate sections mounted together, each with separate bus. (Front and rear sections must be equal in width. Six (6) 20" wide sections per shipping block maximum.) A front-to-rear horizontal bus link will be provided only when an incoming line lug compartment, main breaker, or main disconnect is specified. This splice link will be located at the opposite end of the center from the incoming line section.	1373
Corner Section (UL) ■	Inside corner configuration, 15" deep, 25-1/8" wide, designed to contain bus work only, with no available space for the installation of units. For 20" deep, 30-1/8" wide, and available power bus (600-1600 Amp only), refer to price adders below. Corner sections may be specified with an incoming line lug provision (see Bul. 2191M, page 50) but are not available in either NEMA Type 3R or back-to-back construction.	1766
10" Wide Incoming Line Section (UL) ■	This section must be specified as part of a 2-section shipping block, shipped adjacent to a 20", 25", or 30" wide section. It cannot be specified as free standing or adjacent to a full-section drive unit, 156A-360A SMC section, full-section programmable controller or 2000 Amp breaker, and is not available in NEMA Type 3R or back-to-back construction.	1373

NOTE: To price structure modifications: Add the listed "Adder Prices" in the following table to the "Basic Section Price" from the above tab

	Description	Adder Price Per Section
Cabinet Depth (UL)	15" Deep	STD
	20" Deep	$ 143
Enclosure Type (UL)	NEMA Type 1	STD
	NEMA Type 1 w/gasket (gasketed unit support pans)	129
	NEMA Type 12 (totally gasketed enclosure with bottom closing plates)	326
	NEMA Type 3R (non-walk-in) front mounted only. Available for internal sections 30" wide maximum. The external width of the NEMA 3R cabinet is 5" wider than its internal section. (Price adder includes adder for the 20" deep modification.) Refer to Publication 2100-2.3.3. ■	2564
Bottom Closing Plates (UL)	For NEMA Type 1 & 1 w/gasket	57
	For corner section NEMA Type 1 & 1 w/gasket	143
Power Bus Rating and Material (UL)	600A aluminum with tin plating	STD
	800A aluminum with tin plating	199
	600A copper with tin plating	186
	800A copper with tin plating	242
	1200A copper with tin plating	445
	1600A copper with tin plating	535
	2000A copper with tin plating	674
	600A copper with silver plating	32[illegible]
	800A copper with silver plating	4[illegible]
	1200A copper with silver plating	[illegible]
	1600A copper with silver plating	[illegible]
	2000A copper with silver plating	[illegible]

■ Horizontal ground bus must be specified in order to obtain (UL) Listing.
■ Not available in back-to-back construction.

BASIC STRUCTURE MODIFICATIONS FOR ASSEMBLED MOTOR CONTROL CENTERS

NOTE: To price structure modifications: add the listed "Adder Prices" in the following table to the "Basic Section Price" from page 10.

NOTE: SHADING INDICATES PE PROGRAM.

Description			Adder Price Per Section
Bracing (UL)	42KA (rms Symmetrical)		STD
	65KA (rms Symmetrical)		$ 242
Ground Bus Unplated Copper (UL) ■	None. Includes one (1) #6-250 MCM ground lug in incoming line section only.		STD
	1/4" x 1" horizontal ground bus		34
	1/4" x 2" horizontal ground bus		80
	Two (2) 1/4" x 1" horizontal ground bus top and bottom (cable interconnected)		76
	Two (2) 1/4" x 2" horizontal ground bus top and bottom (cable interconnected)		174
Vert. Grd. Bus Unplated Copper (UL) ■	3/16" x 3/4" vertical plug-in ground bus		57
	3/16" x 3/4" vertical ground bus for grounding unit load		57
Ground Bus Tin Plated Copper (UL) ■	1/4" x 1" horizontal ground bus		60
	1/4" x 2" horizontal ground bus		106
	Two (2) 1/4" x 1" horizontal ground bus top and bottom		127
	Two (2) 1/4" x 2" horizontal ground bus top and bottom		226
Vert. Grd. Bus Tin Plated Copper (UL) ■	3/16" x 3/4" vertical plug-in ground bus		86
	3/16" x 3/4" vertical ground bus for grounding unit load		86
Horizontal Power Bus Splice Kit (UL)	Splice bars, hardware and installation instructions for 3 phase splicing. One (1) kit required per shipping split on front mounted line-ups, two (2) for back-to-back.	For 600A aluminum tin plated bus	100
		For 800A aluminum tin plated bus	107
		For 600A copper tin plated bus	114
		For 800A copper tin plated bus	143
		For 1200A copper tin plated bus	172
		For 1600A copper tin plated bus	229
		For 2000A copper tin plated bus	393
		For 600A copper silver plated bus	143
		For 800A copper silver plated bus	172
		For 1200A copper silver plated bus	229
		For 1600A copper silver plated bus	286
		For 2000A copper silver plated bus	465
Horizontal Ground Bus Splice Kit (UL) ■	One (1) - 1/4" x 1" (unplated copper)		14
	One (1) - 1/4" x 2" (unplated copper)		28
	One (1) - 1/4" x 1" (tin plated copper)		31
	One (1) - 1/4" x 2" (tin plated copper)		62
Pull Box (UL)	12" high x 15" deep or 20" deep		320
Shutters (UL)	For isolation of plug-in stab openings, 12 per section (automatic)		206
	For isolation of plug-in stab openings, 12 per section (manual)		103
Protective Caps (UL)	For unused plug-in stab openings		51

■ Horizontal ground bus must be specified in order to obtain (UL) Listing.
■ Horizontal ground bus (with same plating) must also be specified.
■ For applications utilizing ground bus mounted both top and bottom or for back-to-back line-ups, two (2) ground bus splice kits are required for joining each shipping block.

SC-II & PE-II PROGRAMS

BASIC STRUCTURE MODIFICATIONS FOR ASSEMBLED MOTOR CO

NOTE: To price structure modifications: add the listed "Adder Prices" in the following table Price" from page 10.

NOTE: SHADING INDICATES PE PROGRAM.

	Description
External Mounting Channel (UL)	Two (2) 1-1/2" x 3"
Unit Isolating Barriers (UL)	For closing the wire opening between unit and vertical wireway.
Master MCC Nameplate (UL)	Located on top horizontal wireway cover of the second vertical section in lineup.
NO-OX-ID® (UL)	NO-OX-ID® compound on bus.
NEMA 3R Lifting Angle (UL)	Optional lifting angle for NEMA Type 3R cabinets only. This angle is not removable.

SC-I PROGRAM

MISCELLANEOUS VERTICAL SECTIONS

MAXIMUM SHIPPING BLOCK -- 1 VERTICAL SECTION

END CLOSING PLATES ARE SUPPLIED ON THESE SECTIONS.

Description	Working Depth (Inches)	Section		NEMA Type 1			NEMA Ty	
		Depth (Inches)	Width (Inches)	Catalog Number ■		Prices	Catalog Number ■	
Vertical Section Includes - Full Six Space Factor Door & Mounting Plate. No Vertical Wireway. No Power Bus.	11-1/2	15	20	2100-	EAC1__1A	$ 1630	2100-	EJC1__1A
			30		EAC1__3A	2462		EJC1__3A
			35		EAC1__4A	2879		EJC1__4A
	19	20	20		EAC2__1C	1773		EJC2__1C
			30		EAC2__3C	2677		EJC2__3C
			35		EAC2__4C	3129		EJC2__4C

■ The Catalog Numbers listed are not complete. Select ground bus options A, B or C and price from table on page 8.

SC-I & PE-I PROGRAMS

MISCELLANEOUS VERTICAL SECTIONS

MAXIMUM SHIPPING BLOCK -- 1 VERTICAL SECTION. END CLOSING PLATES ARE SUPPLIED ON THESE SECTIONS.

NOTE: SHADING INDICATES PE PROGRAM.

MISCELLANEOUS VERTICAL SECTIONS WITH FUSIBLE DISCONNECT.

Description	Working Depth (Inches)	Section Depth (Inches)	Section Width (Inches)	Disc. Rating (Amps)	NEMA Type 1 Catalog Number ■	NEMA Type 1 Prices	NEMA Type 12 Catalog Number ■	NEMA Type 12 Prices
Vertical Section Includes - Full Six Space Factor Door & Mounting Plate. No Vertical Wireway. No Power Bus.	11-1/2	15	20	30, 60	2100-FA__1__1A-__	$ 1865	2100-FJ__1__1A-__	$ 2191
				100	FA__1__1A-__	2037	FJ__1__1A-__	2363
			30	30, 60	FA__1__3A-__	2697	FJ__1__3A-__	3187
				100	FA__1__3A-__	2869	FJ__1__3A-__	3359
			35	30, 60	FA__1__4A-__	3113	FJ__1__4A-__	3683
				100	FA__1__4A-__	3285	FJ__1__4A-__	3855
		20	20	30, 60	FA__2__1A-__	2008	FJ__2__1A-__	2334
				100	FA__2__1A-__	2180	FJ__2__1A-__	2506
			30	30, 60	FA__2__3A-__	2912	FJ__2__3A-__	3402
				100	FA__2__3A-__	3084	FJ__2__3A-__	3574
			35	30, 60	FA__2__4A-__	3363	FJ__2__4A-__	3933
				100	FA__2__4A-__	3535	FJ__2__4A-__	4105

MISCELLANEOUS VERTICAL SECTIONS WITH CIRCUIT BREAKER

Description	Working Depth (Inches)	Section Depth (Inches)	Section Width (Inches)	NEMA Type 1 Catalog Number ■	NEMA Type 1 Prices	NEMA Type 12 Catalog Number ■	NEMA Type 12 Prices
Vertical Section Includes - Full Six Space Factor Door & Mounting Plate. No Vertical Wireway. No Power Bus.	11-1/2	15	20	2100-GAC1__1A-_____	$ 2259	2100-GJC1__1A-_____	$ 2585
			30	GAC1__3A-_____	3091	GJC1__3A-_____	3581
			35	GAC1__4A-_____	3508	GJC1__4A-_____	4078
		20	20	GAC2__1A-_____	2402	GJC2__1A-_____	2728
			30	GAC2__3A-_____	3306	GJC2__3A-_____	3796
			35	GAC2__4A-_____	3758	GJC2__4A-_____	4328

TABLE A

Fuse Clip Voltage	Voltage Code
250	A
600	C

TABLE B

Fuse Clip Type	Fuse Clip Designator / Fuse Clip Size (Amps) 30	60	100
R	24R	25R	26R
J	24J	25J	26J
H	24	25	26

TABLE C

Number	Trip Current (Amps)
30	15
31	20
32	30
34	40
35	50
36	60
37	70
40	100
41	125
42	150

TABLE D

Thermal Magnetic Circuit Breaker Type ■	Suffix	Frame	Adder 15A-100A	Adder 125A-150A
Std. Interrupting Capacity	CT	FDB	STD	$ 745
Std. I.C. w/Current Limiter	CD	FDB-LFB	$ 400	1594
Med. Interrupting Capacity	CB	FD	167	1114
High Interrupting Capacity	CM	HFD	252	1283

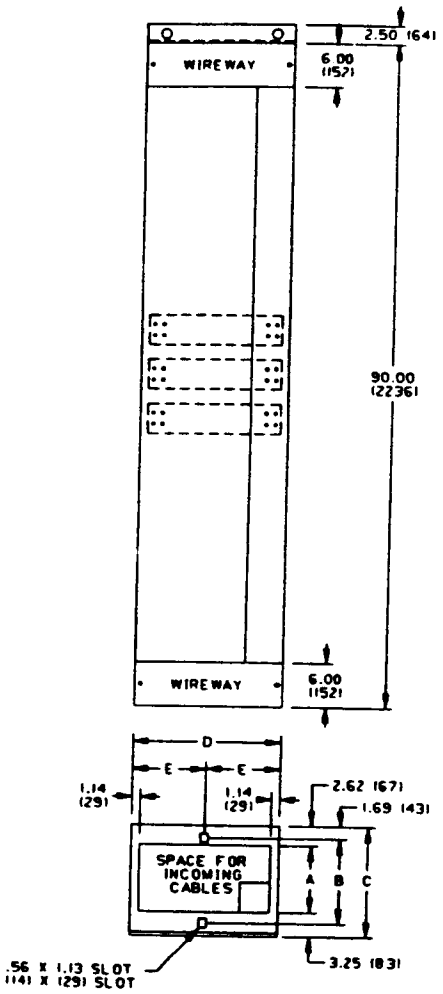
■ The Catalog Numbers listed are not complete. Select ground bus options A, B or C and price from table on page 8. Select the appropriate **Voltage Code** from Table "A" to identify the Fuse Clip Voltage and add the **Fuse Clip Designator** from Table "B" to identify the Fuse Clip Size and Type, e.g. 2100-FAC1A1A-**24R**.

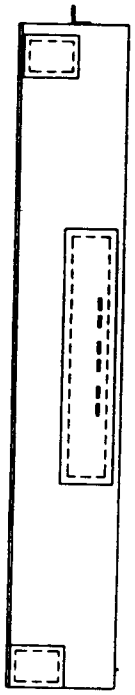
■ Catalog Number shown is not complete. Select ground bus options A, B or C and price from table on page 8. Select the appropriate **Number** from Table "C" to identify the Trip Current and add the **Suffix Letter** from Table "D" to identify the Circuit Breaker Type, e.g. 2100-GAC1B1A-**30CT**.

■ Refer to Appendix for circuit breaker Interrupting Capacity.

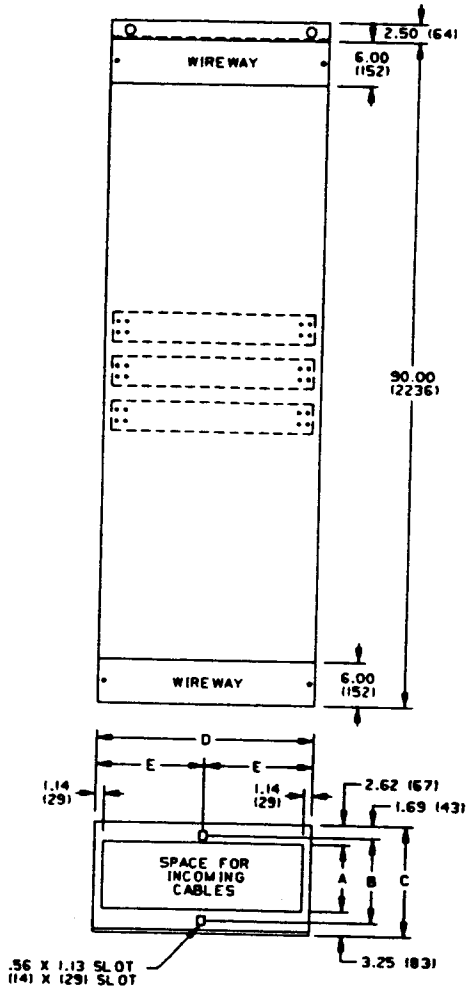
APPROXIMATE DIMENSIONS

Basic 20" Wide Section





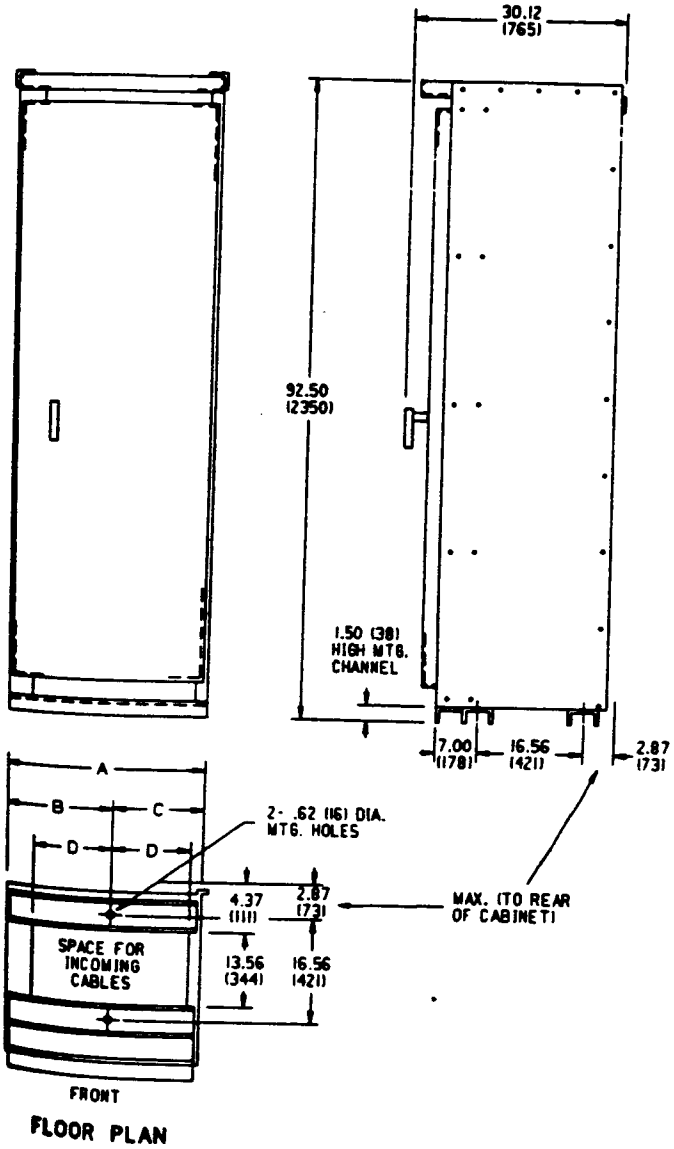
Special 25", 30" and 35" Wide Sections



	15" Deep								20" Deep						
	20" Wide		25" Wide		30" Wide		35" Wide		20" Wide		25" Wide		30" Wide		35" W
Dimension	Inch	MM	Inch	MM	Inch	MM	Inch	MM	Inch	MM	Inch	MM	Inch	MM	Inch
A	9.13	(232)	9.13	(232)	9.13	(232)	9.13	(232)	14.13	(359)	14.13	(359)	14.13	(359)	14.13
B	11.56	(294)	11.56	(294)	11 56	(294)	11.56	(294)	16.56	(421)	16.56	(421)	16.56	(421)	16.56
C	15.00	(381)	15.00	(381)	15.00	(381)	15.00	(381)	20.00	(508)	20.00	(508)	20.00	(508)	20.00
D	20.00	(508)	25.00	(635)	30.00	(762)	35.00	(889)	20.00	(508)	25.00	(635)	30.00	(762)	35.00
E	10.00	(254)	12.50	(318)	15.00	(381)	17 50	(445)	10.00	(254)	12.50	(318)	15.00	(381)	17.50

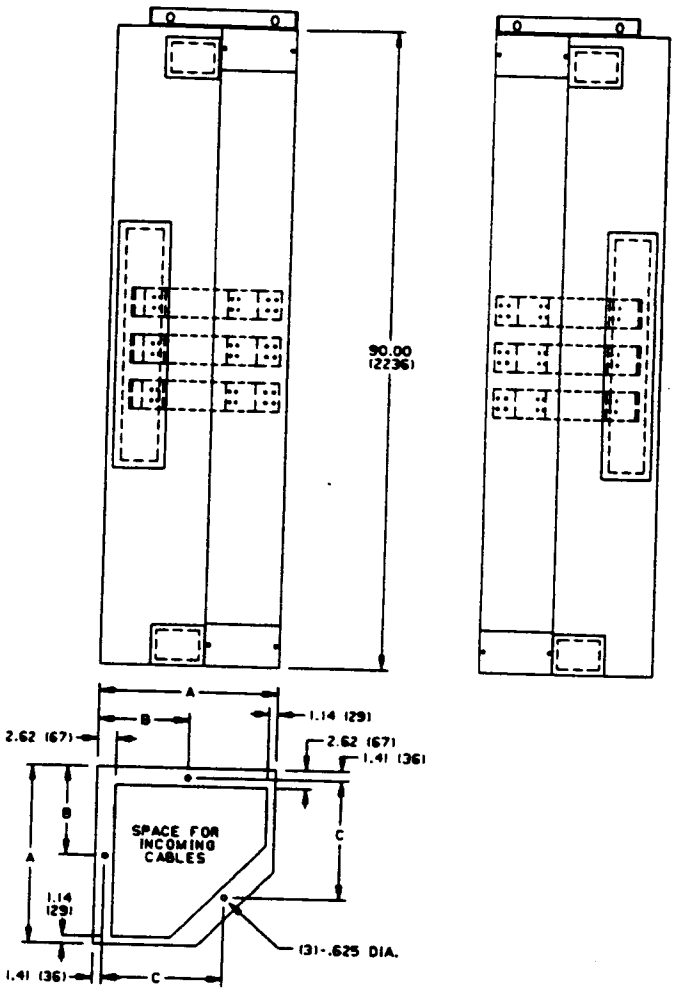
APPROXIMATE DIMENSIONS

NEMA 3R Section



FLOOR PLAN

Corner Section



Interior Section Width	FLOOR PLAN DIMENSIONS							
	A		B		C		D	
	Inch	MM	Inch	MM	Inch	MM	Inch	MM
20.00	25.00	(635)	13.75	(349)	11.25	(286)	8.87	(225)
23.00	30.00	(762)	16.25	(413)	13.75	(349)	11.37	(289)
30.00	35.00	(889)	18.75	(476)	16.25	(413)	13.87	(352)

	SECTION DEPTH			
	15 Deep		20 Deep	
Dimension	Inch	MM	Inch	MM
A	25.13	(638)	30.13	(765)
B	12.63	(321)	15.13	(384)
C	16.81	(427)	21.81	(554)

BULLETIN 2113 - FULL VOLTAGE NON-REVERSING STARTERS WITH CIRCUIT BREAKER (FVNR)

HEATER ELEMENTS NOT INCLUDED. $27.00 PER SET. SEE PAGE 68.

PRICE INCLUDES DOOR AND UNIT SUPPORT PAN. PRICE SECTION SEPARATELY.

NOTE: SHADING INDICATES PE PROGRAM.

NEMA Size	Horsepower Line Voltage 208V	240V	480V	600V	Space Factor	Catalog Number ■ Wiring Type A or B	NEMA Type 1	NEMA Type 1 (w/gasket) & 12	Prices Class I Type A	Type B
1 (UL)	1/8 - 7-1/2	1/8 - 7-1/2	1/8-10	1/8-10	1	2113A- or 2113B-	BA__-___	BD__-___	$ 550	$ 600
Dual 1 (UL)	1/8 - 7-1/2	1/8 - 7-1/2	1/8-10	1/8-10	1.5 ■		BA__-___ ■	BD__-___ ■	1100	1200
2 (UL)	10	10-15	15-25	15-25	1		CA__-___	CD__-___	650	715
Dual 2 (UL)	10	10-15	15-25	15-25	1.5 ■		CA__-___ ■	CD__-___ ■	1300	1430
3 (UL)	15-25	20-30	30-50	30-50	1.5		DA__-___	DD__-___	1411	1501
4 (UL)	30-40	40-50	60-100	60-100	2		EA__-___	ED__-___	2121	2171
5 (UL)	50-75	60-100	125-200	125-200	3.5		FA__-___	FD__-___	5480	5530
6	100-150	125-200	250-400	250-400	6 ■	PE-■	GA__-___	GD__-___	14038	141[illegible]

■ The Catalog Numbers listed are not complete. Select the **Control Voltage Code** from Table "A" to identify Control Type desired. Select the appropriate **Number** from Table "B" to identify the Horsepower and add the **Suffix Letter** from Table "C" to identify the Circuit Breaker Type, e.g. 2113A-BA**BD-30CA**.

■ Available as dual mounted unit only, supplied without power terminal blocks.

■ Dual mounting of combination starters in one unit, add two **Numbers** from Table "B" to identify the Horsepower and add the **Suffix Letter** from Table "C" to identify the Circuit Breaker Type, e.g. 2113B-BABD-**3941CA**.

■ 25" wide. Factory mounted, no vertical wireway. Separate or Transformer control only.

TABLE A

Control Voltage Code 208V	240V	480V	600V	Control Type
H	A	B	C	**120V Transformer Control:** Specify and price a control circuit transformer (option "6S" or "6P") from page 63.
HD	AD	BD	CD	**120V Separate Control:** Listed prices apply. Control circuit fusing and/or disconnecting interlock may be required to comply with NEC.
H	A	B	C	**Common Control:** Specify and price control circuit fusing (option "22") from page 64. Required to comply with NEC. Common control is not available on NEMA size 6 starters.

TABLE B

Number	Motor HP	Number	Mot[illegible] HP
30	1/8	44	[illegible]
31	1/4	45	[illegible]
32	1/3	46	[illegible]
33	1/2	47	[illegible]
34	3/4	48	[illegible]
35	1	49	[illegible]
36	1-1/2	50	1[illegible]
37	2	51	1[illegible]
38	3	52	1[illegible]
39	5	54	2[illegible]
40	7-1/2	56	2[illegible]
41	10	57	3[illegible]
42	15	58	3[illegible]
43	20	59	4[illegible]

TABLE C

NEMA Size	Instantaneous Circuit Breakers ■ ■ High Interrupting Capacity Suffix	Frame	Adder	High I.C. w/Current Limiter ■ Suffix	Frame	Adder	Thermal Magnetic Circuit Breakers ■ Std. Interrupting Capacity Suffix	Frame	Adder	Std. I.C. w/Current Limiter ■ Suffix	Frame	Adder	High Interrupti[illegible] Capacity Suffix	Frame	[illegible]
1 (UL)	CA	HMCP	STD	CC	HMCP-ELC	$ 300	CT	FDB	$ 107	CD	FDB-LFB	$ 507	CM	HFD	$[illegible]
2 (UL)	CA	HMCP	STD	CC	HMCP-ELC	300	CT	FDB	107	CD	FDB-LFB	507	CM	HFD	[illegible]
3 (UL)	CA	HMCP	STD	CC	HMCP-ELC ■	695	CT	FDB	167	CD	FDB-LFB ■	1016	CM	HFD	[illegible]
4 (UL)	CA	HMCP	STD	CC	HMCP-ELC ■	1454	CT	JDB ■	448	--	--	--	CM	HJD ■	[illegible]
5 (UL)	CA	HMCP250 HMCP400	STD	--	--	--	CT	JDB KDB	448	--	--	--	CM	HJD HKD	[illegible]
6	--	--	--	--	--	--	WT	LC MC	STD	--	--	--	WB	HLC HMC	[illegible]

■ Refer to Appendix for circuit breaker Interrupting Capacity and Short Circuit Withstand Ratings.

■ For motor applications where transient inrush currents exceed 13 times full load current, consult factory.

■ Circuit breakers with current limiters are not available on dual mounted units.

■ Add 0.5 space factor.

Modifications - See Pa[illegible]
Discount Schedule [illegible]

BULLETIN 2193LE - BOLT-ON LIGHTING PANEL

LOAD TERMINAL BLOCKS NOT FURNISHED. UNITS ARE NOT WIRED. NO PLUG-IN STABS.

PRICE INCLUDES DOOR AND UNIT SUPPORT PAN. PRICE SECTION SEPARATELY.

Type	Panel Bus & Main Lug Ampere Rating	Max. Number of 1-Pole Circuit Breakers	Space Factor	Catalog Number ■ Wiring Type A	Catalog Number ■ NEMA Type 1	Catalog Number ■ NEMA Type 1 (w/gasket) & 12	Prices Class I Type A
WITH MAIN LUG ONLY (MLO)							
Single Phase 3-Wire 120/240 Volts A.C. 10,000 Amps I.C. RMS SYM	100	18 (UL)	2.0	2193LE-	AAL118-00WT	AJL118-00WT	$ 528
	225	30 (UL)	2.5		CAL130-00WT	CJL130-00WT	702
		42 (UL)	3.0		CAL142-00WT	CJL142-00WT	905
Three Phase 4-Wire 120/208 Volts A.C. 10,000 Amps I.C. RMS SYM	100	18 (UL)	2.0		AAL318-00WT	AJL318-00WT	528
		30 (UL)	2.5		AAL330-00WT	AJL330-00WT	702
	225	42 (UL)	3.0		CAL342-00WT	CJL342-00WT	905
WITH MAIN CIRCUIT BREAKER (MCB)							
Single Phase 3-Wire 120/240 Volts A.C. 10,000 Amps I.C. RMS SYM	100	16 (UL)	2.0	2193LE-	AAB116-40WT	AJB116-40WT	1244
	225	30 (UL)	3.5		CAB130-45WT	CJB130-45WT	1444
		42 (UL)	4.0		CAB142-45WT	CJB142-45WT	1687
Three Phase 4-Wire 120/208 Volts A.C. 10,000 Amps I.C. RMS SYM	100	15 (UL)	2.0		AAB315-40WT	AJB315-40WT	1244
		27 (UL)	2.5		AAB327-40WT	AJB327-40WT	1444
	225	42 (UL)	4.0		CAB342-45WT	CJB342-45WT	1687

■ The Catalog Numbers listed do not include branch breakers. Refer to Table "A" for catalog string numbers.

FACTORY INSTALLED BOLT-ON BRANCH BREAKERS ■

TABLE A

Trip Rating @ 40°C (Amps)	Catalog String Number ■	Adder Price Each	Continuous Ampere Rating @ 40°C	Catalog String Number ■	Adder Price Each	Continuous Ampere Rating @ 40°C	Catalog String Number ■	Adder Price Each
1-Pole Thermal Magnetic 120/240VAC Circuit Breaker 10,000 Amps I.C. SYM			**2-Pole Thermal Magnetic 120/240VAC Circuit Breaker 10,000 Amps I.C. SYM**			**3-Pole Thermal Magnetic 120/240VAC Circuit Breaker 10,000 Amps I.C. SYM ■**		
15A (UL)	30A___	$ 22	15A (UL)	30B___	$ 43	15A (UL)	30C___	$ 116
20A (UL)	31A___		20A (UL)	31B___		20A (UL)	31C___	
30A (UL)	32A___		30A (UL)	32B___		30A (UL)	32C___	
15A w/GRD FLT (UL) ■	30D___	150	50A (UL)	35B___		50A (UL)	35C___	
20A w/GRD FLT (UL) ■	31D___		100A (UL)	40B___	99	100A (UL)	40C___	176
Filler Plate (UL)	00A___	2	–	–	–	–	–	–

■ Refer to page 20 for Catalog Numbers and Pricing for field installed branch breakers. When breakers are to be factory installed, specify and price filler plates for all remaining blank spaces in panel.

■ The Catalog String Numbers listed are not complete. Specify the number of branch breakers, e.g. 32A18. Use two digits for quantities less than 10, e.g. 03 for quantity three. Multiple branch breakers of different poles and trips are available by adding string numbers to the end of the catalog number, e.g. 2193LE-AAL118-00WT-30A08-31B02-30C02. The branch breakers will be automatically located by the factory. The maximum amperes connected to any one connector cannot exceed 100 Amps on bolt-on branch breakers.

■ Ground fault interrupting circuit breakers provide 5mA personnel protection.

■ For use on three phase lighting panels only.

FACTORY ASSEMBLED CIRCUIT BREAKER PANELBOARDS

NQOD COMBINATION PLUG-ON BOLT-ON — 240V. AC MAXIMUM

APPLICATION DATA

APPLICATION: For use on ac systems. Meet Federal [illegible] W-P-115b, Type 1, Class 1, UL listed.

SERVICE: 1Ø2W, 1Ø3W, 3Ø3W, 3Ø4W, 3Ø Grd [illegible] 240V. ac max.

I.E.R.: Integrated Equipment Short Circuit Rat[illegible] Page 85.

MAINS: Distributed phase bussing:
Type NQOD - Combination Plug-on [illegible]

Main Lugs:	Main Breaker
100A.	100A. - QOB, ●FH, ●FA [illegible]
225A.	225A. - Q2, KA, KH, IK
400A.	400A. - Q4, LA, LH
600A.	

BRANCHES: Plug-on QO and bolt-on QOB circuit breakers.

QO - 10-70A.	1, 2 and 3-pole	QOB - 10-70A.	1, 2 and 3-pole
QO - 80-100A.	2 and 3-pole	QOB - 80-100A.	2 and 3-pole
QO - 110-125A.	2-pole	QOB - 110-125A.	2-pole

See Page 56 for branch terminal lug data.

CABINETS: MONO-FLAT fronts — concealed trim screws and door hinges, flush lock. Gray baked enamel finish. Box — galvanized steel with knockouts.

● Available factory assembled only.
See Page 55 for main breaker interrupting rating.
Top or Bottom Feed with single row bus construction.

TABLE 1 — BASE PRICE

Mains Rating	Main Lugs 2-Pole	Main Lugs 3-Pole	Main Breaker (Circuit Breaker Interrupting Rating - Page 55) Standard [illegible] Breaker	Standard 2-Pole	Standard 3-Pole	HIC Breaker	HIC 2-Pole	HIC 3-Pole	Extra HIC Breaker	Extra HIC 2-Pole	Extra HIC 3-Pole	I-LIMITER Breaker	I-LIMITER 2-Pole	I-LIMITER 3-Pole	Add For Solid Neutral
60A	...	...	QOB FA	$ 302 426	$ 380. 529.	QOB-VH FH	$ 323. 647.	$ 415. 755.	FC	$ 712.	$ 859.	IF	$1133.	$1356.	$ 39
100A	$167.	$199.	QOB FA	321 491	409 589.	QOB-VH FH	356. 704.	453. 807.	FC	802.	962.	IF	1133.	1356.	39
225A	181.	226.	Q2 KA	812 1169	995. 1287.	Q2-H Q2H KH	996. 1098. 1795.	1140. ... 2023.	KC	1935.	2245.	IK	2098.	2454.	39.
400A	299.	358.	Q4 LA	1288 1430.	1486. 1643.	LH	2103.	2427.	...	...	...	...	...	...	112.
600A	350.	404.	...	...		...	...	...	...	...	...	...	...	...	158.

BRANCH BREAKERS — PRICE PER BREAKER

Breaker Ampere Rating	PLUG-ON 1-Pole 120/240V. ac Price	PLUG-ON 2-Pole 120/240V. ac Price	PLUG-ON 2-Pole 240V. ac Price	PLUG-ON 3-Pole 240V. ac Price	BOLT-ON 1-Pole 120/240V. ac Price	BOLT-ON 2-Pole 120/240V. ac Price	BOLT-ON 2-Pole 240V. ac Price	BOLT-ON 3-Pole 240V. ac Price
TABLE 2 — 10,000 AIC — Plug-On Branch Breakers (QO, QO-H)					Bolt-On Branch Breakers - QOB, QOB-H			
15-60	$ 17.	$ 37.	$ 71.◆	$ 98.	$ 20.	$ 37.	$ 74.◆	$ 98.
70	27.	59.	81.◆	111.	29.	61.	83.◆	118.
80-100	...	73.	106.◆	128.	...	74.	110.◆	132.
110-125	...	137.	...	...	...	138.	...	...
QWIK-GARD — Class A - (QO-GFI)					QWIK-GARD — Class A - (QOB-GFI)			
15-30	76.	137	...	...	78.	138.	...	...
40-60	...	137.	...	...	...	138.	...	...
TABLE 3 — **BRANCH BREAKERS (High Interrupting Capacity)** 22,000 AIC Plug-on Branch Breakers — QO VH					22,000 AIC Bolt-on Branch Breakers — QOB-VH			
15-30	$ 25.	$ 59.	...	$130.	$ 27.	$ 61.	...	$133.
35-60	...	59.	...	130.	...	61.	...	133.
70	...	81.	...	157.	...	83.	...	164.
80-100	...	106.	...	171.	...	108.	...	176.
110-125	...	287.	...	...	...	...	...	...
QWIK-GARD — Class A - QO-VHGFI					QWIK-GARD — Class A - (QOB-VHGFI)			
15-30	145.	...	...	...	147.	...	...	...
42,000 AIC Plug-on Branch Breakers — QOH					42,000 AIC Bolt-on Branch Breakers			
35-60	...	$106.	...	...	...	...	...	...
70	...	171.	...	...	...	...	...	...
80-100	...	198.	...	...	...	...	...	...
110-125	...	404.	...	...	...	...	...	...
65,000 AIC Plug-on Branch Breakers — QH					65,000 AIC Bolt-on Branch Breakers — QHB			
15-30	39.	98.	...	169.	41.	100.	...	171.
TABLE 4 — **SPECIALTY BRANCH BREAKERS** (10,000 AIC) KEY OPERATED								
15-30	$ 22.	...	...	...	$ 22.	...	...	...
QO-HID — For High Intensity Discharge Lighting					QOB-HID — For High Intensity Discharge Lighting			
15-30	20.	41.	...	...	22.	42.	...	108.
SWITCH NEUTRAL								
		2 Wire (2 space)		3 Wire (3 space)		2 Wire (2 space)		3 Wire (3 space)
15-50	...	44.	...	64.	...	44.	...	64.
QO-EM ENERGY MANAGEMENT★					QOB-EM ENERGY MANAGEMENT★			
15-60	56.	110.	...	...	66.	132.	...	...
SPACE ONLY								
All of Above	8.	17.	17.	25.	8.	17.	17.	25.

Shunt Trip, Auxiliary Switch, and Alarm Switch — accessories for circuit breakers — add price from Page 86 and 87.
◆ UL Listed for use on 3Ø, grounded BØ systems, with 5,000 AIC.
★ 24V dc Power Supply Module: Plug-on ..... $ 98.
Bolt-on ..... $104.

QO and QWIK-GARD are Registered Trademarks of Square D Company.

FACTORY ASSEMBLED CIRCUIT BREAKER PANELBOARDS

SPECIAL FEATURES — NQOD — 240V. AC

- MAIN BREAKER ACCESSORIES — shunt trip, auxiliary alarm, etc., — add price from Page 77. Not available on Q2, 225A. main breaker.
- COMPRESSION LUGS — Square D mechanical lugs are standard.
  Square D VCEL compression lugs ..... no charge.
  Other compression type - specify lug to be used ..... $37. per lug.
- SUB-FEED LUGS — Main lugs interior only - 1Ø or 3Ø. Box sizes change as follows:

  NQOD - No change except: 225A. 42 cir. - 41"H x 20"W or 14"W
  54 cir. - 47"H x 20"W or 14"W
  400A. Add 3" to standard box height.
  See Page 92 for dimensions.

Mains Rating	Sub-Feed Wire Range	Price
100A.	(1) #14-1/0 Al/Cu	$37.
225A.	(1) #6-300 MCM Al/Cu	37.
400A.	(1) #4-500 MCM Al/Cu	47.

- SUB-FEED CIRCUIT BREAKER (NQOD) — Main lugs or main breaker interior —1Ø or 3Ø.
  Maximum 1 per 225A. panel—maximum 2 per 400-600A. panel.

SUB-FEED BREAKERS (110-225A.)				
No. of Poles	Q2	Q2-H	KA	KH
2	$349.	$507.	$708.	$1332.
3	532.	660.	825.	1561.
Space Only	238.	238.	238.	238.

SUB-FEED BREAKER CABINET DATA					
Max. No. of Branch Spaces	Box Height (20"W x 5¾"D)				
	NQOD				NQO/NQOB
	225A.		400/600A.		400A. Main Breaker
	Main Lugs	Main Breaker	Main Lugs	Main Breaker	
30	56	71	71	...	...
42	62	77	74	...	74
48	62	77	...	...	...

- THRU-FEED LUGS — NQOD 1Ø or 3Ø 225-600A. Main Lugs
  225-400A. Main Breaker

THRU-FEED LUGS		
Mains Rating	Thru-Feed Wire Range	Price
225A.	(1) #6-300 MCM Al/Cu	$ 98.
400A.	(1) #3/0-750 MCM Al/Cu and (1) #6-300 MCM Al/Cu	238.
600A.	(2) #3/0-500 MCM Al/Cu	238.

THRU-FEED LUG CABINET DATA				
Max. No. of Branch Spaces	Box Height (20"W x 5¾"D)			
	NQOD			
	225A.		400/600A.	
	Main Lugs	Main Breaker	Main Lugs	Main Breaker
30	41	56	59	74
42	47	62	62	77
48	47	62	...	...

- LIGHTING CONTACTORS (NQOD) for tungsten and ballast lamp loads. (Push buttons not included).

Ampere Rating	Electrically Held		Mechanically Held			
	Square D Class 8903		Square D Class 8903		ASCO Bul. 920	
	2-Pole	3-Pole	2-Pole	3-Pole	2-Pole	3-Pole
30	$ 674.	$ 780.	$ 892.	$ 892.	$ 942.	$1091.
60	838.	1012.	1115.	1263.	1196.	1534.
75	...	...	...	...	...	...
100	1063.	1273.	1263.	1520.	1196.	1534.
150	...	...	...	...	1334.	1846.
200	1775.	2128.	2185.	2508.	1856.	2611.
					2185.	2900.

Contactor charge includes contactor, space, mounting, cable connection to main and split bus if required. Contact Field Office for box sizes.

- COPPER BUS BARS, COPPER NEUTRAL, AND COPPER GROUND BAR
  Copper bus is standard on 600A. interiors.
  For copper bus 100, 225A. ..... add $37.
  400A. ..... add $94.
  Copper neutral ..... add $19.
  Copper ground bar ..... add $14.
- SPLIT BUS (NQOD) — Main Lugs or Main Breaker Interior

No. Poles	Ampere Rating			
	100A.	225A.	400A.	600A.
2	$ 86.	$ 86.	$181.	$213.
3	118.	118.	213.	233.

- TOP-FEED if specified will be supplied no charge. Column width panelboards are standard as top-feed, bottom-feed supplied no charge.

CABINETS

- NAMEPLATES for identification purposes. Price includes engraving and mounting.
  Black and white laminated bakelite ..... $ 22.
  Stainless steel ..... 39.
- WEATHERPROOF or DUSTTIGHT Cabinets—NEMA 3R, 3S or 12 ..... $434.★
- ENDWALLS
  Blank ..... no charge
  Special drilling or knockouts — Template must accompany order ..... $37.
- STANDARD COMMERCIALLY AVAILABLE COLORS USAS #49 Gray as standard
  For other colors ..... $182.★
- CABLE TROUGH and PULL BOXES for column width panelboards.

Cable Troughs (L = Length)						Pull Boxes with S/N		
L (In.)	8⅝"x 5" Catalog Number	Price	L (In.)	8⅝"x 5" Catalog Number	Price	S/N Terminals	Catalog Number	Price
36	■MTX836	$133.	84	■MTX884	$189.	26	MPX815-26	$107.
48	■MTX848	145.	96	■MTX896	203.	42	MPX815-42	107.
56	■MTX856	158.	104	■MTX8104	220.			
66	■MTX866	168.	112	■MTX8112	238.			

■ 6⅝"x 5" cable trough available for 6⅝"W column width. Change "8" in catalog number to "6" (i.e. MTX636). Same price as listed above. MTX . . . B cable troughs (i.e. MTX836B) are available with trough barriers when more than 30 conductors are to be run in the trough. Same price as listed above.

★ If individual order calls for duplicate devices with the same special feature or if a quantity of 10 or more assorted panelboards is involved, deduct 25% of the price shown for the additional feature.

For additional features not listed, contact your local Square D Field Office.

NQOD

CABINET DATA

MAIN LUGS ONLY

Number of Spaces 100A	225A	400A	600A	Box Dimensions H	W	D	Box Catalog Number
Standard Width							
12	....	....	....	20	14	5¾	NQB520
20■,24★	....	....	....	23			NQB523
30★	....	....	....	26			NQB526
....	30	....	....	32			NQB532
....	42	....	....	35			NQB535
....	54	....	....	41			NQB541
12	....	....	....	20	20	5¾	MH20
20■,24★	....	....	....	23			MH23
30★	....	....	....	26			MH26
....	30	....	....	32			MH32
....	42	....	....	35			MH35
....	54	....	....	41			MH41
....	....	30	....	50			MH50
....	....	42	....	53			MH53
....	....	54	....	59			MH59
....	....	....	30	53			MH53
....	....	....	42	56			MH56
....	....	....	54	62			MH62

MAIN CIRCUIT BREAKER

Number of Spaces 60, 100A QOB or QOB-VH	100A FA, IF, FH	225A Q2, Q2-H, Q2H, KA, KH, IK	400A LA, LH	Box Dimensions H	W	D	Box Catalog Number
12	....	....	....	23	14	5¾	NQB523
20■,24★	....	....	....	26			NQB526
30★	....	....	....	29			NQB529
....	12	....	....	32			NQB532
....	20■,24★	....	....	35			NQB535
....	30★	....	....	38			NQB538
....	....	30	....	44			NQB544
....	....	42	....	50			NQB550
....	....	54	....	56			NQB556
12	....	....	....	23	20	5¾	MH23
20■,24★	....	....	....	26			MH26
30★	....	....	....	29			MH29
....	12	....	....	32			MH32
....	20■,24★	....	....	35			MH35
....	30★	....	....	38			MH38
....	....	30	....	44			MH44
....	....	42	....	50			MH50
....	....	54	....	56			MH56
....	....	....	30	65			MH65
....	....	....	42	68			MH68
....	....	....	54	74			MH74

NQO

MAIN LUGS ONLY

Number of Spaces 100A	225A	400A	Box Dimensions H	W	D	Box Catalog Number
Column Width						
12	....	....	26½	8⅝‡	5	LX826B
20■	....	....	40			LX840B
24★	....	....	40			LX840B
30★	....	....	40			LX840B
....	30■	....	45			LX845B
....	42	....	58	8⅝		LX858B

MAIN CIRCUIT BREAKER

Number of Spaces 60, 100A QOB QOB-VH	100A IF	125A Q2 or KA	225A IK	400A LA	Box Dimensions H	W	D	Box Catalog Number
Column Width								
12	....	....	....	....	40	8⅝‡	5	LX840B
20■	....	....	....	....	40			LX840B
24★	....	....	....	....	45			LX845B
30★	....	....	....	....	45			LX845B
....	....	30■	....	....	62	8⅝		LX862B
....	....	42	....	....	62			LX862B

NQOB

MAIN LUGS ONLY

Number of Spaces 100A	225A	400A	600A	Box Dimensions H	W	D	Box Catalog Number
Column Width							
12	....	....	....	26½	8⅝‡	5	LX826B
20■	....	....	....	40			LX840B
24★	....	....	....	40			LX840B
30★	....	....	....	40			LX840B
....	30■	....	....	45			LX845B
....	42	....	....	58	8⅝		LX858B

■ 1∅3W only. ★ 3∅4W only.
‡ For optional 6⅞" W x 5" D column width box, replace "8" in catalog number with "6" (i.e. LX632B). No extra charge.

MAIN CIRCUIT BREAKER

Number of Spaces 60, 100A QOB QOB-VH	100A IF	125A Q2 or KA	225A IK	400A LA	Box Dimensions H	W	D	Box Catalog Number
Column Width								
12	....	....	....	....	40	8⅝‡	5	LX840B
20■	....	....	....	....	40			LX840B
24★	....	....	....	....	45			LX845B
30★	....	....	....	....	45			LX845B
....	....	30■	....	....	62	8⅝		LX862B
....	....	42	....	....	62			LX862B

MAIN LUGS TERMINAL DATA

Ampere Rating	Wire Range Wire Bending Space per NEC Table 373-6	Lug Wire Range
100	(1) #10-1 Cu or (1) #6-1 Al	(1) #10-2/0 Cu or (1) #6-2/0 Al
225	(1) #6-300 MCM Al/Cu	(1) #6-300 MCM Al/Cu
400	(2) #1 0-300 MCM Al/Cu or (1) #1 0-750 MCM Al/Cu	(2) #1/0-300 MCM Al/Cu or (1) #1/0-750 MCM Al/Cu
600	(2) #3 0-500 MCM Al/Cu	(2) #3/0-500 MCM Al/Cu

MAIN BREAKER TERMINAL DATA

Ampere Rating	Breaker Type	Wire Range Wire Bending Space per NEC Table 373-6	Lug Wire Range
100	QOB	(1) #4-1 Al/Cu	(1) #4-2/0 Al/Cu
100	•FA, •FH, •IF	(1) #14-1 Al/Cu	(1) #14-1/0 Al/Cu
225	Q2	(1) #4-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu
225	KA, KH, IK	(1) #4-300 MCM Al/Cu	(1) #4-350 MCM Al/Cu
400	Q4, LA, LH	(1) #1-500 MCM Al/Cu or (2) #1-250 MCM Al/Cu	(1) #1-500 MCM Al/Cu or (2) #1-250 MCM Al/Cu

PANELBOARD SPACE REQUIREMENTS

Maximum Panelboard Mains Rating▲	QO, QOB Circuit Breakers For NQOD 1-Pole	2-Pole	3-Pole
100	1	2	3
225			
400			
600			

▲Branch circuit breakers installed in panel may not exceed mains rating of panel.

FACTORY ASSEMBLED PRICING PROCEDURE

The following Factory Assembled pricing procedure may be used to price NQOD (combination plug-on or bolt-on) panelboards. For dimensional information see above.

1. Select BASE PRICE for main lugs or main breaker from TABLE 1 on Page 90. Add price for solid neutral when required. Include equipment ground bar when required.
2. List BRANCH BREAKERS (either plug-on or bolt-on) and determine total spaces required using PANELBOARD SPACE REQUIREMENTS table. Select price from TABLES 2, 3 and 4. Include space only charge for future requirements.
3. Box size and catalog number may be obtained from CABINET DATA table above. If total spaces required exceeds the maximum listed, price as two or more panels and add price for sub-feed or thru-feed lugs from Page 91, so installer can cable between sections.
4. Add price for special features from Page 91. Contact field office for additional special features.
5. For complete price, add all prices. Order by description.

PRICING SAMPLE
208Y/120V. AC, 3∅4W, SURFACE MOUNTED, BOTTOM-FEED
225A. MAIN BREAKER, PLUG-ON BRANCHES

No. Req'd.	Brkr. Type	Brkr. Amps.	No. of Poles	Total Spaces	Price Per Brkr.	Total Price
20	QO	20	1	20	$ 17.00	$340.00
1	QO	30	2	2	37.00	37.00
2	QO	20	3	6	98.00	196.00
2	QO	70	3	6	111.00	222.00
2	QO	100	3	6	128.00	256.00
2	SPACE ONLY		1	2	8.00	16.00
				42		
	Q2 Main Breaker					991.00
	Solid Neutral					39.00
Box Size — 50"H x 20"W x 5¾"D				Total Price		$2097.00

CLASS 7410 7411

GENERAL PURPOSE TRANSFORMERS — THREE PHASE

General purpose dry type transformers for indoor installations. All ventilated transformers have core and coil assemblies mounted on rubber isolation pads to reduce the sound level. Manufactured and tested to meet, or exceed, IEEE, NEMA and ANSI standards. Compact size permits installations near the load being supplied.

UL listed through 500 KVA Three Phase, 167 KVA Single Phase.

KVA	†Catalog Number	Price	Full Capacity Taps	Deg. C. Temp. Rise	◆ Dimensions (inches) Height	Width	Depth	Weight Pounds	Mounting	‡ Enclosure See Page 162	Wiring See Page 175
THREE PHASE — **480 VOLTS DELTA PRIMARY 208Y/120 VOLTS SECONDARY 60 HERTZ**											
3	**3T2F**	$ 374.	2—5%FCBN	115	13½	14¾	9	120	Wall	I-O(C)	8
6	**6T2F**	429.	2—5%FCBN	115	13½	14¾	9	145	Wall	I-O(C)	8
9	**9T2F**	573.	2—5%FCBN	115	14¾	19⅛	12¼	235	Wall	I-O(C)	8
15	**15T2F**	862.	2—5%FCBN	115	14¾	19⅛	12¼	300	Wall	I-O(C)	8
15	**15T68F**	862.	4—2-1/2%2+2—	115	14¾	19⅛	12¼	300	Wall	I-O(C)	8
15	**15T3H**	780.	6—2-1/2%2+4—	150	23	22¼	15	230	Floor	I-O(C)	9
30	**30T2F**	1294.	2—5%FCBN	115	22	25	13⅝	660	Wall	Ie(D)	10
30	**30T3H**	1151.	6—2-1/2%2+4—	150	23	22¼	15	320	Floor	I-O(C)	16
45	**45T3H**	1385.	6—2-1/2%2+4—	150	26	24	15	390	Floor	Ie(D)	10
75	**75T3H**	2087.	6—2-1/2%2+4—	150	30	30	20	620	Floor	Ie(D)	10
112.5	**112T3H**	2777.	6—2-1/2%2+4—	150	37	30	20	730	Floor	Ie(D)	10
150	**150T3H**	3627.	6—2-1/2%2+4—	150	42	36	24	1000	Floor	Ie(D)	10
225	**225T3H**	4836.	6—2-1/2%2+4—	150	42	36	24	1250	Floor	Ie(D)	10
300	**300T3H**	6201.	6—2-1/2%2+4—	150	48	48	29½	2000	Floor	Ie(D)	10
500	**500T68H**	9828.	4—2-1/2%2+2—	150	58	48	29½	2575	Floor	Ie(D)	11
750	750T90H	15971.	4—3-1/2%2+2—	150	68	56	36	3800	Floor	Ie(D)	11
1000	1000T77H	19266.	2—5%1+1—	150	91½	72	54	6300	Floor	I (F)	16
THREE PHASE — **480 VOLTS DELTA PRIMARY 240 VOLTS DELTA SECONDARY 60 HERTZ**											
6	**6T5F**	$ 429.	2—5%FCBN	115	13½	14¾	9	145	Wall	I-O(C)	12
9	**9T75F**	573.	4—2½%FCBN	115	14¾	19⅛	12¼	235	Wall	I-O(C)	13
15	**15T75F**	862.	4—2½%FCBN	115	14¾	19⅛	12¼	300	Wall	I-O(C)	13
15	**15T6H**	780.	6—2½%2+4—	150	23	22¼	15	230	Floor	Ie(D)	14
30	**30T6H**	1151.	6—2½%2+4—	150	23	22¼	15	320	Floor	Ie(D)	14
45	**45T6H**	1385.	6—2½%2+4—	150	26	24	15	390	Floor	Ie(D)	14
75	**75T6H**	2087.	6—2½%2+4—	150	30	30	20	620	Floor	Ie(D)	14
112.5	**112T6H**	2777.	6—2½%2+4—	150	37	30	20	730	Floor	Ie(D)	14
150	**150T6H**	3627.	6—2½%2+4—	150	42	36	24	1000	Floor	Ie(D)	14
225	**225T6H**	4836.	6—2½%2+4—	150	42	36	24	1250	Floor	Ie(D)	14
300	**300T6H**	6201.	6—2½%2+4—	150	48	48	29½	2000	Floor	Ie(D)	14
500	**500T63H**	9750.	4—2½%2+2—	150	58	48	29½	2575	Floor	Ie(D)	15
750	750T91H	15893.	4—3½%2+2—	150	68	56	36	3800	Floor	Ie(D)	15
1000	1000T78H	19110.	2—5%1+1—	150	91½	72	54	6000	Floor	I (F)	17
THREE PHASE — **■ 480 VOLTS DELTA PRIMARY 240/120 VOLTS SECONDARY 60 HERTZ, 3 PHASE, 4 WIRE** — See Note #1											
30	**30T6HCT**	$ 1270.	6—2½%2+4—	150	23	22¼	15	320	Floor	Ie(D)	20
45	**45T6HCT**	1516.	6—2½%2+4—	150	26	24	15	390	Floor	Ie(D)	20
75	**75T6HCT**	2254.	6—2½%2+4—	150	30	30	20	620	Floor	Ie(D)	20
112.5	**112T6HCT**	3023.	6—2½%2+4—	150	37	30	20	730	Floor	Ie(D)	20
150	**150T6HCT**	3791.	6—2½%2+4—	150	42	36	24	1000	Floor	Ie(D)	20
225	**225T6HCT**	5015.	6—2½%2+4—	150	42	36	24	1250	Floor	Ie(D)	20
300	**300T6HCT**	6981.	6—2½%2+4—	150	48	48	29½	2000	Floor	Ie(D)	20
500	500T63HCT	9972.	4—2½%2+2—	150	58	48	29½	2575	Floor	Ie(D)	26
750	750T91HCT	15877.	4—3½%2+2—	150	68	56	36	3800	Floor	Ie(D)	26
1000	1000T78HCT	19305.	2—5%1+1—	150	91½	72	54	6300	Floor	I (F)	27

■ CAUTION: Single phase load limited to maximum 5% of rated KVA. Contact Sorgel headquarters for other loading.
NOTE #1 CONNECT "B" PHASE TO X3 TO MEET N.E.C.384-3

KVA	†Catalog Number	Price	Full Capacity Taps	Deg. C. Temp. Rise	Height	Width	Depth	Weight Pounds	Mounting	‡ Enclosure See Page 162	Wiring See Page 175
THREE PHASE — **480 VOLTS DELTA PRIMARY 480Y/277 VOLTS SECONDARY 60 HERTZ**											
15	**15T76H**	$ 1066.	4—2½%2+ & 2—	150	23	22¼	15	230	Floor	Ie(D)	11
30	**30T76H**	1270.	4—2½%2+ & 2—	150	23	22¼	15	320	Floor	Ie(D)	11
45	**45T76H**	1524.	4—2½%2+ & 2—	150	26	24	15	390	Floor	Ie(D)	11
75	**75T76H**	2295.	4—2½%2+ & 2—	150	30	30	20	620	Floor	Ie(D)	11
112.5	**112T76H**	2925.	4—2½%2+ & 2—	150	37	30	20	730	Floor	Ie(D)	11
150	**150T76H**	3783.	4—2½%2+ & 2—	150	42	36	24	1000	Floor	Ie(D)	11
225	**225T76H**	5109.	4—2½%2+ & 2—	150	42	36	24	1250	Floor	Ie(D)	11
300	**300T76H**	6630.	4—2½%2+ & 2—	150	48	48	29½	2000	Floor	Ie(D)	11
500	500T76H	10530.	4—2½%2+ & 2—	150	58	48	29½	2575	Floor	Ie(D)	11
THREE PHASE — **480 VOLTS DELTA PRIMARY 380Y/220 VOLTS SECONDARY 60 HERTZ**											
15	15T96H	$ 1014.	4—2½%2+ & 2—	150	23	22¼	15	230	Floor	Ie(D)	11
30	30T96H	1248.	4—2½%2+ & 2—	150	23	22¼	15	320	Floor	Ie(D)	11
45	45T96H	1560.	4—2½%2+ & 2—	150	26	24	15	390	Floor	Ie(D)	11
75	75T96H	2321.	4—2½%2+ & 2—	150	30	30	20	620	Floor	Ie(D)	11
112.5	112T96H	3101.	4—2½%2+ & 2—	150	37	30	20	730	Floor	Ie(D)	11
150	150T96H	3810.	4—2½%2+ & 2—	150	42	36	24	1000	Floor	Ie(D)	11
225	225T96H	5238.	4—2½%2+ & 2—	150	42	36	24	1250	Floor	Ie(D)	11
300	300T96H	7001.	4—2½%2+ & 2—	150	48	48	29½	2000	Floor	Ie(D)	11
500	500T96H	10647.	4—2½%2+ & 2—	150	58	48	29½	2575	Floor	Ie(D)	11

† CATALOG NUMBERS SHOWN IN BOLD TYPE ARE AVAILABLE FROM REDISTRIBUTION CENTER.
● Units can be converted for outdoor service with use of weathershields shown on Page 162.
‡ ENCLOSURE CODE—I = Indoor, O = Outdoor. Letters in parentheses indicate illustration on Page 162.
TAPS on transformers 225 KVA and larger may vary in 3% to 5% steps to obtain best design.
LUGS: Furnished by customer.
◆ DO NOT USE FOR CONSTRUCTION; CONTACT SORGEL PLANT FOR CERTIFIED PRINTS.

PE2

SORGEL and QUIET QUALITY are Registered Trademarks of Square D Company.

Safety Switches

Double Throw Switches

Features and Dimensional Data

NEMA 1
30, 60, 100
Ampere
Switch

30 to 600 Amperes
240, 600 Volts Ac
2, 3 Poles
Copper - Aluminum Terminals

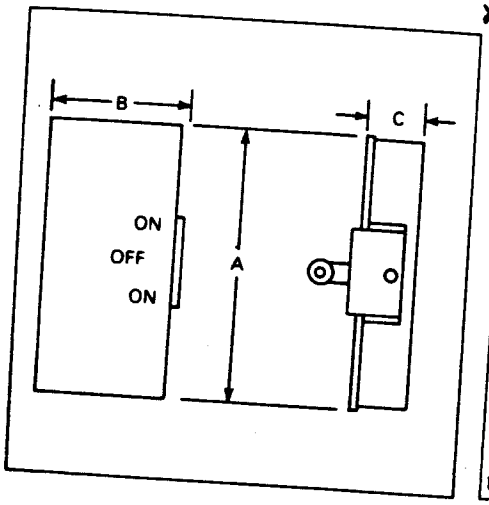
Enclosures
NEMA 1 General Purpose
NEMA 3R Raintight
Typical Specifications
Furnish and install for use as a transfer switch where indicated double-throw switches having the electrical characteristics, ratings and modifications shown on the drawings.

All switches shall have: NEMA 1 general purpose enclosures unless otherwise noted; metal nameplates, front cover mounted, that contain a permanent record on switch type, catalog number and hp ratings (with both standard and time delay fuses); handle whose position is easily recognizable and is padlockable in the "OFF" position; visible blades; reinforced fuse clips; nonteasible, positive, quick make-quick break mechanisms; and switch assembly plus operating handle as an integral part of the enclosure base.

All switches shall be Underwriters' Laboratories, Inc. listed, Hp rated, meet Federal Specification WS-865c, and NEMA Specifications KS1-1975. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position. Heavy duty switches shall have line terminal shields. Safety switches shall be TS-600 type as manufactured by Westinghouse Electric Corporation or approved equal.

NEMA 1 Indoor, NEMA 3R Outdoor

In Inches For metric dimensions (mm), multiply by 25.4 (1 in. = 25.4 mm)
Not to be used for construction purposes unless approved. For additional dimensions, refer to the Distribution Service Center.



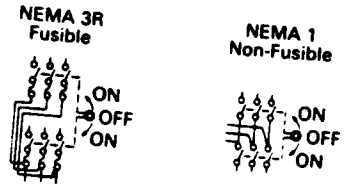
Fusible Switches

Catalog Number	Dimensions A In.	B In.	C In.	Conduit Sizes, Inches
XFK321	37	12½	5	½, ¾, 1
XFK322	37	12½	5	1¼, 1½, 2
XFK323	37	12½	5	
XFK324	51 23/64	19 9/16	6 3/16	2, 2½
XFN325	65 19/64	20 5/32	11 5/32	2½, 3
XFN326	70 19/64	22 5/32	13 5/32	3, 3½
XFK361	37	12½	5	½, ¾, 1
XFK362	37	12½	5	1¼, 1½, 2
XFK363	37	12½	5	
XFK364	51 23/64	19 9/16	6 3/16	2, 2½, 1½
XFN365	65 19/64	20 5/32	11 5/32	2½, 3
RXFK321	37	12½	5	—
RXFK322	37	12½	5	½, ¾, 1
RXFK323	37	12½	5	1¼, 1½, 2
RXFK324	51 23/64	19 9/16	6 3/16	—

Non-Fusible Switches

Catalog Number	Dimensions A In.	B In.	C In.	Conduit Sizes, Inches
XUK321	25	12½	5	½, ¾, 1
XUK322	25	12½	5	1¼, 1½, 2
XUK323	25	12½	5	
XUK324	37 55/64	19 9/16	6 3/16	1½, 2, 2½
XUN325	41 19/64	20 5/32	11 5/32	2½, 3
XUN326	49 19/64	22 5/32	13 5/32	3, 3½
XUK361	25	12½	5	½, ¾, 1
XUK362	25	12½	5	1¼, 1½, 2
XUK363	25	12½	5	
XUK364	37 55/64	19 9/16	6 3/16	1½, 2, 2½
XUN365	41 19/64	20 5/32	11 5/32	2½, 3
XUN366	49 19/64	22 5/32	13 5/32	3, 3½
RXUK361	25	12½	5	
RXUK362	25	12½	5	½, ¾, 1
RXUK363	25	12½	5	1¼, 2½, 2
RXUK364	37 55/64	19 9/16	6 3/16	
RXUN365	33 9/16	24	11¼	
RXUN366	43	25⅝	13¼	

NEMA ENCLOSURE TYPE	DEFINITIONS NEMA Standard 1-10-1979
1	Type 1 enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment
3R	Type 3R enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
12	Type 12 enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping noncorrosive liquids
12K	Type 12K enclosures with knockouts are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping noncorrosive liquids other than at knockouts
4	Type 4 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
5	Type 5 enclosures are intended for indoor use primarily to provide a degree of protection against dust and falling dirt
7	Type 7 enclosures are for use indoors in locations classified as Class I, Groups A, B, C, or D, as defined in the *National Electrical Code*
9	Type 9 enclosures are for use in indoor locations classified as Class II, Groups E, F, or G, as defined in the *National Electrical Code*



Typical Schematic "Double Throw"

All products in this catalog meet the new wire bending space requirements as identified in 1981 NEC Section 373-6 (b).

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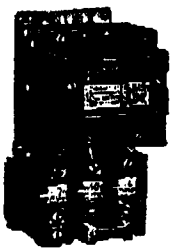
Revised Nov., 1984

AC MAGNETIC STARTERS
WITH MELTING ALLOY OVERLOAD RELAYS

CLASS 8536



Type SCO-3
Size 1,
3 Pole Starter

Line voltage magnetic starters are used when full starting torque and the resulting current inrush is not objectionable. Motor overload protection is provided by melting alloy type thermal overload relays. All starters include a N.O. holding circuit contact as standard.

- Reliable Overload Protection
  One piece factory tested thermal units
- Easy Inspection and Maintenance
- Small Size
- Quick Installation
- Increased Flexibility
- Complete Enclosure Line
- Easy Field Modifications
- Long Electrical and Mechanical Life
- 600 Volts Max. — 50-60 Hertz

2 POLE SINGLE PHASE — 3 POLE POLYPHASE

No. of Poles	NEMA Size	Maximum Ratings		General Purpose Enclosure NEMA Type 1		Rainproof, Sleet Resistant, Outdoor Use Enclosure NEMA Type 3R		Watertight and Dusttight Enclosure NEMA Type 4		Watertight, Dusttight and Corrosion-Resistant Glass Polyester Enclosure NEMA Type 4X		For Hazardous Locations: Class I, Groups C & D Class II, Groups E and G NEMA Type 7 & 9		For Hazardous Locations: Class II Groups E and G Enclosure NEMA Type 9		Dusttight and Driptight Industrial Use Enclosure NEMA Type 12✦		Open Type		Number of Thermal Units Required ✱
		Volts©	Max. HP+	Type	Price✱	Type	Price✱	Type	Price✱	Type	Price✱	Type	Price✱	Type	Price✱	Type	Price✱	Type	Price✱	
2 Pole Single Phase	00	115 230	⅛ 1	SAG-11	$ 116.	Use Size 0		Use Size 0		Use Size 0		Use Size 0		Use Size 0		Use Size 0		SAO-11	$ 108.	1
	0	115 230	1 2	SBG-1	139.	SBH-1	$ 173.	SBW-11	$ 278.	SBW-21	$ 270.	SBR-1	$ 888.	SBE-1	$ 298.	SBA-1	$ 178.	SBO-1	122.	1
	1	115 230	2 3	SCG-1	180.	SCH-1	198.	SCW-11	284.	SCW-21	284.	SCR-1	812.	SCE-1	322.	SCA-1	198.	SCO-1	142.	1
	1P	115 230	3 5	SCG-2	194.	SCH-2	242.	SCW-12	338.	SCW-22	336.	SCR-2	852.	SCE-2	370.	SCA-2	242.	SCO-2	186.	1
	2	115 230	3 7½	SDG-6	268.	SDH-6	368.	SDW-16	586.	SDW-26	586.	SDR-6	888.	SDE-6	794.	SDA-6	368.	SDO-6	258.	1
	3	115 230	7½ 15	SEG-6	462.	SEH-6	588.	SEW-16	888.	SEW-26	1113.	....	....	....	....	SEA-6	588.	SEO-6	402.	1
3 Pole Poly-phase	00	200-230 380 460-575	1½ 1½ 2	SAG-12	116.	Use Size 0		Use Size 0		Use Size 0		Use Size 0		Use Size 0		Use Size 0		SAO-12	108.	3
	0	200-230 380-575	3 5	SBG-2	144.	SBH-2	192.	SBW-12	284.	SBW-22	284.	SBR-2	822.	SBE-2	312.	SBA-2	192.	SBO-2	136.	3
	1	200-230 380-575	7½ 10	SCG-3	164.	SCH-3	212.	SCW-13	308.	SCW-23	308.	SCR-3	828.	SCE-3	338.	SCA-3	212.	SCO-3	158.	3
	2	200 230 380-575	10 15 25	SDG-1	334.	SDH-1	412.	SDW-11	812.	SDW-21	812.	SDR-1	1918.	SDE-1	822.	SDA-1	412.	SDO-1	254.	3
	3	200 230 380-575	25 30 50	SEG-1	540.	SEH-1	644.	SEW-11	948.	SEW-21	1188.	SER-3	1528.	SEE-1	1230.	SEA-1	644.	SEO-1	480.	3
	4	200 230 380 460-575	40 50 75 100	SFG-1	1220.	SFH-1	1584.	SFW-11	1918.	SFW-21	2285.	SFR-1	3484.	SFE-1	2482.	SFA-1	1584.	SFO-1	1082.	3
	5	200 230 380 460-575	75 100 150 200	SGG-1	2878.	....	....	SGW-11	3792.	....	....	SGR-1	5888.	SGE-1	4778.	SGA-1	3788.	SGO-1	2870.	3
	6	200 230 380 460-575	150 200 300 400	SHG-2	8116.	....	....	SHW-2	10118.	....	....	SHR-1	18302.	....	....	SHA-2	8188.	SHO-2	8118.	3
	7	230 460-575	300 600	SJG-2	10778.	....	....	SJW-2	12778.	....	....	....	....	....	....	SJA-2	11888.	SJO-2	8778.	0
	8	230 460-575	450 900	KG-1	14878.	....	....	KW-1	19878.	....	....	....	....	....	....	KA-1	16888.	KO-1	12278.	3

✱ PRICES DO NOT INCLUDE THERMAL UNITS. FOR SELECTION, SEE "OVERLOAD AND SHORT CIRCUIT PROTECTION."

+ For other electrical ratings, see page 5.

✦ HAZARDOUS LOCATIONS

NEMA Type 12 devices are available U.L. Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request Form G2-1. No additional charge.

ORDERING INFORMATION REQUIRED

1. Class and type number.
2. Line voltage, frequency and phase.
3. Control voltage and frequency, if different from line voltage.
4. Any special features required.

©Voltage ratings in the price table above are those at which motors are rated and are not necessarily identical with the starter (contactor) coil rating. The table below lists the common 60 hertz motor voltage ratings and the corresponding starter (contactor) coil voltage which will be furnished for those ratings. When ordering starters (contactors), always indicate coil voltage.

System	Motor Voltage	Coil Voltage: Starters (Class 8536)	Coil Voltage: Contactors (Class 8502)
Single Phase	115 230	120/240 120/240	120 240
Poly-phase	Separate Control 200-208 220-230 380 (50 Hz.) 440-480 550-575	120 208 240 380 (50 Hz.) 480 600	120 208 240 380 (50 Hz.) 480 600

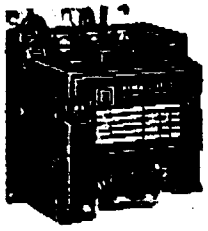
CLASS 8502

AC MAGNETIC CONTACTORS
WITHOUT OVERLOAD PROTECTION

Revised Nov., 1984

Magnetic contactors are used to switch heating loads, capacitors, transformers or electric motors where overload protection is separately provided. A normally open holding circuit contact for three wire control is provided on all contactors as standard.

- Easy Inspection and Maintenance
- Small Size
- Quick Installation
- Increased Flexibility
- 1 and 2 Pole Single Phase — 3, 4, and 5 Pole Polyphase
- Complete Enclosure Line
- Easy Field Modifications
- Long Electrical and Mechanical Life
- 50-60 Hertz — 600 Volts Max.



Type SCO-2
Size 1, 3 Pole Contactor

1 AND 2 POLE SINGLE PHASE — 3 POLE POLYPHASE

No. of Poles	NEMA Size	Continuous Current Rating Amperes +	Horsepower Rating Volts©	Horsepower Rating Max. HP+	General Purpose Enclosure NEMA Type 1 Type	General Purpose Enclosure NEMA Type 1 Price	Watertight and Dusttight Enclosure NEMA Type 4 Type	Watertight and Dusttight Enclosure NEMA Type 4 Price	Watertight, Dusttight and Corrosion-Resistant Glass-Polyester Enclosure NEMA Type 4X Type	Watertight, Dusttight and Corrosion-Resistant Glass-Polyester Enclosure NEMA Type 4X Price	For Hazardous Locations Class I, Groups C & D Class II, Groups E and G NEMA Type 7 & 9 Type	For Hazardous Locations Class I, Groups C & D Class II, Groups E and G NEMA Type 7 & 9 Price	Dusttight and Driptight Industrial Use Enclosure NEMA Type 12✦● Type	Dusttight and Driptight Industrial Use Enclosure NEMA Type 12✦● Price	Open Type Type	Open Type Price
1 Pole Single Phase *	0	18	115 230	1 2	SBG-5	$ 180.	SBW-15	$ 240.	....	....	SBR-5	$ 884.	SBA-5	$ 148.	SBO-5	$ 92.
	1	27	115 230	2 3	SCG-5	120.	SCW-15	264.	....	....	SCR-5	888.	SCA-5	168.	SCO-5	112.
2 Pole Single Phase *	00	9	115 230	⅛ 1	SAG-11	96.	Use Size 0		Use Size 0		Use Size 0		Use Size 0		SAO-11	88.
	0	18	115 230	1 2	SBG-1	112.	SBW-11	252.	SBW-21	$ 252.	SBR-1	888.	SBA-1	168.	SBO-1	104.
	1	27	115 230	2 3	SCG-1	132.	SCW-11	276.	SCW-21	276.	SCR-1	888.	SCA-1	180.	SCO-1	124.
	2	45	115 230	3 7½	SDG-1	272.	SDW-11	880.	SDW-21	880.	SDR-1	884.	SDA-1	388.	SDO-1	232.
	3	90	115 230	7½ 15	SEG-1	448.	SEW-11	888.	Consult Local Square D Field Office		SER-1	1424.	SEA-1	682.	SEO-1	388.
	4	135	....	....	SFG-1	1888.	SFW-11	1752.			SFR-1	2284.	SFA-1	1408.	SFO-1	888.
	5	270	....	....	SGG-1	2232.	SGW-11	8112.	....	....	SGR-1	8028.	SGA-1	8112.	SGO-1	1924.
	6	540	....	....	SHG-1	8252.	SHW-1	8252.	....	....	SHR-1	14088.	SHA-1	7332.	SHO-1	4888.
	7	810	....	....	SJG-1	8884.	SJW-1	18804.	....	....	....	....	SJA-1	8884.	SJO-1	7148.
	8	1215	....	....	KG-1	12888.	KW-1	15888.	....	....	....	....	KA-1	14778.	KO-1	11472.
3 Pole Polyphase	00	9	200-230 380 460-575	1½ 1½ 2	SAG-12	168.	Use Size 0		Use Size 0		Use Size 0		Use Size 0		SAO-12	88.
	0	18	200-230 380-575	3 5	SBG-2	124.	SBW-12	284.	SBW-22	284.	SBR-2	888.	SBA-2	172.	SBO-2	116.
	1	27	200-230 380-575	7½ 10	SCG-2	144.	SCW-12	288.	SCW-22	288.	SCR-2	888.	SCA-2	192.	SCO-2	136.
	2	45	200 230 380-575	10 15 25	SDG-2	288.	SDW-12	576.	SDW-22	576.	SDR-2	876.	SDA-2	376.	SDO-2	248.
	3	90	200 230 380-575	25 30 50	SEG-2	480.	SEW-12	888.	SEW-22	1116.	SER-2	1488.	SEA-2	884.	SEO-2	488.
	4	135	200 230 380 460-575	40 50 75 100	SFG-2	1128.	SFW-12	1824.	SFW-22	2280.	SFR-2	2388.	SFA-2	1472.	SFO-2	968.
	5	270	200 230 380 460-575	75 100 150 200	SGG-2	2488.	SGW-12	3280.	....	....	SGR-2	8288.	SGA-2	3280.	SGO-2	2992.
	6	540	200 230 380 460-575	150 200 300 400	SHG-2	7888.	SHW-2	9088.	....	....	SHR-2	14884.	SHA-2	8148.	SHO-2	8712.
	7	810	230 460-575	300 600	SJG-2	8812.	SJW-2	11512.	....	....	....	....	SJA-2	10892.	SJO-2	9152.
	8	1215	230 460-575	450 900	KG-2	14888.	XW-2	18888.	....	....	....	....	KA-2	18888.	KO-2	12884.

© Voltage ratings are those at which motors are rated and are not necessarily identical with contactor coil rating. See © footnote on Page 3.
* The holding circuit contact has the same rating as the main contacts for Sizes 00, 0, and 1 contactors.
+ For other electrical ratings, see Page 5.
✦ Separate NEMA Type 3R enclosures are available. See Class 9991 section.

✦ HAZARDOUS LOCATIONS

NEMA Type 12 devices are available U.L. Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request Form G2-1. No additional charge.

ORDERING INFORMATION REQUIRED

1. Class and type number.
2. Line voltage, frequency and phase.
3. Control voltage and frequency, if different from line voltage.
4. Any special features required.

FACTORY MODIFICATIONS AND FORMS — Pages 22-23
APPLICATION DATA — Pages 6-9
FIELD MODIFICATION KITS — Pages 10-14
DIMENSIONS — Pages 17-21
REPAIR PARTS KITS — Class 9998
ADDITIONAL FIELD MODIFICATION KITS — Class 9999
SEPARATE ENCLOSURES — Class 9991

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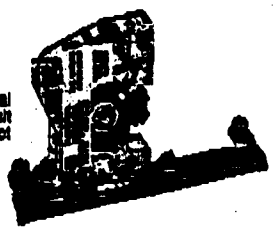
AC MAGNETIC STARTERS AND CONTACTORS

MODIFICATIONS

CLASS 8536 8502



External Single Circuit Auxiliary Contact

AUXILIARY CONTACTS

Additional electrical contacts may be factory or field added to any Type S contactor or starter. See table on page 10 for maximum number of auxiliary units. The table below lists the selection for field addable electrical contacts. Types SX-6 through SX-8 are external auxiliary contacts that can be installed on Sizes 00 through 7. These types are field convertible from normally open to normally closed and vice versa. Types SX-11 and SX-12 are non-convertible internal contacts that can be installed on Sizes 00, 0, 1, and 2 devices only. On these devices, one Class 9999 Type SX-11 is used as the holding circuit contact, and one additional internal contact can be factory or field added (maximum of two internal contacts total).

For factory installed electrical contacts, either specify the number of normally open and normally closed contacts per contactor, or select Form designation from table at right. Price adder for each factory installed electrical contact is $44., D1A discount.

NEMA Size	Type	Electrical Contact Kit Description	Class 9999 Type	Class 9999 Price
00-7	SA-SJ	External (Field Convertible)		
		1 N.O. Contact	SX-6	$24.
		1 N.C. Contact	SX-7	24.
		1 N.O. and 1 N.C. Isolated Contacts	SX-8	32.
00-2	SA-SD	Internal		
		1 N.O. Contact	SX-11	24.
		1 N.C. Contact	SX-12	24.
8	K	1 N.O. or N.C. (Convertible)	WX-6	162.

Overlapping Contacts — See Class 9999 for selection of auxiliary contacts with overlapping contacts.

MAXIMUM RATINGS FOR TYPE S ELECTRICAL CONTACTS AND TIMERS

Class 9999 Type	Contact Ratings – AC only: Volts AC	(35% Power Factor) Make	(35% Power Factor) Carry and Break	Thermal Rating (Amps.)
SX-6, SX-10, SX-13, SX-17 *	120 or Less	60 Amps.	6 Amps.	10
	120-600	7200 VA	720 VA	10
SX-11, SX-12 SK-3, SK-4	120 or Less	30 Amps.	3 Amps.	3
	120-600	3600 VA	360 VA	3

* Contact ratings for these contacts are in accordance with NEMA A600 ratings.

FORM NUMBER OF ADDITIONAL ELECTRICAL CONTACTS

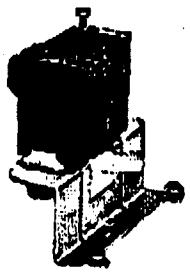
When ordering factory installed additional contacts, the Form designations listed should be used.

Number of N.O. Contacts	Number of N.C. Contacts	Form Number
0	1	X2
0	2	X5
0	3	X9
0	4	X14
1	0	X1
1	1	X4
1	2	X8
1	3	X13
2	0	X3
2	1	X7
2	2	X12
3	0	X6
3	1	X11
4	0	X10

TIMER ATTACHMENT

A mechanically operated pneumatic timer can be added to a Type S contactor. The timer is available with either on-delay or off-delay and is field convertible. One N.O. and one N.C. electrical contact is provided. The poles are physically isolated, however because of electrical clearance, they must be used on the same polarity. Refer to the table above for electrical ratings.

Kit Description	Class 9999 Type	Class 9999 Price
Mechanically operated pneumatic timer, time delay after de-energization (off delay)	SK-3	$112.
Mechanically operated pneumatic timer, time delay after energization (on delay)	SK-4	112.



Class 9999 Type SK-3 Timer Attachment

155
36
8502

AC MAGNETIC STARTERS AND CONTACTORS
MODIFICATIONS

Revised Nov., 1984

POWER POLE ADDERS

FIELD ADDABLE POWER POLES — One single or double circuit power pole may be field added to 2 and 3 pole Size 0-7 Type S contactors and starters. See the table below for selection. There are two sizes of power poles available: NEMA Size 0 and 1, and NEMA Size 2. The ratings for these power pole adders correspond to the NEMA contact ratings found on page 5.

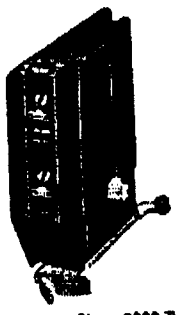
A 2 or 3 pole contactor or starter will accept only one single or double circuit unit. A power pole cannot be used on 4 or 5 pole devices or on devices which are mechanically interlocked. All standard enclosures have sufficient room for field addition of power poles.

When the Size 0 and 1 power pole adder is field added to a NEMA Size 0 or 1 contactor or starter, the return springs must be removed from the device. An instruction sheet provided with the power pole adder explains this procedure further. When the Size 2 power pole is field added to a Size 2 contactor or starter, a coil change is required. Select 4 and 5 pole coil from coil section of catalog, or specify Form Y118 as noted in the footnote below. When a power pole is added to a Size 3-7 device, an adapter bracket (Class 9999 Type SBT-1) is required.

Class 9999 Type SB-6
One Pole Power
Pole Adder

Kit Description	NEMA Size	Class 9999 Type	Class 9999 Price
One normally open power pole adder	0, 1 2	SB-6 SB-11*	$ 44. 80.
One normally closed power pole adder	0, 1 2	SB-7 SB-12*	44. 80.
One normally open and one normally closed power pole adder	0, 1 2	SB-8 SB-13*	88. 160.
Two normally open power pole adder	0, 1 2	SB-9 SB-14*	88. 160.
Two normally closed power pole adder	0, 1 2	SB-10 SB-15*	88. 160.
Adapter bracket	3-7	SBT-1	8.

*To order a Size 2 power pole kit complete with a new starter coil, specify Form Y118, voltage and frequency and add $39.00 to the list price of the kit (e.g. Class 9999 Type SB-11 Form Y118, 120 volts, 60 cycles. Priced at $119.00 list).



Class 9999 Type SB-9
Two Pole Power
Pole Adder

Type	NEMA Size	Class 9999 Type	Form Designation	Price Adder
1 N.O.	0, 1 2	SB-6 SB-11	Y18-6 Y18-11	$50. 86.
1 N.C.	0, 1 2	SB-7 SB-12	Y18-7 Y18-12	50. 86.
1 N.O., 1 N.C.	0, 1 2	SB-8 SB-13	Y18-10 Y18-15	94. 166.
2 N.O.	0, 1 2	SB-9 SB-14	Y18-8 Y18-13	94. 166.
2 N.C.	0, 1 2	SB-10 SB-15	Y18-9 Y18-14	94. 166.

FACTORY INSTALLED POWER POLES — Single or double circuit power pole adders may be ordered factory installed on 2 and 3 pole Type S starters and contactors. Class 9999 Type SB-6 through SB-10 may be installed on Sizes 0-7. Class 9999 Type SB-11 through SB-15 may be installed on Sizes 2-7. From the table at right, select the appropriate Y18 Form designation for the power pole adder desired. Only one power pole adder is possible per contactor.

D1A DISCOUNT

AC MAGNETIC STARTERS AND CONTACTORS

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS

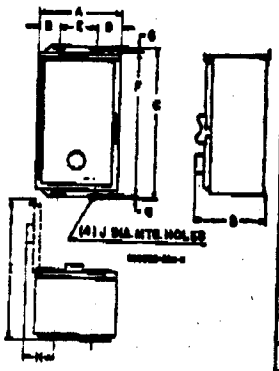


Figure 17
NEMA Type 12
Industrial Use Enclosure

NEMA TYPE 12 — DUSTTIGHT ENCLOSURE

NEMA Size	Class	Type	No. of Poles	Dimensions — Inches (Figure 17) A	B	C	D	E	F	G	H	I	J	Weight (Lbs.) Class 8502	Class 8536
0	8502 & 8536	SBA	All	6 5/16	6 17/32	12 3/4	19 9/16	3 1/4	12	3/4	3 9/16	12 1/2	5/16	15	16
1	8502 & 8536	SCA	All												
2	8502 & 8536	SDA	All	8 1/8	9 9/32	16	19 1/16	5	15	1/2	3 9/16	15 3/16	5/16	22	23
3	8502 & 8536	SEA	All	10 5/32	9 9/16	31 1/2	35 1/64	12	30 1/2	1/2	4 1/2	25 23/32	7/16	65	68
4	8502 & 8536	SFA	All											69	73
5	8502 & 8536	SGA	All	17 7/32	13 7/16	47	41/8	9	46	1/2	5 13/32	28 9/16	9/16	160	177
6	8502 & 8536	SHA	All	20 7/32	13	65	41/8	12	64	1/2	6 7/16	30 7/8	1 1/16	228	233
7	8502 & 8536	SJA	All	34 1/2	23 1/2	93	Floor Mounting							....	....
8	8502 & 8536	KA	All	28	20	90								800	800

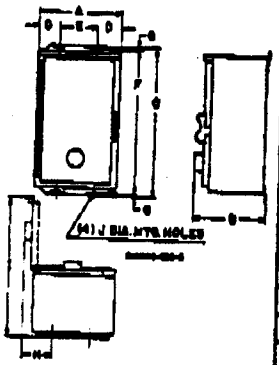


Figure 18
NEMA Type 12
Industrial Use Enclosure

NEMA TYPE 12 — DUSTTIGHT ENCLOSURE WITH FORM FT

NEMA Size	Class	Type	No. of Poles	Dimensions — Inches (Figure 18) A	B	C	D	E	F	G	H	I	J
0	8502 & 8536	SBA	All	11 7/8	8	13 1/2	21 3/16	6 3/4	12 3/4	3/4	3 29/32	18 9/16	5/16
1	8502 & 8536	SCA	All										
2	8502 & 8536	SDA	All	14 7/8	8 1/8	16	26 1/16	9 3/4	15	3/4	3 21/32	21 1/2	5/16
3	8502 & 8536	SEA	2-3	Same as Standard NEMA 12 dimensions, see above.									
4	8502 & 8536	SFA	2-3										
5	8502 & 8536	SGA	All	Same as Standard NEMA 12 dimensions, see above.									
6	8502 & 8536	SHA	All										
7	8502 & 8536	SJA	All	Form FT is supplied as standard. Refer to Page 8.									
8	8502 & 8536	KA	All	28	20	90	Floor Mounting						

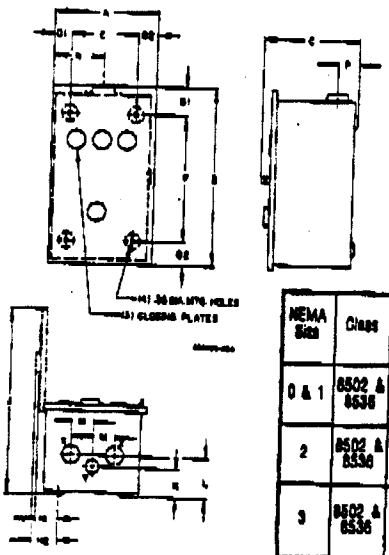


Figure 19
NEMA Type 3R
Outdoor Use Enclosure

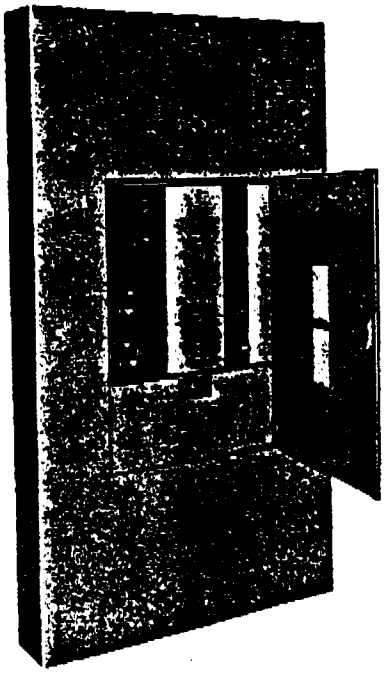
NEMA TYPE 3R — RAINPROOF AND SLEET RESISTANT ENCLOSURES

NEMA Size	Class	Type	No. of Poles	Dimensions — Inches (Figure 19) A	B	C	D1	D2	E	F	G1	G2	H1	H2	J	K	L	M	N	P	K.O. X	K.O. Y
0 & 1	8502 & 8536	SBH, SCH	All	8 27/32	12 9/32	7 1/8	1 3/8	1 7/16	6	7 1/2	2 19/32	2 3/16	2 1/16	2 5/8	14 9/32	1 3/8	1 3/8	1 7/8	4 3/8	12 27/32	1/2 3/4 1	1/2 3/4 1
2	8502 & 8536	SDH	All	9 27/32	15 9/32	8 5/8	1 3/8	1 7/16	7	11 1/2	2 15/32	2 3/16	2 1/16	2 5/8	18 25/32	1 5/16	1 3/4	2 1/8	4 7/8	12 27/32	1 1 1/4 1 1/2	1/2 3/4
3	8502 & 8536	SEH	All	12 27/32	25 9/32	8 1/8	1 3/8	1 7/16	10	20 1/2	2 19/32	2 3/16	2 1/16	2 5/8	19 23/32	1 5/16	1 13/16	2 7/16	5 1/8	12 27/32	1 1 1/4 2 2 1/2	1/2 3/4
4	8502 & 8536	SFH	All	12 27/32	40 9/32	9 1/8	1 3/8	1 7/16	10	35 1/2	2 19/32	2 3/16	2 1/16	2 5/8	20 9/32	1 5/16	2 3/16	2 11/16	5 3/8	12 27/32	1 1 1/4 2 2 1/2	1/2 3/4

CLASS 2110

JUNE, 1984

I-LINE®
CIRCUIT BREAKER PANELBOARDS
APPLICATION DATA



I-LINE PANELBOARD
TYPE HCW - 800A MAIN LUGS

Type:

I-LINE circuit breaker power distribution panelboards for use on ac or dc systems. Underwriters Laboratories listed under File E-33139 and File E-8078. Meets Federal Specification W-P-115A, Type I, Class I.

Suitable for use as service equipment.

- All main circuit breaker panelboards.
- All main lugs panelboards with branch mounted back-feed main circuit breaker.
- All main lugs panelboards with 27" of branch mounting space and with six circuits or less.
- Solid neutral is insulated, but may be bonded to the box with grounding strap.

Service:

1Ø2W, 240V, ac
1Ø3W, 120/240V, ac
3Ø3W, 240V, ac
3Ø3W, 240V, ac Gr. BØ
3Ø4W, 208Y/120V, ac
3Ø4W, 480Y/277V, ac
3Ø3W, 480V, ac
3Ø3W, 600V, ac

2W, 250V, dc
3W, 125/250V, dc

MAINS RATINGS AND MECHANICAL LUG SIZES

Amperes	Main Lugs		Main Circuit Breaker	
	Actual Lug Size	UL Wire Bending Space	Actual Lug Size	UL Wire Bending Space
100	....	....	(1) #14-1/0 Al/Cu	(1) #14-#1 Al/Cu
225	(1) #6-300 MCM Al/Cu	(1) #6-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu
400	(2) #2-600 MCM Al/Cu	(1) #2-600 MCM Cu or (2) #2-500 MCM Al/Cu	(1) #1-600 MCM Al/Cu (2) #1-250 MCM Al/Cu	(1) #1-600 MCM Cu or (2) #1-250 MCM Al/Cu
600	(2) #2-600 MCM Al/Cu	(2) #2-500 MCM Al/Cu	(3) #3/0-500 MCM Al/Cu	(3) #3/0-500 MCM Al/Cu
800	(3) 3/0-750 MCM Al/Cu	(3) 3/0-500 MCM Al/Cu	(3) 3/0-500 MCM Al/Cu	(3) 3/0-500 MCM Al/Cu
1200	(4) 3/0-750 MCM Al/Cu	(4) 3/0-500 MCM Al/Cu	....	....

All lugs are suitable for 75° C wire.
Torque values are included on the neutral diagram.

MAINS RATINGS AND VCEL LUG SIZES

Amperes	Main Lugs		Main Circuit Breaker	
	Actual Lug Size	UL Wire Bending Space	Actual Lug Size	UL Wire Bending Space
100	....	....	(1) #8-1/0 Al/Cu	(1) #8-#1 Al/Cu
225	(1) #4-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu	(1) #4-300 MCM Al/Cu
400	(1) #2/0-600 MCM Al/Cu or (1) 500-750 MCM Al (2) #4-300 MCM Al/Cu	(1) #2/0-600 MCM Al/Cu or (1) 500-750 MCM Al (2) #4-250 MCM Al/Cu	(1) 500 MCM Cu or (1) 500-750 MCM Al	(1) 500 MCM Cu or (1) 500-750 MCM Al
600	(2) #2/0-500 MCM Al/Cu	(2) #2/0-500 MCM Al/Cu	(2) #2/0-500 MCM Al/Cu	(2) #2/0-500 MCM Al/Cu
800	(3) #2/0-500 MCM Al/Cu	(3) #2/0-500 MCM Al/Cu	(2) 500 MCM Cu or (2) 500-750 MCM Al	(2) 500 MCM Cu or (2) 500-750 MCM Al
1200	(4) 500 MCM Cu or (4) 500-750 MCM Al	(4) 500 MCM Cu or (4) 600 MCM Al	....	....

All lugs are suitable for 75° C wire.
Torque values are included on the neutral diagram.

I-LINE PANELBOARD
TYPE HCM - 225A MAIN BREAKER

©1984 Square D Company

I-LINE®
CIRCUIT BREAKER PANELBOARDS

APPLICATION DATA

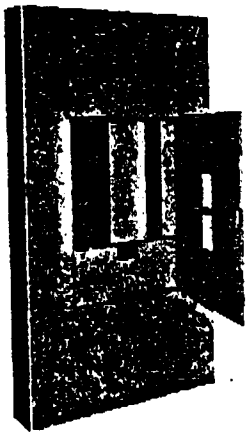
NEMA 1 Enclosures:

Fronts

- Door with flush lock, gray baked enamel electrodeposited over cleaned phosphatized steel.
- Welded steel directory card frame on inside of door.
- Assembled trim clamps.

Boxes

- 26" wide are galvanized steel with knockouts.
- 32", 42" and 48" wide are gray baked enamel electrodeposited over cleaned phosphatized steel, without knockouts.
- All 26", 32" and 42" wide boxes have removable endwalls.



NEMA 1 ENCLOSURE

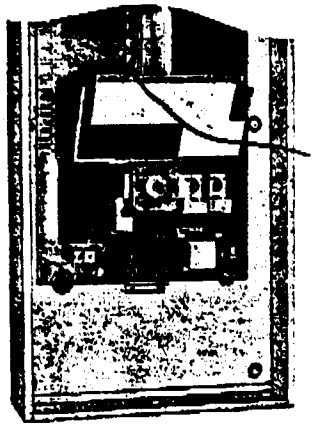
NEMA 3R/12 Enclosures:

- Gasketed door with vault handle, padlocking provisions, and welded steel directory card frame.
- 3 - point latching.
- End and side gutter trim.
- No knockouts.
- Gray baked enamel electrodeposited over cleaned phosphatized steel.

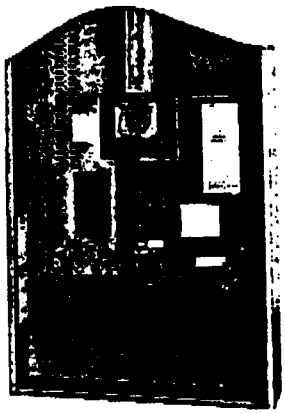
NEMA 3R/12 ENCLOSURES

Mains:

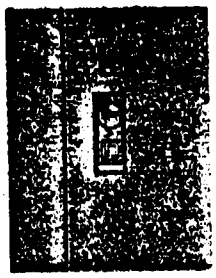
- Main lugs or main circuit breaker and solid neutral mounted in same mains compartment.
- Hinged cover isolates main lugs compartment.
- Main lugs interior positioned for top or bottom feed.
- Main circuit breaker interiors are bottom feed.
- Top feed main circuit breaker interiors ordered by using Digest unassembled main circuit breaker panelboard modifications.



MAIN LUG AND SOLID NEUTRAL COMPARTMENT

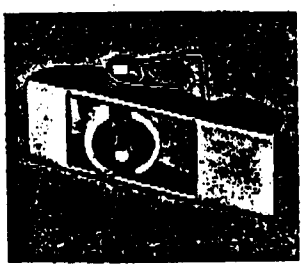


MAIN CIRCUIT BREAKER AND SOLID NEUTRAL COMPARTMENT



FLUSH LOCK-USED ON TYPE HCN, NEMA 1 FRONTS

FLUSH VAULT LOCK-USED ON TYPE HCM, HCW AND HCWM NEMA 1 FRONTS



I-LINE TRIM CLAMP USED ON ALL NEMA 1 FRONTS

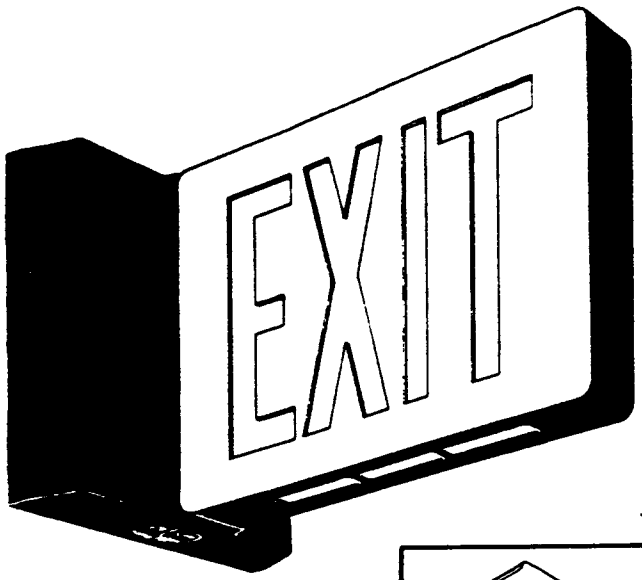
VAULT HANDLE - USED ON ALL NEMA 3R/12 ENCLOSURES

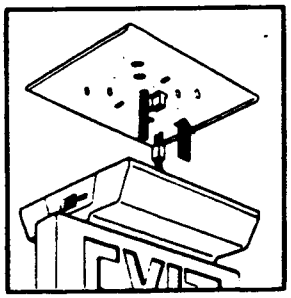
FE-ELN SERIES-1 Lamp
F2E-ELN SERIES-2 Lamp

Signature SERIES

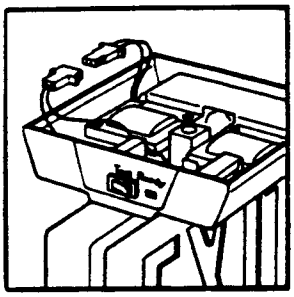
Fluorescent

SELF-POWERED, DIE-CAST, ARCHITECTURAL EMERGENCY EXIT SIGNS

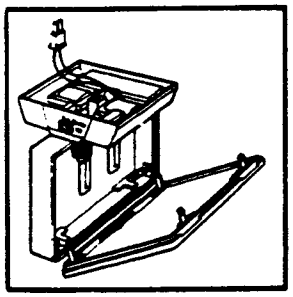




Labor-Saving Plug-In Power Connector Mounting Plate



Nickel-Cadmium Powered Inverter with Polarized Battery Connector Provides 100% Light Output in the Emergency Mode, Utilizing the Same Lamps for Both Normal and Emergency Illumination.



2-Lamp (F5TT) – Canopy Mounted 120/277V Dual Voltage Ballasts

APPROVAL	JOB INFORMATION

LITHONIA® EMERGENCY SYSTEMS
LIFE SAFETY SYSTEMS

SPECIFICATIONS

CONSTRUCTION

- Precision-molded, thick-wall, die-cast aluminum construction. Ultra-slim, compact housing and battery pack.
- Lustrous, fine-grain brushed face finish with matte black electrostatic polymeric trim and matching battery pack. Clear lacquer finish on brushed face inhibits fingerprints and other surface contaminants.
- Optional finishes: matte black, ivory white and dark bronze.
- Compact dimensions allow application in confined spaces.
- Universal, completely concealed, easily removed directional arrow knockouts.
- Hinged faceplate and spring latches for easy lamp compartment access.
- Fully overlapping light seal prevents light leaks.
- Reinforced, impact-resistant fiberglass color panels. Printed panels finished with chip and scratch resistant baked epoxy coating.
- Uniform graphics illumination without shadows or hot spots. 6" high letters with 3/4" stroke.
- Efficient, non-yellowing, prismatic polycarbonate downlight diffuser.
- Dual voltage (120 & 277 V) ballast(s).

LAMP(S)

- Compact fluorescent 1 lamp FE Series (PL7) and 2 lamp F2E Series (PL5).
- 15,000-20,000 hours rated average life continuous operation.
- Low energy consumption – only 15 watts with 1 lamp or 22 watts with 2 lamps (120V).

BATTERY

- Sealed, maintenance-free, nickel cadmium battery delivers 90 minutes capacity to emergency lamps. Ensures long life over wide temperature ranges.
- 24-hour battery recharge after 90-minute discharge.
- Contemporary, slim profile, rocker-type test switch and rectangular LED provide visual and manual means of monitoring system operation.
- Low voltage disconnect prevents excessively deep discharge that can permanently damage battery.
- Polarized battery connector simplifies installation and maintenance; prevents charger damage due to improper connection.

ELECTRONIC

- Constant-current series resistor type charger. Isolation-type charger transformer protects unit and installer from potentially dangerous failure modes.
- AC LVD Reset enables unit testing at time of installation and ensures full 90-minute discharge.

MOUNTING

- Universal (top, end, or back) mounting. Plug-In Power Connector Mounting Plate permits quick, labor-saving installation. Completely concealed, easily removed mounting knockouts. No exposed hardware.

CODES

- U.L. Listed. Meets current Life Safety Code (NFPA 101-1985), NEC and OSHA illumination standards.

WARRANTY

- 3-year unconditional warranty. (For complete details, see Warranty Sheet in Technical Data Section).

FE-ELN SERIES -1 Lamp
F2E-ELN SERIES -2 Lamp

Signature SERIES

Fluorescent

MOUNTING SPECIFICATIONS

SELF-POWERED, DIE-CAST, ARCHITECTURAL EMERGENCY EXIT SIGNS

ELECTRICAL SPECIFICATIONS
Primary Circuit

SUPPLY VOLTAGE	LAMP DESCRIPTION	RATED LIFE	INPUT WATTS	MAXIMUM AMPS	POWER FACTOR	MINIMUM START TEMPERATURE (F)
1-lamp 120/277	One-F7TT 7 watt compact fluorescent	20,000* hours	15/18	.230/.175	.545/.375	0°
2-lamp 120/277	Two-F5TT 5 watt compact fluorescent	20,000* hours	22/26	.490/.325	.375/.290	0°

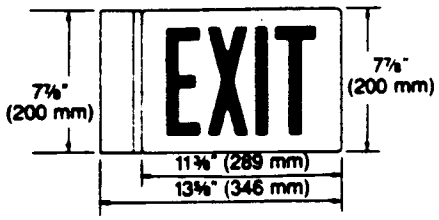
* Based on continuous operation

BATTERY SPECIFICATIONS

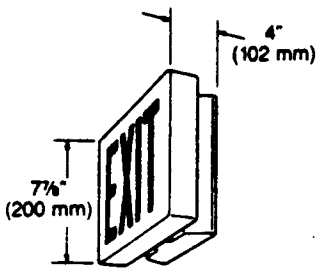
TYPE	VOLTAGE	SHELF LIFE*	EXPECTED LIFE*	MAINTENANCE	OPTIMUM TEMP**
Sealed Nickel Cadmium	6	3 Years	7-9 Years	None†	32-100°

*At 77°F
**Optimum ambient temperature range where unit will provide rated capacity for 90 minutes. Higher and lower temperatures affect life and capacity. Consult factory for detailed information.
†Periodic system status test recommended

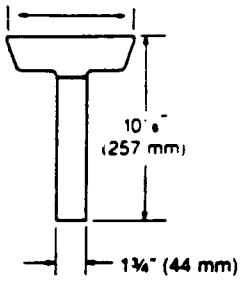
End Mounting



Back Mounting



Top Mounting
7¼" (184 mm)



Shipping Weight:
FES1R ELN 9.0 lbs. (4.1 kgs.)
F2ES1R ELN 10.0 lbs. (4.5 kgs.)

ORDERING INFORMATION

GRAPHICS STYLE AND COLOR	EXIT		EXIT		EXIT	
	Stencil Face		Panel Face			
HOUSING COLOR	Red	Green	Red On White	Green On White	White On Red	White On Green
BRUSHED FACE MATTE BLACK TRIM	FES1R ELN	FES1G ELN	FEP1R ELN	FEP1G ELN	FEP1WR ELN	FEP1WG ELN
MATTE BLACK	FESM1R ELN	FESM1G ELN	FEPM1R ELN	FEPM1G ELN	FEPM1WR ELN	FEPM1WG ELN
IVORY WHITE	FESW1R ELN	FESW1G ELN	FEPW1R ELN	FEPW1G ELN	FEPW1WR ELN	FEPW1WG ELN
DARK BRONZE	FESB1R ELN	FESB1G ELN	FEPB1R ELN	FEPB1G ELN	FEPB1WR ELN	FEPB1WG ELN

All units shown are single lamp. For two-lamp, add "2" to the catalog number (ex. F2ES1R ELN).
All units are dual voltage (120 & 277V).
All units shown are single face. For double face, change "1" to "2" in catalog number (ex. FES2G ELN).
Special wording available on panel face – consult factory.

OPTIONS
Add suffix to catalog number

TP	Tamperproof (Two #8-32 T20 Torx Head Screws)
LL	Less Lamps
VR	Vandal-Resistant Shield (1/8" Thick Polycarbonate with Four Torx Head Screws)

ACCESSORIES
Order as separate item

ELA-SS12 EL	12" Stem Kit

FIXTURE SCHEDULE

Type	Catalog Number

REMARKS

LITHONIA® EMERGENCY SYSTEMS
LIFE SAFETY SYSTEMS
A DIVISION OF LITHONIA LIGHTING
2528 LANTRAC COURT, DECATUR, GEORGIA 30035 • 404 987-4200 • TELEX 261381 LITHO UR • FAX 404 981-8141

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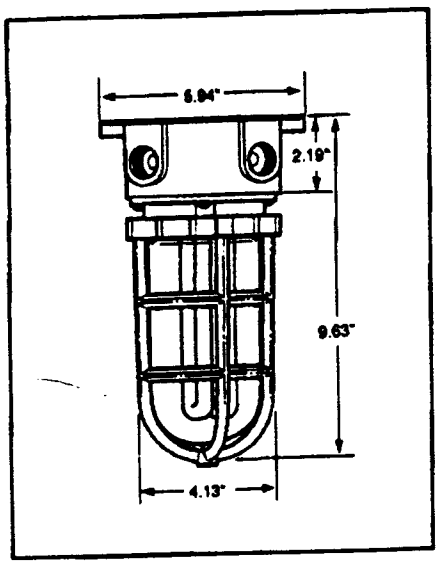
CALL BODINE for BATTERY BACK-UP

DAN

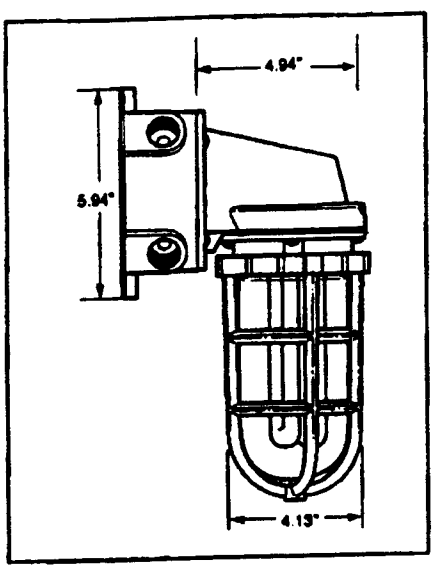
canlet®

Non-Metallic Compact Fluorescent Vapor Proof Fixture (18W Lamp Included)

BODINE AMERSUP
CENTAURI SALES
823-9816
DAVE WARNER



Ceiling Mount #2080I-CFCM



Wall Mount #2080I - CFWM

BODINE B 426.

Specifications

Construction
The housing is corrosion resistant glass reinforced polyester thermoplastic. The guard is manufactured in a high impact resistant glass reinforced polymer alloy. All screws and inserts are brass. Gaskets are long life silicone.

Color
Grey

Lamp
The fixture comes equipped with an OSRAM Dulux D/E 18 W compact fluorescent lamp (2700K). The four pin configuration mates with a G24q-2 lamp holder.

Ballast
The high frequency electronic ballast is totally encapsulated for corrosion resistance. 120 volt, .32 amps, high power factor.

Installation
The ceiling box has four 3/4" threaded hubs with liquid tight knockouts. Can be wired using conduit or cords and strain relief connectors. Two mounting feet are spaced at 5 1/4". Use minimum 75°C rated lead wires.

Maximum Fixtures per 20 Amp Circuit.
Single Phase - 30 Fixtures
Three Phase - 20 Fixtures

Minimum Starting Temperature
-15° F (-26° C)

UL Listings

UL 1570	Wet Location, in any orientation
UL 595	Marine - Outside Type (Saltwater)

Ordering Information

CONFIGURATIONS

Ceiling Mount
#2080I - CFCM

Wall Mount
#2080I - CFWM

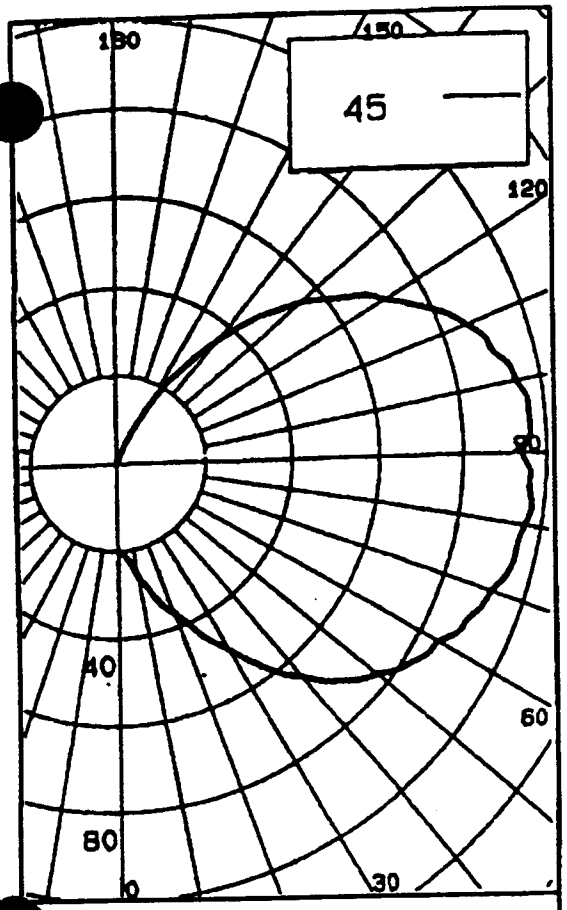
GLOBES

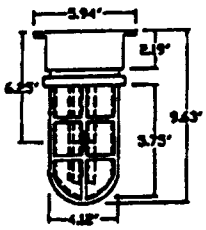
All fixtures are equipped with standard clear glass globes, unless otherwise indicated.

Optional Globes		*Catalog #*
Clear	(heat treated)	2080-VTGL-T
Red	(heat treated)	2080-VTGL-R
Green	(heat treated)	2080-VTGL-G
Amber	(heat treated)	2080-VTGL-A
Opal	(heat treated)	2080-VTGL-O

Catalog # (Configurations)	Catalog # (Globes)

canplas INDUSTRIES LTD.
31 Patterson Rd., Box 1800,
Barrie, Ontario, Canada L4M 4V3
(705) 726-3361 Fax (705) 726-8991





Canlet Fixture Cat. No. 2080I-CFCM with Clear Glass Globe and Non-Metallic Guard

One 18W OSRAM Dulux D/E Compact Fluorescent Lamp, Lumen Rating = 1200 LMS.

Candlepower Summary (45 Degrees)

Angle	CP	LMS.	Angle	CP	LMS.
0	20		90	105	
5	22	2	95	109	103
10	28		100	108	
15	34	9	105	102	96
20	42		110	97	
25	48	20	115	90	78
30	56		120	81	
35	66	36	125	73	57
40	76		130	62	
45	80	55	135	54	35
50	88		140	43	
55	93	73	145	32	16
60	97		150	20	
65	103	88	155	10	4
70	105		160	5	
75	109	100	165	0	1
80	108		170	0	
85	110	104	175	0	0
90	105		180	0	

Luminance Summary - CD/SQ. M.

Angle	Mean CD/SQ. M.
45	5319
55	5785
65	6233
75	6755
85	7182

Tested According to IES Procedures.
Test Distance - 7.9 meters (26.0 ft.)

Zonal Lumens and Percentages

Zone	Lumens	% Lamp	% Luminaire
0-30	31	2.63	3.58
0-40	67	5.66	7.72
0-60	196	16.37	22.34
0-90	489	40.79	55.66
40-90	421	35.13	47.94
60-90	293	24.42	33.33
90-180	389	32.49	44.34
0-180	879	73.27	100.00

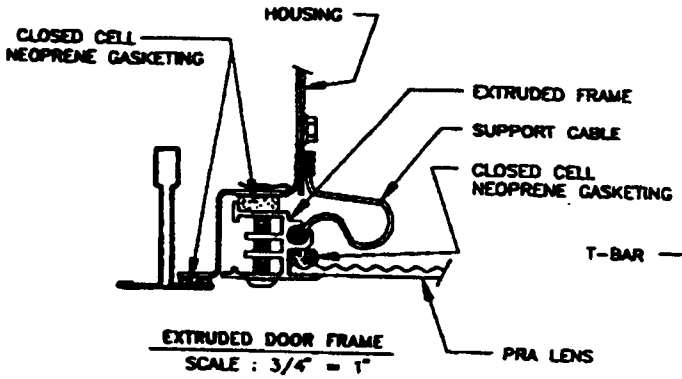
Efficiency = 73.3% S/MH = 3.6 SC = 3.4

canlet

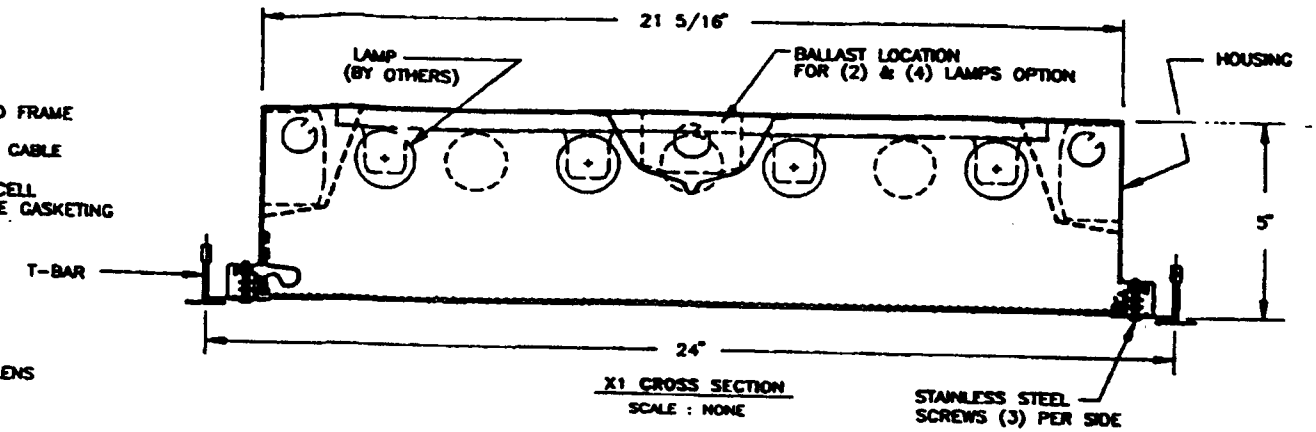
The specifications included in this brochure are correct as of time of printing. However, Canplas reserves the right to make product improvements at their discretion.

PRINTED IN CANADA

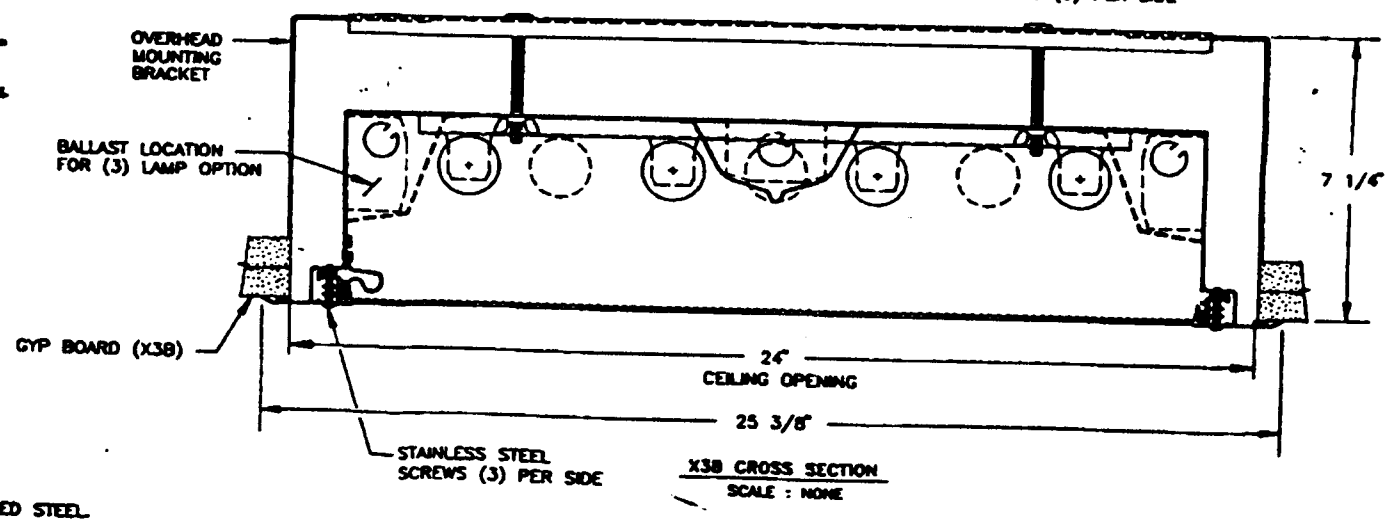
DAN



EXTRUDED DOOR FRAME
SCALE : 3/4" = 1"



X1 CROSS SECTION
SCALE : NONE



X3B CROSS SECTION
SCALE : NONE

SPECIFICATION GUIDE
CL4993A-242RS-PRA.125"-X1
CL4993A-242RS-PRA.125"-X3B
CL4993A-243RS-PRA.125"-X1
CL4993A-243RS-PRA.125"-X3B
CL4993A-244RS-PRA.125"-X1
CL4993A-244RS-PRA.125"-X3B
CL4993A-222URS-PRA.125"-X1
CL4993A-222URS-PRA.125"-X3B

NOTES :

1.- FIXTURE SHOULD NOT BE HOSED DOWN WITH WATER AIMED DIRECTLY AT FIXTURE.

2.- EXTRA GASKETING FACTORY SUPPLIED AND FIELD INSTALLED BY CONTRACTOR TO CEILING.

GENERAL SPECIFICATIONS :

1.- CONSTRUCTION : DIE FORMED #20 GA. COLD ROLLED STEEL.

2.- BAKED WHITE ENAMEL FINISH : PAINT COMPOSITION- POLYESTER FOR CORROSION RESISTANCE. ACRYLIC FOR NON YELLOWING.

3.- DOOR FRAME : EXTRUDED ALUMINUM PAINTED BLACK, OR WHITE. (SPECIFY)

4.- LENS : .125 THK. PRA. OTHER LENSES AVAILABLE UPON REQUEST. SILICONE BETWEEN LENS AND DOOR FRAME AVAILABLE. (CONSULT FACTORY)

5.- BALLAST : RAPID START SLH, (SPECIFY VOLTAGE).

6.- LAMP : F40-T12 (BY OTHERS).

7.- LABELS : U.L. WET LOCATION & I.B.E.W.

REV	DESCRIPTION	DATE	APP

PRUDENTIAL LIGHTING
1774 EAST 21ST STREET L.A. CA 90058

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS ±
DECIMALS ±
ANGULARITY ±

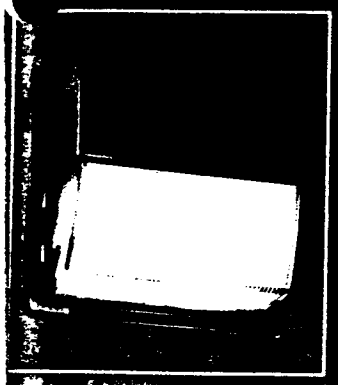
FINISH: NOTED
MATERIAL: NOTED

SCALE: NOTED
DWN: R.C. DATE: 3.5.90
CHECK: SPH DATE: 9.9.90
APPR: DATE:
SHEET OF

TITLE: 2' x 4' RECESSED WET LOCATION

DWG NO: CL4993 A

TWH
Wall-Pak



70/400W HID, 35W LPS, (UL) Wet Location

Use in pedestrian areas, stairways or garages

ORDERING SEQUENCE

CATALOG NUMBER			VOLTAGE
High Pressure Sodium	70	TWH 70S	120[1]
	100	TWH 100S	208
	150	TWH 150S	240
	200	TWH 200S	277[1]
	250	TWH 250S	480
	400	TWH 400S	TB[2]
Metal Halide	100	TWH 100M	
	175	TWH 175M	
	250	TWH 250M	
	400	TWH 400M[4]	
Mercury Vapor	100	TWH 100H	
	175	TWH 175H	
	250	TWH 250H	
Low Pressure Sodium	35	TWH 35L	

OPTIONS

Shipped Installed In Fixture	
SF	Single Fuse (120,277V)
DF	Double Fuse (208,240,480V)
QRS	Quartz Restrike System (lamp not included)
PE	Photoelectric Cell
-70F	Reduced Ambient Operation (-70°F)
RHP	Reactor High Power Factor (150 HPS)
RNP	Reactor Normal Power Factor (150 HPS)
MOG	Mogul Base Socket
LS	Lamp Support (mogul socket only)
DMB	Architectural Color - Medium Bronze
DBL	Architectural Color - Black
DWH	Architectural Color - White
DNA	Architectural Color - Natural Aluminum
DSS	Architectural Color - Sandstone
DGC	Architectural Color - Charcoal Grey
DTG	Architectural Color - Tennis Green
DBR	Architectural Color - Bright Red
DSB	Architectural Color - Steel Blue
CR	Corrosion-Resistant Finish (Polyester)
CRT	Corrosion-Resistant Finish (Teflon)
FS	Full Shield for IES cutoff
Shipped Separately[3]	
WG	Wire Guard
VG	Vandal Guard

FEATURES

HOUSING: Rugged, lightweight, corrosion-resistant die-cast aluminum housing. All external hardware is stainless steel. Standard finish is dark bronze GIC polyester powder electrostatically applied and oven-cured. Other architectural colors are available as options.

OPTICS: Reflector is specular anodized aluminum. Refractor is acrylic borosilicate glass. Lens sealed and gasketed to inhibit the entrance of outside contaminants. Medium base porcelain socket for 70-150W. HPS and 70W MH. Mogul socket for all others. Socket bracket is adjustable.

BALLAST: 70-150W HPS. High reactance, high power factor. All others: Constant wattage autotransformer. Ballast is 100% copper wound and factory tested. Electrical components mounted on front cover on 250-400W HPS and 400W. MH. All others on back wiring.

INSTALLATION: Accommodates end top wiring. Feed-thru is achieved by using a conduit tee. Mounts on any flat surface.

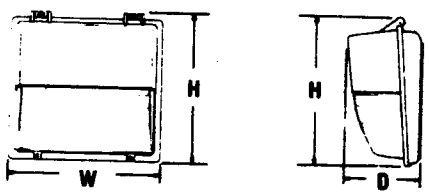
LISTING: UL 1572 listed for wet locations.

ADDITIONAL INFORMATION

Wattage	Ballast	Weight Lbs.	Weight Kg.
High Pressure Sodium - Med/Clear			
70		24	11
100	HX-HPF	24	11
150		26	18
High Pressure Sodium - Mog/Clear			
200		28	13
250	CWA	32	15
400		42	19
Metal Halide - Med(100)/Mog/Clear			
100		26	12
175	CWA	26	12
250		32	15
400 (E-18 lamp only)		42	19
Mercury Vapor - Mog/Coated			
100		21	10
175	CWA	23	10
250		26	12
Low Pressure Sodium - D.C. Bay/Clear			
35	HPF-LAG	25	11

ACCESSORIES (Field Installed)

Ordered Separately.
See Building Mounted Options Section.



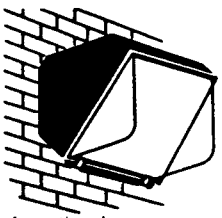
H = 15 3/4" (40 cm)
W = 16 1/4" (42.6 cm)
D = 8" (20.3 cm)

NOTES:

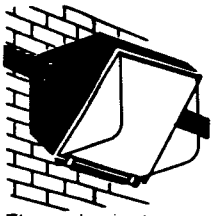
1. Provided with dual tap (120/277V) ballast when ordered as 120V or 277V.
2. Multi-tap Ballast (120,208,240,277V).
3. May be ordered as accessory. MUST see Bldg. Mtd. Options section.
4. Requires E-18 or ED-28 lamp.

LITHONIA HI-TEK

Mounting Systems



Junction box (recessed or surface).



Through-wire to surface conduit.

The Lumark Wally provides efficient, controlled security lighting for residential and commercial applications such as building perimeters, loading areas, stairways hallways or driveways.

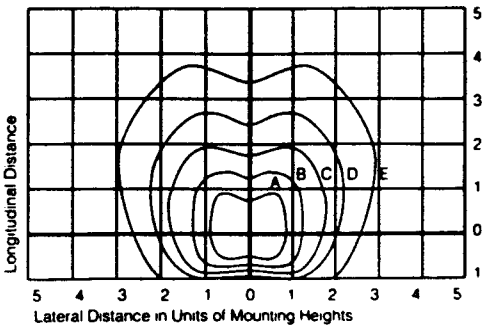
Photometrics

The Wally's prismatic, polycarbonate refractor/door delivers excellent photometric performance. Efficiency and eye appeal combine in this handsome wall light.

Footcandle Table
Select mounting height and read across for footcandle values of each isofootcandle line

Mounting Height	Footcandle Values for Isofootcandle lines				
	A	B	C	D	E
10"	4.50	2.25	1.13	0.56	0.23
15"	2.00	1.00	0.50	0.25	0.10
20"	1.12	0.56	0.28	0.14	0.06
25"	0.72	0.36	0.18	0.09	0.04

Catalog Number HPWY-PL-100-120V-LL
100-Watt HPS
9,500-Lumen Clear Lamp



Ordering Information

Catalog Number Logic

1st & 2nd Digits = Lamp Type	3rd & 4th Digits = Product Family	5th & 6th Digits = Refractor Type	7th, 8th & 9th Digits = Lamp Wattage	10th, 11th, 12th & 13th Digits = Voltage	14th & 15th Digits = Standard Issue
HP = HPS	WY = Wally	PL = Polycarbonate	35 50 70 100	120V	LL = Lamp Included

Catalog Number	Lamp Wattage	Lamp Type	Voltage	NEMA Beam	Net Wt. (Lbs.)	Shipping Volume (Cu. Ft.)
HPWY-PL-35-120V-LL	35	HPS	120	6 x 6	7	0.40
HPWY-PL-50-120V-LL	50	HPS	120			
HPWY-PL-70-120V-LL	70	HPS	120			
HPWY-PL-100-120V-LL	100	HPS	120			

Options (add as suffix)

F1 Internal Fusing

TR Tamper-resistant lens screws

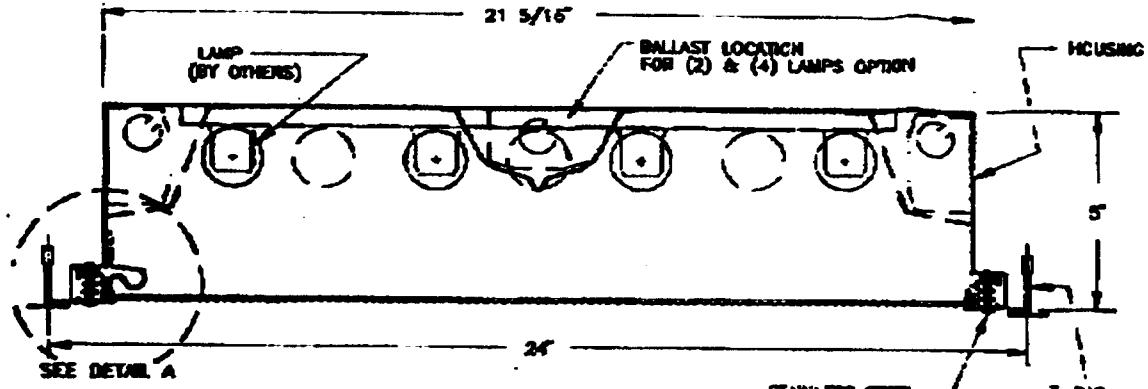
Accessories (order separately)

TRSD-8/32-U Tamper-resistant screwdriver

PC Photocontrol

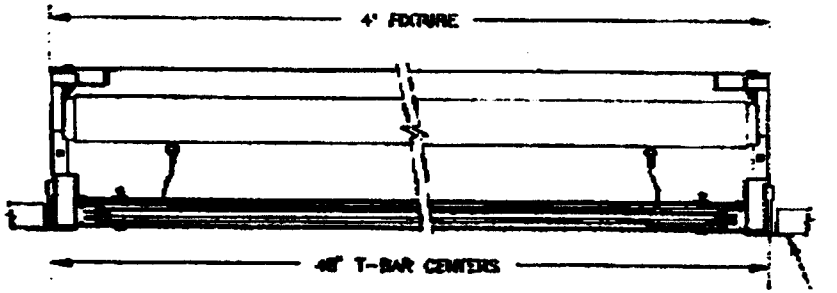
Lumark Lighting
P.O. Box 824
Vicksburg, Mississippi 39181
601.638.1522
Fax 601.634.9606

COOPER LIGHTING

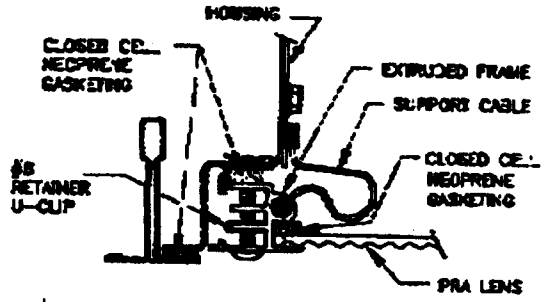


X1 CROSS SECTION
SCALE : NONE

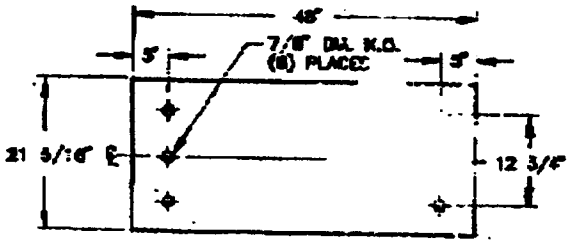
SPECIFICATION GUIDE		
CATALOG NUMBER	NOMINAL SIZE	LAMPS
CL4993B-242RS-PRA.125"-X1	2" X 4"	2-40 RS
CL4993B-243RS-PRA.125"-X1	2" X 4"	3-40 RS
CL4993B-244RS-PRA.125"-X1	2" X 4"	4-40 RS
CL4993B-222URS-PRA.125"-X1	2" X 2"	2-40 URS



ROW SIDE VIEW
(SCALE: 1/4" = 1")



DETAIL A
SCALE: 3/4" = 1"



BACK PLAN
(NO SCALE)

TYPE ①

GENERAL SPECIFICATIONS:

1.- CONSTRUCTION : DIE FORMED #20 GAUGE COLD ROLLED STEEL.
2.- BAKED WHITE ENAMEL FINISH : PAINT COMPOSITION- POLYESTER FOR CORROSION RESISTANCE, ACRYLIC FOR NON YELLOWING.
3.- DOOR FRAME : EXTRUDED ALUMINUM. (SPECIFY BLACK, OR WHITE.)
4.- LENS : .125 THK. PRA, KSH-HT90. (OTHER LENSES AVAILABLE UPON REQUEST.)
SILICONE BETWEEN LENS AND DOOR FRAME AVAILABLE. (CONSULT FACTORY)
5.- BALLAST : RAPID START SLH (SPECIFY VOLTAGE)
6.- LAMPS : F40-T12 (BY OTHERS.)
7.- LABELS : J.L. WET LOCATION & I.B.E.W.

GENERAL NOTES:

1.-EXTRA GASKETING SUPPLIED BY FACTORY, AND FIELD APPLIED TO CEILING BY CONTRACTOR.
2.-FIXTURE SHOULD NOT BE HOSED DOWN WITH WATER AIMED DIRECTLY AT FIXTURE.

REV	DESCRIPTION	DATE	APP

PRUDENTIAL LIGHTING
1171 EAST 21ST STREET, LA CA 90011

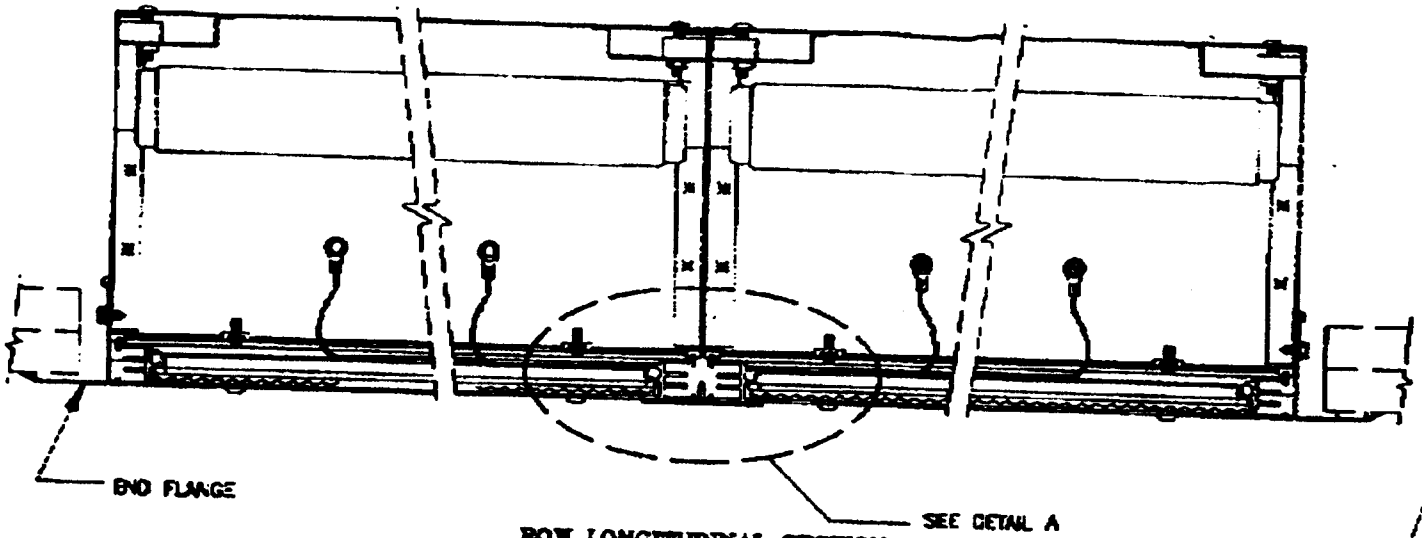
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS ±
DECIMALS ±
ANGULARITY ±

FINISH: NOTED
MATERIAL: NOTED

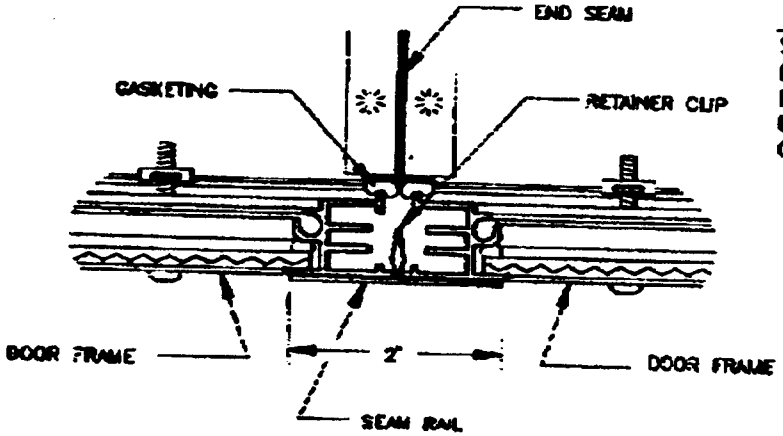
SCALE: NOTED
DWN: PM DATE: 2.5.91
CHECK: GPH DATE: 2.11.91
APPR: DATE:
SHEET OF

TITLE: RECESSED X1 FIXTURE FOR WET LOCATION

DWG NO: CL4993 REV: B

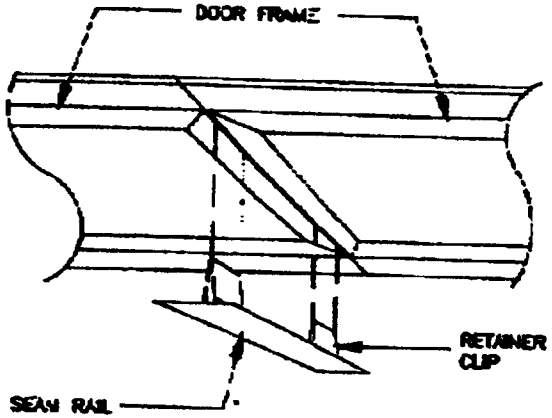


ROW LONGITUDINAL SECTION
NO SCALE



DETAIL A
FULL SCALE

GENERAL NOTES :
SEAM RAIL : #20 GAUGE COLD ROLLED STEEL
INSERT TOP OF RETAINER CLIP INTO GAP
BETWEEN FRAME ENDS AND PUSH UP
UNTIL SEAM RAIL POPS INTO POSITION
CLOSING LIGHT LEAK.



SKETCH 1.
(NO SCALE)

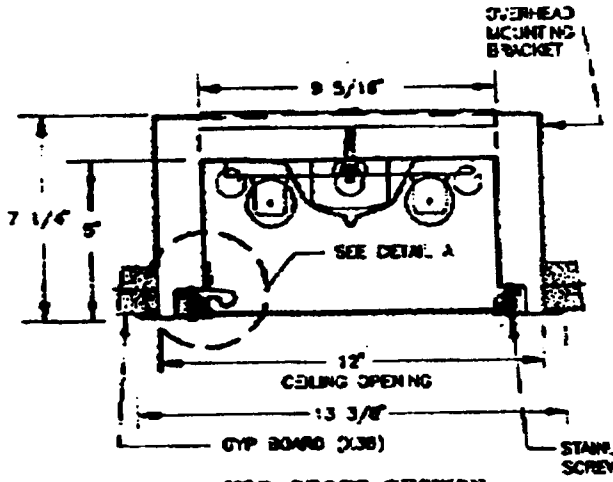
REV	DESCRIPTION	DATE	APP

PRUDENTIAL LIGHTING
1770 EAST 21ST STREET, L.A. CA 90058

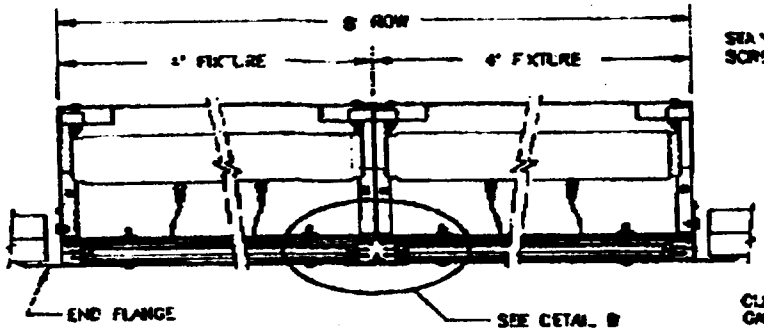
SCALE: NOTED
DWN: P.H. DATE: 2.8.91
CHECK: SPH DATE: 2.12.91

TITLE: ROW MOUNTING SEAM RAIL

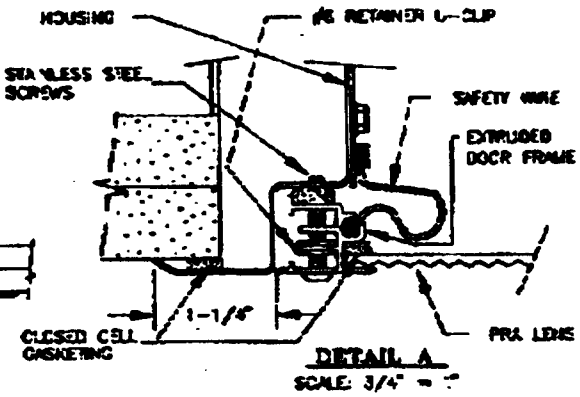
DWG NO: C_4993 REV: B



X3B CROSS SECTION
SCALE: 1/4" = 1"



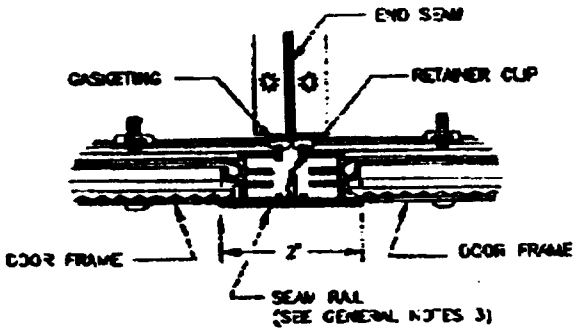
ROW SIDE VIEW
(SCALE: 1/4" = 1")



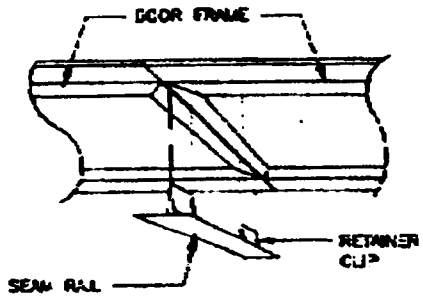
DETAIL A
SCALE: 3/4" = 1"

GENERAL SPECIFICATIONS:

1.- CONSTRUCTION : DIE FORMED #20 GAUGE COLD ROLLED STEEL.
2.- BAKED WHITE ENAMEL FINISH : PAINT COMPOSITION— POLYESTER FOR CORROSION RESISTANCE, ACRYLIC FOR NON YELLOWING.
3.- DOOR FRAME : EXTRUDED ALUMINUM. (SPECIFY BLACK, OR WHITE.)
4.- LENS : .125 THK. PRA, KSN-H990. (OTHER LENSES AVAILABLE UPON REQUEST.)
SILICONE BETWEEN LENS AND DOOR FRAME AVAILABLE. (CONSULT FACTORY)
5.- BALLAST : RAPID START SLH (SPECIFY VOLTAGE)
6.- LAMPS : F40-T12 (BY OTHERS.)
7.- LABELS : U.L. WET LOCATION & I.B.E.W.



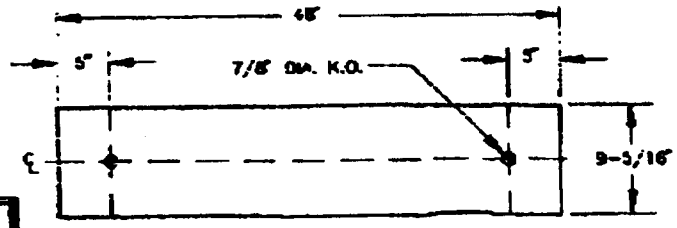
DETAIL B
(NO SCALE)



SKETCH 1.
(NO SCALE)

GENERAL NOTES:

1.- EXTRA GASKETING SUPPLIED BY FACTORY, AND FIELD APPLIED TO CEILING BY CONTRACTOR.
2.- FIXTURE SHOULD NOT BE HOSED DOWN WITH WATER AIMED DIRECTLY AT FIXTURE.
3.- SEAM RAIL TO BE FIELD INSTALLED AT ALL INTERMEDIATE FRAME ENDS. (SEE SKETCH 1.)



BACK PLAN
(NO SCALE)

SPECIFICATION GUIDE		
CATALOG NUMBER	NOMINAL SIZE	LAMPS
CL4993-14GR-PRA.125"-X3B	1' X 4'	2-40 T12

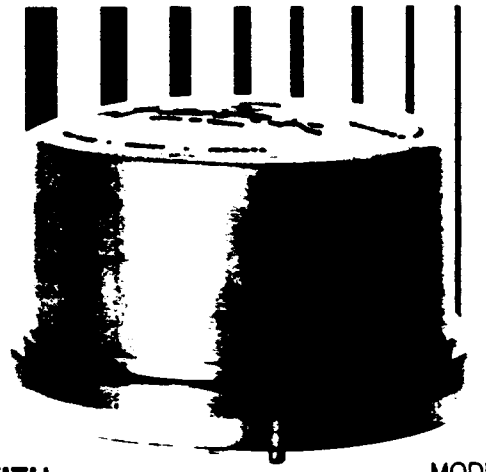
REV	DESCRIPTION	DATE	APP

PRUDENTIAL LIGHTING
1770 EAST 26TH STREET, L.A. CA 90011

SCALE: NOTED
DATE: 2.2.91
DRAWN: SPH 12.14.91
NOTED
NOTED

RECESSED X3B FIXTURE FOR WET LOCATION

CL4993 B



TORK®

PRODUCT BULLETIN

NO. B-2000
2000 SERIES
SEPTEMBER 1988

TURN-LOCK STREET LIGHTING PHOTOELECTRIC CONTROLS WITH SURGE PROTECTION

MODEL
2003

Over-the counter Utility or Replacement Models

MODELS 2003/2003S 2004/2004S 2007D	Omni-directional-Time Delay relay provides delayed response in excess of 15 seconds.
MODELS 2005/2007/2008	Magnetic-relay type provides immediate response to light changes and to application of power on installation. Model 2007/2007D is Dual-Voltage — operates on all voltages between 105 and 277 volts.

APPLICATION: For street and highway lighting luminaires equipped with locking type receptacle. Lighting is automatically turned ON at dusk and OFF at dawn. Designed expressly to respond to natural daylight.

DESCRIPTION: Self contained control is completely weatherproof and is not affected by moisture, vibration, or changes in temperature. Designed to be as inconspicuous as possible while maintaining sound engineering design principles for long trouble-free operation.

FEATURES:

Profile: In keeping with the aesthetic requirements of modern luminaires, the unit is designed with a lower profile than most types of self contained photoelectric controls.

Operational Level: Factory preset for ON at 1 to 3 foot-candles. Average ratio of ON to OFF is about 1 to 3. For special turn-on and turn-off, consult factory.

Temperature Range: —50° to +60°C. (—60° to +140°F).

Surge Protection: A surge protector is included as a safe-guard against induced high-voltage and follow through current. Margin of protection, 60C sparkover-1500V rms. Critical impulse sparkover is 10,000 amps, 1-1/2 x 40 ms wave, 2000 volts.

MODELS 2003/2004/2007D

DELAY
In excess of 15 seconds.

CADMIUM SULPHIDE CELL
One inch diameter, epoxy coated for maximum stability.

DIRECTIONAL ORIENTATION
Omni-directional.

CONTACTS
Normally closed.
Rated 1500 Watts, 1800VA.

DOME
Translucent polycarbonate, aluminum filled, reflects high (5000 F/C and above) sunlight rays but is virtually transparent to 50 F/C and lower.

GUARANTEE
[illegible] years from date of installation. Provision for marking installation date molded into base.

MODELS 2005/2007/2008

DELAY
None.

CADMIUM SULPHIDE CELL
One inch diameter, passivated for maximum stability.

DIRECTIONAL ORIENTATION
Window should face north.

CONTACTS
Normally closed.
Rated 1000 watts, 1800VA.

DOME
Raintight polyacrylic with acrylic window containing ultraviolet inhibitor.

GUARANTEE
One year from date of installation. Provision for marking installation date molded into base.

Canada:
Electric Ltd.
Fuller Road
[illegible], Ontario L1S 2E1
(416) 683-3400

TORK®

1 GROVE STREET, MT. VERNON, NY 10550 TEL: 914-664-3542
FAX: 914-664-5052

ORDERING INFORMATION

All models contain the following:

1. Mercury Vapor/HID rating of 1800 volt-amperes
2. Surge protection
3. One inch diameter cells (except where noted)
4. SPST switching-normally closed

Model #	Voltage 50/60 Hz	Watts Tungsten	Delay/Instant Response
*2003	120	1500	Delay
2004	208-277	1500	Delay
2007D	105-277 (Dual)	1500	Delay
*2003S	120	1500	Delay
*2004S	208-277	1500	Delay
2005	105-130	1000	Instant
2007	105-277 (Dual)	1000	Instant
2008	480	1000	Instant

*contains cost effective 1/2 inch cells

For a condensed catalog on all TORK photoelectric controls — see brochure B-PC.

5400 SERIES CONTACTOR

For all Photoelectric control loads in excess of the capacity of the Photoelectric control contacts, to maximum of 6000W. Includes Photoelectric control.

Enclosure: NEMA Type III Raintight. Beige enamel finish. Two 1/2" - 3/4" combination K.O. in bottom.

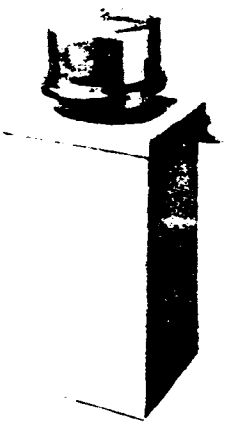
Receptacle: 3-prong turn-lock meets the requirements of EEI-NEMA. Adjustable over full 360 degrees for proper Photoelectric control orientation.

Power Consumption: Approximately 5 watts during Daylight, 15 watts at Night.

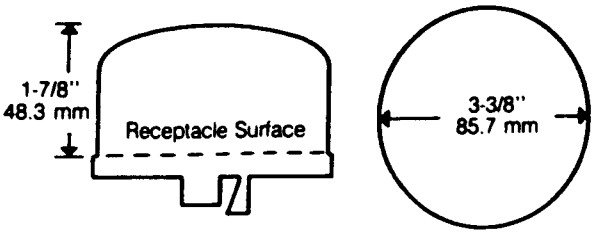
Warranty: One year from date of installation.

Model	Includes Photoelectric Control Model	Voltage 50/60 Hz	Contact Rating Per Pole	Switch
5403	2003S	105-130	3000 Watts	DPST
5404	2004S	208-277	3000 Watts	DPST
5420	2003S	105-130	1000 Watts	SPDT

(See Bulletin B5400 for additional specifications.)

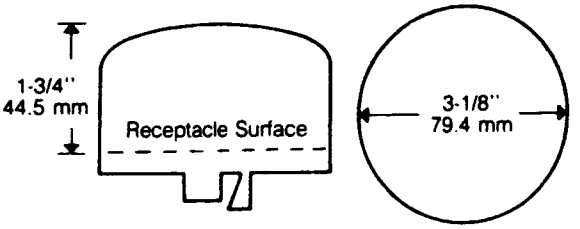


DIMENSIONS



2003/2004/2007D

DIMENSIONS



2005/2007/2008

TURN-LOCK PHOTOELECTRIC CONTROL ACCESSORIES

2420 Series:
Consists of Receptacle with Mounting Bracket.

Model
2421 with 12" AWG #12 leads, 120v color coded
2422 with 20" AWG #14 leads, 240v color coded

Shorting Cap:
Model 2500

It is our intent to provide accurate and current specification information. However, in the interest of product improvement, TORK may occasionally alter construction or dimensional detail without liability.

REPRESENTED BY:

H-7891EM
Compact Fluorescent Downlight

H-7891EM Compact Fluorescent Emergency Downlights feature two 13 watt energy saving compact fluorescent lamps in a Specification Grade fixture. The H-7891EM series matches the H-7891 downlights in appearance and will automatically provide 120 minutes of emergency power upon interruption of AC power. Typically, the H-7891EM would be installed on a 24-hour lighting circuit. However, for added installation flexibility, these fixtures can be installed on switched circuits. Note: 277VAC Switched applications require the EMS-277 accessory.

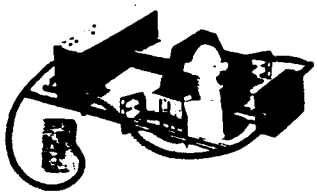
Units are supplied factory prewired, only requiring a standard AC connection to the junction box provided. The battery charge indicator light and test switch are prewired to a quick-connect molex plug.

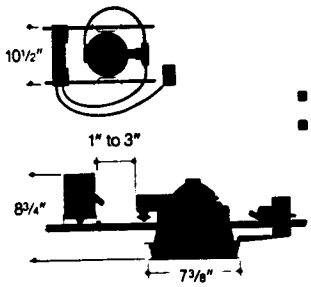
Mechanical: Heat dissipating die-cast aluminum socket holder for two 13W compact fluorescent lamps. Polarized quick connect assembly for ease of installation. Exclusive Universal Mounting Bracket adjusts 5" vertically from inside or outside of fixture. Bar hangers permit horizontal adjustment. One-piece precision die-cast aluminum 1½" deep collar accommodates varying dimensions of ceiling materials.

Electrical: A higher power factor reactor type ballast system provides normal illumination. Inaudible high-frequency inverter operates one lamp at full 900 lumens output in emergency mode. Integral transformer allows operation on either 120 volt or 277 volt input on switched or unswitched circuits. Unit can be installed on switched circuits by using EMS-277 switching module provided 24 hour unswitched 277V power supply is also available.

Field Installed Accessories:

9840C	Clear Specular Reflector Trim
9840G	Gold Specular Reflector Trim
9840BA	Black Coilex Baffle Trim
TRM-8P	White Metal Trim Ring
TRM-8-MB	Black Metal Trim Ring
TRR-8	Rimless Trim Ring
HB2-24	24" Bar Hangers
EMS-277	Accessory for switched 277 Volt installations





Product Information: Capacity in Watts to 87 [illegible] of Rated Voltage

Model	DC Volts	Batt	Rated Watts 1½ Hrs.	2 Hrs	Lamp Type	Watts	No	Shipping Wt.
■ **H-7891EM**	–	LC	–	–	Compact Fluorescent	13	–	16

■ Indicates Quick Ship Product

UMB Series
NEMA 4X Enclosure

The ideal dependable unit for environments where an emergency lighting unit will be exposed to water spray or penetrating steam and dampness. The UMB Series is best suited for use in areas like waste water treatment plants, food processing facilities and most industrial locations where NEMA 4, 4X or 12 protection is required.

Heads: The lamp housing is constructed of flame-resistant and impact-resistant Noryl 190 injection molded thermoplastic with matching grey finish. The three dimensional swivel assembly permits 80° aiming adjustment from vertical and approximately 358° rotation. The placement is secured with a lockable pivot mounted on a rotating base ring. Heads and swivels are silicon sealed to prevent moisture from entering housing.

Lamps: Designed specifically for emergency lighting applications, the PAR36 type sealed beam design insures optimum glare-free trapezoidal light distribution along with horizontal and vertical adjustment by rotating the lens within the housing.

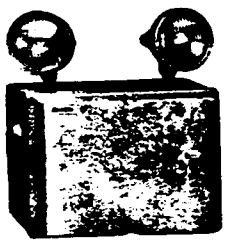
Housing: The rugged industrial grey fiberglass housing is both watertight and corrosion-resistant. Gasketed cover is internally hinged and housing is equipped with a one-way breather vent. Enclosure is suitable for environments requiring NEMA 4, 4X or 12 protection.

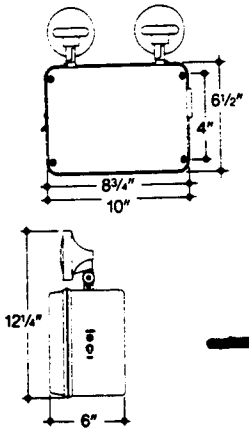
Factory Installed Options:

TH	Thermal Heater
TDM	Time Delay Monitor

Field Installed Accessories:

WG-3	Wire Guard





Product Information: Capacity in Watts to 87 [illegible] of Rated Voltage

Model	DC Volts	Batt.	Rated Watts 1½ Hrs.	2 Hrs	Lamp Type	Watts	No	Shipping Wt.
■ **UMB-1**	6	LC	18	–	Incandescent	9	29-03	[illegible]
UMB-6	6	LC	27	24	Incandescent	9	29-0[illegible]	[illegible]
UMB-7	6	LC	54	48	Incandescent	9	29-03	[illegible]
UMB-10	6	PL	15	12	Incandescent	7.2	29-75	[illegible]
UMB-11	6	PL	24	18	Incandescent	7.2	29-75	[illegible]
UMB-14	6	NC	15	12	Incandescent	7.2	29-75	[illegible]
UMB-15	6	NC	24	18	Incandescent	7.2	29-75	[illegible]
UMB-8	12	LC	36	30	Incandescent	8	29-49	[illegible]
UMB-9	12	LC	54	48	Incandescent	8	29-49	[illegible]
UMB-12	12	PL	30	24	Incandescent	8	29-49	[illegible]
UMB-13	12	PL	48	36	Incandescent	8	29-49	[illegible]
UMB-16	12	NC	30	24	Incandescent	8	29-49	[illegible]
UMB-17	12	NC	48	36	Incandescent	8	29-49	[illegible]

■ Indicates Quick Ship Product

Battery: LC Lead Calcium, NC Nickel Cadmium, PL Pure Lead

Metal Heads
Attractively styled fixture for remote mounting. Three-dimensional die-cast aluminum swivel assembly permits 80° aiming adjustment from vertical and approximately 358° rotation. Lockable pivot is mounted on a rotating spin ring base. Lampholder housing is made of corrosion-resistant 22 gauge die-formed spun aluminum with a baked acrylic enamel finish. Stainless steel gang plate mounts flush against the wall and is made for installation on a standard electrical box.

Single and double remote fixtures are available in 6 volt, incandescent or halogen lamps. Single head remotes supplied with single gang plate. Double head remotes supplied with three gang plates.

Product Information

Single Head	Double Head	Lamp Type	Volts	Watts	Shpg. Wt.
■ **6T-6-MHWH**	■ **6T-6-DMHWH**	Halogen, White	6	6	2/4
■ **6T-12-MH**	**6T-12-DMH**	Halogen, Beige	6	12	4/4
6X-7-MHWH		Incandescent, White	6	7.2	2

■ Indicates Quick Ship Product

Weather Resistant
The PAR36 type lamp housing is constructed of flame-resistant and impact-resistant Noryl 190 injection molded thermoplastic with beige finish. Ideal for industrial applications, the sealed swivel and coated lamp terminals resist oil, water and dust. The three dimensional swivel assembly permits 80° aiming adjustment from vertical and approximately 358° rotation. The placement is secured with a lockable pivot mounted on a rotating base ring.

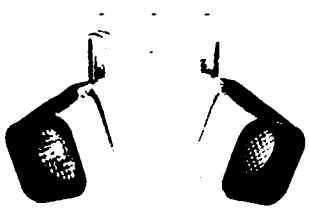
Single and double remote fixtures are supplied with thermoplastic housing and swivel, die-cast aluminum mounting plate and gasket. Available in 6 or 12 volt, incandescent or halogen PAR36 type sealed beam lamps.

Product Information

Single Head	Double Head	Lamp Type	Volts	Watts	Shpg. Wt.
■ **6T-6-W**	**6T-6-DW**	Halogen	6	6	4/6
6T-8-W	**6T-8-DW**	Halogen	6	8	4/6
■ **6X-7-W**	**6X-7-DW**	Incandescent	6	7.2	4/6
■ **6X-9-W**	**6X-9-DW**	Incandescent	6	9	4/6
■ **12T-8-W**	**12T-8-DW**	Halogen	12	8	4/6
12T-12-W	**12T-12-DW**	Halogen	12	12	4/6
■ **12X-8-W**	**12X-8-DW**	Incandescent	12	8	4/6
12X-25-W	**12X-25-DW**	Incandescent	12	25	4/6

■ Indicates Quick Ship Product

DR Series
DR Series remote pinchback matches RD Series emergency lighting fixtures. The lamp housing is constructed of injection molded polypropylene with high gloss opaque white finish. The three dimensional permanently tensioned swivel assembly permits 80° aiming adjustment from vertical and approximately 358° rotation. The pinchback design features a R18 size aperture with removable matte black baffle. Single remotes supplied on single gang mounting plate. Double remotes supplied with 3-gang mounting plate.



Product Information

Single Head	Double Head	Lamp Type	Volts	Watts	Shpg. Wt.
■ **DR-1-12**	■ **DR-2-12**	Halogen	6	6	3/6
DR-1-66	**DR-2-66**	Halogen	6	12	3/6
■ **DR-1-45**	■ **DR-2-45**	Halogen	12	12	3/6

■ Indicates Quick Ship Product

Pyrotronics

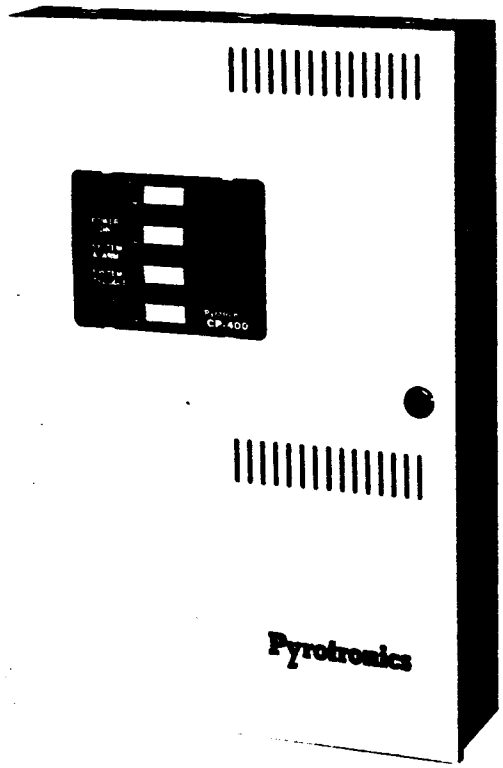
Universal Alarm Control

Fire Alarm Control Panel

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL CP-400

- 4 Zone Fire Alarm Control Panel Expandable to 8 Zones
- 4 Zone Extender Module with Supervisory Service Feature
- Remote Annunciator Capability
- Subsequent Alarm and Trouble
- Alarm Verification Option
- Supplementary Relay Option
- Municipal Tie, Leased Line Option
- Class A (Style D) Option
- Selectable Timed Alarm Silence Feature
- Selectable Drill Switch Feature
- Selectable March Time Feature
- 24 or 60 Hour Battery Backup
- UL and CSFM Listed



Introduction

DESIGN FEATURES

The Pyrotronics CP-400 is an expandable 4 zone fire alarm control panel designed to use Pyrotronics two wire ionization, photoelectric, thermal and flame detectors, as well as direct shorting devices such as manual stations and water flow switches.

The standard 4 zone CP-400 system includes subsequent alarm, subsequent trouble, brown out protection, non-silencable waterflow alarm, selectable march time feature, selectable timed alarm silence feature, relay contacts — 2 alarm and 1 trouble, and 2 alarm indicating circuits.

The CP-400 is expandable to 8 zones with the use of a 4 zone expansion module. The 4 zone expansion module may be used for either alarm or supervisory service.

The CP-400 is designed to meet the varied fire alarm detection needs of small office buildings, apartment buildings, department stores, hotels or anywhere a cost efficient, general purpose fire alarm control panel is required.

The CP-400 meets the requirements of NFPA 72A, B & C and is UL listed.

Architects Specification

An expandable 4 zone fire alarm control panel shall be a Pyrotronics Model CP-400. The 4 zone fire alarm control panel shall be expandable to 8 zones with the use of a 4 zone expansion module. The 4 zone expansion module shall have the capability of being used either for alarm or supervisory service. The standard 4 zone system shall include: subsequent alarm, subsequent trouble, brown out protection, non-silencable waterflow alarm, selectable march time feature, selectable timed alarm silence feature, relay contacts — 2 alarm and 1 trouble, 2 alarm indicating circuits, and a 24 hour battery backup. The fire control panel shall have remote annunciator capabilities. Remote annunciation shall be provided by any Pyrotronics Model AN series remote annunciators. The expandable 4 zone fire alarm control panel may have the following options: alarm verification, supplementary relay, municipal tie or leased line, Class A (Style Z), or 60 hour battery backup. The expandable 4 zone fire alarm control panel shall meet the requirements of NFPA 72A, B & C and be UL listed.

Description/Operating Features

INITIATING CIRCUITS

The standard CP-400 provides 4 Class B (Style B) initiating circuits, each of which will operate any combination of up to 30 Pyrotronics ionization or photoelectric fire detectors. Any number of thermal detectors or manual stations or other direct shorting devices may be connected to each zone. Also, a number of flame detectors, which is determined by the power requirements of that individual flame detector, may be connected to each zone. All of these initiating devices can be mixed on the same zone circuit providing the total power requirement of the circuit does not exceed 3 mA supervisory current.

POWER SUPPLY AND BATTERY BACKUP

Input power is 120 VAC at 1.3 Amps. The system reverts to 24 hour or 60 hour battery backup if AC power is lost or if AC input power drops below approximately 96 VAC.

INDICATING CIRCUITS

The CP-400 provides for two system operated 1.5 Amp, Class B (Style W) indicating circuits with an output voltage of 24 VDC (nominal). The CP-400 indicating circuits provide the choice of march time as a standard feature, as well as a 5 or 10 minute timed alarm silence option.

VISUAL AND AUDIBLE INDICATORS

Green, yellow and red LEDs, respectively indicate power, system trouble and system alarm on the front panel. Additional red and yellow LEDs indicate individual zone alarms and troubles.

For diagnostic purposes yellow LEDs located on the CP-400 I/O circuit board indicate ground fault and indicating circuit troubles.

A trouble audible will sound with any system or zone trouble and will silence when the trouble condition is cleared.

The trouble audible can be manually silenced by the operation of a momentary push button silence switch. However, the trouble audible will resound upon appearance of a subsequent zone trouble or system trouble.

MANUAL CONTROLS

The silence and reset switches of the CP-400 are located on the standard zone board which is accessible only by unlocking the cabinet door. These switches are momentary. The switches are clearly marked "S" for silence and "R" for reset.

AVAILABLE RELAY CONTACTS

The CP-400 provides one DPDT alarm related and one SPDT trouble related relay, both of whose contacts are rated at 120 VAC, 3 Amp or 30 VDC, 3 Amp.

Optional System Expansion Modules

4 ZONE EXTENDER WITH SUPERVISORY SERVICE MODULE

Model: ZNE-404S

The CP-400 can be expanded to a total of 8 zones with the use of the 4 zone extender module, Model ZNE-404S. The ZNE-404S has all the features of the CP-400 standard four zones except the ZNE-404S may be used for either alarm or supervisory service. The ZNE-404S is connected to the primary zone board by means of a ribbon cable connector.

ALARM VERIFICATION WITH DRILL SWITCH MODULE

Model: RC-400

The RC-400 provides alarm verification for up to 8 selected zones. The RC-400 blocks the alarm on the selected zone and resets the panel after 7.5 seconds. Any alarm release during the next 73 second period causes a panel alarm and activates all the alarm outputs.

A drill switch is also provided with the RC-400 which operates only the audible alarms. In the event of a true alarm during a drill, the alarm function overrides the drill switch.

CLASS A OPTION

Model: 405A

Up to 8 Class A (Style D) initiating and 2 Class A (Style Z) indicating circuits are available by adding the optional 405A Class A conversion module. (Note: The DI-4A/H detector is not compatible with the 405A module.)

MUNICIPAL TIE, LEASED LINE MODULE

Model: LT-4

The LT-4 module provides the capability of operating and supervising leased lines for alarms, troubles or supervisory service as well as operating a local energy municipal box. The LT-4 includes three separate leased line circuits along with one municipal tie circuit. A disconnect switch is also provided for system test.

SUPPLEMENTARY RELAY MODULE

Model: 405R

The 405R provides 4 alarm relays each with two Form "C" (DPDT) contacts. The four relays may be activated selectively by any combination of zones in alarm.

SUPERVISED REMOTE ANNUNCIATOR DRIVER MODULE

Model: AND-400

The AND-400 drives Pyrotronics AN series remote annunciators and provides panel supervision to the annunciator connections.

REMOTE ANNUNCIATORS

Models: AN-404, 404S, 408, 408S

Pyrotronics series AN remote annunciators are designed to operate with the CP-400 fire detection control panel. The AN-404 is a 4 zone alarm and system trouble remote annunciator. The AN-408 is an 8 zone alarm and system trouble remote annunciator. An optional weatherproof gasket is available only for models AN-404 and AN-408. The AN-404S and AN-408S in addition to providing the basic zone alarm and system trouble remote annunciation also feature a trouble silence switch with an audible ring back. The remote annunciators opaque, masked, typeable plastic legend strips are easily modified as conditions or locations change. Legend strip inserts can accommodate up to 20 typed characters or 20 eight point transfer letters per zone. High intensity long life red LEDs are used for zone alarm indication and yellow LEDs are used for system trouble indication. LED indicators are visible through the legend only when lit. Each AN series annunciator comes completely assembled and ready for easy installation in standard electrical gang boxes for either flush or surface mounting.

CP-400 Accessories

FLUSH TRIM PLATE

Model: FT-4

Note: The exterior dimension of the FT-4 is 17" x 23".

POWER LIMITING MODULE

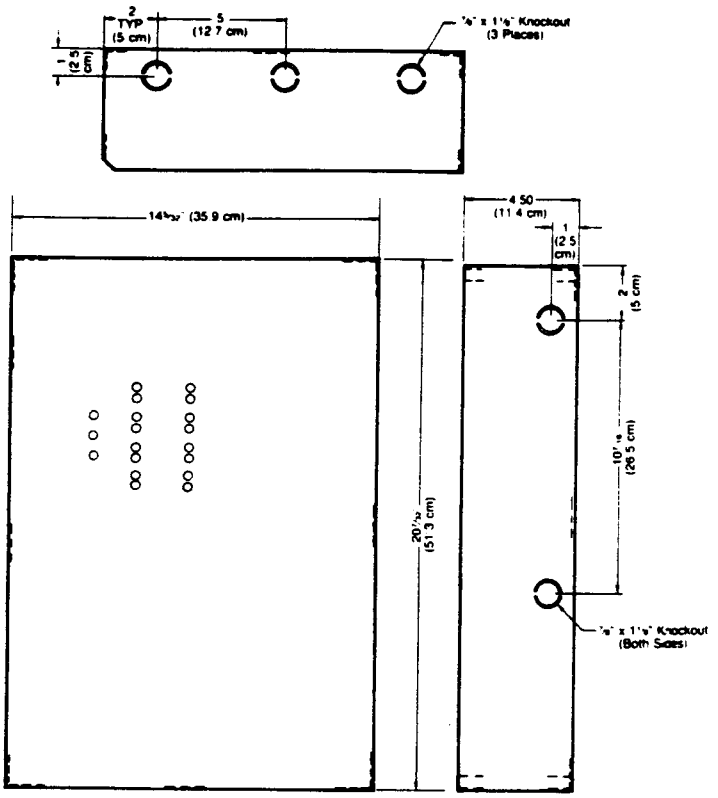
Model: PL-35

The PL-35 allows power limiting wiring of alarm indicating circuits. (See Pyrotronics specification sheet #3180).

Ordering Information

Model Number	Description	Approximate Shipping Wgts. lbs	kg
CP-400	4 Zone Fire Alarm Panel	22	10
ZNE-404	4 Zone Extender Module	1	.45
RC-400	Alarm Verification Module	1	.45
LT-4	Leased Line/Municipal Tie Module	1	.45
405A	Class A Conversion Module	1	.45
405R	Supplementary Relay Module (4 Relays)	1	.45
BP-24	6.0 AH Battery Pack	10.6	4.8
BP-60	10 AH Battery Pack	19.4	8.8
BP-61	15 AH Battery Pack	20.0	9.0
FT-4	Flush Trim Plate	6	2.7
PL-35	Power Limiting Module	.4	.2
AND-400	Supervised Remote Annunciator Driver	.75	.34
AN-404	Remote 4 Zone Annunciator	.5	.23
AN-404S	Remote 4 Zone Annunciator with audible ring back, silence switch	.65	.3
AN-408	Remote 8 Zone Annunciator	.65	.3
AN-408S	Remote 8 Zone Annunciator with audible ring back, silence switch	.82	.37

Mounting Data – Dimensions



Note: Front door closes flush onto the backbox.

Current Requirements

Component	Current (A)	AH/24 hr	AH/60 hr
CP-400 Panel	0.110	2.64	6.60
ZNE-404	0.055	1.32	3.30
405R	0.005	0.12	0.30
RC-400	.0005	.012	.03
AND-400: See Note #3	—	—	—
AN-404 / AN-404S	.015	.365	.905
AN-408 / AN-408S	.015	.368	.908
405A: See Note #4	—	—	—
LT-4	0.005	0.12	0.30
Each L.L. Connection	0.009	0.216	0.54
Allow for Audibles	3A Output	0.52	0.52
Additional Loads:	Add any current drawn from the auxiliary power terminals.		

NOTES:
1. For 24 hour battery backup, the following apply: 6 AH battery (Model BP-24)—175mA supervisory current; 10 AH battery (Model BP-60)—250mA supervisory current. For 60 hour battery backup, the following limits apply: 15 AH battery (Model BP-61)—230mA supervisory current. For all four categories, the audible alarm current is 3A max. **2.** Refer to Operation, Installation and Maintenance Manual, P/N 315-087711, and Operating Instructions, P/N 315-087712 for additional information. **3.** AND-400 current requirements included in AN Series annunciators. **4.** Standby and alarm requirements are included in the CP-400 8 zone system.

Expansion Module Placement

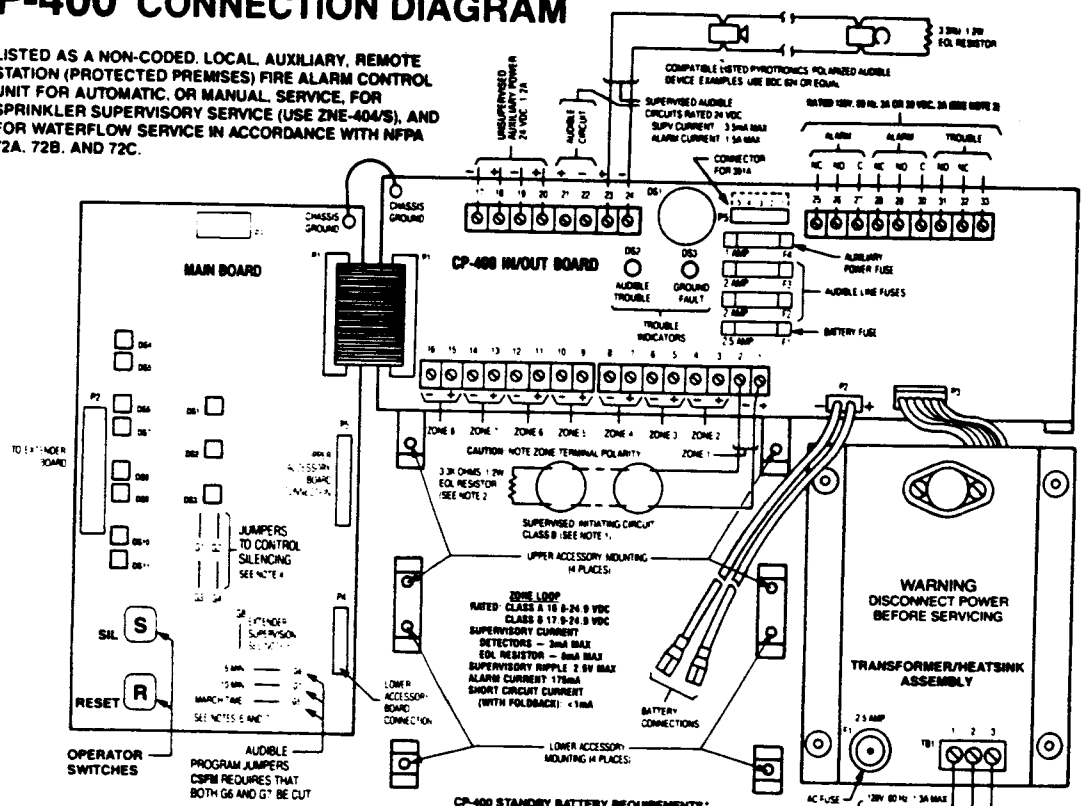
Available Space and Placement	ZNE-404S	RC-400	405A	405R	LT-4	AND-400
Interior of Control Panel Door (1 space available)	One Space Required					
Main Circuit Board (1 space available)		One Space Required				
Upper Accessory Mounting Position on the Backbox (2 spaces available)				One Space Required	One Space Required	One Upper Space & One Lower Space Required
Lower Accessory Mounting Position on the Backbox (2 spaces available)			One Space Required			

Note: The 405A, 405R, LT-4 or AND-400 can be mounted one on top of another. Care should be taken not to exceed the CP-400 optional module mounting capacity of 2 level stacking.

Typical Wiring

Model CP-400 CONNECTION DIAGRAM

LISTED AS A NON-CODED, LOCAL, AUXILIARY, REMOTE STATION (PROTECTED PREMISES) FIRE ALARM CONTROL UNIT FOR AUTOMATIC, OR MANUAL, SERVICE, FOR SPRINKLER SUPERVISORY SERVICE (USE ZNE-404/S), AND FOR WATERFLOW SERVICE IN ACCORDANCE WITH NFPA 72A, 72B, AND 72C.



CAUTION
Be sure to program the CP-400 before connecting the power

CP-400 STANDBY BATTERY REQUIREMENTS*

COMPONENT	CURRENT (A)	AH/24 Hr	AH/60 Hr
CP-400 Four Zone Panel	0.110	2.64	6.60
Smoke Detector	0.0001	0.0024	0.006
Allowance for Audibles	3A output	0.52	0.52
Additional Loads	Add any current drawn from the auxiliary power terminals or the annunciator driver in power loss trouble		

*AC power loss with trouble acknowledged

NOTES:

1. Initiating devices — A maximum of 30 smoke detectors (any combination of those listed below as compatible detectors) and any number of direct shorting devices such as thermals, manual stations, and waterflow switches may be used. Total circuit line resistance is 36 ohms max. except when using detector relays (Model RR-3). Maximum resistance is 20 ohms. Maximum (3mA for detectors, 7mA for EOLR) supervisory current: 10mA per zone.
2. Mounting plate P/N 500-621296 can be used for mounting end-of-line resistor. Place EOL resistor (3.3K ohms, 1/2 watt) across associated terminals when external circuit is not used.
3. Alarm and trouble contacts are shown in supervisory status.
4. Jumpers G1, G2, G3, and G4 on the main board may be cut to allow timeout or manual silencing of alarm bells for zones 1 through 4, respectively. The jumpers must remain intact on any zone used for waterflow alarm.
5. If an optional four-zone extender board is installed, cut jumper G8 on the main board to supervise the connection of the extender board.
6. To use power limited wiring to NFPA 70 NEC, the audible circuits, terminals 21-24 must use the PL-35 module. Refer to Instructions P/N 315-088567. Initiating circuits, terminals 1-16, and connections for the 301A are power limited as they are.
7. If 10 minute nominal timeout of audibles is desired, cut jumper G6 on the main board. If 5 minute nominal timeout of audibles is desired, cut jumper G7 on the main board. If manual silencing only is desired, cut both jumpers G6 and G7 (CSFM requires that both G6 and G7 must be cut). If any zone is to be silencable (any G1 through G4 was cut), at least G6 or G7 must be cut.
8. Initiating circuits and connections for the 301A annunciator are power limited per NFPA 70, National Electrical Code.
9. Use only the following compatible polarized indicating devices. Bells, single-stroke, Models* BDS-624, -1024, CDS-24. Bells, vibrating, Models BDC-624*, -1024*, CDC-24*. Horn, vibrating, with flashing lamp feature, Model AV-32D. Horn, electric, Model SEA-3, indoor or outdoor use. Horn-lamp assemblies Models HSD-24, -24F. Horn, vibrating, Model HDC 24, for indoor or outdoor use. Flashing signal light, Model V-33D. Audible detector base, Model ADB-3.
10. Charging current, normal 27.4V, 50mA
    Maximum charging current 2A
    Charger load current 0.2A max
    Battery load current 4.7A max
11. For 24 hour battery backup, the following limits apply
    6 AH battery (P/N 175-084476) – 175mA supervisory current
    10 AH battery (P/N 175-084477) – 250mA supervisory current
    For 60 hour battery backup, the following limits apply
    15 AH battery (P/N 175-387194) – 230mA supervisory current
    For all four categories the audible alarm current is 3A max.
12. Refer to **OPERATION, INSTALLATION, AND MAINTENANCE Manual**, P/N 315-087711, and **Operating Instructions**, P/N 315-087712 for additional information.

*Suitable for outdoor use when used with Catalog No. WBK-2 backbox

COMPATIBLE DETECTORS

Detector Compatibility Identifier	Base Compatibility Identifier	Installation/Wiring Instructions
DI-1A	–	P/N 315-045796B
DI-3/3H	DB-3	P/N 315-081943M
*DI-4A/H	DB-4	P/N 315-085257H
DI-6	DB-4	P/N 315-085257H
DI-A3/A3H	DB-3	P/N 315-081943M
DI-B3/B3H	AD-3I/3P	P/N 315-086590C
	AD-3RI/3RP	P/N 315-086591C
	SA-3I/3P	P/N 315-086593A
PE-3000/3000T	DB-3	P/N 315-086441C
PEC-3/3T	DB-3	P/N 315-086545G

*DI-4A not compatible with 405A

CP-400, ZNE-404, ZNE-404/S, and 405A are the compatibility identifiers

OPTIONAL AUXILIARY MODULES AVAILABLE

Model	Description	Installation/Operating Instructions
Model 301A	Unsupervised remote system annunciator	P/N 315-075233C
Model 405A	Class A zone adapter for eight zones and two audible loops	P/N 315-087051C
Model 405B	Alarm relay output module for eight zones	P/N 315-087038A
Model 405R	Relay control output module	P/N 315-087497B
Model AND-400	Supervised remote annunciator driver	P/N 315-087899A
Model LT-4	Leased line and municipal tie module	P/N 315-087834B
Model RC-400	Alarm verification module	P/N 315-087863A
Model ZNE-404	Four zone extender board	P/N 315-087107B
Model ZNE-404/S	Four zone extender board with supervisory service capability	P/N 315-087900B

Pyrotronics A Division of CERBERUS Technologies, Inc.
8 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

5/89
15M
IG

Printed in U.S.A.

May 1989
Supersedes sheet dated 4/88
Replaces Catalog Number 3063

Pyrotronics

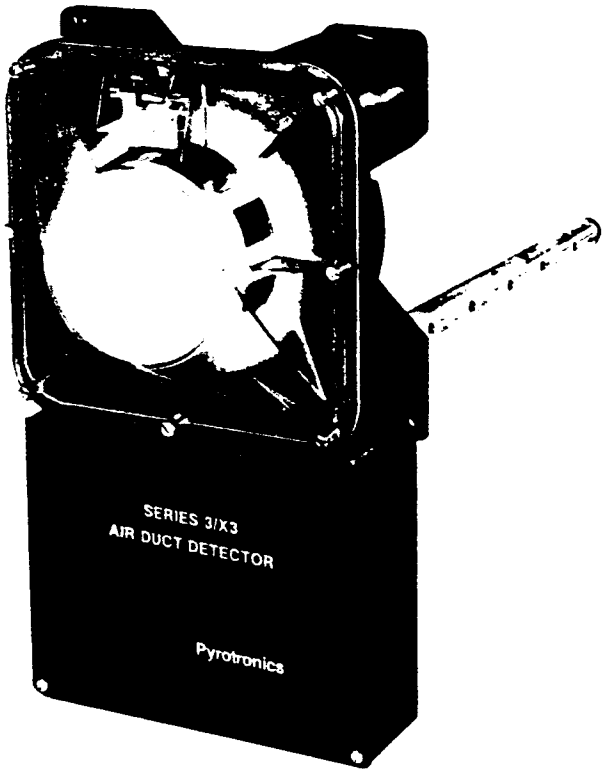
Automatic Fire Detectors

Air Duct Detector

ENGINEER AND ARCHITECT SPECIFICATIONS

SERIES 3/X3

- Plug-in Series 3 and X3 Ionization or Photoelectric Detectors
- Optional Relays for Supplementary Equipment Operation
- Optional Control Module for Self-contained Operation (Series 3 Detectors Only)
- Alarm LED Visible from front
- Clear Housing Cover for Quick Identification of Detector Type
- UL listed



Introduction

The Pyrotronics Series 3/X3 Air Duct Detector Housings are designed to be used with Pyrotronics Series 3 and Series X3 ionization or photoelectric detectors. Designed for installation directly to heating, ventilating, and air conditioning duct systems, they comply with National Fire Protection Association Standard No. 90A. When equipped with ionization or photoelectric detectors, these units will signal the presence of hazardous quantities of products of combustion or smoke being carried through the duct system. Air duct detectors are not intended to be substituted for open area detection.

The Series 3/X3 Air Duct Housings can be equipped with optional relays. These relays are utilized to operate any supplementary equipment when smoke or particles of combustion are detected.

Note: Most control equipment including System 3 guarantees only one detector to alarm per zone. Therefore only one detector per zone is permitted when the detector operated relay function is critical. The connection of a remote lamp or a remote relay per detector is allowed, but not both.

The XL3 control panel assures operation of all detector operated relays, therefore up to 30 detectors per circuit having relays for critical functions may be used. The connection of a remote lamp or a remote relay is allowed for each detector but not both.

The Series 3/X3 Air Duct Housings (see Ordering Information) are Underwriters Laboratories, Inc. listed.

Description

The Pyrotronics Series 3/X3 Air Duct Housing is uniquely designed to use the highly sensitive yet stable Series 3 and Series X3 ionization detectors; Models DI-B3, DI-B3H, DI-BX3 and DI-BX3H or photoelectric detectors; Models PEC-3 and PEX-3000.

The sensitivity of Series 3 detectors can be checked in place under actual dynamic air flow conditions using a Pyrotronics Sensitivity Test Module. The sensitivity of Series X3 detectors can be checked in place under actual dynamic conditions at the XL-3 control panel or may be printed by command on the optional printer.

The detector unit employs a cross-sectional sampling principle of operation. Inlet sampling tubes are available in four lengths (see table below). Outlet sampling tubes are of one common length. A continuous cross-sectional sample of air moving through the duct is taken. This averages the effects of linear flow, stratification or skin effect phenomena occuring in the duct that could prevent combustion products or smoke (especially in large ducts) from reaching a spot type detector.

In addition, the unique design of the Pyrotronics sampling chamber insures uniform sensitivity in air velocities, ranging from a low of 500 feet per minute to as high as 4000 feet per minute.

The inlet sampling tube length is determined by the width of the air duct being protected. The inlet tube nearest to but greater than the duct width should be used (see table). The inlet tube can then be trimmed at the job site to the exact width of the duct. The outlet sampling tube for all ducts, irrespective of width, has a fixed length of approximately 3 inches (7.5 cm) and is supplied with the duct housing.

Sampling Tube Selection Table

Duct Width	Sampling Tube Model No.
9" to 1'9" (21 cm to 51 cm)	STA-2
1'9" to 3'3" (51 cm to 97.5 cm)	STA-3
3'3" to 6'3" (97.5 cm to 187.5 cm)	STA-6
6'3" to 9'9" (187.5 cm to 292.5 cm)	STA-10
Greater than 9'9" (292.5 cm)	Consult Pyrotronics

Maintenance of the detector is easily accomplished by the removal of the Series 3/X3 Duct Housing sampling chamber cover. The detector, which plugs into the housing, is easily removed for cleaning by a trained technician.

All that is necessary for the installation of the air duct detector is the cutting of three small holes for the sampling tube installation (template included) and the drilling of four holes for mounting the air duct housing. The unit is then easily mounted in place and connections made to the existing wires or terminals if optional accessories are utilized.

Architect's Engineers Specifications

The Air Duct Housing for the fire detection system shall be a Pyrotronics Series 3/X3 air duct housing.

The Air Duct Housing shall incorporate the use of one of the following detectors.

Series 3 Ionization	Model DI-B3
Series 3 Ionization (High Altitude 3000-8000 ft.)	Model DI-B3H
Series 3 Photoelectric	Model PEC-3
Series X3 Ionization	Model DI-BX3
Series X3 Ionization (High Altitude 3000-8000 ft.)	Model DI-BX3H
Series X3 Photoelectric	Model PEX-3000

The Air Duct Housing unit shall be designed for detection of combustion products and/or smoke in air conditioning and ventilation system ducts in compliance with National Fire Protection Association Standard 90A. The assembly shall consist of a housing to accommodate sampling tubes which extend into and across the duct of the ventilation system.

While the fans are operating, a continuous cross-sectional sampling of air from the duct shall flow through the selected ionization or photoelectric detector, after which the sampled air shall be returned to the duct.

Air handling equipment shall be shut down by a signal from the fire detection system control equipment. When the air duct housing incorporates the optional relay, the shut down of air handling devices may be accomplished by a signal directly from the detector.

The Air Duct Housing shall be available with a self-contained power supply so that it can function as a stand-alone unit if desired. The self-contained stand-alone unit will power and supervise two satellite units.

The Air Duct Housing shall utilize a plug-in detector head located in the air sampling chamber. The detector shall be either ionization or photoelectric. There shall be provisions to check the detector sensitivity in place under actual air flow conditions.

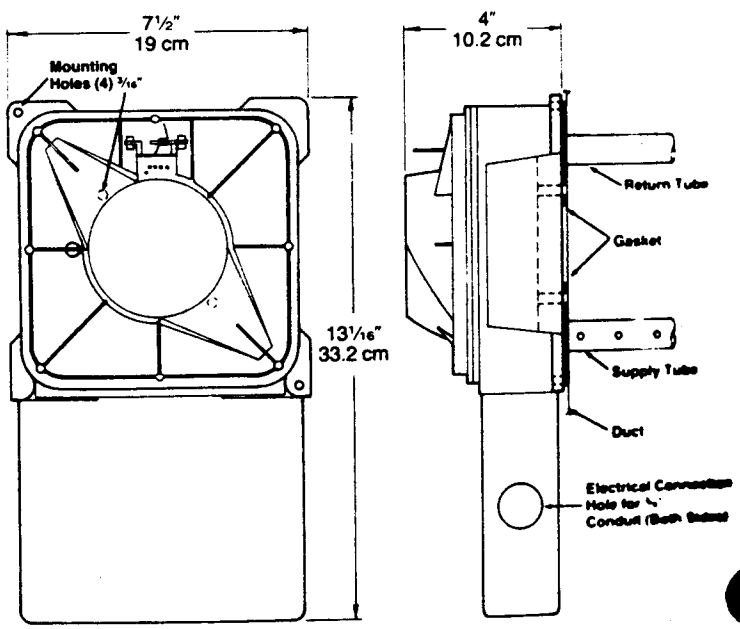
The Air Duct Housing shall be mounted directly outside of the air duct by means of four bolts (supplied). A template shall be provided for making necessary cut-outs and holes. Complete instructions shall be supplied with the unit.

The Air Duct Housing shall be a Pyrotronics Model _____ (see listing on back page) and shall be Underwriter Laboratories, Inc. listed, specifically for use in air handling systems.

Note to Architect: When building codes regulate the location of detectors within ventilating systems, make sure that the number and locations of detectors is in accordance with the code regulations.

Air Duct Detector – Series 3/X3

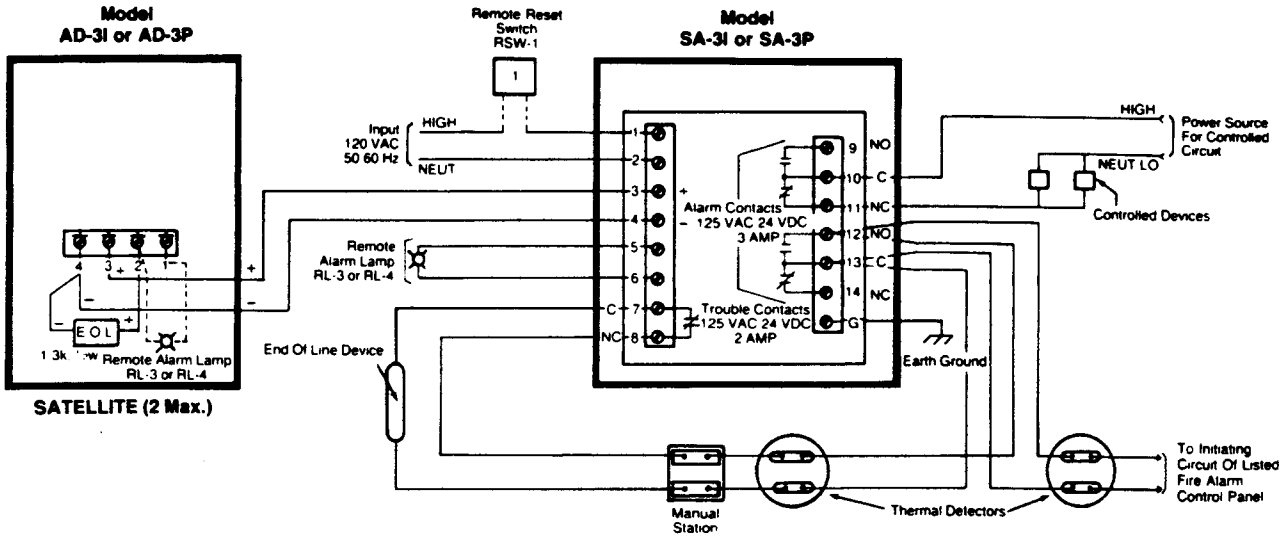
Dimensions:



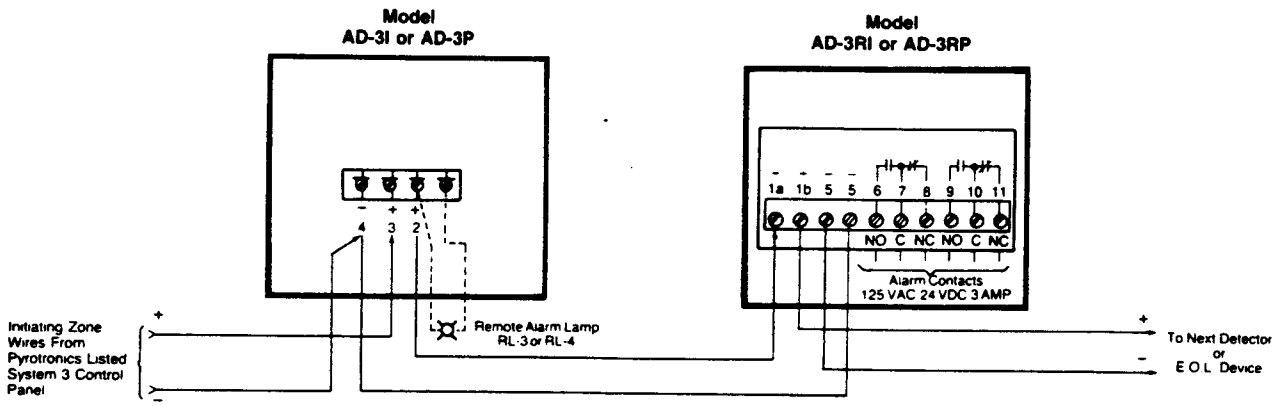
AIR DUCT DETECTOR – SERIES 3/X3

Typical Wiring:

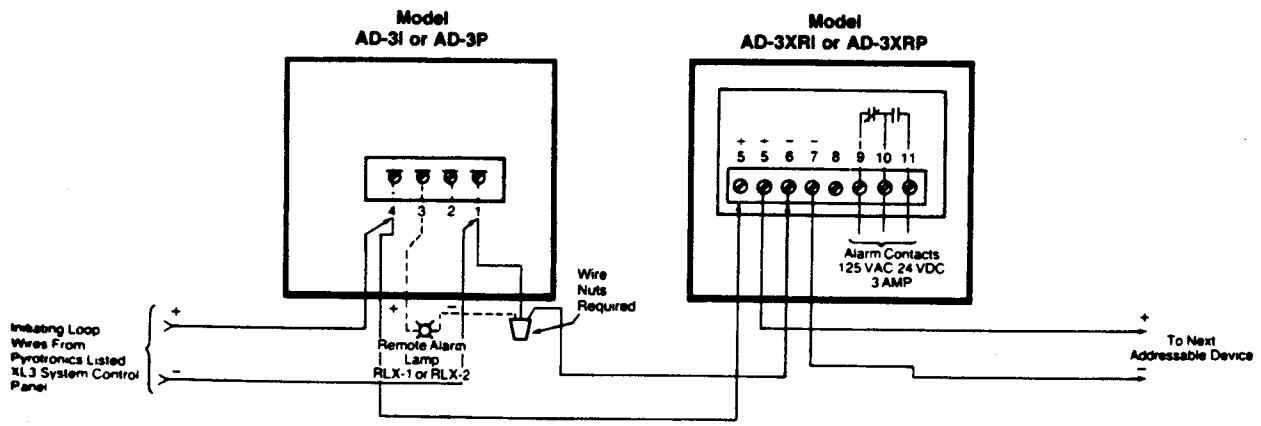
Typical Wiring For Self-Contained Unit and Satellite



Typical Wiring For System 3 Dependent Unit



Typical Wiring For XL3 System Dependent Unit



Ordering Information

Model No.	Description	Shipping Weight Lbs.	Kg.
AD-3I	Series 3/X3 air duct housing with cover for the Series 3 and Series X3 Ionization Detectors	5	2.25
AD-3P	Series 3/X3 air duct housing with cover for the Series 3 and Series X3 Photoelectric Detectors	5	2.25
AD-3RI	Series 3/X3 air duct housing with Series 3 remote relay and with cover for Series 3 Ionization Detectors	6	2.7
AD-3RP	Series 3/X3 air duct housing with Series 3 remote relay and with cover for Series 3 Photoelectric Detectors	6	2.7
AD-3XRI	Series 3/X3 air duct housing with Series X3 remote relay and with cover for Series X3 Ionization Detectors	6	2.7
AD-3XRP	Series 3/X3 air duct housing with Series X3 remote relay and with cover for Series X3 Photoelectric Detectors	6	2.7
SA-3I	Series 3 air duct housing with power supply for self-contained unit operation and with cover for Series 3 Ionization Detectors	7	3.15
SA-3P	Series 3 air duct housing with power supply for self-contained unit operation and with cover for Series 3 Photoelectric Detectors	7	3.15
STA-2	Sampling Tube, for ducts 9" to 1'9"	1	.45
STA-3	Sampling Tube, for ducts 1'9" to 3'3"	2	.9
STA-6	Sampling Tube, for ducts 3'3" to 6'3"	4	1.8
STA-10	Sampling Tube, for ducts 6'3" to 9'9" Sampling Tubes greater 9'9" consult Pyrotronics	6	3.7
RSW-1	Reset Switch	1	.45
DI-B3	Series 3 Ionization Detector	1	.45
DI-B3H	Series 3 Ionization Detector (for altitudes of 3000-8000 ft.)	1	.45
DI-BX3	Series X3 Ionization Detector	1	.45
DI-BX3H	Series X3 Ionization Detector (for altitudes of 3000-8000 ft.)	1	.45
PEC-3	Series 3 Photoelectric Detector	1	.45
PEX-3000	Series X3 Photoelectric Detector.	1	.45
TM-I3*	Sensitivity Test Module for Series 3 Ionization Detector	1	.45
TM-P3*	Sensitivity Test Module for Series 3 Photoelectric Detector	1	.45
TMC	Sensitivity Test Module Cable Assembly	1	.45

*Required for Models TM-I3 and TM-P3.

Note: Minimum hardware required is one Air Duct Housing Assembly, one Sampling Tube and one Detector.

NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

CERBERUS PYROTRONICS

Cerberus Pyrotronics
8 Ridgedale Avenue
Cedar Knolls, New Jersey 07927

11/89
10M
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Printed in U.S.A.

August 1987
Supersedes sheet dated 4/86

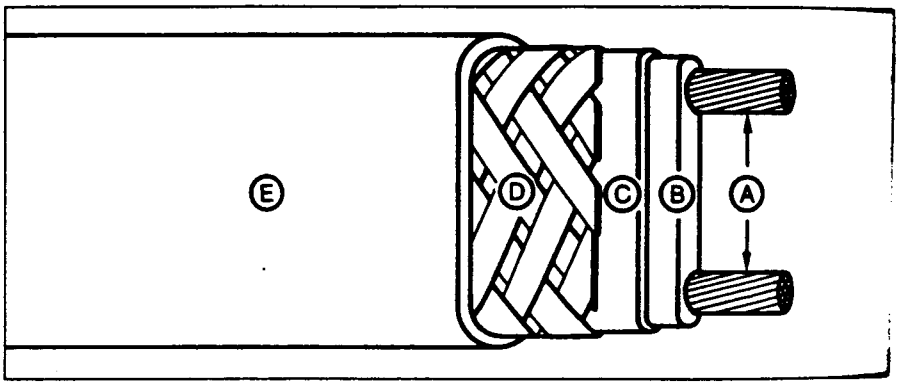
Self-regulating Rapid-Trace™ heating cable/low temperature

3, 5, 8 & 10 W/ft.

120 and 240V

150°F (65°C) max. maintenance temperature

Type SRL



Applications

SRL self-regulating heating cable provides safe, reliable heat tracing for freeze protection of pipes, valves, tanks and similar applications. The 150°F (65°C) maximum pipe maintenance temperature rating is also suitable for certain process applications. Chromalox SRL can be used in hazardous as well as certain corrosive areas.

Approvals

Consult individual Product Data Sheets or Bulletin PJ709 for Third Party Approval or listing information.

Construction

Standard

A. Buss wires. Twin 16 AWG copper buss wires provide good current capability.

B. Matrix. A semiconductive polymer core whose electrical resistance varies with temperature. When process temperature drops, the core's heat output increases; conversely, as process temperature rises, heat output decreases.

C. Jacket. This flame retardant insulation jacket is a thermoplastic rubber material with excellent water resistance. It also resists certain mildly corrosive chemicals.

Optional

D. Tinned-Copper Braid ("-C"). An optional braid covering the jacket which is primarily used where mechanical protection or a positive ground path is required, such as hazardous (classified) areas. Add suffix C to catalog number.

E. Overcoat over-braid ("-CR" and "-CT"). TPR ("-C") or fluoropolymer ("-CT") jacket over the braid. The TPR coating is for certain aqueous and mildly corrosive solutions. The fluoropolymer coating is used for exposure to most other corrosive materials. Add suffix CR or CT to the catalog number.

Features

☐ Overlap Chromalox SRL without fear of burnout.

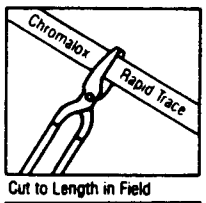
☐ Saves energy. Because self-regulating SRL will throttle itself back as it senses increasing temperatures.

☐ Cut SRL to any desired length (up to the maximum circuit length). Field splices can be performed easily in minutes. No scrap, no wasted cold sections, no worry!

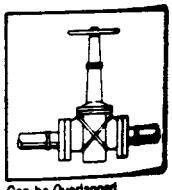
☐ Surpasses steam tracing by far! Lower installed cost than steam. Less maintenance, expense and down time.

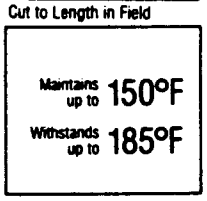
☐ Self-regulating effect makes an over-temperature condition virtually impossible.

☐ Lower installation costs due to easier, faster installation. Chromalox termination kits, splice and tee kits expedite installation.

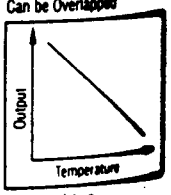


Cut to Length in Field


Can be Overlapped



Low Temperature



Self-Regulating

Output at Rated Voltage at 50°F		Std. Construction				W/C tinned copper braid				W/CR overcoat				W/CT overcoat			
Watts/ ft.	Volts	Catalog No.	Status	PCN	Wt. lbs. /1000'	Catalog No.	Status	PCN	Wt. lbs. /1000'	Catalog No.	Status	PCN	Wt. lbs. /1000'	Catalog No.	Status	PCN	Wt. lbs. /1000'
3	120	SRL 3-1	$	382619	35	SRL 3-1C	$	382678	53	SRL 3-1CR	$	382731	64	SRL 3-1CT	$	383400	66
3	240	SRL 3-2	$	382627	35	SRL 3-2C	$	382686	53	SRL 3-2CR	$	382740	64	SRL 3-2CT	$	383419	66
5	120	SRL 5-1	$	382635	35	SRL 5-1C	$	382694	53	SRL 5-1CR	$	382758	64	SRL 5-1CT	$	383443	66
5	240	SRL 5-2	$	382643	35	SRL 5-2C	$	382707	53	SRL 5-2CR	$	382766	64	SRL 5-2CT	$	383451	66
8	120	SRL 8-1	$	382328	35	SRL 8-1C	$	382555	53	SRL 8-1CR	$	382598	64	SRL 8-1CT	$	383460	66
8	240	SRL 8-2	$	382336	35	SRL 8-2C	$	382563	53	SRL 8-2CR	$	382600	64	SRL 8-2CT	$	383478	66
10	120	SRL 10-1	$	382803	35	SRL 10-1C	$	382820	53	SRL 10-1CR	$	382846	64	SRL 10-1CT	$	383486	66
10	240	SRL 10-2	$	382811	35	SRL 10-2C	$	382838	53	SRL 10-2CR	$	382854	64	SRL 10-2CT	$	383494	66

Status $ means stock item available for immediate shipment.
Specify: Catalog No., PCN, length, installation kit and controls for heating cable.

Catalog nomenclature

SRL	3	— 1 or 2	C	R or T
Self-Regulating Low Temp.	W/ft	1 = 120V 2 = 240V	Braid	Over-coat

General specifications

Maximum pipe maintenance temperature/POWER ON ..... 150°F/65°C
Maximum intermittent exposure temperature/POWER OFF ..... 185°F/85°C
Bus wire gauge ..... 16 AWG
Approximate cable size ..... 3/8" x 1/8"
(CR & CT only) ..... 7/16" x 3/16"

Alternate voltage operation

SRL Rating	Percent Output operated at 208V	220V	277V
SRL 3-2	80%	87%	115%
SRL 5-2	82%	90%	113%
SRL 8-2	86%	91%	112%
SRL 10-2	87%	92%	110%

Maximum circuit lengths

SRL Rating	Max. Circuit Length	SRL Rating	Max. Circuit Length
SRL 3-1	385'	SRL 8-1	210'
SRL 3-2	695'	SRL 8-2	420'
SRL 5-1	295'	SRL 10-1	180'
SRL 5-2	540'	SRL 10-2	360'

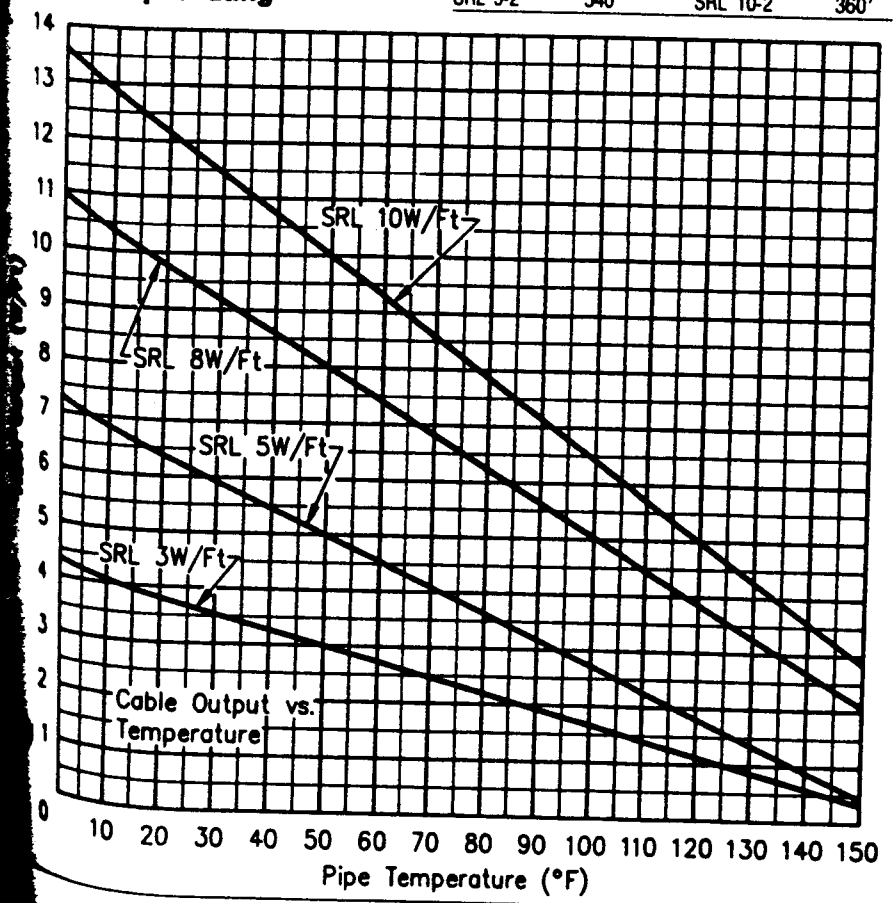
Start-up current (Amps/ft.)

Watts /ft.	Volts	Temperatures °F -20	0	+50
3	120	.06	.05	.04
3	240	.05	.04	.03
5	120	.14	.12	.08
5	240	.09	.08	.05
8	120	.27	.21	.17
8	240	.15	.13	.08
10	120	.31	.25	.21
10	240	.17	.15	.12

Circuit breaker selection. Circuit breakers must have sufficient capacity to allow for the inrush current of initial start-up. To determine the circuit breaker size required, multiply the start-up in amps/ft. times the installed total cable length in feet at the expected start-up temperature (°F).

NOTE: Thermal circuit breakers are recommended since magnetic circuit breakers could "nuisance trip" at low temperature.

Thermal output rating



Division 2 hazardous areas
Chromalox expertise in hazardous area applications provides safe, reliable installations by complying with the rigid standards established by Factory Mutual. Chromalox SRL 3 and SRL 5 heating cables carry a T6 rating. Chromalox SRL8 and SRL10 heating cables carry a T5 rating.

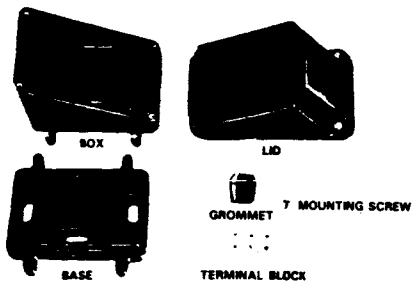
Refer to Chromalox Design Guide for Heat Tracing Products (PJ 304) for detailed information.

Consult factory for assistance.

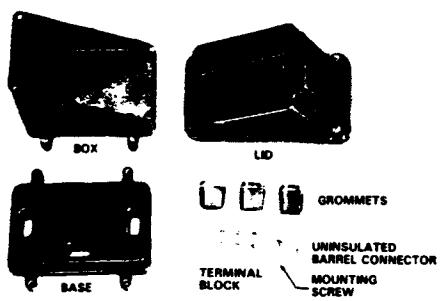
Cable

Rapid-Trace heating cable accessories/Type DL

Installation Kits



Catalog No.	Status	PCN	Wt. lbs.	Description
RTPC-1	S	384016	1	**Power connection kit**
RTPC-2	S	384024	1	1 molded junction box consisting of:
RTPC-3	AS	384032	1	1 base
RTPC-4	AS	384040	1	1 box (with conduit opening)
RTPC-5	AS	384059	1	1 lid
RTPC-6	AS	384067	1	1 three position terminal block[1]
RTPC-7	AS	384075	1	1 mounting screw for terminal block
RTPC-8	AS	384083	1	1 cable grommet[2]
RTPC-1SL	AS	390758	2	**Power connection kit with signal light**
RTPC-2SL	AS	390766	2	Same as above except
RTPC-3SL	AS	390774	2	—1 lid (with signal light installed)
RTPC-4SL	AS	390782	2	
RTPC-5SL	AS	390790	2	
RTPC-6SL	AS	390803	2	
RTPC-7SL	AS	390811	2	
RTPC-8SL	AS	390820	2	



Catalog No.	Status	PCN	Wt. lbs.	Description
RTST-1	S	384155	1	**Splice and tee kit**
RTST-2	AS	384163	1	1 molded junction box consisting of:
RTST-3	AS	384171	1	1 base
RTST-4	AS	384180	1	1 box
RTST-5	AS	384198	1	1 lid
RTST-6	AS	384200	1	1 three position terminal block[1]
RTST-7	AS	384219	1	1 mounting screw for terminal block
RTST-8	AS	384227	1	3 cable grommets[2]
RTST-1SL	AS	385801	2	**Splice and tee kit with signal light**
RTST-2SL	AS	385810	2	Same as above except
RTST-3SL	AS	385828	2	—1 lid (with signal light installed)
RTST-4SL	AS	385836	2	
RTST-5SL	AS	385844	2	
RTST-6SL	AS	385852	2	
RTST-7SL	AS	385860	2	
RTST-8SL	AS	385879	2	

Catalog No.	Status	PCN	Wt. lbs.	Description
RTES-1	S	384294	1	**End seal kit**
RTES-2	S	384307	1	1 end cap
RTES-3	S	384315	1	1 pressure plate
RTES-4	AS	384323	1	1 cable grommet[2]
RTES-5	AS	384331	1	
RTES-6	AS	384340	1	
RTES-7	AS	384358	1	
RTES-8	AS	384366	1	

Notes:
1. Four-position terminal block provid RTPC-6, RTST-5 and RTST-6.
2. Kit suffix number is the same as th number (i.e. An RTPC-3 Kit uses a grommet).

Local controls for heating cables/DL Series

22 Amp, SPDT
120 to 480V
Set point range 0 to 225°F
Ambient sensing
Type RTAS

Temperature Set Point Range: 0 to 225°F (–18 to 107°C)

Switch Rating: 22 AMPS @ 120 to 480V ac, SPDT

Minor Scale Divisions: 10°F (5.6°C)

Max. Sensor Exposure Temperature: 250°F (121°C)

Sensor Dimensions: 9/16 inch (14.3 mm) O.D. x 3 inches (7.6 cm) long

Operating Ambient Temperature Range: –40 to +160°F (–40 to +71°C)

Factory Pre-set and Calibrated for 40°F (4.4°C) Operation

11 Amp, SPDT
120 to 250V
Set point range 0 to 225°F
Ambient sensing
Type RTAS-EP*

Temperature Set Point Range: 0 to 225°F (–18 to 107°C)

Switch Rating: 11 AMPS @ 120 to 250V ac, SPDT

Minor Scale Divisions: 10°F (5.6°C)

Max. Sensor Exposure Temperature: 250°F (121°C)

Sensor Dimensions: 9/16 inch (14.3 mm) O.D. x 3 inches (7.6 cm) long

Operating Ambient Temperature Range: –40 to +160°F (–40 to +71°C)

Factory Pre-set and Calibrated for 40°F (4.4°C) Operation

*For Division 2 hazardous areas.

Exterior View

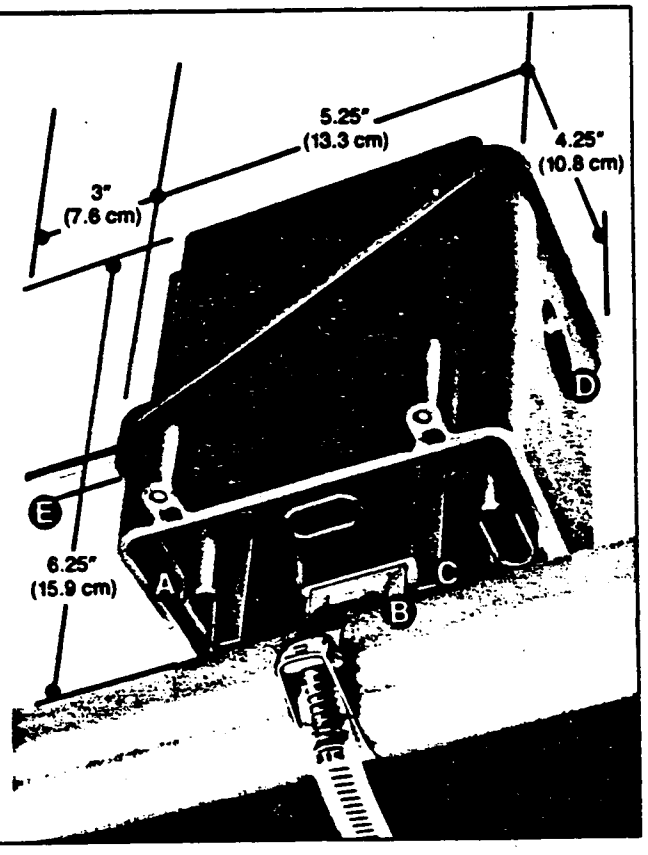
Ⓐ Strategically placed cable entries allow maximum flexibility for installation. (Heating cable cut away for clarity)

Ⓑ Stainless steel tiedown support provides positive attachment to pipes.

Ⓒ Heavy duty support legs give stable mounting and provide conduit clearance for applications with up to three inches of insulation.

Ⓓ Opening for 3/4-inch (20 mm) conduit hub

Ⓔ Stainless steel sheath temperature sensor.



SPDT Switch rating Amps	Volts	Used with	Max. No. of Power Conn.	Catalog No.	Status	PCN	Wt. lbs.
Type RTAS for ordinary (non-hazardous) areas							
22	120 to 480	SRL, SRL-C	2	RTAS-1	$	384438	2
22	120 to 480	SRL-CR, SRL-CT	2	RTAS-2	AS	384446	2
22	120 to 480	CWM, CWM-C	1	RTAS-3	AS	384454	2
22	120 to 480	CWM-CT	1	RTAS-4	AS	384462	2
22	120 to 480	SRL-M, SRL-MC	2	RTAS-5	AS	384470	2
22	120 to 480	SRL-MCR, SRL-MCT	2	RTAS-6	AS	384489	2
22	120 to 480	SRM, SRM-C	2	RTAS-7	AS	384497	2
22	120 to 480	SRM-CT	2	RTAS-8	AS	384500	2
Type RTAS-EP for Division 2 Hazardous areas							
11	120 to 250	SRL, SRL-C	2	RTAS-1EP	AS	384577	2
11	120 to 250	SRL-CR, SRL-CT	2	RTAS-2EP	AS	384585	2
11	120 to 250	CWM, CWM-C	1	RTAS-3EP	AS	384593	2
11	120 to 250	CWM-CT	1	RTAS-4EP	AS	384606	2
11	120 to 250	SRL-M, SRL-MC	2	RTAS-5EP	AS	384614	2
11	120 to 250	SRL-MCR, SRL-MCT	2	RTAS-6EP	AS	384622	2
11	120 to 250	SRM, SRM-C	2	RTAS-7EP	AS	384630	2
11	120 to 250	SRM-CT	2	RTAS-8EP	AS	384649	2