Appendix E – Volume 1 Manufacturers Supplied Equipment Information

Operation, Maintenance and Monitoring Manual

Off-Site Interim Remedial Measure
Former Unisys Facility
Great Neck, New York

NYSDEC Site ID# 130045

March 2006

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

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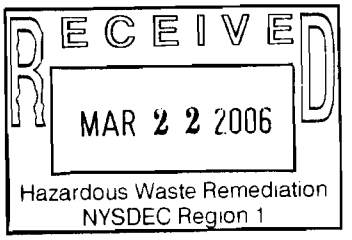

T. Air Stripper Butterfly Shut-Off Valves (V-1, V-2, V-3, V-4, V-5, V-6, V-7, V-8, V-9, V-10, V-11, V-12, V-13, V-14, V-15, V-16, V-17)
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J. Diffusion Well Butterfly Shut-Off Valves (V-712, V-722, V-732)
K. Diffusion Well Flow Regulating Valves (V-715, V-725, V-735)
L. Diffusion Well Pressure Gauges (PI-711, PI-712, PI-713, PI-721, PI-722, PI-723, PI-731, PI-732, PI-733)

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D. Air Stripper Effluent Air Pressure Indicating Transmitter (PIT-313)
E. Air Flow Rate Indicating Transmitters (FE/FIT-313, FE/FIT-641)
F. Air Flow Switch (FSL-642)
G. Duct Heater Discharge Air Temperature Transmitter (TT-502)
H. Duct Heater Discharge Air Temperature Switch (TSH-503)
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J. Air Flow Butterfly Shut-Off Damper and Spool Pieces (V-501, SP-601, SP-602, SP-611, SP-612, SP-621, SP-622, SP-631, SP-632, SP-633, SP-634)
K. Pressure Indicators (PI-502, PI-611, PI-621, PI-631, PI-634, PI-636, PI-643, PI-651)
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C. 350 VA Uninterruptible Power Supplies

D. Surge Protectors
E. Time Delay Relays
F. 2-Pole and 3-Pole Relays
G. 4-Pole Relays
H. 15 Amp Circuit Breaker
I. 2 Amp, 3 Amp, and 5 Amp Circuit Breakers
J. Power Supply
K. Control Panel Pilot Lights and Pushbuttons
L. Small Single Level Terminal Block
M. Large Single Level Terminal Block
N. Single Level Ground Block
O. Dual Level Contact Block
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Q. Single Level Fused Terminal Block
R. Optical Converter
S. Control Panel Annunciator System
T. MicroLogix 1200 Programmable Controllers
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Section 7 Main Control Panel and Recovery Well Remote Control Panel

W. Interface Module
X. Industrial Non-Display Computer
Y. Remote Access Dial-in Ethernet Modem
Z. Ethernet Switch
AA. Auto-Dialer
BB. Recovery Well Process Meter
CC. Fiber Optical Cable Enclosure Panel
DD. 12 Fiber Optical Cable
EE. Fiber Optic Fan Out Kit
FF. Fiber Optic Distribution Patch Panel
GG. Optical Fiber Patch Panel Adapter Kit

Section 1

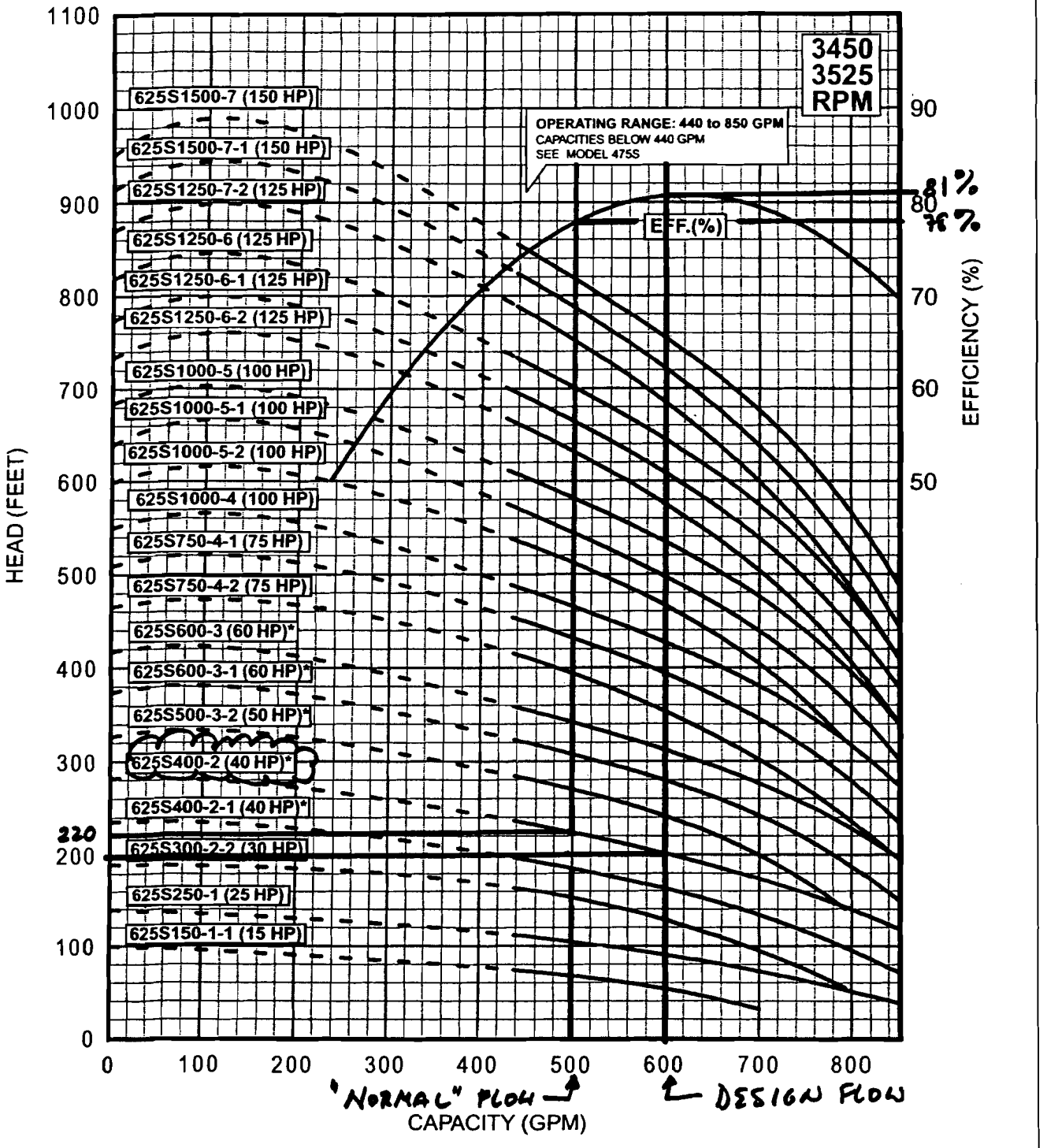
Section 1-A

Pump and Motor (P-101)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Model 625S 625 GPM Performance Curves

FLOW RANGE: 440 - 850 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-150 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 2548 Annex B
@ 10 ft. min. submergence.

GRUNDFOS

Technical Data — 625 GPM — Model 625S

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
625S150-1-1	A	15	6"	6" NPT	49.4	28	21.4	5.7	8.3	190
625S250-1	A	25	6"	6" NPT	54.5	33.1	21.4	5.7	8.3	212
625S300-2-2	A	30	6"	6" NPT	63.2	35.7	27.5	5.7	8.3	236
625S400-2-1*	A	40	6"	6" NPT	68.3	40.8	27.5	5.7	8.3	247
625S400-2*	A	40	6"	6" NPT	68.3	40.8	27.5	5.7	8.3	260
625S500-3-2*	A	50	6"	6" NPT	94.5	57.8	36.7	5.7	8.4	356
625S600-3-1*	A	60	6"	6" NPT	78.5	41.8	36.7	7.5	8.4	387
625S600-3*	A	60	6"	6" NPT	84.1	47.4	36.7	7.5	8.4	387
625S750-4-2	A	75	8"	6" NPT	86.4	47.4	39.0	7.5	8.6	492
625S750-4-1	A	75	8"	6" NPT	86.4	47.4	39.0	7.5	8.6	492
625S1000-4	A	100	8"	6" NPT	93.9	54.9	39.0	7.5	8.6	569
625S1000-5-2	A	100	8"	6" NPT	100.0	54.9	45.1	7.5	8.6	591
625S1000-5-1	A	100	8"	6" NPT	100.0	54.9	45.1	7.5	8.6	591
625S1000-5	A	100	8"	6" NPT	100.0	54.9	45.1	7.5	8.6	591
625S1250-6-2	A	125	8"	6" NPT	121.4	68.8	52.6	7.5	8.6	785
625S1250-6-1	A	125	8"	6" NPT	121.4	68.8	52.6	7.5	8.6	785
625S1250-6	A	125	8"	6" NPT	121.4	68.8	52.6	7.7	8.6	785
625S1250-7-2	A	125	8"	6" NPT	127.6	68.8	58.8	7.7	8.6	789
625S1500-7-1	A	150	8"	6" NPT	136.6	77.8	58.8	7.7	8.6	881
625S1500-7	A	150	8"	6" NPT	136.6	77.8	58.8	7.7	8.6	881

NOTES: All models suitable for use in 8" wells unless otherwise noted.
Weights include pump end with motor in lbs.
*Alternate motor sizes available.

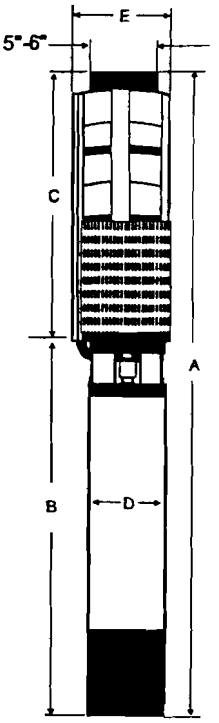
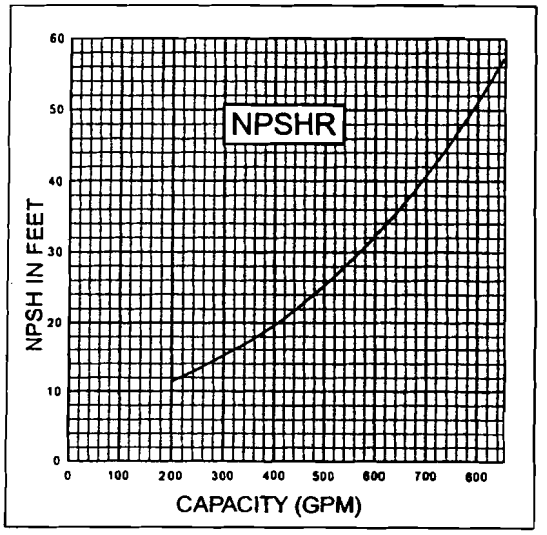


Fig. A

MATERIALS OF CONSTRUCTION

Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	329/416 Stainless Steel
Coupling Key	302/304 Stainless Steel
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/304 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel
Top/Lower Bearing	NBR/316 Stainless Steel
Upthrust Disc	Carbon/Graphite HY22
Check Valve Spring	301 Stainless Steel

NOTES: Specifications are subject to change without notice.



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Phone (800) 333-1366 • FAX (800) 333-1363
Canada: Oakville, Ontario • **Mexico:** Apodaca, N.L.

LSP-TL-1625 Rev.8/96
PRINTED IN USA

RW-100 PUMP: # C25S400-2

GRUNDFOS

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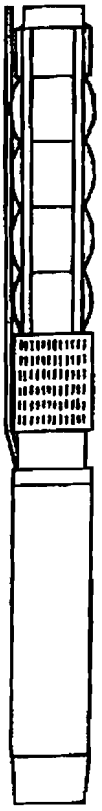


Dismantling & Reassembly

6-8-10" Submersibles

385S · 475S · 625S · 800S · 1100S

Torques

Split Cone Nut, pos. 11
- 385S & 475S ..... 88 ft lbs
- 625S & 800S ..... 134 ft lbs
- 1100S ..... 221 ft lbs

(Reassembly step 9)

Strap Nuts, pos. 19 ..... 88 ft lbs
(Reassembly step 29)

Motor Lead Plug
- 6" motor ..... 60-70 ft lbs
- 8 & 10" motor ..... 120-150 ft lbs

(Reassembly step 36)

Motor Nut, pos. 19a
- M12 nuts ..... 52 ft lbs
- M16 nuts ..... 110 ft lbs

Motor Bolt, pos. 22 (6" motor)
- 385S & 475S ..... 52 ft lbs
- 625S - 1100S ..... 74 ft lbs

Motor Bolt and Nut, Pos. 22
- 385S & 475S ..... 111 ft lbs
- 625S - 1100S (M16 nut) ..... 148 ft lbs
- 1100S (M20 nut) ..... 288 ft lbs

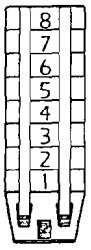
Contents

L-SP-TL-009 (Rev.2/97)

Dismantling Procedures 385S·475S·625S·800S·1100S

In the instructions that follow, the numbers in parenthesis (pos. 7) indicate the position number of that part as it is shown on the Parts List and Kits diagram.

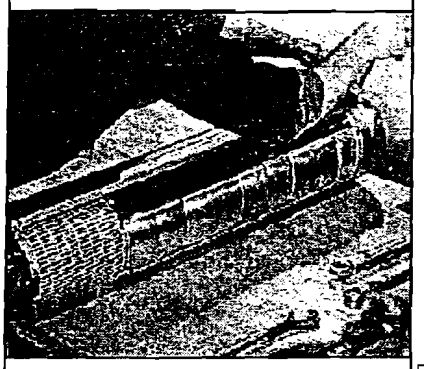
1 Before beginning, it is a good idea to check for proper shaft rotation as well as shaft "end play" (see page 11 in Reassembly instructions). The results may help you explain any unusual component wear later on.



It is also a good idea to mark the order of the chambers of the pump to aid you in reassembly. With some type of marking pen, number the chambers of the pump in order (beginning with chamber #1 just above the Suction Interconnector).

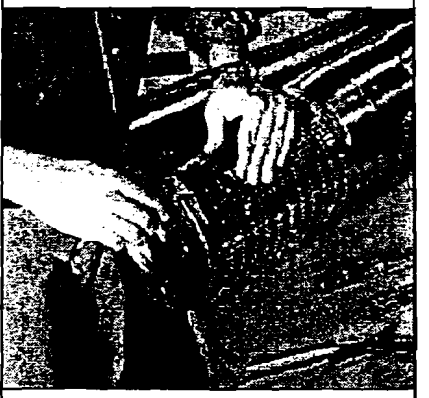
As you dismantle the pump, lay the components out in this order. This will help you identify possible causes of unusual wear, etc. (i.e. if adjacent chambers show the same type of wear, the cause may be something completely different than, say, if chambers 1 and 4 show the same wear.)

2



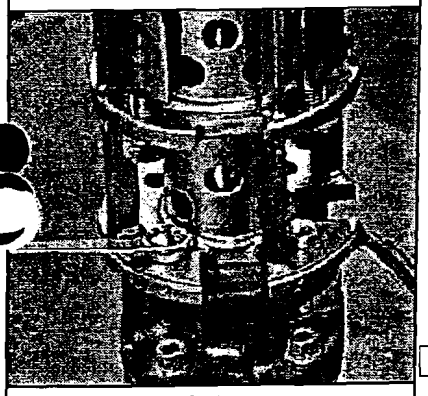
Remove the four screws (pos. 18a) in the Suction Interconnector (pos. 14) and the Discharge Housing (pos. 1). Remove the Cable Guard (pos. 18) and the rubber cable protector (pos. 23).

3



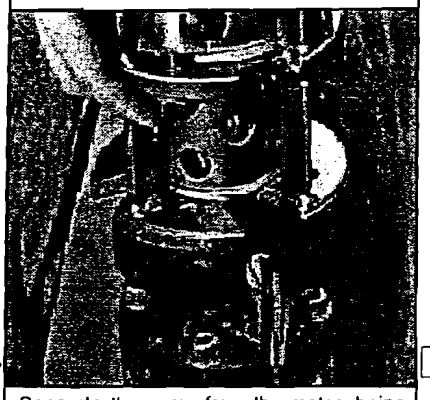
Remove the side clip (pos. 28) holding the Strainer in place (pos. 15). Spread the seam on the Strainer apart and remove it from the Suction Interconnector.

4



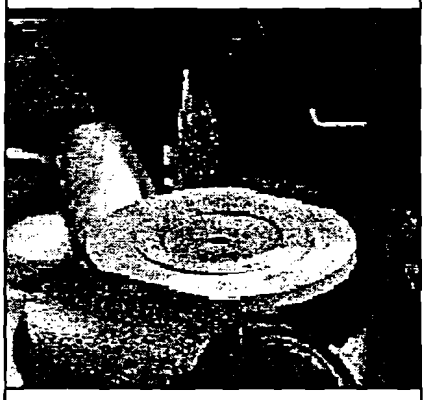
Remove the motor fasteners.

5



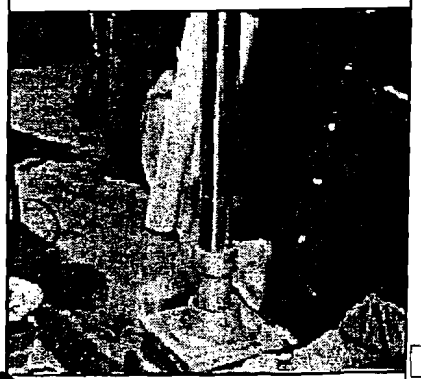
Separate the pump from the motor, being careful not to damage the motor leads.

6



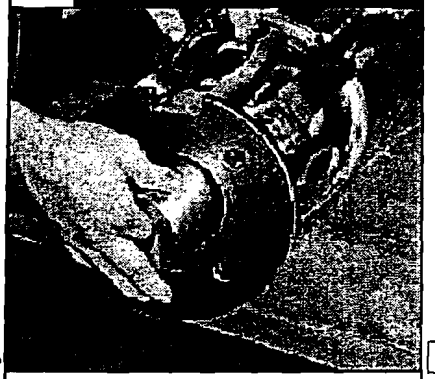
Clamp the appropriate Building Plate into a vise (see "which building plate to use" on next page).

7



Select the appropriate Shaft Spacer and Shaft Holding Bolt and set the Spacer on the Building Plate (see "which Shaft Spacer and Holding Bolt" on next page).

8 **1100S ONLY**



Loosen the allen screw(s) in the Shaft Coupling through the Suction Interconnector with 3 mm allen wrench and remove the Coupling by pulling it off of the Shaft.

9

Place the pump on the Mounting Plate and use an allen wrench to tighten the Shaft Holding Bolt into the bottom of the pump Shaft, through the Spacer.

10 Which building plate to use?

Which shaft spacer and holding bolt to use?

385S through 800S

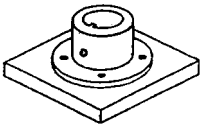
For pumps with 6" motors
Building Plate SV0049

For pumps with 8" motors
Building Plate SV0195

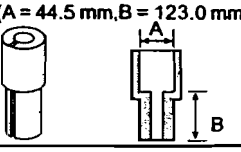
Motor Diameter	Pump Model	# of Stages	Shaft Spacer	Holding Bolt
6"	385S - 800S	All	SV0390 (71 mm)	SV0076 (M10 x 110 mm)
8"	385S - 475S	All	SV00141 (99 mm)	SV0211 (M10 x 140 mm)
	625S - 800S	All	SV0197 (100 mm)	

1100S

For 1100S pumps
Building Plate SV5210

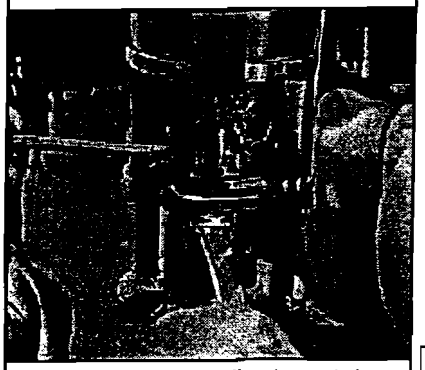


6"	1100S	All	SV5211 (A = 24.5 mm, B = 71 mm)	SV0076 (M10 x 110 mm)
8"	1100S	2 - 3	SV5213 (A = 30.17 mm, B = 98.5 mm)	SV0209 (M10 x 130 mm)
8"	1100S	4 - 5	SV5214 (A = 44.5 mm, B = 98.5 mm)	SV0209 (M10 x 130 mm)
10"	1100S	All	SV5216 (A = 44.5 mm, B = 123.0 mm)	SV5218 (M10 x 160 mm)



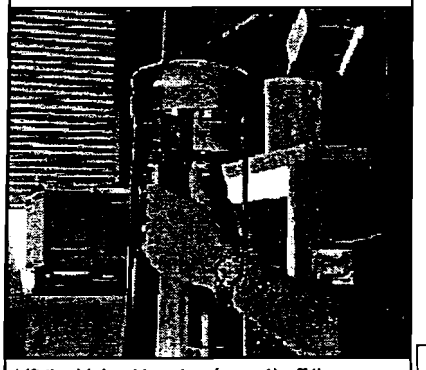
NOTE: For 1100S pumps, align the building plate key with the shaft spacer keyway and then align the shaft spacer key with the pump shaft keyway.

11



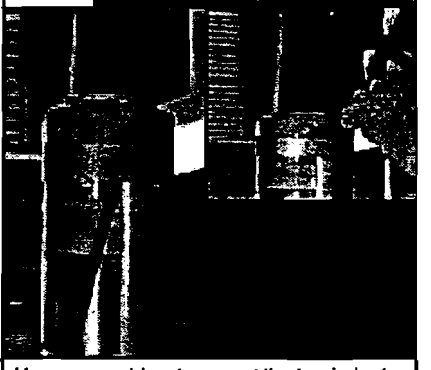
Use a wrench to remove the strap nuts (pos. 19) and washers (pos. 71). You may need to insert a screwdriver under the strap (where the threaded stud is welded) to keep the strap from twisting as the nuts are removed.

12



Lift the Valve Housing (pos. 1) off the pump. If it sticks, you may need to tap it on its side with a rubber hammer. A second person may be needed for this step to spread the straps as the housing is being removed.

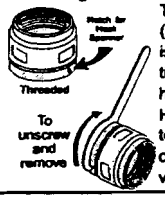
13 If it becomes necessary to remove the straps.



Use a screwdriver to pry out the two indentations in the Strap Retaining Ring (pos. 69). Use a drift or the Punch Driver (SV.0207) and a hammer to partially drive down the Strap Retaining Ring.

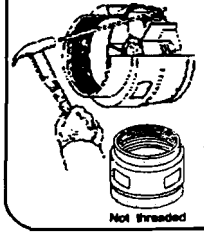
14 All 385S, 475S and 800S or 625S up to 5 Stages Proceed to step 15

6 - 7 Stage 625S and 4 - 6 Stage 1100S



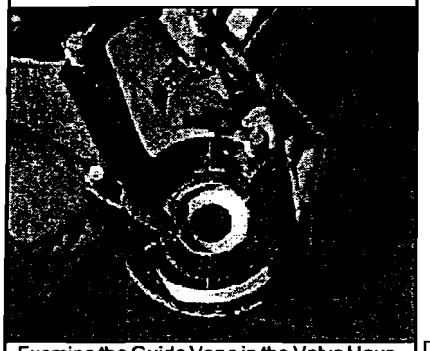
The valve seat retainer (pos. 3a) for these pumps is threaded and screwed tightly into the valve housing (pos. 1). Use the Hook Spanner (SV.5225) to loosen the retainer counterclockwise from the valve housing.

1 - 3 Stage 1100S



The valve seat retainer (pos. 3a) for these pumps is not threaded. Remove it from inside the valve housing (pos. 1) using a hammer and a punch.

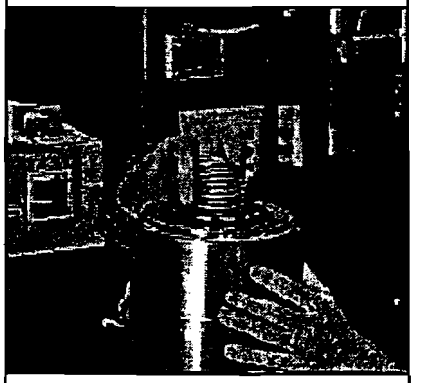
15



Examine the Guide Vane in the Valve Housing. If it is damaged, remove it with the Guide Vane Punch or the butt of a rubber hammer.

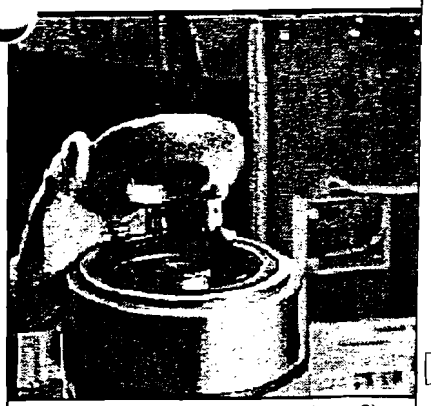
385S & 475S ..... use punch SV.0202
625S & 800S ..... use punch SV.0208
1100S ..... no punch available

16



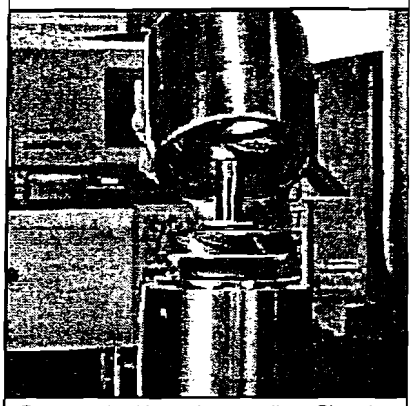
Remove the Check Valve Spring (pos. 39).

17



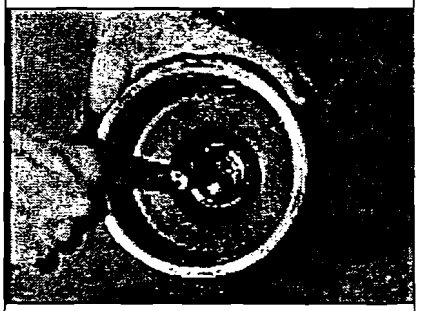
Remove the Check Valve Cone (pos. 2).

18



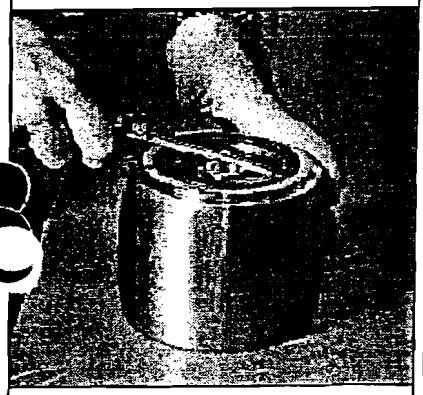
Remove the Upper Intermediate Chamber (pos. 4). Once again, a good hit with a hammer may be needed to break it loose from the adjoining Intermediate Chamber.

19



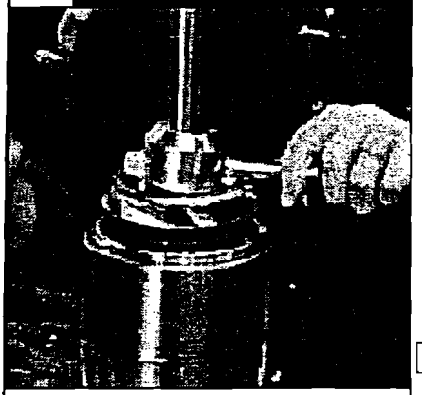
The Upper Bearing (pos. 6) is made of hard rubber and encased in a stainless steel shell. It has a hexagon shape for maximum water lubrication. If it appears worn or damaged, use a screwdriver to remove it from the Upper Intermediate Chamber. The casing may have to be removed using a drill or lathe with a boring tool.

20



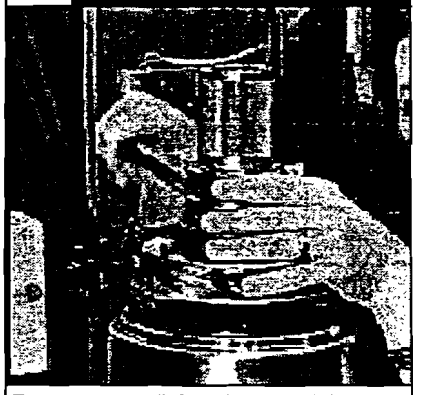
If the Check Valve Seat appears worn or damaged, use a screwdriver to pry it up and remove it.

21 **385S & 475S**



To loosen the Split Cone Nut (pos. 11) use the Split Cone Nut Wrench and Driver SV0285

22 **625S, 800S & 1100S**

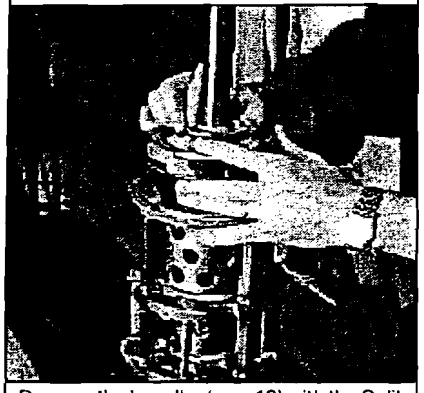


To loosen the Split Cone Nut (pos. 11) use the appropriate Socket Spanner along with torque wrench SV0500 and Tap for Split Cone Nut Wrench SV0402.

23

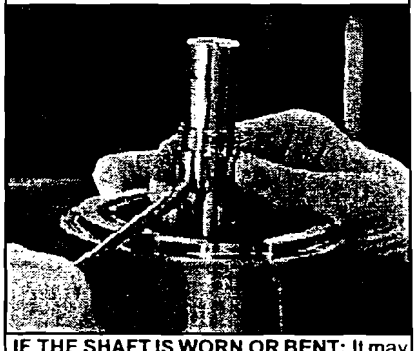
To loosen the Split Cone and Nut even further, use a rubber hammer and for **385S & 475S** turn the Split Cone Nut Wrench over and tap it down as shown. For **625S, 800S and 1100S** strike the Socket Spanner with the Split Cone Driver as shown.

24



Remove the Impeller (pos. 13) with the Split Cone and Nut. It may help to push down on the nut with thumbs while pulling up on Impeller.

25

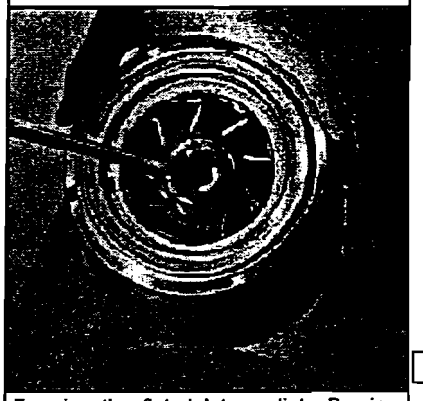


IF THE SHAFT IS WORN OR BENT: It may prevent the easy removal of the Split Cone. In these cases, you can remove the Split Cone Nut and Impeller first, then wedge a screwdriver into the slot of the Split Cone and pry it open while removing it from the Shaft.

26

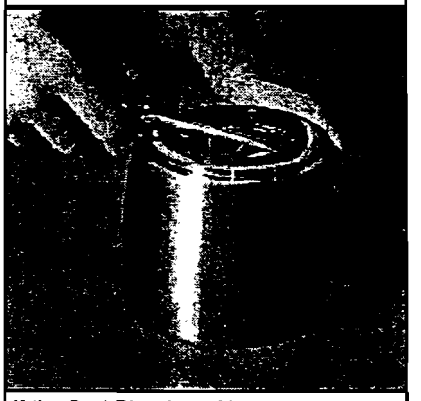
Remove the Intermediate Chamber (pos. 9).

27



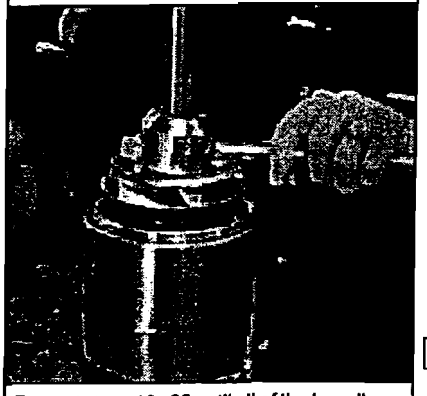
Examine the fluted Intermediate Bearing (pos.8) in the Intermediate Chamber. If necessary, push it out of the Intermediate Chamber with a screwdriver.

28



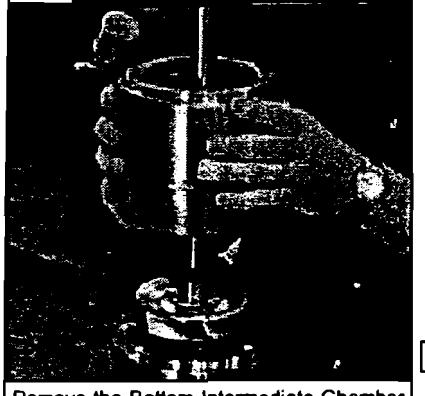
If the Seal Ring (pos. 7) appears worn or damaged, use a screwdriver to pry it up and remove it.

29



Repeat steps 19 - 25 until all of the Impellers, Split Cones and Nuts, and Intermediate Chambers have been removed from the pump. **Except 385S & 475S (see steps 30-32)**

30 385S & 475S

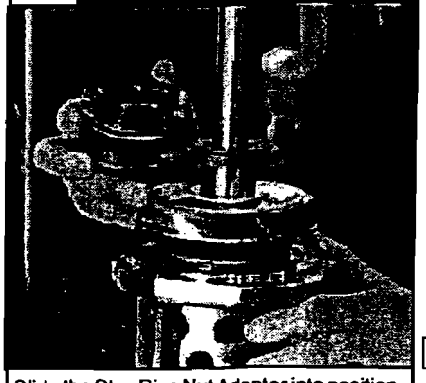


Remove the Bottom Intermediate Chamber with Stop Ring .

31 385S & 475S

Remove the Stop Ring Washer by sliding it off of the Shaft.

32 385S & 475S



Slide the Stop Ring Nut Adapter into position, loosen and remove the bottom Impeller in the same manner as the others, using the top of the adapter as the Split Cone Nut.

33

Remove the Suction Interconnector (pos. 14) and the Shaft or Shaft and Coupling from the Building Plate. Examine them for defects or wear.

34

If the seal ring (pos. 7) appears worn or damaged, use a screwdriver to pry it up and remove it. **THE PUMP IS NOW COMPLETELY DISASSEMBLED.**

When Should A Part Be Replaced ?

Part	Position(s)	Minimum Operating Condition
Discharge Chamber	1	Should be clean to ensure proper seating to other machined seating areas. The threads should be clean with no major blemishes. If the Check Valve and Seat are welded into the Discharge Chamber, check to see if it is bent or worn. Replace as necessary.
Check Valve	2	Should be free of pitted areas and fit to the valve seat.
Check Valve Seat	3	Should be free of any nicks that would prevent proper seating of the check valve.
Upper Intermediate Chamber	4	Should be free of pitted areas. Bearing (pos.6) should show little wear. The guide vanes should show no wear (from possible rubbing against the impellers) and the guide vane welds and tabs should all be intact.
Upper and Lower Bearing	6/6b	Should show no wear, blistering (from running the pump dry), or swelling (a typical reaction to chemicals).
Stop Disc	5	Should be thicker than 4mm, free of cracks and not severely damaged by sand or dry running.
Seal Ring	7	Should show no wear, blistering (from running the pump dry), or swelling (a typical reaction to chemicals).
Intermediate Chamber Bearing	8	Same as for Seal Ring (pos. 7) above.
Stop Ring Washer	8a	Should have raised surfaces, be thicker than 4mm, free of cracks and not severely damaged by sand or dry running.
Split Cones ,Nuts and Stop Ring Nut	11/12 11c	Should be replaced with each reassembly, since it is rare when used cones and nuts can be tightened well enough to keep the impeller from spinning on the shaft.
Impeller	13	The eyelet area around the wear ring (pos. 72) should show only minor wear. If deeply worn, either the wear ring or the entire impeller should be replaced. There should be no contact wear patterns from the intermediate chambers, which might indicate upthrust condition.
Intermediate Chambers	9/10	There should be no contact wear patterns from wear on the impellers. Should be free of pitted areas. The guide vanes should show no wear (from possible rubbing against the impellers) and the guide vane welds and tabs should all be intact.
Suction Interconnector	14	Should show no pitting, breaks, or buckling.
Strainer	15	Should not be bent or show wear on edges.
Shaft	16	Should show light visible wear at upper shaft where upper bearing surfaces rotate on shaft.
Strap	17	Should not be pitted or bent; threads on studs should be clean and show no galling.
Cable Guard and Clips	18	Should show no pitting, broken welds on tabs, or arched burn holes caused from cut motor leads.
Nut	19	Threads should be clean and show no galling.
Coupling	24	Should show no pitting, breaks, or buckling.
Check Valve Spring	39	Measure length to be sure it has not been compressed to the point that it is useless (part dimensions are shown in the Parts List).
Strap Ring	69	Should show no pitting, breaks, or buckling.
Check Valve Guide	70	Should show no pitting, breaks, or buckling.
Impeller Wear Ring	72	See position 13 Impeller

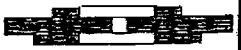
Refer to the Parts List section for a complete list of part numbers.

Reassembly Procedures 385S·475S·625S·800S·1100S

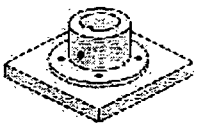
In the instructions that follow, the numbers in parenthesis (pos. 7) indicate the position number of that part as it is shown on the Parts List and Kits diagram.

1 Which building plate to use? / Which shaft spacer and holding bolt to use?

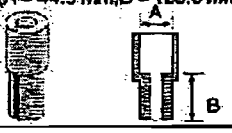
385S through 800S

	Motor Diameter	Pump Model	# of Stages	Shaft Spacer	Holding Bolt
For pumps with 6" motors Building Plate SV0049 	6"	385S - 800S	All	SV0390 (71 mm)	SV0076 (M10 x 110 mm)
For pumps with 8" motors Building Plate SV0195 	8"	385S - 475S 625S - 800S	All All	SV00141 (99 mm) SV0197 (100 mm)	SV0211 (M10 x 140 mm)

1100S

For 1100S pumps Building Plate SV5210 	6"	1100S	All	SV5211 (A = 24.5 mm, B = 71 mm)	SV0076 (M10 x 110 mm)
	8"	1100S	2 - 3	SV5213 (A = 30.17 mm, B = 98.5 mm)	SV0209 (M10 x 130 mm)
	8"	1100S	4 - 5	SV5214 (A = 44.5 mm, B = 90.5 mm)	SV0209 (M10 x 130 mm)
	10"	1100S	All	SV5216 (A = 44.5 mm, B = 123.0 mm)	SV0218 (M10 x 160 mm)

NOTE: For 1100S pumps, align the building plate key with the shaft spacer keyway and then align the shaft spacer key with the pump shaft keyway.



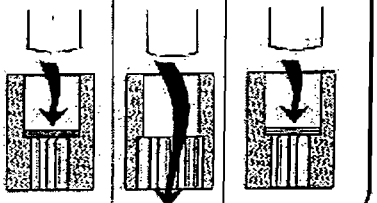
2

Check to make sure the motor coupling (pos. 24) and key (pos. 16) slide easily onto the pump shaft if it was removed.

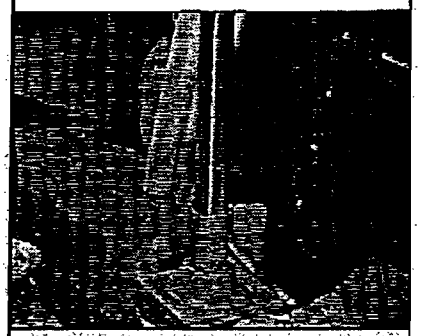
For 6" coupling: The pump shaft should bottom out on the disc inside the coupling.

For 8" coupling: The shaft should not bottom out.

For 1100S400-1: The pump shaft should bottom out on the disc inside the coupling.

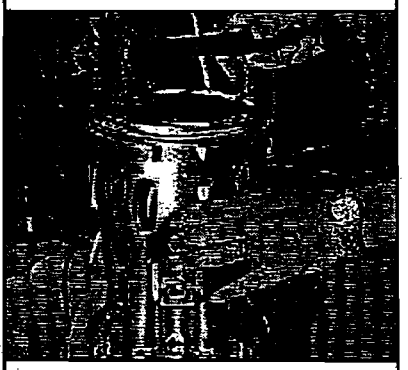


3



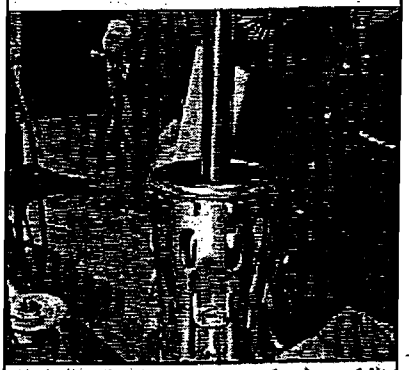
Fit the Shaft (pos. 16) and Coupling (pos.24) (except 1100S shaft only) to the Mounting Plate using the Shaft Spacer and Shaft Holding Bolt. Make sure the Shaft is clean and free of oil.

4



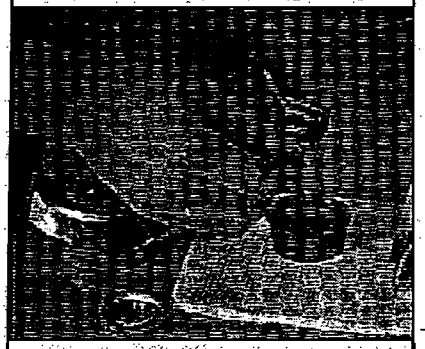
Use a rubber hammer to tap the Seal Ring (pos. 7) into the Suction Interconnector (pos. 14).

5



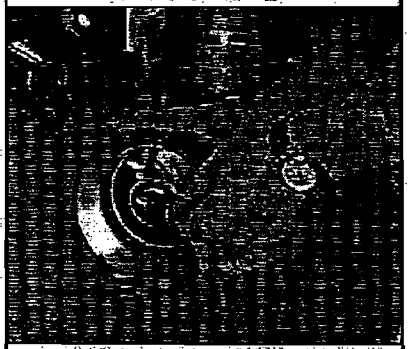
Slide the Suction Interconnector (pos. 14) down over the Shaft and center it on the Building Plate.

6



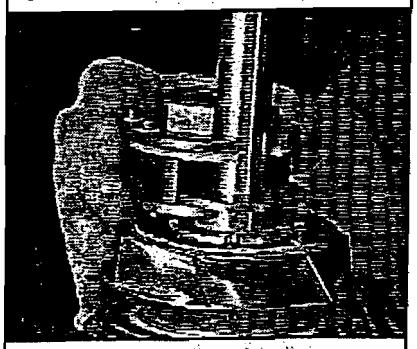
To prepare the Split Cones (pos. 12) for assembly, apply BondorLube (V.7020910) or equivalent to the cones. BondorLube 403/3 is a non-toxic anti-galling lubricant REQUIRED for stainless steel split cones.

7



Insert the threaded end of the Split Cone (pos. 12) up through the bottom of the Impeller (pos. 13). Screw the Split Cone Nut (pos. 11) or the Stop Ring Nut (pos.11c) two or three turns on the Split Cone.

8 385S and 475S only

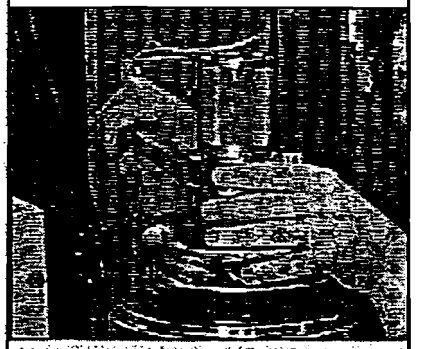


Follow the instructions in step 9 and 10, except for 385S and 475S, use the Stop Ring Nut in place of the Split Cone Nut. Also use the stop ring nut adapter with the Split Cone Nut Wrench. NEVER STRIKE the Stop Ring Nut.

9

Place the impeller assembly onto the shaft and while pulling up on the impeller, press down on the Split Cone Nut and press it down as far as it will go. Use a rubber hammer and Split Cone Nut wrench to tap the assembly down until it contacts the Suction Interconnector or Intermediate Chamber.

10

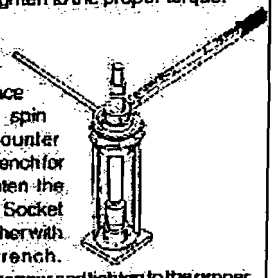


Using a rubber hammer or Split Cone Driver and Split Cone Nut Wrench and Driver, tap down on the Split Cone Nut while tightening until the Impeller seats into place. Tighten the Split Cone Nut or Stop Ring Nut to the proper torque.

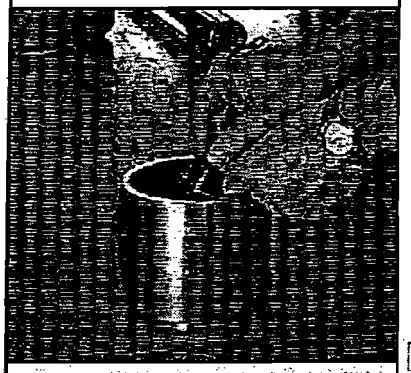
11

385S - 475S
Hold the Impeller in place so it doesn't spin using the Counter Tightening Wrench for Impeller (SV.0313).
Use the Split Cone Nut Wrench (SV.0285) together with the Tap (SV.0402) and a torque wrench and tighten to the proper torque.

625S - 1100S
Hold the Impeller in place so it doesn't spin using the Counter Tightening Wrench for Impeller. Tighten the nut using the Socket Spanner together with a torque wrench. Remove the spanner and tighten to the proper torque.



12



Insert an Intermediate Bearing (pos. 8) into the Intermediate Chamber (pos. 9) by pinching its sides together and working it into place.

13

Use a rubber hammer to tap the Seal Ring (pos. 7) into place (with the smooth side or "this side up" side facing up).

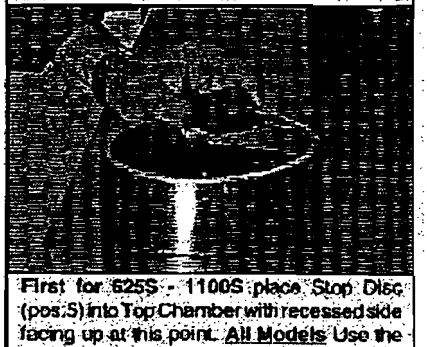
14 385S and 475S only

Lower the Stop Ring over the Shaft and rest it on the Stop Ring Nut with the recessed side down over the nut. Slide the Lower Intermediate Chamber onto the Shaft and down against the Suction Interconnector.

15 All other models

Slide an Intermediate Chamber onto the Shaft. Use a rubber hammer to gently tap it into place. Repeat steps 9-13 and 15 until the unit is fully assembled.

16

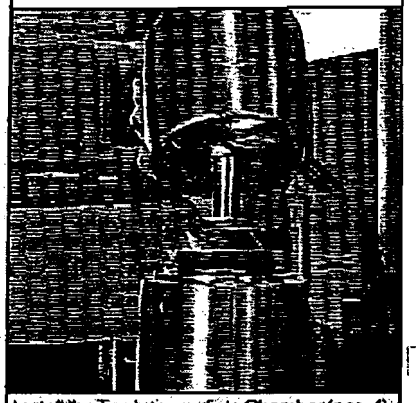


First for 625S - 1100S place Stop Disc (pos. 5) into Top Chamber with recessed side facing up at this point. All Models Use the Shaft Bearing Driver and a rubber hammer to install the Upper Bearing (pos. 6) into the Top Intermediate Chamber (pos. 4). The beveled end of the bearing should go into the housing first (facing down at this point).

17

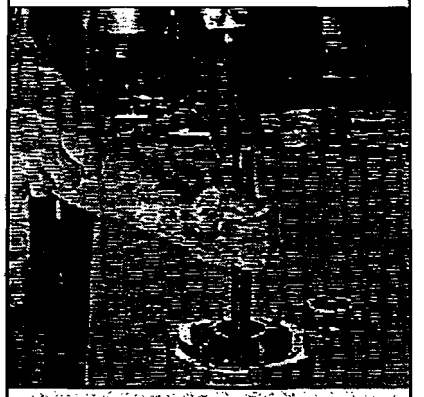
Turn the Top Intermediate Chamber over and use a rubber hammer to tap the Check Valve Seat into place. The stainless steel side of the seat should face down towards the chamber. For 6 - 7 stage 625S and 1 - 5 stage 1100S see steps 23 and 24.

18



Install the Top Intermediate Chamber (pos. 4).

19

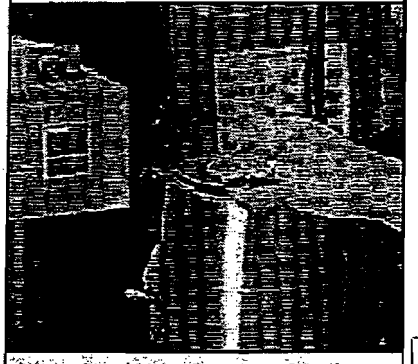


Use the Guide Vane Punch and a rubber hammer to tap the Guide Vane (pos. 70) into the valve housing (pos. 1).

20 385S and 475S only

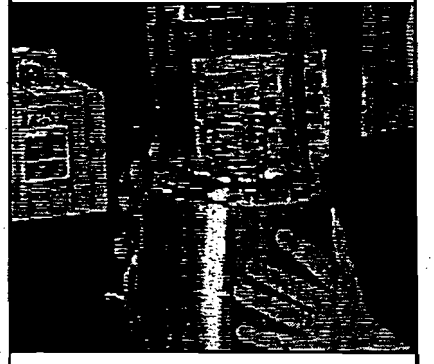
Install the Spring by placing it in the center of the Check Valve Guide (pos.70). Place the Check Valve on the Spring and work it in under the lips of th Check Valve Guide.
385S and 475S only

21 All other Models



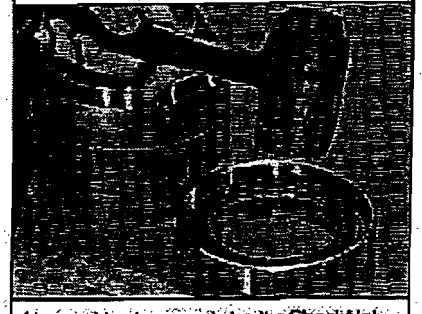
Set the Check Valve Cone (pos.2) in place on the check valve seat.

22



Set the Check Valve Spring (pos. 39) in place.

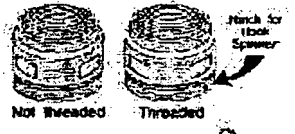
23 Pumps with Check Valve Seat Retainers



Use a rubber hammer to tap the Check Valve Seat into place in the Check Valve Seat Retainer (pos.3a). The stainless steel side of the seat should face down towards the retainer. Set the retainer on the Top Intermediate Chamber unless threaded, see step 24.

24 6 - 7 Stage 625S AND 4 - 6 STAGE 1100S ONLY

Install the valve seat retainer (pos. 3a) into the valve housing (pos. 1).

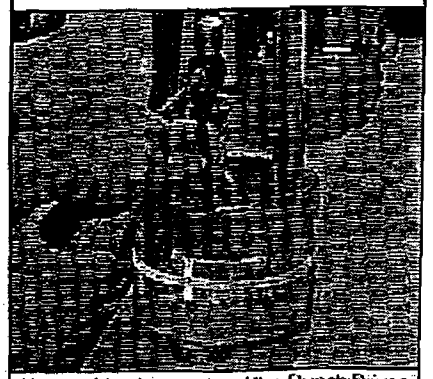


If it is threaded, use the Hook Spanner (SV.5225) to tighten it as shown at right.

25 385 - 800S ONLY

While holding the Straps (pos. 17) in place - using either an elastic band or the hands of a second person - slide the Strap Ring (pos. 69) down onto the Valve Housing. Position the weld on the Strap Ring so it is in the center of one of the straps and the nameplate so it wont fall behind the cable guard.

26 385 - 800S ONLY

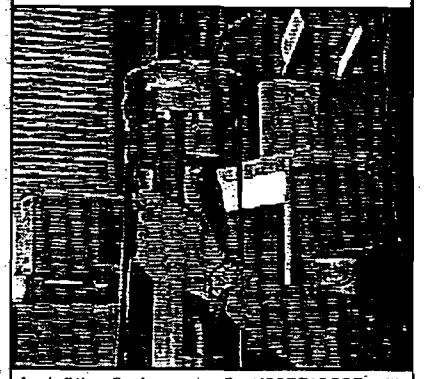


Use a rubber hammer and the Punch Driver (SV.0207) to drive the Strap Ring all the way down. It should bottom out on the lip of the Valve Housing.

27 385 - 800S ONLY

Use a hammer and punch to deform the strap ring to prevent it from slipping down. Two spots on the ring should be deformed -- directly opposite from eachother (180°), with neither spot next to the strap ring weld.

28

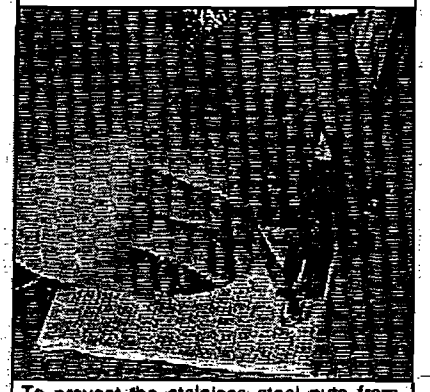


Install the discharge section (385S-800S, with straps) onto the pump. Make sure the holes for the cable guard Srews (pos.18a) line up with the screw holes in the inlet. There are two sets of holes, they should both line up.

29 385 - 800S ONLY Bend the straps slightly to fit their threaded stud ends through the holes in the Suction Interconector. WARNING: keeping fingers out of the way as the assembly can drop down into position suddenly.

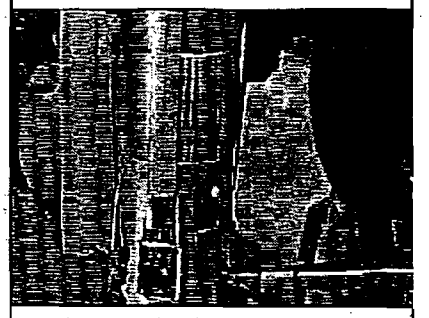
1100S ONLY Bend the straps slightly to fit their threaded stud ends through the holes in the Discharge Chamber and the Suction Interconnector. WARNING: Be careful not to knock the Discharge Chamber off of the top of the pump when inserting the Straps.

30



To prevent the stainless steel nuts from galling on the threaded studs, apply BonderLube (V.7020910) or equivalent to the threaded studs.

31



Fit the Washers (pos. 71) and the Strap Nuts (pos. 19) to the threaded ends of the Straps. Screw the nuts diagonally onto the threaded studs and tighten them to the proper torque. You may need to keep the strap from twisting by inserting a screwdriver under it as the nuts are tightened.

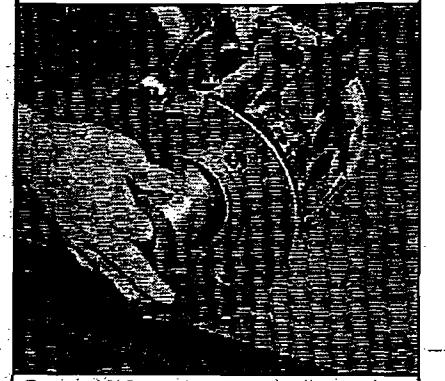
32

The amount of "end play" in the pump shaft is very important. If there is too much or too little, the life of the pump (and motor) will be shortened. Therefore, the amount of end play must be accurately measured before the motor is mounted.

Two measurements are needed to ensure the end play is correct. One is with the shaft in the "up" or "top" position, the other with the shaft in the "down" or "bottom" position.

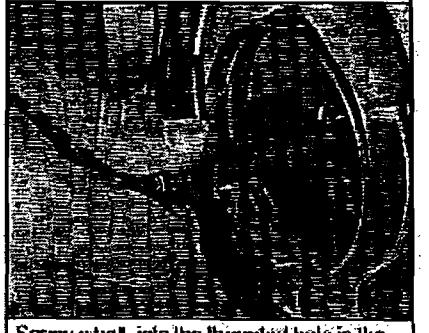
To make these measurements, remove the pump from the mounting plate and lay it on its side. Then ...

33 1100S only



For 1100S Only: slide coupling into position on the pump shaft. Tighten the allen set screws through the Suction Interconnector holes with a 3mm allen wrench.

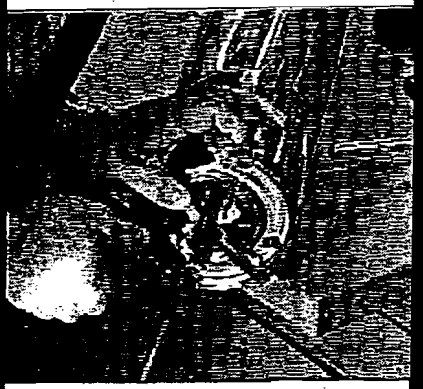
34



Screw a bolt into the threaded hole in the end of the shaft.
For Shaft Down - Pull on the bolt until the shaft is all the way out. Remove the bolt.
For Shaft Up - Push on the bolt until the shaft is all the way in. Remove the bolt.

35 MEASURING THE PUMP SHAFT "END PLAY"

PUMPS WITH 6" MOTORS



Use a depth guage to measure from the motor mounting surface to the contact disc inside the coupling.

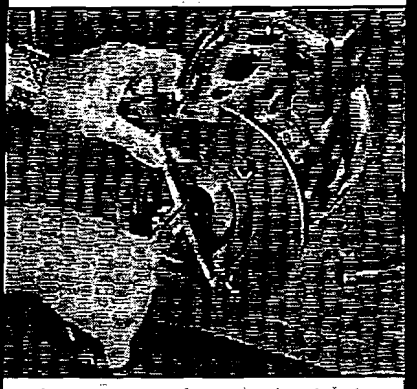
END PLAY MEASUREMENTS

All measurements in millimeters (mm)

With Coupling

Model	Down	Up
385S/475S	71.0±0.5	>/=74.0
625S/800S	71.0±0.5	>/=74.0
1100S	71.0±0.5	>/=76.0

PUMPS WITH 8" MOTORS



Use a depth guage to measure from the motor mounting surface to the contact disc inside the coupling.

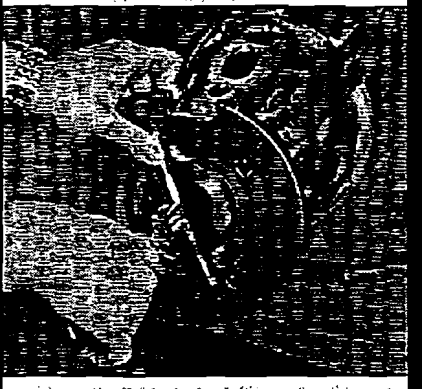
END PLAY MEASUREMENTS

All measurements in millimeters (mm)

With Coupling

Model	Down	Up
385S/475S	100.0±0.5	>/=103.0
625S/800S	100.0±0.5	>/=103.0
1100S	100.0±0.5	>/=106.0

PUMPS WITH 10" MOTORS



Use a depth guage to measure from the motor mounting surface to the contact disc inside the coupling.

END PLAY MEASUREMENTS

All measurements in millimeters (mm)

With Coupling

Model	Down	Up
385S/475S	N/A	N/A
625S/800S	N/A	N/A
1100S Hitachi Motors	122.5±0.5	>/=134.0

36

If the amount of end play you measure is outside the limits stated, the pump has been assembled incorrectly. The most common errors made are:
(1) using the wrong shaft spacer, and
(2) improper seating of the impellers.

Rebuild the pump until the end play measurements fall within the limits given.

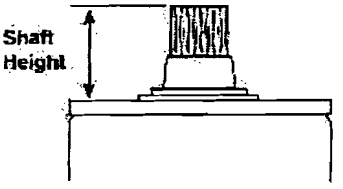
Before attaching the pump to the motor, the height of the motor shaft should be checked.

The motor shaft height is measured from the mounting surface (where the motor meets the pump) to the end of the motor shaft.

Step 37 indicates how this measurement is taken. The table indicates the allowable measurements.

37

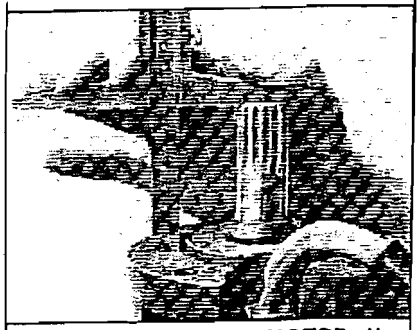
If the motor shaft length you measure falls outside these limits, it may mean the thrust bearing is worn or defective and there is too much (or too little) end play. In either case, the motor must be replaced



MOTOR SHAFT HEIGHT

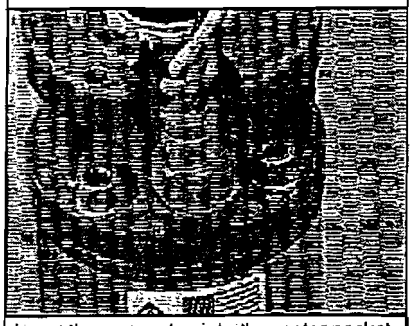
Motor Size	*Shaft Height Should Be Between*		
6" NEMA	2.86 (72.64 mm)	and	2.88 inches (73.03 mm)
8" NEMA	3.99 (101.35 mm)	and	4.00 inches (101.60 mm)
10" NEMA	4.98 (126.60 mm)	and	5.02 inches (127.40 mm)
10" Plueger	3.96 ((101.25 mm)	and	4.02 (102.2 mm)

38



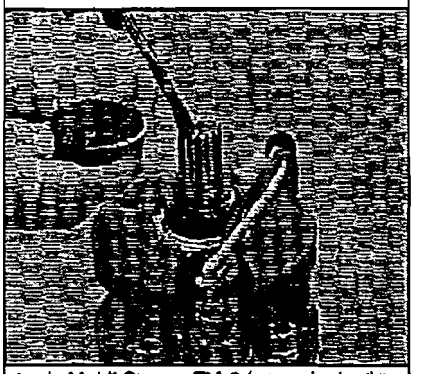
CHECKING A 6" NEMA MOTOR: Use measuring tool SV.0115 to check the shaft height.
CHECKING AN 8" NEMA MOTOR: Use measuring tool SV.0282 or a depth guage to check shaft height(shown in picture).
CHECKING A 10" NEMA MOTOR: Use a depth gauge to check shaft height.

39



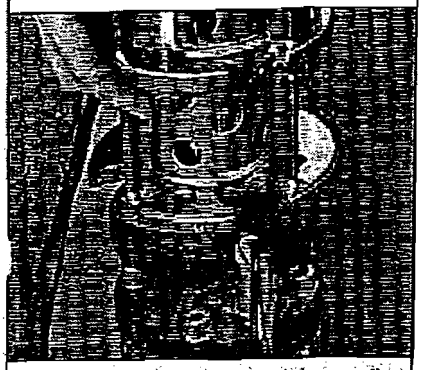
Insert the motor plug into the motor socket. Make sure the key on the plug aligns with the keyway in the socket. Press the plug firmly into the socket and tighten the nut - BUT DO NOT OVERTIGHTEN.
5" motors ..... tighten to 60-70 ft lbs
8" motors ..... tighten to 120-150 ft lbs

40



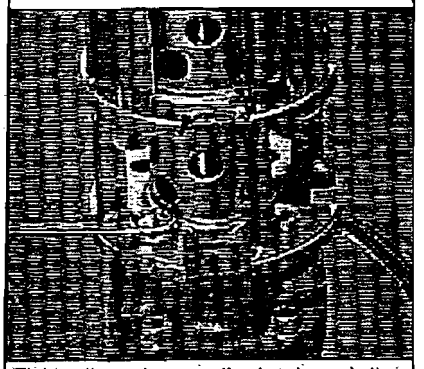
Apply Mobil Grease FM-2 (or equivalent) to the splined end of the motor shaft and to the motor mounting hardware.

41



Place the pump on the motor. Make sure the grooves (splines) on the motor shaft mate with those inside the coupling and also make sure the opening in the Suction Interconnector lines up with the motor cable.

42

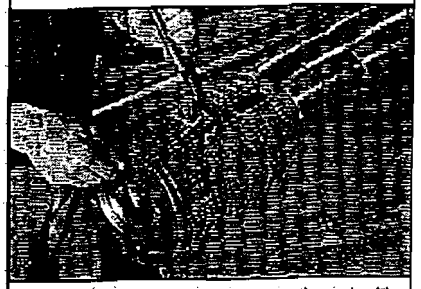


Tighten the motor mounting hardware to the proper torques.

43

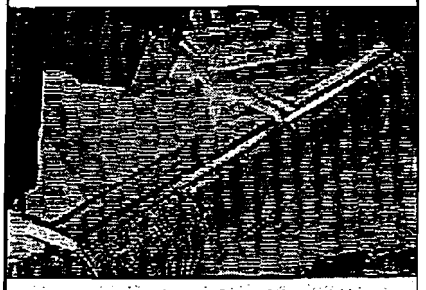
Install the Strainer (pos.15) around the Suction Interconnector. It must fit in the recesses in the top and bottom of the Suction Interconnector. **For 6" pumps** align the gap with the motor cable. **For 8 and 10" pumps** align the gap opposite the motor cable.

44



While holding the Strainer gap closed with channel lock pliers, slide the Strainer Clip (pos.28) up from the bottom and then tap it up until it lines up with the bottom of the strainer. Bend the clip with a screwdriver to lock it in place. For 1100S slide the second clip down from the top until it lines up with the top of the strainer.

45



Place the Motor Lead Guard (pos.29) over the motor cable where the top of the Cable Guard (pos.18) will rest. Place the Cable Guard over the motor cable and fasten the four screws(pos.18a) to the Suction Interconnector and Discharge Housing. If the Cable Guard is indented at one end, that end is the bottom.

THE PUMP IS NOW COMPLETELY ASSEMBLED.

Special Tools

Tools not generally available from normal sources

Part No.	Description and Use
SV0049	**Building Plate**
SV0390 SV0197	**Shaft Spacing Pipe** For 6" motors, Ø22/10.5 x 71 mm For 8" and 10" motors, Ø22/10.5 x 100 mm
SV0078 SV0211	**Shaft Holding Bolt** For 6" motors, M10 x 110 mm For 6"-10" motors, M10 x 140 mm
SV0874	**Socket Spanner**
SV0875	**Split Cone Driver**
SV5225	**Wrench for Valve Seat Retainer**
SV0137	**Counter Tightening Wrench for Impeller**
SV0402	**Tap for Split Cone Nut Wrench** 14 x 18 x Ø14 mm
SV 0115 SV 0262	**Shaft Height Gauge** For 6" motors For 8" motors
SV0208	**Punch for Valve Guide**
SV0315	**Punch/Driver for Bearing Pos. 6, 6b**

Standard Tools

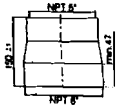
Comparable tools can be purchased through normal sources

Part No.	Description
ID1206	**Allen Wrench** M10 - NV8, for 6" and 8" motors
SV0054 SV0122 SV0073 SV0186	**Wrench** NV 19, for 6" motors NV 24, for 8" motors NV 30, for 10" motors M18 - NV22
SV0230	**Motor Cable Wrench** NV42
SV0500	**Torque Wrench** 75 - 400 Nm
SV0522 SV0519 SV0524 SV0530	**Torque Wrench Socket** M16 - NV 22 M12 - NV 19, for 6" motors M16 - NV 24, for 8" motors M 20 - NV 30, for 10" motors

Part Dimensions

By position number
All dimensions in millimeters (mm)

63- Adapter for Discharge

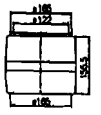


1-Discharge Valve Housing

2 -Valve Cone

3 - Valve Seat

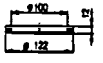
4 ,9, 10 - Intermediate Chamber



5 - Stop Disk

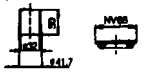
6 - Top Bearing

7 - Neck Ring

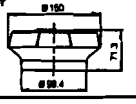


8 - Intermediate Bearing

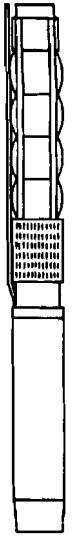
11, 12 - Split Cone and Nut



13 - Impeller



GRUNDFOS



Parts List

6-8-10" Submersibles

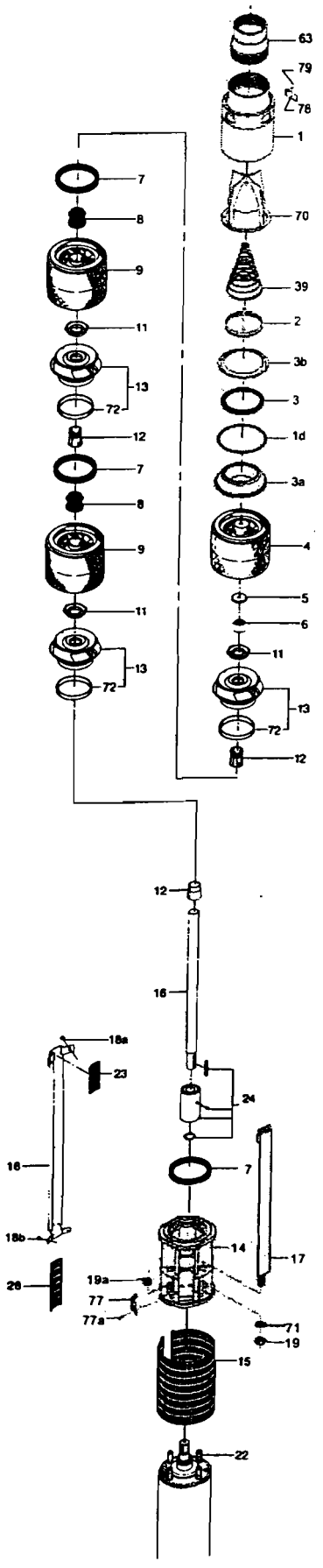
Contents .

625S

Model D

Production AFTER 7/27/98 Stg's 1-5
Production AFTER 6/9/99 Stg's 6-7

L-SP-TL-11S (Rev.6/99)



Pos. No.	Part Description	MODEL HP x 10	MODEL Stages	Qty. Used	Comments/Dimensions	PART No.
1	Valve Housing	150-1000	1-5	1	6" NPT	175136
		1250-1500	6-7	1	6" NPT threaded	175137
1d	Valve Housing O-Ring	150-1500	1-7	1	NBR	96417830
2	Check Valve Cone	150-1500	1-7	1		175148
3	Check Valve Seal	150-1500	1-7	1	vulcanized NBR	170143
3a	Lwr. Check Valve Seat Retainer	150-1000	1-5	1	*a	170675
	Lwr. Check Valve Seat Retainer	1250-1500	6-7	1	threaded *b	170677
3b	Upr. Check Valve Seat Retainer	150-1500	1-7	1		170144
4	Top Intermediate Chamber	150-1500	1-7	1		175106
5	Stop Disc	150-1500	1-7	1	carbon/graphite/teflon	170137
6	Upper Bearing	150-1500	1-7	1	NBR	175607
7	Seal/Neck Ring	150-1500	1-7	#Stgs	NBR	175115
8	Intermediate Bearing	200-1500	2-7	#Stgs-1	vulcanized NBR	170201
9	Intermediate Chamber	200-1500	2-7	#Stgs-1		175102
11	Split Cone Nut	150-1500	1-7	#Stgs		170570
12	Split Cone	150-1500	1-7	#Stgs		170214
13	Impeller	150-1500	1-7	#Stgs-**		175101
	Impeller (reduced diameter)	**	**	**	** see explanation note	175125
14	Suction Interconnector (inlet)	150-500	1-3	1	for 6" motors	170640
		400-1500	2-7	1	for 8" motors	170641
15	Strainer	150-1500	1-7	1		170014
16	Shaft 6" motor	150-250	1	1	L=274.5 mm	171A01
		300-400	2	1	L=430 mm	171E02
		500	3	1	L=585.5 mm	171A03
16	Shaft 8" Motor	400	2	1	L=397 mm	171C02
		500-600	3	1	L=552.5 mm	171C03
		750-1000	4	1	L=718 mm	171E04
		1000	5	1	L=873.5 mm	171E05
		1250-1500	6	1	L=1029 mm	171E06
		1500	7	1	L=1184.5 mm	171E07
17	Strap	150-250	1	4	L=499.5 mm	208001
		300-400	2	4	L=655 mm	208002
		500-600	3	4	L=810.5 mm	208003
		750-1000	4	4	L=966 mm	208004
		1000	5	4	L=1121.5 mm	208005
		1250-1500	6	4	L=1277 mm	208206
		1500	7	4	L=1432.5 mm	208207
18	Cable Guard 6" Motor	150-250	1	1	L=569.5 mm	208501
		300-400	2	1	L=725 mm	208502
		500	3	1	L=880.5 mm	208503
18	Cable Guard 8" Motor	400	2	1	L=725 mm	208602
		500-600	3	1	L=880.5 mm	208603
		750-1000	4	1	L=1036 mm	208604
		1000	5	1	L=1191.5 mm	208705
		1250-1500	6	1	L=1347 mm	208706
		1500	7	1	L=1502.5 mm	208707

18a	Cheese-head Screw	150-1500	1-7	2	M5 x 6 mm	ID1393
18b	Cheese-head Screw	150-1500	1-7	2	M5 x 10 mm	96413437
19	Strap Nut	150-1500	1-7	4	M16	ID1389
19a	Motor Nut	150-300	1-2	4	1/2" UNF for MS6000	ID2162
22	Motor Bolt	150-500	1-3	4	for 6" motor 1/2" - 20 UNF SS	UB0006
		500-1500	2-7	4	for 8" motor 5/8" - 11 x 8.8 cm SS	1800011
22a	Lock Washer	150-500	1-3	4	1/2" for 6" motor	UW0006
		500-1500	2-7	4	5/8" for 8" motor	UW0002
23	Rubber Motor Lead Guard	150-500	1-3	1	for 6" motor	130043
	Plastic Motor Lead Guard	400-1500	2-7	1	for 8" motor	130099
24	Coupling	150-250	1	1	for 6" motor w/22.23mm, 7/8" shft.	795940
		300-500	2-3	1	for 6" mtr. w/24.5mm, 31/32" shft.	795941
		400-750	2-4	1	for 6" mtr. w/24.5mm, 31/32" shft.	165007
		750-1500	4-7	1	for 8" mtr. w/30.17mm,1-3/16" sh.	175052
26	Lock for Strainer	150-500	1-3	1	for 6" motor	160020
		500-1500	2-7	1	for 8" motor	160038
39	Spring for Check Valve Cone	150-1500	1-7	1		170251
63	Adapter for Discharge	150-1500	1-7	1	6" to 5" NPT	200135
70	Check Valve Guide	150-1500	1-7	1		175142
71	Washer for Strap Nut	150-1500	1-7	4		160021
72	Impeller Wear Ring	150-1500	1-7	#Stgs	included in pos. 13	170207
77	Cover for pos. 14 6" & 8" Motor	150-1500	1-7	1	30 x 50	200628
77a	Screw for Cover	150-1500	1-7	2	M5 x 10 mm	96413437
78	Name Plate w/CSA	150-1500	1-7	1		984461
79	Rivet for name Plate	150-1500	1-7	2	3 x 5 mm 304SS	96022882

**In pumps with model numbers having a -# after the number of stages, the -# is the quantity of reduced diameter impellers.
Example: 625S1000-5-2 (this pump has 2 reduced diameter impellers and 3 standard impellers)

*a ..... Mid 1999 part changed from 175640 to 170675.
*b ..... Mid 1999 part changed from 175641 to 170677.

625S Bolt Kits: for attaching pump to motor.				
Part Description	HP x 10	Stages	Position #'s included (Qty.*)	Part #
For 6" motors	150-500	1-3	22(4), 22a(4), 23	UB9002
For 8" motors	500-1500	2-7	22(4), 22a(4), 22b(4), 23	1800018

Product Data

6" ENCAPSULATED SUBMERSIBLE MOTORS

5 through 15 horsepower single-phase.
5 through 60 horsepower three-phase.
200 to 575 volts-60 and 50 hertz.

APPLICATION DATA

These motors are built for dependable operation in 6" diameter or larger water wells. Temperature and time ratings are continuous in 86° F (30° C) water at 1/2 ft./sec. flow past motor. Rotation: single-phase, CCW facing shaft end; three-phase, electrically reversible.

BASIC FEATURES

- Full 3450 RPM design point
- Maximum temperature winding wire NEMA class 200
- Anti-track self-healing resin system
- Hermetically-sealed windings
- Removable Water-Bloc™ lead
- Double flange design
- Stainless steel shell
- Stainless steel splined shaft
- Kingsbury-type water lubicated thrust bearing
- Pressure equalizing diaphragm
- Sand slinger
- 3-lead & 6-lead (Wye Delta) configurations for 3-phase
- Copper bar rotor

SPECIAL FEATURES

- **Ni-Resist:** Special construction option for some Salt Water and high pH applications. All Ni-Resist motors include a Subtrol-Plus heat sensor.
- **316 Stainless Steel:** Special construction option for Acid, low pH, and Seawater applications. All 316 SS motors include a Subtrol-Plus heat sensor.
- **Sand Fighter™** models available for sandy wells.
- **Mining And Offshore Application Motors** available with flat jacketed nitrile lead and Sand Fighter™ sealing system, consult factory.

A complete line of single-phase control boxes is available from Franklin Electric.

SUBTROL-PLUS® OVERLOAD OPTION FOR THREE-PHASE MOTORS

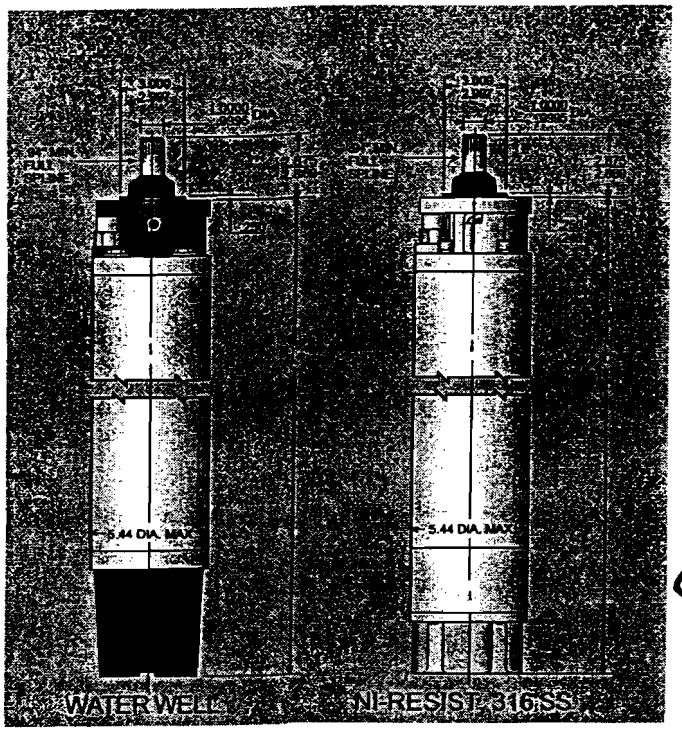
A field proven and contractor friendly premium motor protection system. It protects the motor against overload, underload, overheating and rapid cycling. It also extends the motor warranty to a full three years. The motor must be manufactured with a Subtrol-Plus® heat sensor.

MADE IN THE U.S.A.

Franklin Electric

6-INCH SUBMERSIBLE MOTORS

DIMENSIONS



AVAILABILITY①

Single-Phase *Capacitor start, capacitor run (control box required)*

		Water Well "L" Dim.		Ni-Res, 316 SS "L" Dim.		316 SS Shipping Weight	
hp	kw	ins	cm	ins	cm	lbs	kgs
5	3.7	25.4	64.6	25.0	63.6	112	51
7½	5.5	28.0	71.1	27.6	70.1	125	57
10	7.5	30.6	77.7	30.2	76.6	143	65
15	11.0	33.1	84.2	32.7	83.1	156	71
Three-Phase							
5	3.7	22.9	58.1	22.5	57.1	103	47
7½	5.5	24.2	61.4	23.8	60.4	110	50
10	7.5	25.4	64.6	25.0	63.6	118	54
15	11.0	28.0	71.1	27.6	70.1	131	60
20	15.0	30.6	77.6	30.2	76.6	147	67
25	18.5	33.1	84.2	32.7	83.1	158	72
30	22.0	35.7	90.7	35.3	89.6	176	80
40	30.0	40.8	103.7	40.4	102.6	206	94 *
50	37.0	55.3	140.5	55.7	141.5	304	138
60	45.0	61.3	155.7	61.7	156.8	334	152

① 60 Hz - Nominal 3,450 RPM
50 Hz - Nominal 2,875 RPM

CONSTRUCTION MATERIALS

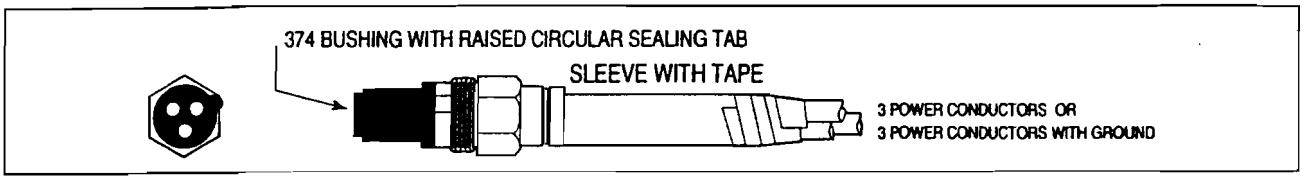
Component	Environment Type		
	Standard Water Well	*Ni-Resist*	*316 SS*
1. Castings	Gray Iron	Ni-Resist Type 1B	316 SS
2. Stator Shell	301 SS	316 SS	316 SS
3. Stator Ends	Low Carbon Steel	316 SS	316 SS
4. Shaft Extension	303 SS, Except 17-4 SS On 40-60hp	17-4 SS	17-4 SS
5. Fasteners	300 & 400 Series SS	316 SS	316 SS
6. Seal Cover	304 SS & Sintered Bronze	316 SS	316 SS
7. Seal	Carbon/Ceramic Face	Sand Fighter™ Seal System	Sand Fighter™ Seal System
8. Diaphragm	Nitrile Rubber	Nitrile Rubber	Nitrile Rubber
9. Diaphragm Plate	304 SS	316 SS	316 SS
10. Diaphragm Spring	302 SS	17-7 SS	17-7 SS
11. Slinger	Nitrile Rubber	Type 100 Hydrin	Type 100 Hydrin
12. Lead Wire (or Cable)	Hypalon 75°C	Hypalon 75°C	Hypalon 75°C
13. Lead Potting	Epoxy	Epoxy	Epoxy
14. Filter	Delrin & Polyester	316 SS Plug	316 SS Plug
15. Insulation	Class F	Class F	Class F

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Franklin Electric
400 E. Spring Street, Bluffton, Indiana 46714
Tel: 219 824 2900 Fax: 219 824 2909
www.franklin-electric.com

Submersible Motors

6" Motor Replacement Leads – RHW & Nitrile Lead Material



STANDARD RHW HYPALON 75°C LEAD①

Excellent resistance to ozone, abrasion, heat and oxidizing chemicals.

FRANKLIN PART NUMBER	REPLACEMENT KIT NUMBER	LEAD LENGTH (FEET)	JAM NUT MATERIAL	AWG WIRE SIZE	3 LEAD 460V; 60Hz; 3ø HP USAGE	POWER CONDUCTOR PER CONNECTOR
152 610 905	305 241 905	50	316 S.S.	#10	5-30 Hp	3 w/GND
152 610 907	305 241 907	75	316 S.S.	#10	5-30 Hp	3 w/GND
152 610 910	305 241 910	100	316 S.S.	#10	5-30 Hp	3 w/GND
152 610 912	305 241 912	125	316 S.S.	#10	5-30 Hp	3 w/GND
152 610 915	305 241 915	150	316 S.S.	#10	5-30 Hp	3 w/GND
152 314 901	305 108 901	13 (4 meters)	Brass	#8	All Ratings	3 w/GND
152 314 903	305 108 903	26 (8 meters)	Brass	#8	All Ratings	3 w/GND
152 316 902	305 202 902	13 (4 meters)	316 S.S.	#8	All Ratings	3 w/GND
152 316 903	505 202 903	26 (8 meters)	316 S.S.	#8	All Ratings	3 w/GND
152 316 905	305 202 905	50	316 S.S.	#8	5-30 Hp	3 w/GND
152 316 907	305 202 907	75	316 S.S.	#8	5-30 Hp	3 w/GND
152 316 910	305 202 910	100	316 S.S.	#8	5-30 Hp	3 w/GND
152 316 912	305 202 912	125	316 S.S.	#8	5-30 Hp	3 w/GND
152 316 915	305 202 915	150	316 S.S.	#8	5-30 Hp	3 w/GND

SPECIAL FLAT NITRILE 90°C LEAD WITH JACKET (COLOR OF JACKET RED)①③

Excellent resistance to petroleum, mineral and vegtable oils. Good resistance to acids and bases except those having strong oxidizing effects. Poor resistance to oxygenated solvents such as acetone, methyle ethyl ketone (MEK) and other ketones.

FRANKLIN PART NUMBER	REPLACEMENT KIT NUMBER	LEAD LENGTH (FEET)	JAM NUT MATERIAL	AWG WIRE SIZE	3 LEAD 460V; 60Hz; 3ø HP USAGE	POWER CONDUCTOR PER CONNECTOR
152 128 901	305 200 901	13 (4 meters)	316 S.S.	#8	All Ratings	3 w/jacket no GND
152 128 919	305 200 919	26 (8 meters)	316 S.S.	#8	All Ratings	3 w/jacket no GND
152 128 903	305 200 903	50	316 S.S.	#8	5-30 Hp	3 w/jacket no GND
152 128 904	305 200 904	75	316 S.S.	#8	5-30 Hp	3 w/jacket no GND
152 128 905	305 200 905	100	316 S.S.	#8	5-30 Hp	3 w/jacket no GND
152 128 906	305 200 906	125	316 S.S.	#8	5-30 Hp	3 w/jacket no GND
152 128 902	305 200 902	150	316 S.S.	#8	5-30 Hp	3 w/jacket no GND

APPLICATIONS

NOTE: MOTOR WARRANTY IS VOID if Franklin supplied leads or drop cables are not used.

Replacement leads are available in 25 ft. increments up to 150 ft. Special-cut lengths are available at an additional charge. Consult factory for price and availability.

FOOTNOTES:

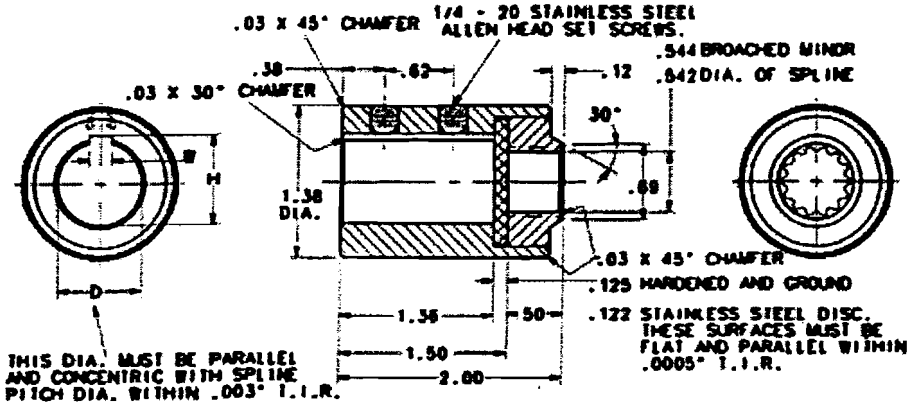
① Refer to Franklin Field Service manuals for accurate cable sizing.
③ Lead sleeve 1" longer than standard.

Franklin Electric
400 East Spring Street
Bluffton, Indiana 46714
Tel: 219.824.2900 Fax: 219.824.2909
www.franklinelect.com

Click Here for Part Specification Information

Splined Stainless Steel Couplings

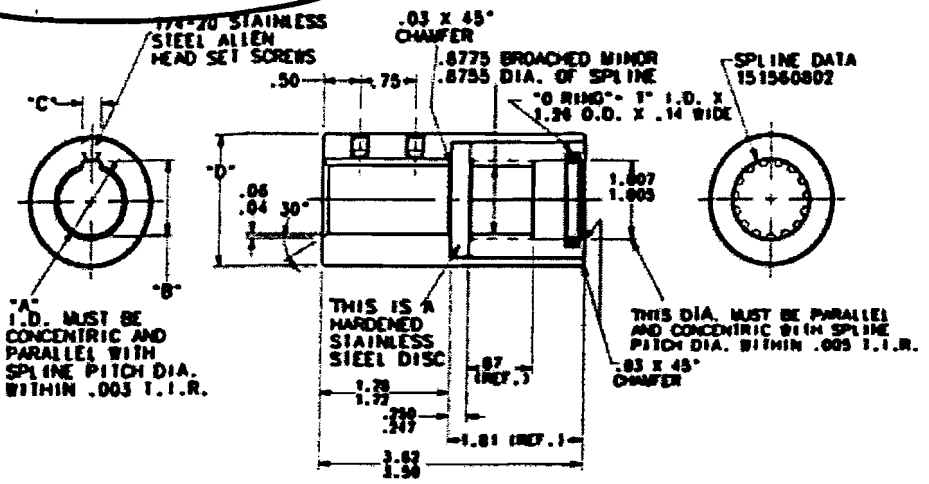
COUPLING - 4"



Spline Data

- 14 Teeth
- 24/48 Diametral Pitch
- 30° Pressure Angle
- .5052 Base Circle Dia.
- .001 Max. Out of Roundness
- .0015 Max. Cumulative Pitch Error (Any Two Teeth)
- .0005 Max. Involute Profile Error
- .0003 Max. Lead Error
- Flat Root Side Fit Type
- Sliding Class "A" Fit
- Spline Data Per American Std. A.S.A. B5. 15-1950 Based on Short Dedendum Internal Spine

COUPLING - 6"



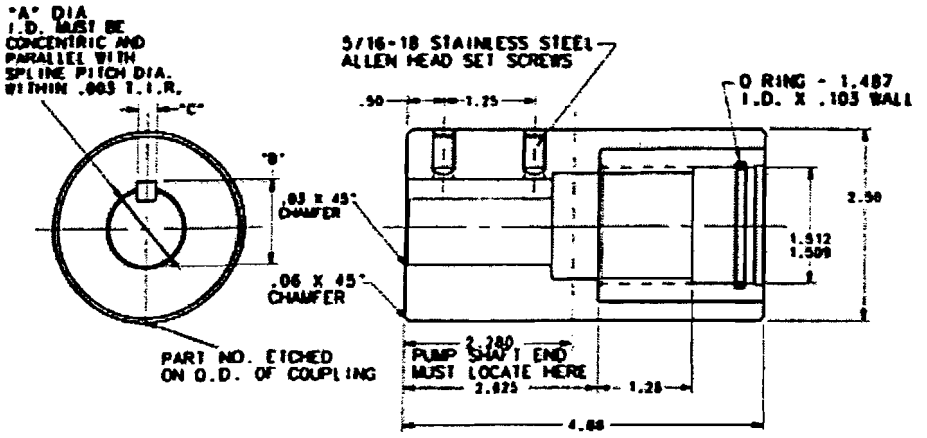
Spline Data

- 15 Teeth
- 16/32 Diametral Pitch
- 30° Pressure Angle
- .8119 Base Circle Dia.
- .001 Max. Out of Roundness
- .0015 Max. Cumulative Pitch Error (Any Two Teeth)
- .0005 Max. Involute Profile Error
- .0003 Max. Lead Error
- Flat Root Side Fit Type
- Sliding Class "A" Fit
- A.S.A. B5. 15-1950 Based on Short Dedendum Internal Spine

COUPLING - 8"

Spline Data

- 23 Teeth
- 16/32 Diametral Pitch
- 30° Pressure Angle
- 1.2449 Base Circle Dia.
- .001 Max. Out of



Roundness

- .0015 Max. Cumulative Pitch Error (Any Two Teeth)
- .0005 Max. Involute Profile Error
- .0003 Max. Lead Error
- Flat Root Side Fit Type
- Tolerance Class 5
- NS B92. 1-1970

FOOTNOTE: "Dimensions "A", "B", "C" depend on particular coupling selected. Dimension "D" is 1.688" for all 6" couplings except here dimension "D" is 1.875"

Click Here for Part Specification Information

Franklin Electric Co., Inc. 400 E. Spring St., Bluffton, IN, 46714, U.S.A.
E-mail: webmaster@fele.com Tel: 260.824.2900 Fax: 260.824.2909

Section 1-B

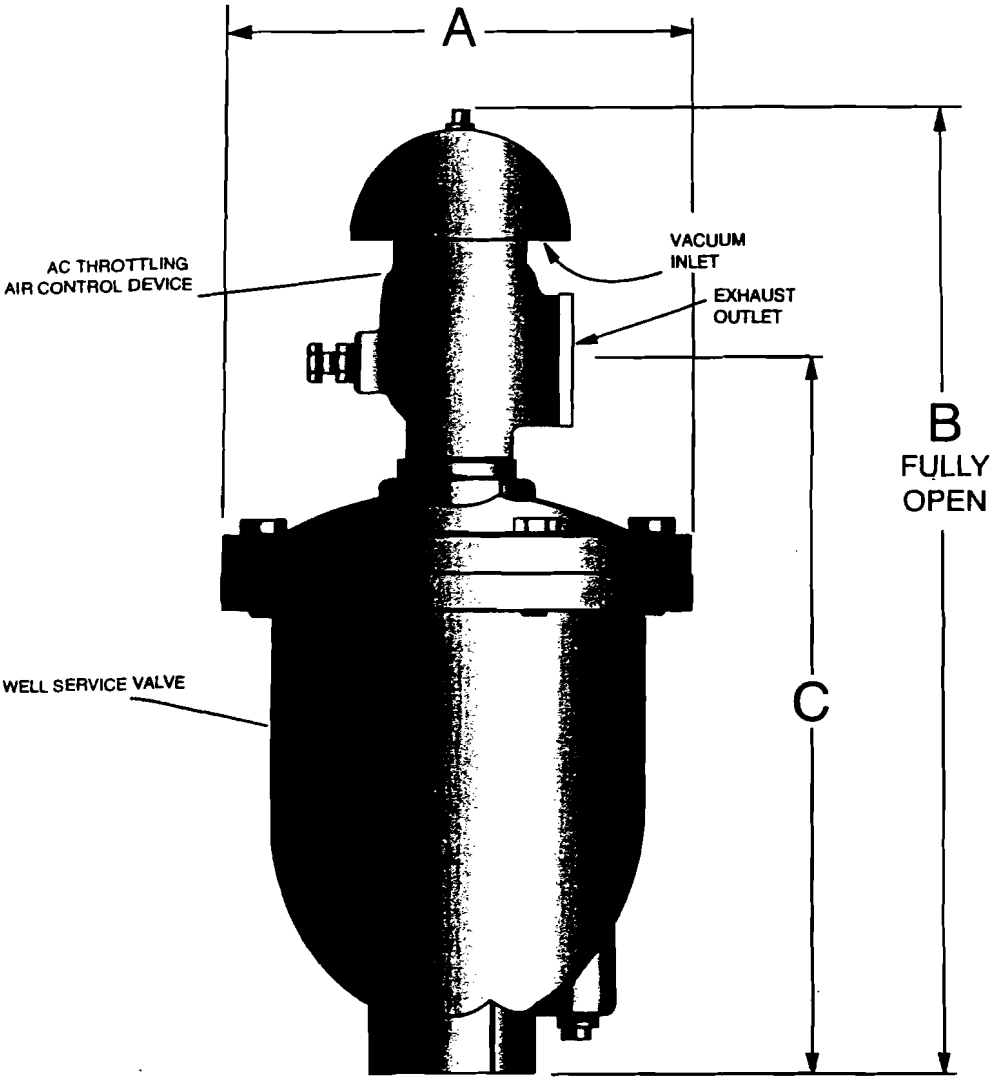
Air Release Valves (V-101, V-102)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

CLA-VAL

Series AC

For Model 37 Well Service Valves



Dimensions for Model AC installed on
Model 37 Well Service Valves

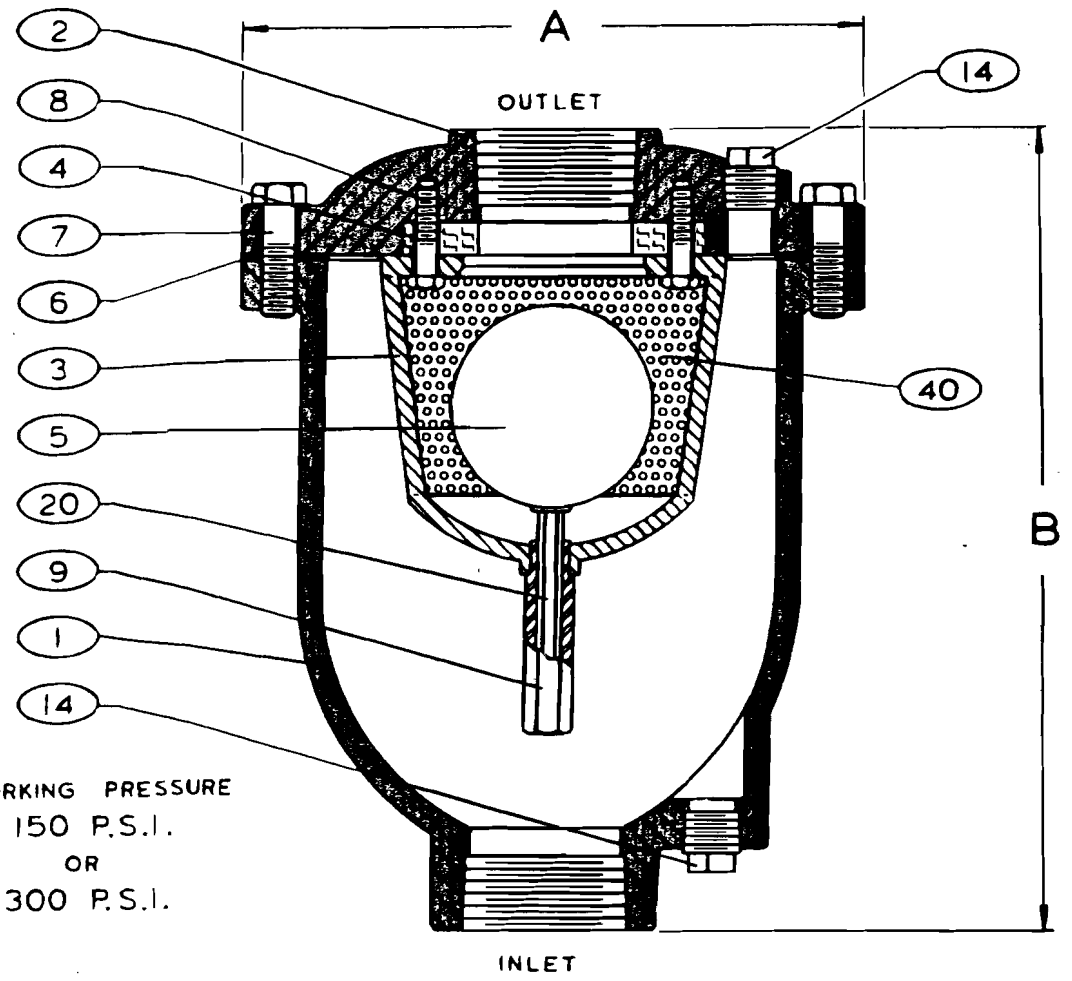
Model No.	Valve Size	A	B	C
370-WS	1/2"	6 1/8	11 3/4	8 3/4
371-WS	1"	7	14 3/4	11
372-WS	2"	9 1/2	20 1/8	14 3/8
373-WS	3"	9 1/2	22 1/8	15 3/4

For Valve Detail, see E-sheet Model 37 Well Service Valves

CLA-VAL

Series 37

Well Service Valve with Baffle Screen



Detail No.	Part Name	Material	Detail No.	Part Name	Material
1	Body	Cast Iron ASTM A126, Class B	7	Cover Bolt	Alloy Steel ASTM A449, Grade 5
2	Cover	Cast Iron ASTM A126, Class B	8	Retaining Screw	Stainless Steel ASTM A449,
3	Baffle	Ductile Iron ASTM A536-51T	9	Guide Bushing	Stainless Steel ASTM A276 T303
4	Seat	Buna - N	14	Pipe Plug	Malleable Iron
5	Float	Stainless Steel ASTM A-240, T304	20	Guide Shaft	Stainless Steel ASTM A276 T303
6	Gasket	Garlock #3000 (Non-Asbestos)	40	Baffle Screen	Stainless Steel ASTM A240 T304

Note: AC throttling device is recommended for well Service installations inside the pump station for shock control.

Model No	Valve Size	A	B	Inlet Size	Outlet Size
370-WS	1/2"	6 1/8"	7"	1/2" N.P.T.	1/2" N.P.T.
* 371-WS	1"	7"	9 1/2"	1" N.P.T.	1" N.P.T.
372-WS	2"	9 1/2"	12"	2" N.P.T..	2" N.P.T.
373-WS	3"	9 1/2"	12"	3" N.P.T.	3" N.P.T.

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CLA-VAL

Series AC

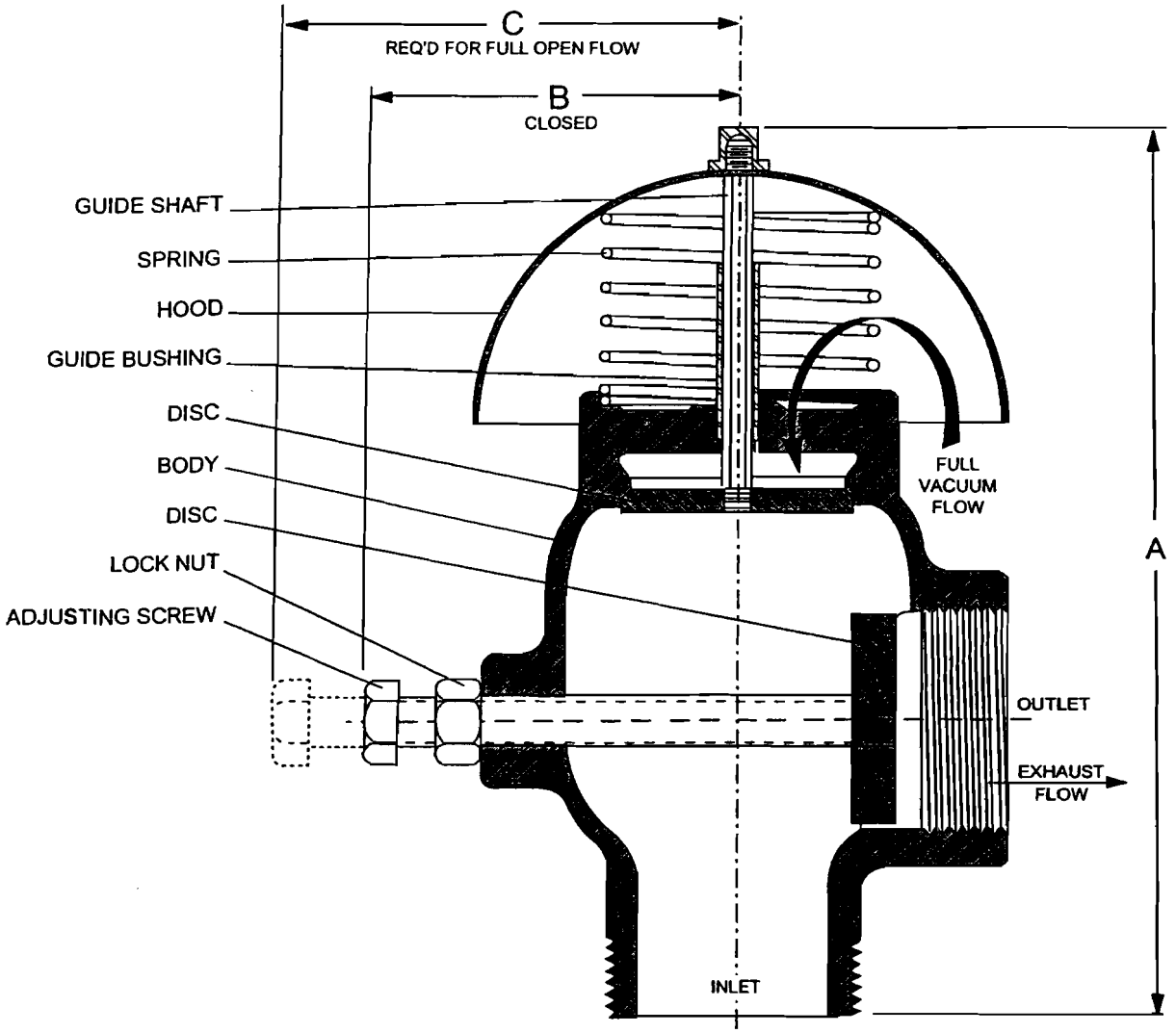
For Model 37 Well Service Valves

Design Function

The Series AC Throttling Air Control Device is designed for use with Series 37 Well Service Valves to provide adjustable air Throttling during pump startups, to minimize pump and piping shock. It is easily installed in the field on new Series 37 valve installations.

Model #	Stock #	Size NPT	A	B	C
HAC	27001-01H	1/2"	4 7/16	1 7/16	2
1AC	27000-02F	1"	5 3/4	2 1/8	3
* 2AC	27000-03D	2"	8 7/8	3 1/8	4 5/16
3AC	27000-04B	3"	12 5/8	4 5/16	6 7/16

For Reference Only • Individual Parts Not Available • Sold only as complete unit.



Also Available 4" thru 8" sizes Contact the Factory

Purchase Specification

Model No. 37
WELL SERVICE VALVES

1/2", 1", 2", 3" NPT

Installation

The Model 37 Well Service Valve is typically installed between the pump discharge and check valve. Mount the unit in the vertical position on top of the pipeline with an isolation valve installed below the valve in the event servicing is required. An enclosure with adequate venting is recommended. Piping the discharge back to the well is suggested.

Description

The well service air valve shall be able to automatically exhaust large quantities of air in the pump column during pump start-up and allow air to re-enter the column during pump shut-down. The air valve shall be designed to be installed between outlet of vertical turbine pumps and the pump check valve.

The inlet and outlet of the valve shall have the same cross-section area. The valve shall have NPT Threaded or ANSI Flanged inlet and outlet. The float shall be guided by a stainless steel guide shaft and seal drip-tight against a synthetic rubber seal. 4" and larger valves shall have dual guided shafts of hexagonal cross section and a protective discharge hood.

The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast iron and the valve internal parts shall be of stainless steel or Buna-N® rubber.

Note: 3" and smaller sizes shall be equipped with a stainless steel diffuser screen to protect float from excess water force. 4" and larger sizes shall be equipped with a device which will throttle the flow of water into the valve and be designed to permit full flow of air but limit the flow of water to the valve.

Material Specification

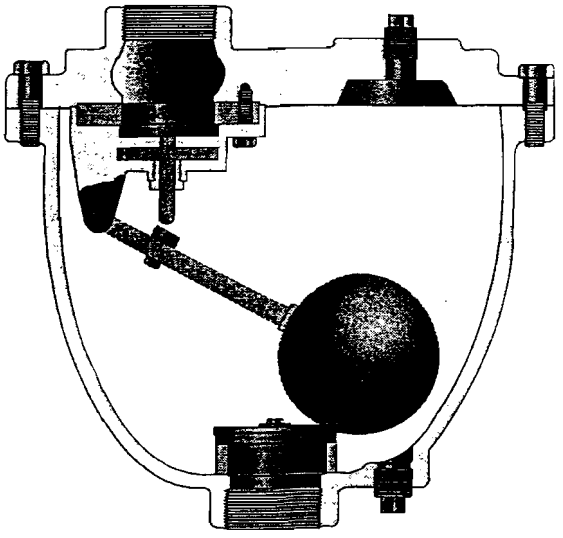
Valve Size:
Main Valve Body and Cover:
Main Valve Trim:
End Detail:
Pressure Rating:
Temperature Range:
Rubber Material:
Desired Options:

The Well Service Air Valve shall be Model 37 from Cla-Val Co. Newport Beach, CA, U.S.A .92659-0325

CLA-VAL™

— Series — 36

Combination Air Release and



- **Stainless Steel or Bronze Trim Standard**
- **Stainless Steel Floats Guaranteed**
- **Fully Ported Valves - No Restrictions**
- **Easily Serviced Without Removal From Pipeline**
- **Engineered For Drip Tight Seal At Low Pressures**

The Cla-Val Series 36 Air and Vacuum Valve is a multipurpose valve that combines the operation of both the Model 34 Air Release Valve and Model 35 Air and Vacuum Valve. It functions to exhaust large quantities of air in the pipeline during the filling cycle and to admit air, as necessary, to prevent potentially dangerous vacuum from forming when being emptied either intentionally or as a result of pipeline breakage.

Installation

The Series 36 Combination Air Valve should be installed at high points at grade changes within the pipeline.

Mount the unit in the vertical position on top of the pipeline with an isolation valve installed below each valve in the event servicing is required. A vault with adequate venting and drainage should also be provided.

Purchase Specification

The combination air valve shall combine the operating features of both an air and vacuum valve and an air release valve in one housing. The air and vacuum valve portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allow air to reenter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, or other emergency. The air release valve portion shall automatically release small amounts of air from the pipeline while it is under pressure.

The inlet and outlet of the valve shall have the same cross-section area. The float shall be guided by a stainless steel guide shaft and seat drip tight against a synthetic rubber seal. 4" and larger valves shall have dual guided shafts of hexagonal cross section and a protective discharge hood.

The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast iron and the valve internal parts shall be of stainless steel or Buna-N® rubber.

The Combination Air Release and Vacuum Valve shall be eries 36 from Cla-Val., Newport Beach, CA, U.S.A.

General Specifications

Size Inlet/Outlet
1", 2", 3", 4" NPT
3" through 8"
125 lb. flange & ANSI
300 lb. flange & ANSI

Pressure Ratings (see note)
150 psi
300 psi

Temperature Range
Water to 180°F

Note: Specify when operating pressure is below 10 PSI

Materials
Body and Cover:
Cast Iron ASTM A 126, Class B

Float:
Stainless Steel

Plug:
Stainless Steel

Internal Parts:
Stainless Steel

Seal: Buna-N® Rubber

When Ordering, Please Specify

1. Model Number
2. Inlet/Outlet Size
3. Inlet Pressure Rating
4. Orifice Size

Optional:
For Anti-Shock Air Valve shut-off, order with arrestor check device, order valve with suffix "AC"
See Data Sheet Page 33

Series 36

Vacuum Valve Data and Sizing Guide

Air and Vacuum Valve Sizing

1. Series 36 Combination Air Release and Vacuum Valves should be sized to handle the maximum amount of air to be exhausted or admitted into the pipeline and not exceed an acceptable pressure differential across the valve discharge orifice.
2. Each high point or change in grade must be examined independently when determining valve size. Use the steepest slope for calculations.
3. Use the flow capacity charts located on Series 36 Data Sheet to assist in valve sizing.
4. Determine the smallest valve size capable of **exhausting** air equal to the filling rate of the pipeline in CFS while not exceeding a pressure differential of 2 psi across the valve orifice. (Based on pump capacity).

   The following formula is recommended to calculate the rate of flow in CFS for filling the pipeline:

   Where: CFS = Cubic feet per second
   GPM= Gallons per minute

5. Determine the smallest valve size capable of **admitting** air equal to the potential flow in CFS while not exceeding a pressure differential of 5 psi across the valve orifice. (Based on gravity flow).

   The following formula should be used to calculate the rate of flow in CFS that can occur within the pipeline under gravity flow conditions.

$$Q = .0007872\ C\sqrt{S\ D^5}$$

   Where: Q = Flow of water in cubic feet per second
   C = Coefficient in Chezy's formula = 110
   S = Slope in feet per foot of length
   D = Inside pipe diameter in inches

6. If thin wall pipe is being used, the risk of pipeline collapse due to the formation of vacuum must be considered. The following formula may be used to calculate the collapsing pressure of thin walled cylindrical steel pipe using a safety factor of four:

$$P = 16{,}250{,}000 \left(\frac{T}{D}\right)^3$$

   Where: P = Collapsing pressure in psi
   T = Thickness of pipe in inches
   D = Diameter of pipe in inches

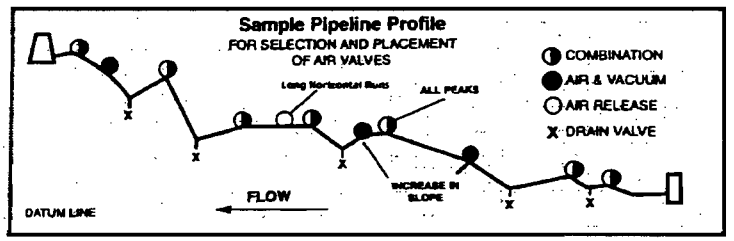
7. For other pipe materials or thickness consult pipe manufacturer for pipe collapsing pressure.

8. Determine the smallest valve size capable of admitting the required air in CFS (as found in step 5) without exceeding the collapsing pressure (as found in step 6) or 5 psi, whichever is less. Do not exceed a pressure differential greater than 5 psi.

9. Finally compare the valve size determined in step 4 with the valve size determined in steps 5 or 6. If they differ, always select the larger valve size.

10. Cla-Val has available upon request, a Slide Rule Air Valve Calculator. It will greatly reduce the amount of time necessary to size valves for pipeline service.

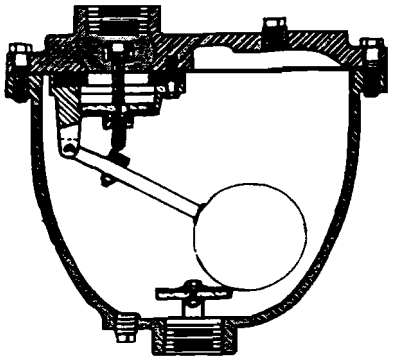
11. Valve effectiveness is affected by location in piping system. The Series 36 Combination Air Release and Vacuum Valves should be installed at all high points or changes in grade in a pipeline system. They should also be installed in high points where air will tend to accumulate during normal pressurized operation. For more information, see "Sizing Guide for Model 34 Air Release Valves" Data Sheet.



CLA-VAL

COMBINATION AIR RELEASE AND VACUUM VALVES

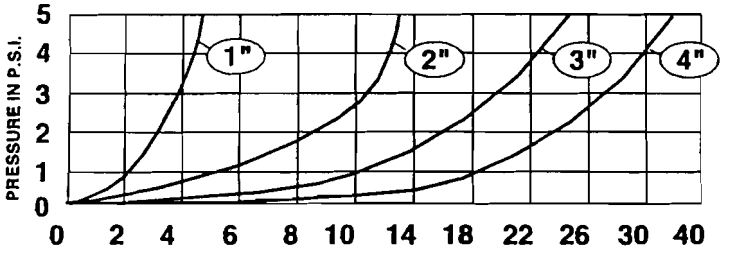
Single Body Style



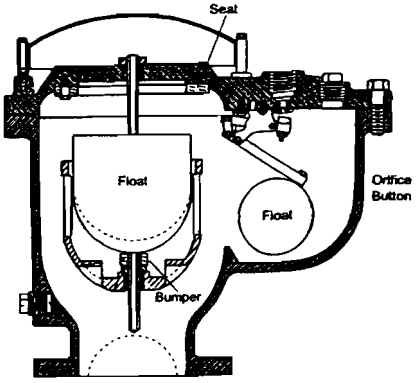
Series 36
1" through 4"

Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs
1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
1 X 1	5/64"	300 psi	10 1/2"	11 /38"	40
2 X 2	3/32"	300 psi	13"	14"	71
3 x 3	3/32"	300 psi	17"	16"	112
4 X 4	3/32"	300 psi	19"	18 1/2"	170

*Bronze trim at reduced cost

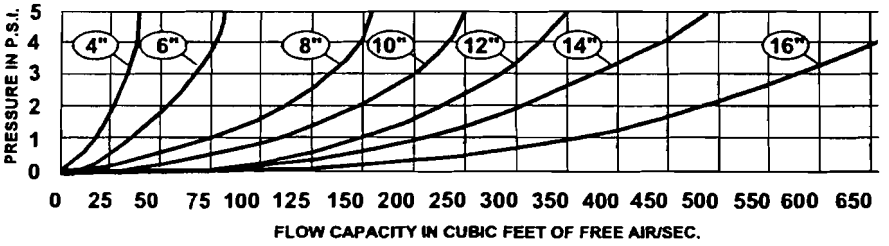


Single Body Style

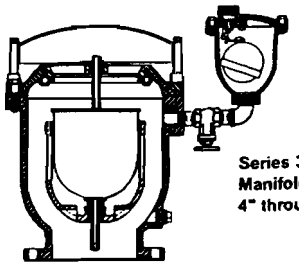


Series 36
6" through 8"

Model No.	Large Orifice Inlet x Outlet Inches	Small Orifice Diameter	Max W.P.	Height	Width	Wt. Lbs
366-CAV038	6 x 6	3/8"	150 psi	20 1/4"	21"	225
366-CAV732.3	6 x 6	7/32"	300 psi	20 1/4"	21"	225
368-CAV038	8 x 8	3/8"	150 psi	23 1/2"	25"	320
368-CAV732.3	8 x 8	7/32"	300 psi	23 1/2"	25"	320



Dual Body Style



Series 36 MTP Type
Manifold Design
4" through 16"

Model No.		Large Orifice Inlet/Outlet Inches	Small Orifice Inches		Inches		Weight lbs.	
125	250		125	250	Height	Width	125	250
MTP364/34.332	MTP364/34.116.3	4 x 4	3/32	1/16	21	20	125	132
MTP366/34.332	MTP366/34.116.3	6 x 6	3/32	1/16	21	20	175	195
MTP368/34.332	MTP368/34.116.3	8 x 8	3/32	1/16	21	20	226	255
MTP3610/34.332	MTP3610/34.116.	10 x 10	3/32	1/16	21	20	385	425
MTP3612/34.332	3	12 x 12	3/32	1/16	21	20	580	625
MTP3614/34.332	MTP3612/34.116.	14 x 14	3/32	1/16	21	20	685	750
MTP3616/34.332	3	16 x 16	3/32	1/16	21	20	875	985

For sizing assistance, see sizing guide or request a Cla-Val Air Valve Slide rule Calculator.

P.O. Box 1325 ¥ Newport Beach, CA 92659-0325 ¥ Phone: 949-722-4800 ¥ Fax: 949-548-5441 ¥ E-mail: claval@cla-val.com ¥ Website cla-val.com

Section 1-C

Butterfly Isolation Valves (V-103, V-106)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

NIBCO

DUCTILE IRON BUTTERFLY VALVES

LD/WD 1000 AND 2000

APPLICATIONS

For use in Commercial Construction and General Utility Service:

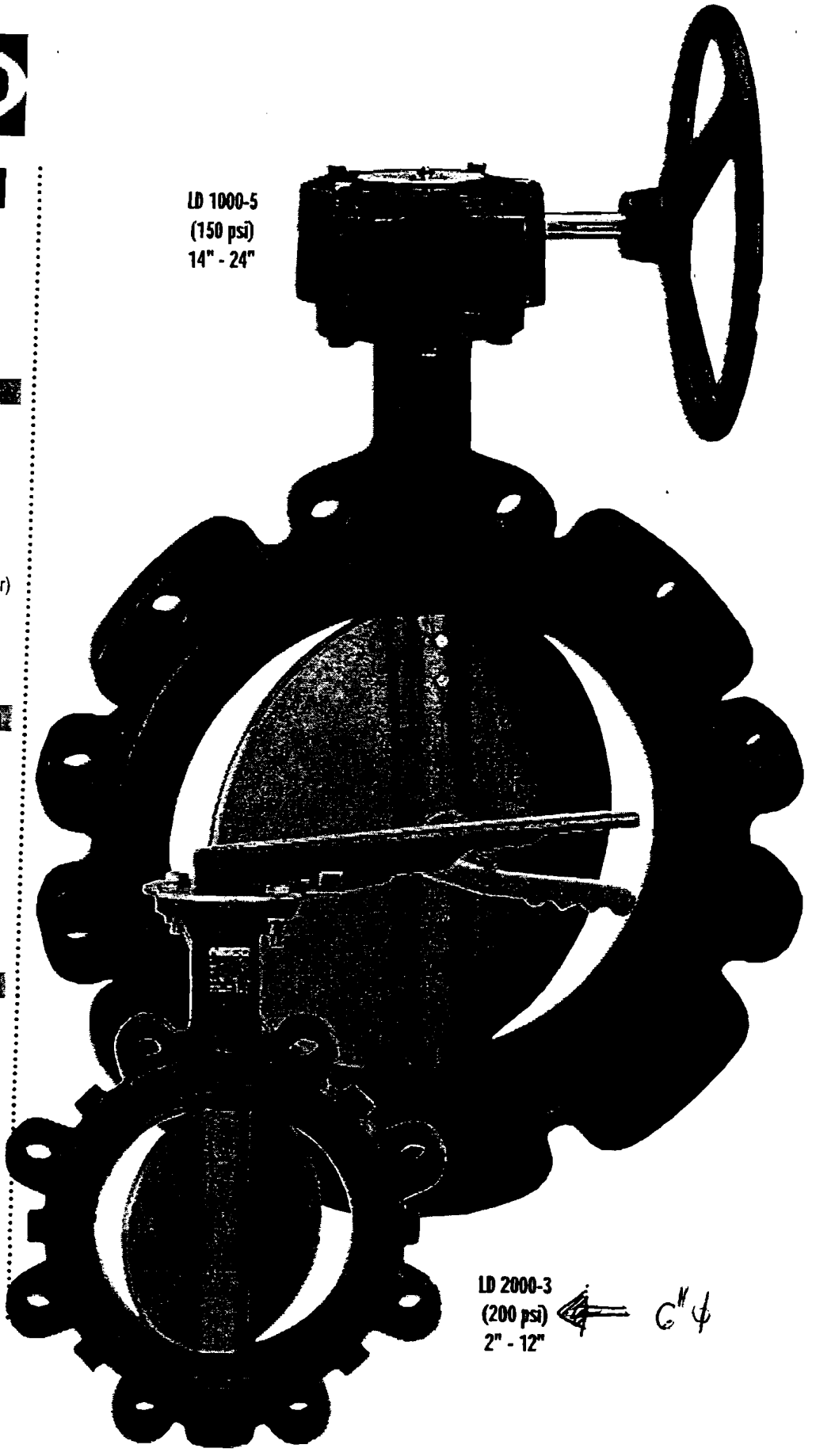
- HVAC (Condenser, Chilled Water, Hot Water Heating
- Hot and Cold Domestic Water
- Compressed Air (BUNA liner)
- Vacuum Service
- End of Line Service (Dead End)
- Modulating Control Services

MATERIALS & CONSTRUCTION

- Molded in Liner (2" - 12")
- Internal Stem/Disc Drive
- Ductile Iron Body
- Streamlined Spherical Disc
- Upper and Lower Bushings
- High Strength 416SS Stem
- Extended Neck
- Threaded Double Seal Collar Bushing (2" - 12")

DESIGN CRITERIA

- Meets or exceeds requirements of MSS SP-67.
- United States Coast Guard Approval.
- Suitable for use with ANSI Class 125 and 150 flanges.
- Pressure rating 200 psi (2"-12") and 150 psi (14"-24")
- Vacuum to 28" mercury
- Bubble tight shutoff at full pressure
- Wide choice of seat and disc combinations to suit customer application.



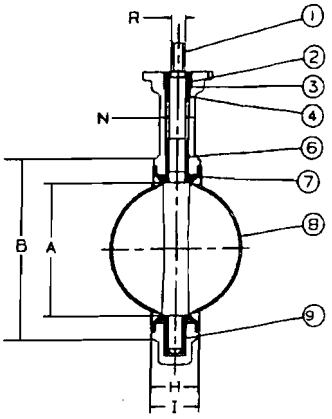
LD 1000-5
(150 psi)
14" - 24"

LD 2000-3
(200 psi)
2" - 12"

Printed in the U.S.A.

LD/WD 2000 SERIES 200 PSI

SPECIFICATIONS

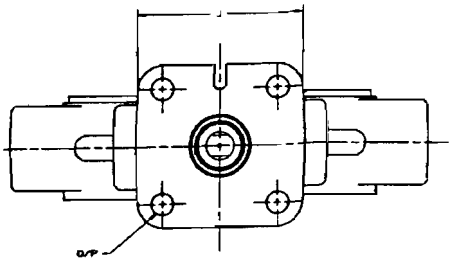


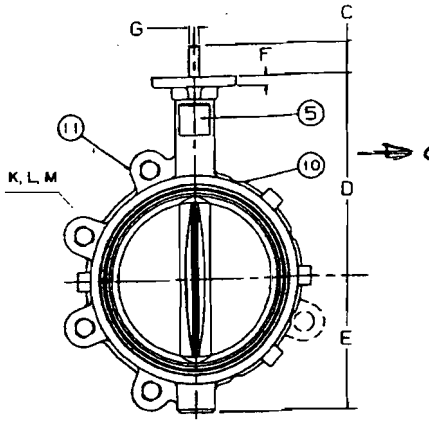
LD/WD2000 SERIES Material List

PART		SPECIFICATION
1.	Stem	Stainless Steel, ASTM A-582 type 416, ASTM A564 Type 17.4 PH*
2.	Collar Bushing	Brass, ASTM B-124
3.	Stem Seal	EPDM Ruber
4.	Body Seal	EPDM Rubber
5.	Nameplate	Aluminum
6.	Upper Bushing	Copper CDA 122
7.	Liner	EPDM Rubber, BUNA (NBR), Fluoroelastomer
8.	Disc	Aluminum, Bronze, ASTM B-148 Alloy 954/955 † Ductile Iron, ASTM A395 (Plated) † Stainless Steel, ASTM A743 Grade CF8M
9.	Lower Bushing	Copper CDA 122
10.	Body (Wafer)	Ductile Iron, ASTM A-536
11.	Body (Lug)	Ductile Iron, ASTM A-536

* Optional Stem Material

† LD 3000 Series only





LD/WD2000 SERIES Dimensions

SIZE	A	B	C	D	E	F	G Flat	METAL H	RUBBER I	J Square
2"	2.53	4.00	1.25	5.38	2.62	.38	.312	1.688	1.812	3.25
2.5"	2.90	4.75	1.25	5.88	3.12	.38	.370	1.812	1.938	3.25
3"	3.15	5.25	1.25	6.12	3.38	.38	.370	1.812	1.938	3.25
4"	4.15	6.75	1.25	6.88	4.00	.38	.403	2.062	2.188	3.25
5"	5.15	7.62	1.25	7.38	4.75	.38	.496	2.188	2.312	3.25
6"	6.15	8.62	1.25	8.00	5.25	.38	.496	2.188	2.312	3.25
8"	8.15	10.87	1.25	9.25	6.50	.50	.560	2.375	2.500	3.25
10"	10.15	13.25	1.25	10.50	8.00	.50	.686	2.688	2.812	4.75
12"	12.15	16.00	1.25	12.00	9.25	.50	.748	3.000	3.125	4.75

LD/WD2000 SERIES Dimensions

SIZE	N Dia.	O B.C.	P Dia.	R Dia.	Capscrew Data/Stud Data K No.	L Dia.	Wafer Length	Lug Length	M B.C.	Lug Approx. Net Wt. (lbs.)	Wafer Approx. Net Wt. (lbs.)
2"	.500	3.25	.437	.437	4	5/8-11unc	4	1 1/2	4 3/4	7	6
2.5"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 1/2	5 1/2	9	8
3"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 3/4	6	9 1/2	8 1/2
4"	.625	3.25	.437	.562	8	5/8-11unc	5	1 7/8	7 1/2	15	12
5"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	8 1/2	19	15
6"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	9 1/2	24	18
8"	.875	3.25	.437	.781	8	3/4-10unc	5 3/4	2 1/4	11 3/4	35	29
10"	1.125	5.00	.562	1.000	12	7/8-9unc	6 1/4	2 1/4	14 1/4	56 1/2	45 1/2
12"	1.250	5.00	.562	1.062	12	7/8-9unc	6 3/4	2 1/2	17	87	72

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SPECIFICATIONS AND TECHNICAL DATA

TORQUE is the rotary effort required to operate a valve. This turning force in a Butterfly Valve is determined by three factors. (1) Friction of the disc to seat for sealing (2) bearing friction and (3) dynamic torque.

BREAKAWAY TORQUE is the total of the torques resulting from bearing friction and seat/disc interference friction at a given pressure differential. This value is normally the highest required torque to operate a valve and is used in sizing actuators. The torques listed are valid for water and lubricating fluids at ambient temperature.

LD/WD 2000 SERIES Torque Data		
SIZE	100 PSI	200 PSI
2"	140	180
2½"	190	235
3"	250	300
4"	430	530
5"	590	760
6"	795	1,035
8"	1,850	2,350
10"	2,350	2,900
12"	3,875	5,390

LD/WD 1000 SERIES Torque Data		
SIZE	75 PSI	150 PSI
14"	3,837	4,870
16"	5,003	6,685
18"	6,567	8,958
20"	8,540	11,950
24"	13,220	18,680

NOTE: Torque data shown is for general service (clean water, ambient temperatures). For non-lubricating, high temperatures or aggressive media, consult NIBCO Technical Service. Torque listed for EPDM. When calculating torque for Buna or Fluorocarbon, multiply by 1.25

SAMPLE BUTTERFLY VALVE SPECIFICATION

Line Control Valves 2" and Larger:

BUTTERFLY VALVES: Valve shall be full lug or wafer body style. Valves to be manufactured in accordance with MSS SP-67. The valves shall be rated at least 200 psi (2" - 12") and 150 psi (14" - 36") bi-directional differential pressure. **Body** to have 2" extended neck for insulation and to be **shock resistant ductile iron**. Valves to have aluminum bronze disc and **molded in or cartridge seat** of EPDM rubber. Stem shall be 400 series stainless steel. Top and bottom stem bushings of dissimilar material are required with a positive stem retention mechanism. Sizes 2" to 6" shall be lever operated with 10 position throttling plate; sizes 8" and larger shall be gear operated. **Lug style valves shall be capable of providing bi-directional "Dead End Service" at full pressure without the need for a down stream blind flange.**

ACCEPTABLE VALVES:
NIBCO - LD2000 (2" - 12"), LD1000 (14" - 24") and N150235G0 (30" - 36").

Key to Butterfly Valve Figure Number System*

L	D	-	2	0	0	0	-	0
BODY TYPE	BODY MATERIAL		PRESSURE RATING	SEAT MATERIAL	DISC MATERIAL	STEM & BUSHING COMBINATIONS		OPERATING MECHANISM
						Stem / Upper & Lower / Collar		
L- Lug	D- Ductile Iron		L- Actuated	0- EPDM	0- Alum. Bronze	0- 416 S.S. / Copper Alloy / —		0- Bare Stem
W- Wafer	C- Cast Iron		1- 150 PSI	1- Buna-N (Nitrile)	1- Ductile Iron[1]	1- 416 S.S. / 316 S.S. / Brass		3- L/Lock (Std.)
G- Grooved			2- 200 PSI	2- Fluoroelastomer	2- CF8M	2-17-4 PH / 316 S.S. / 316 S.S.		5- Gear op.
			3- 250 PSI	5- UL/FM	6- EPDM Coated Brass or D.I.[2]	7- 416 S.S. / TFE / —		
			4- 300 PSI	7- Polymid	7- Buna-N Coated Brass or D.I.[2]	8- 316 S.S. / TFE / —		

** This key is a guide only, it is not intended to infer that all combinations can or will be produced.*
1. Electro Nickel Plated. 2. Grooved end only.

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Section 1-D

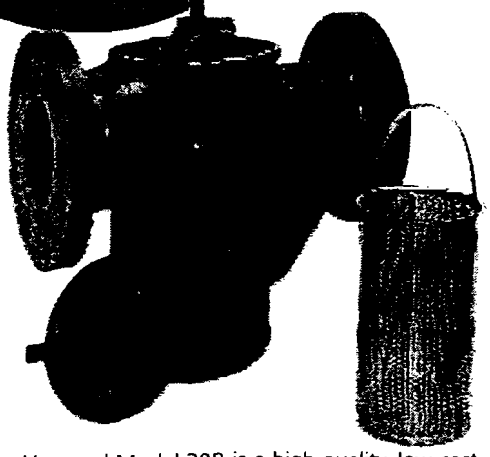
Basket Strainer (BS-104)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Model 30R Economy Basket Strainer

Sizes 1-1/2" to 8" • Iron • Threaded or Flanged

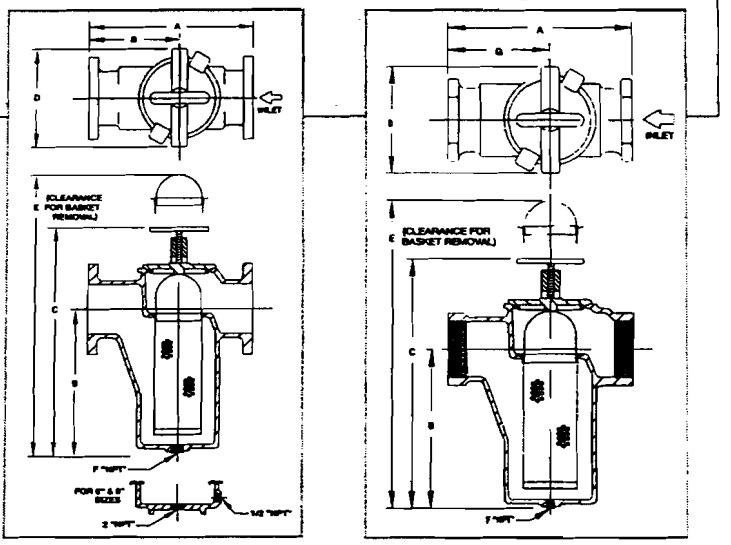
Economical System Protection



The Hayward Model 30R is a high quality, low cost simplex basket strainer...perfect for cost sensitive applications. While the cost of the Model 30R is low, its design incorporates many features found only on more expensive units including machined basket seats to protect against bypass insuring all of the flow is strained. The cover of the Model 30R is a clamp type and is hand removable without the need for tools, this makes access to the basket quick and easy for cleaning or change out and every size strainer comes standard with a drain plug. The Model 30R is the best choice simplex strainer for low or moderate pressure applications such as swimming pools, cooling towers, and large air conditioning installations.

Features:
- Hand removable cover
- Drain plug
- Machined basket seat
- Standard perforated stainless steel basket

Options:
- Basket perforations from 1/32" to 1/2"
- Basket mesh from 20 to 400
- Monel baskets
- Vent Valves
- Drain Valves
- 1/4" NPT taps
- Magnetic basket inserts
- Pressure differential gauges and switches



Dimensions and weights are for reference only. Contact Hayward for certified drawings.

Dimensions (in / mm) Flanged

Pipe Size	A	B	C	D	E	F	G	Dry Wt. lb / kg
1-1/2	7.75 / 197	6.50 / 165	10.63 / 270	6.00 / 152	14.88 / 378	3/4 / 20	4.44 / 113	12 / 5.5
2	9.63 / 245	7.50 / 191	11.63 / 295	7.50 / 191	17.38 / 441	1-1/4 / 32	5.63 / 143	27 / 12.3
2-1/2	11.00 / 279	9.13 / 232	15.25 / 387	8.00 / 203	22.38 / 568	1-1/4 / 32	5.88 / 149	45 / 20.5
3	11.88 / 302	9.13 / 232	15.25 / 387	8.00 / 203	22.38 / 568	1-1/4 / 32	6.50 / 165	59 / 26.6
4	13.75 / 349	9.63 / 245	16.63 / 422	9.25 / 235	30.00 / 762	1-1/2 / 40	8.44 / 214	71 / 32.2
* 6	17.50 / 445	12.38 / 315	26.13 / 664	14.75 / 375	35.00 / 889	2 / 50	10.31 / 262	150 / 68.1
8	23.63 / 600	17.75 / 451	32.63 / 829	14.75 / 375	48.00 / 1219	2 / 50	14.50 / 368	230 / 104.3

Dimensions (in / mm) Threaded

Pipe Size	A	B	C	D	E	F	G	Dry Wt. lb / kg
1-1/2	7.00 / 178	6.50 / 165	10.63 / 270	6.00 / 152	14.88 / 378	3/4 / 20	3.88 / 99	7 / 3.2
2	8.50 / 216	7.50 / 191	11.63 / 295	7.50 / 191	17.38 / 441	1-1/4 / 32	4.81 / 122	20 / 9.1
2-1/2	11.50 / 292	9.13 / 232	15.25 / 387	8.00 / 203	22.38 / 568	1-1/4 / 32	6.00 / 152	34 / 15.5
3	11.50 / 292	9.13 / 232	15.25 / 387	8.00 / 203	22.63 / 575	1-1/4 / 32	6.00 / 152	34 / 15.5

Selection Chart

Size	Material	End Connections*	Seals	Pressure Rating
1-1/2" to 3"	Iron	Threaded	Buna N	200 psi at 100F
1-1/2" to 8"		Threaded or Flanged 125#		

* DIN flanges and BSP threads available

C_V Factors*

Size	Value	Size	Value
1-1/2"	58	4"	240
2"	90	6"	370
2-1/2"	140	8"	600
3"	200		

* For water with clean, perforated basket

Installation Considerations

Installation Considerations

For protection of pipeline equipment under relatively clean service conditions where there is little debris loading for both vapor (natural gas, air, steam etc.) and liquid service, a y-strainer is generally the strainer of choice. In liquid service applications however, where the debris loading is higher and collection of solids is required, basket strainers should be considered. This is because basket strainers, both simplex and duplex, have more gross strainer basket area than a y-strainer has gross screen area, and the ratio of free area to pipe area for basket strainers is greater than for a similar size y-strainer.

Y-strainers can be installed in either a horizontal or vertical pipeline, whereas basket type strainer are designed for installation in horizontal lines. The flow must always be into the inlet – into the screen or basket (s) – for satisfactory operation. If y-strainers are installed in a vertical line, the flow must be from top to bottom (downward). The blow down (drain) may be angled 45 degrees maximum.

The following items should all be considered in selecting the proper strainer of an application:

The material of construction.
The design and working pressures.
The design and working temperatures.
The service (liquid or vapor).
The flow rate and viscosity (if a liquid).
The particle size to be retained.
The debris loading.
The seal material (o-ring or gasket).
Whether the line flow can be interrupted or not for basket/screen cleaning.
The clean start up pressure.
The location of the strainer.

Cast iron and carbon steel construction basket strainers are generally acceptable for fresh/city water, and lube oil services. Bronze and stainless steel are generally acceptable for brackish/salt water use. Carbon steel is generally acceptable for straining fuel oils. Stainless steel is generally acceptable for most chemical applications.

Y-strainers constructed of cast iron, bronze, carbon and stainless steel are generally acceptable for steam, air, natural gas or liquids.

Don't overstrain, the opening in the basket or screen should never be smaller than one-half the size of the largest particle whose presence in the system is considered harmful.

Back to "Installation Considerations"

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www.haywardindustrial.com

Operating Instructions
Model 30R
Pipeline Strainer

April 8, 2003

HAYWARD SIMPLEX STRAINER MODEL 30R OPERATING INSTRUCTIONS

All Hayward basket strainers are "one-way". Inlet and outlet ports are indicated on the strainer body. If there is any doubt, fluid flow should always be into the top of the strainer basket and then out through the basket sides. Thus, all unwanted material is retained in the basket.

TO OPERATE HAYWARD SIMPLEX STRAINERS

1. Be sure the cover is tightly closed.
2. Be sure the drain is closed.
3. Open the valve on the outlet side of the strainer.
4. Slowly open the valve on the inlet side of the strainer (to prevent damage from water hammer).
5. The strainer is now in service

TO CLEAN HAYWARD SIMPLEX STRAINERS

1. Close the valve on the inlet side of the strainer.
2. Close the valve on the outlet side of the strainer.
3. Open the drain.
4. To remove the basket from the strainer, loosen the yoke screw and swing the yoke free of the cover area.
5. Remove the cover from the top of the strainer.
6. The basket handle will protrude slightly out of the strainer well. (This unique design offers both a means of removing the basket easily and also allows the basket to be firmly seated around the machined seating surface when closed.) Remove the basket from the well by pulling straight up on the basket handle.
7. Clean the basket by using a brush or by soaking in a solvent or cleaning solution. Avoid striking baskets to loosen their contents. This will dent them out of shape and eventually break the welds. Baskets should be cleaned as soon as possible after removal from the strainer. Otherwise, the contents may harden and become difficult to remove. It is recommended that one spare basket be kept on hand at all times. When changing baskets for cleaning, we suggest that the spare or cleaned basket be installed in the strainer so your start up is not delayed cleaning the used basket.
8. Install the basket in the strainer. Be sure the cover O-ring is on the cover. The basket should be properly centered in the well and firmly seated. Replace the cover. The cover should be centered before the yoke screw is tightened. The O-ring should be periodically inspected for nicks and tears. A spare O-ring should also be kept on hand. Check the O-ring seating surface, it should be kept free of dirt and grit.
9. Swing the yoke over the well cover and make sure the yoke is connected to the yoke stud. Tighten the yoke screw down to the well cover only until a seal is made between the well cover and the strainer body.
10. The strainer is now ready to be put back in operation. Follow the steps listed above under "To Operate Hayward Simplex Strainers

Section 1-E

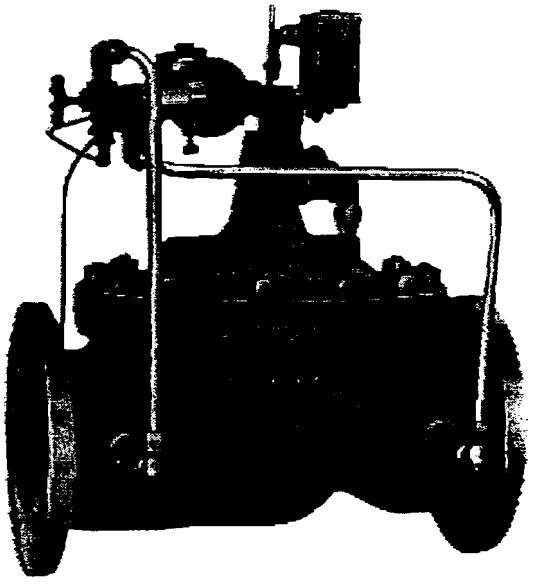
Pressure Regulating Valve (V-105/SOV-101)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

CLA-VAL

MODEL 60-31 / 660-31

Booster Pump Control Valve



- **Simple Hydraulic Operation**
- **Low Head Loss**
- **Built-in Check Valve**
- **Proven Reliable Design**

The Cla-Val Model 60-31/660-31 Booster Pump Control valve is a pilot-operated valve designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump.

The pump starts against a closed valve. When the pump is started, the solenoid control is energized and the valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops.

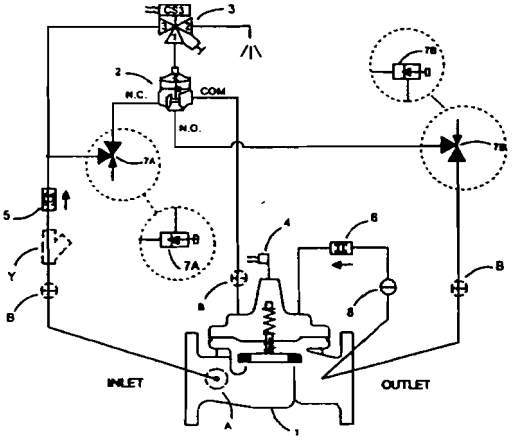
The Model 60-31/660-31 is an automatic valve of a modified globe-type design with a built-in, lift type, check feature. It is hydraulically operated and diaphragm-actuated. A three-way solenoid valve controls the valve operation. Flow control valves located in the pilot control system provide regulation of both the opening and closing rate. Self-cleaning strainers insure that the pilot control supply is clean.

Schematic Diagram

Item	Description
1	Hycheck (Main Valve)
2	102C-3H Three Way Hytrol
3	CS3SM Solenoid Control
4	X105LCW Switch Assembly
5	CDC Disk Check Valve
6	CDC/CSC Check Valve
7	CNA Angle Valve
8	CK2 Cock (Isolation Valve)

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Cock (Isolation Valve)
Y	X43 "Y" Strainer

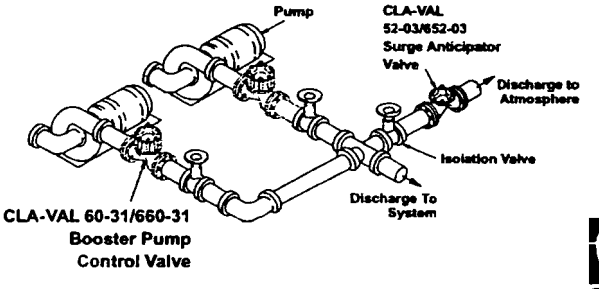
Note: For main valve option descriptions, refer to the 100-04 (60-31) or 100-23 (660-31) Technical Data Sheet.



Typical Application

Install Model 60-31/660-31 valve as shown. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch. A Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.

Designed for multiple pump applications.



CLA-VAL

Model 60-31 (Uses Basic Valve Model 100-04)

Specifications

Available Sizes

Pattern	Flanged
Globe	4" - 16"
Angle	4" - 16"

Operating Temp. Range

Fluids
-40° to 180° F

Cover Capacity

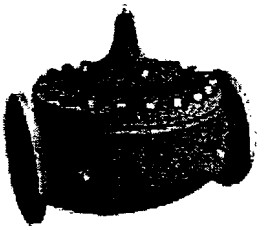
Liquid Volume Displaced from Diaphragm Chamber When Valve Opens			
Valve Size	Displacement	Valve Size	Displacement
4"	.169 gal	12"	4.00 gal
6"	.531 gal	14"	6.50 gal
8"	1.26 gal	16"	9.57 gal
10"	2.51 gal	24"	9.57 gal

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 lb.	300 lb.
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400
ASTM A743	Stainless Steel	B16.5	285	400
356-T6	Aluminum	B16.1	275	—

Note:
*ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.

4" Globe, Flanged

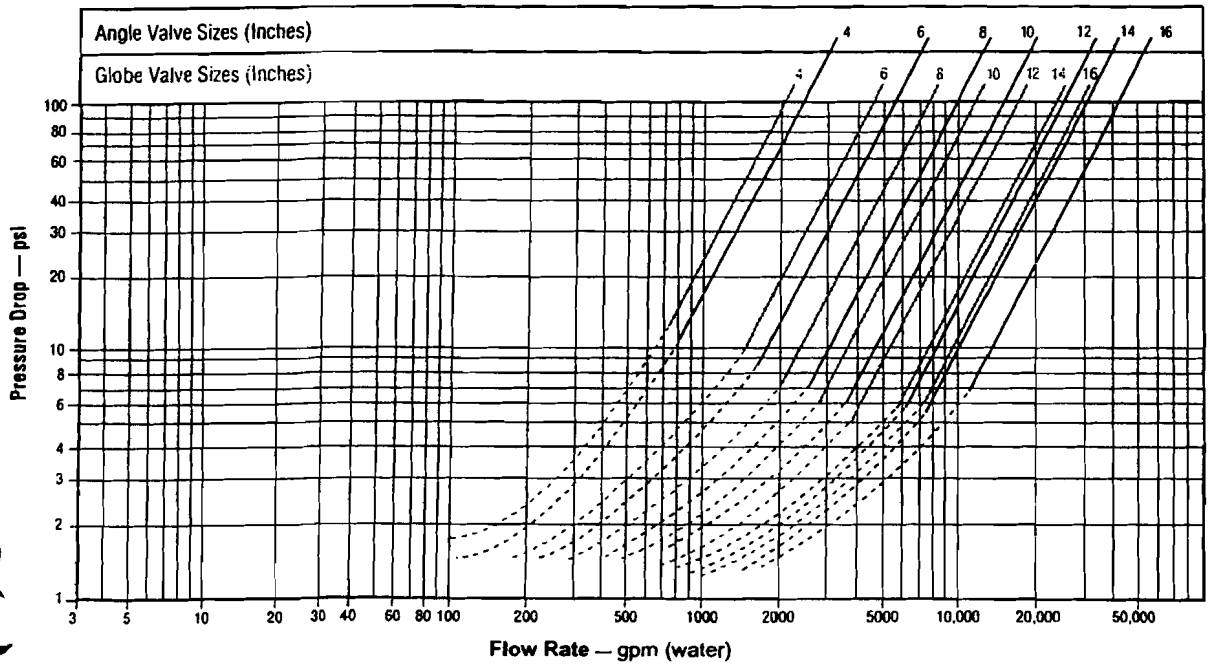


12" Globe, Flanged

Materials

Component	Material Options				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	4" - 16"	4" - 16"	4" - 16"	4" - 16"	4" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is standard. Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

Model 60-31 Flow Chart (Based on normal flow through a wide open valve.)



Model 660-31 (Uses Basic Valve Model 100-23)

Specifications

Available Sizes

Pattern	Flanged
Globe	6" - 24"
Angle	6", 8"

Operating Temp. Range

Fluids
-40° to 180° F

Cover Capacity

Liquid Volume Displaced from Diaphragm Chamber When Valve Opens			
Valve Size	Displacement	Valve Size	Displacement
6"	.169 gal	12"	2.51 gal
8"	.531 gal	16"	4.00 gal
10"	1.26 gal	20"	9.57 gal
		24"	9.57 gal

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 lb.	300 lb.
ASTM A536	Ductile Iron	B16.42	250	400
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ASTM B62	Bronze	B16.24	225	400
ASTM A743	Stainless Steel	B16.5	285	400
356-T6	Aluminum	B16.1	275	—

Note: *ANSI standards are for flange dimensions only. Flanged valves are available faced but not drilled.

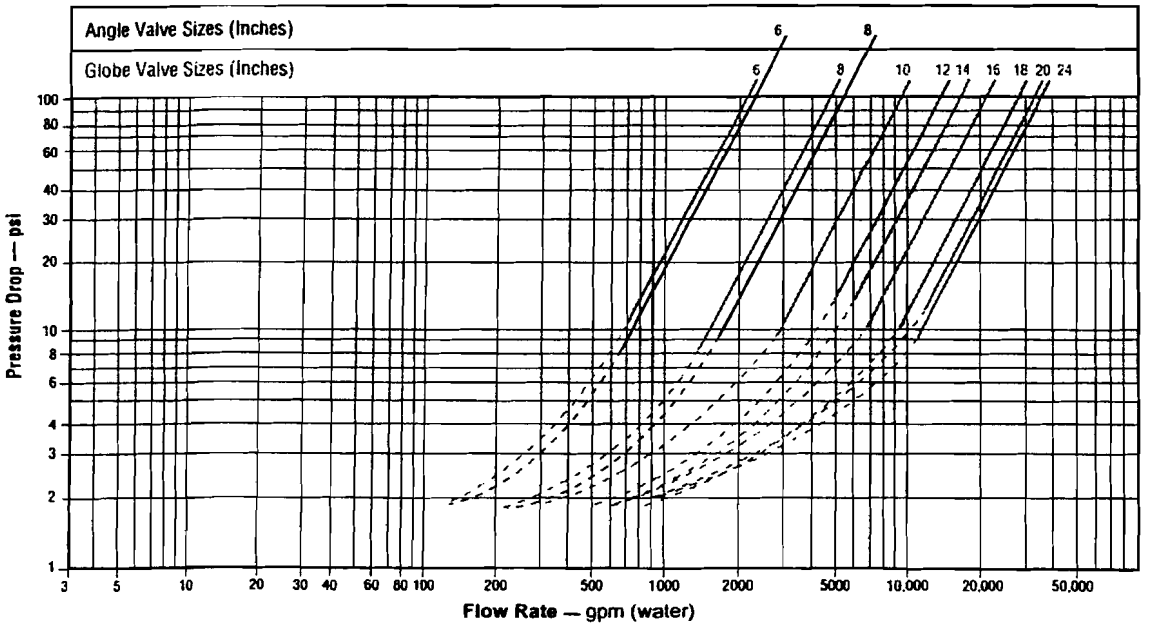
6" Globe, Flanged

Materials

Component	Material Options				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	6" - 24"	6" - 24"	6" - 16"	6" - 16"	6" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is standard. Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna N® Rubber				
Diaphragm	Nylon Reinforced Buna N® Rubber				
Stem, Nut & Spring	Stainless Steel				

12" Globe, Flanged

Model 660-31 Flow Chart (Based on normal flow through a wide open valve.)



Valve Selection

		These Symbols ▲ and ▲ Indicate Available Sizes									
	Inches	4	6	8	10	12	14	16	18	20	24
	mm	100	150	200	250	300	350	400	450	500	600
	End Detail	Flanged									
Model 60-31	Basic Valve 100-04 Globe	▲	▲	▲	▲	▲	▲	▲			
	Basic Valve 100-04 Angle	▲	▲	▲	▲	▲	▲	▲			
	Suggested Flow (GPM) Max. Continuous	800	1800	3100	4900	7000	8400	11000			
	Suggested Flow (GPM) Max. Intermittent	990	2250	3900	6150	8720	10540	13700			
	Suggested Flow (Liters/sec) Max. Continuous	50	113	195	309	441	529	693			
	Suggested Flow (Liters/sec) Max. Intermittent	62	142	246	387	549	664	863			
Model 660-31	Basic Valve 100-23 Globe		▲	▲	▲	▲	▲	▲	▲	▲	▲
	Basic Valve 100-23 Angle		▲	▲							
	Suggested Flow (GPM) Max. Continuous		1025	2300	4100	6400	9230	9230	16500	16500	16500
	Suggested Flow (Liters/sec) Max. Continuous		65	145	258	403	581	581	1040	1040	1040

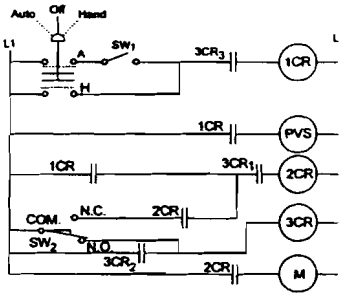
+ 660-31 is the reduced internal port size version of the 60-31.

For 100-04 basic valves suggested flow calculations were based on flow through Schedule 40 Pipe. Maximum continuous flow is approx. 20 ft/sec (6.1 meters/sec) & maximum intermittent is approx. 25 ft /sec (7.6 meters/sec). For 100-23 basic valves suggested flow calculations were based on flow through the valve seat. Approx. 26 ft/sec (7.9 meters/sec) is used for maximum continuous flow.

Wiring Diagram

Auto-Off-Hand = Selector Switch
1CR = Relay, DPST Normally Open
2CR = Relay, DPST Normally Open
3CR = Relay, TPST Normally Open
SW_1 = Switch, Remote Start, Automatic
SW_2 = Switch, SPDT, Valve Limit Switch Connect to N.C. Terminal
PVS = Pilot Valve Solenoid
M = Pump Motor Starter

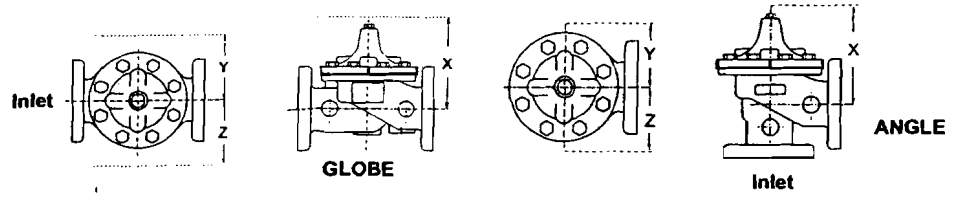
Note: SW_2 and PVS supplied by Cla-Val Co. All other electrical items supplied by customer. SW_2 is included in the X105L switch assembly which is mounted on the pump control valve cover.



Pilot System Dimensions (In Inches)

We recommend providing adequate space around valve for maintenance work.

Valve Size	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
X Max.	20.00	23.75	26.75	33.50	39.00	42.25	46.00	46.00	50.25	50.25
Y Max.	6.00	8.00	10.25	12.00	14.25	16.75	18.00	18.00	18.00	18.00
Z Max.	11.00	13.00	15.00	17.00	19.00	22.00	23.00	23.00	23.00	23.00



Pilot System Specifications

Temperature Range
Water: to 180°F Max

Materials
Standard Pilot System Materials
Pilot Control:Bronze ASTM B62
Trim:Stainless Steel Type 303
Rubber:Buna-N® Synthetic Rubber
Optional Pilot System Materials
Pilot Systems are available with optional Aluminum, Stainless Steel or Monel materials at extra cost.

Solenoid Control
Body:
Brass ASTM B283
Enclosure:
NEMA Type 1,2,3,3S,4,4X general purpose
NEMA Type 6,6P,7,9 watertight Explosion Proof available at extra cost

Voltages:
110, 220, -50Hz Ac
24, 120, 240, 480 - 60Hz AC
6, 12, 24, 120, 240 - DC
Others available at extra cost

Max. operating pressure differential: 200 psi*

Coil:

Insulation molded Class	F
Watts AC	6
AC Volt Amps Inrush	30
AC Volt Amps Holding	16
Watts DC	10.6

Note: For optimum operation of built-in check feature, installation with valve stem vertically position is recommended.

When Ordering, Please Specify

1. Catalog No. 60-31 or No. 660-31
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Screwed or Flanged
6. Trim Material
7. Electrical Selection
8. Desired Options
9. When Vertically Installed

CLA-VAL

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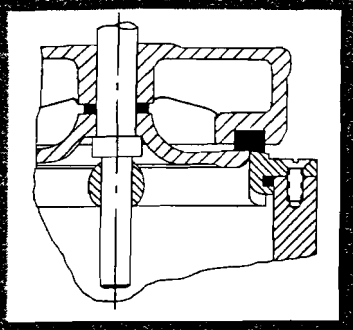
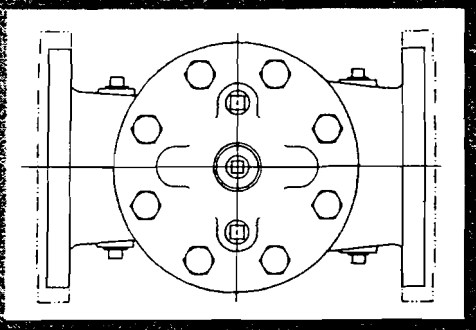
Phone: 905-563-4963
Fax: 905-563-4040

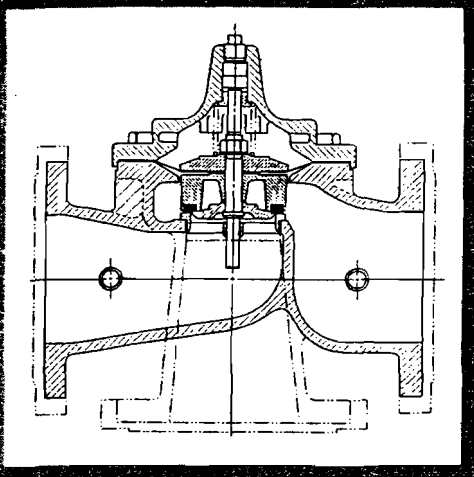
CLA-VAL EUROPE
Chemin des M sanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50

www.cla-val.com

Represented By:

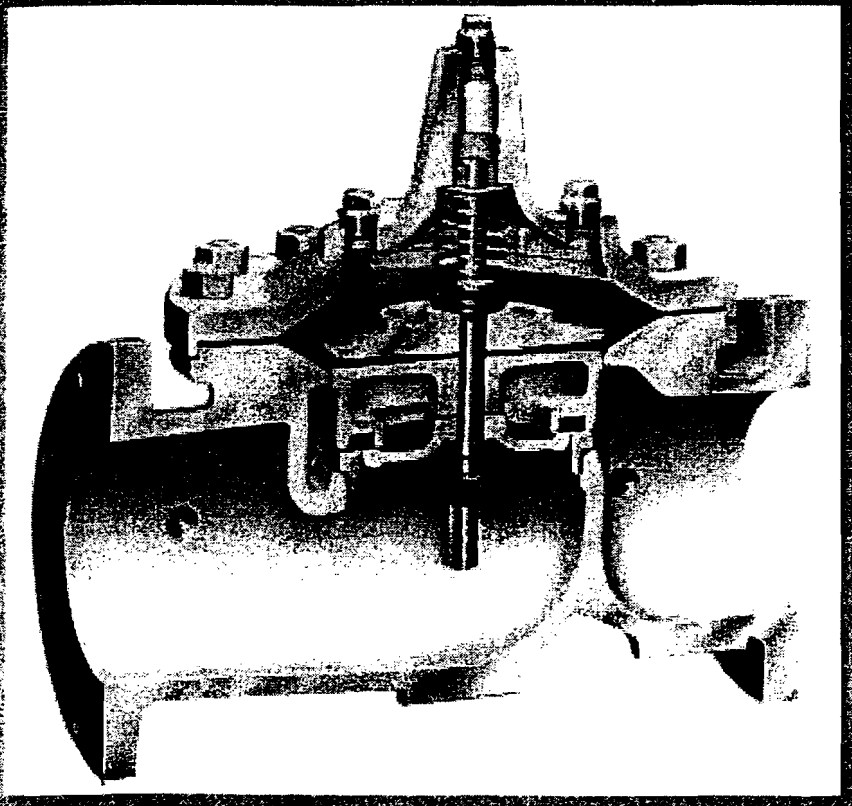






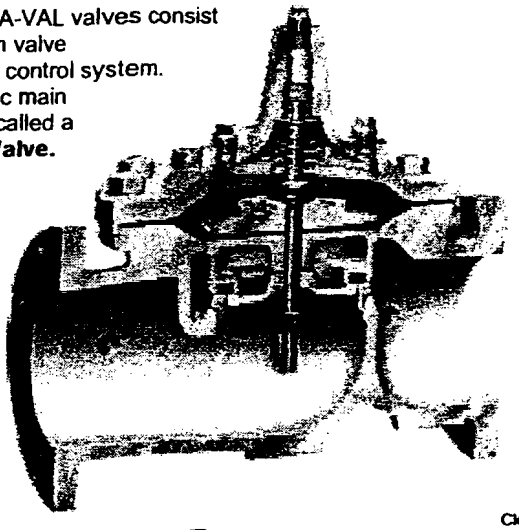
CLA-VAL®

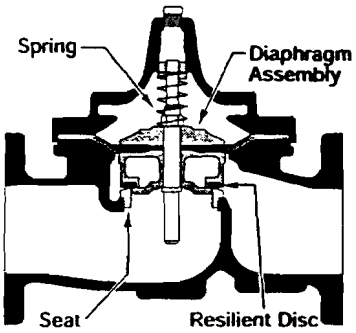
Inside CLA-VAL Automatic Control Valves



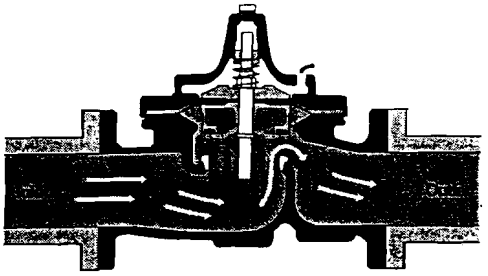
BASIC MAIN VALVE

Most CLA-VAL valves consist of a main valve and pilot control system. The basic main valve is called a **Hytrol Valve.**

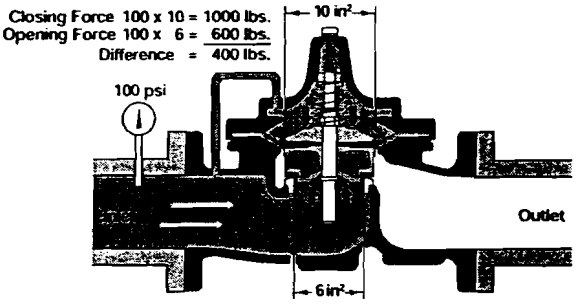




When no pressure is in the valve, the spring and the weight of the diaphragm assembly hold the valve closed.



With the cover chamber vented to atmosphere, the valve will open from line pressure under the disc.

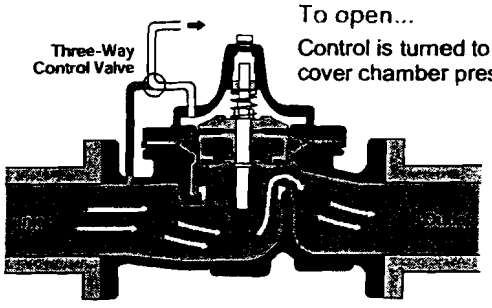


If inlet pressure is connected into the cover chamber, the valve closes tightly. In this example, the 400 pound difference is the force which pushes the disc against the seat and causes the valve to seal drip-tight.

NON-MODULATING CONTROLS

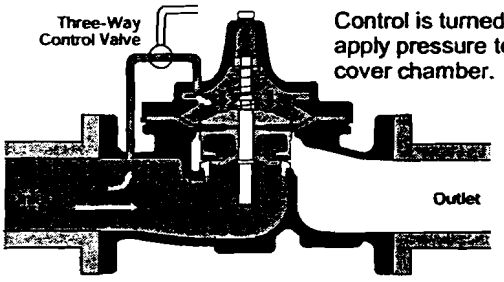
A simple control which either opens the valve wide or closes it tightly is a three-way valve. The type of operation this control gives is called "non-modulating" because the valve cannot pause in a partially open position.

Once the control is turned to either position, operating fluid flows into or out of the cover chamber until the valve is open or closed. For example...



To open...

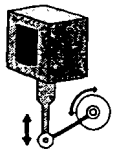
Control is turned to exhaust cover chamber pressure.



To close...

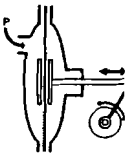
Control is turned to apply pressure to cover chamber.

Ordinary three-way valves usually are not satisfactory because they require so much force to operate. An easy-turning control which can be operated in a variety of ways is usually used. Here are some of them and how they are operated...



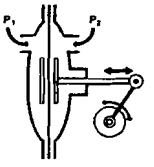
With a solenoid

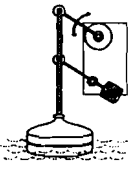
By hand



By pressure

By a difference in two pressures





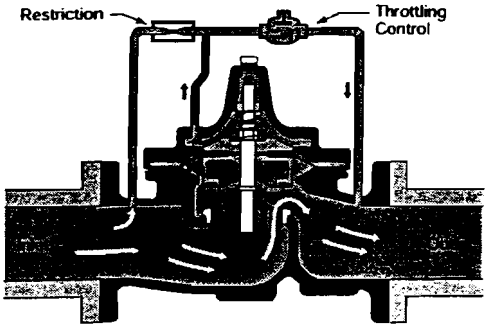
By a float

MODULATING CONTROLS

So far only valves that either open wide or close tightly (non-modulating) have been illustrated. The CLA-VAL Automatic Valve modulates if the cover pressure is held between the inlet and outlet pressure. To do this requires a slightly different kind of control system.

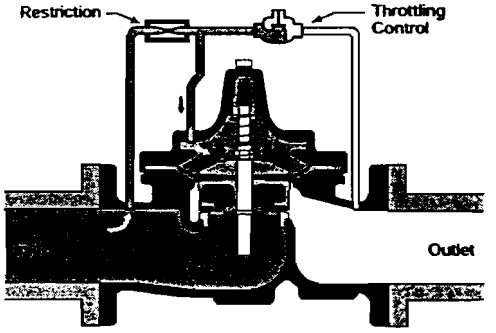
Valve Open

When the throttling control opens to a point where more pressure is relieved from the cover chamber than the restriction can supply, cover pressure is reduced and the valve opens.



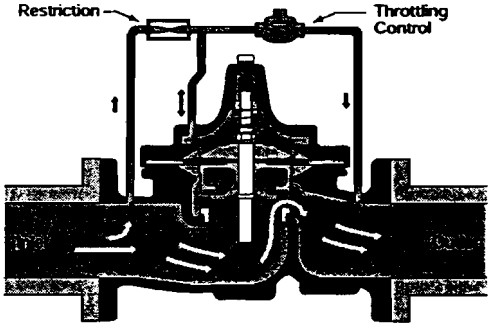
Valve Closed

When the modulating control closes sufficiently to direct a great enough pressure into the cover chamber to overcome opening forces of line pressure, the main valve closes.



ValveThrottling

The main valve modulates to any degree of opening in response to changes in the throttling control. At an equilibrium point the main valve opening and closing forces hold the valve in balance. This balance holds the valve partially open, but immediately responds and readjusts its position to compensate for any change in the controlled condition.

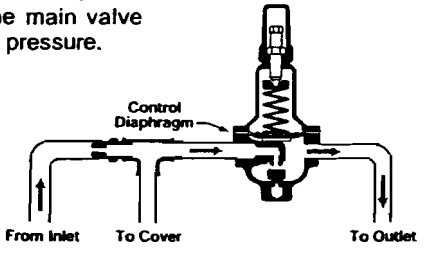


AUTOMATIC CONTROLS

Some of the automatic controls which will make many types of operation possible are shown here...

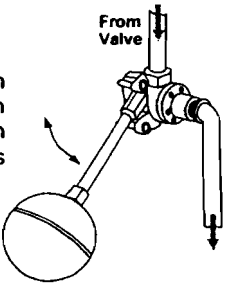
Pressure Reduction

Outlet pressure on control diaphragm causes the main valve to hold a steady outlet pressure.



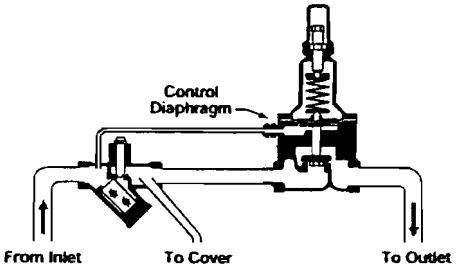
Liquid Level Controller

Slight changes in flow through the float control causes main valve to counteract changes in reservoir level so liquid level is held constant.



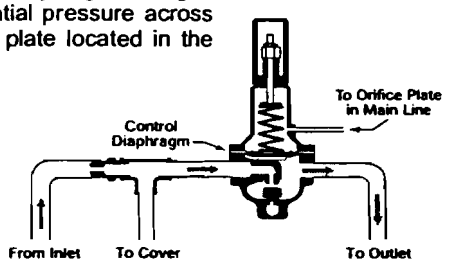
Pressure Relief

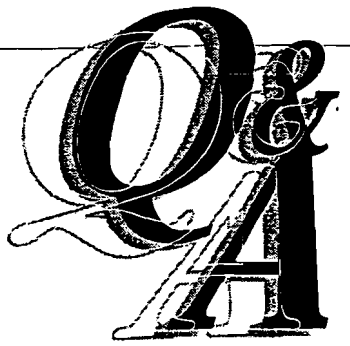
Inlet pressure on control diaphragm causes the main valve to hold a steady inlet pressure.



Rate of Flow Controller

Limits the maximum flow rate by changes to the main valve counteract any slight changes in differential pressure across an orifice plate located in the main line.

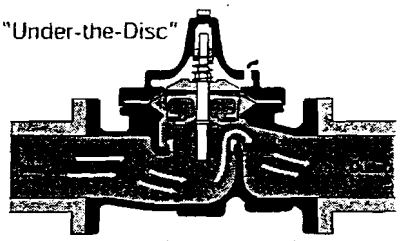




Q Which way should fluid flow through a CLA-VAL Valve?

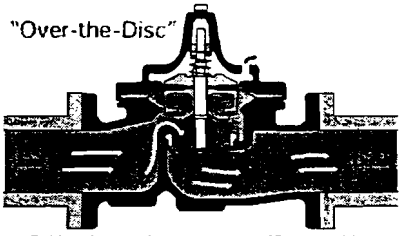
A Just as with any globe valve, the usual way is "under–the–disc" as shown. The main exception to the "under-the-disc" rule of thumb is the check valve.

"Under-the-Disc"



Normal so valve closes against the pressure

"Over-the-Disc"



O.K.... but only under specific conditions

Q What is the spring for in a Hytrol valve?

A To provide enough force to close the valve when no difference exists between inlet, cover and outlet pressures. When the inlet pressure is greater than outlet pressure (even by a small amount) the hydraulic forces, NOT THE SPRING hold the valve tightly closed.

Q Can pressure other than line pressure be used to operate CLA-VAL Valves?

A Yes. Frequently, when line fluid is too dirty or otherwise unsuitable, a separate source of pressure is desired. Clean water, air (with some limitations), or oil are suitable. The important point is to make sure the operating pressure is equal or greater than inlet pressure AT ALL TIMES.

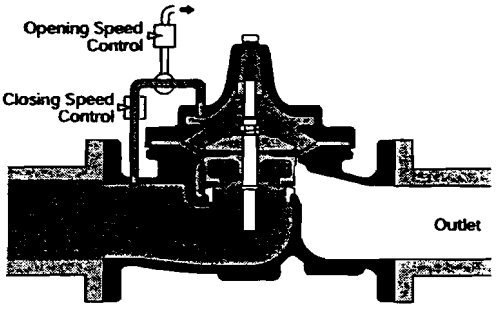
Q What should be done if line pressure is very low? (Below 10 psi)

A Usually a separate source of operating pressure is required. A spring to open the valve may be necessary. Consult the factory for recommendations.

Q Can the opening and closing speed of a CLA-VAL Valve be controlled?

A Yes. It is a matter of controlling the rate at which operating fluid flows into or out of the cover chamber.

Here is a typical valve equipped with both opening and closing speed controls. A simple needle valve can be used for these controls.



CLA-VAL®

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CLA-VAL SA
Chemin des Mesanges 1
CH-1032 Romanel/
Lusanne, Switzerland
Phone: 41-21-643-15-55
FAX: 41-21-643-15-50

B-48 (R798)

CLA-VAL

Purchase Specification

Model No. 60-31/660-31
BOOSTER PUMP CONTROL VALVE
Sizes 4" - 24"

Function
The Booster Pump Control Valve is designed for installation on the discharge of booster pumps to eliminate starting and stopping surges caused by the pump. The valve shall be equipped with a builtin lift type check feature to prevent reverse flow. It shall operate independently of the solenoid control.

Main Valve
The valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

Main Valve Body
No separate chambers shall be allowed between the main valve cover and body. The valve body and cover shall be of cast material. Ductile Iron is standard and other materials shall be available. No fabrication or welding shall be used in the manufacturing process. Total shipping weight shall be equal or greater in all respects to the Hytrol 100-04/100-23 body.

The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

The diaphragm assembly containing a nonmagnetic two piece stainless steel stem of sufficient diameter to withstand high hydraulic pressures and shall be guided by two bearings; in the valve cover and an integral bearing in the valve seat. The builtin lift type check is designed to prevent pressure reversal caused by power failure. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

The flexible, nonwicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc guide, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of North American manufacture.

Purchase Specification

The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one year warranty. The valve manufacturer shall be able to supply a complete line of equipment from 4" through 24" sizes and a complete selection of complementary equipment.

Material Specification
Valve Size:
Main Valve Body and Cover:
Main Valve Trim:
End Detail:
Pressure Rating:
Temperature Range:
Rubber Material:
Coating:
Desired Options:
Pilot Control System

Control of valve operation shall be by means of an externally mounted, three-way solenoid pilot valve. The solenoid shall be designed to operate on either AC or DC current and have a manual operator installed. The valve shall utilize line pressure for operation.

Limit Switch
An adjustable limit switch assembly shall be mounted on the main valve connected to the main valve stem. It shall be actuated by opening or closing of the valve and easily adjusted to operate at any point of the valve's travel. The limit switch will be used to complete the pump-off cycle.

A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

Material Specification for Pilot Control:
Pressure Rating:
Trim:
Rubber Material:
Tubing and Fittings:
Operating Fluids:
Adjustment Range:
Solenoid Voltage:
Solenoid Enclosure Type:
Desired Options:

This valve shall be a Cla Val Co. Model No. 60-31/660-31 Booster Pump Control Valve as manufactured by Cla Val Co., Newport Beach, CA 92659-0325.

CLA-VAL

ENGINEERING DATA

Flow of Water Through Standard Wrought Iron or Steel Pipe

Based on Saph and Schoder Formula

Note: For old or rough pipes add 25% to the pressure drop given in the table. Velocities given in light face type. Pressure drop given in bold face type.

$$P = \frac{3.68V^{1.86}}{d^{1.25}}$$

P = Pressure drop, lbs. per sq. in. per 1000 ft. of pipe
V = Velocity, feet per second
d = Inside diameter of pipe, inches

PRESSURE DROP POUNDS PER SQ. IN. PER 1000 FT. OF PIPE
(1.0 Lb. per Sq. In. = 2.30 Ft. of Water)

Discharge Gallons Per Mn.	1" Vel. Ft. per Sec.	1" Pressure Drop	1 1/4" Vel. Ft. per Sec.	1 1/4" Pressure Drop	1 1/2" Vel. Ft. per Sec.	1 1/2" Pressure Drop	2" Vel. Ft. per Sec.	2" Pressure Drop	2 1/2" Vel. Ft. per Sec.	2 1/2" Pressure Drop	3" Vel. Ft. per Sec.	3" Pressure Drop	3 1/2" Vel. Ft. per Sec.	3 1/2" Pressure Drop	4" Vel. Ft. per Sec.	4" Pressure Drop	5" Vel. Ft. per Sec.	5" Pressure Drop
1	0.37	0.55																
2	0.74	2.00	0.43	0.50														
3	1.12	4.25	0.64	1.08	0.47	0.50												
4	1.49	7.30	0.86	1.85	0.63	0.86												
5	1.86	11.10	1.07	2.81	0.79	1.31												
6	2.24	15.40	1.28	3.94	0.95	1.82												
8	2.98	25.30	1.72	6.70	1.26	3.11	0.57	0.52										
10	3.72	40.00	2.14	10.20	1.57	4.70	0.76	0.88	0.67	0.55								
15	5.60	85.00	3.21	21.80	2.36	10.10	0.96	1.34	1.00	1.18								
20	7.44	145.00	4.29	36.80	3.15	17.10	1.43	2.85	1.34	2.00	0.87	0.68						
25			5.36	56.00	3.94	26.00	1.91	4.85	1.68	3.04	1.08	1.02	0.81	0.49				
30			6.43	78.50	4.72	36.40	2.39	7.32	2.01	4.26	1.30	1.44	0.97	0.69				
35			7.51	100.00	5.51	48.30	2.87	10.40	2.35	5.14	1.52	1.92	1.14	0.93	0.86	0.49		
40					6.30	62.50	3.35	13.70	2.68	7.29	1.74	2.45	1.30	1.18	1.01	0.63		
45					7.08	78.00	3.82	17.60	3.00	9.12	1.95	3.08	1.46	1.48	1.13	0.79		
50					7.87	94.00	4.30	22.10	3.35	11.00	2.17	3.72	1.62	1.80	1.26	0.96		
60							4.78	26.70	4.02	15.50	2.60	5.20	1.95	2.54	1.51	1.24		
70							5.74	37.50	4.69	21.40	3.04	7.25	2.27	3.48	1.76	1.88	1.12	0.57
80	6"						6.69	51.80	5.37	26.40	3.48	8.90	2.59	4.33	2.01	2.30	1.28	0.70
90							7.65	63.80	6.04	32.80	3.91	11.10	2.92	5.31	2.26	2.86	1.44	0.87
100	1.11	0.45					8.60	79.10	6.71	40.00	4.34	13.50	3.24	7.78	2.52	3.47	1.60	1.06
125	1.39	0.68					9.56	96.80	8.38	60.60	5.42	20.50	4.05	9.90	3.15	5.28	2.00	1.62
150	1.67	0.95							10.06	87.10	6.51	28.80	4.86	13.90	3.78	7.40	2.41	2.28
175	1.94	1.26	8"						11.73	115.90	7.59	39.00	5.67	18.40	4.41	9.80	2.81	3.00
200	2.22	1.62									8.68	49.00	6.48	23.60	5.04	12.80	3.21	3.85
225	2.50	2.00	1.44	0.51							9.77	60.60	7.29	29.30	5.67	15.80	3.61	4.76
250	2.78	2.45	1.60	0.63							10.85	74.10	8.10	35.80	6.30	19.00	4.01	5.85
275	3.06	2.93	1.76	0.74							11.94	88.20	8.91	42.80	6.93	22.80	4.41	6.92
300	3.33	3.44	1.92	0.87							13.02	104.00	9.72	50.20	7.56	26.80	4.81	8.20
325	3.61	3.98	2.08	1.02									10.53	58.00	8.18	31.00	5.21	9.55
350	3.89	4.55	2.24	1.12	10"								11.35	66.80	8.82	35.70	5.61	10.90
375	4.16	5.17	2.40	1.32									12.17	75.20	9.45	40.30	6.01	12.40
400	4.44	5.85	2.56	1.49	1.63	0.48							12.97	85.30	10.08	45.50	6.41	14.00
425	4.72	6.53	2.72	1.67	1.73	0.53							13.78	95.30	10.70	50.70	6.82	15.60
450	5.00	7.28	2.88	1.85	1.83	0.59							14.59	106.00	11.33	56.80	7.22	17.40
475	5.27	8.07	3.04	2.05	1.93	0.66							15.40	118.00	11.96	62.80	7.62	19.20
500	5.55	8.90	3.20	2.28	2.04	0.73	12"								12.59	69.30	8.02	21.30
550	6.11	10.60	3.53	2.71	2.24	0.87									13.84	82.70	8.82	25.40
600	6.66	12.50	3.85	3.18	2.44	1.02									15.10	97.00	9.62	29.80
650	7.21	14.40	4.17	3.67	2.65	1.18	1.84	0.48							16.36	112.00	10.42	34.50
700	7.77	16.60	4.49	4.23	2.85	1.36	1.99	0.55	14"								11.22	39.70
750	8.32	19.00	4.81	4.80	3.05	1.54	2.13	0.63									12.02	45.00
800	8.88	21.30	5.13	5.41	3.26	1.73	2.27	0.70									12.82	50.80
850	9.44	23.70	5.45	6.05	3.46	1.94	2.41	0.79	1.98	0.48							13.62	56.70
900	10.00	26.40	5.77	6.72	3.66	2.16	2.55	0.87	2.10	0.53							14.42	62.80
950	10.55	29.20	6.09	7.45	3.87	2.38	2.69	0.96	2.21	0.59	16"						15.22	69.80
1,000	11.10	32.30	6.41	8.18	4.07	2.63	2.84	1.06	2.33	0.65							16.02	78.80
1,100	12.22	38.60	7.05	9.82	4.48	3.15	3.12	1.27	2.56	0.78							17.63	91.80
1,200	13.32	45.10	7.69	11.60	4.88	3.64	3.41	1.50	2.80	0.91	2.11	0.45					18.24	106.00
1,300	14.43	52.50	8.33	13.40	5.29	4.30	3.69	1.74	3.03	1.06	2.28	0.52						
1,400	15.54	60.00	8.97	15.40	5.70	4.88	3.97	1.99	3.26	1.22	2.46	0.60	18"					
1,500	16.65	68.80	9.62	17.50	6.10	5.59	4.26	2.28	3.49	1.39	2.64	0.69						
1,600	17.76	77.10	10.26	19.70	6.51	6.29	4.54	2.56	3.73	1.56	2.81	0.77						
1,800	19.98	96.10	11.54	24.50	7.32	7.85	5.11	3.19	4.19	1.93	3.16	0.96	2.47	0.52	20"			
2,000	22.20	117.00	12.83	29.90	8.13	9.57	5.67	3.86	4.66	2.37	3.51	1.17	2.75	0.63				
2,500			16.03	45.10	10.18	14.50	7.09	5.88	5.82	3.58	4.39	1.77	3.43	0.96				
3,000			19.24	63.20	12.21	20.40	8.51	8.23	6.98	5.02	5.27	2.49	4.12	1.35	3.30	0.55	24"	
3,500			22.43	84.00	14.25	27.20	9.93	10.90	8.16	6.68	6.14	3.31	4.81	1.79	3.85	0.78		
4,000			25.65	108.00	16.28	34.70	11.35	14.10	9.32	8.52	7.02	4.22	5.49	2.29	4.41	1.04	3.02	0.51
4,500					18.31	43.20	12.76	17.40	10.48	10.60	7.90	5.22	6.18	2.85	4.96	1.32	3.40	0.64
5,000					20.35	52.30	14.18	21.30	11.63	12.90	8.78	6.40	6.86	3.48	5.51	1.64	3.78	0.79
6,000					24.42	73.10	17.02	29.80	13.97	18.20	10.52	8.98	8.24	4.85	6.61	2.00	4.54	1.09
7,000					28.50	98.00	19.85	39.60	16.30	23.20	12.28	11.90	9.61	6.47	7.71	3.74	5.29	1.45
8,000					32.57	125.00	22.70	50.90	18.62	30.90	14.04	15.20	10.98	8.25	8.82	4.76	6.05	1.86
9,000							25.53	62.80	20.95	38.30	15.79	19.00	12.35	10.30	9.92	5.90	6.81	2.20
10,000							28.37	77.00	23.30	46.70	17.57	23.40	13.73	12.20	11.02	7.22	7.56	2.92
12,000							34.00	108.00	27.95	66.00	21.08	32.70	16.48	17.70	13.22	10.20	9.07	3.96
14,000									32.60	87.50	24.60	43.30	19.22	23.60	15.42	13.50	10.59	4.51
15,000									34.95	99.40	26.35	49.50	20.60	26.70	16.52	15.30	11.34	5.99
16,000									37.25	112.00	28.10	55.40	21.96	30.20	17.62	17.40	12.10	6.78
18,000											31.60	69.20	24.70	37.80	19.83	21.80	13.60	8.45
20,000											35.10	84.80	27.45	45.60	22.03	26.40	15.12	10.30
22,000											38.64	100.00	30.20	54.00	24.23	31.20	16.63	12.20
24,000													32.95	63.80	26.43	36.80	18.15	14.30
25,000													34.30	69.00	27.54	39.80	18.90	15.40
30,000													41.20	96.20	33.04	55.50	22.68	21.80
35,000													48.10	129.00	38.55	74.20	26.45	28.80
40,000															44.10	95.30	30.25	37.00
45,000															49.80	119.00	34.00	45.90
50,000																	37.80	56.00
55,000																	41.60	66.80
60,000																	45.36	78.20

Reprint courtesy of Crane Co.

Flange Dimensions and End Details

CLA-VAL

All flanged Cla-Val valves are furnished faced and drilled unless otherwise specified. The dimensions and drilling of end flanges conform to standards of the American National Standards Institute. The ANSI tables are given here for your convenience. When ANSI standards call for 1/16" raised face, this face is included in the dimensions for the thickness of flange. All dimensions are given in inches.

Ductile Iron Valves* Class 150 and 300 (ANSI B16.42 — 1987)

Nominal Pipe Size	Diameter of Flange		Thickness of Flange		Diameter of Raised Face		Diameter of Bolt Circle		Number of Bolts		Diameter of Bolts		Diameter of Bolt Holes	
Pressure Class	150	300	150	300	150	300	150	300	150	300	150	300	150	300
1.5	5.00	6.12	.56	.81	2.88	2.88	3.88	4.50	4	4	.50	.75	.62	.88
2	6.00	6.50	.62	.88	3.62	3.62	4.75	5.00	4	8	.63	.63	.75	.75
2.5	7.00	7.50	.68	1.00	4.12	4.12	5.50	5.88	4	8	.63	.75	.75	.88
3	7.50	8.25	.75	1.12	5.00	5.00	6.00	6.62	4	8	.63	.75	.75	.88
4	9.00	10.00	.94	1.25	6.19	6.19	7.50	7.88	8	8	.63	.75	.75	.88
6	11.00	12.50	1.00	1.44	8.50	8.50	9.50	10.62	8	12	.75	.75	.88	.88
8	13.50	15.00	1.12	1.62	10.62	10.62	11.75	13.00	8	12	.75	.88	.88	1.00
10	16.00	17.50	1.19	1.88	12.75	12.75	14.25	15.25	12	16	.88	1.00	1.00	1.12
12	19.00	20.50	1.25	2.00	15.00	15.00	17.00	17.75	12	16	.88	1.12	1.00	1.25
14	21.00	23.00	1.38	2.12	16.25	16.25	18.75	20.25	12	20	1.00	1.12	1.12	1.25
16	23.50	25.50	1.44	2.25	18.50	18.50	21.25	22.50	16	20	1.00	1.25	1.12	1.38
20	27.50	30.50	1.69	2.50	23.00	23.00	25.00	27.00	20	24	1.13	1.25	1.25	1.38
24	32.00	36.00	1.88	2.75	27.25	27.25	29.50	32.00	20	24	1.25	1.50	1.38	1.62

Cast Iron Valves* Class 125 and 250 (ANSI B16.1 — 1989)

Nominal Pipe Size	Diameter of Flange		Thickness of Flange		Diameter of Raised Face		Diameter of Bolt Circle		Number of Bolts		Diameter of Bolts		Diameter of Bolt Holes	
Pressure Class	125	250	125	250	125	250	125	250	125	250	125	250	125	250
1.5	5.00	6.12	.56	.81	—	3.56	3.88	4.50	4	4	.50	.75	.62	.88
2	6.00	6.50	.62	.88	—	4.19	4.75	5.00	4	8	.63	.63	.75	.75
2.5	7.00	7.50	.69	1.00	—	4.94	5.50	5.88	4	8	.63	.75	.75	.88
3	7.50	8.25	.75	1.12	—	5.69	6.00	6.62	4	8	.63	.75	.75	.88
4	9.00	10.00	.94	1.25	—	6.94	7.50	7.88	8	8	.63	.75	.75	.88
6	11.00	12.50	1.00	1.44	—	9.69	9.50	10.62	8	12	.75	.75	.88	.88
8	13.50	15.00	1.12	1.62	—	11.94	11.75	13.00	8	12	.75	.88	.88	1.00
10	16.00	17.50	1.19	1.88	—	14.06	14.25	15.25	12	16	.88	1.00	1.00	1.12
12	19.00	20.50	1.25	2.00	—	16.44	17.00	17.75	12	16	.88	1.12	1.00	1.25
14	21.00	23.00	1.38	2.12	—	18.94	18.75	20.25	12	20	1.00	1.12	1.12	1.25
16	23.50	25.50	1.44	2.25	—	21.06	21.25	22.50	16	20	1.00	1.25	1.12	1.38
20	27.50	30.50	1.69	2.50	—	25.56	25.00	27.00	20	24	1.12	1.25	1.25	1.38
24	32.00	36.00	1.88	2.75	—	30.31	29.50	32.00	20	24	1.25	1.50	1.38	1.62

Bronze Valves* Class 150 and 300 (ANSI 16.24 — 1979)

Nominal Pipe Size	Diameter of Flange		Thickness of Flange		Diameter of Raised Face		Diameter of Bolt Circle		Number of Bolts		Diameter of Bolts		Diameter of Bolt Holes	
Pressure Class	150	300	150	300	150	300	150	300	150	300	150	300	150	300
1.5	5.00	6.12	.44	.69	—	—	3.88	4.50	4	4	.50	.75	.62	.88
2	6.00	6.50	.50	.75	—	—	4.75	5.00	4	8	.63	.63	.75	.75
2.5	7.00	7.50	.56	.81	—	—	5.50	5.88	4	8	.63	.75	.75	.88
3	7.50	8.25	.62	.91	—	—	6.00	6.62	4	8	.63	.75	.75	.88
4	9.00	10.00	.69	1.06	—	—	7.50	7.88	8	8	.63	.75	.75	.88
6	11.00	12.50	.81	1.19	—	—	9.50	10.62	8	12	.75	.75	.88	.88
8	13.50	15.00	.94	1.38	—	—	11.75	13.00	8	12	.75	.88	.88	1.00
10	16.00	—	1.00	—	—	—	14.25	—	12	—	.88	—	1.00	—
12	19.00	—	1.06	—	—	—	17.00	—	12	—	.88	—	1.00	—

Cast Steel Valves* Class 150 and 300 (ANSI 16.5 — 1988)

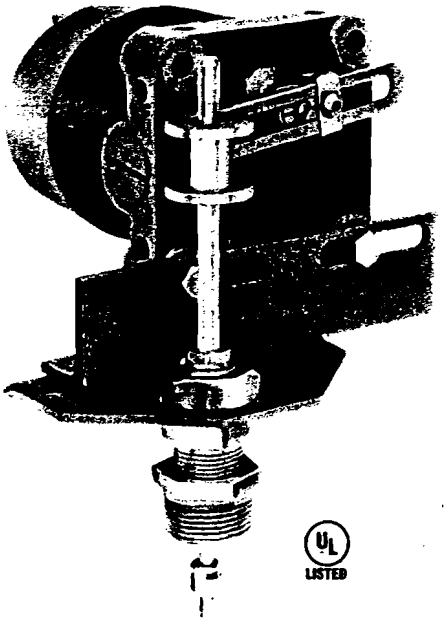
Nominal Pipe Size	Diameter of Flange		Thickness of Flange		Diameter of Raised Face		Diameter of Bolt Circle		Number of Bolts		Diameter of Bolts		Diameter of Bolt Holes	
Pressure Class	150	300	150	300	150	300	150	300	150	300	150	300	150	300
1.5	5.00	6.12	.56	— .81	2.88	2.88	3.88	4.50	4	4	.50	.75	.62	.88
2	6.00	6.50	.62	— .88	3.63	3.63	4.75	5.00	4	8	.63	.63	.75	.75
2.5	7.00	7.50	.69	— 1.00	4.13	4.13	5.50	5.88	4	8	.63	.75	.75	.88
3	7.50	8.25	.75	— 1.12	5.00	5.00	6.00	6.62	4	8	.63	.75	.75	.88
4	9.00	10.00	.94	— 1.25	6.19	6.19	7.50	7.88	8	8	.63	.75	.75	.88
6	11.00	12.50	1.00	— 1.44	8.50	8.50	9.50	10.62	8	12	.75	.75	.88	.88
8	13.50	15.00	1.12	— 1.62	10.63	10.63	11.75	13.00	8	12	.75	.88	.88	1.00
10	16.00	17.50	1.19	— 1.88	12.75	12.75	14.25	15.25	12	16	.88	1.00	1.00	1.12
12	19.00	20.50	1.25	— 2.00	15.00	15.00	17.00	17.75	12	16	.88	1.12	1.00	1.25
14	21.00	23.00	1.38	— 2.12	16.25	16.25	18.75	20.25	12	20	1.00	1.12	1.12	1.25
16	23.50	25.50	1.44	— 2.25	18.50	18.50	21.25	22.50	16	20	1.00	1.25	1.12	1.38
20	27.50	30.50	1.69	— 2.50	23.00	23.00	25.00	27.00	20	24	1.13	1.25	1.25	1.38
24	32.00	36.00	1.88	— 2.75	27.25	27.25	29.50	32.00	20	24	1.25	1.50	1.38	1.62

*Cla-Val valves can be furnished in aluminum.

CLA-VAL™

— MODEL — **X117C**

Valve Position Transmitter



- **Accurately Monitors Valve Position**
- **Weather-Sealed and Explosion-Proof**
- **Used on 131 Electronic Control Valves**
- **Easy Field Adjustments**
- **Compact and Rugged Construction**

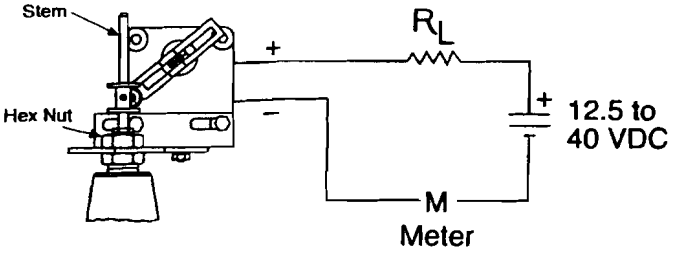
The Cla-Val Model X117C Valve Position Transmitter is an accurate monitor of valve position. Through an industry standard 4-20 mA output, the X117C delivers the level of accuracy required for computer-guided control valve systems (SCADA type). The electronic components are enclosed in a rugged, sealed aluminum housing. The assembly is mounted externally on the cover of the Cla-Val main valve. An extension of the valve stem projects outside of the cover at the center boss and is mechanically linked to the electronic components. As the valve stem rises and lowers, the X117C provides an output signal in direct proportion to the valve's position. The X117C is available with optional switches for additional signal functions as Model X117CLS.

Wiring Diagram

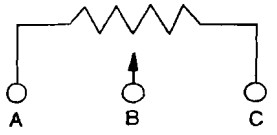
The signal from the position sensing mechanism is converted to a two-wire 4 to 20 mA current output. The voltage compliance range is 12.5 to 40 VDC (12.5 is transmitter voltage consumption). The required, but not supplied, maximum load resistance can be calculated using the following formula:

$$R_L \text{ Max.} = \frac{\text{Vsupply} - 12.5}{.020}$$

Current Output

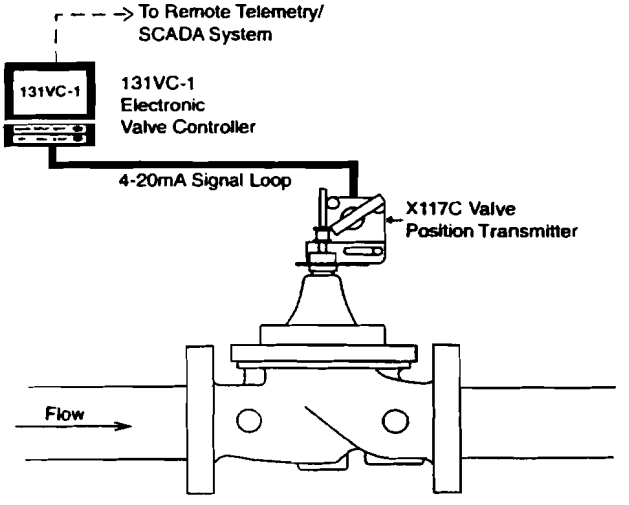


Resistive Output (Optional)
A variable voltage signal using terminals A,B and C is available with the resistive output option.



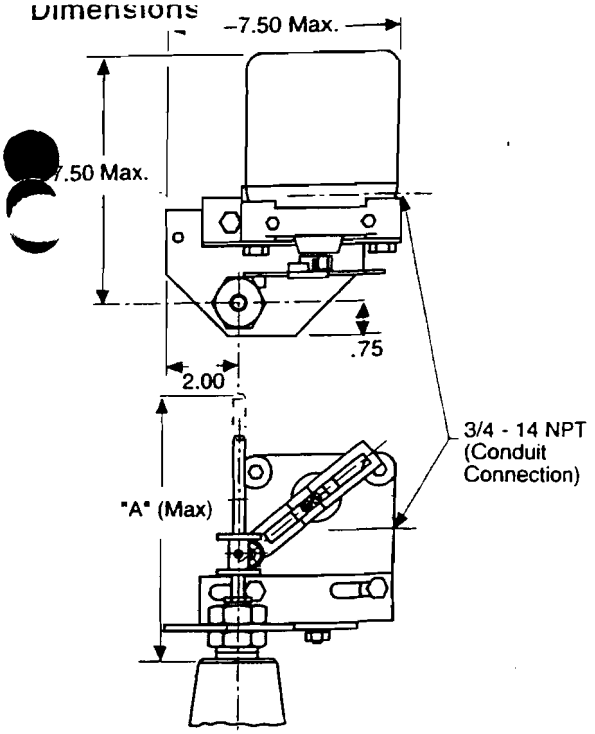
Typical Installation

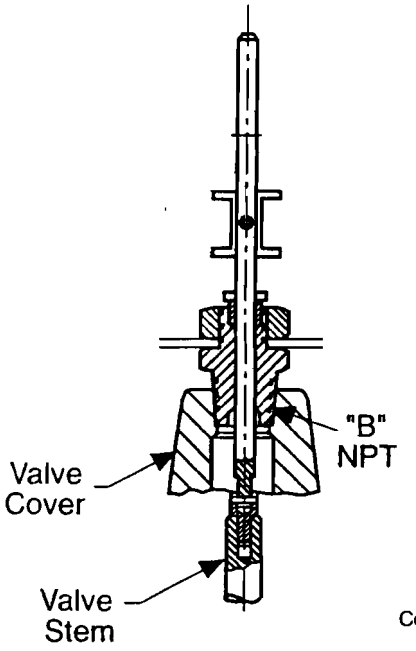
The X117C Valve Position Transmitter can be used to transmit valve position to the optional 131VC-1 Electronic Valve Controller.



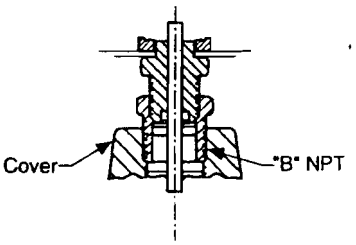
CLA-VAL

Dimensions

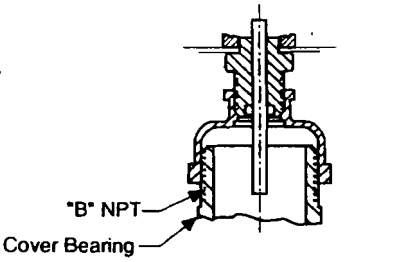




1 1/4" 6" Sizes Only



8",10",12"&14" Sizes Only



16",20" & 24" Sizes Only

Pilot System Dimensions (In Inches)

VALVE SIZE	1 ¼" & 1½"	2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	20"(600)	24"(600)	24"
A (MAX.)	10.19	7.16	7.16	7.34	7.00	6.69	6.91	9.88	9.09	9.16	10.78	10.78	10.78	19.12
B NPT	.25	.50	.50	.50	.75	.75	1.00	1.00	1 .25	1 .50	2.00	2.00	2.00	1.00

Specifications

Valve Sizes
1/4" thru 24"

Pressure Rating
400 psi Max.

Temperature
-13° to 185° F

Materials
Cast aluminum housing
Steel bracket
Brass adapter
Stainless steel stem
Buna-N® synthetic rubber seals
Other materials available
as extra cost option

Electrical

Housing, weather sealed and explosion proof to NEMA Standards:
1, 3, 4, 7, 9, and 13
UL Listed:
Class I, Groups C and D.
Class II, Groups E, F and G
CSA Certified:
Class I, Groups C and D
Class II, Groups E, F and G

Output
Current: 4-20 mA
Span: Adjustable from 15° to 90° of angular rotation
Null: 4mA position may be set at any angular position

Optional
Resistive Output:
500 ohms ± 10% in center (free position)
975 ohms max. at 105°
rotation clockwise (CW)
25 ohms min. at 105° rotation CCW
2 watts power at 70° C/105° F at full scale.
Switches:
2 SPDT
UL/CSA rating
15 amps,120, 240 or 480 VAC
.5 amp 125 VDC
.25 amp 250 VDC

When Ordering, Please Specify

1. For New Valves – At time of order specify:
"With X117C Installed".
2. For Retrofitting Existing Valves specify: all nameplate data of valve to which X117C will be installed.
3. Current or resistive output.
4. Add LS to model number for optional limit switches, ie: X117CLS.
5. When Vertically Installed.

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA, LTD.
4687 Christie Drive
Beamsville, Ontario
Canada LOR 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL SA
Chemin des Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50

www.cla-val.com

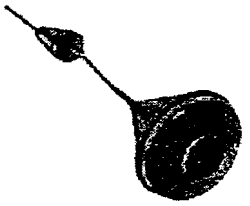
Represented By:

Section 1-F

Float Switch (LS-111)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Heavy Duty Free-Floating Liquid Level Switches



Dual Level

- Maximum Pressure: 28 psi
- Maximum Temperature: 140° F
- Minimum Liquid Specific Gravity: .7

The large float (6 45/64" Dia. x 6 3/32" Ht.) on these cable-suspended switches senses level changes in large tanks. They work well in slurries and viscous media. To empty a tank, use a NO (normally open) switch. To fill tank, use a NC (normally closed) switch. Float is black polypropylene, with 16 ft. of PVC-covered 22/2 cable. Rated for 6 amps @ 250 VAC.

Single-level switches actuate at one level; great for triggering an alarm.

Dual-level switches go on at one level and off at another. Help avoid excessive pump wear by setting actuation points at two levels. Actuation points are adjustable between 10" to 50" by moving the control weight (included).

	To Empty a Tank (Normally Open)		To Fill a Tank (Normally Closed)	
		Each		Each
Single Level	47025K39	$83.60	47025K38	$83.60
Dual Level	47025K49	114.40	47025K48	114.40

47025K39 (Same as 47025K13)

Heavy Duty Liquid-Level Float Switch Single Level, To Empty Tank, 6-45/64" Dia, 16'Cable

$ 83.60 Each

Section 1-G

Sump Pump w/Backflow Prevention Device (P-111)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton™ Submersible Effluent Pumps

ENGLISH

ESPAÑOL

Description

Dayton submersible effluent pumps are self-contained and are especially designed to handle septic tank effluent. They will provide sufficient pressure to pump material through small diameter pipe to gravity interceptors, treatment plants, or remote leach fields. This pump is designed to pump effluent, nonexplosive and noncorrosive liquids, and shall **NOT** be installed in locations classified as hazardous in accordance with the United States National Electrical Code (NEC), ANSI/NFPA 70. Never install the pump in a trench, ditch, or hole with a dirt bottom; the legs will sink into the dirt and the suction will become plugged.

c SP US
CSA 108
UL 778
LR16567

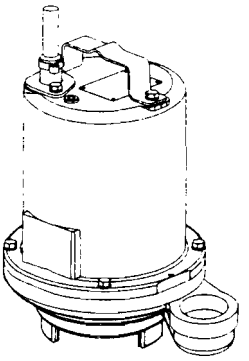


Figure 1

Specifications

TEMPERATURE..... 104°F (40°C) Continuous
IMPELLER ..... Single Vane, enclosed
SOLIDS HANDLING..... 3/4" (19mm) spherical
PAINT..... Air dry enamel
SEAL ..... Single mechanical
CABLE ENTRY ..... 20 ft. (6m) cord, quick connect, cord w/plug on 120 & 240 volt, 1 phase, custom molded for sealing and and strain relief
UPPER BEARING..... Single row, ball design oil lubrication, radial load
LOWER BEARING..... Single row, ball design, oil lubrication, radial & thrust load

MOTOR ..... NEMA L- single phase
NEMA B - three phase, torque curve, oil-filled, squirrel cage induction, standard - class B insulation
SINGLE PHASE..... Permanent Split Capacitor (PSC) Includes overload protection in motor
THREE PHASE ..... Dual voltage 240/480. ***4HU78 Pre-wired for 480 volts.** Requires overload protection to be included in control panel

	Pump Material							
Models	Volute	Motor Housing	Seal Plate	Impeller	Shaft	Square Rings	Hardware	Seal
4HU75	Cast Iron	Cast Iron	Cast Iron	Polypropylene	416 SS	Buna-N	300 Series SS	Silicon Carbide/Buna-N
4HU76	Cast Iron	Cast Iron	Cast Iron	Polypropylene	416 SS	Buna-N	300 Series SS	Silicon Carbide/Buna-N
4HU77	Cast Iron	Cast Iron	Cast Iron	Polypropylene	416 SS	Buna-N	300 Series SS	Silicon Carbide/Buna-N
4HU78	Cast Iron	Cast Iron	Cast Iron	Polypropylene	416 SS	Buna-N	300 Series SS	Silicon Carbide/Buna-N

Models	Hp	Volt	Ph	NEMA Start Code	Full Load Amps	Locked Rotor Amps	Cord Size	Cord Type	Cord O.D. Inches (mm)	Winding Resistance Main -- Start
4HU75	1/2	120	1	G	11.9	24.6	14/3	SJTOW	0.375 (9.5)	1.26 -- 8.4
4HU76	1/2	240	1	E	5.1	10.2	14/3	SOW	0.530 (13.5)	7.60 -- 9.6
4HU77	1	240	1	F	8.3	21.8	14/3	SOW	0.530 (13.5)	2.70 -- 10.96
4HU78	1	480*	3	J	2.8	9.1	14/4	SOW	0.570 (14.5)	5.9/23.59--

(*) Voltage convertable, see page 10. Winding Resistance ± 5% Pump rated for operation at ± 10% voltage at motor.

Form 5S5010
Printed in U.S.A.
09701
0604/110/VCPVP
CRN013
06/04

Dayton™

Dayton™ Submersible Effluent Pumps

ENGLISH

Performance

Models	Hp	Speed (Nominal)	Disch. NPT	Gal./Min @ Total Head in Feet							
				5 Ft	10 Ft	20 Ft	40 Ft	60 Ft	80 Ft	100 Ft	Shut Off
4HU75	1/2	3450 RPM	2" (51mm)	79	76	66	47	25	----	----	79 Ft
4HU76	1/2	3450	2" (51mm)	79	76	66	47	25	----	----	79
4HU77	1	3450	2" (51mm)	87	85	80	68	52	34	12	109
4HU78	1	3450	2" (51mm)	87	85	80	68	52	34	12	109

Dimensions

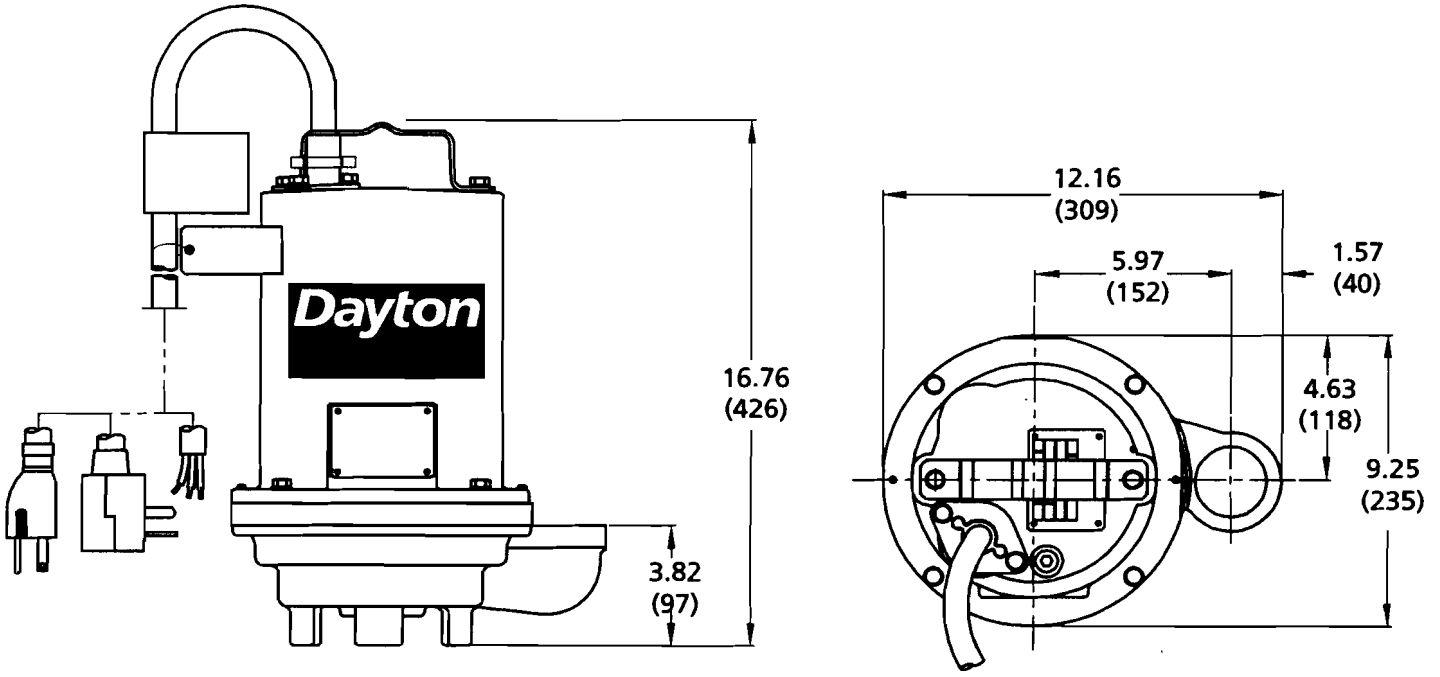


Figure 2 - Dimensions (mm)

For Repair and Service Call 1-866-632-9866

Models 4HU75, 4HU76, 4HU77 and 4HU78

General Safety Information

Please read this before installing or operating pump. this information is provided for SAFETY and to PREVENT EQUIPMENT PROBLEMS. To help recognize this information, observe the following symbols:

NOTE: Indicates special instructions which are important but not related to hazards.

IMPORTANT: Indicates factors concerned with assembly, installation, operation, or maintenance which could result in damage to the machine or equipment if ignored.

⚠ CAUTION ***Warns about hazards that will or can cause minor personal injury or property damage if ignored.***

⚠WARNING ***Warns about hazards that can cause severe personal injury, death, or major property damage if ignored.***

⚠ DANGER ***Warns about hazards that will cause serious personal injury, death, or major property damage if ignored.***

1. Most accidents can be avoided by using COMMON SENSE.

⚠ CAUTION ***Do not wear loose clothing that may become entangled in the impeller or other moving parts.***
Always wear appropriate safety gear, such as safety glasses, when working on the pump or piping.

⚠ CAUTION ***Pumps build up heat and pressure during operation. Allow time for pumps to cool before handling or servicing.***

2. Only qualified personnel should install, operate, and repair pump.

⚠ CAUTION ***Keep clear of suction and discharge openings. Do not insert fingers in pump with power connected.***

⚠ DANGER ***Do not pump hazardous materials (flammable, caustic,etc.) unless the pump is specifically designed and designated to handle them.***

3. Make sure lifting handles are securely fastened each time before lifting.
4. Do not lift pump by the power cord.
5. Do not exceed manufacturer's recommendation for maximum performance, as this could cause the motor to overheat.
6. Secure the pump in its operating position so it can not tip over, fall, or slide.
7. Keep hands and feet away from impeller when power is connected.

⚠ DANGER ***Submersible pumps are not approved for use in swimming pools, recreational water installations, decorative fountains, or any installation where human contact with the pumped fluid is common.***

8. Operation against a closed discharge valve will cause premature bearing and seal failure on any pump.

⚠WARNING ***To reduce risk of electrical shock, pump must be properly grounded in accordance with the United States National Electric Code (NEC), or the Canadian Electrical Code (CEC) and all applicable state, and local codes and ordinances.***

⚠WARNING ***To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing.***

9. Any wiring of pumps should be performed by a qualified electrician.

⚠ CAUTION ***Never operate a pump with a power cord that has frayed or brittle insulation.***

10. Cable should be protected at all times to avoid punctures, cuts, bruises, and abrasions - inspect frequently.

⚠ CAUTION ***Never handle connected power cords with wet hands. Never operate a 120 volt pump with a plug-in type power cord without a ground fault circuit interrupter.***

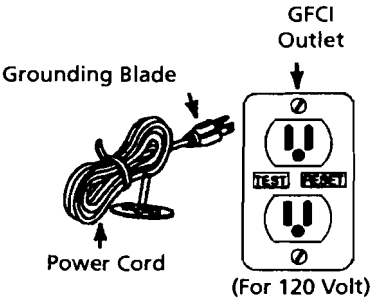


Figure 3

11. Do not remove cord and strain relief. Do not connect conduit to pump.

⚠WARNING ***To reduce risk of electrical shock, all wiring and junction connections should be made per the United States National Electric Code (NEC), or the Canadian Electrical Code (CEC) and applicable state or province and local codes. Requirements may vary depending on usage and location. See wiring diagrams in manual.***

Dayton Electric Mfg. Co. is not responsible for losses, injury, or death resulting from a failure to observe these safety precautions, misuse or abuse of pumps or equipment.

Dayton™ Submersible Effluent Pumps

ENGLISH

Unpacking

Upon receiving the pump, it should be inspected for damage or shortages. If damage has occurred, file a claim immediately with the carrier that delivered the pump. If the manual is removed from the packaging, do not lose or misplace.

STORAGE

Short Term - Pumps are manufactured for efficient performance following short inoperative periods in storage. For best results, pumps can be retained in storage, as factory assembled, in a dry atmosphere with constant temperatures for up to six (6) months.

Long Term - For storage of six (6) months to twenty-four (24) months, the units should be stored in a temperature controlled area, a roofed-over walled enclosure that provides protection from the elements (rain, snow, wind-blown dust, etc.), and whose temperature can be maintained between +40° F and +120° F. If extended high humidity is expected to be a problem, all exposed parts should be inspected before storage and all surfaces that have the paint scratched, damaged, or worn should be recoated with a water base, air dry enamel paint. All surfaces should then be sprayed with a rust-inhibiting oil.

Pump should be stored in its original shipping container. On initial start up, rotate impeller by hand to assure seal and impeller rotate freely.

If it is required that the pump be installed and tested before the long term storage begins, such installation will be allowed, provided:

1. The pump is not installed under water for more than one (1) month.
2. Immediately upon satisfactory completion of the test, the pump is removed, thoroughly dried, repacked in the original shipping container, and placed in a temperature controlled storage area.

Installation

SUBMERGENCE

It is recommended that the pump be operated in the submerged condition and the sump liquid level should never be less than "A" dimension in Figure 4.

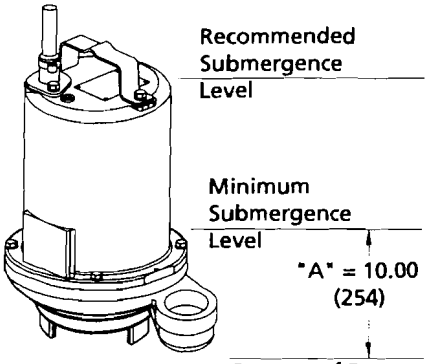


Figure 4

DISCHARGE

Discharge piping should be as short as possible. Both a check valve and a shut-off valve are recommended for each pump being used. The check valve is used to prevent backflow into the sump. Excessive backflow can cause flooding and/or damage to the pump. The shut-off valve is used to stop system flow during pump or check valve servicing.

ELECTRICAL CONNECTIONS

An acceptable motor control switch shall be provided at the time of installation.

POWER AND CONTROL CABLE

The cord assembly mounted to the pump must not be modified in any way except for shortening to a specific application. Any splice between the pump and the control panel must be made in accordance with all applicable electric codes. It is recommended that a junction box, if used, be mounted outside the sump or be of at least Nema 4 (EEMAC-4) construction if located within the wet well.

Do not use the power or control cable to lift pump. **NOTE:** The white wire is **NOT** a neutral or ground lead, but a power carrying conductor.

OVERLOAD PROTECTION

Single Phase - The type of in-winding overload protector used is referred to as an inherent overheating protector and operates on the combined effect of temperature and current. This means that the overload protector will trip out and shut the pump off if the windings become too hot, or the load current passing through them becomes too high. It will then automatically reset and start the pump up after the motor cools to a safe temperature. In the event of an overload, the source of this condition should be determined and rectified immediately.

⚠ CAUTION ***Do not cycle or run pump if an overload condition occurs !***

If current through the temperature sensor exceeds the values listed, an intermediate control circuit relay must be used to reduce the current or the sensor will not work properly.

Temperature Sensor Electrical Ratings		
Volts	Continuous Amperes	Inrush Amperes
110-120	3.00	30.0
200-240	1.50	15.0
440-480	0.75	7.5

WIRE SIZE

Consult a qualified electrician for proper wire size. See table on page 1 for electrical information.

Models 4HU75,4HU76, 4HU77 and 4HU78

Installation (Continued)

Pre-operation

CHECK VOLTAGE AND PHASE
Before operating pump, check to make sure that the voltage and phase information stamped on the pump's identification plate matches the available power.

CHECK PUMP ROTATION
Before putting pump into service for the first time, the motor rotation must be checked. Improper motor rotation can result in poor pump performance and can damage the motor and/or pump. To check the rotation, suspend the pump freely, momentarily apply power and observe the "kickback". "Kickback" should always be in a counter-clockwise direction as viewed from the top of the pump ("kickback" is always opposite to impeller rotation). "Rotation" and "kickback" direction is noted on the pump motor housing.

INCORRECT ROTATION
Models 4HU75, 4HU76 & 4HU77 In the unlikely event that the rotation is incorrect for a single-phase pump, contact the Repair and Service, toll-free at 1-866-632-9866

Model 4HU78 in the event that the rotation is incorrect for a three-phase installation, interchange any two power cable leads at the control box. **DO NOT** change leads in the cable housing in the motor. Recheck the "kickback" rotation again by momentarily applying power.

IDENTIFICATION PLATE
Note the numbers from the pump's identification plate and record at the end of the manual for future reference.

INSULATION TEST
Before the pump is put into service, an insulation (megger) test should be performed on it. The ohm values as well as the volts and amps should be recorded.

PUMP-DOWN TEST
After the pump has been properly wired and lowered into the basin, sump, or lift station, it is advisable to check the system by filling with liquid and allowing the pump to operate through it's pumping cycle. The time needed to empty the system, or pump-down time, should be recorded.

Maintenance

As the motor is oil filled, no lubrication or other maintenance is required. A preventive maintenance program should include the following checks when the pump performance deteriorates:

1. Inspect motor chamber for oil level and contamination and repair as stated in "Checking Oil".
2. Inspect impeller and body for excessive build-up or clogging and repair as stated in "Impeller & Volute Service".
3. Inspect motor and bearings and replace as stated in "Motor & Bearing Service".
4. Inspect seal for wear or leakage and repair as stated in "Shaft Seal Service".

Service and Repair

Refer to Figure 17.

⚠ DANGER ***Electrical power to the pump motor must be disconnected and locked out to prevent any dangerous electrical hazards or personnel danger before any service work is done to the pump.***

⚠ CAUTION ***Operating pump builds up heat and pressure. Allow time for pump to cool to room temperature before handling or servicing.***

⚠ CAUTION ***Always wear eye protection when working on pumps.***

LUBRICATION
Anytime the pump is removed from operation, the cooling oil in the motor housing (Ref. No. 19) should be checked visually for oil level and contamination.

CHECKING OIL
To check oil, set unit upright. Remove pipe plug (Ref. No. 20) from motor housing (Ref. No. 19). With a flashlight, visually inspect the oil in the motor housing (Ref. No. 19) to make sure it is clean and clear, light amber in color, and free from suspended particles.

Milky white oil indicates the presence of water. Oil level should be just above the motor (Ref. No. 11) when pump is in vertical position.

TESTING OIL
1. Place pump on it's side, remove pipe plug (Ref. No. 20), from motor housing (Ref. No. 19) and drain oil into a clean, dry container.
2. Check oil for contamination using an oil tester with a range to 30 Kilovolts breakdown.
3. If oil is found to be clean and uncontaminated (measure above 15 KV. breakdown), refill the motor housing as stated in "Replacing Oil".
4. If oil is found to be dirty or contaminated (or measures below 15 KV. breakdown), the pump must be carefully inspected for leaks at the shaft seal (Ref. No. 6), cable assembly (Ref. No. 26), and pipe plug (Ref. No. 20), before refilling with oil. To locate the leak, perform a pressure test as stated in "Pressure Test." After leak is repaired, refill with new oil as stated in "Replacing Oil".

Dayton™ Submersible Effluent Pumps

ENGLISH

Service and Repair (Continued)

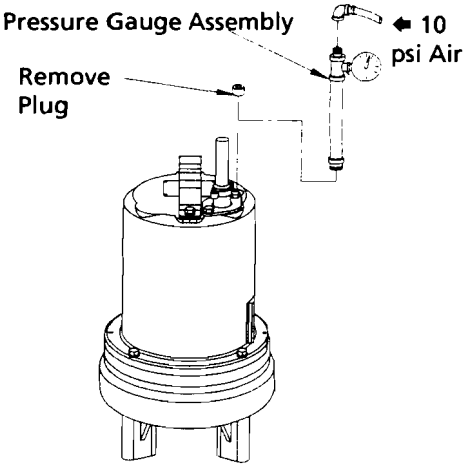


Figure 5

⚠ CAUTION ***Pressure builds up extremely fast, increase pressure by "tapping" air nozzle. Too much pressure will damage seal. Do not exceed 10 psi.***

PRESSURE TEST

Pumps that have been disassembled- If the pump has been disassembled, the oil should be drained before a pressure test, as stated in "Replacing Oil".

Remove pipe plug (Ref. No. 20) from motor housing (Ref. No. 19). Apply pipe sealant to pressure gauge assembly and tighten into hole (See Figure 5). Pressurize motor housing to 10 psi. Use a soap solution around the sealed areas and inspect joints for "air bubbles". If, after five minutes, the pressure is still holding constant, and no "bubbles" are observed, slowly bleed the pressure and remove the gauge assembly. Replace oil as stated in "Replacing Oil." If the pressure does not hold, then the leak must be located and repaired.

Pumps that have NOT been disassembled - The pressure test may be done with the oil at its normal level. Remove pipe plug (Ref. No. 20) from motor housing (Ref. No. 19). Apply pipe sealant to pressure gauge assembly and tighten into hole (See Figure 5).

Pressurize motor housing to 10 psi. Use a soap solution around the sealed areas and inspect joints for "air bubbles". For sealed areas below the oil level, leaks will seep oil. If, after five minutes, the pressure is still holding constant, and no "bubbles"/oil seepage is observed, slowly bleed the pressure and remove the gauge assembly. Replace oil as stated in "Replacing Oil." If the pressure does not hold, then the leak must be located and repaired.

REPLACING OIL

Drain all oil from motor housing (Ref. No. 19) and dispose of properly. Set unit upright and refill with new cooling oil as per Table 1 (See parts list for amount). Fill to just above motor (Ref. No. 11) as an air space must remain in the top of the motor housing (Ref. No. 19) to compensate for oil expansion. Apply pipe thread compound to threads of pipe plug (Ref. No. 20) then assemble to motor housing (Ref. No. 19).

⚠ CAUTION ***Do not overfill oil. Overfilling of motor housing with oil can create excessive and dangerous hydraulic pressure which can destroy the pump and create a hazard. Overfilling oil voids warranty. For single phase units, oil level should be below capacitor.***

Table 1 - Cooling Oil - Dielectric

Supplier	Grade
BP	Enerpar SE 100
Conoco	Pale Paraffin 22
Mobil	D.T.E. Oil Light
G & G Oil	Circulating 22
Texaco	Diala -Oil-AX
Woco	Primium 100

IMPELLER & VOLUTE SERVICE

Disassembly and Inspection - To clean out volute (Ref. No. 1) or replace impeller (Ref. No. 5), or U-cup (Ref. No. 3), disconnect power, remove capscrew (Ref. No. 18) and lockwasher (Ref. No. 17). Vertically lift motor and seal plate assembly from volute (Ref. No. 1) (See Figure 6).

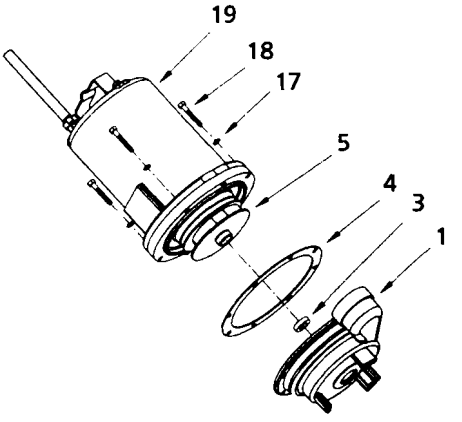


Figure 6

Clean out body if necessary. Check U-cup (Ref. No. 3) for damage. If U-cup (Ref. No 3) needs replacement, cut the U-cup (Ref. No. 3) from the volute (Ref. No. 1) and clean surface of bore. Clean and examine impeller (Ref. No. 5), for cracks or breakage and replace if required, inspect gasket (Ref. No. 4) and replace if cut or damaged. If the impeller (Ref. No. 5) needs replacing, place a flat screwdriver in the slot of the end of the shaft to hold the shaft stationary while unscrewing the impeller (Ref. No. 5).

REASSEMBLY

To install impeller (Ref. No. 5), clean the threads with thread locking compound cleaner. Apply removable Loctite® 609 or equivalent to shaft threads. Screw impeller (Ref. No. 5) onto the shaft hand tight while using a screwdriver in the slot at the end of the shaft to hold it stationary. It is important that the spring of the shaft seal (Ref. No. 6) seats in the hub of the impeller (Ref. No. 5).

Models 4HU75, 4HU76, 4HU77 and 4HU78

Service and Repair (Continued)

Rotate impeller to check for binding. Install U-cup (Ref. No. 3) by first applying adhesive to bore of volute (Ref. No. 1). Be sure not to get adhesive on inside diameter of U-cup (Ref. No. 3). Position gasket (Ref. No. 4) on volute flange and position impeller and motor housing on volute (Ref. No. 1).

⚠ CAUTION ***When assembling volute (Ref. No. 1) to rest of the pump be sure the inside lip of the U-cup (Ref. No. 3) is not pushed out of place (See Figure 7).***

Position lockwasher (Ref. No. 17) on cap screw (Ref. No. 18) and screw into volute (Ref. No. 1). Torque to 100 in-lbs. Check for free rotation of motor and impeller.

⚠ CAUTION ***Handle seal parts with extreme care. DO NOT scratch or mar lapped surfaces.***

SHAFT SEAL SERVICE
Disassembly and Inspection
To expose shaft seal (Ref. No. 6) for examination, disassemble volute (Ref. No. 1) and impeller (Ref. No. 5). If further repair is required, remove retaining ring (Ref. No. 6d), spring (Ref. No. 6c) and rotating member (Ref. No. 6b) from shaft (See Figures 8 & 9).

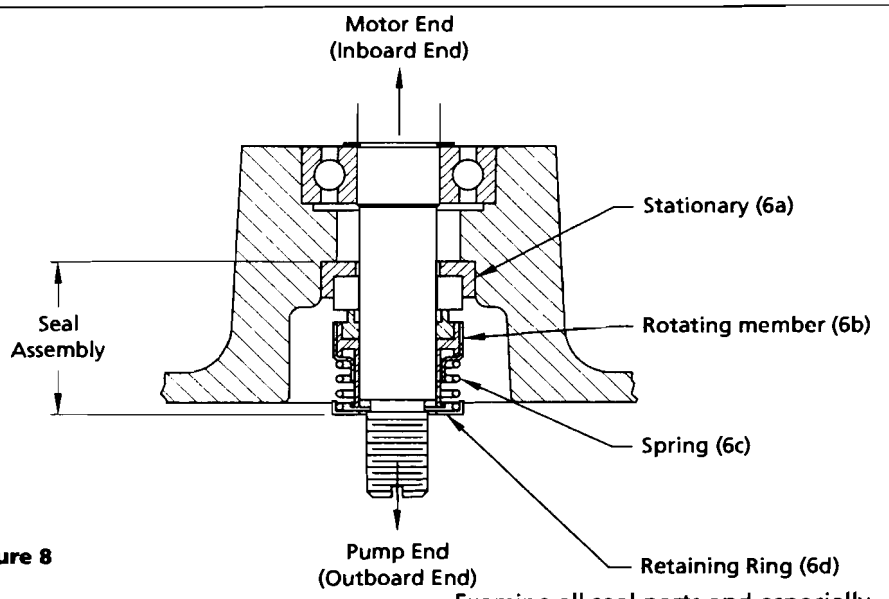


Figure 8

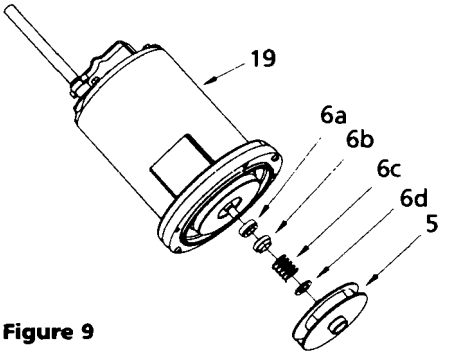
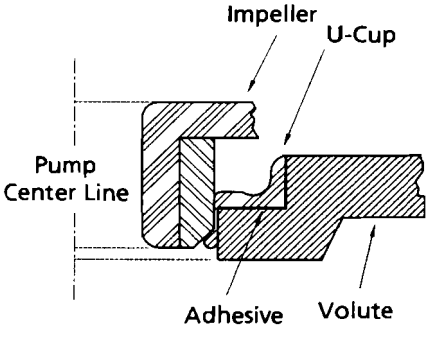


Figure 9

Examine all seal parts and especially contact faces. Inspect seal (Ref. No. 6) for signs of wear such as uneven wear pattern on stationary members, chips and scratches on either seal face. **DO NOT** interchange seal components, replace the entire shaft seal (Ref. No. 6). If replacing seal (Ref. No. 6), remove stationary (Ref. No. 6a) by prying out with flat screwdriver.

REASSEMBLY
Seal - Clean and oil seal cavities in seal plate (Ref. No. 2). Lightly oil **(Do not use grease)** outer surface of stationary member (Ref. No. 6a). Press stationary member (Ref. No. 6a) firmly into seal plate (Ref. No. 2), using a seal pusher. **NOTE:** Nothing but the seal pusher is to come in contact with seal face (See Figure 10).



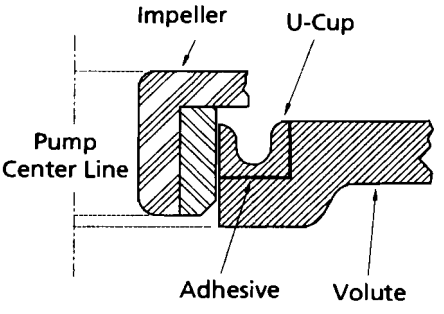


Figure 7

IMPROPER POSITION OF U-CUP **PROPER POSITION OF U-CUP**

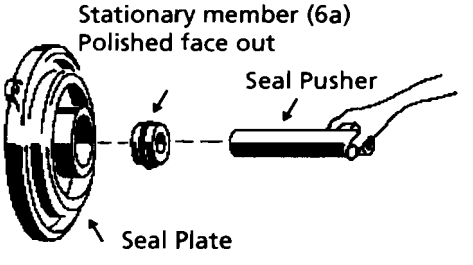


Figure 10

Dayton™ Submersible Effluent Pumps

ENGLISH

Service and Repair (Continued)

⚠ CAUTION ***Do not hammer on the seal pusher. It will damage the seal face.***

Make sure the stationary member is in straight. Slide a bullet over motor shaft. Lightly oil **(Do not use grease)** shaft, bullet, and inner surface of bellows on rotating member (Ref. No. 6b) See Figure 11.

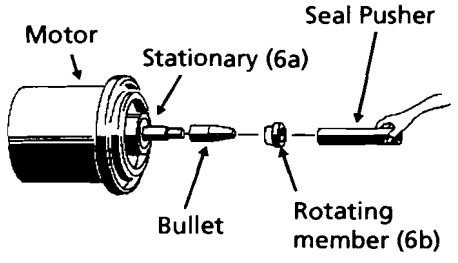


Figure 11

With lapped surface of rotating member (Ref. No. 6b) facing inward toward stationary member (Ref. No. 6a), slide rotating member (Ref. No. 6b) over bullet and onto shaft, using seal pusher, until lapped faces of (Ref. No. 6a) and (Ref. No. 6b) are together (See Figure 8).

It is extremely important to keep seal faces clean during assembly. Dirt particles lodged between these faces will cause the seal to leak. Place spring (Ref. No. 6c) over shaft and in place on rotating member (Ref. No. 6b), making sure it is seated on retainer and not cocked or resting on bellows tail. Slide retaining ring (Ref. No. 6d) over shaft and let rest on spring (Ref. No. 6c). Assemble impeller (Ref. No. 5) and volute (Ref. No. 1), replace oil.

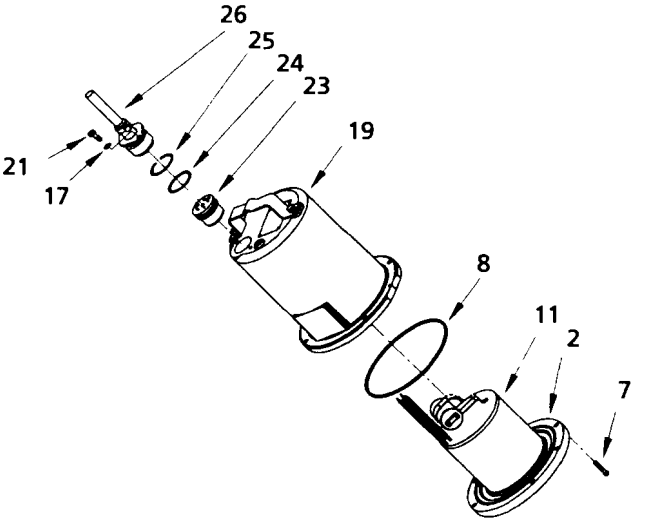


Figure 12

MOTOR AND BEARING SERVICE
Disassembly and Inspection

To examine or replace the motor (Ref. No. 11), capacitor (Ref. No. 16) on single phase units 4HU75, 4HU76 & 4HU77 only, and bearing (Ref. No. 9), drain oil from motor, disassemble volute (Ref. No. 1), impeller (Ref. No. 5) and shaft seal (Ref. No. 6).

Position unit upright, using blocks to avoid resting unit on shaft. Unscrew cable hex bolts (Ref. No. 21) and remove compression flange (Ref. No. 26a) and power cord (Ref. No. 26). Remove retaining ring (Ref. No. 25) with a flat head screwdriver. Pull the terminal block (Ref. No. 23) out of the housing (Ref. No. 19) using a T-bolt or a pair of pliers and a .25-20 screw in the threads of the terminal block (Ref. No. 23). Be sure to leave slack on the motor leads connected underneath.

Use needle nose pliers to pull each female connector off of the pins on the underside of the terminal block (Ref. No. 23), See Figure 12. The unit voltage should be noted. Remove socket head cap screws (Ref. No. 7). Vertically lift the motor housing (Ref. No. 19) from seal plate (Ref. No. 2) by lifting handle (Ref. No. 22).

Inspect square ring (Ref. No. 8) for damage or cuts. Remove the motor bolts and lift motor stator (Ref. No. 11a) from seal plate (Ref. No. 2). Disconnect capacitor leads from capacitor (Ref. No. 16) on single phase units 4HU75, 4HU76 & 4HU77 only. Examine bearing (Ref. No. 9) and replace if required. If replacement is required, remove bearing (Ref. No. 9) from motor shaft using a wheel puller or arbor press, (See Figure 13).

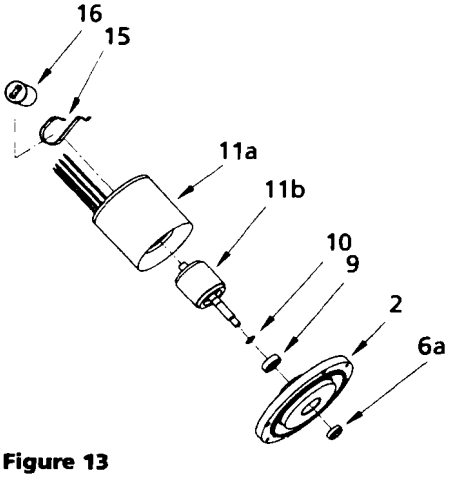


Figure 13

⚠ CAUTION ***Risk of electric shock. Use an insulated screwdriver when grounding capacitor.***

Models 4HU75, 4HU76, 4HU77 and 4HU78

Service and Repair (Continued)

Check motor capacitor (Ref. No.16) on single phase units, 4HU75, 4HU76 & 4HU77 only, with an Ohm meter by first grounding the capacitor by placing a screwdriver across both terminals and then removing screwdriver. Connect Ohm meter (set on high scale) to terminals. If needle moves to infinity (∞) then drifts back, the capacitor is good. If needle does not move or moves to infinity (∞) and does not drift back, replace capacitor (Ref. No. 16). Inspect motor winding for shorts and check resistance values. Check rotor for wear. If rotor or the stator windings are defective, the complete motor must be replaced.

⚠ CAUTION ***All parts must be clean before reassembly.***

REASSEMBLY

Bearings- When replacing bearing Ref. No. 9), be careful not to damage the rotor or shaft threads. Clean the shaft thoroughly. Press bearing (Ref. No. 9) on the motor shaft, position squarely onto the shaft applying force to the inner race of the bearing only, until bearing (Ref. No. 9) seats against the retaining ring (Ref. No. 10).

Motor- Slide lower bearing (Ref. No. 9) and motor shaft squarely into the seal plate (Ref. No. 2) until bearing (Ref. No. 9) seats on the bottom. Place stator (Ref. 11a) over rotor (Ref. No. 11b), lining up motor bolts with holes in seal plate (Ref. No. 2). Position capacitor (Ref. No. 16) on single phase units, 4HU75, 4HU76 & 4HU77 only, so that it will lay on the opposite side of the cable entry bosses of the motor housing (Ref. No. 19). Reconnect capacitor leads. Torque motor tie bolts to 17 in-lbs. Set square ring (Ref. No. 8) in grove on seal plate (Ref. No. 2).

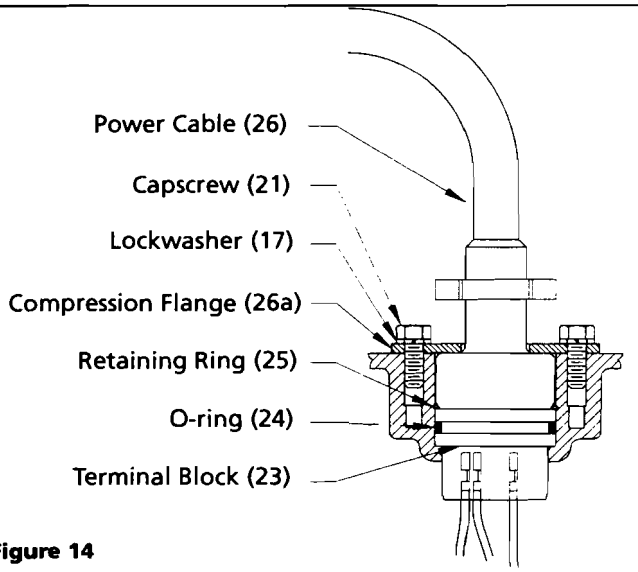


Figure 14

WIRING CONNECTIONS

Check power cable (Ref. No. 26) for cracks or damage and replace if required (See Figure 14).

Make internal wiring connections which are independent of the terminal block (Ref. No. 23) as shown, using connectors (Ref. No. 27 & 28) and wire assemblies (Ref. No. 14) as required. **DO NOT** use wire nuts. Slip motor leads and ground wire through fiberglass sleeve (Ref. No. 12). Lower motor housing (Ref. No. 19) down onto seal plate (Ref. No. 2) while aligning holes and stringing motor leads through the cable entry bore(s). (Slipping cords inside a 1 ft. length of .5" conduit makes this easier). Place socket head cap screws (Ref. No. 7) through seal plate (Ref. No. 2) into motor housing (Ref. No. 19) and torque to 60 in-lbs.

Reconnect motor leads to the underside of the terminal block (Ref. No. 23), as shown in Figure 16. Note that the pins are numbered underneath the terminal block. Place o-ring (Ref. No 24) into groove in terminal block and lubricate with dielectric oil. Press the terminal block (Ref. No. 23) into the housing so it seats completely below the retaining ring groove. Place retaining ring (Ref. No. 25) into groove in cable entry bore of motor housing (Ref. No. 19).

CABLE ASSEMBLY

Refill the cooling oil (if it has been drained). Make wire connections. Insert female end of cable plug into housing bore aligning timing mark with hole in terminal block (Ref. No. 23) (See Figure 15). Compress cable plug with compression flange (Ref. No. 26a) by tightening hex bolts (Ref. No. 21) into the housing (Ref. No. 19). Torque to 132 in-lbs.

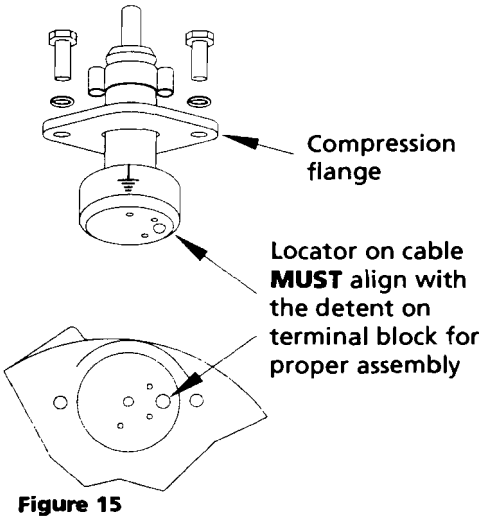


Figure 15

Dayton™ Submersible Effluent Pumps

ENGLISH

Service and Repair (Continued)

Single Phase, 120/240 VOLT AC (PSC) Models 4HU75, 4HU76 & 4HU77	
Green (Ground)	Green
Black	1
White	2
Flag connector	Capacitor
Flag connector	Capacitor

Three Phase, 480 VOLT AC Model 4HU78	
Green (Ground)	Green
T1	1
T2	2
T3	3
	T4 & T7 Together
	T5 & T8 Together
	T6 & T9 Together

Three Phase, 240 VOLT AC	
Green (Ground)	Green
T1 & T7	1
T2 & T8	2
T3 & T9	3
	T4, T5 & T6 Together

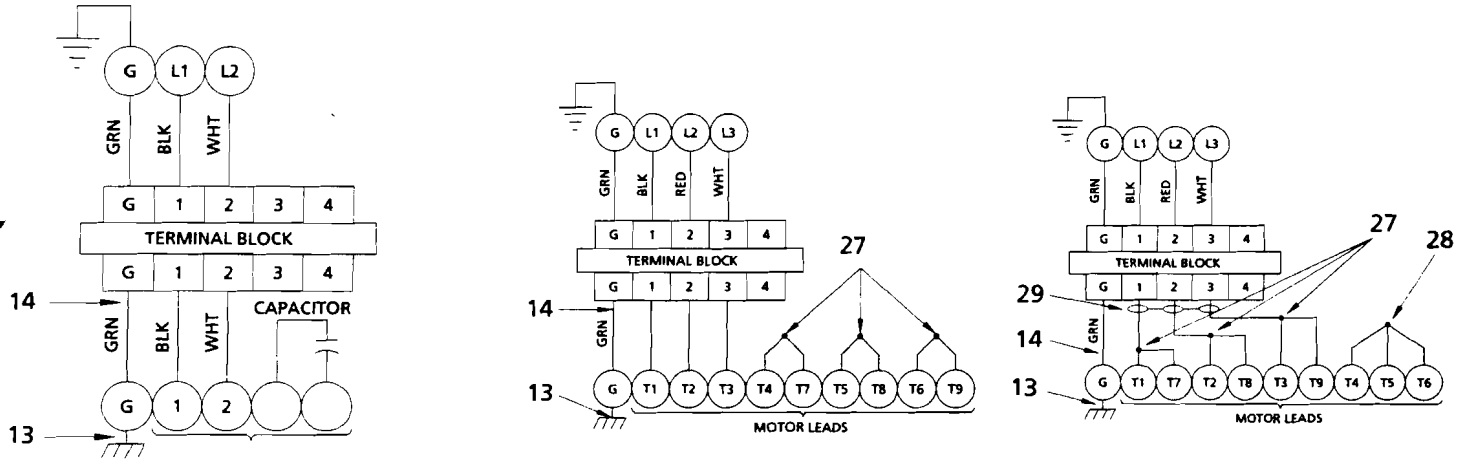


Figure 16

Field Conversion Three Phase 480 to 200/240 Volts AC Models 4HU78			
Model	NEMA Start Code	Full Load Amps	Locked Rotor Amps
4HU78	J	5.9/5.6	19.9/18.4

Models 4HU75, 4HU76, 4HU77 and 4HU78

Troubleshooting Chart

⚠ CAUTION ***Always disconnect the pump from the electrical power source before handling. If the system fails to operate properly, carefully read instructions and perform maintenance recommendations. If operating problems persist, the following chart may be of assistance in identifying and correcting them.***

NOTE: Not all problems and corrections will apply to each pump model.

Symptom	Possible Cause (s)	Corrective Action
Pump will not run	1. Poor electrical connection, blown fuse, tripped breaker, or other interruption of power; improper power supply	1. Check all electrical connections for security. Have electrician measure current in motor leads. If current is within ± 20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current
	2. Motor or switch inoperative	2. Go to manual operation of pump
	3. Float movement restricted	3. Reposition pump or clean basin as required to provide adequate clearance for float
	4. Switch will not activate pump or is defective	4. Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch (Float Switch)
	5. Defective motor	5. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions
	6. Insufficient liquid level	6. Make sure liquid level is at least equal to suggested turn-on point
Pump will not turn off	1. Float movement restricted	1. Reposition pump or clean basin as required to provide adequate clearance for float
	2. Switch will not activate pump or is defective	2. Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch (Float Switch)
	3. Excessive inflow or pump not properly sized for application	3. Recheck all sizing calculations to determine proper pump size
	4. Pump may be airlocked	4. Loosen union slightly to allow trapped air to escape. Verify that turn-off level of switch is set so that impeller cavity is always flooded. Clean vent hole
Pump hums but doesn't run	1. Incorrect voltage	1. Check all electrical connections for security. Have electrician measure current in motor leads. If current is within ± 20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current
	2. Impeller jammed or loose on shaft, worn, or damaged, impeller cavity or inlet plugged	2. Check impeller for freedom of operation, security, and condition. Clean impeller cavity and inlet of any obstruction
Pump cycles too frequently or runs periodically when fixtures are not in use	1. Check valve stuck closed or installed backwards	1. Remove and examine check valve for proper installation and freedom of operation
	2. Fixtures are leaking	2. Repair fixtures as required to eliminate leakage
	3. Ground water entering basin	3. Check for leaks around basin inlet and outlets

Dayton™ Submersible Effluent Pumps

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Troubleshooting Chart (Continued)

Symptom	Possible Cause (s)	Corrective Action
Pump delivers insufficient capacity	1. Incorrect voltage	1. Check all electrical connections for security. Have electrician measure current in motor leads. If current is within ±20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current
	2. Excessive inflow or pump not properly sized for application	2. Recheck all sizing calculations to determine proper pump size
	3. Discharge restricted	3. Check discharge line for restrictions, including ice. If line passes through or into cold areas
	4. Check valve stuck closed or installed backwards	4. Remove and examine check valve for proper installation and freedom of operation
	5. Shut-off valve closed	5. Open valve
	6. Impeller jammed or loose on shaft, worn or damaged, impeller cavity or inlet plugged	6. Check impeller for freedom of operation, security, and condition. Clean impeller cavity and inlet of any obstruction
	7. Pump may be airlocked	7. Loosen union slightly to allow trapped air to escape. Verify that turn-off level of switch is set so that impeller cavity is always flooded. Clean vent hole
	8. Pump running backwards	8. Check rotation. If power supply is three phase, reverse any two of three power supply leads to ensure proper impeller rotation
Pump shuts off and turns on independent of switch (trips thermal overload protector) **⚠ CAUTION** ***Pump may start unexpectedly. Disconnect power supply*** NOTE: Some pumps do not have thermal load protection on the motor Check pump specifications to determine	1. Incorrect voltage	1. Check all electrical connections for security. Have electrician measure current in motor leads. If current is within ±20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current
	2. Excessive inflow or pump not properly sized for application	2. Recheck all sizing calculations to determine proper pump size
	3. Impeller jammed, loose on shaft, worn or damaged; impeller cavity or inlet plugged	3. Check impeller for freedom of operation, security, and condition. Clean impeller cavity and inlet of any obstruction
	4. Excessive water temperature (internal protection only)	4. Check pump temperature limits & fluid temperature
Pump operates noisily or vibrates excessively	1. Worn bearings, motor shaft bent	1. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions
	2. Debris in impeller cavity or broken impeller	2. Check impeller for freedom of operation, security, and condition. Clean impeller cavity and inlet of any obstruction
	3. Pump running backwards	3. Check rotation. If power supply is three phase, reverse any two of three power supply leads to ensure proper impeller rotation
	4. Piping attachments to building structure too rigid or too loose	4. Replace portion of discharge pipe with flexible connector

Notes

For Repair Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

ENGLISH

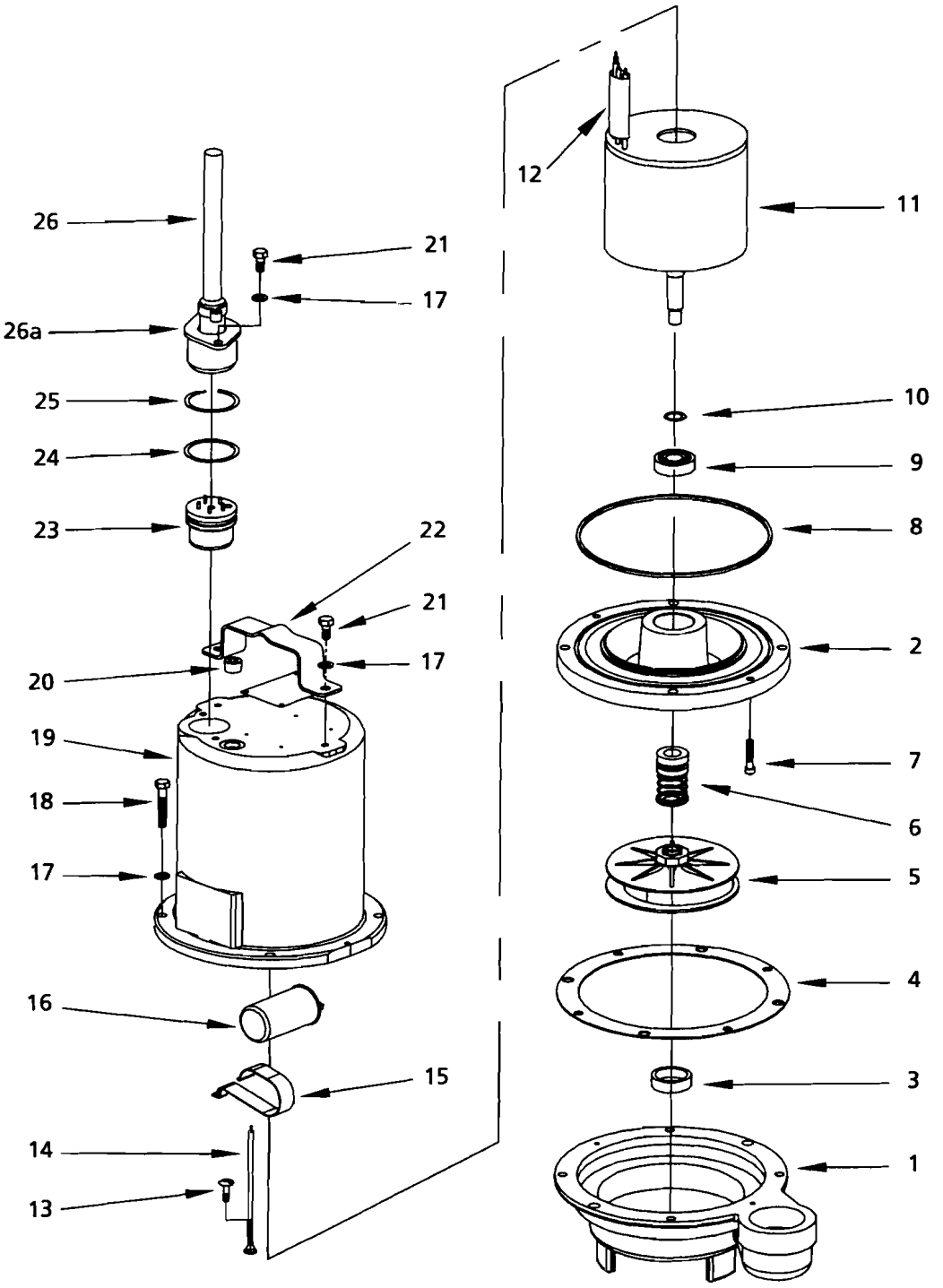

Figure 17 – Repair Parts Illustration

Repair Parts List

Ref. No.		Description	Part Number For Pump Models 4HU75	4HU76	4HU77	4HU78	Qty.
1		Volute	103763	103763	103763	103763	1
2		Seal plate	084532	084532	084532	084532	1
3		U-cup	066908	066908	066908	066908	1
4	■	Gasket	027344	027344	027344	027344	1
5		Impeller	103512TE	103512TE	103512	103512	1
6	■	Shaft seal SC/SC/B	005080SD	005080SD	005080SD	005080SD	1
7		1/4-20 x 1¼" Lg SS Sk Hd Capscrew	084948	084948	084948	084948	2
8		Square ring	027269	027269	027269	027269	1
9		Bearing	017414	017414	017414	017414	1
10		Retaining ring	085326	085326	085326	085326	1
11		Motor	068926BS	068927BS	068928BS	071355BS	1
△		Cooling oil	029034	029034	029034	029034	90 oz
12		Sleeve	625-02117	625-02117	625-02117	625-02117	1
13		#8-32 x 3/8" Lg SS Capscrew	016660	016660	016660	016660	1
14		Ground wire	105111	105111	105111	105111	1
15		Capacitor bracket	039858	039858	039858	-------	1
16		Capacitor	070965	070965	070965	-------	1
17		5/16 SS Lockwasher	026322	026322	026322	026322	8
18		5/16-18 x 1¾" Lg SS Capscrew	1-135-1	1-135-1	1-135-1	1-135-1	4
19		Motor housing	105196	105196	105196	105196	1
20		3/8" NPT Pipe Plug	014270	014270	014270	014270	1
21		5/16-18 x 1" Lg SS Capscrew	1-156-1	1-156-1	1-156-1	1-156-1	4
22		Handle	103503	103503	103503	103503	1
23		Terminal block	103584	103584	103584	103583	1
24		O-ring	2-31051-224	2-31051-224	2-31051-224	2-31051-224	1
25		Retaining ring	105197	105197	105197	105197	1
26		20 Ft (6 m) Power cable assy.	103756XA	110949XA	110949XA	103742XA	1
26a	†	Compression flange	103582	103582	103582	103582	1
27	*	Terminal connector (see page 10)	-------	-------	-------	625-00163	3
28	*	Terminal connector (see page 10)	-------	-------	-------	105150	1
29	*	Receptacle (see page 10)	-------	-------	-------	111951	3
Kits							
■		Seal repair kit	107276SD	107276SD	107276SD	107276SD	
(†)		Included with item #26	-------	-------	-------	-------	
		Seal tool kit	107271	107271	107271	107271	
		Pressure gage kit	085343	085343	085343	085343	
(△)		See Table 1 for replacement oil					
(*)		Not shown					
----		Not available					

Dayton™ Submersible Effluent Pumps

For Repair and Service, call 1-866-632-9866

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LIMITED WARRANTY

DAYTON ONE YEAR LIMITED WARRANTY. *Dayton™ Submersible Effluent Pumps, Models covered in this manual, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from jurisdiction to jurisdiction.*

LIMITATION OF LIABILITY. *To the extent allowable under applicable law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to and shall not exceed the purchase price paid.*

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Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in the "LIMITED WARRANTY" above is made or authorized by Dayton.

PRODUCT SUITABILITY. *Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the products are installed or used. Before purchase and use of a product, review the product applications, and all applicable national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consumer products: e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you, (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you, and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION*. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714 U.S.A.

Series 007
Double Check Valve Assembly

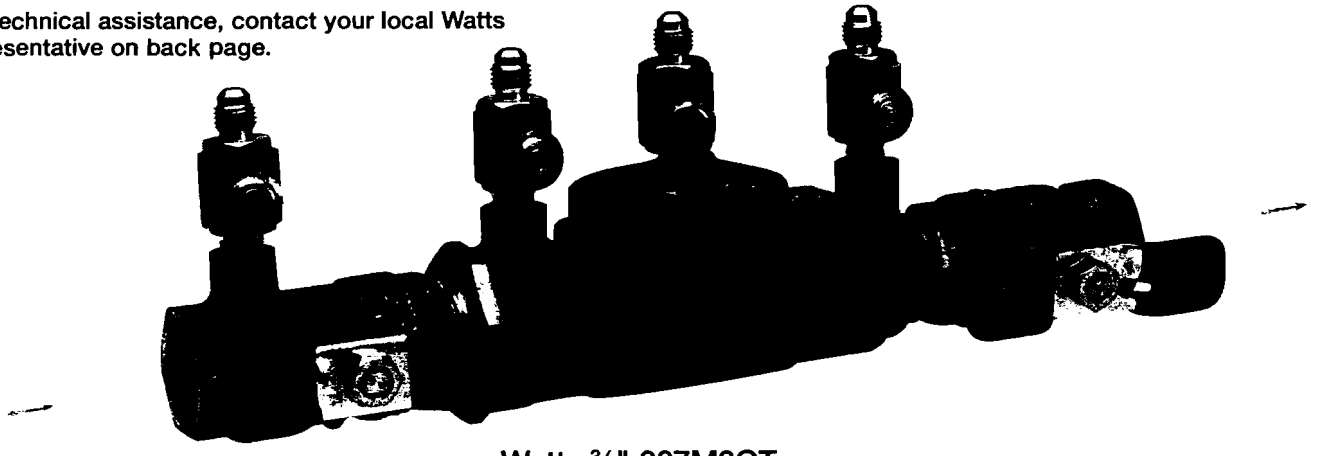
Sizes: ½" – 3"

- Installation
- Service
- Repair Kits
- Maintenance

For field testing procedure, send for IS-TK-DP/DL, IS-TK-9A, IS-TK-99E and IS-TK-99D.

For other repair kits and service parts, send for PL-RP-BPD and F-RK-DC.

For technical assistance, contact your local Watts representative on back page.



Watts ¾" 007M3QT

CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

(Installer: California law requires that this warning be given to the consumer.)

For more information: www.wattsind.com/prop65

IMPORTANT: Inquire with governing authorities for local installation requirements.

NOTE: For Australia and New Zealand: Pipeline strainers should be installed between the upstream shutoff valve and the inlet of the backflow preventer.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

WATTS® REGULATOR

Installation Instructions
Series 007 Double Check Valve Assemblies

Indoors - Figure 1

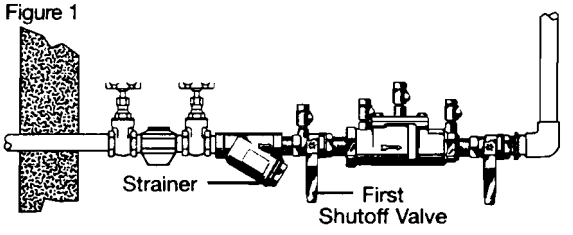
Check local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve in the line with arrow on valve body pointing in the direction of flow.

For indoor installations, it is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

CAUTION: Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon during emergencies, such as fire sprinkler lines, etc.
It is important that Series 007 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions. Regular inspection, testing and cleaning assures maximum life and proper product function.

NOTE: Fire Protection System Installations
The National Fire Protection Agency (NFPA) Guidelines require a confirming flow test to be conducted whenever a "main line" valve such as the shut-off valves or a backflow assembly have been operated. Certified testers of backflow assemblies must conduct this test. The trim valves of the confirming flow test. When the test is completed the trim valves must be returned to a fully open position.

Figure 1



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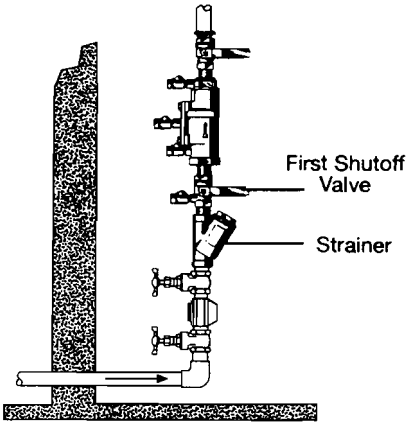
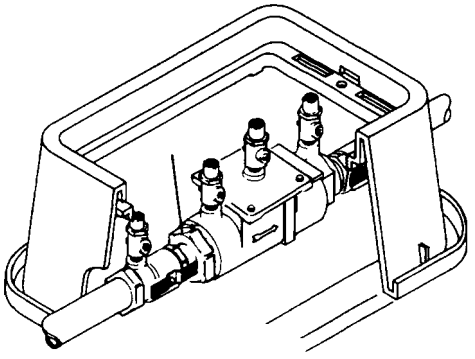


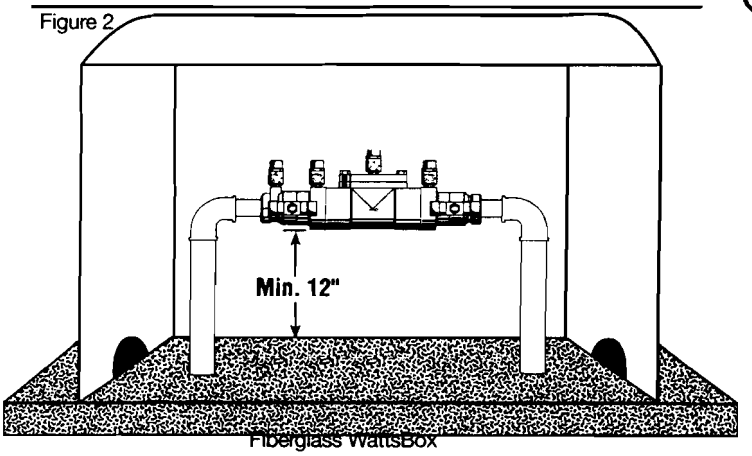
007QT-S Vertical flow-up or vertical flow-down installation (flow-up shown)

Outside - Figure 2



Meter Box Installation

Figure 2

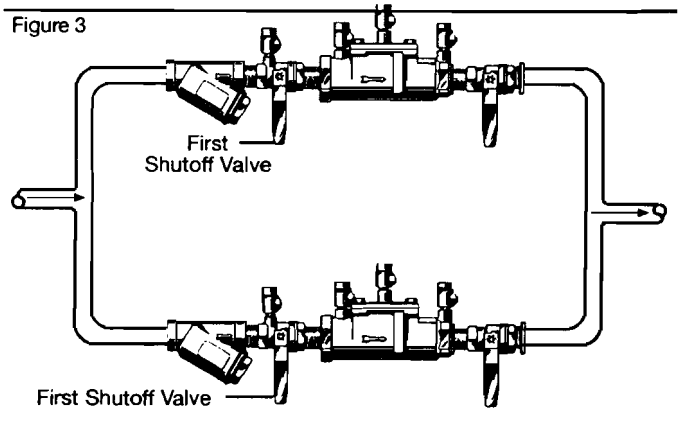


Now Available, WattsBox Insulated Enclosures.
For more information, send for ES-WB or ES-WB-T.

Parallel - Figure 3

Two or more Series 007 smaller size valves may be piped in parallel (where approved) to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water/where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increased capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line.
For two valve installations the total capacity of the devices should equal or exceed that required by the system.
The quantity of valves used in parallel should be determined by the engineers judgement based on the operating conditions of a specific installation.

Figure 3



007QT-S

Service, Replacement Parts and Maintenance

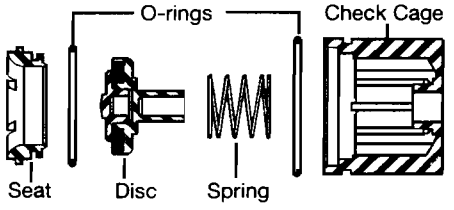
Servicing the First and Second Check Valves

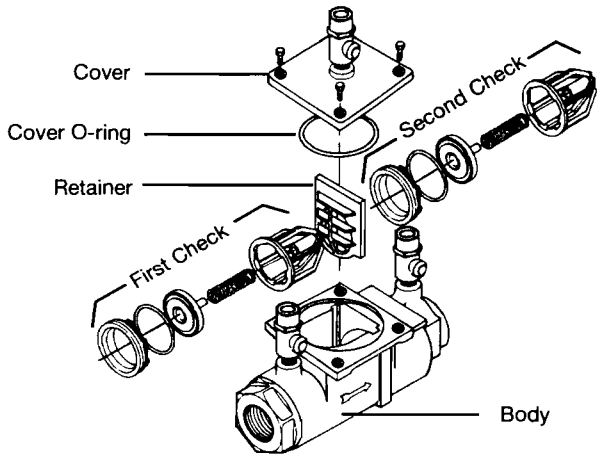
NOTE: Before servicing be certain water is turned off or shut-off valves are closed

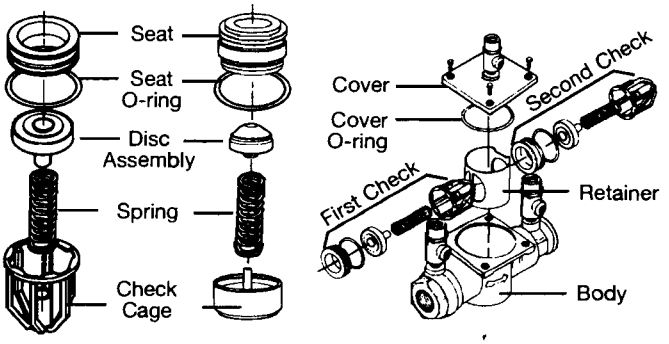
1. After removing the cover, remove the retainer for the body bore. The check valve modules can now be removed from the valve by hand or with a screwdriver.

Note: For Series 007 sizes ½" - 2", the seats and springs of the first and second check modules are not interchangeable. The heavier spring and smaller diameter seat belong with the first check module. Series 007M1 sizes ¾" - 1" and Series 007M2 ¾" have interchangeable seats and springs.

2. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate clockwise against the cage, for ¾" Series 007M2 pull apart seat and cage. The seat, cage, spring and disc assembly are now individual components.
3. The disc assembly may now be cleaned and reassembled or, depending on its condition, it may be discarded and replace with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary.
4. Reassemble the check valve module in the reverse order. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replaced. On the ¾" - 1" size, this retainer may have to be tilted slightly into place. Replace cover.







½" - 2" Replacement Parts

When ordering, specify ordering code number, kit number and valve size

Check Kits: 1st or 2nd Check

0887193	RK 007 CK4	½"
0887026	RK 007M1 CK4	¾" - 1"
0887377	*RK SS007 CK4	½"
0888070	*RK SS007M3 CK1	½" - ¾"
0888071	*RK SS007M3 CK2	½" - ¾"
0887393	*RK SS007M2 CK1	¾"
0887397	*RK SS007M2 CK2	¾"
0887373	*RK SS007M1 CK4	1"

1st Check

0887023	RK 007 CK1	¾" - 1"
0887045	RK 007M2 CK1	¾"
0888550	RK 007M3 CK1	¾"
0887025	RK 007 CK1	1½" - 2"
0887186	RK 007M1 CK1	1½" - 2"
0887719	RK 007M2 CK1	1¼" - 1½"

2nd Check

0887024	RK 007 CK2	¾" - 1"
0887046	RK 007M2 CK2	¾"
0888551	RK 007M3 CK2	¾"
0887028	RK 007 CK2	1½" - 2"
0887187	RK 007M1 CK2	1½" - 2"
0887720	RK 007M2 CK2	1¼" - 1½"

Stainless Steel 1st or 2nd Check

0887022	RK 007 CK1 SS	¾" - 1"
0887030	RK 007 CK2 SS	¾" - 1"
0887032	RK 007M1 CK4 SS	¾" - 1"
0887031	RK 007 CK1 SS	1½" - 2"
0887035	RK 007 CK2 SS	1½" - 2"
0887189	RK 007M1 CK1 SS	1½" - 2"
0887190	RK 007M1 CK2 SS	1½" - 2"

Kit includes: Seat, seat o-ring, disc assembly, spring, check cage, cover o-ring.

Cover Kit

0887195	RK 007 C	½"
0887036	RK 007 C	¾" - 1"
0887038	RK 007M1 C	¾" - 1"
0887039	RK 007M2 C	¾"
0888553	RK 007M3 C	¾"
0887037	RK 007 C	1½" - 2"
0887191	RK 007M1 C	1½" - 2"
0887722	RK 007M2 C	1¼" - 1½"
0887379	*RK SS007 C	½"
0887380	*RK SS007M2 C	¾"
0888073	*RK SS007M3 C	½" - ¾"
0887381	*RK SS007M1 C	1"

Kit includes: Cover and cover o-ring

Complete Rubber Parts

0887194	RK 007 RT	½"
0887040	RK 007 RT	¾" - 1"
0887042	RK 007M1 RT	¾" - 1"
0887043	RK 007M2 RT	¾"
0888552	RK 007M3 RT	¾"
0887041	RK 007 RT	1½" - 2"
0887188	RK 007M1 RT	1½" - 2"
0887721	RK 007M2 RT	1¼" - 1½"
0887378	*RK SS007 RT	½"
0887394	*RK SS007M2 RT	¾"
0888072	*RK SS007M3 RT	½" - ¾"
0887374	*RK SS007M1 RT	1"

Kit includes: Cover o-ring, two seat discs and two seat o-rings.

*SS prefix denotes stainless steel body.

Installation Instructions
2½" and 3" 007

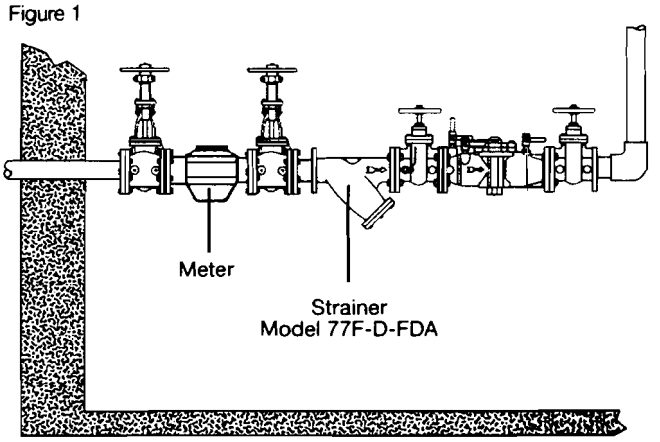
Indoors - Figure 1

Series 007 may be installed in either a vertical or horizontal position. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve in the line with arrow on valve body pointing in the direction of flow.
For indoor installations, it is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

CAUTION: Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon during emergencies, such as fire sprinkler lines, etc.
It is important that Series 007 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions.

NOTE: Fire Protection System Installations
The National Fire Protection Agency (NFPA) Guidelines require a confirming flow test to be conducted whenever a "main line" valve such as the shutoff valves or a backflow assembly have been operated. Certified testers of backflow assemblies must conduct this test. The trim valves of the detector meter bypass line, on assemblies so equipped, should be shut off during the confirming flow test. When the test is completed the trim valves must be retuned to a fully open position.

Figure 1



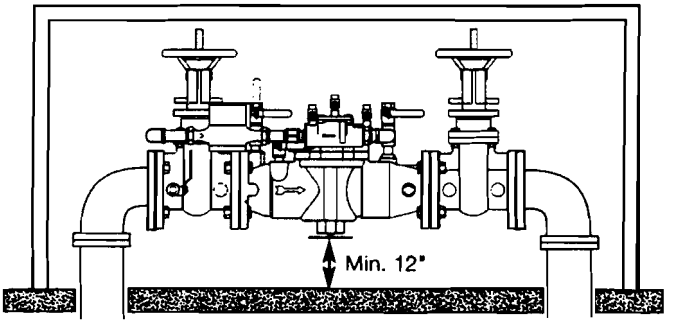
2½", 3" 007

Outside Building Above Ground - Figure 2

In an area where freezing conditions do not occur, Series 007 can be installed outside of a building. The most satisfactory installation is above ground and should be installed in this manner whenever possible. In an area where freezing conditions can occur, Series 007 should be installed above ground in an insulated enclosure.

Annual inspection of all water system safety and control valves is required and necessary. Regular inspection, testing and cleaning assures maximum life and proper product function.

Figure 2



Now Available, WattsBox Insulated Enclosures.

For more information, send for ES-WB or ES-WB-T.

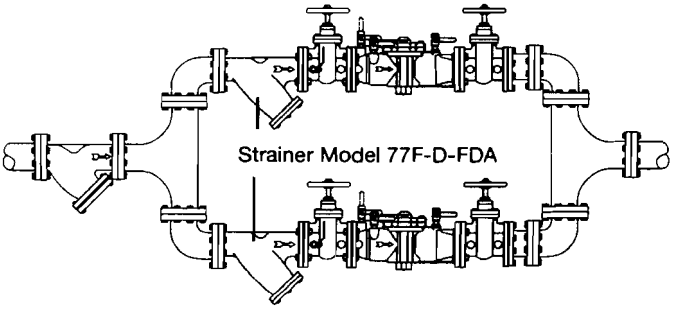
Parallel - Figure 3

Consult Local codes for Approval

Two or more Series 007 smaller size valves may be piped in parallel (where approved) to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water/where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increase capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line. For two valve installations the total capacity should equal or exceed that required by the system.
The quantity of valves used in parallel should be determined by the engineers judgement based on the operating conditions of a specific installation. (See F-FC regarding flow curves)

INSTALLATION NOTE: The flange gasket bolts for the gate valves should be retightened during installation as the bolts may have loosened due to storage and shipping.

Figure 3

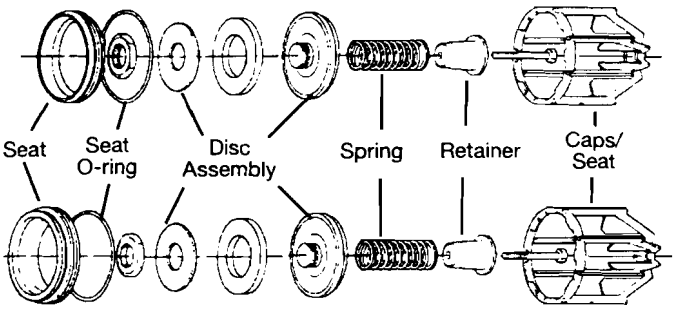


2½", 3" 007

Servicing First and Second Check Valves
2½" and 3" 007

1. Remove cover bolts and cover.
2. Remove the retainer from the body bore. The check valve modules can now be removed from the valve by hand or with a screwdriver.
3. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate counterclock-wise against the cage. The seat, spring cage, spring and disc assembly are now individual components.
4. The disc assembly may now be cleaned and reassemble or depending on its condition, may be discarded and replaced with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary. For more information, refer to repair parts price list PL-RP-BPD.
5. Reassemble the Check valve modules. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replace.

NOTE: No special tools required to service Series 007.



Check Assemblies

Replacement Parts
2½" and 3" 007

When ordering, specify ordering code number, kit number and valve size.

First Check Kit

0887285	RK 007 CK1	2½", 3"

Kit Includes: Seat, seat o-ring, disc assembly, spring, spring retainer, check cage and cover o-ring.

Second Check Kit

0887286	RK 007 CK2	2½", 3"

Kit Includes: Seat, seat o-ring, disc assembly, spring, spring retainer, check cage and cover o-ring.

First and Second Check Rubber Parts

0887287	RK 007 RT	2½", 3"

Kit Includes: Two seat discs, two seat o-rings, two cover o-rings.

Cover Kit

0887288	RK 007 C	2½", 3"

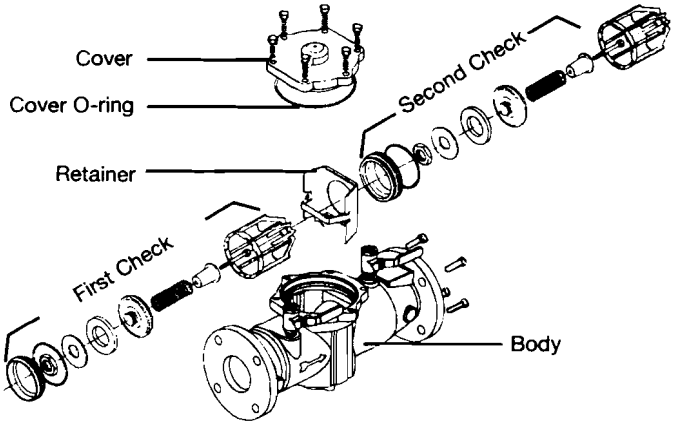
Kit includes: Cover and cover o-ring.

Seat Kit

0887289	RK 007 S	2½", 3"

Kit Includes: Seat and seat o-ring.

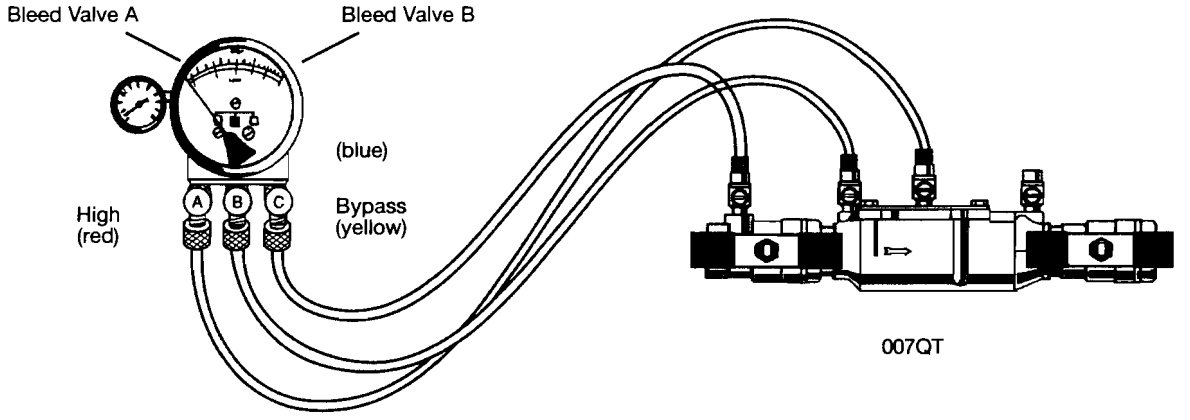
"Use only original equipment manufactured parts to protect the validated warranty."



Test Procedure for Double Check Valve Assembly

A. Before starting test, all needle valves and bleed valves on test kit must be closed.
B. Flush test cocks before test.

NOTE: Supply pressure gauge reading will decrease when performing this test procedure.



Test No. 1 - Check Valve No. 1

NOTE: Close all needle valve "A", "B" and "C" and bleed valve "A" and "B" on test kit.

Step 1 Insure shutoff No. 1 is open, shutoff No. 2 is closed.

Step 2 Install high side hose between connection "A" high-side and test cock No. 3, low side hose between "B" low side and test cock No. 2 and open both test cock No. 2 and 3.

Step 3 Open bleed valve "A" to bleed air from the high side. Close "A" then open bleed valve "B" to bleed low side. Close "B."

Step 4 Connect bypass hose between connection "C" bypass and loosely to test cock No. 1. Open needle valves "A" high side and "C" bypass to vent air from bypass hose. Tighten bypass hose at test cock No. 1, open test cock No. 1.

Step 5 Close shutoff No. 1. Slowly open bleed "B" until differential gauge rises to 2psi and close. If the differential reading does not decrease, record check valve as "tight."

Step 6 Close all test cocks and open bleed valves "A" and "B." Then close needle valves "A," "B" and "C" and bleed valves "A" and "B." Remove hoses from test cocks.

Test No. 2 - Check Valve No. 2

Step 7 Move the high side hose to test cock No. 4, low side hose to test cock No. 3 and open both test cock No. 3 and 4. Remove bypass hose from test cock No. 1, open shutoff valve No. 1.

Step 8 Open bleed valve "A" to bleed air from the high side. Close bleed "A" then open bleed "B" to bleed low side. Close bleed "B."

Step 9 Connect bypass hose loosely to test cock No. 1. Open needle valves "A" high side and "C" bypass to vent air from the bypass hose. Tighten bypass hose at test cock No. 1, open test cock No. 1.

Step 10 Close shutoff No. 1, then slowly open bleed "B" until differential gauge rises to 2psi and close. If the differential reading does not decrease, record check as tight. Close all test cocks and remove hoses. Open bleed valves "A" and "B." Restore valve to original working condition.

NOTE: The assembly will fail both the first and second check valve tests above, if shutoff No. 2 leaks excessively. To test for a leaky No. 2 shutoff, use the following procedure.

Test for Leaky No. 2 Shutoff

Step 11 Connect the high side hose to test cock No. 1, low side hose to test cock No. 4. Open test cocks No. 1 and 4. Close shutoffs No.1 and 2.

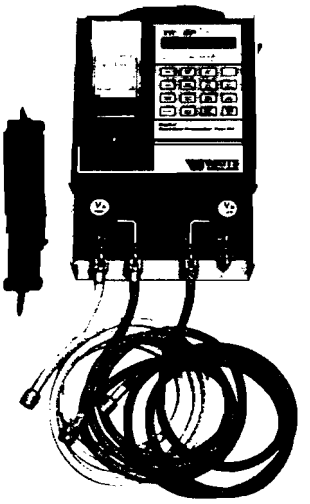
Step 12 Close needle valve "C" bypass. Open needle valve "A" high side, then open needle valve "B" low side one turn, loosen hose at test cock No. 4 to remove air. Retighten hose.

Step 13 If the differential gauge rises above 0 there is excessive leakage at shutoff No. 2 and it must be replaced to test the assembly.

Watts Backflow Preventer Test Kits

Model TK-DL

Backflow Preventer Test Kit



TK-DL has Digital Print-Out and Computer Download
An advanced piece of test
equipment designed to make pressure and differential gauges obsolete in the testing of backflow preventers.

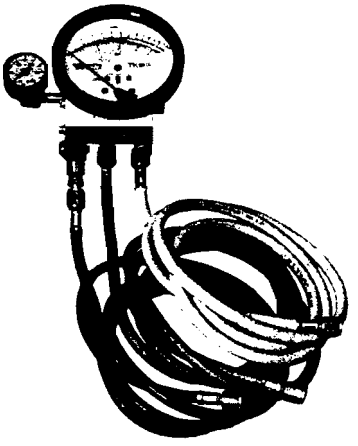
- Accuracy
- Versatility
- Readability
- Portability
- Documentation

Test kit contains hoses, adapters, digital printout unit with complete instructions in rugged case.

For additional information, send for PG-TK.

Model TK-99E

Backflow Preventer Test Kit



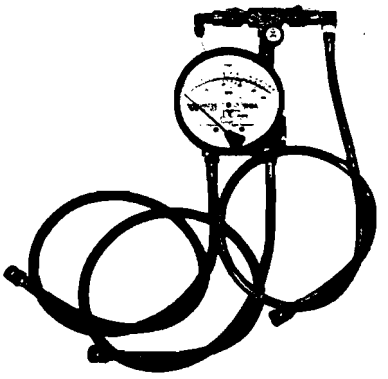
TK-99E has been designed for simplified operator operation and rugged reliability in a compact package. Offering the latest in gauge technology, the Watts TK-99E provides dependable accuracy when testing pressure vacuum breakers, reduced pressure backflow preventers or double check assemblies.

- A large 4.5" anti-parallax dial which indicates descending measurement, accurate to ± 1% of full scale.
- Complete kit contains gauge with color-coded valves and hoses, hose adapters, shock cord for easy mounting, supply pressure gauge. All contained in a durable carrying case with room for tools.

For additional information, send for PG-TK.

Model TK-9A

Backflow Preventer Test Kit



Entry level test kit designed to test pressure vacuum breakers, reduced pressure backflow preventers, or double check assemblies. Accuracy to ± 2% of full scale.

- Max. pressure 175psi.
- Max. temperature 210°F.

Test kit contains: gauge, test valves, hoses, adapters, securing strap, instruction guide and lightweight case.

For additional information, send for PG-TK.

Model TK-99D

Backflow Preventer Test Kit

Hand held digital test kit designed to test PVB's, SVB's, DCVA's, DCDA's, RP's and RPDA's

For additional information, send for PG-TK.

Model TK-7

Backflow Preventer Test Kit

Tests the individual check modules of the Watts No. 7 Residential Dual Check. Also used to test Series 709, 770 and 007 Double Check Valve Assemblies.

For additional information, send for PG-TK.

For Technical Assistance Call Your Authorized Watts Agent.

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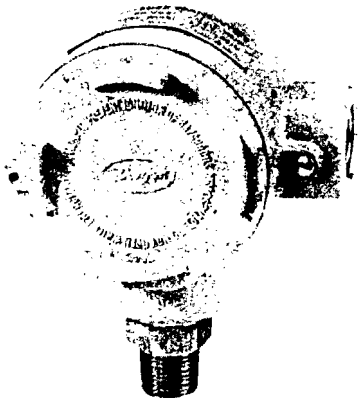
Section 1-H

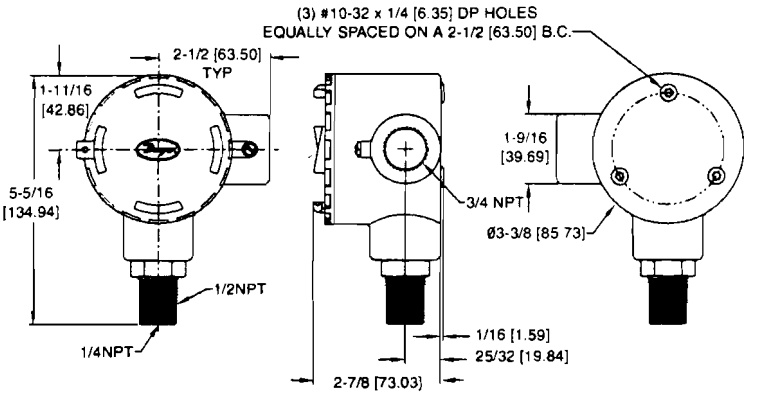
Pressure Transmitters (PT-101, PT-102)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series 634ES Pressure Transmitter 0-60 PSIG

Specifications - Installation and Operating Instructions





The **Series 634ES Pressure Transmitter** senses a single air, compatible gas or liquid pressure and converts it into a standard 4-20 mA output signal. Ranges are available from 0-10 through 0-6000 psi. All models are field adjustable so any range within these limits can be achieved by recalibration using the easily accessible span and zero potentiometers.

Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. The signal is conditioned and converted into a 4-20 mA output signal.

For applications requiring direct pressure or percent of full span readings, the optional A-701 digital readout makes an ideal companion device, providing a bright .6" high, 3-1/2" digit LED and supplying power to the Series 634ES Transmitter.

Model Number	Series 634ES Models and Ranges in PSI (bar)			
	As Stocked	Min. Range	Max. Range	Max Pressure
634ES-0	10 (.69)	10 (.69)	20 (1.38)	30 (2.07)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	60 (4.14)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	100 (6.9)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	200 (13.8)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	400 (27.6)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	500 (34.5)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	1000 (69)
634ES-7	1000 (69)	600 (41 4)	1250 (86)	2000 (138)
634ES-8	2000 (138)	1250 (86)	2500 (172)	4000 (276)
634ES-9	4000 (276)	2500 (172)	6000 (414)	7500 (517)

PHYSICAL DATA

GENERAL

Maximum Pressure: See chart on this page.
Wetted Parts: 316, 316L Stainless Steel.
Housing: Designed to meet NEMA-4X.

ELECTRICAL

Power Supply: 12.3-35 VDC-2 wire.
Output Signal: 4-20 mA DC (limited at 38 mA DC).
Loop Resistance: 0 - 1100 ohms from 12.3 to 35 VDC.

$$R_{L\ max} = \frac{Vps - 12.3V}{20\ mA}$$

Current Consumption: DC: 38 mA max.

MATERIALS

Housing: Cast aluminum; textured gray polyurethane finish.
Pressure Connection: Stainless Steel.

MECHANICAL

Weight: 1 lb., 12 oz. (.8 kg).
Span and Zero Adjustments: Protected potentiometers, located in auxiliary housing.
Pressure Connection: 1/4" female NPT x 1/2" male NPT.

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC.
Full Span: 16 mA DC.
Accuracy: ±0.5% of span.
Warm-up Time: 10 minutes.

STABILITY/ENVIRONMENTAL

Operating Temperature: 20 to 120°F (- 6.7 to 48.9°C).
Thermal Errors: ± 0.02%/°F typical.
Stability: 1% F.S./yr.

STANDARD ACCESSORIES

(3) "Z" mounting brackets.
(3) 10-32 x 4" RH machine screws.

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Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

INSTALLATION

LOCATION: Select a location where temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tube feeding the pressure to the instrument can be run practically any length required, but long lengths will slightly increase response time. Avoid surfaces with excessive vibration.

POSITION: A vertical position is recommended, as all stocked models are spanned and zeroed at the factory in this position. They can be used at other angles, but final spanning and zeroing must be done while transmitter is in the alternative position.

PRESSURE CONNECTIONS: A single pressure connection is provided at the bottom of the transmitter housing. It has1/4" female NPT and 1/2" male NPT threads. Attach positive pressure to this port.

MOUNTING: The Series 634ES Transmitter can be mounted three ways:

(A) Supported directly by pipe providing pressure.

(B) Attached to a mounting surface with 10-32 x 1/4" machine screws (included). The machine screws are installed through the mounting surface into tapped holes on back of unit.

(C) Mounted with "Z" brackets (included). Attach "Z" brackets to tapped holes on back of unit and fasten to front of mounting surface.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 634ES Transmitter are made inside the enclosure. Remove the cover, feed stripped and tinned leads through the conduit opening and connect to terminal block screws marked + and -. See Figure A for locations of terminal block, span and zero adjust potentiometers. See Figure B (Pg. 3) for schematic diagram.

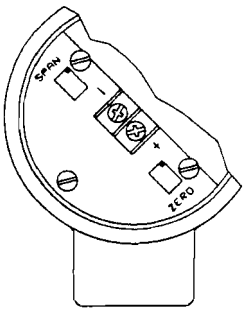

FIG. A

An external power supply delivering 12.3 to 35 VDC with minimum current capability of 40 mA must be used to power the control loop in which the Series 634ES Transmitter is connected. See Figure B for connection of the power supply, transmitter and receiver.

The range of appropriate receiver load resistance (R_L) for the power supply voltage available is given by the formula and graph in Figure C on Pg. 3.

Shielded 2-wire cable is recommended for control loop wiring, and the cable shielding may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient.

Should polarity of the transmitter or receiver inadvertently become reversed, the loop will not function properly, but no damage will be done to the transmitter.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

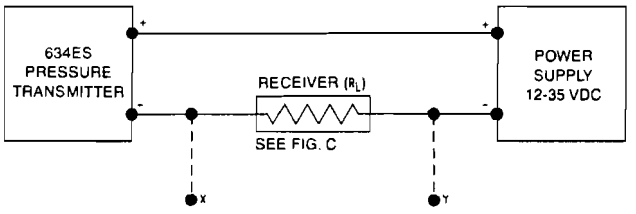

FIG. B

Series 634ES Transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, 2 watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (-) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 Ω, 2 watt, ± 1% tolerance metal film resistor which is adequate for this application.

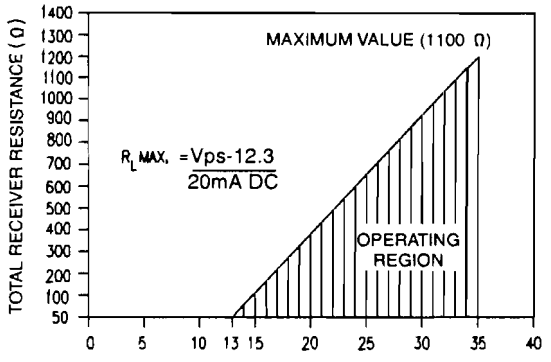

FIG. C

WIRE LENGTH - The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of receiver resistance to total loop resistance. For extremely long runs (over 1000 feet) choose receivers with higher resistances to minimize size and costs of connecting leads. When wiring length is under 100 feet, lead wire as small as 22 AWG can be used.

PRESSURE RANGING - Each Series 634ES Transmitter is factory-calibrated to the range given in the model number chart. However, special calibration is also available. If this is the case, the transmitter will be so marked. For purposes of clarification in these instructions, range is defined as that pressure which, applied to the transmitter, produces 20 mA of current in the loop. Zero pressure is always assumed to be 4 mA. If a transmitter pressure range other than that supplied is required, follow the re-ranging procedure described on Pg. 4.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

PRESSURE RE-RANGING PROCEDURE

1. With the transmitter correctly connected to the companion receiver, an accurate milliameter with a full scale reading of approximately 30 mA should be inserted in series with the current loop. A controllable pressure source capable of achieving the desired range should be connected to the pressure port of the transmitter and teed into an accurate reference pressure gauge or manometer. The instrument must be ranged in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust "zero" control so that loop current is 4 mA.

4. Apply full range pressure and adjust loop current to 20 mA using "span" control.

5. Relieve pressure and allow transmitter to stabilize for two minutes.

6. Zero and span adjustments may be interactive, so repeat steps 3 through 5 until zero and full range pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove the milliameter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA output signal provided by the Series 634ES Pressure Transmitter is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is only necessary that these devices all be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading, this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 634ES Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 634ES Pressure Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

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Section 1-I

Pressure Indicators (PI-101, PI-102, PI-103)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for Type 213.40S)

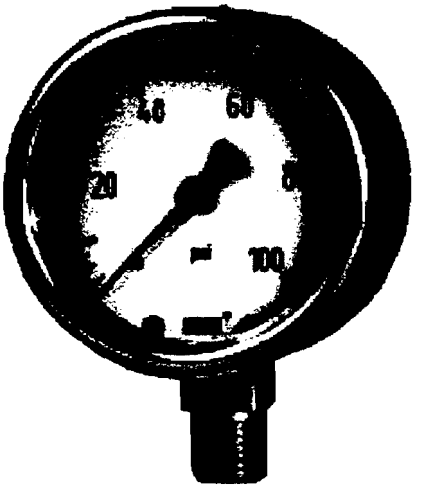
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

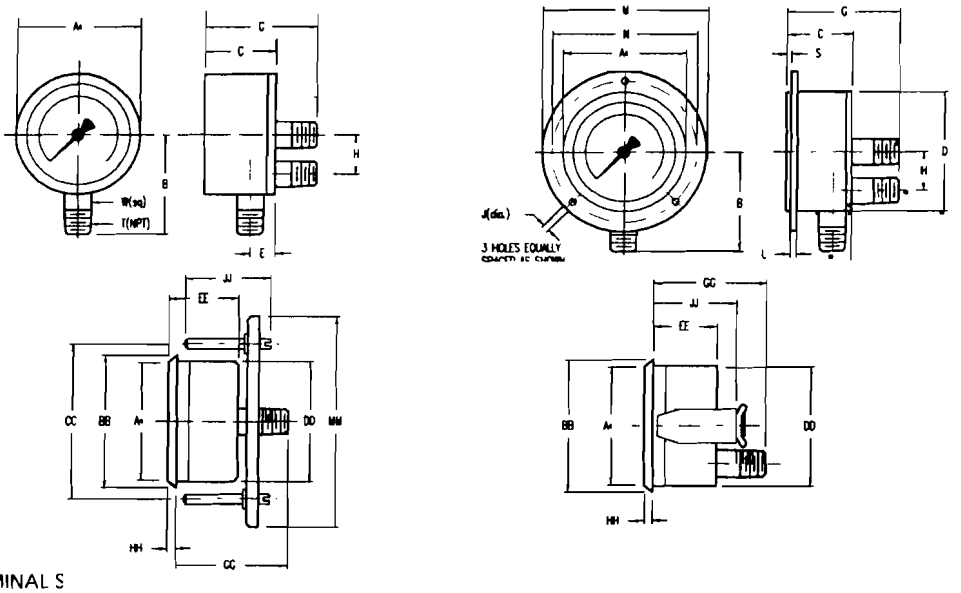
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



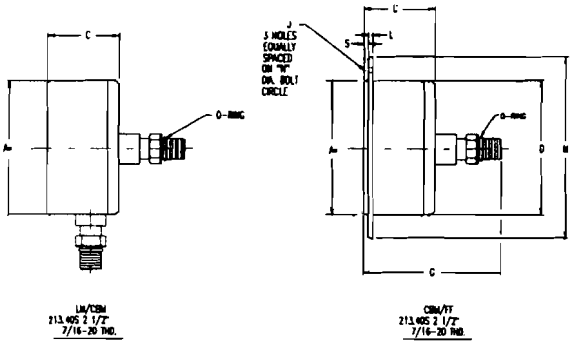
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14
		KEY	L	M	N	S	W	
		mm	2.0	85	75	2.0	22	
		in	.08	3.35	2.95	.08	0.87	

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/01

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

Section 2

Section 2-A

HDPE Containment Pipe Pressure Switch (PSH-121)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

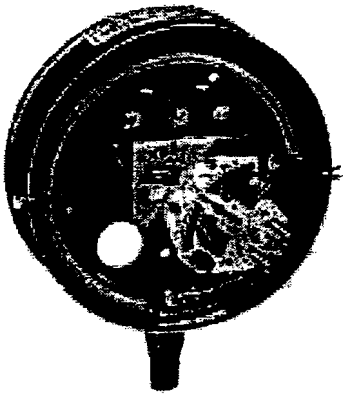
ENCLOSURE

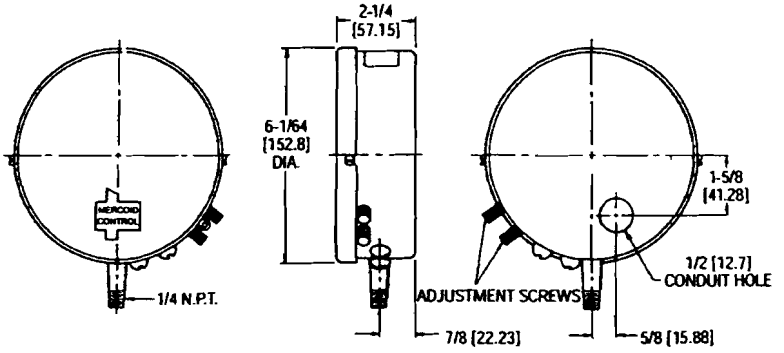
Bulletin IN-523

Mercoid®

Series DA/DS-7000 Bourdon Tube Pressure Switches

Specifications - Installation and Operating Instructions





Series DA/DS-7000 Bourdon Tube Pressure Switches are SPDT snap-action switches that combine extremely high sensitivity and repeatability with easily adjustable set and reset points through non-interactive external adjustments. These switches have visible calibrated dials for set points and on-off indicators to indicate switch actuation. DA models are equipped with two external adjustments. One sets the high pressure operating point; the other sets the reset point. Deadband or the difference between set and reset points is adjustable over the full scale. DS models have a fixed deadband.

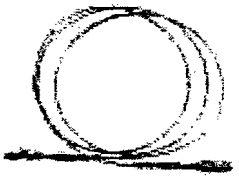
NOTE: The DS7300 has no status indicator.

INSTALLATION

The switch may be mounted in any position. Select a location recommended by equipment manufacturer. Where excessive vibration occurs, mount the switch remotely, using an appropriate remote connection and mounting bracket. See accessories, below.

ACCESSORIES

Mounting Bracket



Remote Connection

Pigtail Siphon

PHYSICAL DATA

Pressure Range: Models range from 0 to 30" Hg (0 to 762.5 mm/Hg) Vac. to 800 to 8000 psig (55.16 to 551.6 bar).

Maximum Temperature: 180°F (82°C). For higher temperature media applications, a remote connection or siphon (pigtail) should be used.

Pressure Connections: ¼" NPT standard; ½" NPT on ranges 500 to 5000 psig and 800 to 8000 psig.

Housing: Pressed steel with transparent cover.

Wiring Connections: Three-screw type.

Wetted Parts: Same as Bourdon tube material (brass, 403SS or 316SS) on all ranges except 23K, 24K, and 9K, which have carbon steel bottom connections.

Weight: 4 lb/1.8 kg (standard); 6 lb/2.7 kg (weatherproof); 8 lb/3.6 kg (explosion-proof)

Max. Pressure: Max. adjustment of operating range.

CAUTIONS:

Control movement must not be oiled. Do not overload. Note electrical rating on name plate and be sure that total current passing through the switch is within specified rating.

When testing a boiler or system, never exceed maximum pressure rating on control or it may be seriously damaged. Remove control if higher pressures are required.

Do not fail to use a siphon on steam where range is 35 lbs (2413 mbar) or more.

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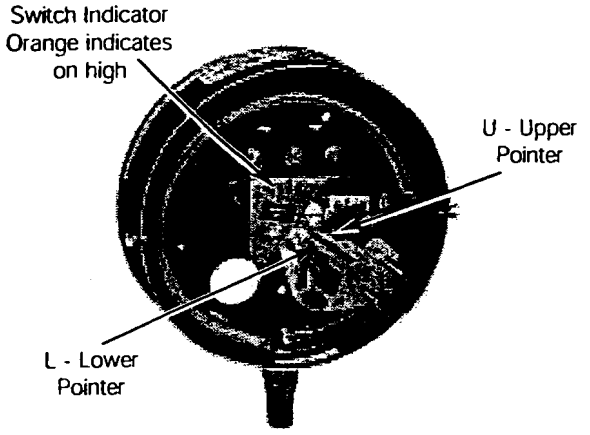
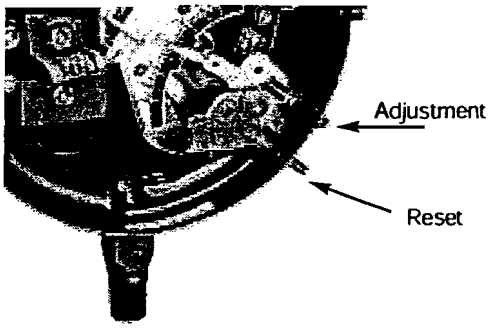
ADJUSTMENTS: HOW TO SET OPERATING POINT

Double Adjustment Types - Fully Automatic:
With double-adjustment switches (prefixed DA, DAH or DAW), adjust the upper pointer "U" to set HIGH PRESSURE POINT for switch operation and adjust the lower pointer "L" to set LOW PRESSURE OPERATING POINT. The difference between the "U" and "L" pointers is the operating differential between "on-off" switch operation.



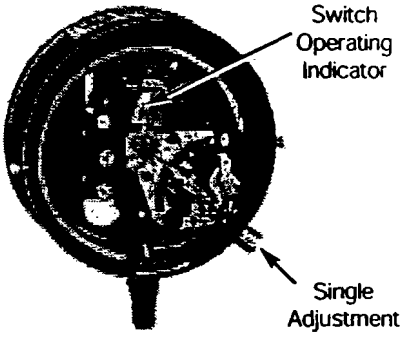
Double-Adjustment Types
Fully Automatic

Semi-Automatic Control with Manual Reset:
Models prefixed DR, DRH, DRW and with suffix L or U (example: DR-7021-153U) have a single adjustment that sets the operating point for automatic operation. A push-button reset must be operated manually to restore the circuit to the original position after automatic operation. Example: Type DR-7021-153L has a circuit that opens automatically on a pressure rise to the pressure indicated by the pointer on the scale; no matter how much the pressure drops, the circuit will not re-close until the reset button is operated. Suffix L denotes control will operate automatically on an increase. Suffix U denotes control will operate automatically on an decrease.



Semi-Automatic Types
with Manual Reset

SINGLE ADJUSTMENT TYPES—FULLY AUTOMATIC:
Models prefixed DS, DSH, DSW, N3DSW are equipped with a single adjustment. Differential is fixed (not adjustable). The single pointer on the scale sets the pressure at which switch operation occurs. Differential is listed in chart indicates approximate fixed differential.



Single Adjustment Types Fully Automatic

LOCKING DEVICE

When the control has been adjusted to desired range, the locking bar may be inserted between the adjustment screws with the slot passing over the projecting lugs. By placing a sealing wire between the locking bar and the hole in the lug protruding from the adjustment assembly, adjustments cannot be tampered with.

For DRF, DAW, DRW, adjusting knob cover may be sealed in place with sealing wire through cover bolt hole. For DAH, sealing wire may pass through locking bar and hole in hub above adjusting knobs.

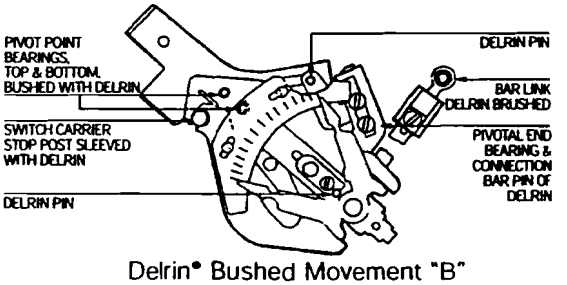
DELRIN® BUSHED MOVEMENT "B"

Delrin® bushed movements prolong control life by alleviating wear of metal surfaces due to excessive vibration and/or pulsation. They also prolong switch life in environments where corrosion may be a factor. Models with Delrin movements are identified by the letter "B after the suffix number. Examples: -153B, -153UB, etc.

®Delrin is a registered trademark of E. I. DuPont de Nemours & Co.

CONTROL NUMBER

Part of the control number (the fourth number in the sequence) identifies the type of control case. Digit 1 of 7021, 7031, 7041, denotes a plain case with bottom connection. Digit 2 of 7022, 7032, etc., denotes a plain case with back connection. Digit 3 of 7023, 7033, 7043, etc., denotes a flanged case with bottom connection. Digit 4 of 7024, 7034, etc., denotes a flanged case with back connection. (Digit 3 of 7321, 7331, 7341, etc., denotes hermetically sealed snap switch.)

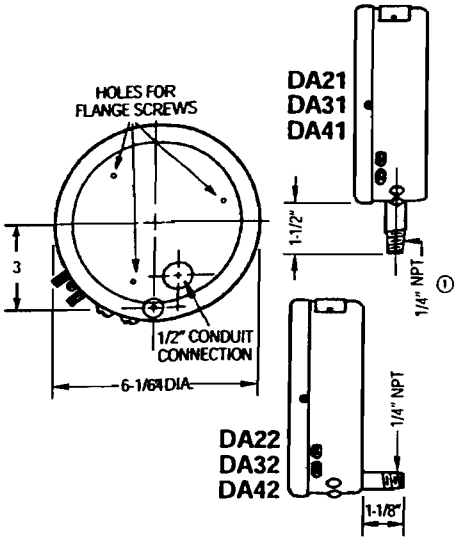


Delrin® Bushed Movement "B"

CIRCUITS (SWITCH OPERATION)

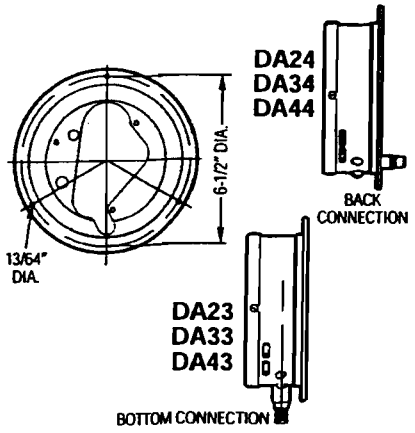
Suffix number after control number denotes switch action:
Suffix -153 designates SPDT; one circuit closes as other circuit opens.
Suffix - 804 designates two SPDT switches; two close, two open.

GENERAL PURPOSE CONTROLS, TYPES DA, DL, DR, DS
Mount control in any position. Do not twist the case when installing. Use a wrench on the square part of the control connection. On controls with operating Range No. 15S (500 to 5000 psi (34.47 to 344.75 bar)) or Range No. 16S (800 to 8000 psi (55.16 to 551.6 bar)), be sure the special sealing nut (with Teflon® insert) is turned to the uppermost threaded section of the ½" pressure connection. Apply a flat open-end wrench to the flat side of the bottom pressure connection when piping the control. After properly connecting the control, tighten the sealing nut to assure a leak-proof connection.



General Purpose
Types DA, DS, DR, DL

FLANGED CASE CONTROLS
Mount by means of the three holes in the flange. Note: Series D7030 when used for steam with operating ranges of 35 psi (2.413 bar) or higher, must be siphoned to prevent live steam entering the Bourdon tube. With high-pressure steam exceeding 100 psi (6.895 bar), use a remote connection. (Note accessories on Page 1.)
Series D-7020 incorporate an orifice as standard in the pressure connection to dampen surges or pulsations.



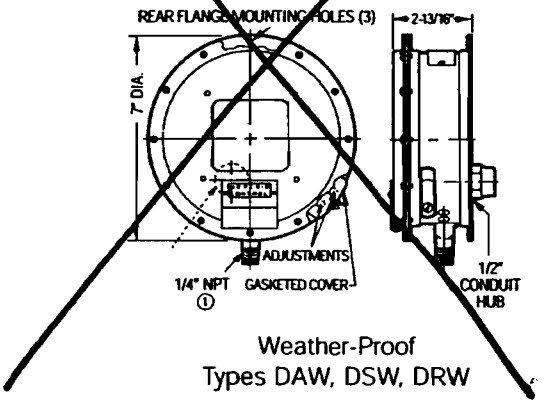
Flange for Surface Mounting

WEATHER-RESISTANT (RAINTIGHT)
NEMA 2, 3, TYPES N3DAW, N3DRW, N3DSW
These switches are supplied with flanged case, bottom connection, for surface mounting.

WATERTIGHT AND WEATHERPROOF
NEMA 2, 3, 4, 5, TYPES DAW, DRW, DSW, C4DAW*, C4DAW*, C5DSW*

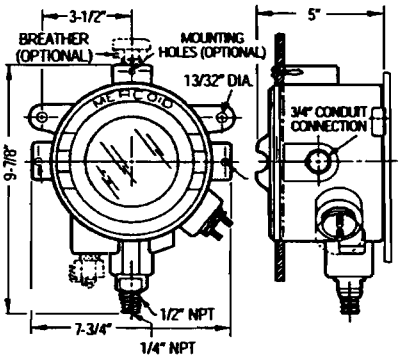
These switches are supplied with flanged case, bottom connection, for surface mounting only.

* Conforms to Canadian Standards Association requirements



Weather-Proof
Types DAW, DSW, DRW

EXPLOSION-PROOF TYPES DAH, DRH, DSH
Mount with mounting lugs attached to control housing.



Explosion-Proof
Types DAH, DRH, DSH

WIRING
Wire in accordance with the National Electrical Code and local regulations. For general purpose controls, use a short piece of BX between the rigid conduit and the control so the control will not be subjected to conduit expansion and contraction. Where the control is directly connected into the load circuit, it should be connected into the hot side of the line. Do not exceed electrical rating as stamped on the control nameplate. DS-7300 controls are equipped with a terminal block. Field connection should be made to terminal block pole in common with required pole of the control's switch. The color code is:
Black - Common
Blue - ON Hi
Red - ON Lo

RANGES:			TYPE DA Double Adjustment Minimum Differential	TYPE DS Single Adjustment Fixed Differential		
Bourdon Tube Material	**Range Number**	**Adjustable Operating Range (PSIG)**	**SPDT DA-7031-153 DAW-7033-153 DAH-7031-153**	**SPDT DS-7231-153 DSW-7233-153 DSH-7231-153**	**(2) SPDT DS-7231-804 DSW-7233-804 DSH-7231-804**	**SPDT DS-7331-153 DSW-7333-153 DSH-7331-153**
Brass Bourdon Tube	2	0-30" Hg Vac	9" Hg	3" Hg	2.5" Hg	5" Hg
	3	1.0" Hg Vac-12 psig	4 psig	1.5 psig	1.25" psi	3" psi
	1	1/8-15 psig	4 psig	1.5 psig	1.25 psig	3 psig
	2A	1/8-20 psig	4 psig	1.5 psig	1.25 psig	3 psig
	4	1-35 psig	5 psig	1.5 psig	1.5 psig	3 psig
	27	25" Hg Vac-50 psig	8 psig	2.5 psig	2 psig	3.75 psig
	5	2-60 psig	6 psig	2 psig	1.5 psig	3 psig
	6	5-100 psig	9 psig	2.5 psig	2 psig	3.75 psig
	7	5-150 psig	16 psig	3.5 psig	3.5 psig	5.25 psig
	8	10-200 psig	16 psig	4.75 psig	4 psig	6.75 psig
	9	10-300 psig	16 psig	6 psig	6 psig	9 psig
403SS Bourdon Tube	**Range Number**	**Adjustable Operating Range (PSIG)**	**SPDT DA-7021-153 DAW-7023-153 DAH-7021-153**	**SPDT DS-7221-153 DSW-7223-153 DSH-7221-153**	**(2) SPDT DS-7221-804 DSW-7223-804 DSH-7221-804**	**SPDT DS-7321-153 DSW-7323-153 DSH-7321-153**
	25S	30" Hg Vac-50 psig	12 psig	3.5 psig	3 psig	5.25 psig
	26S	30" Hg Vac-75 psig	12 psig	3.5 psig	3 psig	5.25 psig
	5S	2-60 psig	9 psig	3 psig	2.5 psig	4.5 psig
	6S	5-100 psig	13 psig	3.5 psig	3 psig	5.25 psig
	8S	10-200 psig	15 psig	4.75 psig	4 psig	7.125 psig
	9S	10-300 psig	20 psig	7 psig	6 psig	10.5 psig
	9AS	40-350 psig	19 psig	7psig	6 psig	10.5 psig
	10S	25-600 psig	45 psig	12 psig	10 psig	18 psig
	11S	50-1000 psig	95 psig	22 psig	20 psig	33 psig
	12S	100-1500 psig	130 psig	35 psig	30 psig	52.5 psig
	13S	300-2500 psig	260 psig	60 psig	50 psig	90 psig
	15S	500-5000 psig	900 psig	200 psig	110 psig	300 psig
	16S	800-8000 psig	1500 psig	500 psig	180 psig	750 psig
316SS Bourdon Tube	**Range Number**	**Adjustable Operating Range (PSIG)**	**SPDT DA-7041-153 DAW-7043-153 DAH-7041-153**	**SPDT DS-7241-153 DSW-7243-153 DSH-7241-153**	**(2) SPDT DS-7241-804 DSW-7243-804 DSH-7241-804**	**SPDT DS-7341-153 DSW-7343-153 DSH-7341-153**
	26E	30" Hg Vac- 75 psig	10 psig	3.5 psig	4 psig	5.25 psig
	23E	5-75 psig	8 psig	4 psig	2.5 psig	6 psig
	6E	10-100 psig	10 psig	3.5 psig	4 psig	5.25 psig
	24E	10-150 psig	11 psig	4.5 psig	3 psig	6.75 psig
	9E	10-300 psig	28 psig	8 psig	6 psig	12 psig
	21E	30-400 psig	52 psig	12 psig	10 psig	18 psig
	22E	75-800 psig	120 psig	25 psig	17 psig	37.5 psig
	11E	100-100 psig	190 psig	35 psig	30 psig	52.5 psig
	13E	200-2500 psig	400 psig	75 psig	95 psig	112.5 psig
316SS Bourdon Tube Carbon Steel Bottom Connection	**Range Number**	**Adjustable Operating Range (PSIG)**	**SPDT DA-7041-153 DAW-7043-153 DAH-7041-153**	**SPDT DS-7241-153 DSW-7243-153 DSH-7241-153**	**(2) SPDT DS-7241-804 DSW-7243-804 DSH-7241-804**	**SPDT DS-7341-153 DSW-7343-153 DSH-7341-153**
	23K	5-75 psig	8 psig	4 psig	2.5 psig	6 psig
	24K	10-150 psig	11 psig	4 psig	3 psig	6 psig
	9K	10-300 psig	28 psig	8 psig	6 psig	12 psig
	Two SPDT Switches* Electrical Ratings		See Code F See Code D	See Code E	See Code D	See Code K

	ELECTRICAL RATINGS		
Code	**AC Capacity** 120V 240V 480V	**DC Capacity** 120V 240V	**AC Horsepower** 120V 240V
D	15A 15A NA	.5A .25A	1/8 1/4
E	15A 15A 15A	NA NA	1/4 1/2
F	12A 10A 5A	.5A .25A	1/4 1/2
G	5A @ 250 AC. Resistive & Inductive; 30V DC Resistive		
K	5A @ 125/250 AC, Resistive; 30V DC Resistive		

Circuit Suffix No.
-153 **Switch Action on Pressure/Temperature Increase**
SPDT: one OPENS as one CLOSES
-804 **(2) SPDT: two OPEN as two CLOSE**

Electrical Rating Code
D-7000 D-2000 D-7300
D E K
F* G

*Note: Minimum differentials increase when using multiple circuits. Controls using #804 circuits in ranges over 35 psig have 30% higher minimum differentials; ranges under 35 psig are not available in Code F.

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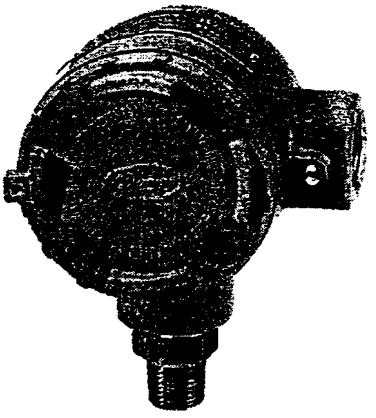
Section 2-B

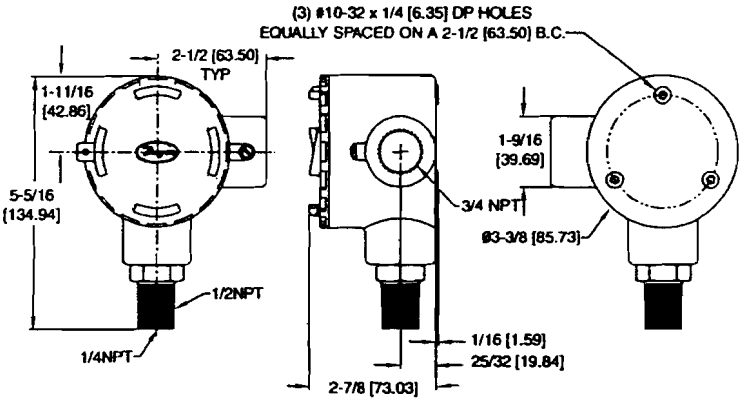
HDPE Containment Pipe Pressure Transmitter (PT-121)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions





The **Series 634ES Pressure Transmitter** senses a single air, compatible gas or liquid pressure and converts it into a standard 4-20 mA output signal. Ranges are available from 0-10 through 0-6000 psi. All models are field adjustable so any range within these limits can be achieved by recalibration using the easily accessible span and zero potentiometers.

Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. The signal is conditioned and converted into a 4-20 mA output signal.

For applications requiring direct pressure or percent of full span readings, the optional A-701 digital readout makes an ideal companion device, providing a bright .6" high, 3-1/2˝ digit LED and supplying power to the Series 634ES Transmitter.

Model Number	Series 634ES Models and Ranges in PSI (bar)			
	As Stocked	Min. Range	Max. Range	Max Pressure
634ES-0	10 (.69)	10 (.69)	20 (1.38)	30 (2.07)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	60 (4.14)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	100 (6.9)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	200 (13.8)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	400 (27.6)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	500 (34.5)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	1000 (69)
634ES-7	1000 (69)	600 (41.4)	1250 (86)	2000 (138)
634ES-8	2000 (138)	1250 (86)	2500 (172)	4000 (276)
634ES-9	4000 (276)	2500 (172)	6000 (414)	7500 (517)

PHYSICAL DATA

GENERAL

Maximum Pressure: See chart on this page.
Wetted Parts: 316, 316L Stainless Steel.
Housing: Designed to meet NEMA-4X.

ELECTRICAL

Power Supply: 12.3-35 VDC-2 wire.
Output Signal: 4-20 mA DC (limited at 38 mA DC).
Loop Resistance: 0 - 1100 ohms from 12.3 to 35 VDC.

$$R_{L\ max} = \frac{Vps - 12.3V}{20\ mA}$$

Current Consumption: DC: 38 mA max.

MATERIALS

Housing: Cast aluminum; textured gray polyurethane finish.
Pressure Connection: Stainless Steel.

MECHANICAL

Weight: 1 lb., 12 oz. (.8 kg).
Span and Zero Adjustments: Protected potentiometers, located in auxiliary housing.
Pressure Connection: 1/4˝ female NPT x 1/2˝ male NPT.

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC.
Full Span: 16 mA DC.
Accuracy: ±0.5% of span.
Warm-up Time: 10 minutes.

STABILITY/ENVIRONMENTAL

Operating Temperature: 20 to 120°F (- 6.7 to 48.9°C).
Thermal Errors: ± 0.02%/°F typical.
Stability: 1% F.S./yr.

STANDARD ACCESSORIES

(3) "Z" mounting brackets.
(3) 10-32 x 4" RH machine screws.

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Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

INSTALLATION

LOCATION: Select a location where temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tube feeding the pressure to the instrument can be run practically any length required, but long lengths will slightly increase response time. Avoid surfaces with excessive vibration.

POSITION: A vertical position is recommended, as all stocked models are spanned and zeroed at the factory in this position. They can be used at other angles, but final spanning and zeroing must be done while transmitter is in the alternative position.

PRESSURE CONNECTIONS: A single pressure connection is provided at the bottom of the transmitter housing. It has1/4" female NPT and 1/2" male NPT threads. Attach positive pressure to this port.

MOUNTING: The Series 634ES Transmitter can be mounted three ways:

(A) Supported directly by pipe providing pressure.

(B) Attached to a mounting surface with 10-32 x 1/4" machine screws (included). The machine screws are installed through the mounting surface into tapped holes on back of unit.

(C) Mounted with "Z" brackets (included). Attach "Z" brackets to tapped holes on back of unit and fasten to front of mounting surface.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 634ES Transmitter are made inside the enclosure. Remove the cover, feed stripped and tinned leads through the conduit opening and connect to terminal block screws marked + and -. See Figure A for locations of terminal block, span and zero adjust potentiometers. See Figure B (Pg. 3) for schematic diagram.

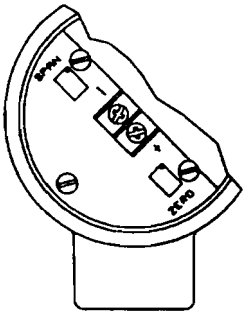

FIG. A

An external power supply delivering 12.3 to 35 VDC with minimum current capability of 40 mA must be used to power the control loop in which the Series 634ES Transmitter is connected. See Figure B for connection of the power supply, transmitter and receiver.

The range of appropriate receiver load resistance (R_L) for the power supply voltage available is given by the formula and graph in Figure C on Pg. 3.

Shielded 2-wire cable is recommended for control loop wiring, and the cable shielding may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient.

Should polarity of the transmitter or receiver inadvertently become reversed, the loop will not function properly, but no damage will be done to the transmitter.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

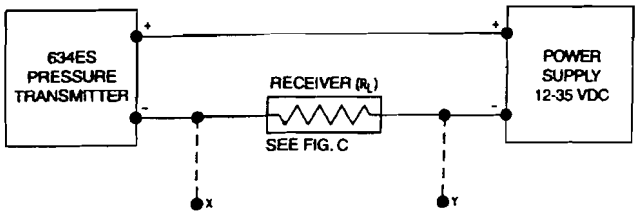

FIG. B

Series 634ES Transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, 2 watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (-) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 Ω, 2 watt, ± 1% tolerance metal film resistor which is adequate for this application.

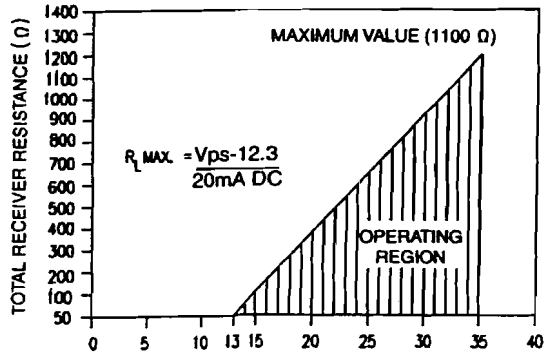

FIG. C

WIRE LENGTH - The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of receiver resistance to total loop resistance. For extremely long runs (over 1000 feet) choose receivers with higher resistances to minimize size and costs of connecting leads. When wiring length is under 100 feet, lead wire as small as 22 AWG can be used.

PRESSURE RANGING - Each Series 634ES Transmitter is factory-calibrated to the range given in the model number chart. However, special calibration is also available. If this is the case, the transmitter will be so marked. For purposes of clarification in these instructions, range is defined as that pressure which, applied to the transmitter, produces 20 mA of current in the loop. Zero pressure is always assumed to be 4 mA. If a transmitter pressure range other than that supplied is required, follow the re-ranging procedure described on Pg. 4.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

PRESSURE RE-RANGING PROCEDURE

1. With the transmitter correctly connected to the companion receiver, an accurate milliameter with a full scale reading of approximately 30 mA should be inserted in series with the current loop. A controllable pressure source capable of achieving the desired range should be connected to the pressure port of the transmitter and teed into an accurate reference pressure gauge or manometer. The instrument must be ranged in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust "zero" control so that loop current is 4 mA.

4. Apply full range pressure and adjust loop current to 20 mA using "span" control.

5. Relieve pressure and allow transmitter to stabilize for two minutes.

6. Zero and span adjustments may be interactive, so repeat steps 3 through 5 until zero and full range pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove the milliameter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA output signal provided by the Series 634ES Pressure Transmitter is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is only necessary that these devices all be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading, this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 634ES Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 634ES Pressure Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

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Section 2-C

HDPE Containment Pipe Pressure Indicator (PI-121)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for **Type 213.40S**)

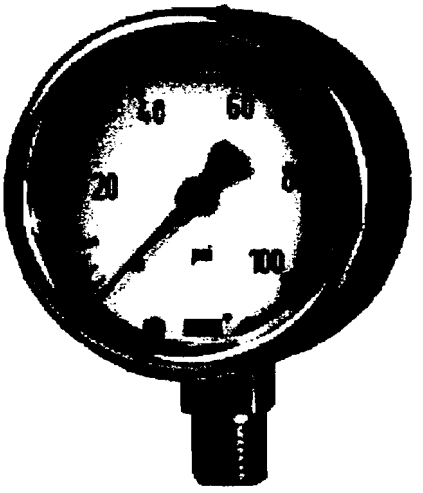
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

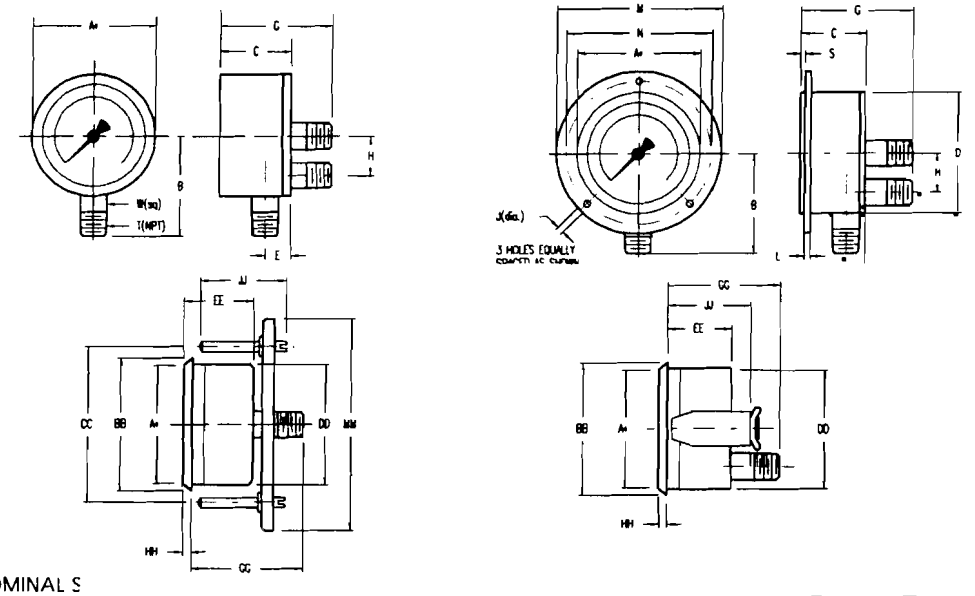
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



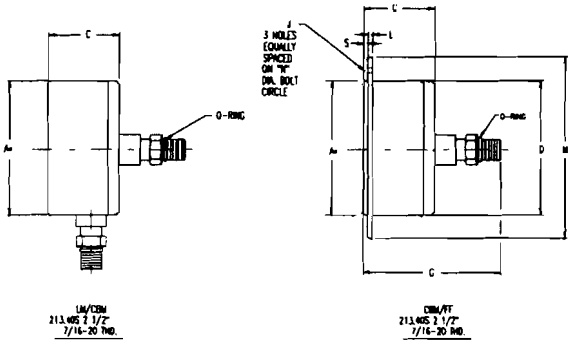
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14

KEY	L	M	N	S	W
mm	2.0	85	75	2.0	22
in	.08	3.35	2.95	.08	0.87

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

Section 2-D

Butterfly Isolation Valves (V-107, V-109)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

NIBCO

DUCTILE IRON BUTTERFLY VALVES

LD/WD 1000 AND 2000

APPLICATIONS

For use in Commercial Construction and General Utility Service:

- HVAC (Condenser, Chilled Water, Hot Water Heating
- Hot and Cold Domestic Water
- Compressed Air (BUNA liner)
- Vacuum Service
- End of Line Service (Dead End)
- Modulating Control Services

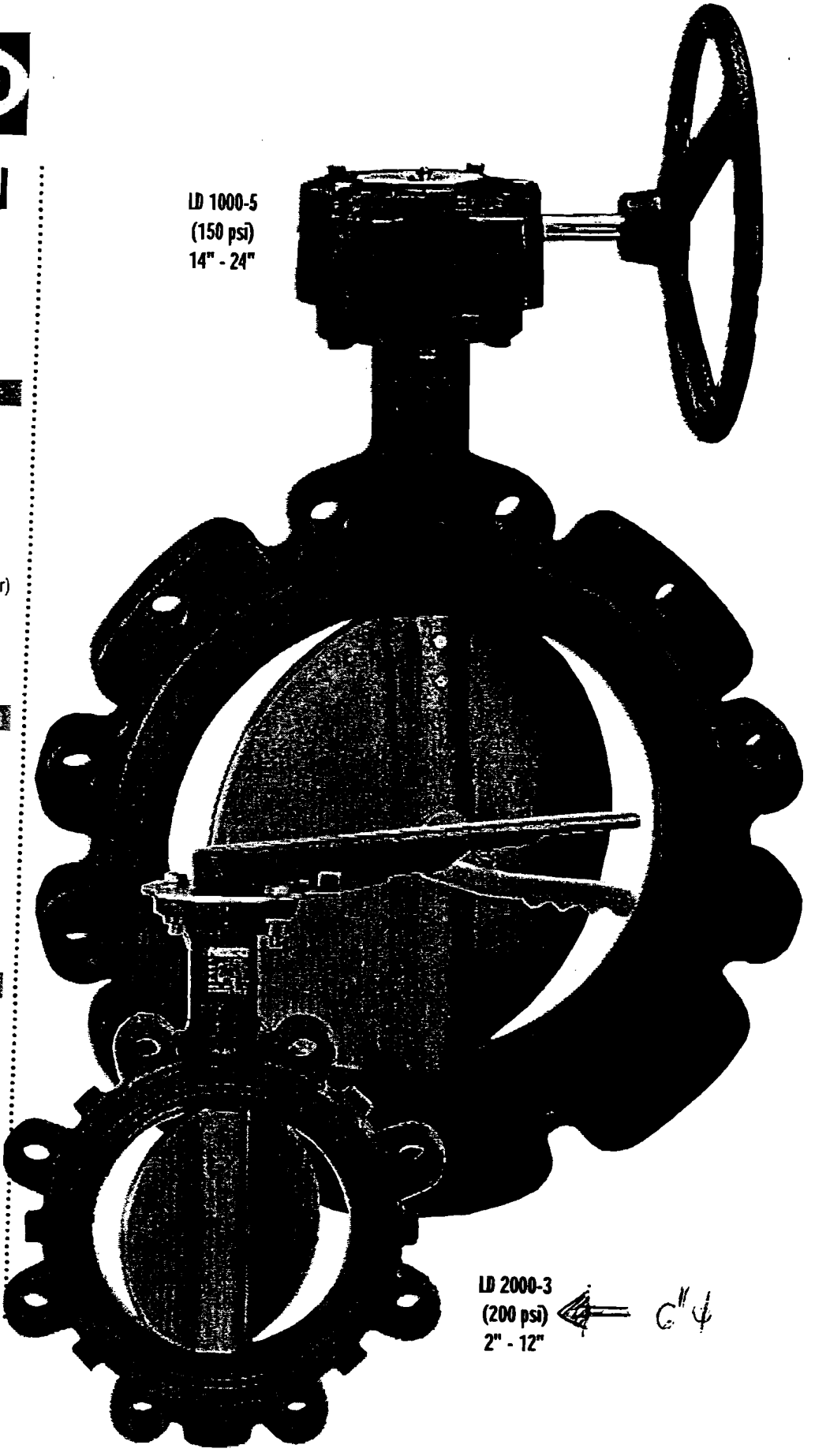
MATERIALS & CONSTRUCTION

- Molded in Liner (2" - 12")
- Internal Stem/Disc Drive
- Ductile Iron Body
- Streamlined Spherical Disc
- Upper and Lower Bushings
- High Strength 416SS Stem
- Extended Neck
- Threaded Double Seal Collar Bushing (2" - 12")

DESIGN CRITERIA

- Meets or exceeds requirements of MSS SP-67.
- United States Coast Guard Approval.
- Suitable for use with ANSI Class 125 and 150 flanges.
- Pressure rating 200 psi (2"-12") and 150 psi (14"-24")
- Vacuum to 28" mercury
- Bubble tight shutoff at full pressure
- Wide choice of seat and disc combinations to suit customer application.

LD 1000-5
(150 psi)
14" - 24"

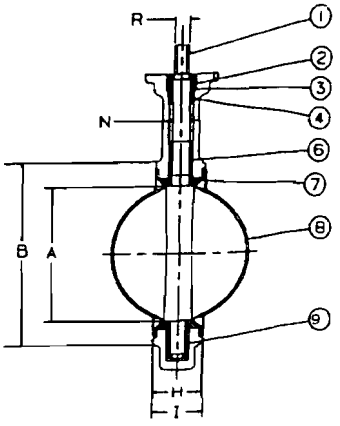


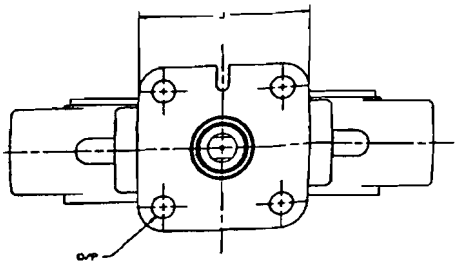
LD 2000-3
(200 psi)
2" - 12"

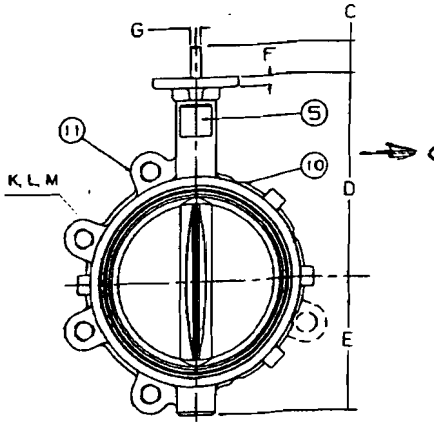
Printed in the U.S.A.

LD/WD 2000 SERIES 200 PSI

SPECIFICATIONS







LD/WD2000 SERIES Material List	
PART	SPECIFICATION
1. Stem	Stainless Steel, ASTM A-582 type 416, ASTM A564 Type 17.4 PH*
2. Collar Bushing	Brass, ASTM B-124
3. Stem Seal	EPDM Ruber
4. Body Seal	EPDM Rubber
5. Nameplate	Aluminum
6. Upper Bushing	Copper CDA 122
7. Liner	EPDM Rubber, BUNA (NBR), Fluoroelastomer
8. Disc	Aluminum, Bronze, ASTM B-148 Alloy 954/955
	† Ductile Iron, ASTM A395 (Plated)
	† Stainless Steel, ASTM A743 Grade CF8M
9. Lower Bushing	Copper CDA 122
10. Body (Wafer)	Ductile Iron, ASTM A-536
11. Body (Lug)	Ductile Iron, ASTM A-536

* Optional Stem Material
† LD 3000 Series only

LD/WD2000 SERIES Dimensions										
SIZE	A	B	C	D	E	F	G Flat	METAL H	RUBBER I	J Square
2"	2.53	4.00	1.25	5.38	2.62	.38	.312	1.688	1.812	3.25
2.5"	2.90	4.75	1.25	5.88	3.12	.38	.370	1.812	1.938	3.25
3"	3.15	5.25	1.25	6.12	3.38	.38	.370	1.812	1.938	3.25
4"	4.15	6.75	1.25	6.88	4.00	.38	.403	2.062	2.188	3.25
5"	5.15	7.62	1.25	7.38	4.75	.38	.496	2.188	2.312	3.25
6"	6.15	8.62	1.25	8.00	5.25	.38	.496	2.188	2.312	3.25
8"	8.15	10.87	1.25	9.25	6.50	.50	.560	2.375	2.500	3.25
10"	10.15	13.25	1.25	10.50	8.00	.50	.686	2.688	2.812	4.75
12"	12.15	16.00	1.25	12.00	9.25	.50	.748	3.000	3.125	4.75

LD/WD2000 SERIES Dimensions											
					Capscrew Data/Stud Data					Lug Approx.	Wafer Approx.
SIZE	N Dia.	O B.C.	P Dia.	R Dia.	K No.	L Dia.	Wafer Length	Lug Length	M B.C.	Net Wt. (lbs.)	Net Wt. (lbs.)
2"	.500	3.25	.437	.437	4	5/8-11unc	4	1 1/2	4 3/4	7	6
2.5"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 1/2	5 1/2	9	8
3"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 5/8	6	9 1/2	8 1/2
4"	.625	3.25	.437	.562	8	5/8-11unc	5	1 7/8	7 1/2	15	12
5"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	8 1/2	19	15
6"	.750	3.25	.437	.656	8	3/4-10unc	5 3/4	2	9 1/2	24	18
8"	.875	3.25	.437	.781	8	7/8-10unc	5 3/4	2 1/4	11 3/4	35	29
10"	1.125	5.00	.562	1.000	12	7/8-9unc	6 1/4	2 1/4	14 1/4	56 1/2	45 1/2
12"	1.250	5.00	.562	1.062	12	7/8-9unc	6 3/4	2 1/2	17	87	72

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International Service • Tel: +1/219.295.3221 • Fax: +1/219.295.3455
www.nibco.com

SPECIFICATIONS AND TECHNICAL DATA

TORQUE is the rotary effort required to operate a valve. This turning force in a Butterfly Valve is determined by three factors. (1) Friction of the disc to seat for sealing (2) bearing friction and (3) dynamic torque.

BREAKAWAY TORQUE is the total of the torques resulting from bearing friction and seat/disc interference friction at a given pressure differential. This value is normally the highest required torque to operate a valve and is used in sizing actuators. The torques listed are valid for water and lubricating fluids at ambient temperature.

LD/WD 2000 SERIES Torque Data		
SIZE	100 PSI	200 PSI
2"	140	180
2½"	190	235
3"	250	300
4"	430	530
5"	590	760
6"	795	1,035
8"	1,850	2,350
10"	2,350	2,900
12"	3,875	5,390

LD/WD 1000 SERIES Torque Data		
SIZE	75 PSI	150 PSI
14"	3,837	4,870
16"	5,003	6,685
18"	6,567	8,958
20"	8,540	11,950
24"	13,220	18,680

NOTE: Torque data shown is for general service (clean water, ambient temperatures). For non-lubricating, high temperatures or aggressive media, consult NIBCO Technical Service. Torque listed for EPDM. When calculating torque for Buna or Fluorocarbon, multiply by 1.25

SAMPLE BUTTERFLY VALVE SPECIFICATION

Line Control Valves 2" and Larger:

BUTTERFLY VALVES: Valve shall be full lug or wafer body style. Valves to be manufactured in accordance with MSS SP-67. The valves shall be rated at least 200 psi (2" - 12") and 150 psi (14" - 36") bi-directional differential pressure. **Body** to have 2" extended neck for insulation and to be **shock resistant ductile iron.** Valves to have aluminum bronze disc and **molded in or cartridge seat** of EPDM rubber. Stem shall be 400 series stainless steel. Top and bottom stem bushings of dissimilar material are required with a positive stem retention mechanism. Sizes 2" to 6" shall be lever operated with 10 position throttling plate; sizes 8" and larger shall be gear operated. **Lug style valves shall be capable of providing bi-directional "Dead End Service" at full pressure without the need for a down stream blind flange.**

ACCEPTABLE VALVES:
NIBCO - LD2000 (2" - 12"), LD1000 (14" - 24") and N150235G0 (30" - 36").

Key to Butterfly Valve Figure Number System*

L	D	-	2	0	0	0	-	0
BODY TYPE	BODY MATERIAL		PRESSURE RATING	SEAT MATERIAL	DISC MATERIAL	STEM & BUSHING COMBINATIONS		OPERATING MECHANISM
						Stem / Upper & Lower / Collar		
L- Lug W- Wafer G- Grooved	D- Ductile Iron C- Cast Iron		L- Actuated 1- 150 PSI 2- 200 PSI 3- 250 PSI 4- 300 PSI	0- EPDM 1- Buna-N (Nitrile) 2- Fluoroelastomer 5- UL/FM 7- Polymid	0- Alum. Bronze 1- Ductile Iron[1] 2- CF8M 6- EPDM Coated Brass or D.I.[1] 7- Buna-N Coated Brass or D.I.[1]	0- 416 S.S. / Copper Alloy / Brass 1- 416 S.S. / 316 S.S. / Brass 2- 17-4 PH / 316 S.S. / 316 S.S. 7- 416 S.S. / TFE / — 8- 316 S.S. / TFE / —		0- Bare Stem 3- L/Lock (Std.) 5- Gear op.

** This key is a guide only, it is not intended to infer that all combinations can or will be produced.*
1. Electro Nickel Plated. 2. Grooved end only.

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www.nibco.com

Section 2-E

Check Valve (V-108)

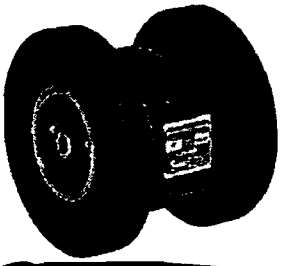
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Class 125/250 Iron Body Silent Check Valves

Flanged • Globe Style • Renewable Seat and Disc • Spring Actuated

Class 125, 200 PSI/13.8 Bar Non-Shock Cold Working Pressure
Class 250, 400 PSI/27.6 Bar Non-Shock Cold Working Pressure
Maximum Temperature to 200° F/93° C*

CONFORMS TO MIL-V-18436F
FM APPROVED



F-910, 125 lb. Class
F-960, 250 lb. Class
Flanged

MATERIAL LIST

	PART	SPECIFICATION
1.	Body	Cast Iron ASTM A 48 Class 35
2.	Seat	Bronze ASTM B 584 Alloy C83600 (B)
2a.	Seat	Buna-N Bonded to Bronze (W)
3.	Disc	Bronze ASTM B 584 Alloy C83600
4.	Spring	Stainless Steel Type 302 ASTM A 313
5.	Bushing	6" and smaller ASTM B 16 8" and larger ASTM B 584 C83600
6.	Set Screws	Stainless Steel Type 304 ASTM A 276

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions A		F-910		F-960	
In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.
2½	65	5.50	140	24	11	24	11
3	80	6.00	152	28	13	36	16
4	100	7.25	184	43	20	59	27
5	125	8.50	216	55	25	78	35
6	150	9.75	248	71	32	103	47
8	200	12.50	318	123	56	179	81
10	250	13.50	343	183	83	253	115
12	300	14.25	362	306	139	401	182
14	350	15.75	400	410	186	511	232
16	400	17.63	448	501	227	697	316
18	450	18.75	476	725	329	960	435
20	500	20.63	524	890	404	1180	535
24	600	24.00	610	1220	553	x	x
30	750	29.25	743	2000	907	x	x
36	900	45.00	1143	4425	2007	x	x

x Not available these sizes.

NOTE: F-910 made to 125 lb. Flange dimensions.
F-960 made to 250 lb. Flange dimensions.

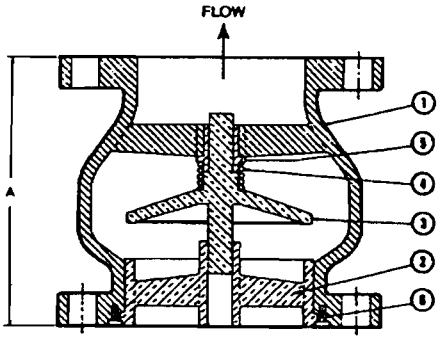
A Wafer Style Butterfly Valve can be mated on the down stream side of the F-910 2½"–10" sizes without use of spacers or adapters.

316 Stainless Steel Trim available – Consult Factory.

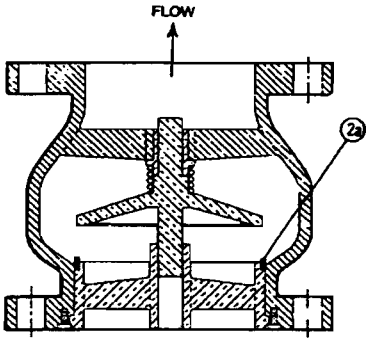
USE THIS VALVE ONLY WITH FLAT FACE FLANGE AND FULL FACE GASKET.

WARNING:
1. Seat end of valve must be mated to a standard flat faced metal flange. Rubber flanges not acceptable.
2. These are not to be used as steam valves.
3. Valves are not to be used near a reciprocating air compressor.
4. Install 5 pipe diameters minimum downstream from pump discharge or elbows to avoid flow turbulence. Flow straighteners may be required in extreme cases.

NOTE: On pump discharge, the preferred check valves are in-line spring loaded, swing design with lever and weight or lever and spring.



F-910-B or F-960-B
Flg x Flg Flg x Flg



F-910-W or F-960-W
Flg x Flg Flg x Flg

* For detailed Operating Pressure, refer to Pressure Temperature Chart on page 107.

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Section 2-F

Water Flow Indicating Transmitter (FE/FIQT-131)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

6 ϕ propeller

MC Propeller

CONFIGURATION SHEET
MAIN LINE FLOWMETER

MODEL MW500 / MZ500

DESCRIPTION

Model MW500 and MZ500 Main Line Propeller Flowmeters are manufactured to comply with the applicable provisions of the American Water Works Association Standard No. C704-92 for propeller type flowmeters. The model MW500 is designed for a maximum continuous working pressure of up to 150 psi and is fitted with AWWA Class D flanges. The model MZ500 is designed for a continuous working pressure of up to 300 psi and is fitted with ANSI B16.5 Class 300 flanges. The impeller and drive assembly are easily removed through the top flange connection. The meter flow tubes are coated with fusion-bonded epoxy for maximum corrosion protection, and integral flow straightening vanes reduce upstream flow turbulence. As with all McCrometer propeller flowmeters, standard features include a magnetically coupled drive, instantaneous flowrate indicator and straight reading, six-digit totalizer.

Impellers are manufactured of high-impact plastic, capable of retaining their shape and accuracy over the life of the meter. Each impeller is individually calibrated at the factory to accommodate the use of any standard McCrometer register. The MW500 and MZ500 can be field-serviced without the need for factory recalibration. Factory lubricated, stainless steel bearings are used to support the impeller shaft. The shielded bearing design limits the entry of materials and fluids into the bearing chamber providing maximum bearing protection.

The instantaneous flowrate indicator is standard and available in gallons per minute, cubic feet per second, liters per second and other units. The register is driven by a flexible steel cable encased within a protective vinyl liner. The register housing protects both the register and cable drive system from moisture while allowing clear reading of the flowrate indicator and totalizer.

INSTALLATION

Standard installation is horizontal mount. If the meter is to be mounted in the vertical position, please advise the factory. A straight run of full pipe the length of five diameters ahead and one diameter behind the meter is the minimum normally recommended.

The McCrometer Propeller flowmeter comes with a standard instantaneous flowrate indicator and straight-reading totalizer. An optional electronic register is also available. *Typical face plates.*

APPLICATIONS

The McCrometer propeller meter is the most widely used flowmeter for municipal and wastewater treatment applications as well as agricultural and turf irrigation measurement. Typical applications include:

- Water and wastewater management
- Center pivot systems
- Sprinkler irrigation systems
- Drip irrigation systems
- Golf course and park water management
- Gravity turnouts from underground pipelines
- Commercial nurseries

SHOWN: MODEL MW500

McCROMETER
3255 West Stetson Avenue
Hemet CA 92545-7799 USA
909-652-6811 / FAX 909-652-3078
e-mail: info@mccrometer.com
Web Site: http://www.mccrometer.com

Lit#24517-20 Rev 1.4/8-02

MAIN LINE FLOWMETER MODEL MW500 / MZ500

SPECIFICATIONS

PERFORMANCE

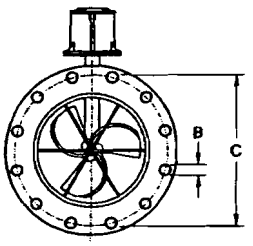
ACCURACY: ±2% of reading guaranteed throughout range.
RANGE: See dimensions chart below
HEAD LOSS: See dimensions chart below
MAXIMUM TEMPERATURE: (Standard Construction) 160°F constant
PRESSURE RATING: Model MW500: 150 psi
Model MZ500: 300 psi

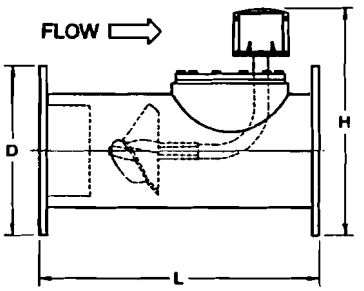
MATERIALS

BEARING ASSEMBLY: Impeller shaft is 316 stainless steel. Ball bearings are 440C stainless steel.
MAGNETS: (Permanent type) Cast or sintered Alnico
BEARING HOUSING: Brass; Stainless Steel optional
REGISTER: An instantaneous flowrate indicator and six-digit straight-reading totalizer are standard. The register is hermetically sealed within a die cast aluminum case. This protective housing includes a domed acrylic lens and hinged cover with locking hasp.
IMPELLER: Impellers are manufactured of high-impact plastic, retaining their shape and accuracy over the life of the meter. High temperature impeller is optional.

OPTIONS

- International flange standards available
- Other than standard laying lengths available
- Register extensions available
- Forward/reverse flow measurement
- All stainless steel construction
- High temperature construction
- "Over Run" bearing assembly for higher-than-normal flowrates
- Electronic propeller meter available in all sizes of this model
- A complete line of flow recording/control instrumentation
- Certified calibration test results





McCROMETER reserves the right to change design or specifications without notice.

MW500/MZ500	DIMENSIONS														
Meter and Nominal Pipe Size	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
Maximum Flow U.S. GPM	250	250	250	600	1200	1500	1800	2500	3000	4000	5000	6000	8500	12,500	17,000
Minimum Flow. U.S. GPM	40	40	40	50	90	100	125	150	250	275	400	475	700	1200	1500
Approx. Head Loss in Inches at Max. Flow	29.50	29.50	29.50	23.00	17.00	6.75	3.75	2.75	2.00	1.75	1.50	1.25	1.00	1.00	1.00
MW500															
Approx. Shipping Weight-lbs.	36	36	43	54	115	135	197	325	465	530	744	890	1,293	1450	1650
B (inches)	3/4	3/4	3/4	3/4	7/8	7/8	1	1	1 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 5/8
C (inches)	4 3/4	5 1/2	6	7 1/2	9 1/2	11 3/4	14 1/4	17	18 3/4	21 1/4	22 3/4	25	29 1/2	36	42 3/4
D (inches)	6	7	7 1/2	9	11	13 1/2	16	19	21	23 1/2	25	27 1/2	32	38 3/4	46
H (inches)	11 3/4	12 1/4	12 1/2	15 1/4	16 1/4	18 1/2	21 3/4	24 1/4	25 1/4	28 1/2	29 1/4	32 1/2	36 3/4	42 3/4	49 1/4
L (inches)	14	16	16	20	22	24	26	28	42	48	54	60	60	60	60
No. of Bolts per Flange	4	4	4	8	8	8	12	12	12	16	16	20	20	28	32
MZ500															
Approx. Shipping Weight-lbs.	50	55	62	90	145	220	340	430	650	820	1,315	1,508	2,165		
B (inches)	3/4	7/8	7/8	7/8	7/8	1	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 5/8		
C (inches)	5	5 7/8	6 5/8	7 7/8	10 5/8	13	15 1/4	17 3/4	20 1/4	22 1/2	24 3/4	27	32		
D (inches)	6 1/2	7 1/2	8 1/4	10	12 1/2	15	17 1/2	20 1/2	23	25 1/2	28	30 1/2	36		
H (inches)	12	12 1/2	12 7/8	15 3/4	17	19 1/4	22 1/2	25	26 1/4	29 1/2	32 3/4	34	38 3/4		
L (inches)	20	20	20	24	26	28	30	32	42	48	54	60	60		
No. of Bolts per Flange	8	8	8	8	12	12	16	16	20	20	24	24	24		

Note: *Flanges meet ASTM-A-181 specs. Larger flowmeters on special order.*

REPRESENTED BY:

McCROMETER
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Lit#24517-20 Rev 1.4/8-02

Flowmeter Accuracy Rests On Proper Installation

Flow meters are becoming mandatory for agricultural irrigation systems in an increasing number of counties and states as stricter water management programs are implemented.

Adding flowmeters to systems designed originally without them is not difficult but requires consideration of a few important installation guidelines to assure the accuracy of the device.

Propeller flowmeters are most common in agriculture and are the subject of this article. While there are many technologies available for measuring flow, the propeller meter has cost and space advantages, especially when it is to be installed in an existing irrigation system.

Because the measuring element of this type of a flowmeter is a propeller positioned in the center of the flowstream, the pipe must be completely full and the flow of the water must not swirl. These basic conditions must be met to assure the accuracy of the flowmeter.

Upstream Disturbances

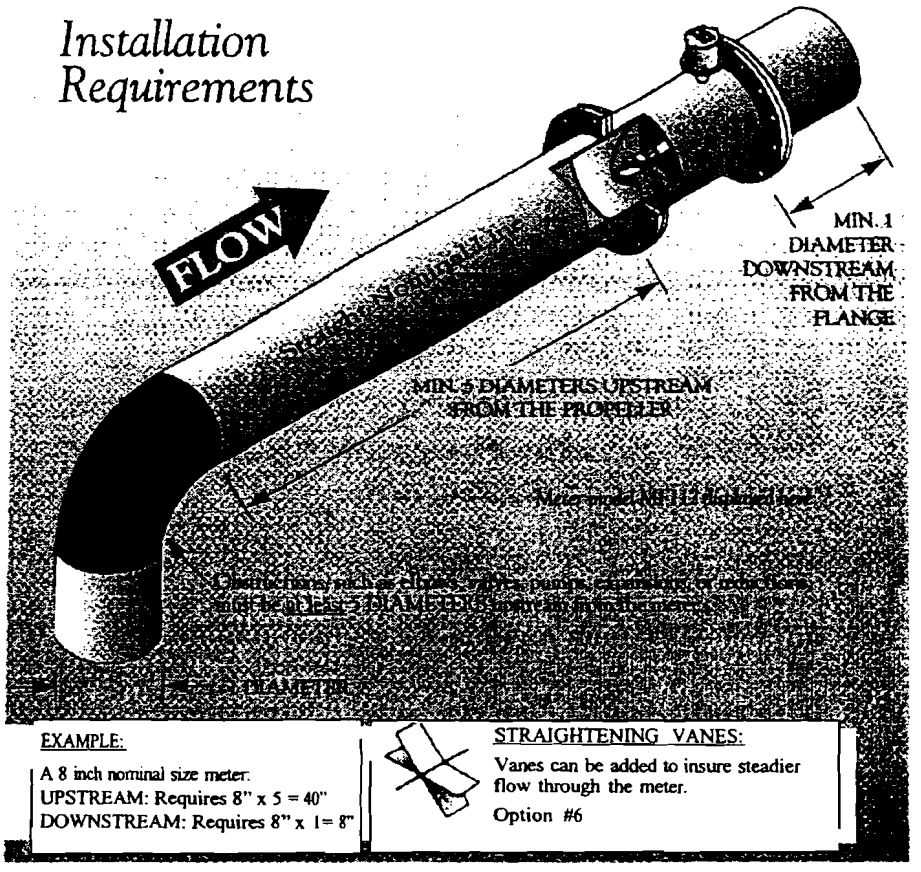
Flowmeters sense water velocity so they are vulnerable to certain upstream disturbances. Upstream obstructions, such as elbows, valves, pumps, and different sized pipe, can disturb the even flow of water through the meter. To solve these disturbances, the flowmeter should be installed downstream of obstructions on straight pipe at least five pipe diameters in length. For example, a flowmeter installed on eight-inch diameter pipe should be at least 40 inches (5 x 8") downstream of any obstruction. In addition, no obstruction should be located within one pipe diameter downstream of the flowmeter. The downstream pipe should be straight for this distance as well.

Certain conditions can cause excessive swirling of the water flow. A centrifugal sand separator or two elbows in different planes are examples. Well-developed swirls created by either of these conditions can travel up to 100 pipe diameters downstream if unobstructed.

Since most installations have less than 100 diameters to work with, straightening vanes can be placed just ahead of the meter. The vanes will break up most swirls and ensure accurate measurement. Some flowmeters include vanes as a feature.

Gravity also conditions flow. Mounting the meter vertically to take advantage of gravity flow conditioning offers some slight advantages. It is important to specify the orientation of the meter when ordering.

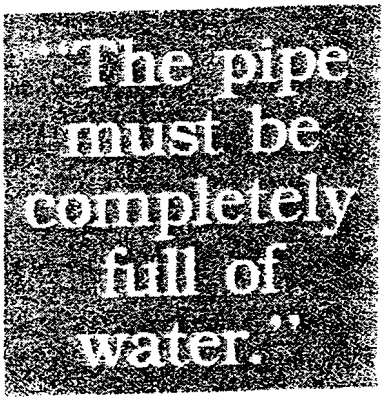
Installation Requirements



Calculate Flow Range

Naturally, a flowmeter is most accurate when used within its design specifications. One of the most important is the range of flow rates. The irrigation manager must calculate the flow rates he needs for his irrigation system in order to select the right flowmeter. The range is typically very large and is expressed as the turndown of the meter. The turndown is the ratio of the maximum flow rate to the minimum flow rate and is often 15: 1. That means the meter would remain accurate up to 15 times it's minimum flow rate. For example, a meter with a minimum flow rate of 100 gpm and a turndown of 15:1 would remain accurate up to a flow of 1,500 gpm. Meters for smaller pipes tend to have lower turndowns and a narrower range of flow rates than larger pipes.

As long as the pipe is full, flowmeters will work within a wide range of pressure. Maximum pressure is the only limitation. Standard meters have a maximum pressure tolerance of 150 psi. This should cover most agricultural applications. If not, meters are available with higher pressure ratings.



The pressure loss caused by the meter (headloss) is minimal when the pipe and meter are sized properly for the flow. The greatest headloss occurs with smaller pipe at high water velocity. By sizing pipe and flowmeter to fit the needed volume of water at a reasonable velocity, headloss is less than one psi.

Propeller flowmeters have an average accuracy of plus or minus two percent when operating within their designed flow range. This further supports the need for selecting the right flowmeter for the particular irrigation system.

Reading Flowmeters

Finally, flowmeters are available that provide totals in specific units, i.e. gallons, acre feet, acre inches, cubic feet etc. Be sure you select a flowmeter that reports and totals in the unit of measurement most appropriate in your area.

Some guidelines are helpful for reading totalizers on flowmeters. All totalizers on propeller meters have a "multiplier." For example, an eight-inch flowmeter that totalizes in gallons will have a multiplier of (X) times 100. That means that the last digit on the right of the six digit totalizer is not gallons, but hundreds of gallons. Usually two zeros are printed on the dial face to the right of the last digit to signify the multiplier.

Four-, six-, and eight-inch meters in gallons have multipliers of 100. Ten-, 12-, and 14- inch meters have multipliers of 1,000.

The same eight-inch flowmeter totalizing in acre feet will have a multiplier of .001. Now zeroes are not added to the reading but a decimal point is included after the first three digits. Usually the digits that signify fractions of acre feet are in a different color and/or X. .001 is printed below the totalizer. As the meter size goes up, the decimal point moves to the right. The person reading the meter must be careful to add the correct amount of zeroes or place the decimal point in the right place. The meter reading can be off by a factor of 10, 100, or 1000!

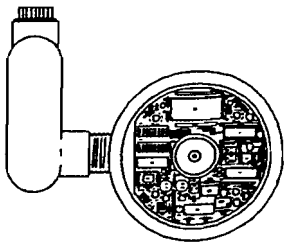
Flowmeters are an important tool in irrigation management and water conservation. Learn how to install them properly and read them accurately. •

Editor's Note: This article was prepared with the assistance of Glenn Voss of McCrometer in Hemet, California and appeared in "Irrigation Journal" April, 1992.

E7000 - 002 TRANSMITTER FOR PROPELLER FLOW ...

Specification Sheet

Model:	Description:	Document #:	Rev:	Date
E7000	Two-Wire 4-20 mA Transmitter	24527-13	1.2	06/02



Features:

- Industry standard 2-wire 4-20 mA output
- Output is linear with flowrate
- Compatible with all McCrometer propeller meters with a mechanical register
- Installation can be accomplished without meter removal from pipe
- For meter sizes up to 24"
- Signal can travel up to 5000 feet
- Additional pulse output and anti-reverse options

E7000-0xx

Anti-Reverse
0 - No
1 - Yes

Pulse Output
0 - None
1 - Dry Contact
2 - Open Collector

E7000 Model:	4-20 mA Output	Dry Contact	Open Collector	Anti-Reverse
E7000-000	•			
E7000-001	•	•		
E7000-002	•		•	
E7000-010	•			•
E7000-011	•	•		•
E7000-012	•		•	•

Electrical Characteristics:

4-20 mA Output:

Operating Temperature:	+25 to +130 degrees F
Supply Voltage:	16 - 40 VDC
Temperature Coefficient:	±1.0%
Linearity:	0.1%
Accuracy:	0.5% over the entire range
Maximum Resistive Load:	Supply Voltage Dependent*
Reverse Voltage Protection:	-300V Maximum

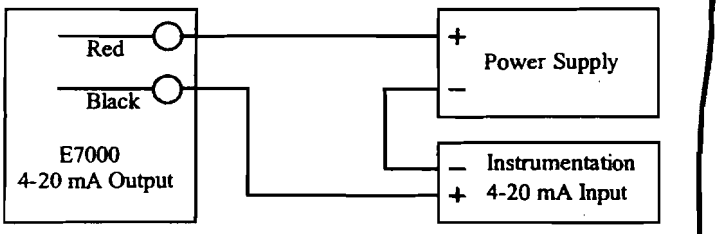
Dry Contact Output:**

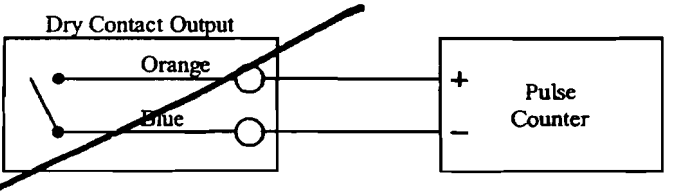
Type:	Relay Contact, Norm. Open
Rated Load (AC):	0.5 A at 125 VAC
Rated Load (DC):	1 A at 30 VDC
Max. Operating Current:	1 A
Max. Switching Power:	30 W, 62.5 VA
Contact Closure Duration:	20 milliseconds
Max. Clicks per Minute:	10

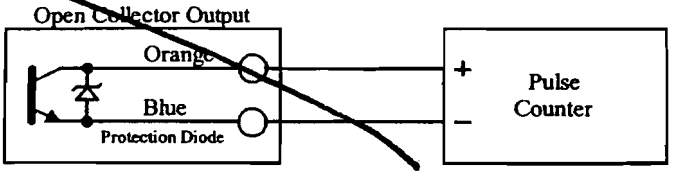
Open Collector Output:**

Type:	NPN Darlington, Isolated
Isolation Voltage:	5000 VAC
Collector to Emitter Voltage:	40 VDC Maximum
Collector Current:	200 mA Maximum
Pulse Output Duration:	20 milliseconds
Max. Pulses per Minute:	350

Typical Wiring Diagrams:







* - Use formula (Supply Voltage - 16) ÷ 0.02 = Maximum Load(Ω)

** - Totalizer output operates only when power is applied to the 4-20 mA loop.

McCROMETER
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Web Site: http:// www.mccrometer.com e-mail: info@mccrometer.com

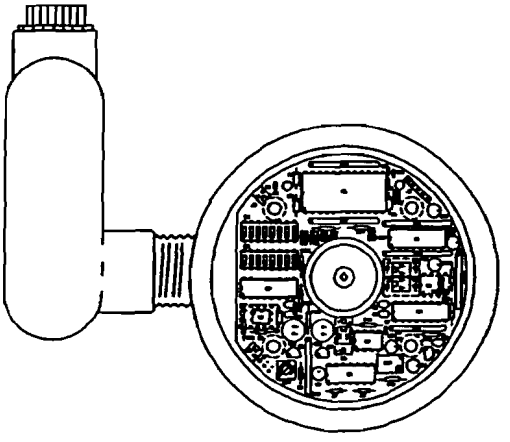
INSTALLATION, OPERATION

AND MAINTENANCE MANUAL

FOR

E7000 AND E7500

4 TO 20 mA ANALOG TRANSMITTERS



McCROMETER

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Table of Contents

I. GENERAL INFORMATION

A. Unpacking and Inspection

Your **E7000** ANALOG TRANSMITTER is engineered to be a highly reliable, accurate system. It has been systematically assembled, inspected, tested and calibrated; then carefully packed or installed on your new McCrometer flowmeter before shipment. If not installed, unpack the transmitter **carefully** and inspect each assembly thoroughly for obvious shipping damage. Notify the freight carrier immediately upon discovery of any damage. The inspection should include the following after carefully removing it from the carton (Figure 1).

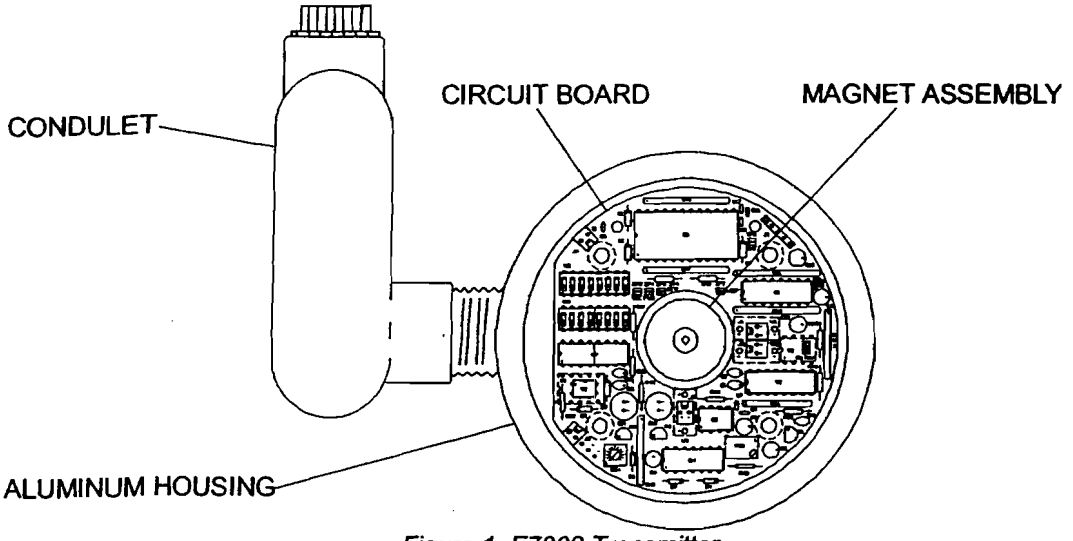

Figure 1. E7000 Transmitter

1. Look for obvious physical damage such as cracks in the housing, loose circuit board, screws, magnet assembly, or condulet.

2. Rotate the magnet by hand and check for smooth rotation of the magnet assembly. Binding or rough operation may indicate that the bearing has been damaged.

3. Check the alignment of the condulet to the body of the housing, they should be parallel. A slight mis-alignment is acceptable but it should be tight. A loose condulet could allow moisture to enter the transmitter or terminal area of the condulet and cause failure. The condulet is attached by a 1/2" close nipple with thread lock on both ends. If the condulet was moved in shipment, the seal of the thread may have been broken.

4. Finally, make sure that all parts are included in the shipment listed below and shown in figure 2.

1. E7000 Analog Transmitter Assembly
2. EH222-10 Installation Kit that contains:

EH221-00	Cable Extension	1 each
10142-20	Screw 10-32 x 3" Long w/ Seal Hole	1 each
10142-30	Screw 10-32 x 2-3/4" Long	5 each
10180-00	O-Ring 3-5/8" OD	1 each
10262-00	Gasket Flat	1 each

3. Operation & Maintenance Manual

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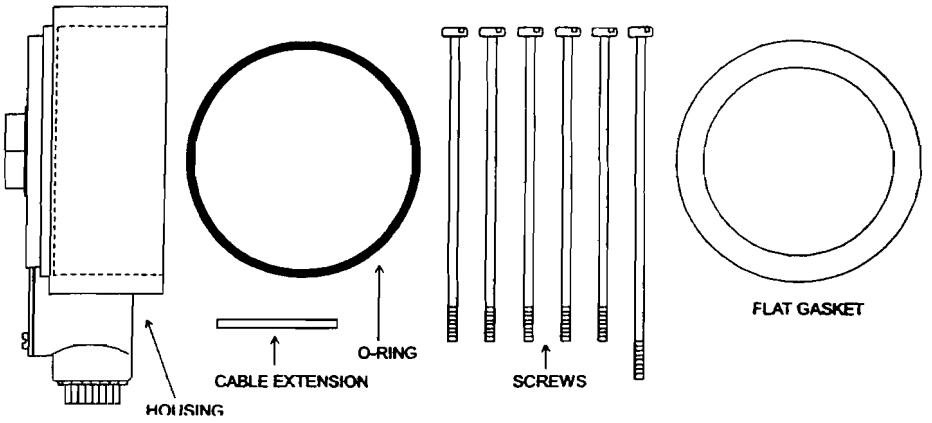

Figure 2. E7000 Retrofit Parts Kit

B. Precautions

Avoid rough handling of the transmitter. The electronic circuits are of solid state technology but damage can result from shock in a fall. During unpacking and installation avoid dusty areas as much as possible. Fine dust or sand can cause erratic operation or failure of the circuitry. Once installed properly, the transmitter assembly is nearly impervious to environmental effects.

When connecting the cables and connectors, be sure that the screws are securely fastened and that the connectors are firmly pressed into place. Normally, you will not have to be concerned with the internal connections unless you are performing maintenance on the assembly after years of perfect operation prior to some inadvertent failure.

Double check the installation, wiring, and power supply used to excite the transmitter to assure that specifications are adhered to properly and precisely to avoid failure and violation of warranty.

C. Description

1. General

The E7000 transmitter is a single assembly mounted on the flowmeter beneath the register assembly. It is contained in an aluminum housing 4.25" in diameter and approximately 2" high. It comes equipped with a standard 1/2" electrical LL19 condulet attached by a brass 1/2" close nipple.

The E7000 uses the mechanical rotation of the flexible drive shaft to turn a magnet assembly generating an electric pulse. The pulse is generated by a rotating magnet assembly that has four or eight magnets placed evenly around the assembly.

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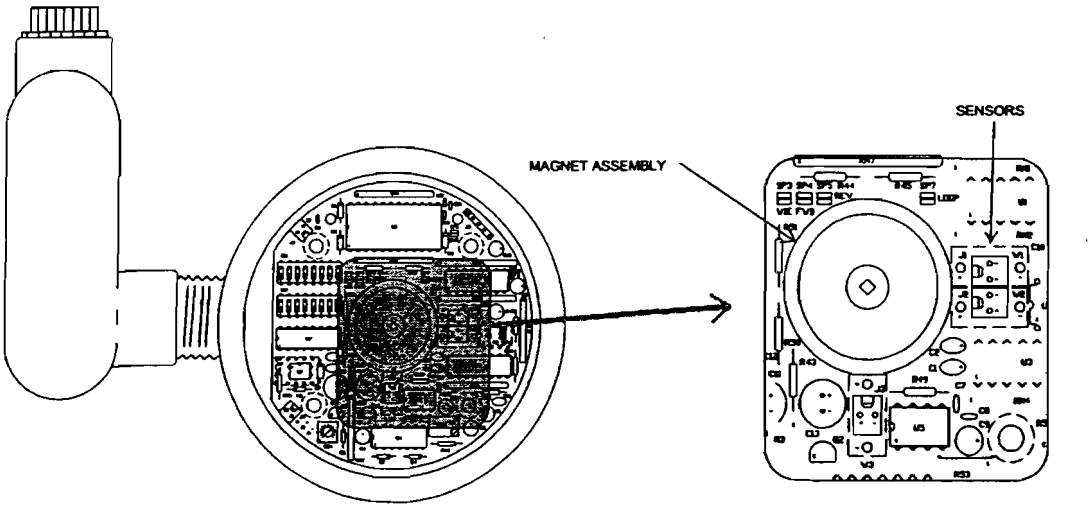

Figure 3. Location of Magnets and Sensors

The magnets pass by the sensor (Figure 3) or sensors depending on whether you have the standard (one sensor) or the anti-reverse (two sensors) transmitter, and in doing so the magnet generates a pulse output that either goes to a digital to analog converter circuitry (standard), or to the quadrature IC (for anti-reverse) and then to the digital to analog converter circuitry.

2. Totalizer Output Circuit

With the E7000 there are **two** totalizer output options. These options must be ordered when the transmitter is manufactured.

1. The DRY CONTACT output.
   This is an internal relay rated at .5 Amps. resistive, 125 VAC, 1 Amp 30 VDC.

2. The optically isolated NPN transistor output.
   The end user supplies the power (up to 40 VDC) and ground to the open collector output.

The pulse output from the Totalizer varies with different pipe sizes. When using the RELAY option the transmitter is limited to under 10 pulses per minute, when using the OPEN COLLECTOR output you can achieve a much greater pulse rate, up to 700 pulses per minute.

3. Switch Selected Scale Output

The E7000 Totalizer output can be reprogrammed in the field. What this means is that the amount of fluid that passes through the meter before one totalizer pulse can be changed by simply changing the switch settings on the board shown in Figure 4. Contact McCrometer if the totalizer scaled pulses will be set to a different value.

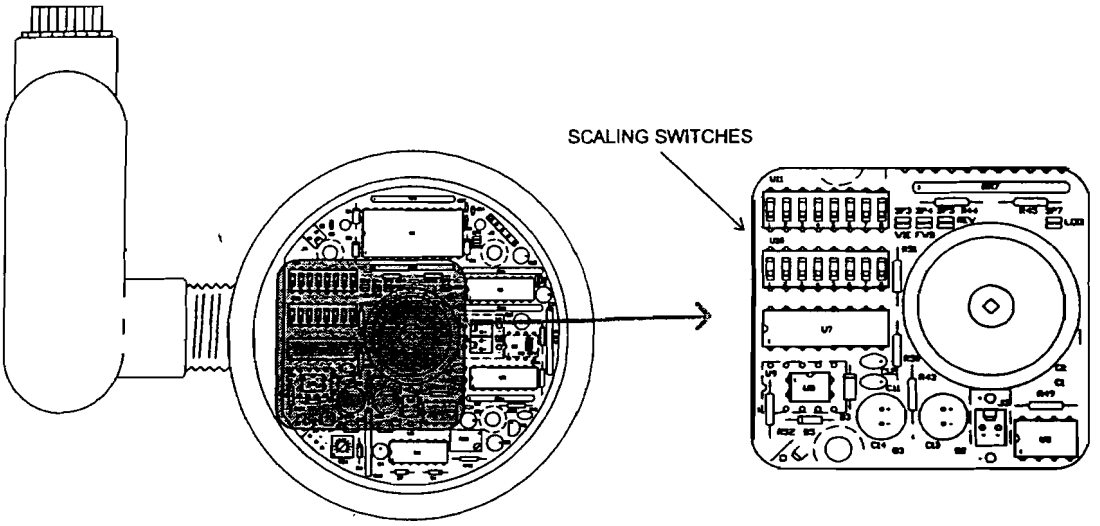

Figure 4. Location of Scaling Switches

II SPECIFICATIONS

A. Overall Systems Specifications

Accuracy: 0.5% over entire range
Linearity: 0.1%
Operation Temperature: 25 to 130 ° F
Supply Voltage: 16 to 40 VDC, Nominal 24 VDC, Minimum 25mA
Maximum Resistive Load = 1200 Ohms
(Power Supply Voltage - 16 VDC)/20 mA
Example: (40 VDC - 16 VDC)/20 mA = 1200 Ohms
Temperature Coefficient: +/- 1% Over Entire Temperature Range

Option 1, Dry Contact Relay
Maximum Contact Closures per Minute:10
Contact Closure Duration: 20 milliseconds
Rated Load: 0.5 A at 125 VAC, 1 A at 30 VDC
Maximum Operating Voltage: 125 VAC, 110 VDC
Maximum Switched Power: 30W, 62.5 VA

Option 2, Optically Isolated Transistor
Output Type: NPN Darlington, Optically Isolated
Isolation Voltage: 5000 Vac
Totalizing Pulse Duration: 10 Milliseconds
Collector to Emitter Voltage: 40 VDC Maximum
Collector Current: 200 mA Maximum
Maximum Pulses per Minute: 700

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III. INSTALLATION

A. Disassembly

It is necessary to remove the canopy and the register. The analog transmitter mounts between the register and the register mounting plate already installed on top of the pipe protruding from the top of the meter.

* Note: If your meter has the old style plastic canopy and gasket you must replace both the canopy and the base plate with new aluminum ones (Order Canopy Kit RO143).

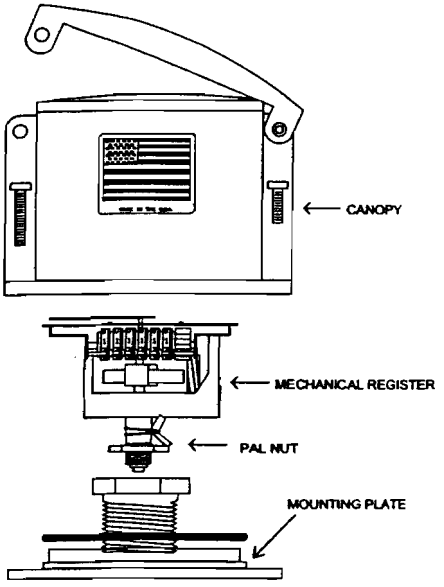

Figure 5. Canopy, Register Removal

THE FLOWMETER CAN BE IN FULL OPERATION DURING THIS PROCEDURE

1. Canopy Removal

Remove the six (6) screws holding the Canopy to the mounting plate and discard, Figure 5. One of the screws has a seal attached, remove it prior to removing that screw. Lift off the canopy carefully to prevent damage to the register.

2. Register Removal

Loosen the pal nut located on the threaded shaft of the register. Carefully unscrew the register counter clockwise and lift it from the bushing.

CAUTION:

Protect the Register from dust while it is outside of the Canopy.

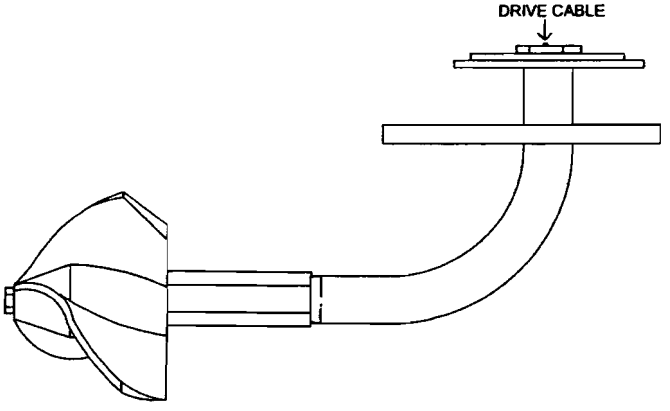

Figure 6. Location of The Drive Cable

You can now see the open end of the ELL with the drive cable, Figure 6. If the flowmeter is in operation the cable will be rotating. If the flowmeter is not installed turn the propeller by hand to check that the bearing and cable rotate freely with no excess play.

B. Re-assembly

1. Analog Transmitter Installation

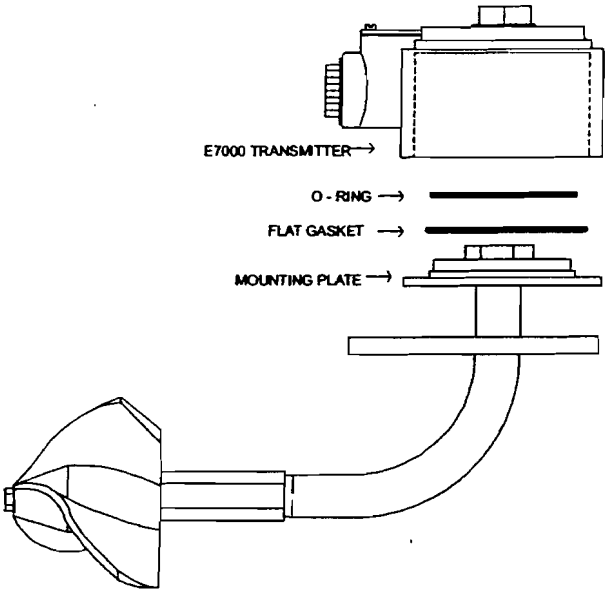

Figure 7. Installation Of The Transmitter

Cleanliness is vital for the operation of the transmitter and the register. Check the threaded area and the mounting plate, Figure 7, they should be free of grease, dust, or any other foreign materials. Place the o-ring over the lip on the mounting plate. Use a small amount of oil to lubricate the o-ring. Rotate the transmitter to align and locate the condulet to the desired position. Lower the transmitter to insert the cable into the center shaft of the transmitter. Continue to lower the unit until it touches the o-ring on the Plate. Work the transmitter carefully down over the o-ring, seat it firmly into place. Avoid unnecessary movement to prevent damage to the o-ring.

Find the short cable extension in the installation kit and insert it into the center of the bearing on top of the transmitter. Place the register with the Pal nut still in place on this cable extension and rotate it clockwise three (3) or four (4) turns. Stop when the register is positioned as it was prior to its' removal and snug up the pal nut. If the flowmeter is operating turn register in until there is a slight binding of the cable in the Register and back out approximately two (2) turns and then tighten the Pal nut; this should give you smooth operation and be correctly positioned.

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2. Canopy Installation

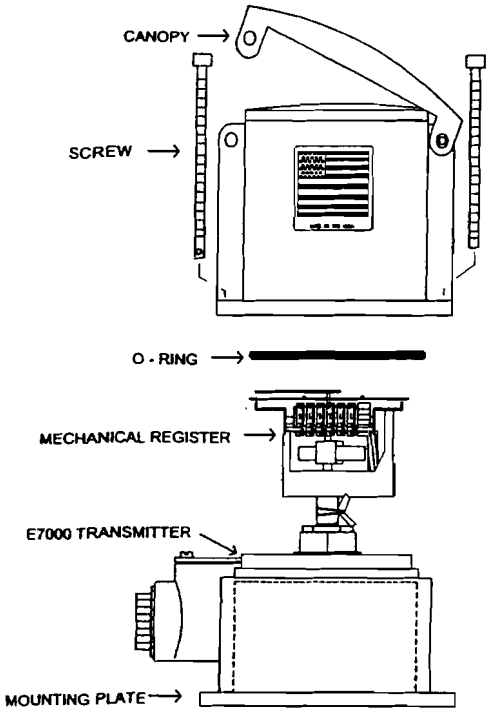

Figure 8. Canopy Installation

The canopy can now be installed. Check the transmitter housing and the canopy for cleanliness and clean if needed, Figure 8. Orient the canopy and lower it carefully over the lubricated o-ring and seat it firmly onto the Transmitter Housing. Again, be careful so that the o-ring on the transmitter housing is not damaged.

Locate the long screws; insert the screws through the canopy, transmitter housing, and the Plate. Tighten them using the crisscross method. Use caution when tightening the screws to prevent thread damage. The o-ring will seal the transmitter and mechanical register from environmental contaminants.

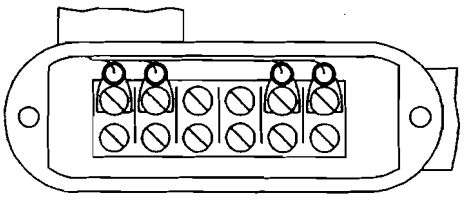

Figure 9.Condulet Wiring

C. Electrical Specifications

1. The Electrical Requirements are:

   a. 16-40 VDC
   b. 20 mAdc minimum per 4-20 mA loop

2. Remove the cover from the condulet and observe the wires connected to the terminal strip, Figure 9.

The color codes is as follows:

   a. Black = RETURN positive 4-20 mA out
   b. Red = Positive (+) from external power
   c. Orange = Positive collector (collector output), or relay contact (normally open)
   d. Blue = Negative emitter (collector output), or relay contact (common)

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3. Connect the external power and loads to the terminals in the condulet as follows:

a. Connect the positive (+) lead from the external power supply to the terminal with the RED wire connected inside the condulet, and the negative (-) side of the power supply to the negative side of the LOAD, then connect a wire from the Positive side of the LOAD to the BLACK wire inside the condulet as shown in Figure 10.

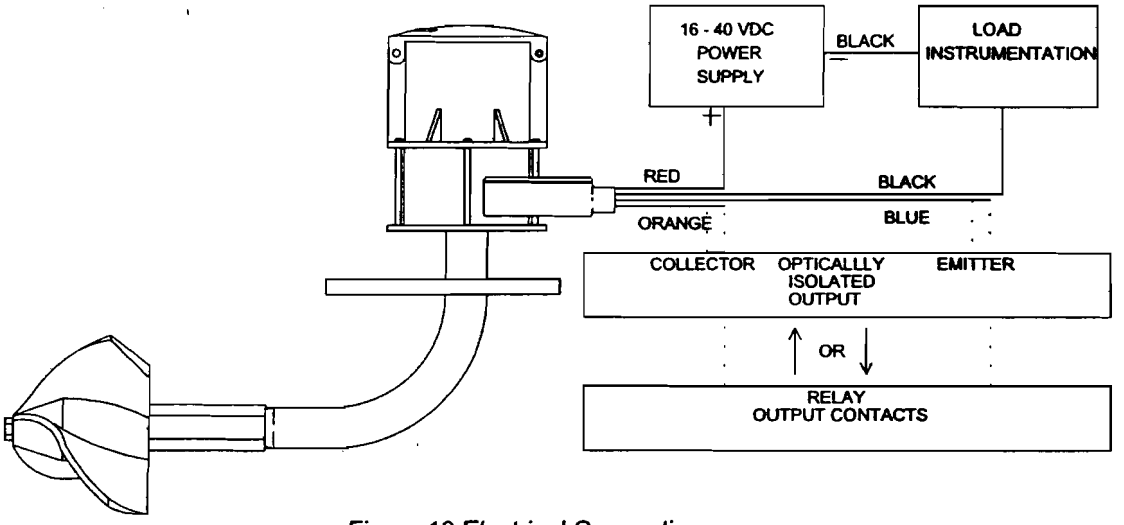

Figure 10.Electrical Connections

b. For quantified pulse output (i.e. 1P=100 gal) use the ORANGE and BLUE wires, depending on what option that you ordered. The ORANGE wire will be either the Collector output or the Normally Open output. And the BLUE wire will be either the Emitter or the Common output.

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IV. OPERATION

A. Function Description

Refer to the Block Diagram in Figure 11 for the following description of the overall system operation. The scope of this manual does not allow a circuit analysis but merely a general outline of the system for a further understanding of the equipment that you have purchased.

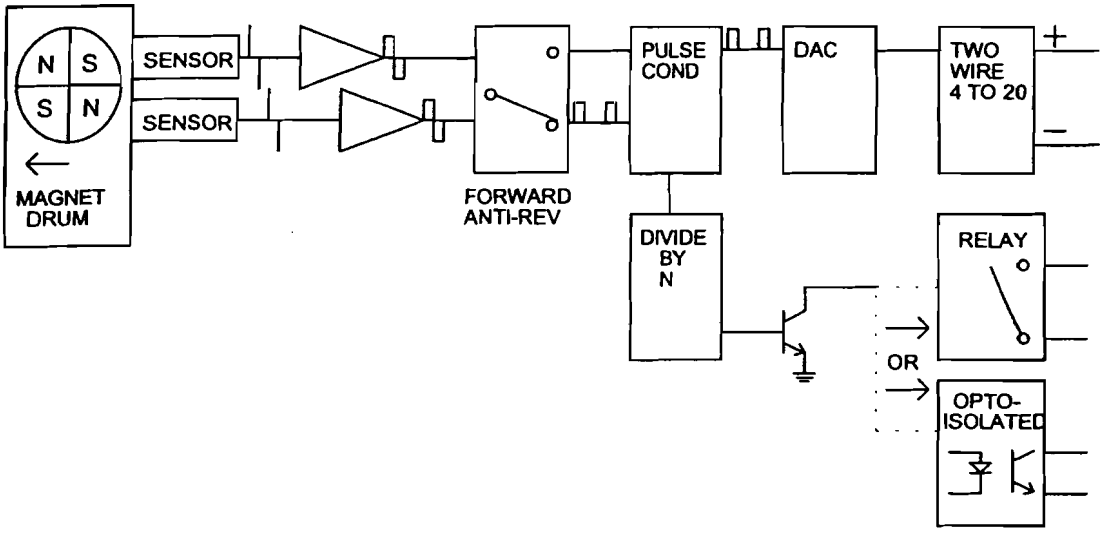

Figure 11 Block Diagram of the E7000

The E7000 was designed as a fully functional integrated system depending only on an external power source. It is composed of one circuit board with several different functions. The magnet drum rotates on the shaft, which passes by the sensor that produces a pulse which is then transformed into a square wave and goes to the directional sensor. Depending on what model of E7000 you have, the directional sensor will either send the pulse to the correct digital to analog converter or only allow the forward pulses to advance to the digital to analog converter.

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V. TROUBLESHOOTING

A. Normal Conditions

1. One of three (3) conditions could exist:
    1. Flowmeter with transmitter in line with flow.
    2. Flowmeter with transmitter in line without flow.
    3. Transmitter not installed on flowmeter

In any of the conditions above the outputs with the magnet rotating at a known speed (RPM) should be at a predicted level. The 4-20 mAdc output should be a steady level of current and the output should be as described on the calibration sheet which can be obtained on request from McCrometer.

B. Troubles and Remedies

Table 1 has a list of conditions, things to check, possible causes of the troubles, and what to do to correct the problems.

Table 1. Troubleshooting

CONDITION	CHECK	POSSIBLE CAUSE	REMEDY
No output	Power supply.	Wrong power supply. or faulty power supply	Replace power supply
	Check AC power at Source	Power supply not plugged in or no power to power supply	Plug in power supply to AC at Source
16 - 40 VDC to E7000 but no outputs	Wiring	Loose or disconnected Wire(s)	Fix Wire(s)
Incorrect Output	Load	Load Exceeds limit	Decrease Load Resistance (RL)
	Magnet	Magnet Assembly Set Screw Loose	Tighten Set Screw

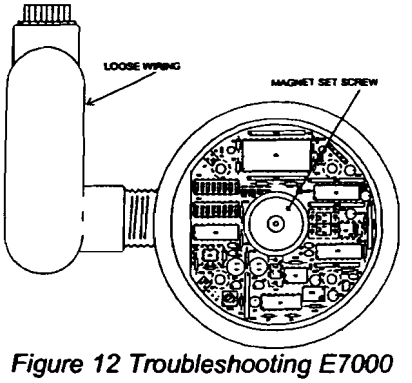

Figure 12 Troubleshooting E7000

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VI. CALIBRATION

It is necessary that you be able to rotate the magnet in the transmitter at a controlled rate and read the current output. The following list of equipment is meant as a reference only, but is the equipment we use in our electronics department at McCrometer. You may use any desired test equipment as long as it has the accuracy and you know the RPM-s applied. Your calibration is only as good as the equipment used and the skill and knowledge of the Technician. If you lack the necessary equipment to calibrate the transmitter, it can be sent to McCrometer for calibration.

1. Fluke 8060A Digital Multimeter
   Used to measure milliamps

2. A known controlled means of rotating the magnet.
   Minarik Electric (818) 507-6500 has quality equipment and a variety from which to choose. (MM21111A - DC Speed Control, 504-00-042 - Rae 1/50HP DC Motor)

A. Preparation

1. Refer to Set Up drawing, Figure 13 and connect the equipment accordingly.
2. Calculate the required motor speed and the corresponding current reading.
3. Ensure that the motor turns the mechanical linkage clockwise when looking at the top of the transmitter.

B. Calculations

Attached to each E7000 is a label showing a full scale propeller RPM. Set the motor at that speed to adjust the current output to 20 mAdc.

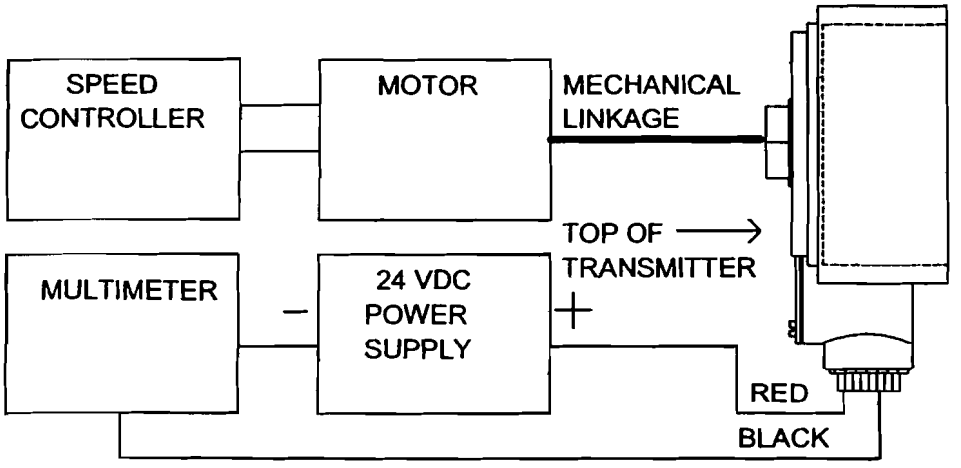

Figure 13 Block Diagram of Calibration Set Up

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C. Calibration

1. With the motor at zero RPM, adjust the potentiometer farthest to the left end of the E7000 circuit board to read 4.0 mAdc on the multimeter, see Figure 14.

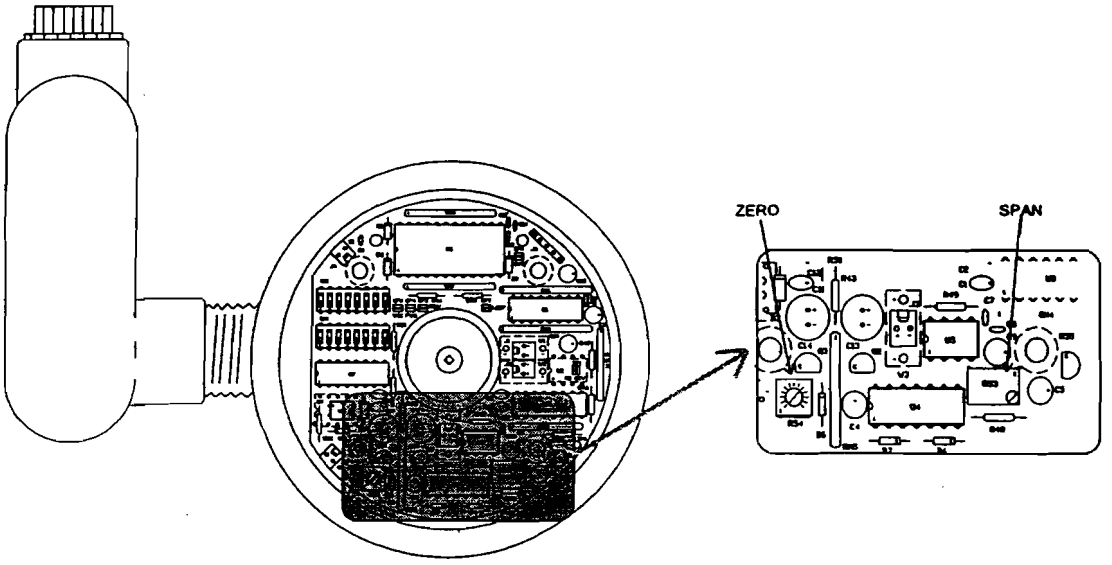

Figure 14 Calibration Of Zero and Span

2. Apply power to the speed control system that you are using and set for Full Scale RPM.

3. Adjust the pot on the right hand side for a reading of 20 mAdc on the multimeter.

4. Stop the rotation of the magnet and check the 4 mAdc reading. It may take a few seconds to stabilize; check and if necessary re-adjust the left potentiometer to obtain the 4 mAdc reading on the multimeter.

5. You may have to repeat the zero and span adjustments two or three times to be sure that the adjustments are stable.

6. Once you are satisfied that the transmitter is calibrated properly and within specifications the equipment can be disconnected from power and stored in a clean and temperature stable environment.

7. A suggestion at this point in your calibration is to put a drop of fingernail polish, or enamel on the adjustment end of the potentiometer to prevent them from turning due to vibration from the flow tubes.

Install the transmitter referring to the INSTALLATION Section.

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VII. WARRANTY

This Warranty Shall apply to and be limited to the original purchaser consumer of any McCrometer product. Meters or instruments defective because of faulty material or workmanship will be repaired or replaced, at the option of McCrometer, free of charge, FOB the factory in Hemet, California, within a period of one (1) year from the date of delivery.

Repairs or modifications by others than McCrometer or their authorized representatives shall render this Warranty null and void in the event that factory examination reveals that such repair or modification was detrimental to the meter or instrument. Any deviations from the factory calibration require notification in writing to McCrometer of such recalibrations or this warranty shall be voided.

In case of a claim under this Warranty, the claimant is instructed to contact McCrometer, 3255 West Stetson Ave., Hemet, Califomia 92545, and to provide an identification or description of the meter or instrument, the date of delivery, and the nature of the problem.

The Warranty provided above is the only warranty made by McCrometer with respect to its products or any parts thereof and is made expressly in lieu of any other warranties, by course of dealing, usages of trade or otherwise, expressed or implied, including but not limited to any implied warranties of fitness for any particular purpose or of merchantability under the uniform commercial code. It is agreed this warranty is in lieu of and buyer hereby waives all other warranties, guarantees or liabilities arising by law or otherwise. Seller shall not incur any other obligations or liabilities or be liable to buyer, or any customer of buyer for any anticipated or lost profits, incidental or consequential damages, or any other losses or expenses incurred by reason of the purchase, installation, repair, use or misuse by buyer or third parties of its products (including any parts repaired or replaced); and seller does not authorize any person to assume for seller any other liability in connection with the products or parts thereof. This Warranty cannot be extended, altered or varied except by a written instrument signed by seller and buyer.

This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

McCrometer reserves the right to make improvements and repairs on product components which are beyond the warranty period at the manufacturer's option and expense, without obligation to renew the expired warranty on the components or on the entire unit. Due to the rapid advancement of meter design technology, McCrometer reserves the right to make improvements in design and material without prior notice to the trade.

All sales and all agreements in relation to sales shall be deemed made at the manufacturer's place of business in Hemet, California, and any dispute arising from any sale or agreement shall be interpreted under the laws of the State of California.

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OTHER McCROMETER PRODUCTS INCLUDE:

Propeller Liquid Flowmeters

Differential Pressure Flowmeters

Differential Pressure Flowmeters

Variable Area Meters

Magnetic Flowmeters

Electronic Instrumentation for Remote Display and Control

FOR MORE INFORMATION CONTACT:

Represented by:

McCROMETER
3255 W. Stetson Avenue, Hemet, CA 92545-7799
Phone: (909) 652-6811 Fax: (909) 652-3078
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Hours: 8 a.m. - 4:30 p.m. PST, Monday-Friday

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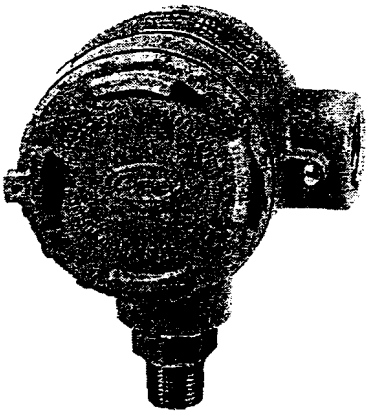
Section 2-G

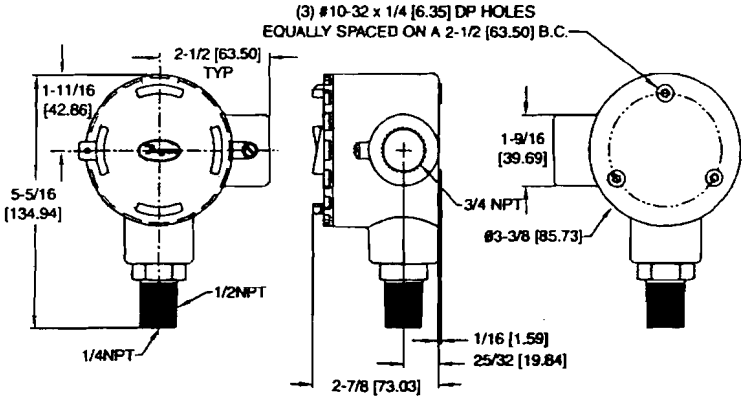
Carrier Pipe Pressure Transmitter (PT-131)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions





The **Series 634ES Pressure Transmitter** senses a single air, compatible gas or liquid pressure and converts it into a standard 4-20 mA output signal. Ranges are available from 0-10 through 0-6000 psi. All models are field adjustable so any range within these limits can be achieved by recalibration using the easily accessible span and zero potentiometers.

Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. The signal is conditioned and converted into a 4-20 mA output signal.

For applications requiring direct pressure or percent of full span readings, the optional A-701 digital readout makes an ideal companion device, providing a bright .6" high, 3-1/2" digit LED and supplying power to the Series 634ES Transmitter.

Model Number	Series 634ES Models and Ranges in PSI (bar)			
	As Stocked	Min. Range	Max. Range	Max Pressure
634ES-0	10 (.69)	10 (.69)	20 (1.38)	30 (2.07)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	60 (4.14)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	100 (6.9)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	200 (13.8)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	400 (27.6)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	500 (34.5)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	1000 (69)
634ES-7	1000 (69)	600 (41.4)	1250 (86)	2000 (138)
634ES-8	2000 (138)	1250 (86)	2500 (172)	4000 (276)
634ES-9	4000 (276)	2500 (172)	6000 (414)	7500 (517)

PHYSICAL DATA

GENERAL

Maximum Pressure: See chart on this page.
Wetted Parts: 316, 316L Stainless Steel.
Housing: Designed to meet NEMA-4X.

ELECTRICAL

Power Supply: 12.3-35 VDC-2 wire.
Output Signal: 4-20 mA DC (limited at 38 mA DC).
Loop Resistance: 0 - 1100 ohms from 12.3 to 35 VDC.

$$R_{L\ max} = \frac{V_{DS}-12.3V}{20\ mA}$$

Current Consumption: DC: 38 mA max.

MATERIALS

Housing: Cast aluminum; textured gray polyurethane finish.
Pressure Connection: Stainless Steel.

MECHANICAL

Weight: 1 lb., 12 oz. (.8 kg).
Span and Zero Adjustments: Protected potentiometers, located in auxiliary housing.
Pressure Connection: 1/4" female NPT x 1/2" male NPT.

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC.
Full Span: 16 mA DC.
Accuracy: ±0.5% of span.
Warm-up Time: 10 minutes.

STABILITY/ENVIRONMENTAL

Operating Temperature: 20 to 120°F (- 6.7 to 48.9°C).
Thermal Errors: ± 0.02%/°F typical.
Stability: 1% F.S./yr.

STANDARD ACCESSORIES

(3) "Z" mounting brackets.
(3) 10-32 x 4" RH machine screws.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.

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Lit-By Fax: 888/891-4963

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

INSTALLATION

LOCATION: Select a location where temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tube feeding the pressure to the instrument can be run practically any length required, but long lengths will slightly increase response time. Avoid surfaces with excessive vibration.

POSITION: A vertical position is recommended, as all stocked models are spanned and zeroed at the factory in this position. They can be used at other angles, but final spanning and zeroing must be done while transmitter is in the alternative position.

PRESSURE CONNECTIONS: A single pressure connection is provided at the bottom of the transmitter housing. It has1/4" female NPT and 1/2" male NPT threads. Attach positive pressure to this port.

MOUNTING: The Series 634ES Transmitter can be mounted three ways:

(A) Supported directly by pipe providing pressure.

(B) Attached to a mounting surface with 10-32 x 1/4" machine screws (included). The machine screws are installed through the mounting surface into tapped holes on back of unit.

(C) Mounted with "Z" brackets (included). Attach "Z" brackets to tapped holes on back of unit and fasten to front of mounting surface.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 634ES Transmitter are made inside the enclosure. Remove the cover, feed stripped and tinned leads through the conduit opening and connect to terminal block screws marked + and -. See Figure A for locations of terminal block, span and zero adjust potentiometers. See Figure B (Pg. 3) for schematic diagram.

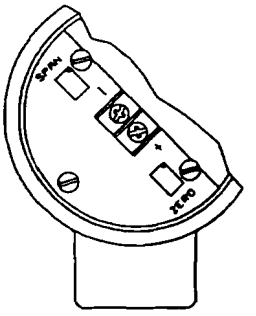

FIG. A

An external power supply delivering 12.3 to 35 VDC with minimum current capability of 40 mA must be used to power the control loop in which the Series 634ES Transmitter is connected. See Figure B for connection of the power supply, transmitter and receiver.

The range of appropriate receiver load resistance (R_L) for the power supply voltage available is given by the formula and graph in Figure C on Pg. 3.

Shielded 2-wire cable is recommended for control loop wiring, and the cable shielding may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient.

Should polarity of the transmitter or receiver inadvertently become reversed, the loop will not function properly, but no damage will be done to the transmitter.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

PRESSURE RE-RANGING PROCEDURE

1. With the transmitter correctly connected to the companion receiver, an accurate milliameter with a full scale reading of approximately 30 mA should be inserted in series with the current loop. A controllable pressure source capable of achieving the desired range should be connected to the pressure port of the transmitter and teed into an accurate reference pressure gauge or manometer. The instrument must be ranged in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust "zero" control so that loop current is 4 mA.

4. Apply full range pressure and adjust loop current to 20 mA using "span" control.

5. Relieve pressure and allow transmitter to stabilize for two minutes.

6. Zero and span adjustments may be interactive, so repeat steps 3 through 5 until zero and full range pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove the milliameter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA output signal provided by the Series 634ES Pressure Transmitter is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is only necessary that these devices all be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading, this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 634ES Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 634ES Pressure Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

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FR# 01-440577-04, Rev. 3

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Section 2-H

Carrier Pipe Pressure Indicator (PI-131)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for **Type 213.40S**)

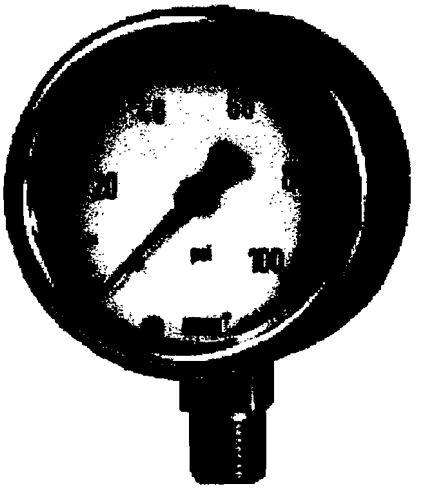
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

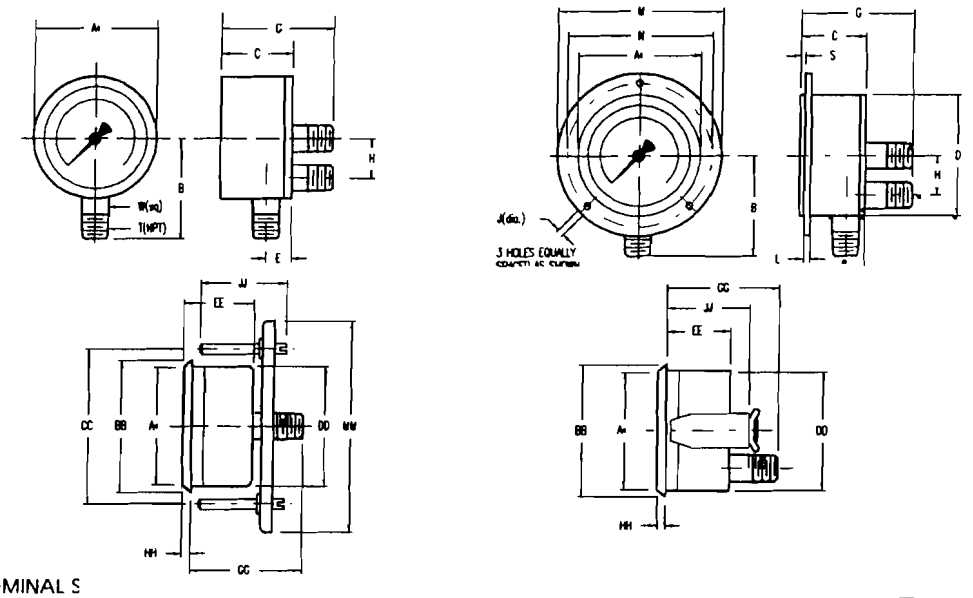
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



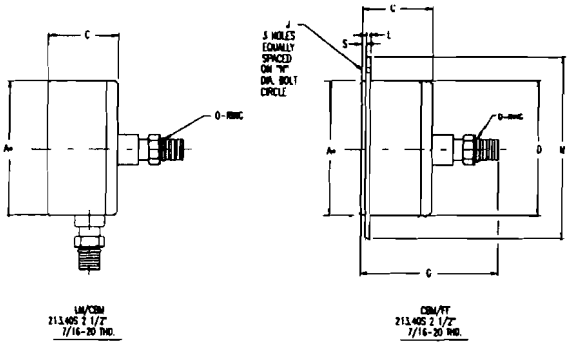
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14

KEY	L	M	N	S	W
mm	2.0	85	75	2.0	22
in	.08	3.35	2.95	.08	0.87

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/01

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

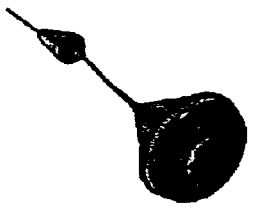
Section 2-I

Level Switch
(LSH-141, LSHH-142)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Mc MASTER-CARR

Heavy Duty Free-Floating Liquid Level Switches



Dual Level

- Maximum Pressure: 28 psi
- Maximum Temperature: 140° F
- Minimum Liquid Specific Gravity: .7

The large float (6 45/64" Dia. x 6 3/32" Ht.) on these cable-suspended switches senses level changes in large tanks. They work well in slurries and viscous media. To empty a tank, use a NO (normally open) switch. To fill tank, use a NC (normally closed) switch. Float is black polypropylene, with 16 ft. of PVC-covered 22/2 cable. Rated for 6 amps @ 250 VAC.

Single-level switches actuate at one level; great for triggering an alarm.

Dual-level switches go on at one level and off at another. Help avoid excessive pump wear by setting actuation points at two levels. Actuation points are adjustable between 10" to 50" by moving the control weight (included).

	To Empty a Tank (Normally Open)		To Fill a Tank (Normally Closed)	
		Each		Each
Single Level	47025K39	$83.60	47025K38	$83.60
Dual Level	47025K49	114.40	47025K48	114.40

47025K39 (Same as 47025K13)

Heavy Duty Liquid-Level Float Switch Single Level, To Empty Tank, 6-45/64" Dia, 16'Cable

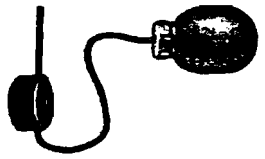
$ 83.60 Each

OVER →

Liquid Level Switches

For information about electrical controls, see page 772.

Dual-Level Free-Floating Liquid Level Switches



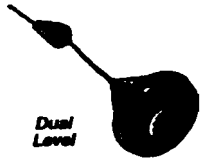
- Maximum Pressure: 29 psi
- Maximum Temperature: 122° F
- Minimum Liquid Specific Gravity:
  8" to 39" Control Range: .7
  12" to 157" Control Range: .9

These top-mounting, cable-suspended switches go on at one level and off at another. They provide a wide range of level control with just one float. Actuation points are field adjustable. A NO (normally open) switch closes when the float rises. A NC (normally closed) switch opens when the float rises. They can be installed in a variety of open tank sizes; even as small as a 55 gallon drum.

Each switch consists of an orange ABS thermoplastic float containing a mechanical switch, and 19.7 ft. of PVC-jacketed ¼" OD, two-conductor cable. Rated .42 amps @ 120 VAC and .21 amps @ 240 VAC.

Control Range	Float Size Dia.	Float Size Lg.	To Empty a Tank (Normally Open)	Each	To Fill a Tank (Normally Closed)	Each
8" to 39"	2 51/64"	4 13/64"	49045K2	$64.80	49045K4	$86.40
12" to 157"	3 19/64"	6½"	49045K6	108.00	49045K8	122.40

Heavy Duty Free-Floating Liquid Level Switches



Dual Level

- Maximum Pressure: 28 psi
- Maximum Temperature: 140° F
- Minimum Liquid Specific Gravity: .7

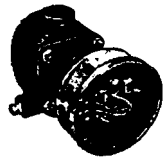
The large float (6 45/64" Dia. × 6 3/32" Ht.) on these cable-suspended switches senses level changes in large tanks. They work well in slurries and viscous media. To empty a tank, use a NO (normally open) switch. To fill tank, use a NC (normally closed) switch. Float is black polypropylene, with 16 ft. of PVC-covered 22/2 cable. Rated for 6 amps @ 250 VAC.

Single-level switches actuate at one level; great for triggering an alarm.

Dual-level switches go on at one level and off at another. Help avoid excessive pump wear by setting actuation points at two levels. Actuation points are adjustable between 10" to 50" by moving the control weight (included).

	To Empty a Tank (Normally Open)	Each	To Fill a Tank (Normally Closed)	Each
Single Level	47025K39	$83.60	47025K38	$83.60
Dual Level	47025K49	114.40	47025K48	114.40

Boiler-Pump Liquid Level Switches



With Automatic Reset

- Maximum Pressure: 150 psi
- Maximum Temperature: 365° F
- Minimum Liquid Specific Gravity: .88

These heavy duty, snap-action, sealed mercury switches are designed for low-water cut-off and feedwater control. See-through junction box cover allows easy inspection and servicing. Pipe-mount to the side of your tank. Choose from automatic and manual reset.

Switches are SPDT (single pole, double throw), and rated for 4 amps @ 120V and 2 amps @ 240V, AC or DC. Housing is NEMA 1, cast iron. Float is Type 304 stainless steel. UL listed; CSA certified. Connections: 1" NPT female top and bottom.

		Each
With Automatic Reset	49675K11	$276.90
With Manual Reset	49675K12	315.06

Free-Floating Liquid Level Switches

- Maximum Pressure: 20 psi
- Maximum Temperature: 140° F
- Minimum Liquid Specific Gravity: 1

Install these free-floating snap-action switches by simply hanging them in your tank. They should float at least 1" from the tank wall, and need approximately 6" of vertical movement to activate. Compact 2¼" Dia. × 3¼" Ht. makes them ideal in small tanks where space is limited.

Use to activate a pump at a single-level point. To empty a tank, use a NO (normally open) switch. To fill tank, use a NC (normally closed) switch.

Float housing is black ABS thermoplastic. Switches include a 14/2 cord with molded three-prong, piggyback style plug (has an outlet on the back). Rated for 15 amps @ 120 VAC. UL listed and CSA certified.

Float-Cable Length	To Empty a Tank (Normally Open)	Each	To Fill a Tank (Normally Closed)	Each
10 ft.	51445K11	$28.72	51445K31	$28.72
20 ft.	51445K12	35.11	51445K32	35.11
30 ft.	51445K13	43.62	51445K33	43.62
50 ft.	51445K14	54.26	51445K34	54.26

Swing-Arm Liquid Level Switches

- Maximum Pressure: Not Rated
- Maximum Temperature:
  High Density Polyethylene Arm: 160° F
  Titanium Arm: 250° F
- Minimum Liquid Specific Gravity: 1

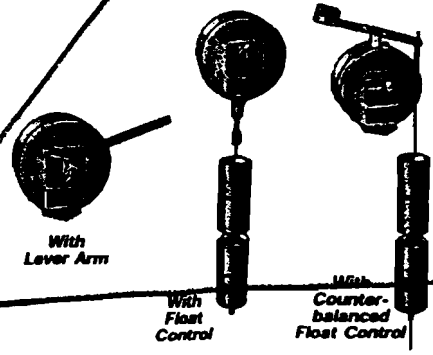
Float housing mounts on the top of your tank, so all electrical wiring is kept outside. Float arm swings 90° from the tank side. As the liquid level drops, the float arm tilts downward until the snap-action mercury switch is actuated. The switch is encased in epoxy, then totally enclosed in a rugged PVC housing. Comes with 4 ft. of 16/2 cable; pigtail end. Rated for 10 amps @ 120 VAC and 5 amps @ 240 VAC.

NO (normally open) switches are open when float arm is down. To empty a tank, use a NO switch.

NC (normally closed) switches are closed when float arm is down. To fill tank, use a NC switch.

Control Range	To Empty a Tank (Normally Open)	Each	To Fill a Tank (Normally Closed)	Each
With High Density Polyethylene Arm				
6" to 9"	6854K81	$127.58	6854K85	$127.58
9" to 13"	6854K82	151.29	6854K86	151.29
12" to 16"	6854K83	154.68	6854K87	154.68
21" to 25"	6854K84	169.35	6854K88	169.35
With Titanium Arm				
6" to 9"	6854K52	197.08	6854K61	197.08
9" to 13"	6854K56	203.54	6854K54	203.54
12" to 16"	6854K69	217.54	6854K67	217.54
21" to 25"	6854K77	233.69	6854K75	233.69

Lever-Arm and Float-Control Liquid Level Switches



With Lever Arm

With Float Control

With Counterbalanced Float Control

As the rod moves up and down with the liquid level, a snap-action, sealed mercury switch activates to open and close electrical circuits. Switch is off when lever is down and on when lever is up; it will not "snap" to its alternate position until the arm has moved a definite amount. Rated for 10 amps @ 120V and 5 amps @ 240V, AC or DC. Enclosure is NEMA 1, 4⅜" diameter, steel, and has a glass window.

Switch with Lever Arm—Add your own float and float rod to this switch. Lever is brass and extends 4½" to the right of the enclosure. It has seven holes, spaced ½" apart. Bottom-mount baseplate has two 3/16" holes.

Switch with Float Control—Use on closed, nonpressurized tanks. Minimum level change required to activate switch is 4". Includes two brass floats that are 2⅛" Dia. × 5½" Ht., a 4-ft. Type 303 stainless steel rod, and adjustable brass stops at the top and bottom.

Switch with Counterbalanced Float Control—Has adjustable deadband; minimum level change required is only 2". Bottom-mount baseplate has two 13/64" holes. Includes two cylindrical brass floats that are 2⅛" Dia. × 5½" Ht., a 4-ft. Type 303 stainless steel rod, and adjustable brass stops at top and bottom.

		Each
Switch with Lever Arm	4944K11	$118.61
Switch with Float Control	4944K12	242.79
Switch with Counterbalanced Float Control	4944K13	278.54

Section 2-J

Sump Pump w/Level Switch (P-141)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

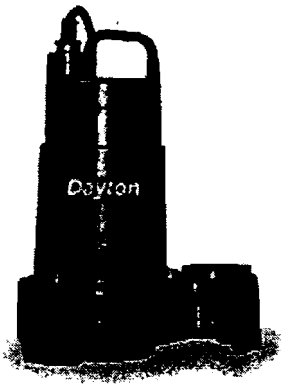
Item Details

< Back

Pumps & Plumbing > Sump, Effluent and Sewage > Sump Pumps

Pump,Sump,1/3 HP

Submersible Cast Iron Sump Pump, Rated Commercial/Industrial, HP Rating 1/3, Voltage @ 60 Hz 120, Current @ 120 VAC 6.8 Amps, Manual Operation, Water Flow @ 5 Feet of Head 65 GPM, Shut Off @ 30 Feet, Discharge NPT 1 1/2 Inches, Maximum Soild Handling 1/2 inch, Maximum Temperature 104 Degrees F, Cord Size 14/3 x 15 Feet Long, Fits Sumps 12 Inches in Diameter x 24 Inches Deep or Greater, Pump Diameter 8.52 Inches, Height 11.76 Inches



Grainger Item:	3BB73	Ship Qty :	1
Price (ea) :	$184.25	Sell Qty (Will-Call) :	1
Manufacturer:	DAYTON	Usually Ships :	Today
Mfg. Model#:	3BB73	Catalog 395 Page:	3088

pump →

Qty.

Add to Order

Compare Alternates

Price shown may not reflect your price.*Log-in* above,or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

OPTIONAL ACCESSORIES

Float Switch Economy

Economy Float Switch,Voltage@60Hz,115V,Cord Length 15 Feet, Wire Gauge 16, Starting Current 60 Amps, Maximum Running Current 10 Amps, Pumping Range Minimum/Maximum

WITH LEVEL SWITCH →

Price (ea): $33.25 Usually Ships : Today
Grainger Item#: 3BY59

Qty.

Add to Order

Alarm,High Water,120v

High Water Alarm, Diameter 3 1/2 Inches, Height 6 1/2 Inches, Width 4 1/2 Inches, 120 VAC, 80 dB Horn, 60 hz, Self Contained, Metallic Enclosure

Price (ea): $62.33 Usually Ships : Today
Grainger Item#: 1D002

Qty.

Add to Order

TECHNICAL SPECIFICATION

Type	Commercial Sum
Amps	6.8
Volts	120
Base Material	Cast Iron
Discharge NPT (In.)	1 1/2
Height (In.)	11 3/4
Dia. (In.)	9 1/8
Max. Head (Ft.)	30
Cord Length (Ft.)	15
GPM of Water @ 5 Ft. of Head	65
GPM of Water @ 10 Ft. of Head	57
GPM of Water @ 15 Ft. of Head	45
GPM of Water @ 20 Ft. of Head	30
GPM of Water @ 25 Ft. of Head	15
Housing	Cast Iron
Impeller Material	Cast Iron
Shaft Material	Stainless Steel
Top Material	Cast Iron
For Use With	Nonflammable Lic Compatible with F Materials of Cons

Section 3

Section 3-A

Air Filters

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

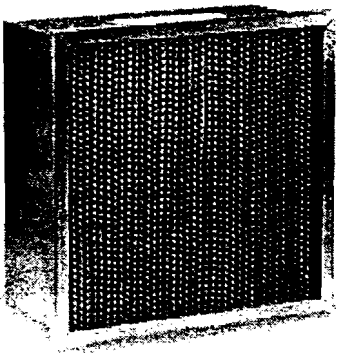
Item Details

< Back

HVAC > Filters > Extended Surface Filters

Air Filter,24x24x12

Air Filter, Filter Efficiency 90-95 Percentage, Capacity 2000 CFM, Initial Operating Resistance (WG) 0.65 Inch, Final Operating Resistance (WG) 1.50 Inches, Media Area 125 Square Feet, Nominal Depth 12 Inches, Nominal Height 24 Inches, Nominal Width 24 Inches, Cartridge



Grainger Item: 5W921
Price (ea) : $94.05
Manufacturer: AIR HANDLER
Mfg. Model#: 19295242412

Ship Qty : 1
Sell Qty (Will-Call) : 1
Usually Ships : Today
Catalog 395 Page: 3574

Qty.

Add to Order

Compare Alternates

Price shown may not reflect your price.*Log-in* above,or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

OPTIONAL ACCESSORIES

Air Filter Gasketing

Filter Gasketing, Roll, Length 75 Feet, Width 13/16 Inch, Thickness 1/8 Inch, Black Neoprene Foam With Adhesive Backing, Maximum Temperature 220 Degrees

Price (ea): $11.94
Grainger Item#: 6C523

Usually Ships : Today

Qty.

Add to Order

Air Filter Gasketing

Filter Gasketing, Roll, Length 50 Feet, Width 13/16 Inch, Thickness 1/4 Inch, Black Neoprene Foam With Adhesive Backing, Maximum Temperature 220 Degrees

Price (ea): $12.00
Grainger Item#: 6C524

Usually Ships : Today

Qty.

Add to Order

ALTERNATE PRODUCTS

Air Filter,24x24x12

V Bank Mini Pleat Air Filter, Filter Efficiency 95 Percentage, Capacity 2000/2500/3000 CFM, Initial Resistance 0.36/0.50/0.64 Inches, Recommended Final

Price (ea): $174.25
Grainger Item#: 4E412

Usually Ships : Today

TECHNICAL SPECIFICATIONS

Item	Cartridge Filter
Filter Efficiency (%)	90-95
Capacity (CFM)	2000
Initial Operating Resistance (In. WG)	0.65
Final Operating (In. WG)	1.50
Media Area (Square-Ft.)	125
Nominal Depth (In.)	12
Nominal Height (In.)	24
Nominal Width (In.)	24
Carton Quantity	1
Characteristics	Glass Microfiber Filter Media is an Inherently Stable Material, Water Resistant and can Withstand Intermittent Exposure to Water
Design	Corrugated Aluminum, Maintain Even Spacing Between each Media Pleat and Allows Total Unrestricted Air Flow to the Entire Media Pack
Frame/Header Material	24-gauge Galvanized Steel which Helps Eliminate Handling Damage and Assures Safe, Long Filter Life
Max. Temp. (F)	200
Standards	Classified as to Flammability only, Class I R13458
	For Industrial, Commercial or

Qty.

Add to Order

Compare Alternates

Application	Institutional such as Hospitals, Nurseries, Food Processing Plants, Pharmaceutical Manufacturing, Compute Equipment Rooms and Electronic Assembly Areas
Function	Remove Bacteria, Poller Smoke, Dust Particles and Chemical Pollutants from the Air
Header Size (In.)	13/16 x 11/16 D
MERV	14

Air Filter,24x24x22in
Fiberglass Pocket Air Filter, Filter Efficiency 90-95 Percentage, Number of Pockets 6, Media Area 50 Square Feet, Capacity 2000 CFM, Initial Low Resistance

Price (ea): $42.90 Usually Ships [?] : Today
Grainger Item#: 5E840

Qty.

Add to Order

Compare Alternates

Filter,Rigid,24x24x12
Rigid Filter, Filter Efficiency 90-95 Percentage, Capacity 2000 CFM, Initial Operating Resistance (WG) 0.66 Inch, Final Operating Resistance (WG) 1.50

Price (ea): $83.45 Usually Ships [?] : Today
Grainger Item#: 5W915

Qty.

Add to Order

Compare Alternates

Air Filter,24x24x22in
Synthetic Pocket Air Filter, Filter Efficiency 90-95 Percentage, Number of Pockets 6, Capacity 2000 CFM, Nominal Height 24 Inches, Nominal Width 24 Inches,

Price (ea): $40.25 Usually Ships [?] : Today
Grainger Item#: 6B641

Qty.

Add to Order

Compare Alternates

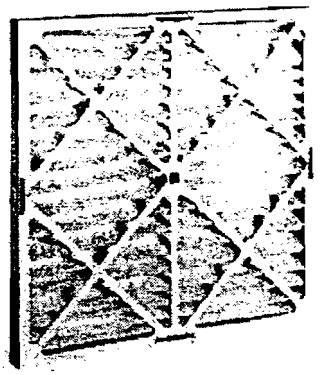
Item Details

< Back

HVAC > Filters > Type Pleated Air Filter

Filter,Pleat,24x24x2

Extended Surface Standard Capacity Pleat Filter, Media Area 12.7 Square Feet, Nominal Height 24 Inches, Nominal Width 24 Inches, Nominal Depth 2 Inches, Height 23 3/8 Inches, Width 23 3/8 Inches, Depth 1 3/4 Inches, Moisture Resistant Frame, Synthetic Fiber Fill, Metal Face. Only shipped in quantities of 12.



Grainger Item: 2W235
Price (ea) : $7.61
Manufacturer: AIR HANDLER
Mfg. Model#: 13024242

Ship Qty ? : 12
Sell Qty (Will-Call) ? : 1
Usually Ships ? : Today
Catalog 395 Page: 3568

Qty.

Add to Personal List | Add to Order

Compare Alternates

Price shown may not reflect your price.*Log-in* above,or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

TECHNICAL SPECIFICATIONS

Nominal Depth (In.)	2
Nominal Height (In.)	24
Nominal Width (In.)	24
Pleats per Linear Feet	10
Nominal Pleat (%)	40
Medium Velocity (FPM)	375
Med. Initial Resistance (In.)	0.18
Avg. Atmospheric Efficiency (%)	20 to 25
Filter Pack Enclosure	Heavy-duty, Moisture Resistant Die Cut Frame
Recommended Final Resistance (In WC)	1.0
High Initial Resistance (In.)	0.26
High Velocity (FPM)	500
Max. Temp. (Deg. F)	150
Media Area (Sq.-Ft.)	12.4
UL Listing	Class 2 (R13458)
Actual Depth (In.)	1 3/4
Actual Height (In.)	23 3/8
Actual Width (In.)	23 3/8
Carton Quantity	12

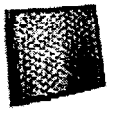
ALTERNATE PRODUCTS

Air Filter,24x24x2

Metal Faced Fiberglass Air Filter, Nominal Height 24 Inches, Nominal Depth 2 Inches, Nominal Width 24 Inches, Height 23 3/8 Inches, Depth 1 5/8 Inches,

Price (ea): $3.57
Grainger Item#: 5W507

Usually Ships ? : Today



Qty.

Add to Order

Compare Alternates

Filter,Panel,24x24

Three Ply Polyester Ring Panel Filter, Actual Height 24 Inches, Actual Width 24 Inches, 15/40 Media, Carton Quantity 24. Only shipped in quantities of

Price (ea): $5.96
Grainger Item#: 6B791

Usually Ships ? : Today

Qty.

Add to Order

Compare Alternates

Filter,Pleat,24x24x2

Extended Surface High Capacity Pleat Filter, Media Area 18.1 Square Feet, Actual Height 23 3/8 Inches, Actual Width 23 3/8 Inches, Actual Depth 1 3/4 Inches,

Also Consider

Extended Surface Standard Capacity Pleat Filter, Media Area 11.2 Square Feet, Nominal Height 20 Inches,

Manufacturer: AIR HANDLER
Grainger Item#: 2W233
Usually Ships ? : Today
Price (ea): $5.99

Qty:

ADD TO ORDER

Price (ea): $8.08 Usually Ships ☑: Today

Grainger Item#: 6B924

Qty.

Add to Order

Compare Alternates

Section 3-B

Air Stripper System Including Towers AS-210 and AS-220, Blower, Ductwork Accessories, Miscellaneous and Drawings

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Air Stripper System
Operation and Maintenance Manual

Water Treatment Division

CLIENT: CREAMER ENVIRONMENTAL, INC.
PROJECT NO. 04-0611
TREATMENT PLANT MODIFICATIONS
OU-2 SOUTH IRM
FORMER UNISYS FACILITY
GREAT NECK, NEW YORK
NYSDEC SITE ID NO. 130045
FOR
LOCKHEED MARTIN CORPORATION

LAYNE PRODUCTION NO. 70-1458

For Service Call: 800-269-4590
or fax to: 732-469-7966
or write to:

97 Chimney Rock Road
Bridgewater, NJ 08807

Table of Contents

Section I
Air Stripper Tower

Air Stripper Data Sheet

LAYNE CHRISTENSEN COMPANY

WATER TREATMENT DIVISION

AIR STRIPPER REPLACEMENT CAP

DATA SHEET

I. Project Information:

- A. Owner: ..... Lockheed Martin Corporation
- B. Customer: ..... Creamer Environmental
- C. Engineer: ..... Arcadis
- D. Installation Location: ..... Great Neck, NY

II. Tagging Information:

- A. Layne Production Number: 70-1458

III. Column:

- A. Model Number: PCS-108.24
- B. Quantity 2
- C. Design Water Flow: ..... 600 gpm
- D. Design Air Flow: ..... 5,000 cfm
- E. Diameter: ..... 9 ft 0 inches
- F. Approximate Overall Height (Cap Section): ..... 5 ft- 4 inches
- G. Inlet Pipe Size: ..... 12" (#1), 10" (#2)
- H. Material: ..... 5052-H32 Aluminum
- I. Coatings:
  1. Interior: ..... Mill Finish
  2. Exterior: ..... Mill Finish

IV. Liquid Distribution:

- A. Primary: ..... Orifice Tray
- B. Material: ..... 304 stainless steel
- C. Distribution Header Material ..... 304 Stainless Steel

Tower Head Loss Calculation

PACKED TOWER/SYSTEM HEAD LOSS

Customer: **Creamer Environmental, Inc.**
Job Number: **70-1458**
Location: **Great Neck, NY**
Engineer: **Arcadis**
Date: **3/12/2004**
Initials: **MSM**

Operating Data

70 = Design Temperature, F
6.6 = Design Pressure, in. w.c.
70 = Standard Temperature, F
14.7 = Standard Pressure, psia

Tower Data

108 = Tower Inside Diameter, inches
780 = Max Water Flow, gpm
5000 = Max Air Flow, cfm

Packing Support Data

70.00% = Percent Open Area, sqft
1.5 = Aperature Width, inches
1 = Number of Supports

Packing Data

JAEGER = Packing Manufacturer
2 = Nominal Packing Size, inches
50 = Total Packed Bed Depth, ft

Distributor Tray Data

10.75 = Diameter of Air Stacks, inches
9 = Length of Air Stacks, inches
8 = Number of Air Stacks
1 = Number of Trays

Mist Eliminator Data

108 = Diameter of Mist Eliminator, inches
63.62 = Actual Area, sqft
11.60 = Minimum Required Area, sqft

Screened Air Outlet Data

0 = Window Height, inches
0 = Window Arc Length, inches
0 = Number of Windows
0.00% = % Open Area of Wire Mesh
0.00% = % Open Area of Expanded Metal

Air Filter Data

0 = Total Filter Area
0 = Pre-filter thickness, inches
0 = Final Filter Thickness, inches

Inlet Ductwork Dimensions

0 = Height, inches
0 = Width, inches
18 = Diameter, inches
30 = Length, feet

Discharge Ductwork Dimensions

0 = Height, inches
0 = Width, inches
18 = Diameter, inches
10 = Length, feet

HEADLOSS SUMMARY

Packing Support :	0.00034	inches H2O	
Packing :	0.48619	inches H2O	
Distributor Tray :	0.01164	inches H2O	
Mist Eliminator :	0.04989	inches H2O	$= 1.5*(Uact / Umax)^2$
Screened Air Outlet :	0.00000	inches H2O	
Ductwork Losses :	**1.00000**	inches H2O	
Air Filters at Changeout :	**0.00000**	inches H2O	
20.00% Safety Factor :	0.30961	inches H2O	

Total Headloss Through System : ***1.858*** **Inches H2O**

Description of Operation

PACKED COLUMN AIR STRIPPER
DESCRIPTION OF OPERATION

The purpose of the packed column air stripper is to remove dissolved gases and volatile compounds such as organic solvents from the water to be treated. This is accomplished by passing the contaminated water through a packed bed in contact with a counter-current stream of air. The packed bed is designed to promote intimate contact between the water and air, so that the maximum transfer of gases and volatile organic compounds from the water stream to the air stream can occur.

Water is introduced into the top of the column and, after passing through a specially designed water distributor to insure even distribution, flows by gravity down through the packed bed which consists of molded plastic, metal, or ceramic shapes specifically designed to maximize the contact with the air stream described above. After passing through the bed the water is collected in a collection pan or holding chamber at the base of the column before being discharged.

Air is introduced at the base of the column above the holding chamber, and rises by induced or forced draft through the packed bed. After receiving the contaminants from the water stream, the air is passed through a device to eliminate water droplets from the air stream and is discharged from the top of the column.

Air stripping is, in theory, a simple process, but to operate at maximum efficiency all components of the system must be carefully engineered. Changes in operating parameters (process flow rates, contaminant concentrations, etc.) will affect the operating balance of the system and must be examined on a case-by-case basis to determine their influence on process efficiency.

Cold Weather Operation

INSTRUCTIONS FOR COLD WEATHER OPERATION

Air stripping systems are generally unaffected by cold weather. However, there are a few points to be aware of:

1. During normal operation, strippers do not tend to freeze. This is because the feed water is at the relatively constant groundwater temperature, usually 50-60°F. The heat capacity of the water is overwhelmingly larger than the heat capacity of the air. The cold air passing through the column is unable to cause any freezing regardless of its temperature.

2. During periods of inactivity, the water in the base of the stripper may tend to freeze. The period of inactivity before freezing will occur must be judged based on the thermal mass of the water retained in the base and the ambient air temperature. If the period of inactivity will exceed the judged safe period, then the water in the base must be drained along with that in any unprotected pipelines. Normal on/off cycles of automatically controlled systems do not generally present freezing problems.

3. Removal efficiency may be slightly affected by low air temperatures. If the effluent quality is near the allowable maximum concentration at higher air temperatures, then the effluent should be monitored as temperatures drop to insure that the quality does not exceed the allowable maximum. The effect on removal efficiency is minimal in most cases. If the stripping system has been operating satisfactorily at normal ambient temperatures, the safety factors employed in the design of these systems will normally accommodate the small drop in removal efficiency without exceeding the allowable effluent concentration.

Tower Maintenance

TOWER MAINTENANCE

Low cost operation and ease of maintenance make air stripping systems simple to manage. The only moving part in the system is the fan delivering the air. The column internals should require no regular maintenance unless very high suspended solids levels are encountered in the influent water or dissolved iron levels in the water are inordinately high.

In order to keep the packed column system operating at optimum efficiency, there are typically several subsystems that must be maintained: blower, water influent pump(s), water effluent pump(s)–if any–control/metering equipment and the packed tower.

Instructions for the inspection and maintenance of the blower and pump(s) are located elsewhere in this manual. The individual component manufacturer's recommendations should be followed in order to keep the equipment functioning properly. This also applies to all control and metering equipment included in the air stripping system. Special attention must be given to sensitive instrumentation in order to assure accurate readings and long life.

The packed tower itself has several components that should be inspected on a regular basis–the interval between inspections is directly related to water quality and will vary from system to system. These components include: the tower shell, the mist eliminator, the water distribution system and all gasketed flanges.

TOWER SHELL

The tower shell is fabricated from 5052-H32 aluminum. This material is an aluminum/magnesium/chromium alloy which has a high resistance to corrosion. The alloy serves well under severe conditions of atmospheric exposure and is commonly used for aeration systems and packed column air strippers in water treatment.

Aluminum alloys owe their high corrosion resistance to a natural oxide film, formed when oxygen in air or dissolved in water contact the aluminum. This oxide film is very thin but highly resistant to most forms of attack; It is chemically inert and does not dissolve in most chemicals. If the surface is gouged sufficiently to remove the film, it will reform immediately upon contact with oxygen in the atmosphere.

The tower has been lined with an epoxy coating system. This system is extremely durable and should last the life-time of the vessel, however, occasional inspection is necessary to ensure its integrity. Whenever possible, inspect the internal surfaces for cracks or pealing. In the unlikely event that cracking or pealing occurs, simply grinding down the affected area and re-coating with a compatible system.

General inspection of the tower shell consists of a simple "walk-by" inspection normally accomplished during daily activities with the system. There is not a great deal that can go wrong with the tower shell. Of course any structural damage due to vandalism or major seismic events should be noted, reported and repaired to avoid any additional damage. Structural damage is, however, highly unlikely.

As a general maintenance rule the tower shell, near the ground, should be rinsed when, and if, mud or dirt build up.

TOWER INTERNALS

Inspection of the tower packing and tower internals is accomplished through the use of tower manways and inspection ports. The number of manways and ports will vary depending on the tower size. If the situation indicates that fouling of the packing will not be a problem, the tower may not have any manways or inspection ports.

The upper manway, located in the tower, provides access for inspection of the water distribution system. Safe access to the manway is available by means of a man-lift or bucket truck only. With the manway cover removed the water distributor, mist eliminator and packing can be inspected.

Evidence of sand, clay or scum on the distributor or packing should be noted; a hand held brush can be used to test the thickness and tenacity of any deposits. The mist eliminator should also be examined for buildups of any kind.

After inspection, if cleaning is necessary, use a brush and mild acid or chlorine solution to loosen dirt and/or scum. Rinse any cleaning solutions after cleaning. Upon completing the inspection--and cleaning when necessary--check the manway gasket and replace it if necessary; remount the manway hatch and bolt down tight.

It is critical to keep in mind that a little dirt buildup is common and it is not necessary to clean the tower internals every time the hatch is opened. In fact, the frequency with which the tower is inspected is directly related to what is discovered with each inspection. Generally the tower should be opened within the first 6 months and then once a year thereafter. in some cases it may be necessary to inspect more often while in others, the manway may be removed only once in 5 or 10 years. The correct frequency of inspection can only be determined by experience and is directly related to the quality of the incoming flow.

TOWER PACKING

The tower packing is the most critical part of an air stripping system. Generally it is a randomly-dumped polypropylene packing that can come in a variety of shapes. It provides the surface area over which water can flow and break up and from which droplets can form.

During the air stripping process air and water mix vigorously within the tower; as a result, oxygen is added to the water and volatile compounds such as volatile organics, carbon dioxide, and hydrogen sulfide are removed. The addition of oxygen can lead to the oxidation of dissolved metals such as iron. The oxidized iron will come out of solution and over a period of time can collect on the surface of the tower packing and in the tower collection basin.

In addition to iron, the presence of iron bacteria or any active bio-culture can lead to a biological buildup within the packed tower. Finally, the removal of carbon dioxide may affect the chemical equilibrium of the water, possibly leading to a scale forming water. Scale, in the form of calcium carbonate may or may not deposit on the tower packing. A careful examination of all the chemical constituents in the water must be conducted to fully assess the potential effects in the air stripper.

There may be several places on the tower where the packing can be inspected. If the tower is equipped with a manway(s), the packing can be easily inspected by removing the cover(s).

Once the manway cover has been removed the packing should be inspected for evidence of discoloration, orange tint indicating iron buildup, slimy film of any kind and off-white buildup.

The tower may also be equipped with one or more inspection ports, six to twelve inches in size. As with the manway inspection, look for buildup and/or discoloration. If the tower has no manways or inspection ports, the top of the packed bed can be inspected by unbolting the top of the tower and removing it.

Finally, the sump manway can be used to inspect the packing. By removing the cover plate, access to the tower basin is attained. Look up into the packing and support tray and down into the basin. Any buildup or settled material should be noted. Regardless of the way in which the packing is to be inspected, the system must be shut down beforehand.

As with the tower internals, the frequency of inspection will vary with the site. An initial inspection using the inspection port should be conducted during the first three months of operation and generally every six months to one year thereafter. If the tower does not have any manways or inspection ports, the condition of the packing can be monitored by frequently checking the blower static pressure (or air volume) and the removal efficiency of the tower. If either an increase in blower static pressure (decrease in air volume) or a decrease in removal percentage is noted, it may be due to build up on the packing. Other possible causes would be higher than normal water flow through the tower and electrical or mechanical problems with the fan. If the packing appears to be the cause, it should be inspected as soon as possible.

If a buildup is noted it may be necessary to treat the packing. Before this is done it is recommended that a Layne technician be called in to inspect the tower to determine whether cleaning is necessary.

If cleaning is necessary, a dilute acid or chlorine rinse is recommended. A proper wash should be run at a rate greater than or equal to 10 gpm/sq ft. The blower should be shut down and the system run in a recycle mode, using the tower basin or an available storage tank as a reservoir and the effluent or fed pump as the recycle pump. If the buildup is biological, superchlorinate the recycle water and monitor the chlorine residual. If the buildup is inorganic use a mild acid. If an acid is used it will have to be neutralized with lime or caustic soda prior to discharge to the sewer. It may be necessary to flush the recycle water and replace with fresh water if the buildup is excessive.

It is important to stress that the cleaning requirements will vary from tower to tower. In the majority of cases involving drinking water supplies, cleaning will only be necessary after years of operation, if at all.

FLANGED CONNECTIONS

Any time a flanged connection--nozzles, pipes, tower body flanges--is separated, the gasket in place must be inspected and replaced, if necessary. If in doubt, replace the gasket.

Maintenance Procedures

MAINTENANCE PROCEDURE

Use the following procedure as a guideline. You may develop your own schedule. However, it is highly recommended that you follow these suggestions.

Monthly intervals of the inspections are for average conditions. Simply conduct the blower maintenance inspection once a month, unless conditions require it be done more frequently, and the rest of the tower annually. Helpful hint: conduct the maintenance on the first of every month, and the annual inspection in the month of its original startup.

It is important to develop a specific routine and follow it. You should keep records of all repairs and changes done to the tower, and a detailed account of all observations. A history of the tower is a useful tool in determining the performance of the tower.

SITE: _____

DATE: _____

BLOWER(S) AND ACCESSORIES

- ☐ Correct the alignment of the sheaves.
- ☐ Tighten loose belts.
- ☐ Replace worn or cracked belts.
- ☐ Clean and/or replace air filters.
- ☐ Lubricate motor and fan bearings.
- ☐ Replace worn or cracked flexible ductwork connections.
- ☐ Check fan blades for residue buildup.

TOWER FOUNDATION

- ☐ Check foundation for evidence of settling (cracking, buckling, etc.)
- ☐ Check anchoring system for secureness.
- ☐ Examine condition of the clearwell.

PACKED TOWER

- ☐ Check shell and piping for leaks and wear.
- ☐ Clean air outlet screens.
- ☐ Tighten bolts on flanged connections.
- ☐ Replace worn, cracked, or leaking gasket material.
- ☐ Inspect packing for staining and/or deposition.
- ☐ Examine the distributor tray and sump for staining and/or deposition.
- ☐ Examine mist eliminator for staining and/or build-up.
- ☐ Remove debris from the distributor tray and sump areas.
- ☐ Gather tower influent and effluent water quality data.

Inspection Services

INSPECTION SERVICE

Adequate inspection and maintenance is essential to the continued successful operation of your plant.

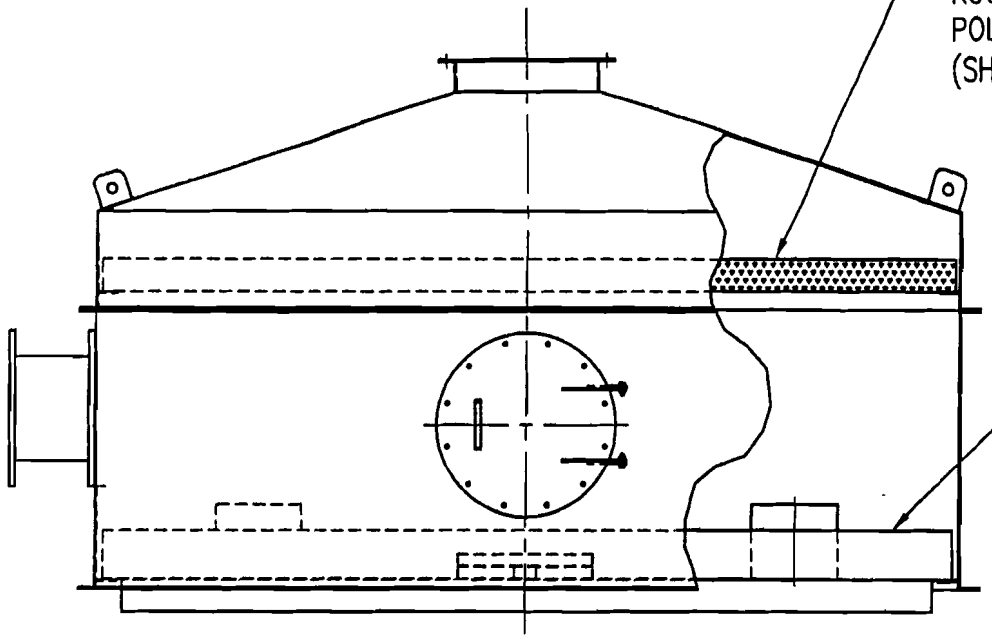
Layne Christensen Company maintains a field service department especially organized for inspections, repair and maintenance work, as well as complete equipment reconditioning.

When troubles arise, we suggest that you first contact us for a preliminary investigation if the cause of the trouble is unknown. Our investigating engineer may then issue complete instructions and determine repair materials required to assure that our field crew will be fully prepared to made the repairs in a minimum amount of time.

CONTACT DIRECTORY

Equipment	Company	Contact	Phone #
Air Stripper Blowers Air Filters	Layne	Chris Horan	1-800-269-4590

Air Stripper Replacement Cap Section
Product Sheet



ELEVATION

(1-REQUIRED TOWER 1, 1-REQUIRED TOWER 2)

TOTAL EMPTY WEIGHT EACH: 850 LBS.
TOTAL OPERATING WEIGHT EACH: 3900 LBS.
PRESSURE DROP THROUGH MIST ELIMATOR: 0.04989 IN W.C
PRESSURE DROP THROUGH DISTRIBUTOR TRAY: 0.01164 IN. W.C.

REV: 1	"AS-BUILT"	DATE: 09/08/04

Layne

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
(800) 269-4590
(732) 469-7966

LAYNE CHRISTENSEN CO. - WATER TREATMENT DIVISION

TITLE: MANUFACTURER'S PRODUCT SHEET
AIR STRIPPER REPLACEMENT CAP SECTION
TREATMENT PLANT MODIFICATIONS
GREAT NECK, NEW YORK

JOB NUMBER:	70-1458	SCALE:	N.T.S.
DRN: PMD	DATE: 03/11/2004	DRAWING NUMBER	REV.
CHK:	DATE:	176A5435	1

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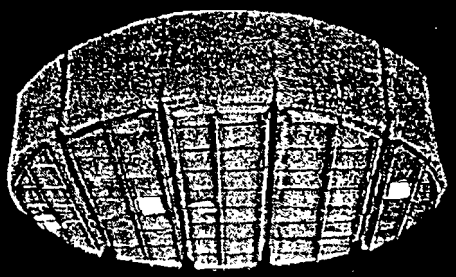
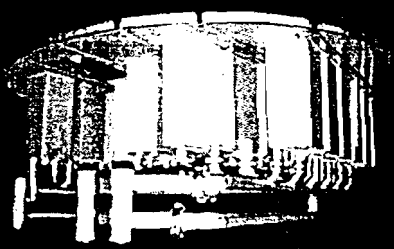
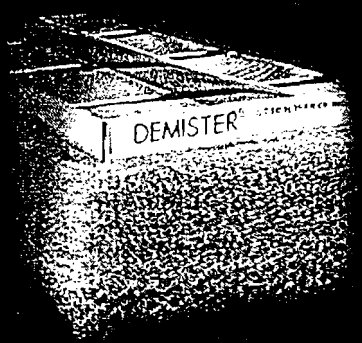
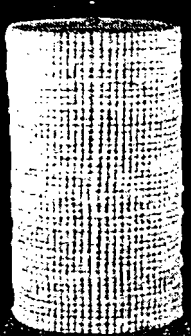
Mist Eliminator Catalog Cuts









Mist Elimination

KOCH-OTTO YORK®

SEPARATIONS TECHNOLOGY

OTTO YORK®

A Koch-Glitsch, LP business group

KOCH-OTTO YORK®
SEPARATIONS TECHNOLOGY
A Koch-Glitsch, LP business group

Types of Mist Eliminators

Almost all mist elimination equipment falls into four classes: vane assemblies of chevron-shaped blades, cyclones, knitted mesh types, and fiberbeds.

When the vessel size is not set by the mist eliminator, such as packed or tray towers, heat exchangers or evaporators, the practical starting point is often the mesh pad type. DEMISTER® knitted mesh mist eliminators provide high separation efficiency at the lowest installed cost.

If the mist contains solid particulates, viscous, sticky liquids, or if large slugs of liquid occur, the fouling resistant FLEXICHEVRON® mist eliminator, or, in extreme cases, tangential inlet multi-cyclones, may offer a better solution. These concerns have made this equipment the standard starting point in industries like oil & gas production.

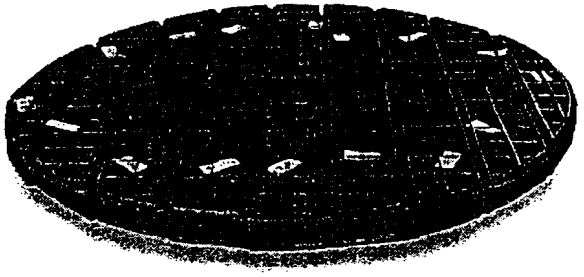
Where the vessel size is set by the mist eliminator, then the benefits of high capacity FLEXICHEVRON® mist eliminators or SpiraFlow™ Cyclone mist eliminators could be the most cost effective overall solution.

	Knitted Mesh	Vane	Cyclone	Fiber Bed
Cost	1	2-3	3-5	10
Gas Capacity	5	6-15	15-20	1
Efficiency	3-10	10-40	7-10	<0.1
Pressure Drop, WC	<25mm (1")	<10-90mm (0.4" - 3.5)	200-350mm (8" - 14")	50-500mm (2" - 20")
Liquid Capacity	5	10	10	1
Solid Handling	3	10	10	1

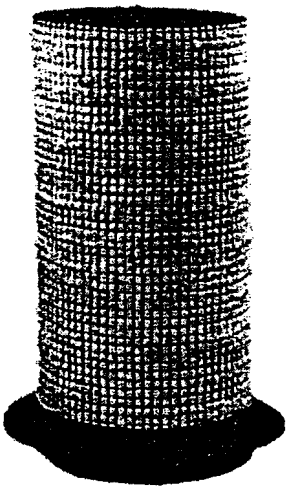
Table 2. Selection guide for choosing from the various common mist elimination equipment. The relative scale used in several categories is based on 1 as the lowest, and the others are scaled.

For applications involving sub-micron particles, FLEXIFIBER® mist eliminators provide excellent solutions.

While these comments help clarify selection, your final selection should be made only after reviewing your application with an equipment designer of proven expertise. KOCH-OTTO YORK®, provides an enormous resource to help you make the best choice for your particular application.



DEMISTER® mist eliminator style 709, in stainless steel.



FLEXIFIBER® mist eliminator type IC-SRF.

FLEXIMESH® Mist Eliminators

Efficient and economical for a wide range of applications

- High collection efficiency
- Lowest installed cost
- Low pressure drop
- Fast delivery and service

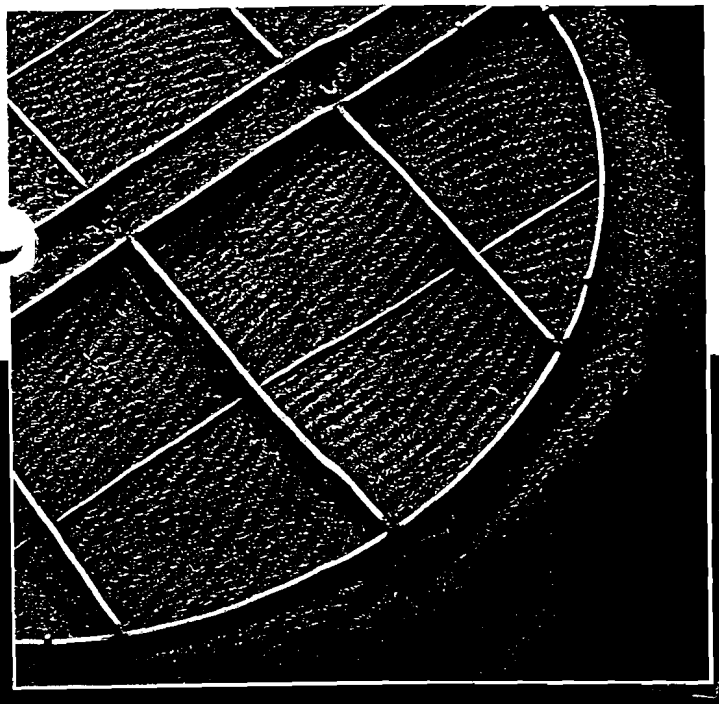
FLEXIMESH® Mist Eliminators are porous blankets of knitted metal or plastic wire mesh custom-designed for a client's specific application. These mist eliminators collect essentially 100% of all liquid particles 2 to 5 microns in diameter, depending on design parameters. They are also offered as liquid/liquid coalescers.

Available in virtually any size or shape, in a broad range of metals or plastics, individual styles of FLEXIMESH® Mist Eliminators can be supplied to meet specific customer needs. The chart lists the 12 most popular styles.

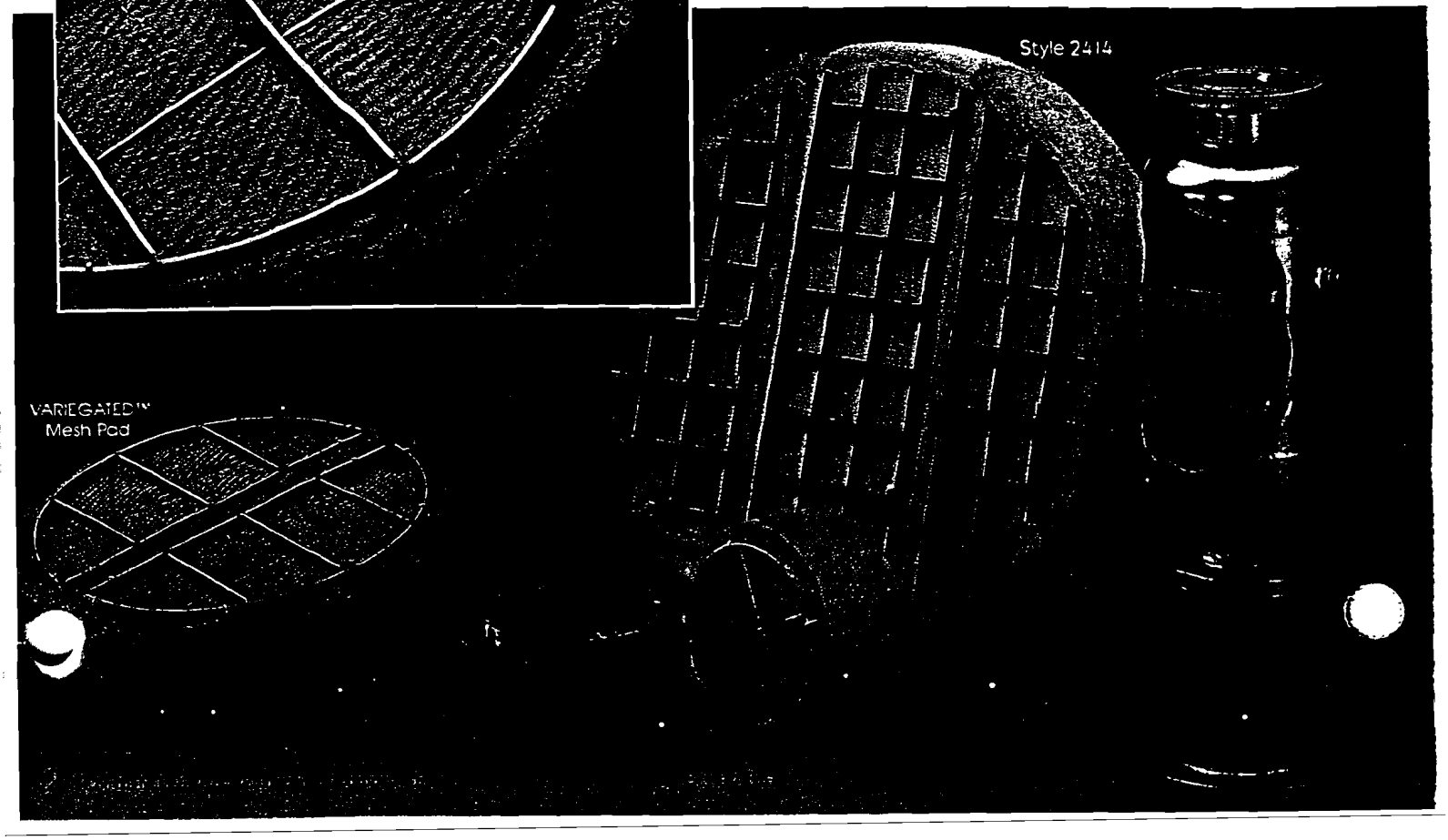
Koch/Dixmet	Density		Surface Area		%Voids
Style No	lb/ft^3	Kg/M^3	FT^2/FT^3	M^2/M^3	
4120	12.0	192	115	377	97.6
4210	10.8	173	110	360	97.7
3710	10.0	160	163	535	94.0
4310	9.0	144	86	282	98.2
3260	8.0	128	140	459	98.4
6440	7.3	117	65	213	98.5
5310	7.0	112	65	213	98.6
9310	5.0	80	48	157	99.0
5520	20.0	320	450	1476	96.0
5540	27.0	432	610	2000	94.6
2212	4.0	64	125	410	97.0
2414	4.0	64	150	492	97.0

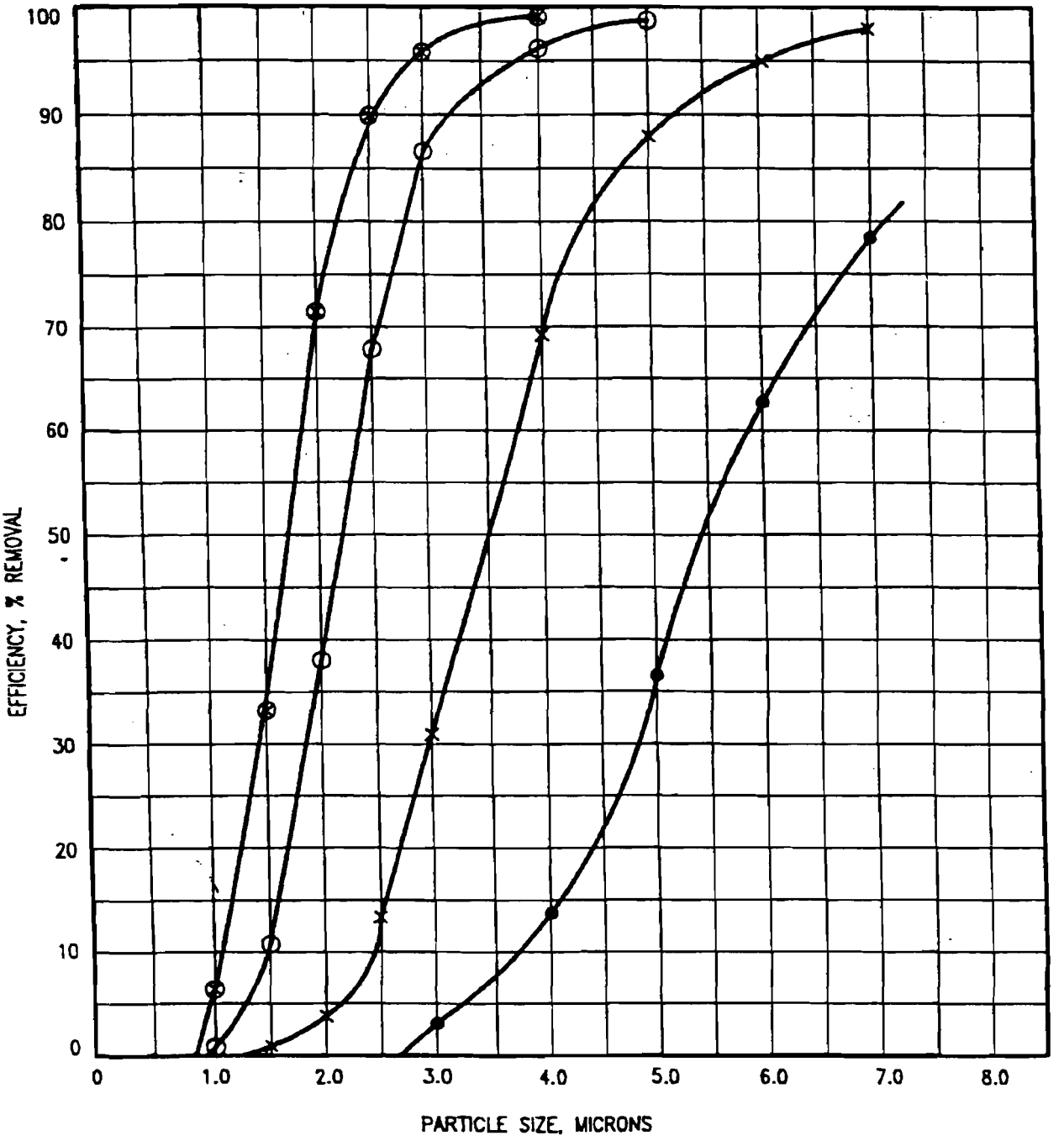
The versatility of these FLEXIMESH® Mist Eliminators makes them ideal for use in absorption and drying towers, evaporators, distillation towers, stripping columns, scrubbers, steam drums, separators, and knockout drums.

"KOCH-OTTO YORK" STYLE NO. 241 IN POLYPROPYLENE



Koch Engineering's patented FLEXIMESH® VARIEGATED™ Mesh Pad (U.S. Patent No. 4,744,806) provides up to 15% higher capacity and up to 25% lower pressure drop than conventional mesh pads. The variegated mesh design is ideal for tough retrofit situations where conventional mesh pads tend to re-entrain. Vessel size for new installations is also reduced when FLEXIMESH® VARIEGATED™ Mesh Pads are specified.





LEGEND

2.5 FT./SEC.

5 FT./SEC.

10 FT./SEC.

15 FT./SEC.

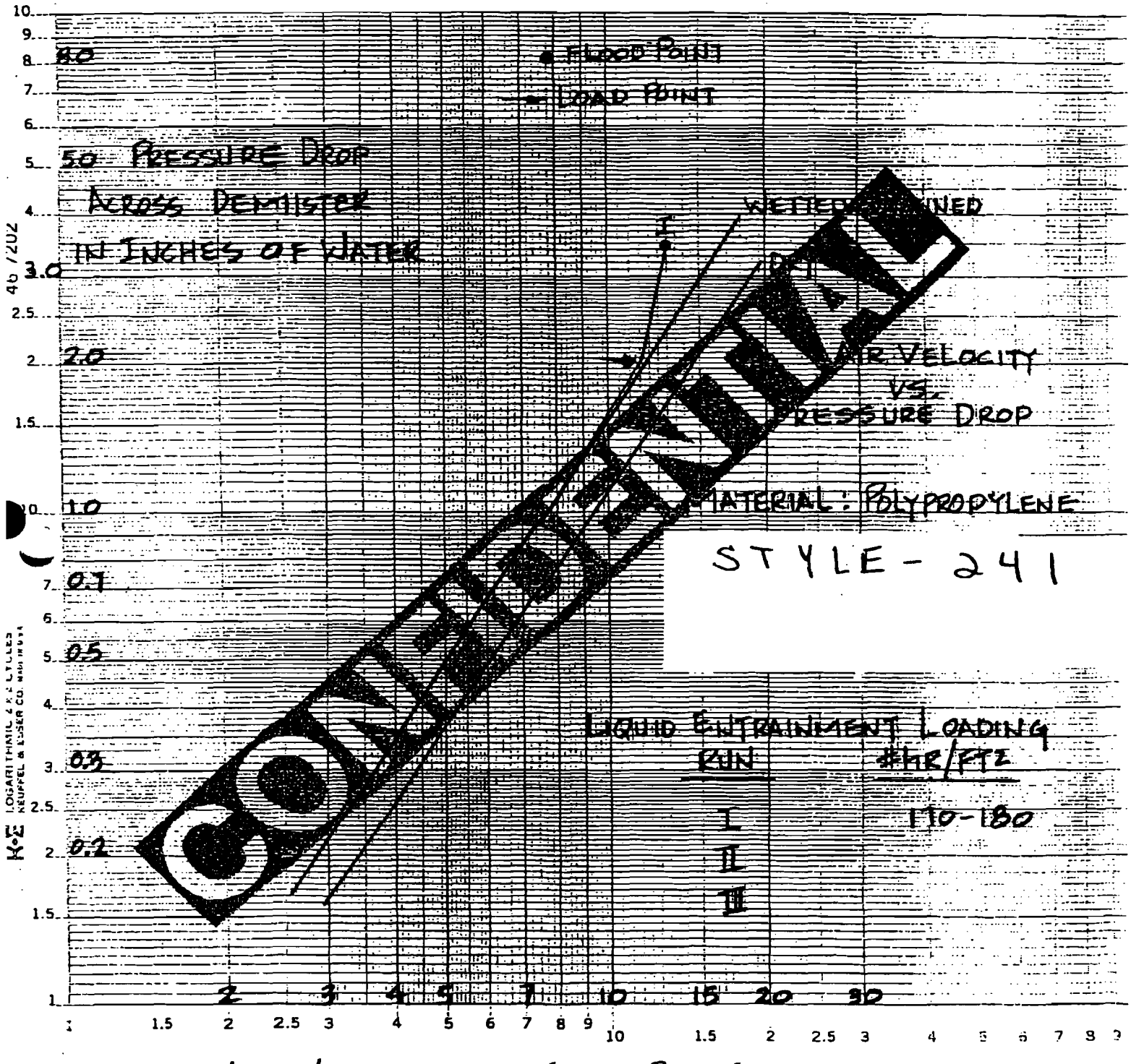
CALCULATED EFFICIENCY
STYLE 24L, 6" THICK

KOCH-OTTO YORK™
SEPARATIONS TECHNOLOGY

INC.

SCALE NONE	JOB NO.	DRAWING NO.	REV.
DWN. / ENGR. RAM / PH	P.O.#		

ΔP vs. MESH DENSITY



molecular weight, pressure, etc. can have a marked effect on droplet size and distribution and would result in poor performance for other types of entrainment separation equipment. Knitted wire mesh pads, on the other hand, have a wide tolerance for such changes and can continue to give good separation efficiency over a very wide range of operating conditions.

As gas flows through the KOCH mesh pad, the flow streamlines are deflected by the wires. The inertia of the liquid droplets will be normally too high for them to follow the streamlines and they impinge on the wires.

Since the kinetic energy of a droplet is determined by its velocity and mass, it is obvious that droplet size is an important factor in separation efficiency.

On a weight basis, it takes 1000 one-micron droplets to equal one 10-micron droplet. At proper velocities, a KOCH mesh pad can remove 3 to 5 micron droplets at better than 90% efficiency. As droplet size increases, efficiencies also increase so that at 8 microns they are on the order of 98% and with a normal distribution of droplet sizes, it can be expected that separation efficiency will be better than 99.9%. The chart below is typical of separation efficiencies obtained using a 6" thick KOCH Style 9310 mist eliminator operating in the range of 4 to 12 feet per second.

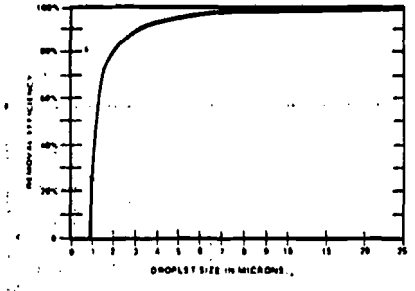


Figure 2.

Normally, a 4" thickness of mesh pad is sufficient for units of 9 to 12 pounds per cubic foot density. A 6" thickness is normally used for 6 pound per cubic foot material. For the few special cases where droplet sizes are near the lower limits of separation efficiency or where entrainment loading is very light, increased thickness of mesh pad will be desirable. It must be remembered that efficiency is not proportional to thickness. Increased thickness of mesh causes the efficiency curve to asymptotically approach 100% and increased thickness may only cause higher pressure drop and higher initial cost without much compensating benefit. Except for unusual cases, 12" would be considered a maximum thickness for mesh mist eliminators. KOCH can furnish any thickness required as one layer or as stacked layers.

Allowable Velocity

Like most types of separation equipment, KOCH mist eliminators work best within their proper velocity limits. Unlike most other types of separation equipment, these operating limits are quite wide. Acceptable separation efficiency can be obtained over the range of 20% to 110% of calculated maximum allowable velocities if liquid droplets are 25 microns and larger in diameter. Where significant amounts of small (less than 10 microns) droplets are involved, higher operating velocities will result in better separation efficiency because of the greater kinetic energy of the droplets.

The relationship of operating velocity, droplet size, liquid and vapor density, liquid viscosity and surface tension, and liquid loading is complex. Of these, the liquid and vapor density have the greatest influence on design velocity. Liquid loading and liquid surface tension also affect design velocity, but for most cases this affect is relativaly minor and can be handled by using a slight safety factor in the design velocity. The Souders-Brown correlation may be used for determining the allowable vapor velocity for wire mesh mist eliminetors.

This mey be most conviniently represented by a form of the Stoke's law equation using a "K" value specific for the type of mesh being used. This equation is:

$$U_{MAX} = K\sqrt{\frac{\rho_L - \rho_V}{\rho_V}} \qquad \text{EQ. 1}$$

The value of "K" that is normally used is 0.35 for mesh densities from 9#/ft.^{3} to 12#/ft.^{3}. A value of 0.4 is normally used for the 5#/ft.^{3} high capacity mesh styles and a "K" of 0.3 is normally used for plastic mesh pads such as Teflon and Polypropylene.

Where liquid viscosity or entrainment loading are high or liquid surface tension is quite low, or the liquid is dirty, a reduced value of "K" must be used.

The curve shown in Figure 3 is for standard mist eliminators and also shows the flooding velocity correlation of Sherwood, Shipley and Holloway for dumped rings for comparison. The suggested design velocity curve allows for normal variations in liquid loading and surface tension etc. The formula of Equation 1 calculates allowable velocity in terms of vapor loading alone, while the correlation in Figure 3 shows that both vapor and liquid loading affect capacity of the mesh pad. Where applications are encountered which deviate widely from normal for any of the variables discussed above, we suggest that KOCH engineers be consulted for additional information and help.

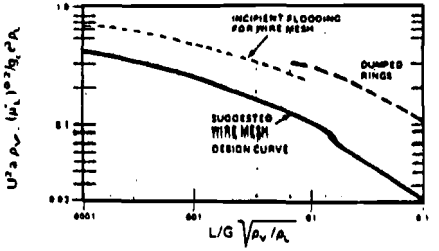


Figure 3. Effect of liquid entrainment load on allowable gas velocity.

Pressure Drop

Pressure drop across wire mesh pads is usually low, normally less then one inch of water, and can be considered negligible for most applications. The benefit of this low pressure drop is quite significant in applications such as vacuum distillation or where large volumes of air must be moved by fan or blower. In terms of power required, each inch of water pressure drop requires 0.158 HP/1000 CFM.

The pressure drop of a wire mesh pad is affected by both vapor and liquid flow rates. Gas flow through dry mesh is predominantly turbulent and the slope of the pressure drop curve is about 1.8. With mesh as with packed towers, pressure drop increases with increased liquid entrainment rates since a greater portion of the void volume is filled with liquid and less volume is available for vapor flow. As a result, the points of incipient flooding (F) and reentrainment (R) occur at lower velocities as liquid entrainment increases.

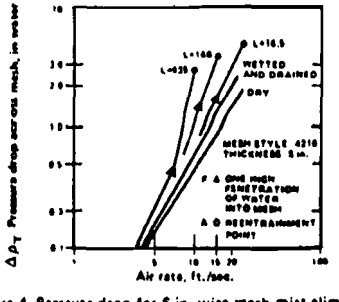


Figure 4. Pressure drop for 6-in. wire mesh mist eliminator, mesh style 4210 at various conditions of liquid loading.

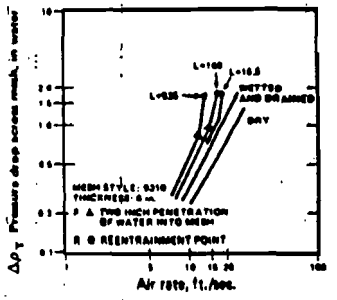


Figure 5. Pressure drop for 6-in. wire mesh mist eliminators; mesh style 9310 at various conditions of liquid loading.

At very low liquid loadings (less than 10 lb./hr./sq. ft.) collected liquid forms individual drops on the wires which fall off as the pull of gravity overcomes the combined forces of surface tension and rising gas flow. At higher liquid loads, liquid forms a clearly defined layer in the lower portion of the mesh pad.

At liquid loadings greater than 100 lbs./hr./sq. ft., increased vapor velocity causes three typical conditions of operation to occur. These are:

(A) Liquid entering the mesh collects in a 1" to 2" deep layer at the bottom of the mesh pad. The depth of this layer does not change to any extent until point F (Figure 4 and 5) is reached.

(B) At vapor flow rates higher than represented by point F, bubbling liquid rises higher and higher into the mist eliminator with each increase in gas rate. A significant portion of the mesh void volume is now occupied by liquid and pressure drop rises more sharply and will fluctuate slightly.

(C) At still higher vapor rates, pressure drop fluctuations increase and the top of the liquid level reaches the top of the mesh pad and reentrainment occurs (point R) at the top of the mesh.

Because it is difficult to determine Point F in most practical applications of wire mesh pads, the "K" values recommended for use in Equation 1 include a sufficient safety factor to insure that operation of the pad is in the region below Point F where efficiant separation of entrained liquid can be reliably obtained.

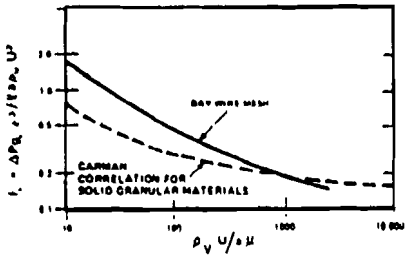


Figure 6. Friction factor, f_c, versus Reynolds number, Re, for wire mesh entrainment separator without entrainment load.

Figure 6 above shows the Carman correlation for pressure drop through solid granular materials. The curve for air flowing through a 6" thick dry mesh pad is also shown.

The pressure drop through a dry wire mesh pad may be calculated by the formula:

$$\Delta P_D = f_c \, t \, a \, \rho_v \, U^2 / g_c \, \epsilon^3 \times \frac{27.7}{144} \qquad \text{EQ. 2}$$

Since the total pressure drop across an operating wire mesh mist eliminator is the sum of the dry pressure drop calculated using Equation 2 plus the additional drop caused by the liquid loading within the mesh, total pressure drop can be determined by the expression:

$$\Delta P_T = \Delta P_D + \Delta P_L \qquad \text{EQ. 3}$$

Curves for pressure drop at various liquid loading rates are shown for KOCH Style 4210 and 9310 mesh in Figure 7 and Figure 8. These curves show the wet pressure drop to which must be added the dry pressure drop calculated from equation 2. The values shown are for water. More viscous liquids would have a higher pressure drop at the same liquid and vapor loadings.

In almost all cases the pressure drop of a normally operating wire mesh pad will be about 1" of water or less which is negligible for all but very low pressure applications. A rough approximation of operating pressure drop may be found by knowing that pressure drop at the calculated maximum allowable velocity is usually 1.5" of water and pressure drop varies with the square of gas velocity. Thus the formula:

$$\Delta P_T = 1.5 \left(\frac{U_{ACT}}{U_{MAX}} \right)^2 \qquad \text{EQ.4}$$

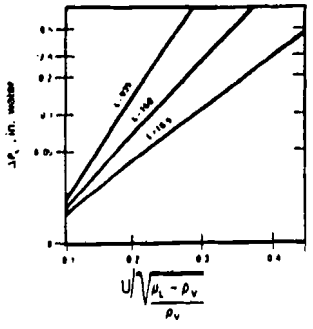


Figure 7. Pressure drop correction for entrainment load for style 4210 wire mesh.

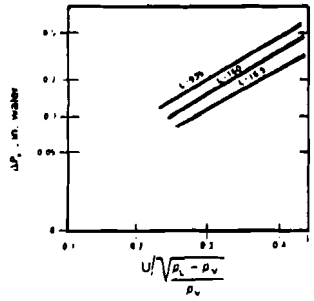


Figure 8. Pressure drop correction for entrainment load for style 9310 wire mesh.

Efficiency

There are four major factors which determine the separation efficiency of a wire mesh separator. These are droplet size of the entrainment, diameter of the wire in the mist eliminator, number of targets in the path of the liquid droplet and vapor velocity.

Small droplets are more difficult to remove than large ones because of the greater mass of the large drops and thus large drops tend to travel in straight lines until they contact a target wire. There is a relationship between the size of the liquid droplet and the size of the target which can be most effective in catching it. Studies have determined that smaller diameter wires will be more efficient in the removal of small liquid droplets. Mesh Pads are available which use finer than normal wire for separation of mist droplets. KOCH style #3260 is an example of this type unit.

The thicker the mesh pad and the more layers of mesh which are used, the more targets which will be in the path of the liquid droplet and the higher the percentage of liquid drops which will be removed from the gas stream.

Because a mesh pad consists of stationary targets, it depends upon the velocity of the vapor stream to provide the inertial force required to insure a collision between the liquid droplet and the wire target. At very low vapor velocities, small droplets tend to drift through the mesh avoiding the targets. Normally the velocity range at which efficient separation is accomplished is very wide, usually 20% to 110% of calculated maximum allowable velocity. With small droplets, less than 10 microns, the velocity range for effective separation narrows and will be 50% to 110% of calculated maximum allowable velocity.

In most industrial applications, droplet size is not known and measurement may be impossible or impractical. Therefore, droplet size must usually be estimated based upon the type of mechanism which generates the entrainment. The following broad generalizations may be used:

Spray – (Twenty microns and up.) Entrainment from low energy input contact devices such as distillation columns, low pressure spray nozzles, evaporators etc.

Mist – (Three micron to twenty micron) Lube oil from compressors, high energy spray nozzles.

Fog – (Three micron and less) Chemical reactions, condensation from saturated gas streams.

A properly designed KOCH mist eliminator is able to achieve separation efficiencies of better than 99.9% over a wide range of operating conditions. The table below indicates the relative performance of various styles of KOCH mesh pads. These values were obtained from air/water testing at atmospheric conditions. Residual entrainment is in parts of liquid per million parts of air by weight.

FLEXIMESH STYLE	THICKNESS OF MESH PAD	RESIDUAL ENTRAINMENT LEAVING PAD
3260	4"	0.35
4210	4"	0.88
4310	4"	1.10
9310	4"	4.20
9310	6"	1.70
9310	12"	0.38

Test results show relative performance of various mesh styles at the same pad thickness and the increase in separation efficiency obtained with greater mesh pad thickness.

In most industrial applications, residual entrainment of from 1 to 4 parts per million is acceptable and this level of performance is easily obtained with 4" or 6" thicknesses of one of the standard KOCH meshes.

Installation

In smaller equipment where full diameter access flanges can be economically used, a one-piece pad will provide the most convenient, low cost method of installation. These units are available in diameters as large as 7 to 8 feet diameter, but are usually limited to 36" to 42" diameter in most applications. Mesh is normally 4" to 6" thick.

In larger equipment, or where a one-piece pad is not possible, sectional pads are used. This type of construction is not limited as to size or shape. Units of up to forty feet diameter have been produced as well as those of unusual shape. Mesh pad thickness is usually 4" or 6", but in some special circumstances could be as much as 24" or greater.

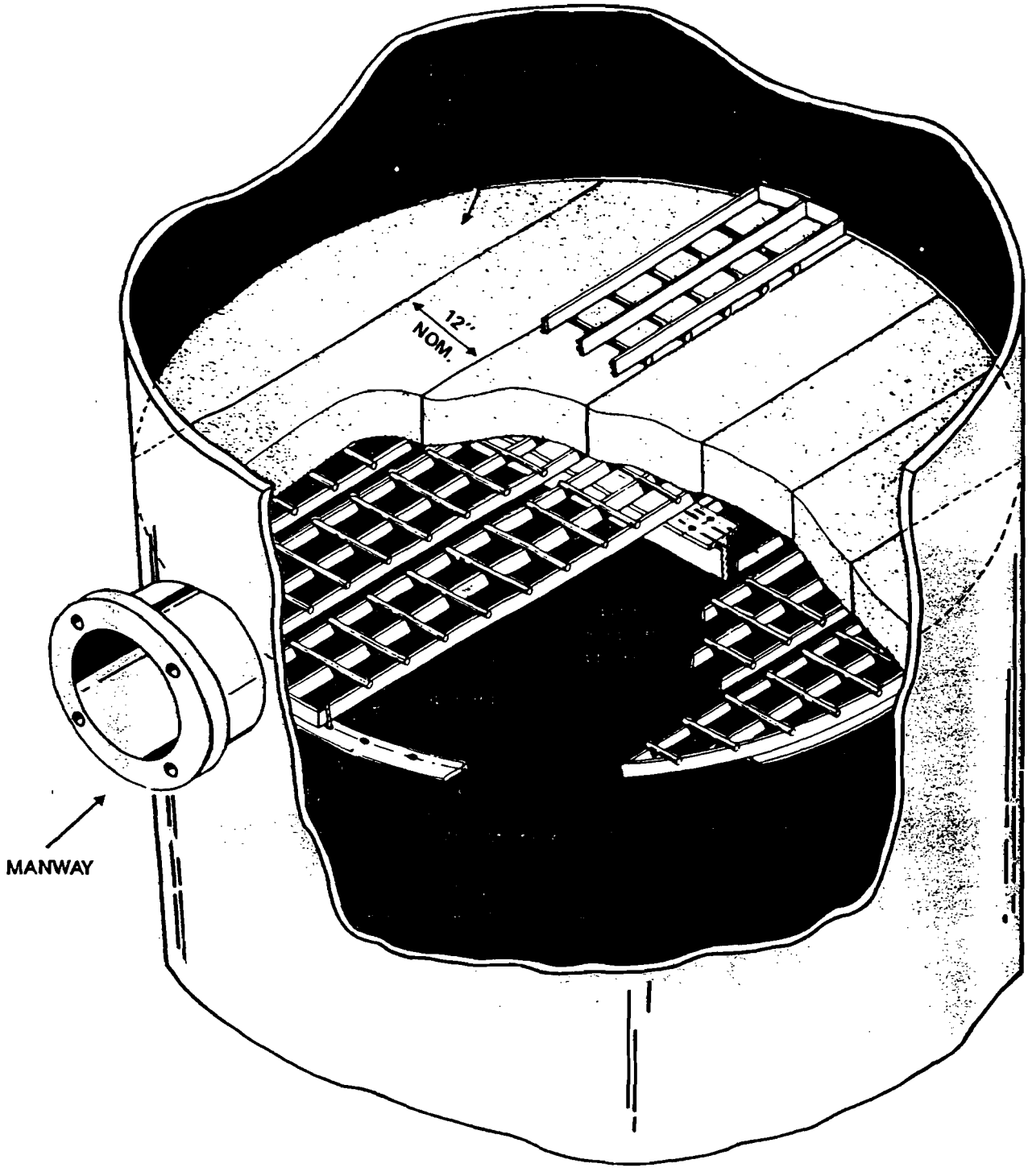
In order to obtain maximum capacity and performance, KOCH mist eliminators should be supported by a grid having a high percentage of open area. Special grids have been developed for this purpose. Subway grating or other similar supports are not recommended as they obstruct liquid drainage and can result in liquid carryover and inefficient operation.

In the event that subway grating or similar supports are used, the gas velocity through the open portion of the grating must not exceed the maximum allowable velocity as calculated using EQ 1.

Wire mesh sections are securely fastened to individual grid sections. Mesh and grid are cut to size and curvature to properly fit inside the vessel. Mesh is resilient and is cut slightly oversize so that it will fit tightly in the vessel. It is not necessary to tie adjacent sections of the mesh pad together.

Where vapor surges are encountered or in pulsating service, the use of rigid sandwich construction with top and bottom grids secured together by vertical tie rods running through the mesh pad is strongly recommended.

Detailed drawings are available upon request which show typical mesh installations in a wide variety of equipment.



Typical FLEXIMESH Mist Eliminator Installation

KOCH

KOCH ENGINEERING COMPANY INC
/MET
rmerly Diversified Metal Products, Inc.]
1275 BLOOMFIELD AVENUE ▪ FAIRFIELD, NJ 07004 ▪ 201/226-4100 ▪ FAX 201/227-8548

KOCH

KOCH ENGINEERING COMPANY INC

FLEXIMESH® MIST ELIMINATORS SECTIONAL TYPE

GENERAL INFORMATION

Mesh pads are constructed slightly oversize to provide a compression fit between sections and the vessel wall to prevent leakage past the mesh. No gaps should be present in a properly installed pad. Support grids, if furnished, are not as wide as the mesh sections and have a nominal 3/4" clearance from the vessel wall.

INSTALLATION INSTRUCTIONS

1. Remove any projections or obstructions which would prevent proper installation or good fit between mesh and vessel wall.
2. Mesh should be 1 to 1.5 percent larger than vessel diameter for 7.5 pound through 12 pound density mesh and 2 to 3 percent larger for 5 pound through 7 pound density mesh to insure proper seal between sections and around outside of pad.
3. All mesh sections will be tagged for ease of installation. Place sections in vessel starting from outside and working toward center. Compress each section slightly as it is installed so it is close to its final location. Do not permanently secure mesh until all sections are in place. The final two sections can usually be installed by tilting mesh as shown below and pressing into place.
4. Secure mesh to annular ring and beams with tie wire furnished. Alternate methods use clamps, "J" bolts, hold-down beams, etc.

OPERATING INSTRUCTIONS

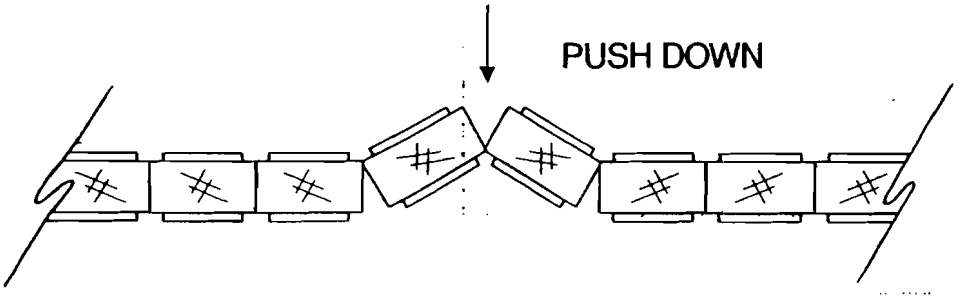
If the mesh pad has been properly sized, the operating pressure drop will be less than 1.5" of water. Higher pressure drops indicate the unit has been improperly sized or it is plugged by solids.

Soluble solids may be washed from the pad using sprays, hoses, etc., or the pad may be removed for cleaning.

If cleaning in solvent is unsuccessful, the pad must be replaced. Consult our Engineering Department for assistance and recommendations.

SPARE PARTS

None required.



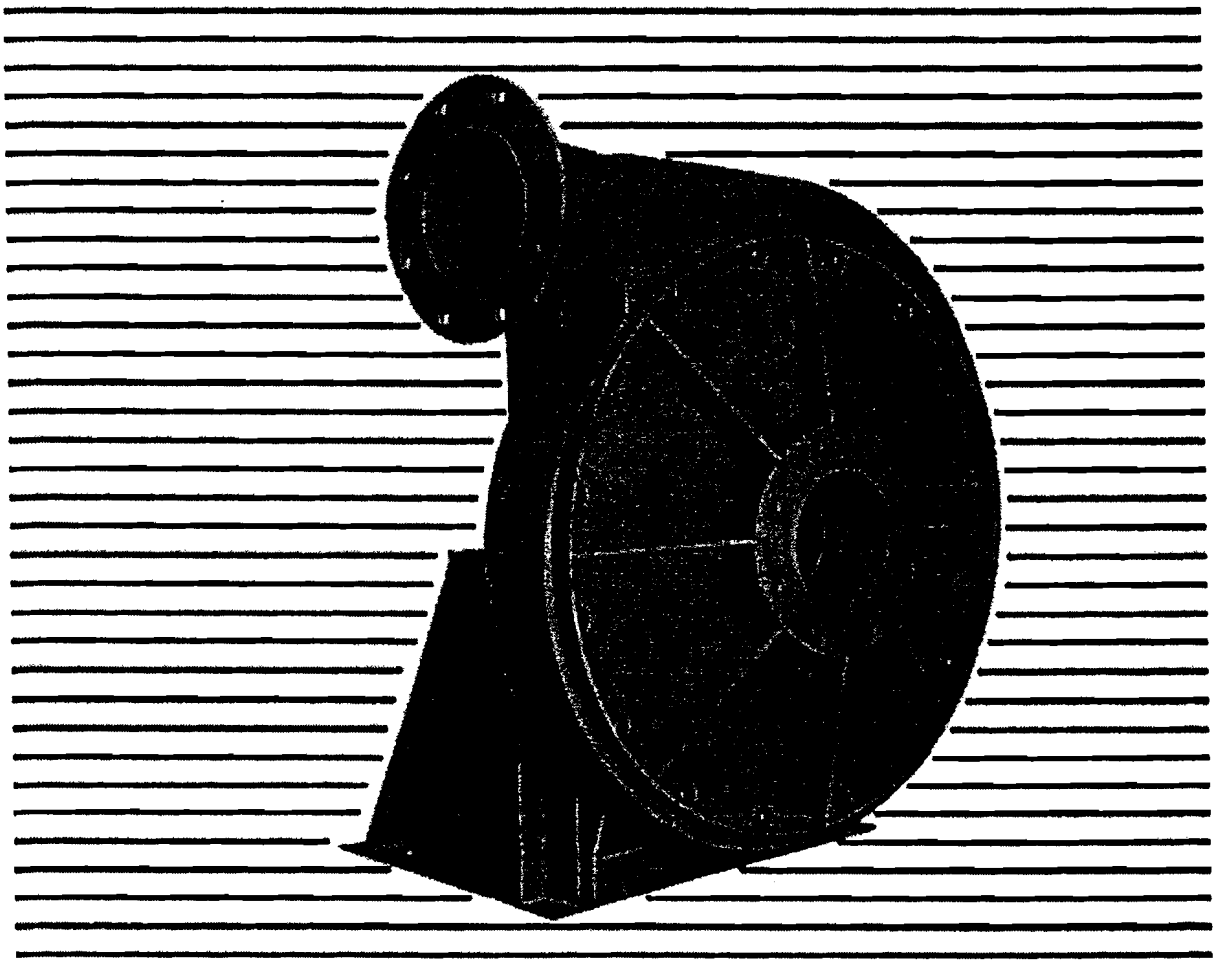
1275 Bloomfield Avenue • Fairfield, New Jersey 07004
201/226-400 • FAX 201/227-8548
MESH MIST ELIMINATORS • KNITTED WIRE MESH PRODUCTS
Plant Locations: Fairfield, New Jersey • Houston, Texas
Calgary, Alberta, Canada • Bergamo, Italy

Section II
Air Blower

Blower Bulletin

Series 6400
Centrifugal RB Pressure Blowers

Designs 6410, 6420, 6430, 6440 & 6450

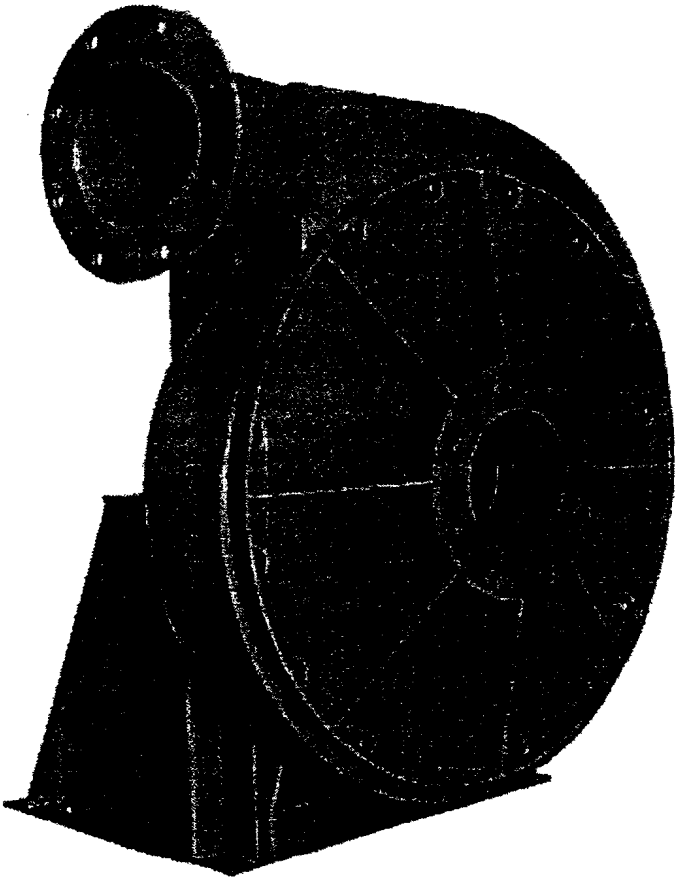


NORTHERN BLOWER®

Flanged Inlet and Outlet
Round punched flanges to facilitate the bolting of duct connections. Inlets and outlets are the same size, and match ANSI 125/250 # drilling.

Radial Blade
Superior combination of efficient operation and rugged, dependable service.

Bearings
Heavy duty ball or split pillow-block spherical roller bearings sized for a generous B-10 life.



Shaft
Turned ground and polished or fully machined to close tolerance.

Shaft Seal
Used to reduce leakage through the shaft hole in the housing.

Heavy Duty
Structural Bearing Pedestal

Housing
Rugged heavy gauge all welded steel housing with substantial framing sections for maximum rigidity. Standard features include flanged inlet, flanged outlet, shaft seal, gasketted inlet and gasketted housing split (where applicable).

Balancing
Wheel and shaft assemblies are dynamically balanced to ANSI S2.19-1989 specifications and are either interference fit or have taper-lock bushings on all models.

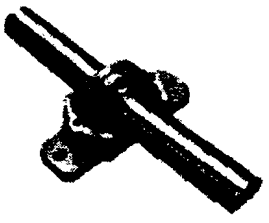
Shafts and Bearings

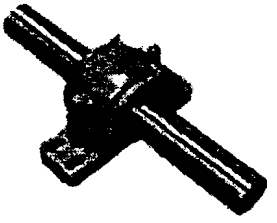
Shafts

Selected to have suitable strength and operate well below the first critical speed for each maximum class condition.

Bearings

Anti-friction, grease lubricated, roller type split housing, manufactured to internationally adopted standards by companies having worldwide acceptance and support services. Bearings are selected for continuous operation with a generous bearing life.





Capacities and Pressures

Catalogued up to 50,000 CFM. Available to 100,000 CFM.
Catalogued up to 70" WG. Available to 145" WG.

Temperatures

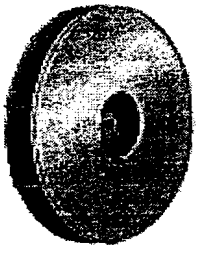
High Temperature Operating Limits		
Arrangement	Without Cooling Wheel	With Cooling Wheel
1 & 8 SISW	300°F	800°F
4 SISW	150°F	—
9F SISW	300°F	650°F

Arrangements

Arrangement	Design	Fan Size Range
A/1, 8 & 9 - SISW	All Designs	25 - 75
A/4 - SISW	Designs 6410 & 6420	25 - 50
A/4 - SISW	Design 6430	25 - 55
A/4 - SISW	Design 6440	25 - 60
A/4 - SISW	Design 6450	25 - 65

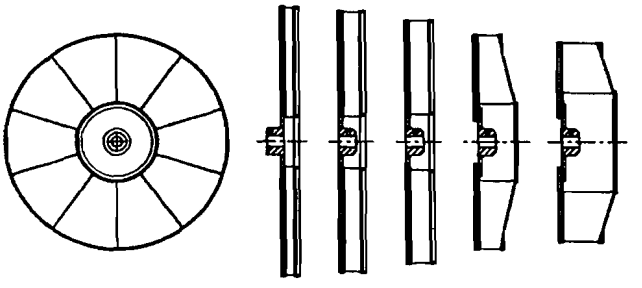
Series 6400
RB Pressure Blower Wheel

The Northern Blower Radial Blade (RB) Pressure Blower wheel is designed to generate high pressure in a single-stage blower. Blades are formed from heavy gauge high strength low alloy steel, stainless steel or other special metal construction.



The fans are offered in a family of wheel designs with overlapping performance ranges. The wheels progress from large diameters with narrow blades to small diameters with wide blades, so that a perfectly sized fan can be supplied for the job. The impellers are available from 85 to 100% of nominal diameter in a fixed width housing.

Performance for these diameters is determined using Northern Blower's **FanFinder™** computer program.



Standard Fan Features

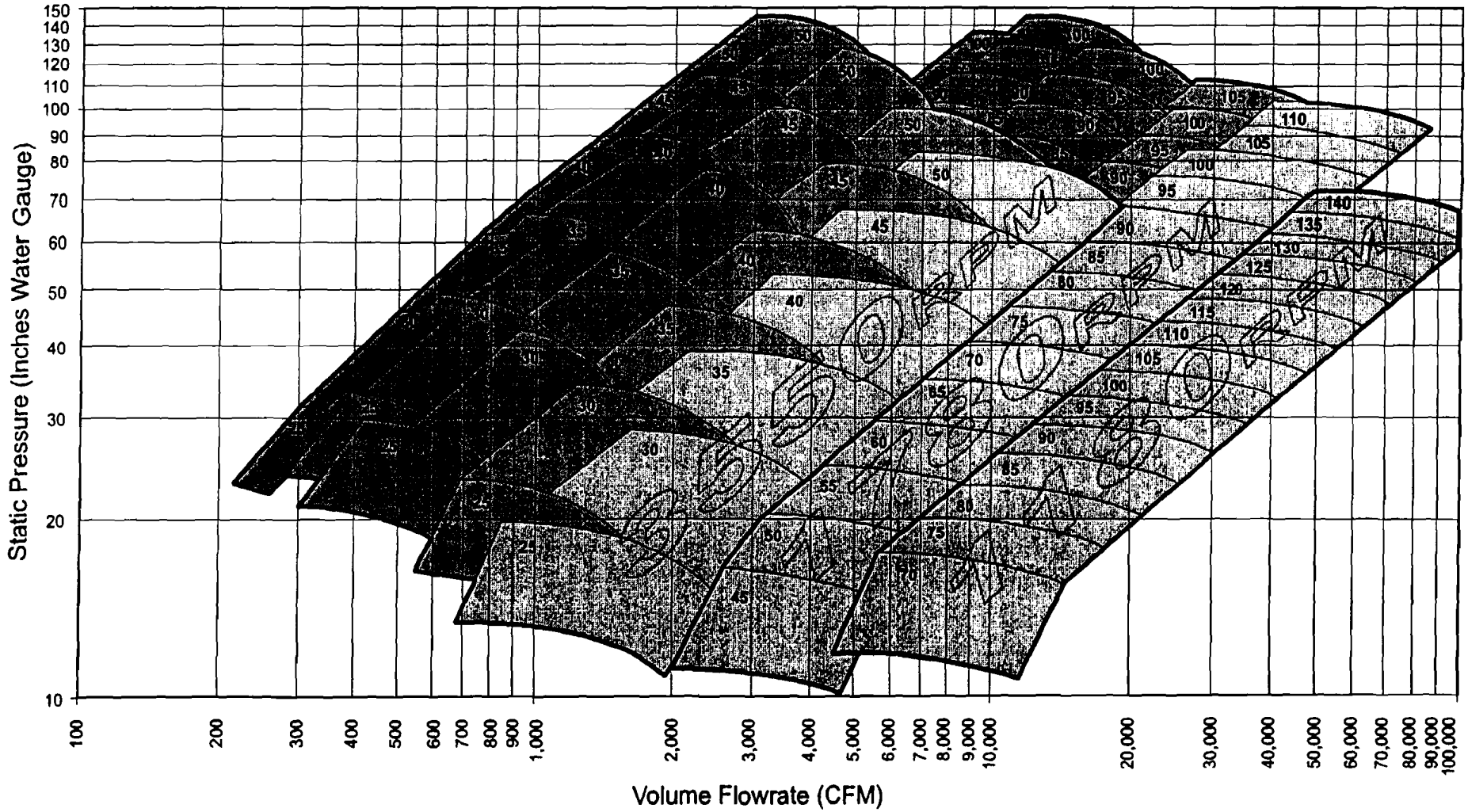
- Heavy Duty Ball or Split Pillow Block Spherical Roller Bearings
- Integral Bearing Pedestal
- Shaft Seal
- Hinged, flush mounted access door
- Punched, flanged inlet and outlet to match ANSI 125/250# drilling
- Continuous welded housing
  - 3/16" thick for sizes 25 to 35
  - 1/4" thick for sizes 40 to 70
  - 3/8" thick for sizes 75 and larger

NORTHERN BLOWER®
CML Northern Blower Inc.
901 Regent Avenue West
Winnipeg, MB, Canada R2C 2Z8
204.222.4216 204.222.7601
www.northernblower.com

Performance Range

Standard Conditions

Design 6410 6420 6430 6440 6450



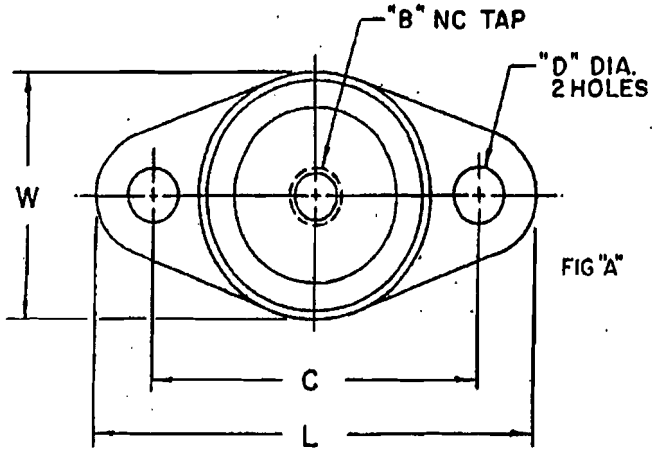


FIG "A"

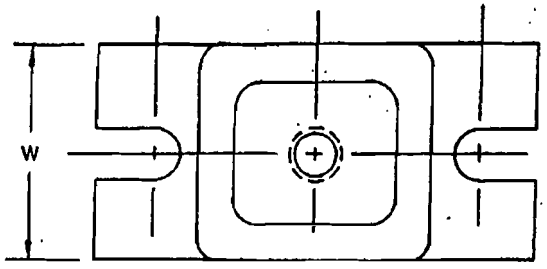
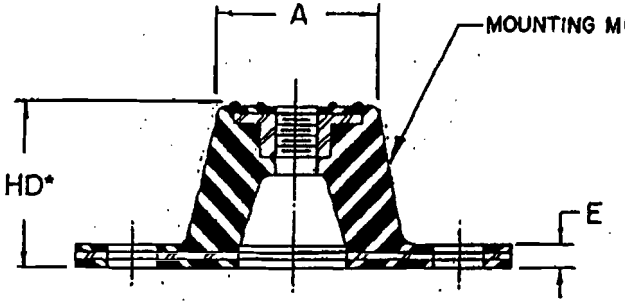


FIG "B"



TYPE		MAX LOAD EACH LBS	DEFLECTION IN INCHES		APPR SHPG WT LBS	DIMENSIONS IN INCHES									FIG
				RD		L	W		*HD	A	B	C	D	E	
RD-1	BLUE	35		0.40	1/4	3 1/8	1 3/4		1 1/4	1 1/4	5/16	2 3/8	11/32	3/16	A
	BLACK	45													
	RED	70													
	GREEN	120													
RD-2	BLACK	170		0.50	1/2	3 7/8	2 3/8		1 3/4	1 3/4	3/8	3	11/32	7/32	A
	RED	240													
	GREEN	380													
	GRAY	550													
RD-3	BLACK	250		0.50	1	5 1/2	3 3/8		2 7/8	2 1/2	1/2	4 1/8	9/16	1/4	A
	RED	525													
	GREEN	750													
	GRAY	1100													
RD-4	BLACK	1500		0.50	3	6 1/4	4 5/8		2 3/4	3	1/2	5	9/16	3/8	B
	RED	2250													
	GREEN	3000													
	GRAY	4000													

* HD DIMENSION APPLIES TO DOUBLE DEFLECTION TYPE RD MOUNTINGS ONLY. (UNDEFLECTED HEIGHT)

CUSTOMER: _____ P.O. NO.: _____

JOB: _____

NO.	ALTERATION	DATE
1	REVISED	5-5-92

DWN BY: DATE:
CHK BY: DATE:
SCALE:

SERIES RD
NEOPRENE MOUNTINGS

VIBRATION MOUNTINGS & CONTROLS
AN A R X COMPANY

BLOOMINGDALE, N.J.
07403

SIZE	DWG NO.	REV
B	VMB-7076	

FSCM NO. 07841

MASTER FORM

Blower Data Sheets, Drawing and Lubrication Instructions

NORTHERN BLOWER®

CML Northern Blower Inc.
901 Regent Ave. West
Winnipeg, Manitoba, Canada, R2C 2Z8

Telephone: (204) 222-4216, FAX: (204) 222-7601
Web Site: http://www.northernblower.com
Email: cml@northernblower.com

ISTOMER Layne Christensen Co.Inc.
97 Chimney Rock Rd.
Bridgewater NJ 08807

RECEIVED
APR 19 2004

SALES OFFICE J.A. Lockwood Co., Inc.

DATE Apr 8, 2004

PLEASE REFER TO THIS NUMBER IN ALL CORRESPONDENCE

SHOP ORDER & SERIAL NUMBER **A51871**

ROJECT Great Neck L.I.
JSTOMER PO 11942-701458

We are sending the following documentation - CERTIFIED FOR CONSTRUCTION

COPIES	FAN DRAWING(S)	ACCESSORY DRAWING(S)	REMARKS
	A51871-01	-	Drawing & Fan Data Sheet
	-	-	Lube
	-	-	Curves
	-	-	Sound
	-	-	O & M

If you have questions regarding this transmittal, please contact your local representative or Northern Blower inside sales.

Best Regards,
CML Northern Blower

NORTHERN BLOWER®
C.M.L. Northern Blower Inc.
901 Regent Avenue West
Winnipeg, Manitoba, Canada
R2C-2Z8
Telephone (204) 222-4216
Fax (204) 222-7601

CUSTOMER
LAYNE CHRISTENSEN CO.INC.
97 CHIMNEY ROCK RD.
BRIDGEWATER NJ 08807

FAN DATA SHEET
S.O. No. **A51871 - 1 of 1**
CUST. PURCHASE ORDER NO. 11942-701458
DISTRICT ORDER NO. Layne
SOLD BY 39 J.A. Lockwood Co., Inc./NB

TAG: B-310
PROJECT: Great Neck L.I.
Qty 1 Design 6440 High Pressure Radial fan, Size 40, 100% SISW, Arr.8, Rot. CCW., Disch. DB.

Conditions	Volume	SP	OV	RPM	Power	Temp	Altitude	Density
Operating	5000 CFM	49.000 in	6140 ft/min	3500	61.38 BHP	70F	0 ft	.0746 lb/cu.ft
Maximum				**3600		70F		

FEATURES
- Punched flanged inlet
- Punched flanged outlet
- Access door, hinged, quick release, position : 3 o'clock
- Housing drain with plug, 1.5 in. NPT dia.
- Coupling guard
- Coupling mount Full
- Shaft seal
- Shaft and bearing guard w/access to bearing zerks

Wheel size 40-2663
Outlet transition to 10.875" x13.125"
- Outlet damper, manual
- Wheel to shaft interference fit
- Bearings: P2B-GTM-115 x 1-15/16

PAINT SPECIFICATION
Paint Specification : Interior and Exterior Surfaces
Surface Prep : # 6 Commercial Sandblast
Primer : 1 coat Intergard Epoxy Primer
Interm : 1 coat Intergard 740 Epoxy
Finish : 1 coat Intergard 740 Epoxy Finish
Total : 4.5 mils dft
Fan Color : ASA-70 Grey
Guard Color : Safety Yellow

MOTOR DATA
- Motor supplied by : NB. Motor mounted by : NB

75 HP, 3600 RPM, 3/60/460, Motor Frame 365TS
TEFC, Premium Efficiency, Baldor Super E motor.
Conduit Box Position F1

DRIVE DATA
- Coupling supplied by : NB. Coupling mounted by : NB

Falk Steelflex 1050T10.
Fan end Bore: 1.6875 / 1.6885
Motor end Bore: 1.8750 / 1.8760

MISCELLANEOUS DATA
- Fan Weight: c/w Motor = 2,700 lbs

NORTHERN BLOWER

FAN SERIAL NO. : A51871-1

DRAWN : 4/6/2004 Neal Boyd

SALES OFFICE : CML Northern Blower Inc.

CUSTOMER : Layne Christensen Co. Inc. P.O. No. : 11942-701458

PROJECT : Great Neck, LI

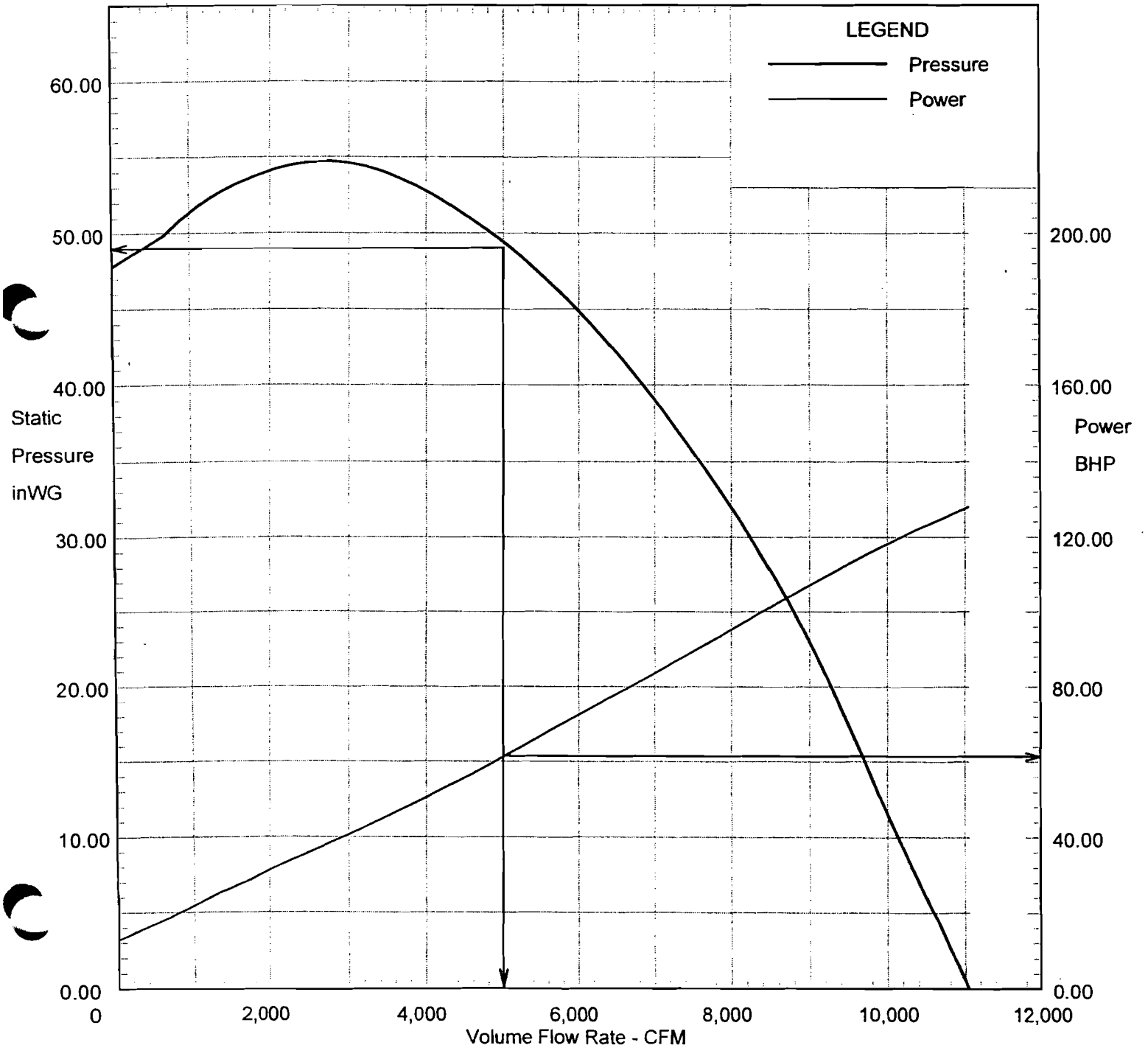
ENGINEER : Arcadis

TAG : B-310

FAN - DESCRIPTION : Design No. 6440 Size 40- 2663 SISW Centrifugal

SELECTION : 5,000 CFM, 49.000 inWG SP, 61.38 BHP

CONDITIONS : Operating: 0.0746 lb/cu.ft, 70.0 F, 3500 RPM [6440_404Min_16146A1]



NORTHERN BLOWER®

Sound Performance

Fan Serial No. : A51871-1
Date : April 6, 2004

CML Northern Blower Inc.
901 Regent Avenue W., Winnipeg, Manitoba, R2C 2Z8, Telephone: 204 222-4216 Telefax: 204 222-7601

CUSTOMER : Layne Christensen Co. Inc. P.O. NO. 11942-701458

TAG : B-310

PROJECT Great Neck, LI

SUBMITTED BY Neal Boyd ENGINEER Arcadis

Design	6440		Inlet Pressure	2.0	
Width	SISW		Temperature	70.0	
Percent Width	100	%	Fan Speed	3500	RPM
Volume Flow Rate	5000		Altitude	0	
Pressure	49.000		Inlet Air Density	.075	
			Power	61.38	BHP
Nominal Fan Size	40	- 2663			
Wheel Diameter	26.63	in			
Duct Diameter	12.000	in			

Sound Data

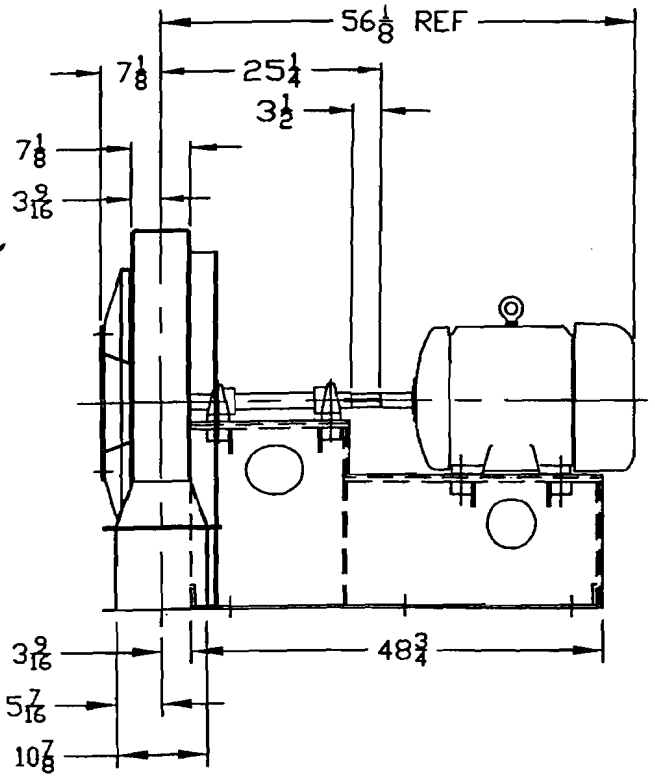
Octave Band

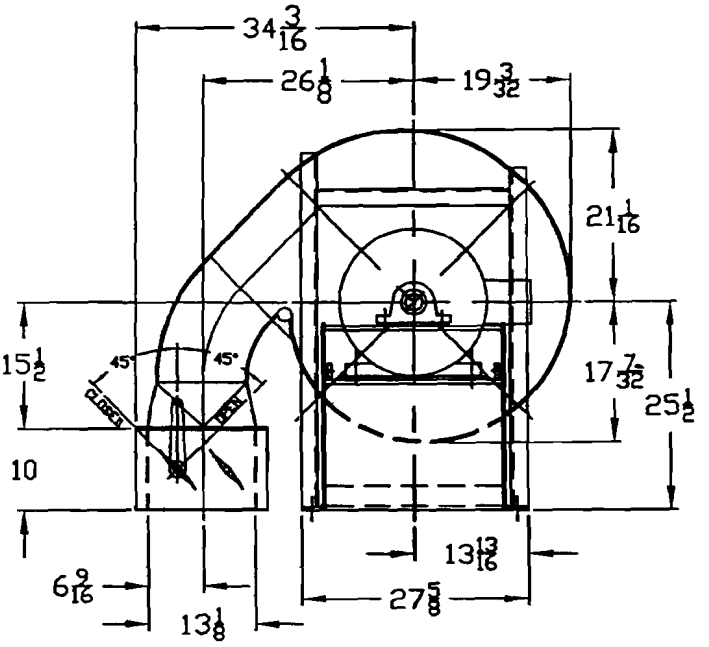
	1	2	3	4	5	6	7	8
Center Frequency	63	125	250	500	1000	2000	4000	8000
Power Level dB	94	97	99	93	93	86	79	75
Pressure Level dB re 20 µPa at 3.30 feet	86	89	91	85	85	78	71	67
Attenuator Correction	0	0	0	0	0	0	0	0
Pressure Level dBA	60	73	83	82	85	79	72	66
Total Log Sum dBA	89							

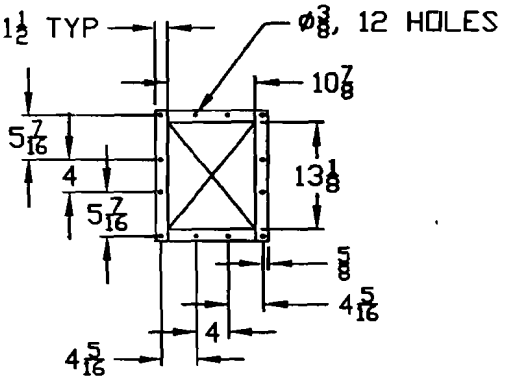
The Sound Power level ratings shown are in decibels, referred to 10 ^-12 watts.

Values shown for Sound Power levels are for :
- Installation Type D: Ducted inlet, Ducted outlet. Ratings do not include the effects of end reflection.

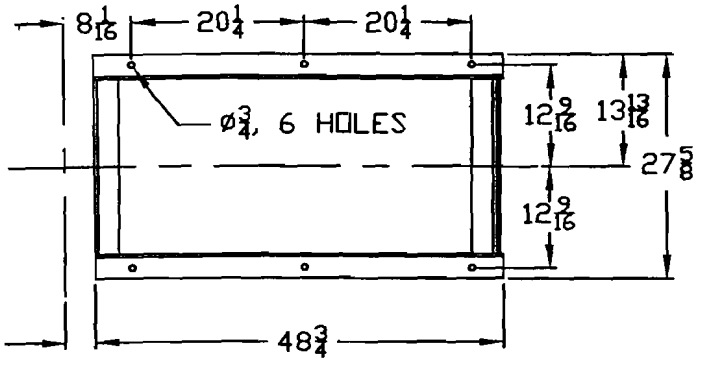
The sound level of fan equipment outside the laboratory may vary widely from those levels stated above.



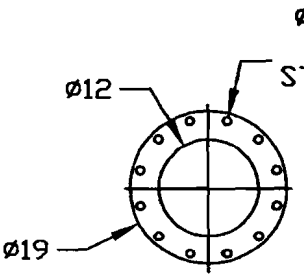




FLANGED OUTLET & DAMPER



FOUNDATION PLAN



FLANGED INLET

NOTES (ALSO REFER TO FAN DATA SHEET)	REVISION
. Hinged Quick Release Access Door (@ 3 o'clock), (8"x6-5/8" Opening)	

CUSTOMER: Layne Christenesen Co. Inc.	HIGH PRESSURE RADIAL FAN	Tolerance ± 1/8" Scale: 1 : 24
PROJECT: Great Neck L.I.	DESIGN: 6440 SIZE: 40-2663	
ARRANG: B-310	ARRG'T: 8, SISW 100% WIDTH	
	ROT.: CCW DISCH.: DB	

NORTHERN BLOWER
901 Regent Ave. West, Winnipeg, Manitoba, Canada, R2C 2Z8
Telephone: (204) 222-4216, Telefax: (204) 222-7601

CERTIFIED FOR CONSTRUCTION

By: KZ / AU Date: 08-Apr-04

S.O.#/DWG.#

A51871-01

NORTHERN BLOWER®

Lubrication Instructions
200 Series Ball Bearings

Procedure For Applying Lubricant To Bearings
Apply sufficient grease when lubricating to cause some purging of grease at the seals.

Lubricant
Use a multi-purpose bearing grease NLGI Grade 2, Lithium soap base with rust inhibitors and antioxidant additives. An oil viscosity of 100 cSt at 40°C is recommended. Grease for high speed applications should be dynamically stable and must not churn or ship. It is not good practice to mix grease with different oil bases as the results are unpredictable.

Several suitable products are: Shell Alvania #2, Exxon (Imperial Oil) Unirex N2, Texaco Premium RB, and Mobile Mobilux #2. For fans with vertical shafts, consider using an NLGI Grade 3 grease such as Shell Alvania 3 or Exxon Unirex N3. **Do not use long fibered greases.**

Consult CML Northern Blower on proper lubrication if bearings are subjected to temperatures below -10°C (15°F) or above 80°C (175°F).

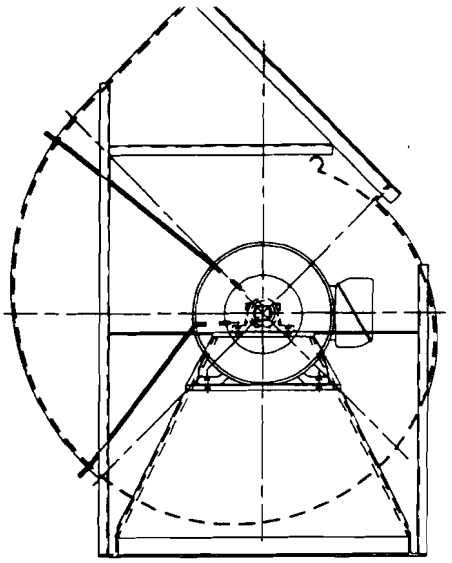
Lubrication Interval Table

RELUBRICATION INTERVAL IN MONTHS OF OPERATION								
SHAFT DIAMETER	SHAFT SPEED IN RPM							
	1000	1500	1800	2000	2500	3000	3500	4000
3/4	12	12	12	12	12	12	10	10
15/16	12	12	12	12	12	10	10	8
1-3/16	12	12	12	12	12	10	8	6
1-7/16	12	12	12	12	10	8	8	6
1-11/16	12	12	12	10	9	8	6	4
1-15/16	12	12	10	10	8	6	4	4
2-3/16	12	12	10	10	6	6	4	3
2-7/16	12	12	10	8	6	4	4	3
2-11/16	12	10	8	8	6	4	3	-
2-15/16	12	10	8	6	6	3	-	-

Notes:
1. Increase the frequency or lubrication in conditions of abnormal temperature, moisture, or dirt.
2. Bearings may run hot for a short time during the "run-in" period, or just after lubricating the bearings.

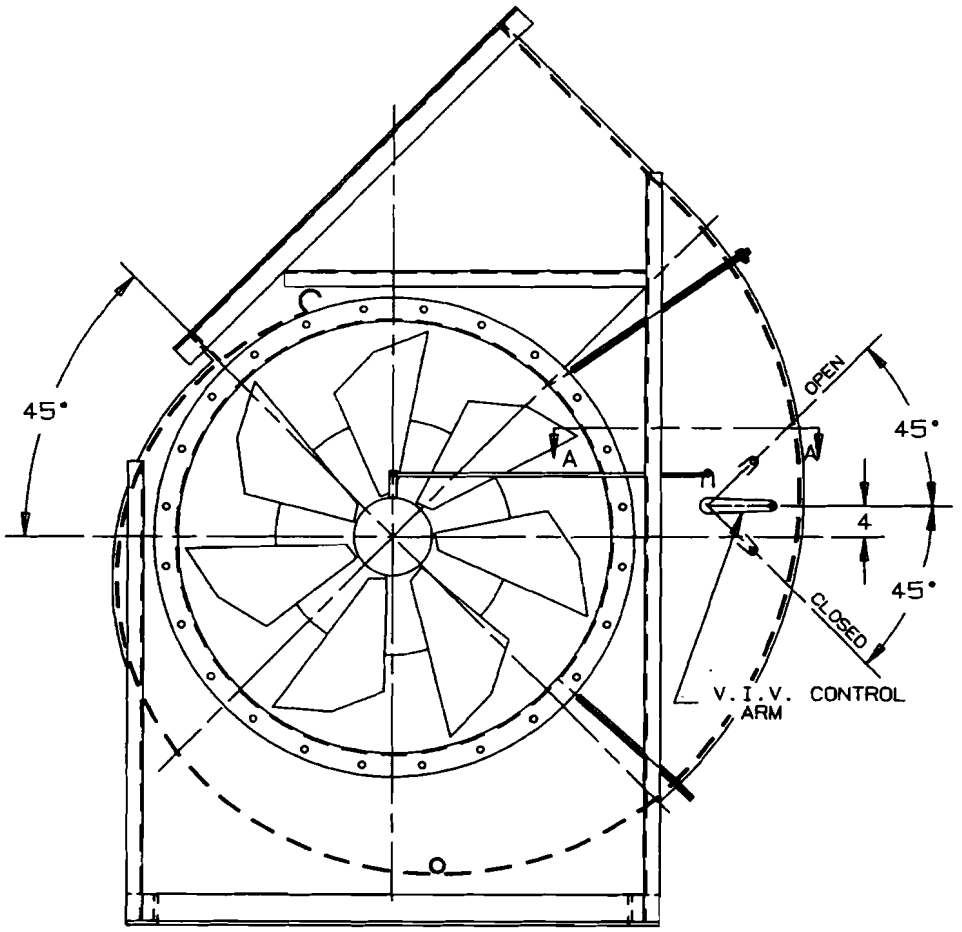
Storage
If the fan is to be idle and not operating for an extended period of time, bearings should be protected as recommended by the manufacturer. The bearings should be completely filled with grease and the fan shaft should be turned at frequent intervals to prevent corrosion and damage.

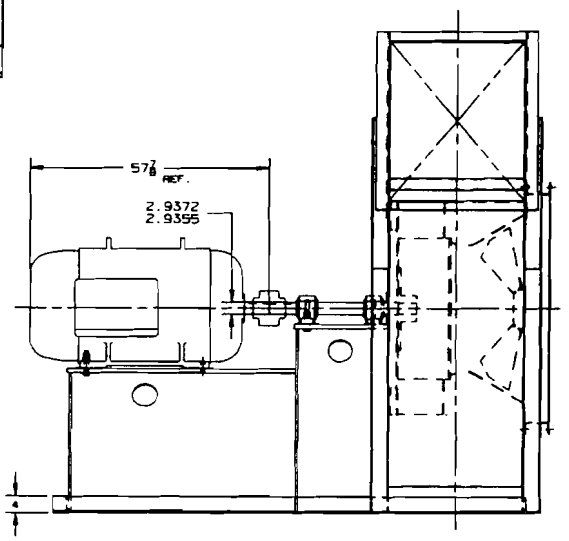
Fan Equipment Operation Manual



FAN EQUIPMENT OPERATION MANUAL

Fan Serial No. A51871





NORTHERN BLOWER

TABLE OF CONTENTS

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Telephone 204-222-4216

Telefacsimile 204-222-7601

901 Regent Avenue West

WINNIPEG, MANITOBA

CANADA

R2C 2Z8

1990

CML NORTHERN BLOWER INC.
STANDARD TERMS AND CONDITIONS and WARRANTY

STANDARD TERMS AND CONDITIONS

TERMS OF PAYMENT: Terms of payment are net thirty (30) days subject to the prior approval of the CML Northern Blower Inc. ("CML Northern") Credit Department. Notwithstanding such approval, if in CML Northern's judgement the customer's financial condition does not warrant the continuation of production or shipment on the original terms, CML Northern reserves the right to request payment in advance. Overdue accounts will bear interest at the prevailing bank rate charged to CML Northern.

ACCEPTANCE AND PRICES: Prices quoted for products manufactured by CML Northern are subject to acceptance by the purchaser no later than thirty (30) days from the date of the Quotation - Proposal.

Prices quoted for items which are not manufactured by CML Northern such as motors and drives, etc. are subject to change at any time the cost of such items charged to CML Northern changes.

Prices on orders for products manufactured by CML Northern are firm provided approval and release for production and shipment is received from the customer within ninety (90) days of the date of CML Northern's receipt of the customer's order and the products are shipped within twelve (12) months of the date of CML Northern's receipt of the customer's order. When such approval and release for production and shipment is received after ninety (90) days of the date of CML Northern's receipt of the customer's order or products are shipped after twelve (12) months of the date of CML Northern's receipt of the customer's order, such prices are subject to adjustment to CML Northern prices in effect on the date approval and release from customer is received by CML Northern or at time of shipment.

Orders for non-stock equipment released for production and scheduled by CML Northern cannot be rescheduled by the customer unless it is done at least eight (8) weeks before the CML Northern scheduled shipping date. If production is started the customer must accept delivery when the order is ready for shipment.

CANCELLATIONS: Accepted orders cancelled by the customer are subject to cancellation charges for all expenses incurred and commitments made by CML Northern. The cancellation charges on completed items will be one hundred (100%) percent of the selling price. The aforementioned cancellation charges shall not in any way whatsoever limit CML Northern's other remedies it may have at law including, without limiting the generality of the foregoing, the ability of CML Northern to claim and recover any amounts or damages to which CML Northern would otherwise be entitled by reason of accepted orders cancelled by the customer.

FREIGHT CLAIMS: Unless otherwise expressly agreed in writing, delivery of the product is made FOB CML Northern Plant. The liability and responsibility of CML Northern for the product ceases upon delivery of the product in good order to the carrier. **All claims for damage and shortage in transit are the customer's responsibility and the customer must file the claim against the carrier.** Claims for factory shortage will not be recognized unless such alleged shortage is reported to CML Northern in writing within ten (10) days after receipt of the product.

TAXES: The amount of any present or future taxes shall be added to the price contained herein and shall be paid by the customer in the same manner and with the same effect as if originally added thereto.

DELAYS: CML Northern shall not be liable to the customer or to any third party for any delays caused by riots, strikes, lockouts, weather, fire, floods, lack of transportation, accidents, the failure of CML Northern's suppliers to meet their contractual obligations, breakdowns, or any other contingency beyond CML Northern's reasonable control and receipt of the product by the customer shall constitute a waiver of all claims for loss or damage due to delay.

PRODUCT CHANGES: CML Northern reserves the right to change or modify the product in the interest of continuous product improvement without liability.

RETURNED GOODS: Goods may not be returned except by the written permission of the President, General Manager or General Sales Manager of CML Northern and when so returned will be subject to a handling charge and transportation costs.

MODIFICATION: These Standard Terms and Conditions may not be modified except by written agreement signed by the President, General Manager or General Sales Manager of CML Northern. **The failure of CML Northern to object to provisions contained in the customer's purchase orders or other communications shall not be deemed waiver of the Standard Terms and Conditions hereof or acceptance of such provisions.** No other terms and conditions other than the Standard Terms and Conditions contained herein and those terms and conditions with respect to the description of product, quantity and price contained in the "Quotation-Proposal" shall be binding upon CML Northern unless made in writing and signed by the President, General Manger or General Sales Manager of CML Northern. Without restricting the generality of the foregoing, agents and sales representatives of CML Northern do not have authority to modify these Standard Terms and Conditions.

WARRANTY

CML Northern Blower Inc. (the "Seller") warrants products of its manufacture (the "product", "equipment" or "fan") to be free of defects in material and workmanship if properly installed, and cared for, and operated under normal conditions, and with competent supervision, all in accordance with the Seller's Operation Manual. If any questions exist as to whether the proposed operation of the Seller's equipment is within "normal conditions" for such equipment, details of such proposed operation should be provided to the Seller at its Winnipeg factory. The Seller will review the proposed operation of the equipment (at a fee) and advise if the proposed operation is acceptable.

(1) The Seller's obligation under this warranty is limited to the repair or replacement, at its option at its Winnipeg factory, of any defective part or parts which shall within one (1) year after shipment thereof to the original purchaser (the "Purchaser"), be returned to its Winnipeg factory with transportation charges prepaid by the Purchaser and upon such repair or replacement the Seller shall have fulfilled all its obligations to the Purchaser. The Seller will not be liable, in any circumstances, for costs or expenses incurred by the Purchaser or any person claiming through the Purchaser in the removal or replacement of equipment alleged to be defective. Except as specifically provided herein, the Seller will not be liable, in any circumstances, for any loss or damage of whatever nature or kind (including, without limiting the generality of the foregoing, direct, indirect, incidental or consequential loss or damage or damage resulting from business interruption) should the equipment be so defective as to preclude the remedy of warranted defects by repair or replacement. In such event, the Purchaser's sole and exclusive remedy shall be the refund of the purchase price paid by the Purchaser for all the defective equipment.

(2) The Seller shall not be liable for the repair or replacement of any such defective part or parts, or for loss, damage, or any expense of repairs when any adjustment, alteration or repair shall have been made or attempted outside of its factory, except if such adjustment, alteration or repair outside its factory is made or attempted after the Seller's written consent is first obtained.

(3) The Seller shall not be liable for any corrosion or fouling caused by any foreign substance deposited in or on the equipment.

(4) Because the Seller is unaware of any forms of construction, materials, alloys or coatings which will successfully resist all abrasion, erosion, corrosion, or deterioration from excessive heat, the Seller's warranty does not apply when any of its products or equipment are subjected to conditions which cause such abrasion, erosion, corrosion or deterioration from excessive heat or any damages similar or related thereto.

(5) The performance of the Seller's fan equipment outside of the laboratory may vary widely and differ from the performance specifications contained in its sales literature. Therefore, the Seller cannot and does not guarantee or warrant the performance of its fan equipment at the Purchaser's location.

(6) ALL WARRANTIES OF THE SELLER, EXPRESS OR IMPLIED, WITH RESPECT TO MOTORS, SWITCHES, CONTROLS OR OTHER ACCESSORIES NOT MANUFACTURED BY THE SELLER, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.

(7) The Seller shall have no liability under the terms of this Warranty or otherwise where the Purchaser undertakes the responsibility of mounting the fan wheel directly to the motor or turbine shafts without the Seller having inspected and tested the assembled unit (at a fee) before the fan is operated in any fashion. If the Seller does not inspect and test the assembled unit within ten (10) days of being requested to do so by the Purchaser and receipt of payment of the aforementioned fee, the Seller shall be deemed to have waived its requirement to inspect and test the assembled unit.

(8) The Seller shall have no liability under the terms of this warranty or otherwise until the Purchaser has made full payment to the Seller for the product or equipment to which this warranty is to apply.

(9) NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE MADE BY THE SELLER EXCEPT AS EXPRESSLY PROVIDED HEREIN.

(10) The terms of this warranty may not be modified except by written agreement signed by the President, General Manager or General Sales Manager of the Seller. The Seller's failure to object to provisions contained in the Purchaser's purchase orders or other communications shall not be deemed waiver of the terms and conditions hereof nor acceptance of such provisions. No representations or warranties other than those contained herein shall be binding upon the Seller unless made in writing and signed by the President, General Manager or General Sales Manager of the Seller. Without restricting the generality of the foregoing, agents and sales representatives of the Seller do not have authority to modify the the terms of this Warranty or make representations or warranties other than those contained herein.

CML NORTHERN BLOWER INC.
OPERATION MANUAL - FAN EQUIPMENT

SAFETY PRECAUTIONS

FAN EQUIPMENT CAN BECOME A SOURCE OF INJURY AND DEATH IF NOT PROPERLY INSTALLED, OPERATED OR MAINTAINED. Do not exceed the maximum operating temperature or speed limits for which the fan equipment was designed. Limits for some lines of fan equipment are given in CML Northern Blower Inc. ("CML Northern") catalogues. Limits for non-catalogued lines of fan equipment should be obtained in writing from the CML Northern Winnipeg factory and not otherwise. Do not rely on limits obtained in any other manner.

The user should make all personnel who operate or maintain the fan equipment aware of all possible hazards.

THE RESPONSIBILITY FOR PROVIDING SAFETY ACCESSORIES FOR FAN EQUIPMENT SUPPLIED BY CML NORTHERN IS THAT OF THE USER OF THE FAN EQUIPMENT. CML Northern sells its fan equipment with or without safety accessories, and accordingly, it can supply standard safety accessories upon receipt of an order. Ensure that all necessary safety accessories have been installed before operation of the fan equipment.

The warning notice set out below should be affixed upon the fan equipment:

CML NORTHERN BLOWER INC.

WARNING

This fan has rotating parts and may be hot. Keep body, hands and foreign objects away from inlet and outlet. Do not touch fan or motor during operation.

Operate, install and maintain only in strict accordance with safety practices and instructions in manufacturer's Operation Manual. Do not exceed the maximum operating temperature, speed,or vibration level identified in the manufacturer's catalogues and Operation Manual. Untrained personnel should never operate, install, adjust or maintain fan or motor.

ADDITIONAL SAFETY ACCESSORIES FOR THE FAN EQUIPMENT ARE AVAILABLE FROM THE MANUFACTURER. THE RESPONSIBILITY FOR PROVIDING SUCH ADDITIONAL SAFETY ACCESSORIES IS THAT OF THE USER OF THE FAN EQUIPMENT. CONSULT THE MANUFACTURER'S OPERATION MANUAL FOR GUIDANCE.

Before starting maintenance work, lock disconnect switch in the off position,de-energize and disconnect all power sources to the motor and to accessory devices and secure fan impeller. Cleanout doors must be secure during operation. Unsecured cleanout doors may shoot open during operation because of pressure build up inside the fan.

Do not start-up when fan impeller is rotating backwards.

FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS AS TO OPERATION, INSTALLATION, ADJUSTMENT, MAINTENANCE, SAFETY EQUIPMENT OR APPROPRIATE OPERATING CONDITIONS COULD RESULT IN DAMAGE TO THIS EQUIPMENT, DAMAGE TO OTHER EQUIPMENT, PERSONAL INJURY OR DEATH.

Should the warning notice not be affixed to the fan equipment purchased, CML Northern will supply such a warning notice upon request made to its head office.

The user of the fan equipment, in making its determination as to the appropriate safety accessories to be installed and any additional warning notices to be affixed upon the fan equipment, should consider (1) the location of the installation of the fan equipment, (2) the accessibility of employees and other persons to the fan equipment, (3) any adjacent equipment, (4) applicable building codes, and (5) applicable health and safety legislation.

Users and installers of the fan equipment should read "RECOMMENDED SAFETY PRACTICES FOR AIR MOVING DEVICES" which is published by the Air Movement and Control Association, 30 West University Drive, Arlington Heights, Illinois, 60004.

INSTALLATION, OPERATION & MAINTENANCE OF CML NORTHERN FAN EQUIPMENT

INTRODUCTION

The purpose of this section is to aid in the proper installation, operation, and maintenance of CML Northern fan equipment. These instructions are intended to supplement good general practices and are not intended to cover detailed instruction procedures.

The receipt, handling, installation, operation and maintenance of CML Northern fan equipment is the responsibility of the user. It is important that the installation and start-up of the fan equipment be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from CML Northern, and arrangements for such supervision and inspection (at a fee) should be made through your local CML Northern representative or at CML Northern's head office. Failure to arrange for such supervision or inspection may affect or void the CML Northern Warranty (please refer to paragraph 7 of CML Northern's Warranty).

SHIPMENT & RECEIVING

CML Northern has thoroughly inspected the fan equipment at its factory and has prepared the fan equipment for shipment in accordance with the uniform freight classification followed by all carriers. The fan equipment should be in perfect condition when received, unless damaged in transit. Upon acceptance by the carrier, as evidenced by a signed bill of lading, the carrier accepts responsibility for all shortages or damage, whether concealed or evident. Claims covering shortages or damage must be made to the carrier by the purchaser. Any shortages or damage should be noted by the user on the delivery receipt.

The fan equipment may contain components manufactured by manufacturers other than CML Northern. Such other manufacturers may have furnished instructions and/or other literature concerning their component. A list of such instructions and/or other literature is forwarded with the fan equipment (see page 15 of this manual). If any of the items on the list are missing, please contact your CML Northern representative, CML Northern at it's head office or contact the component's manufacturer directly.

HANDLING

The fan equipment should be handled with care. Some fans are provided with lifting lugs or holes for easy handling. Others must be handled using nylon straps or well-padded chains and cables which protect the fan's coating and housing. Spreader bars should be used when lifting large parts.

Axial fans should be lifted by using straps around the fan housing only. DO NOT LIFT AXIAL FANS BY THE MOTOR, MOTOR BASE, IMPELLER OR FLANGES.

Centrifugal fans are best lifted using straps attached to structural base members of the fan. DO NOT LIFT CENTRIFUGAL FANS BY THE FAN SHAFT, IMPELLER, FLANGES OR INLET SUPPORTS.

Roof ventilators should be lifted by using straps attached to lifting lugs or base only. Spreader bars should also be used to avoid damage to the butterfly damper assembly or the weatherhood. DO NOT LIFT ROOF VENTILATORS BY THE BUTTERFLY DAMPER ASSEMBLY OR WEATHERHOOD.

Centrifugal rotor assemblies (i.e. impeller and shaft assemblies) have been designed to be supported by the shaft, and should be lifted by slings around the shaft as close as possible to the hub on each side of the impeller (wheel). Slings should not press against the side plates of the wheel as this may damage and distort the wheel. A spreader bar should be used when lifting the rotor assembly (Figure 1). The wheel should never rest on the side plates or blades, nor should the rotor assembly be lifted by any components of the fan wheel. To do so may damage the rotor assembly and destroy the dynamic balance that is necessary for low vibration operation. If this balance is destroyed, rebalancing of the rotor assembly will be necessary. If the wheel and shaft have not been assembled, the fan wheel may be lifted by a timber or wrapped bar of sufficient strength passed through the hub. The finished bore of the hub and the bearing surfaces of the shaft must also be protected from damage.

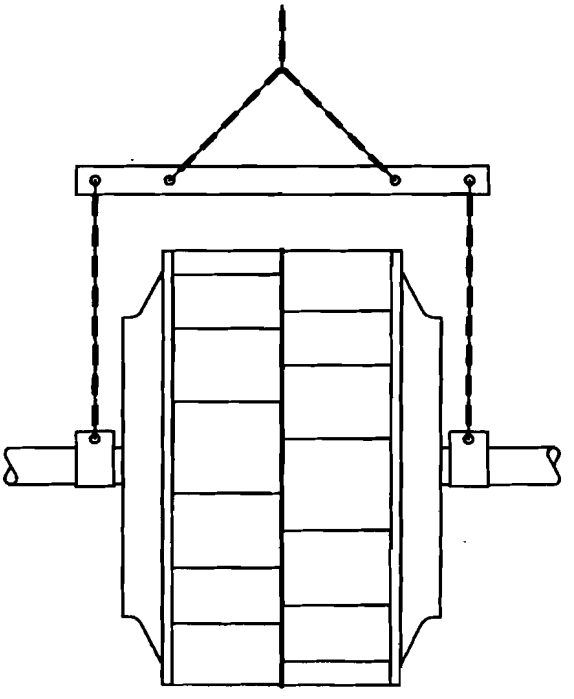


Fig. 1 *Correct use of spreader bar when lifting centrifugal rotor assembly.*

STORAGE

If fan equipment is not installed immediately, fans should be protected so as to remain dry at all times.

(1) **If temporary storage is necessary:**

Store in a dry area which is free of any vibration, and protect from extremes and rapid changes in humidity and temperature.

(A) Temperatures: between 50°F (10°C) and 120°F (49°C).

(B) Maximum relative humidity: 60%.

(C) Shock or vibration: 2 mils displacement maximum to prevent bearings from brinelling. Exceeding this limit will require vibration dampening material under the fan equipment.

(2) **If extended storage is necessary:**

Motor bearings and fan bearings are to be lubricated at the time of placement into extended storage. Motor shafts and fan shafts are to be manually rotated every month and additional lubricant added, purging some of the lubricant in the bearing cavity every six (6) months. LUBRICANT IN THE BEARINGS IS TO BE PURGED AT THE TIME OF REMOVAL FROM STORAGE, ENSURING THAT AN AMPLE SUPPLY OF FRESH LUBRICANT IS IN EACH LUBRICANT CAVITY. LUBRICANT USED MUST BE COMPATIBLE WITH THE LUBRICANT ALREADY IN THE MOTOR AND FAN BEARINGS.

Electric motors in storage may absorb moisture in their windings which may result in a significant loss of insulation resistance. When removed from storage the insulation resistance of all motors should be checked in accordance with the motor manufacturer's instructions or in accordance with IEEE standard 43-1974 "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery". Motors with insufficient insulation resistance must be cleaned and dried in accordance with motor manufacturer's instructions or IEEE standard 43-1974 to return the insulation resistance to acceptable levels. THE APPLICATION OF POWER TO A MOTOR WITH INSUFFICIENT INSULATION RESISTANCE MAY RESULT IN DAMAGE TO THE MOTOR OR DAMAGE TO OTHER EQUIPMENT.

On v-belt drive fans,belts should be checked at the time of removal from storage for proper v-belt tension. Tighten belts if necessary (refer to the "V-BELT DRIVE INSTALLATION" section on page 9 of this manual) .

When installing fan equipment after storage, follow the instructions contained in the "INSTALLATION OF FAN EQUIPMENT" and "OPERATION OF FAN EQUIPMENT" appearing at pages 8 and pages 10 of this manual respectively.

Storage records evidencing compliance with the above requirements should be maintained by the purchaser.

INSTALLATION OF FAN EQUIPMENT

(1) Safe and smooth operation of the fan equipment requires a proper foundation that is level, rigid, and of sufficient structure and mass to support the equipment. IT IS ALWAYS IMPERATIVE TO CONSULT A QUALIFIED STRUCTURAL ENGINEER IN ORDER TO DESIGN A PROPER FOUNDATION.

A properly designed concrete base is the preferred foundation. The concrete base mass should be a minimum of four times that of the fan equipment when the plan view area of the concrete base is no more than twice the plan view area of the fan equipment.

Steel platforms or bases are good alternatives when properly designed. Steel platforms must be braced in all directions. Care must be taken to ensure that the natural frequency of all steel base components differs significantly from the rotating speed of the fan and the driver. FAILURE TO HEED THIS GOOD DESIGN PRACTICE MAY RESULT IN A RESONANT CONDITION AND CONSEQUENT LIFE THREATENING CATASTROPHIC STRUCTURAL FAILURE.

Fans mounted off ground level should be rigidly mounted to a structural platform and should be placed as near as possible to, or over, a solid wall or column (refer to paragraph one of this section).

Supports for suspended fans must be crossbraced to prevent side sway.

(2) Fan equipment must be level prior to operation. Do not twist or distort fan equipment. Shim fan support points before tightening foundation bolts to help ensure distortion does not occur.

(3) For roof mounted fans, place the fan curb panel on the roof curb. Level and then anchor the unit to the curb using lag screws, neoprene washers and flat washers. DO NOT MOUNT UNSUPPORTED STACKS ON THE FAN. STACKS MUST BE INDEPENDENTLY MOUNTED TO THE ROOF. Anchor independently mounted stacks with guy wires to prevent side sway.

(4) Ducts must be independently supported, and must never be supported by the fan. Use flexible duct connections wherever possible. The independent mounting of stacks and ducts to the fan will ensure that the fan will not be twisted or deformed with the addition of external loads.

(5) It is recommended that access doors be placed in ductwork just ahead of the fan inlet and just behind the fan outlet for ease of inspection and maintenance. IN ORDER TO AVOID EQUIPMENT DAMAGE AND PERSONAL INJURY ACCESS DOORS IN A DUCT SYSTEM SHOULD BE SECURELY CLOSED AND SHOULD NEVER BE OPENED WITH THE FAN RUNNING.

(6) Lubricate fan bearings in strict accordance with bearing manufacturer's recommendations. Lubricate bearings upon receipt of fan. Do not overlubricate. Bearings should be locked to the shaft. Ensure that locking mechanisms on bearings are in correct position and that locking mechanisms are fastened before operation of fan.

(7) Flexible couplings must be installed and maintained in accordance with the coupling manufacturer's instructions. Refer to fan submittal drawings for details of drive arrangements and the general location of the coupling halves on the fan and motor shafts.

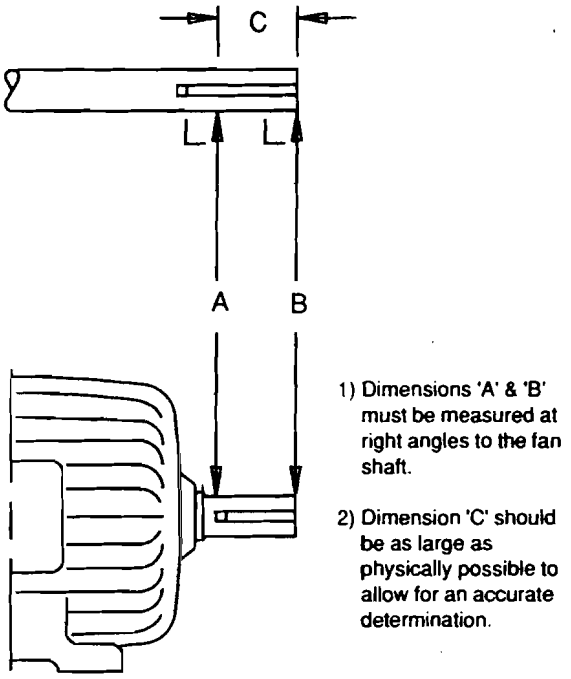


Fig. 2 *Determination of parallel shafts.*

V-BELT DRIVE INSTALLATION

V-belt drive systems are the most common type of belt systems used to drive fan equipment. Other types of belt systems are used ("cog", belts etc.) but are not discussed in this manual.

Proper alignment is essential to long fan bearing, driver bearing, v-belt and sheave life. Ensure that driver and fan shafts are parallel. The most common causes of misalignment are nonparallel shafts and improperly located sheaves. Where shafts are not parallel, v-belts on one side are drawn tighter and pull more than their share of the load. As a result, these v-belts wear out faster, requiring the entire set to be replaced before it has given maximum service. If the sheaves are misaligned, v-belts will enter and leave the grooves at an angle, causing excessive v-belt and sheave wear .

Shaft alignment can be checked by measuring the distance between the shafts at two or more locations as shown in Figure 2. If the distances are equal, the shafts are parallel.

Check the location of the sheaves on the shaft with a straight edge or a length of string. If the sheaves are properly aligned the string will touch them at the points indicated by the arrows in Figure 3. Rotating each sheave one-half (1/2) revolution will indicate if the sheave is misaligned or the shaft is bent. Correct any causes of misalignment.

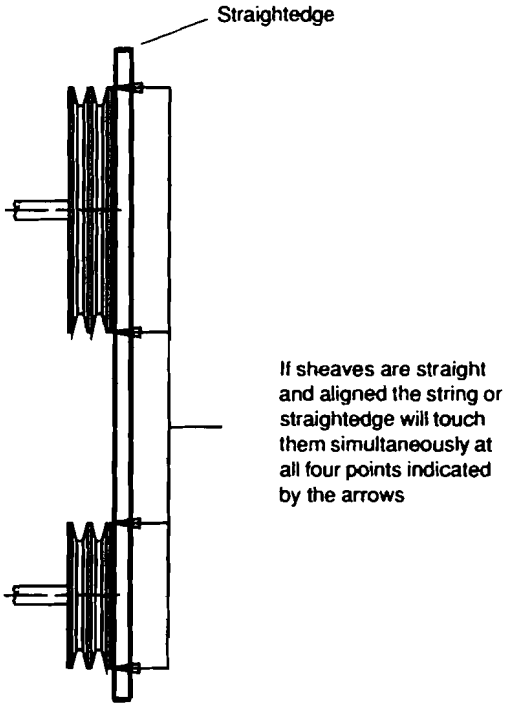


Fig. 3 *Sheave alignment.*

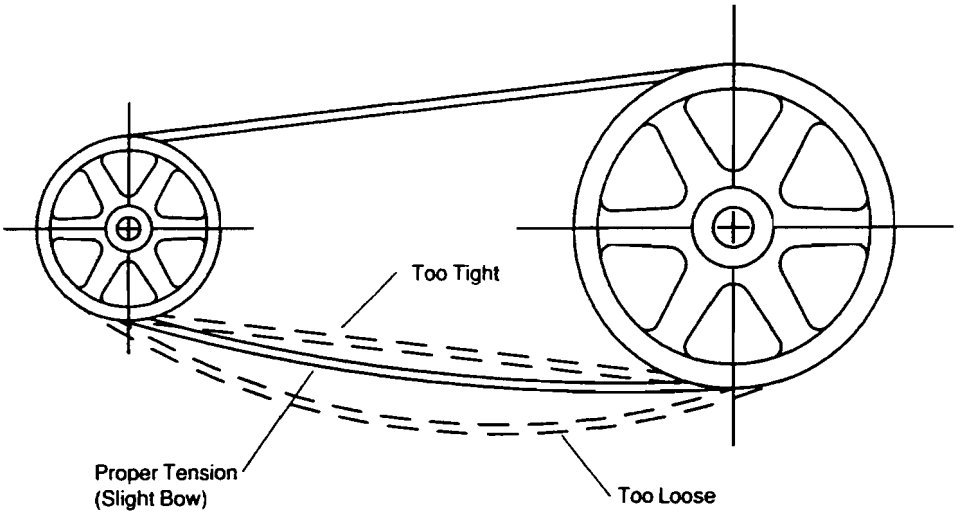


Fig. 4 *Belt tension.*

Always use matched v-belts and never mix new and used v-belts on a drive. Install v-belts correctly:

(i) Shorten the center distance between the driven and driver sheave so the v-belts can be slipped into the sheave groove without damage. While the v-belts are still loose on the drive, rotate the drive until all the slack is on one side. Then increase the center distance until the v-belts are snug (Figure 4). NOTE: Never "roll" or "pry" the v-belts into the sheave grooves. This can damage the v-belt cords and lead to v-belt turnover, short life, or actual breakage. Moreover, it is both difficult and unsafe to install v-belts this way. Keep takeup rails, motor base, or other means of center distance adjustment free of dirt, rust, and grit. Lubricate adjusting screws and slide rails as required.

(ii) Operate the drive and fan a few minutes to seat the v-belts in the sheave grooves (operate the fan equipment only after following the procedure listed in the "Operation of Equipment" section of this manual). Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taught during peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the v-belts squeal severely as the motor comes on or at some subsequent peak load, they are not tight enough to deliver the torque demanded by the fan. The fan should be stopped and the v-belts tightened.

(iii) Check the tension on a new drive frequently during the first day of operation by observing the slack side span. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack side.

OPERATION OF FAN EQUIPMENT

(1) Lock out all power sources.

(2) Ensure that bearings are properly aligned and lubricated with special attention to the locking mechanisms, cleanliness, and possible corrosion. Bearings showing signs of corrosion must be replaced prior to operation of fan equipment.

(3) Check set screws and keys (or taperlock hub if present) in fan impeller, and bolts on cooling wheel.

(4) Check foundation bolts and other hardware for tightness.

(5) Ensure that the fan housing, ducts, etc., are free of foreign objects.

(6) Ensure that all access doors are secure.

(7) Check the impeller to inlet cone and impeller to fan housing clearance to ensure that there is no interference. Turn the impeller by hand, ensuring that it rotates freely.

(8) On belt drive fans, check sheave alignment and v-belt tension (refer to the section entitled "V-BELT DRIVE INSTALLATION" on page 9 of this manual).

(9) If the fan is equipped with damper or variable inlet vane, close same to lessen starting load on motor. Ensure any dampers or variable inlet vanes furnished with the fan, or used in conjunction with the fan, do not stick or bind. If an automatic control mechanism is used to operate the damper or variable inlet vane, adjust the limits of travel of the automatic control mechanism in accordance with the control manufacturer's instructions to avoid putting force on the damper or variable inlet vane when it is fully opened or fully closed.

(10) If the fan is driven by an electric motor, read instructions of motor and starter manufacturer. Ensure that the motor and starter are set up in compliance with the motor and starter manufacturers' instructions prior to any application of electric power. If the fan is powered by some other form of driver, read the manufacturer's instructions prior start-up.

(11) If the fan is equipped with water cooled bearings turn on the water supply to the bearings prior to starting the fan. Consult the water cooled bearing manufacturer's instructions.

(12) If the fan is to handle a "hot gas" (i.e. a gas with a temperature greater than 150°F [65°C]) it is imperative that the fan be subject to only a slow gradual rate of gas temperature change, not to exceed a rate of 15°F/minute (8°C/minute). When the fan is being put in operation the temperature of the gas must not rise at a rate greater than 15°F/minute (8°C/minute). Never subject a "cold" fan to a "hot" gas stream. When the fan is being taken out of operation the temperature of the gas must not decline at a rate greater than 15°F/minute (8°C/minute), and when the gas temperature has reached a level of 150°F (65°C) or less it is imperative that the fan be operated at this temperature for a period of time sufficient to allow the entire fan structure to reach an equilibrium temperature of 150°F (65°C). Only when the entire fan structure has reached an equilibrium temperature of 150°F (65°C) or less can the fan be shut off and removed from operation. Failure to follow these instructions may result in damage to the fan equipment. NEVER EXCEED THE MAXIMUM OPERATING TEMPERATURE OR SPEED FOR WHICH THE FAN WAS DESIGNED.

(13) Connect the power source.

(14) Fan impeller should always be stationary prior to startup. Startup while fan impeller is rotating backwards can cause damage.

(15) Apply power to the driver momentarily (i.e. "bump") to check for proper rotation. Any dampers or other air control devices in the system should be at least partially closed during starting periods to reduce power requirements. Damper closure is particularly important in the case of a fan designed for high temperature operation being "run in" at a temperature less than design temperature.

(16) Apply power to the driver and allow the fan to come up to design speed. Turn off. Look and listen for any unusual noise or mechanical action while the impeller is still spinning. If any are noticed, lock out all power sources, locate cause and correct.

(17) Lock out all power sources and recheck tightness of all set screws, keys, foundation bolts and any other hardware. The initial start up will tend to relieve their tightness and they may require re-tightening.

(18) Reconnect all power sources.

(19) It is recommended that upon fan installation, the operating vibration levels be checked to ensure that the levels do not exceed the levels indicated on the inspection sheets shipped with the fan and/or the vibration levels set forth in the "Vibration" section of this manual.

Once it has been determined that the fan equipment is operating satisfactorily, it should be operated, if practical, for at least eight (8) continuous hours. Operation should be monitored at least once each hour during this period. Inspection should be made for any change of operation during this period. Some bearings will have to "run in" and will heat up during this period. The maximum bearing temperature should not exceed 200°F (93°C). It is normal for bearings lubricated with grease to purge a small amount of the grease through the bearing seals during run-in.

NOTE THAT ALL BOLTS, SETSCREWS AND V-BELTS SHOULD BE RE-TIGHTENED AFTER TWO (2) DAYS OF INITIAL OPERATION.

MAINTENANCE OF FAN EQUIPMENT

BEFORE STARTING MAINTENANCE WORK ON FAN EQUIPMENT LOCK MOTOR, LOCK DISCONNECT SWITCH IN THE OFF POSITION, DE-ENERGIZE AND DISCONNECT ALL POWER SOURCES TO THE MOTOR AND TO ACCESSORY DEVICES, AND SECURE FAN IMPELLER.

Bearings and Lubrication

Selection of the correct fan bearing lubricant and lubrication intervals depends on several factors. Extreme high or low temperatures and dirty or damp surroundings are all conditions that will create a requirement for more frequent lubrication or special lubricants. READ THE BEARING

MANUFACTURER'S INSTRUCTIONS TO DETERMINE THE TYPE AND FREQUENCY OF BEARING LUBRICATION REQUIRED.

THE MOTOR BEARINGS SHOULD BE LUBRICATED IN ACCORDANCE WITH MOTOR MANUFACTURER'S LUBRICATION INSTRUCTIONS AND RECOMMENDATIONS SHOULD BE FOLLOWED CLOSELY.

Bearing failure may be caused by failure to lubricate as often as required, use of an excessive quantity of lubricant or the use of incompatible lubricants. Excessive vibration, especially if the bearing is not rotating, will also cause bearings to fail. Bearings must also be protected from water and moisture to avoid internal corrosion.

Bearings are susceptible to damage from exposure to excess shaft heat transfer which may occur when a fan operating at a temperature greater than 200°F (93°C) is shut down without a sufficient period of gradual temperature reduction. See section (12) of "Operation of Fan Equipment" set forth on page 11 of this manual.

Bearing Replacement
Replacement of fan bearings should not be required for many years if cared for strictly in accordance with bearing manufacturer's instructions. The procedure used to replace fan bearings will vary depending on the type of fan and the type of bearing. It is important that the replacement of bearings be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from CML Northern and arrangements for such supervision or inspection (at a fee) should be made through your local CML Northern representative or at CML Northern's head office.

Variable Inlet Vane
Once a year, the variable inlet vane coverplate should be removed and the moving parts re-packed with grease. The lubrication interval should be increased where moisture or particles are present in the airstream.

CAUTION: Where automatic control mechanisms are used to operate the variable inlet vane, care should be taken to correctly adjust control mechanism stroke limits as OVERTRAVEL MAY DAMAGE THE VARIABLE INLET VANE OPERATING MECHANISM.

Motors
DO NOT OPERATE THE MOTOR WITHOUT FIRST READING THE MOTOR MANUFACTURER'S INSTRUCTIONS. OPERATE THE MOTOR ONLY IN ACCORDANCE WITH THE INSTRUCTIONS.

The fundamental principle of electrical maintenance is to KEEP THE MOTOR CLEAN AND DRY. This requires periodic inspection of the motor. The frequency of the inspections depends upon the type of motor, the service and the motor manufacturer's instructions.

Periodic checks of voltage, frequency and current of a motor while in operation are recommended. Such checks ensure the correctness of frequency and voltage applied to the motor and yield an indication of the fan load. Comparison of this data with previous data will give an indication of the fan performance. Any serious deviations should be investigated and corrected.

Spare Parts
Spare parts may be ordered through your CML Northern sales office by providing the following information:

(1) Part name (e.g. impeller, shaft, motor, bearing, etc).

(2) Fan Serial Number from the nameplate.

(3) If possible, the fan shaft diameter or bearing size together with the fan class specified on the nameplate.

DUE TO THE SMALL NUMBER OF PARTS REQUIRED, SPARE PARTS LISTS ARE NEITHER NECESSARY NOR AVAILABLE.

Vibration
A vibration analyzer must be used to accurately determine the level of fan vibration. Vibration readings should be taken by personnel experienced with vibration analysis and vibration analysis equipment. Trained personnel are available from CML Northern, and arrangements for vibration analysis (at a fee) may be made through your local CML Northern representative or at CML Northern's head office.

The fan should <u>not</u> be operated unless the **vibration velocity** of the fan is less than 0.20 inches per second.

If the vibration analyzer being used to measure vibration levels will provide only **vibration displacement** readings refer to Figure 5. Figure 5 is a graph used to determine whether the **vibration velocity** of a fan is acceptable or unacceptable if the vibration analyser is capable of measuring only the **vibration displacement**. To utilize Figure 5 it is necessary to identify the following:

(1) the **vibration displacement** in mils (where 1 mil is equal to 1/1000th of an inch).

(2) the **vibration frequency** in cycles per minute (generally taken as the fan speed in rpm).

Find the vibration displacement on the left vertical axis of Figure 5, and the vibration frequency on the horizontal axis. DO NOT OPERATE THE FAN if the point of intersection of these values lies in the region labelled "UNACCEPTABLE". All points in the region labelled "UNACCEPTABLE" are indicative of vibration velocities exceeding 0.20 inches per second and corrective action must be taken to reduce the vibration velocity below this value before the fan is returned to normal operation.

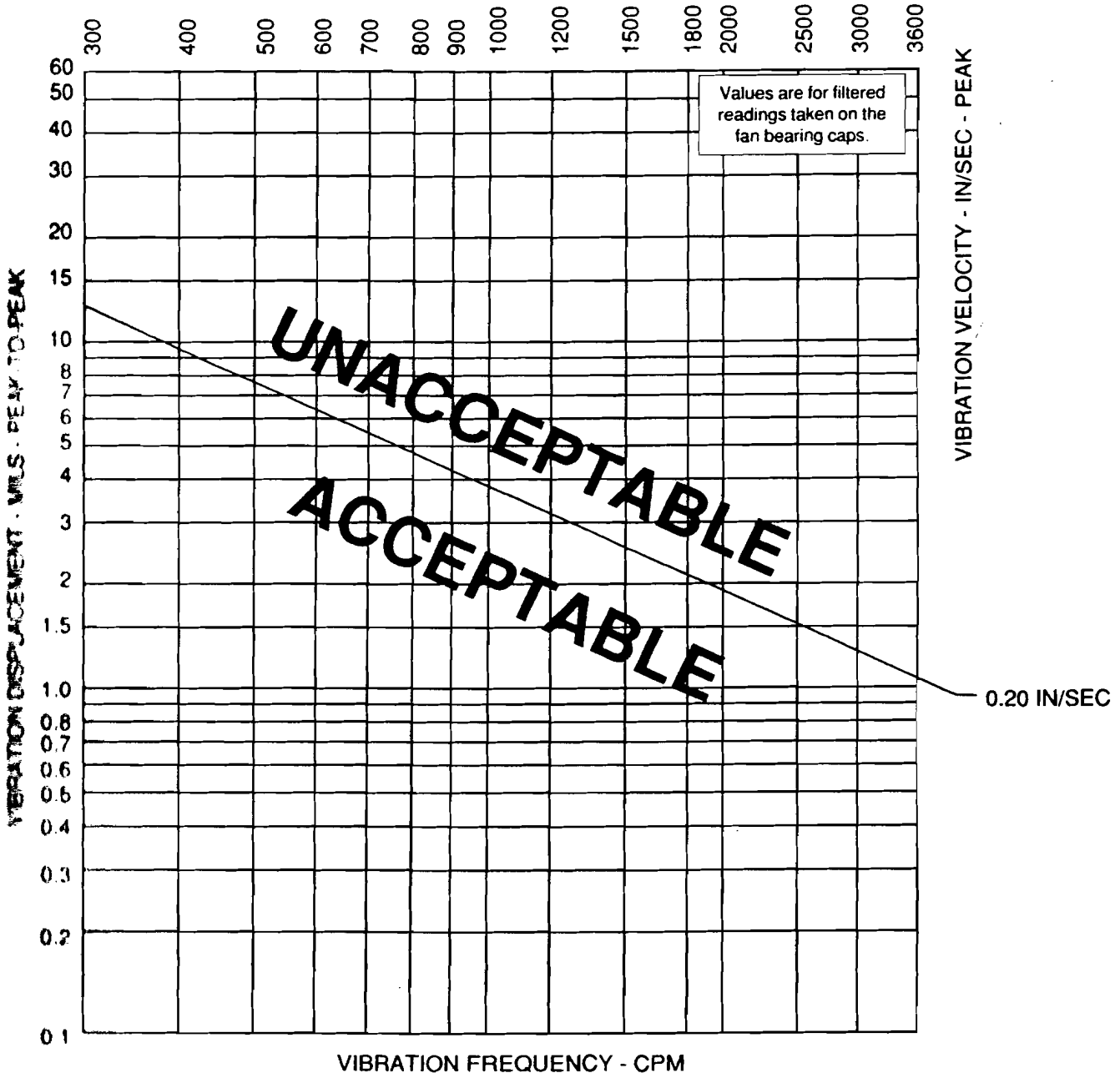


Fig. 5 *Fan Vibration Severity Chart*

FAN TROUBLE-SHOOTING CHART

PROBLEMS	PROBABLE CAUSES
INSUFFICIENT AIR FLOW	. duct elbows near fan inlet or outlet . restricted fan inlet or outlet . impeller rotating in wrong direction . fan speed lower than design . system resistance higher than design . dampers shut . faulty ductwork . dirty or clogged filters and/or coils . inlet or outlet screens clogged
EXCESSIVE AIR FLOW	. system resistance less than design . fan speed too high . filters not in place . registers or grilles not installed . improper damper adjustment
EXCESSIVE HORSEPOWER DRAW	. fan speed higher than design . gas density higher than design . impeller rotating in wrong direction . static pressure less than anticipated . fan size or type not appropriate for application
EXCESSIVE VIBRATION	. accumulated material on impeller . worn or corroded impeller . bent shaft . impeller or sheaves loose on shaft . motor out of balance . impeller out of balance . sheaves eccentric or out of balance . bearing or drive misalignment . mismatched belts . belts too loose or too tight . loose or worn bearings . loose bearing bolts . loose fan mounting bolts . weak or resonant foundation . foundation unlevel . structures not crossbraced . fan operating in unstable system condition
INOPERATIVE FAN	. blown fuse . broken belts . loose sheave . motor too small . wrong voltage

OTHER INSTRUCTIONS and LITERATURE

FAN EQUIPMENT SERIAL No._____ MAY CONTAIN COMPONENTS MANUFACTURED BY MANUFACTURERS OTHER THAN CML NORTHERN. SUCH MANUFACTURERS MAY HAVE FURNISHED INSTRUCTIONS AND/OR OTHER LITERATURE CONCERNING THEIR COMPONENT. A LIST OF SUCH INSTRUCTIONS AND/OR OTHER LITERATURE FORWARDED WITH FAN EQUIPMENT SERIAL No._____ IS GIVEN BELOW.

(1) CML NORTHERN BEARING LUBRICATION INSTRUCTIONS:

- ☐ LUBRICATION INSTRUCTIONS FOR DOUBLE ROW SPHERICAL ROLLER BEARINGS 22500 SERIES SPLIT PILLOW BLOCK.
- ☐ LUBRICATION INSTRUCTIONS FOR SERIES 22400 SERIES DOUBLE ROW SPHERICAL ROLLER BEARINGS.
- ☐ LUBRICATION INSTRUCTIONS FOR 300 SERIES BALL BEARINGS.
- ☐ LUBRICATION INSTRUCTIONS FOR 200 SERIES BALL BEARINGS.

(2) BEARING MANUFACTURER'S INSTRUCTIONS:

☐ YES ☐ NO

(3) MOTOR MANUFACTURER'S INSTRUCTIONS:

☐ YES ☐ NO

(4) COUPLING INSTRUCTIONS:

CML NORTHERN COUPLING INSTRUCTIONS ☐ YES ☐ NO

COUPLING MANUFACTURER'S INSTRUCTIONS ☐ YES ☐ NO

(5) ACTUATOR/CONTROLLER MANUFACTURER'S INSTRUCTIONS:

☐ YES ☐ NO

(6) OTHER LITERATURE/INSTRUCTIONS:

_____

_____

_____

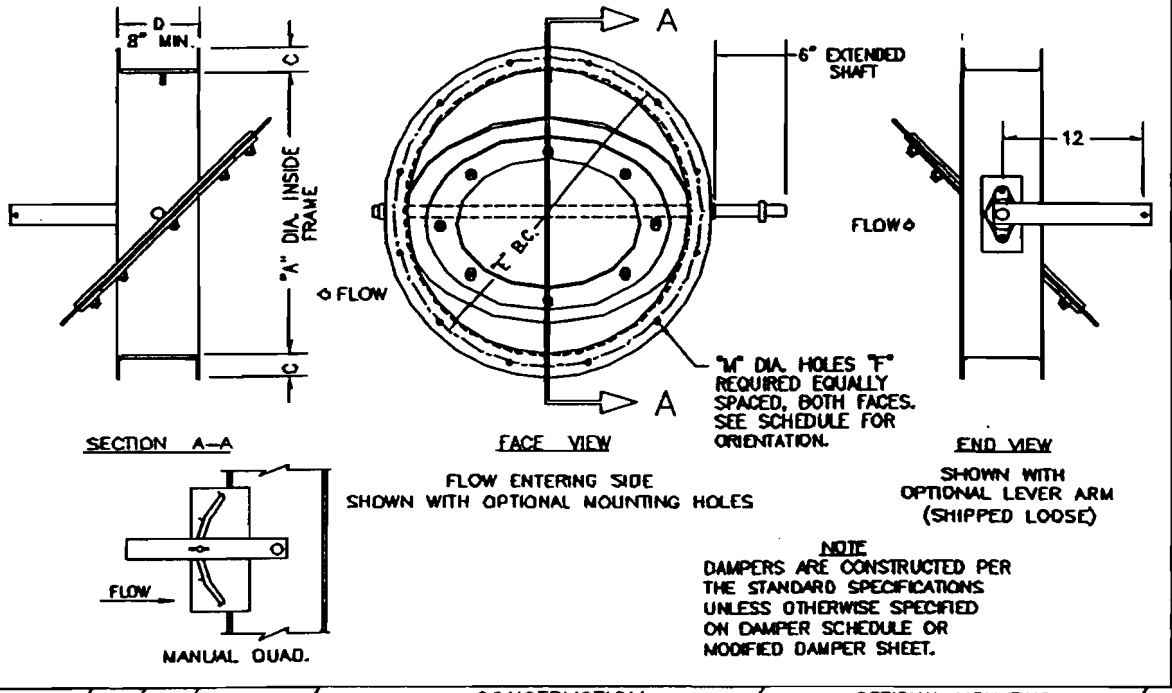
_____

_____

Section III
Ductwork Accessories

Isolation Damper Manufacturer's Standard Data Sheet

H.D. ROUND ISOLATION DAMPER, 4000 FPM MAX. VEL., 15" W.G. MAX. DIFF. PRESS., 12" THRU 60" DIA.

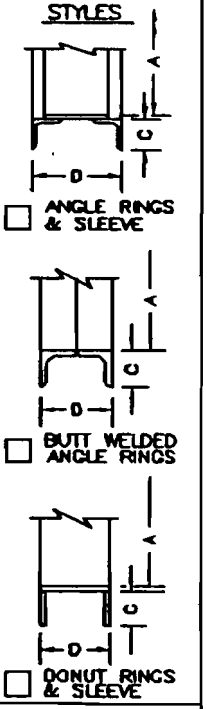


FLOW ENTERING SIDE SHOWN WITH OPTIONAL MOUNTING HOLES

SHOWN WITH OPTIONAL LEVER ARM (SHIPPED LOOSE)

NOTE
DAMPERS ARE CONSTRUCTED PER THE STANDARD SPECIFICATIONS UNLESS OTHERWISE SPECIFIED ON DAMPER SCHEDULE OR MODIFIED DAMPER SHEET.

OPTIONAL FRAME STYLES



AMV ITEM No.	QUANTITY	INSIDE "A" FRAME DIAMETER	CONSTRUCTION OPTIONS: "C" FLANGE WIDTH	"D" FRAME DEPTH	FRAME GA./THK.	SLEEVE GA./THK.	FLANGE GA./THK.	BLADE GA./THK.	AXLE DIAMETER	MANUAL QUAD.	LEVER ARM	OPTIONAL MOUNTING HOLE DIMENSIONS: 1 FLANGE AIR LEAVING SIDE ☐ "E"	1 FLANGE AIR LEAVING SIDE ☐ "F"	BOTH FLANGES ☑ "M"	STRADDLE VERT. CENTERLINE	ON VERTICAL CENTERLINE	REMARKS
	9	18	1.5	8	10		10	3/16	1	Y		19 3/4	12	7/16			650 in lbs torque

SPECIAL ACTUATOR:

SPECIAL FINISH:

VC-56I STANDARD SPECIFICATIONS

FRAME: 8 x 1-1/2 x 10 GA. ROLLED STEEL CHANNEL, THRU 25" DIAMETER.
10 x 2 x 10 GA. ROLLED STEEL CHANNEL, 25"+ THRU 36" DIAMETER.
10 x 2 x 3/16" THK. ROLLED STEEL CHANNEL, 36"+ THRU 60" DIAMETER

SLEEVE: CLOSED WITH OPTIONAL FRAMES)
10 GA. STEEL, THRU 36" DIAMETER.
3/16" THK. STEEL, 36"+ THRU 60" DIAMETER

BLADE: 3/16" THK. STEEL, WELDED TO AXLE, THRU 24" DIAMETER.
1/4" THK STEEL, WELDED TO AXLE, 24"+ THRU 60" DIAMETER.

AXLE: 3/4" DIAMETER STEEL FULL LENGTH, THRU 18" DIAMETER.
1" DIAMETER STEEL FULL LENGTH, 18"+ THRU 28" DIAMETER.
1-1/4" DIAMETER STEEL FULL LENGTH, 28"+ THRU 40" DIAMETER.
1-1/2" DIAMETER STEEL FULL LENGTH, 40"+ THRU 48" DIAMETER.
1-3/4" DIAMETER STEEL FULL LENGTH, 48"+ THRU 60" DIAMETER.

BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

STOPS: 1/2" DIAMETER STEEL PIN.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

FINISH: ONE (1) COAT AMV STANDARD PRIMER.

ACTUATOR: EXTENDED SHAFT (SEE SCHEDULE FOR OPTIONS).

NOTES

1. MAX. TEMP. = 150° F.
2. DAMPERS ARE FOR CLEAN AIR USE ONLY.
3. REFERENCE DWG. #VC-56-6 FOR OPTIONAL MOUNTING HOLE PATTERNS.
4. LEAKAGE SHALL NOT EXCEED .029 SCFM PER INCH OF BLADE CIRCUMFERENCE OR 1 CFM AT 10" W.G. WHICHEVER IS GREATER. A LEAKAGE RATE OF .009 SCFM PER INCH OF BLADE CIRCUMFERENCE OR 1 CFM AT 10" W.G. IS AVAILABLE WITH SPECIAL HANDLING.

REV.	DESCRIPTION	DATE	BY

DATE:

AMV PROD. No.:

CUSTOMER:

CUSTOMER ORDER No.:

AGENT: Air Systems Engineering, Inc.

AGENT ORDER No.:

amv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56I HEAVY DUTY ISOLATION DAMPER

DRN. BY	DWG. NO.	REV.
DATE	VC56I - 710	

awv american warming and ventilating
AMCA MEMBER

7301 International Drive
Holland, OH 43528
Phone: (419) 865-5000
Fax: (419) 865-1375

Air Systems Engineering, Inc.
377 Park Street
Hackensack, NJ 07601

Attn: Eric Wilts

Reference: Low Leak Industrial Dampers

Dear Eric:

American Warming & Ventilating is working on modifying our VC-56-ISO damper for even lower leakage rates. While this construction is not available at the moment, we anticipate being able to ship in approximately 7-8 weeks.

The constructions and leakage rates will be as follows:

Designed for 15" w.g., 5000 FPM velocity, our leakage will be .009 SCFM per inch of circumference at 15" w.g.

Designed for 20" w.g., 5000 FPM velocity, our leakage will be .020 SCFM at per inch of circumference at 20" w.g.

Designed for 30" w.g., 5000 FPM velocity, our leakage will be .023 SCFM at per inch of circumference at 30" w.g.

Designed for 40" w.g., 5000 FPM velocity, our leakage will be .027 SCFM at per inch of circumference at 40" w.g.

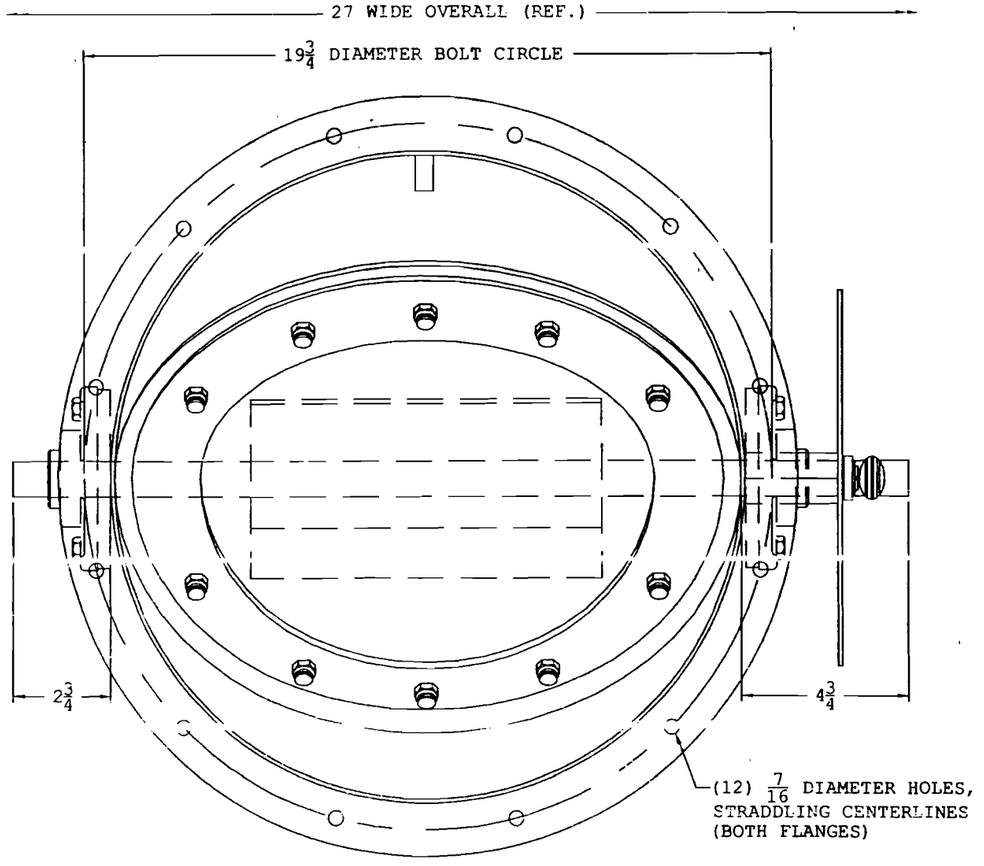
The axle diameters will increase accordingly at the higher pressures and dampers will include reinforcing as required for the appropriate pressure.

If you have any questions or if I can be of further assistance, please feel free to contact me.

Best regards,

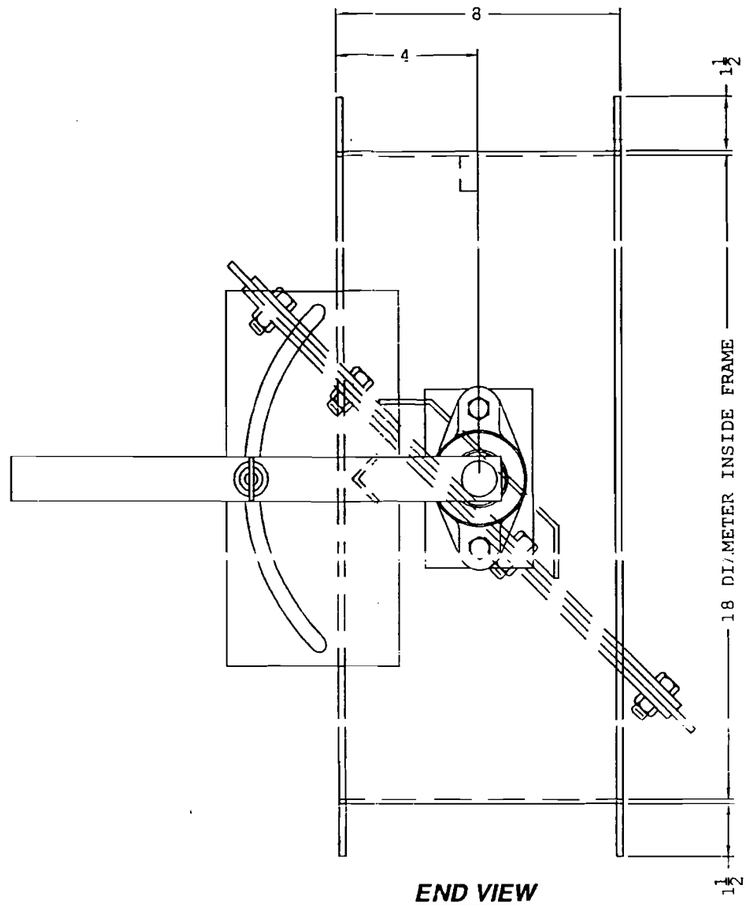
Therese Atkinson
Sr. Estimator/Industrial Group

Isolation Damper Drawings



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

FRAME: 8" DEEP x 10 GAUGE 304 STAINLESS STEEL SLEEVE WITH 1-1/2" x 3/16" THK. 304 STAINLESS STEEL CUT RINGS.

BLADE: 3/16" THK. 304 STAINLESS STEEL PLATE WITH 10 GAUGE 304 STAINLESS STEEL PARALLEL REINFORCING CHANNEL, ALL WELDED TO AXLE.

AXLE: 1" DIAMETER 304 STAINLESS STEEL, FULL LENGTH.

BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

STOPS: 1/2" DIAMETER 304 STAINLESS STEEL PIN.

FINISH: MILL.

ACTUATOR: HEAVY DUTY MANUAL QUADRANT, 304 STAINLESS STEEL.

NOTES

1. DESIGN CRITERIA:
   - MAX. DIFF. PRESS.: 10 IN. W.G.
   - MAX. TEMPERATURE: 150 DEG. F.
   - MAX. VELOCITY: 4000 FPM
   - EST. WEIGHT: 115 LBS.
   - MAX. LEAKAGE: .009 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 10 IN. W.G.
2. QUANTITY: (1) ONE DAMPER REQUIRED AS SHOWN.
3. DAMPER WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH AWV STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPER WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
7. INLET AND OUTLET DUCTS MUST BE OF SUFFICIENT LENGTH TO CONTAIN THE BLADE IN THE FULL OPEN POSITION AND THE DUCT AND JUNCTION OF THE DAMPER MUST BE SMOOTH AND FREE OF PROTRUSIONS THAT MAY DAMAGE THE BLADE EDGE.
8. TAG: 701458, V-501

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED DWG. DIMENSIONS ARE IN INCHES.

FRACTIONS
(+ OR -) 1/16 ----- UP TO 6"
(+ OR -) 3/32 ----- 6" TO 12"
(+ OR -) 1/8 ----- 12" TO 24"
(+ OR -) 1/4 ----- ABOVE 24"
(+ OR -) 2 DEG ---- ANY SPECIFIED ANGLE
REFERENCE ----- GIVEN AS SHOP AID. DIMENSIONS MAY VARY
(+ OR -) 1/16 TRUE LOCATION -- ALL MOUNTING HOLES

DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

CERTIFIED FOR FABRICATION

AWV

REVISION	DATE	DRN / CR	APPD	QA

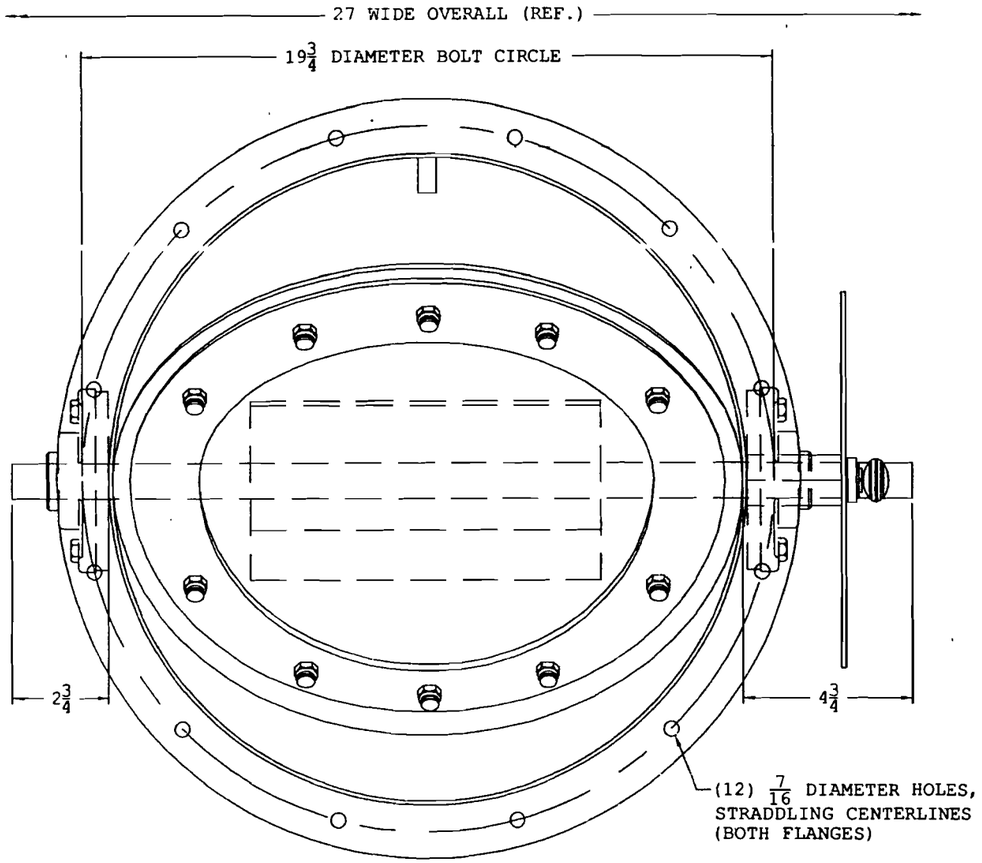
DRAWING STATUS
☒ RELEASED FOR FABRICATION
☐ HELD FOR APPROVAL
☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

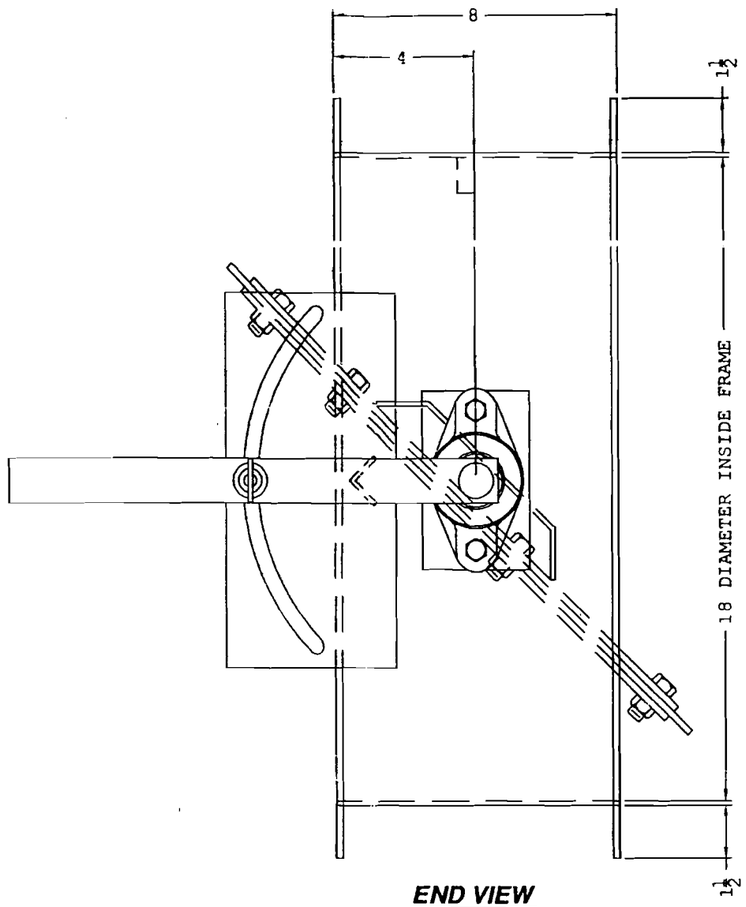
DRAWN 5/20/04	APPD. BY 5/20/04 DWL	Q.A. -	
DRN. BY SJA	DWG. NO. 20835004-1		REV.
DATE 5-18-04			

AutoCAD 208350041



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

FRAME: 8" DEEP x 10 GAUGE 304 STAINLESS STEEL SLEEVE WITH 1-1/2" x 3/16" THK. 304 STAINLESS STEEL CUT RINGS.

BLADE: 3/16" THK. 304 STAINLESS STEEL PLATE WITH 10 GAUGE 304 STAINLESS STEEL PARALLEL REINFORCING CHANNEL, ALL WELDED TO AXLE.

AXLE: 1" DIAMETER 304 STAINLESS STEEL, FULL LENGTH.

BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

STOPS: 1/2" DIAMETER 304 STAINLESS STEEL PIN.

FINISH: MILL.

ACTUATOR: HEAVY DUTY MANUAL QUADRANT, 304 STAINLESS STEEL.

NOTES

1. DESIGN CRITERIA:
   MAX. DIFF. PRESS.: 30 IN. W.G.
   MAX. TEMPERATURE: 150 DEG. F.
   MAX. VELOCITY: 4000 FPM
   EST. WEIGHT: 115 LBS.
   MAX. LEAKAGE: .023 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 30 IN. W.G.
2. QUANTITY: (4) FOUR DAMPER REQUIRED AS SHOWN.
3. DAMPERS WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH AWV STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPERS WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
7. INLET AND OUTLET DUCTS MUST BE OF SUFFICIENT LENGTH TO CONTAIN THE BLADE IN THE FULL OPEN POSITION AND THE DUCT AND JUNCTION OF THE DAMPER MUST BE SMOOTH AND FREE OF PROTRUSIONS THAT MAY DAMAGE THE BLADE EDGE.
8. TAG: 701458, V-611, V-612, V-631 & V-632

CERTIFIED FOR FABRICATION

MAY 2 1 2004

AWV

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED DWG. DIMENSIONS ARE IN INCHES.

FRACTIONS
(+ OR -) 1/16 ----- UP TO 3"
(+ OR -) 3/32 ----- 6" TO 12"
(+ OR -) 1/8 ----- 12" TO 24"
(+ OR -) 1/4 ----- ABOVE 24"
(+ OR -) 2 DEG ---- ANY SPECIFIED ANGLE
REFERENCE ----- GIVEN AS SHOP AID. DIMENSIONS MAY VARY
(+ OR -) 1/16 TRUE LOCATION -- ALL MOUNTING HOLES

DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

REVISION	DATE	DRN	CK	APPD	QA

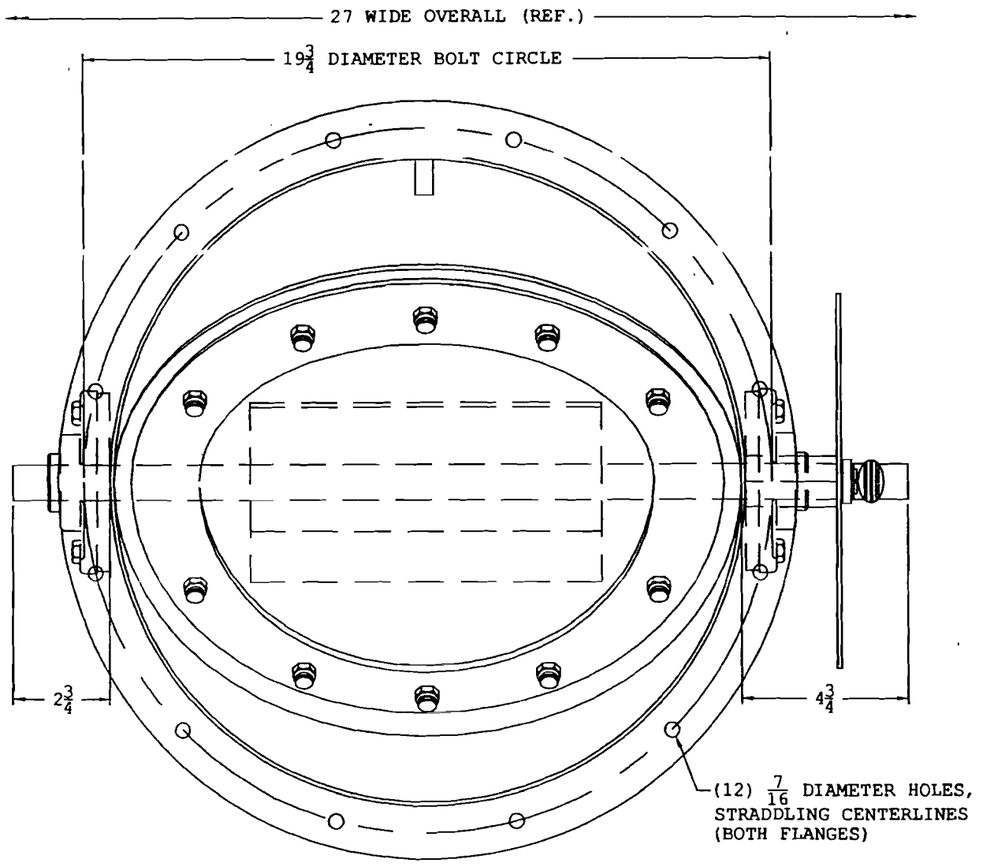
DRAWING STATUS
☒ RELEASED FOR FABRICATION
☐ HELD FOR APPROVAL
☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

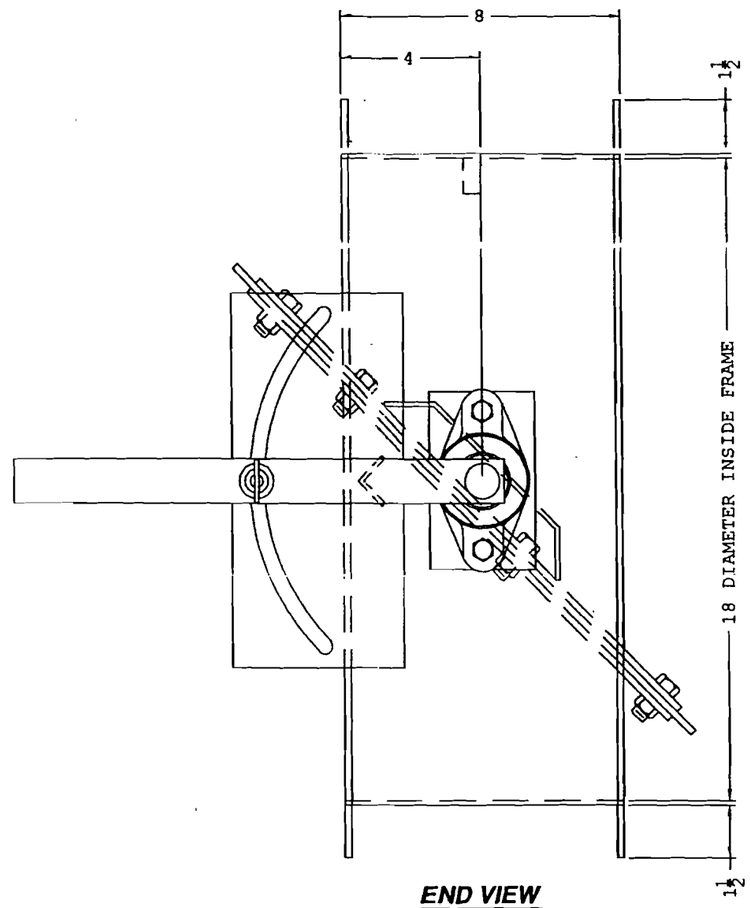
CAD BY	APPD BY	Q.A.	-
DRN. BY SJA	DWG. NO. 20835004-2		REV.
DATE 5-18-04			

AutoCAD 208350042



FACE VIEW
FLOW ENTERING SIDE

FLOW



END VIEW

SPECIFICATIONS

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BEARINGS: RELUBRICABLE BALL WITH NEOPRENE O-RING STUFFING BOXES.

SEALS: FULL CIRCUMFERENCE NEOPRENE SEAL RETAINED BY A SEAL RING BOLTED TO THE BLADE.

STOPS: 1/2" DIAMETER 304 STAINLESS STEEL PIN.

FINISH: MILL.

ACTUATOR: HEAVY DUTY MANUAL QUADRANT, 304 STAINLESS STEEL.

NOTES

1. DESIGN CRITERIA:
   - MAX. DIFF. PRESS.: 40 IN. W.G.
   - MAX. TEMPERATURE: 150 DEG. F.
   - MAX. VELOCITY: 4000 FPM
   - EST. WEIGHT: 115 LBS.
   - MAX. LEAKAGE: .027 SCFM PER INCH OF BLADE CIRCUMFERENCE AT 40 IN. W.G.
2. QUANTITY: (4) FOUR DAMPER REQUIRED AS SHOWN.
3. DAMPERS WILL BE VERTICALLY MOUNTED WITH HORIZONTAL AIRFLOW.
4. GRIND FRAME WELD SMOOTH ON INSIDE OF FRAME. CAULK SEAL BOLTS. CAULK O-RING STUFFING BOX - EACH LAYER.
5. ALL WELDING WILL BE PERFORMED IN ACCORDANCE WITH AWV STANDARD WELD DRAWINGS #10151-STD SERIES, UNLESS OTHERWISE SPECIFIED.
6. DAMPERS WILL BE CYCLE TESTED (3) THREE TIMES UNDER SHOP FLOOR CONDITIONS.
7. INLET AND OUTLET DUCTS MUST BE OF SUFFICIENT LENGTH TO CONTAIN THE BLADE IN THE FULL OPEN POSITION AND THE DUCT AND JUNCTION OF THE DAMPER MUST BE SMOOTH AND FREE OF PROTRUSIONS THAT MAY DAMAGE THE BLADE EDGE.
8. TAG: 701458, V-601, V-602, V-621 & V-622

CERTIFIED FOR FABRICATION

MAY 27 2004

A W V

LAYNE CHRISTENSEN Co. WTD
P.O. No.: 11980701458
AIR SYSTEMS ENG., INC.
P.O. No.: AW04C48
AWV PROD. No.: 208350

STANDARD MANUFACTURING TOLERANCES UNLESS OTHERWISE SPECIFIED DWG. DIMENSIONS ARE IN INCHES.

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REFERENCE ----- GIVEN AS SHOP AID. DIMENSIONS MAY VARY
(+ OR -) 1/16 TRUE LOCATION -- ALL MOUNTING HOLES

DECIMALS
DECIMAL 1 PLACE - (+ OR -) .015
2 PLACE - (+ OR -) .010
3 PLACE - (+ OR -) .005

REVISION	DATE	DRN/CK	APPD	QA

DRAWING STATUS
- ☒ RELEASED FOR FABRICATION
- ☐ HELD FOR APPROVAL
- ☐ AS BUILT DRAWINGS

awv american warming and ventilating
A MESTEK COMPANY
7301 INTERNATIONAL DRIVE HOLLAND, OHIO

VC-56ISO HEAVY DUTY ISOLATION DAMPER

DRN.BY SJA	APPD.BY Shields Dur	Q.A. -	
DATE 5-18-04	DWG. NO. 20835004-3		REV.

AutoCAD 208350043

Isolation Damper Manufacturer's Certificate of Conformance

awv american warming and ventilating

AMCA MEMBER

Certificate of Conformance

Job Name: M.L. Water District TP

Customer: Layne Christensen Company
97 Chimney Rock Rd
Bridgewater NJ 08807

Representative: Air Systems Engineering, Inc.

AWV Job No.: 208350

AWV Model No.: VC-56I(SO)-710

The (9) 18 inch diameter heavy duty round isolation dampers supplied on this project are required to meet low leakage results as follows:

(1) unit 0.009 SCFM/in of perimeter at 10 inches of water gauge
or 0.509 SCFM total

(4) units 0.023 SCFM/in of perimeter at 30 inches of water gauge
or 1.301 SCFM total

(4) units 0.027 SCFM/in of perimeter at 40 inches of water gauge
or 1.526 SCFM total

Leakage performance was recorded as follows for a pre production unit.

- At 20 inches of water gauge; Total leakage: 0.0269 SCFM – 5.3% of allowable at 10 inches of water gauge.
- At 30 inches of water gauge; Total leakage: 0.0409 SCFM – 3.1% of allowable
- At 40 inches of water gauge; Total leakage: 0.0581 SCFM – 3.8% of allowable

The leakage results were significantly below the allowable leakage rates, therefore testing of each unit is not required.

At 40 inches of water gauge, the total leakage of 0.0581 SCFM is less than the requirement at 10 inches of water gauge, thus testing at 10 inches of water gauge is not required.

Test was performed using a pressure decay method for a minimum of 5 minutes in our AMCA registered laboratory in Bradner, Ohio. Test was performed by Mr. John Lockmiller, Laboratory Manager.

William Lampkin
AWV Engineering Manager

24-Jul-04
Date

7301 International Drive • Holland, OH 43528 • Phone: (419) 865-5000 • Fax: (419) 865-1375

Air Sample Probe

ARCADIS

SUBJECT: VAPOR SAMPLE PORT DETAIL

OFF-SITE REMEDIATION SYSTEM

FORMER UNISYS FACILITY, GREAT NECK, NEW YORK

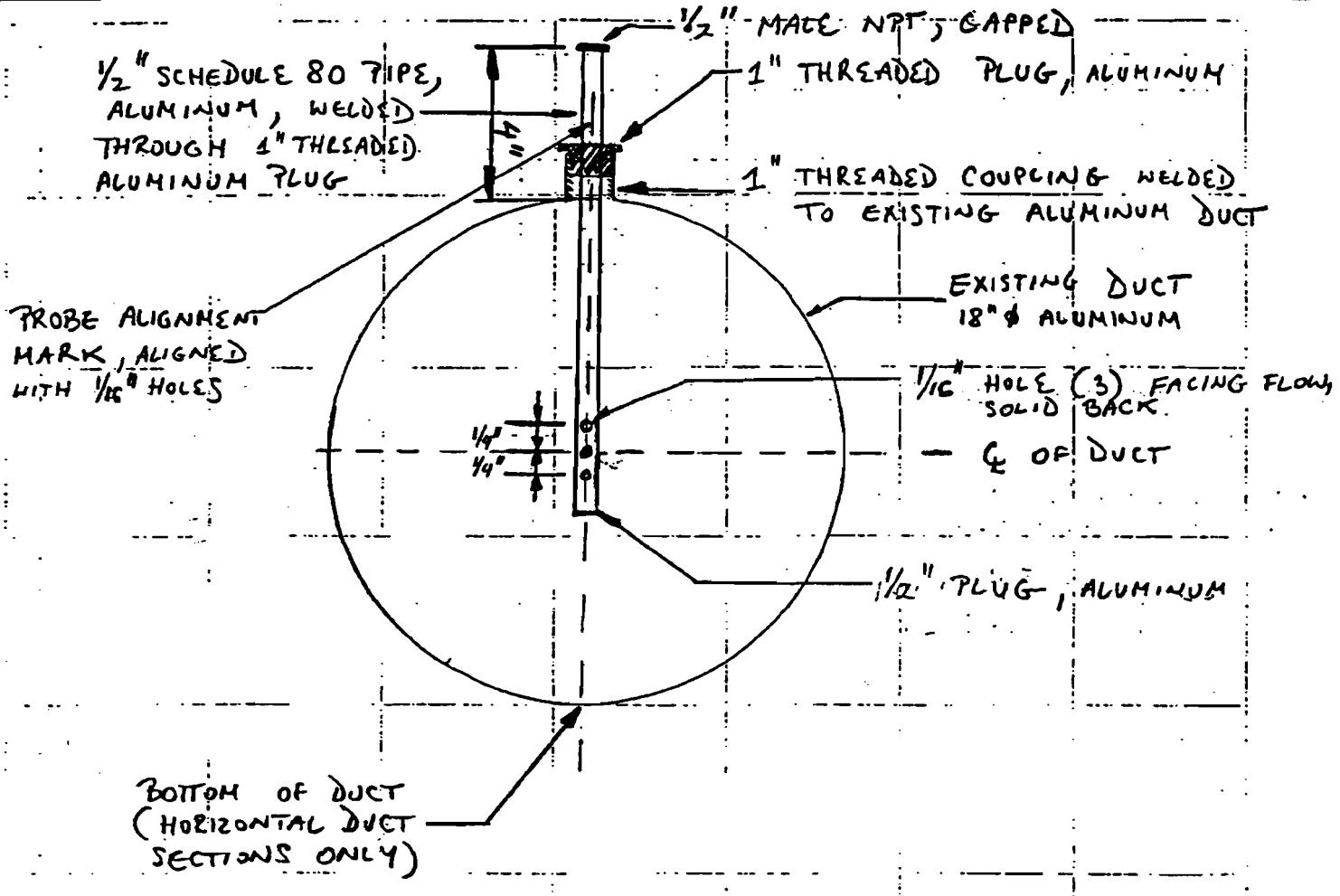
JOB NO:

BY: kk DATE: 4/20/04

CHKD: DATE:

PAGE

SHEET 1



Duct Port Legend, Off-site Groundwater Treatment System, Former Unisys Facility, Great Neck, New York.

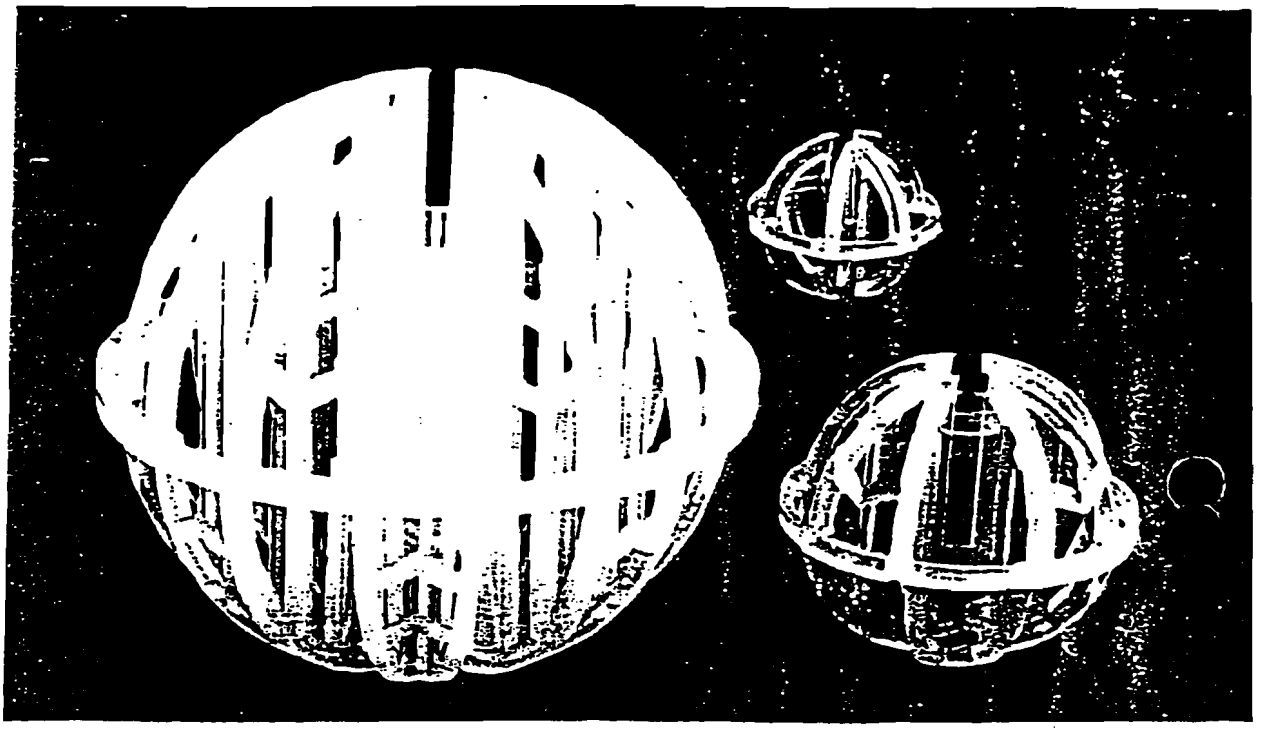
Port Number	Nature	Instrument Number	Duct Connection	Additional Comments
1	Drain	--	3/4" Female NPT	Installed at Bottom of TEE
2	Flow Transmitter	FIT 313	3/4" Female NPT	Installed at Top of Duct
3	Pressure Transmitter	PIT 313	1/4" Female NPT	Installed at Top of Duct
4	Temperature Gage	TI 313	1/2" Female NPT	Installed at Top of Duct
5	Sample Port	S1	1" Per detail	Installed at Top of Duct
6	Drain	--	3/4" Female NPT	Installed at Bottom of TEE
7	RH/Temp Transmitter	RHIT 501	1/4" Female NPT	Installed facing south, 4 feet from top of vertical run
8	RH/Temp Transmitter	RHIT 502	1/4" Female NPT	Installed at Top of Duct
9		REMOVED		
10	Temperature Gage	TI 502	1/2" Female NPT	Installed at Top of Duct
11	Sample Port	S3	1" Per detail	Installed at Top of Duct
12	Pressure Gage	PI 631	1/4" Female NPT	Installed at Top of Duct
13	Sample Port	S4	1" Per detail	Installed facing east, 2 feet from top of vertical run
14	RH/Temp Transmitter	RHIT 621	1/4" Female NPT	Installed facing east, 3 feet from top of vertical run
15	Pressure Gage	PI 621	1/4" Female NPT	Installed facing east, 2.5 feet from top of vertical run
16	Sample Port	S5	1" Per detail	Installed at Top of TEE
17	Sample Port	S6	1" Per detail	Installed at Top of Duct
18	Pressure Gage	PI 611	1/4" Female NPT	Installed at Top of Duct
19	Temperature Gage	TI 631	1/2" Female NPT	Installed at Bottom of Duct
20	RH/Temp Transmitter	RHIT 631	1/4" Female NPT	Installed at Top of Duct
21	Sample Port	S7	1" Per detail	Installed at Top of Duct
22	Flow Transmitter	FIT 631	3/4" Female NPT	Installed at Top of Duct
23	Pressure Gage	PI 633	1/4" Female NPT	Installed at Top of Duct
24	Sample Port	S8/PI641	1" Per detail	Installed facing south, perpendicular to influent duct, 2 feet from bottom of vertical run
25	Temperature Gage	TI 641	1/2" Female NPT	Installed facing south, perpendicular to influent duct, 3 feet from bottom of vertical run
26	Sample Port	S9	1" Per detail	Installed at Top of Duct
27	Pressure Transmitter	PIT 311	1/4" Female NPT	Installed at Top of Duct
28	Drain	--	3/4" Female NPT	Installed at Bottom of TEE
29		NEW	3/4" Female NPT	Installed at Top of Duct and Plugged
30		NEW	3/4" Female NPT	Installed at Top of Duct and Plugged

Section IV
Miscellaneous

Packing Cut-Sheets

PLASTIC JAEGER TRI-PACK

High performance column packin



FEATURES

Plastic Jaeger Tri-Packs® is a hollow, spherical-shaped packing made of injection molded plastic in three sizes: 1", 2" and 3½" diameter. Its symmetrical geometry made from a unique network of ribs, struts and drip rods yields unprecedented performance. It has high void space, greater than packings of comparable size, and achieves superior pressure drop values, up to 90% reduction, as compared to other products. The packing has a high ACTIVE surface area, exposing all of its surface area to be fully wetted during column operation. The performance capabilities of plastic Jaeger Tri-Packs® have resulted in significant savings in hundreds of packed column operations.

BENEFITS

- Highest mass and/or heat transf rate
- Extremely low pressure drop
- Free of plugging, fouling, nestir and wall channeling
- Highest flooding point and lowe wetting point
- Even gas and liquid distributio
- No interlocking or meshi
- Used as a mist eliminato

PLASTIC JAEGER TRI-PACKS®

SPECIFICATIONS

Materials. Nine standard, injection moldable plastics are available:

Polypropylene (PP)	Kynar® (PVDF)
Polyethylene (PE)	Halar® (ECTFE)
Polypropylene Glass-Filled (PP-G)	TopEx (LCP)
Noryl® (PPO)	Tefzel® (ETFE)
	Teflon® (PFA)

Others are available on request.

Sizes. Plastic Jaeger Tri-Packs® packings are made in three sizes:

No. ½... 1" Nominal
No. 1... 2" Nominal
No. 2... 3½" Nominal

PHYSICAL PROPERTIES

Type	No. ½	No. 1	No. 2
Size	1"	2"	3½"
Geometric Surface Area (ft^2/ft^3)	85	48	38
Packing Factor (1/ft)	28	17	12
Void Space (%)	90	93	95
Weight (lb/ft^3)	6.2	4.2	3.3

MASS TRANSFER DATA

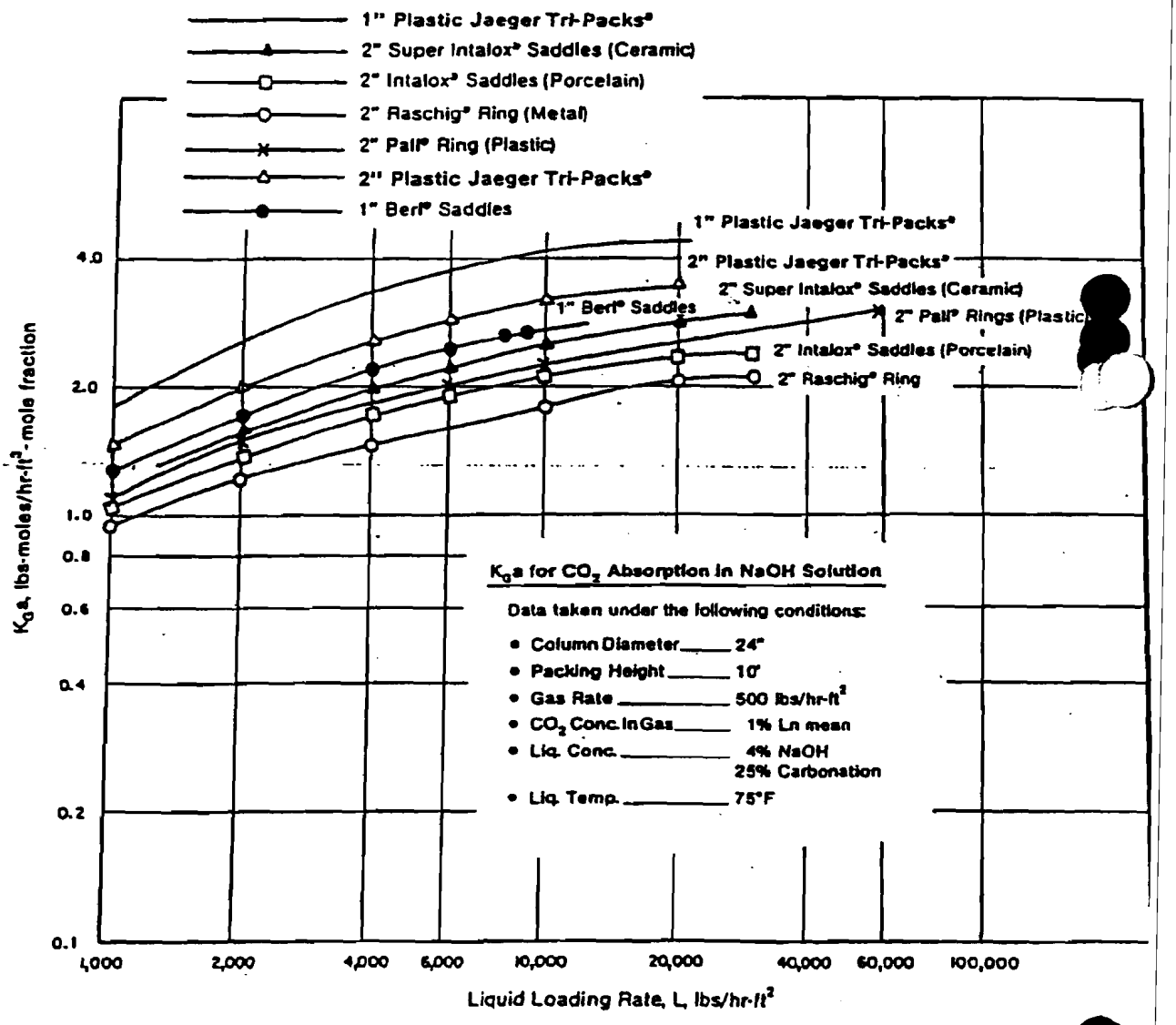
Absorption System	G ($lb/hr\text{-}ft^2$)	L ($lb/hr\text{-}ft^2$)	Temp. (°F)	HTU - Inches 2" & 3½"	HTU - Inches 1"
$HCl\text{-}H_2O$	1792	2048	77	10.6	7.0
HCl-NaOH	1567	2048	68	8.8	6.1
Cl_2-NaOH	1229	2202	122	14.5	9.9
$NO_2\text{-}Na_2S$+NaOH	717	1127	68	49.2	32
$NH_3\text{-}H_2SO_4$	492	1024	68	6.0	4.1
$NH_3\text{-}H_2O$	512	1024	68	8.4	5.6
$NH_3\text{-}H_2O$	512	4096	68	5.4	3.6
SO_2-NaOH	1946	4096	140	12.0	8.1
$HF\text{-}H_2O$	1844	3072	77	6.9	4.6
$CH_3COCH_3\text{-}H_2O$	1700	860	68	15.2	10.2
H_2S-NaOH	1229	1331	68	19.4	13.0

VOC Stripping	G ($lb/hr\text{-}ft^2$)	L ($lb/hr\text{-}ft^2$)	Temp. (°F)	HTU - Inches 2"	HTU - Inches 1"
TCE(ppm)-H_2O	479	12264	77	26.9	21.5
TCE(ppm/ppb)-H_2O	690	12494	60	37.6	30.1
BTX(ppb)-H_2O	722	4998	70	39.2	31.4

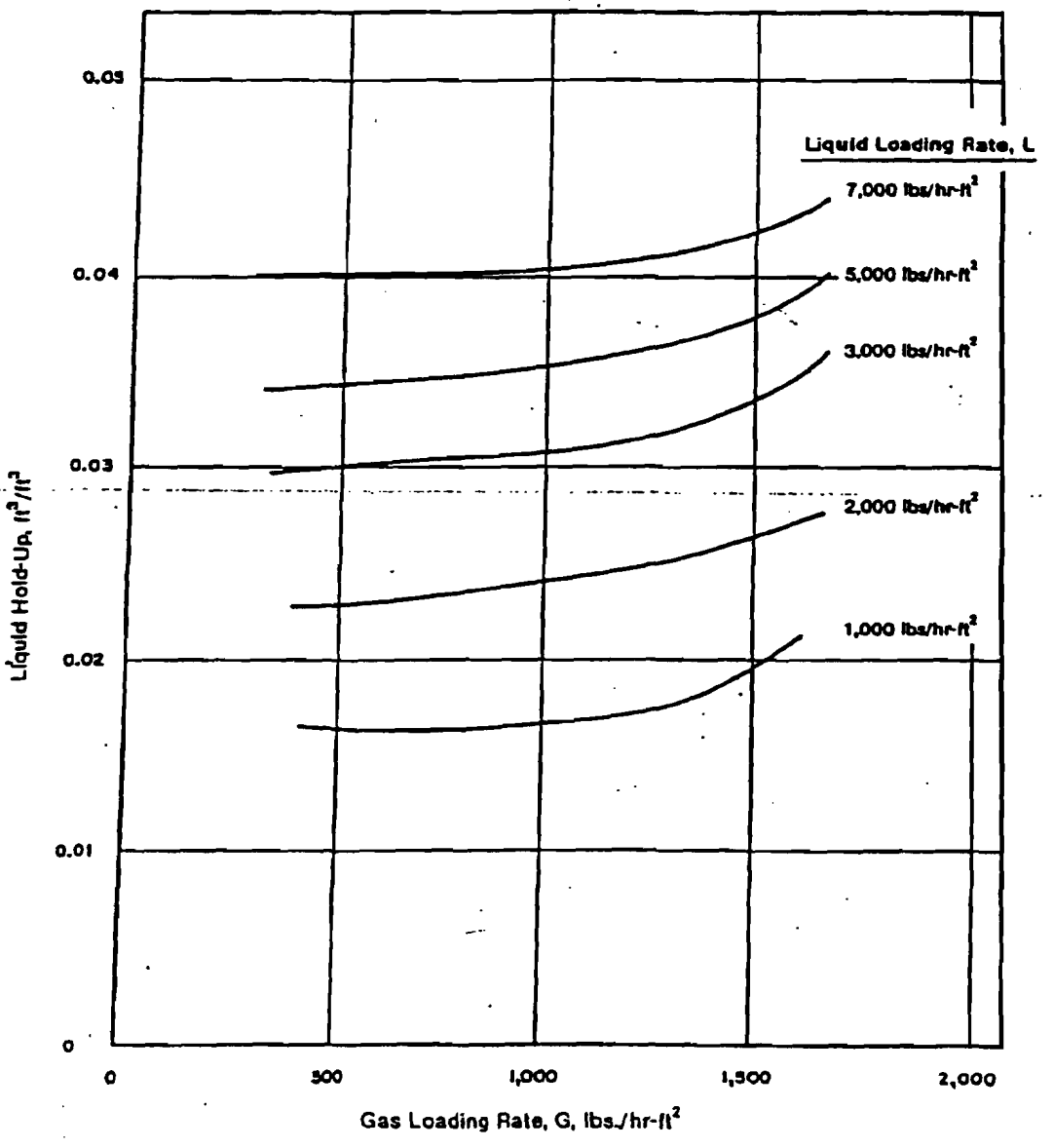
Superior performance by design

JAEGER PRODUCTS, INC.

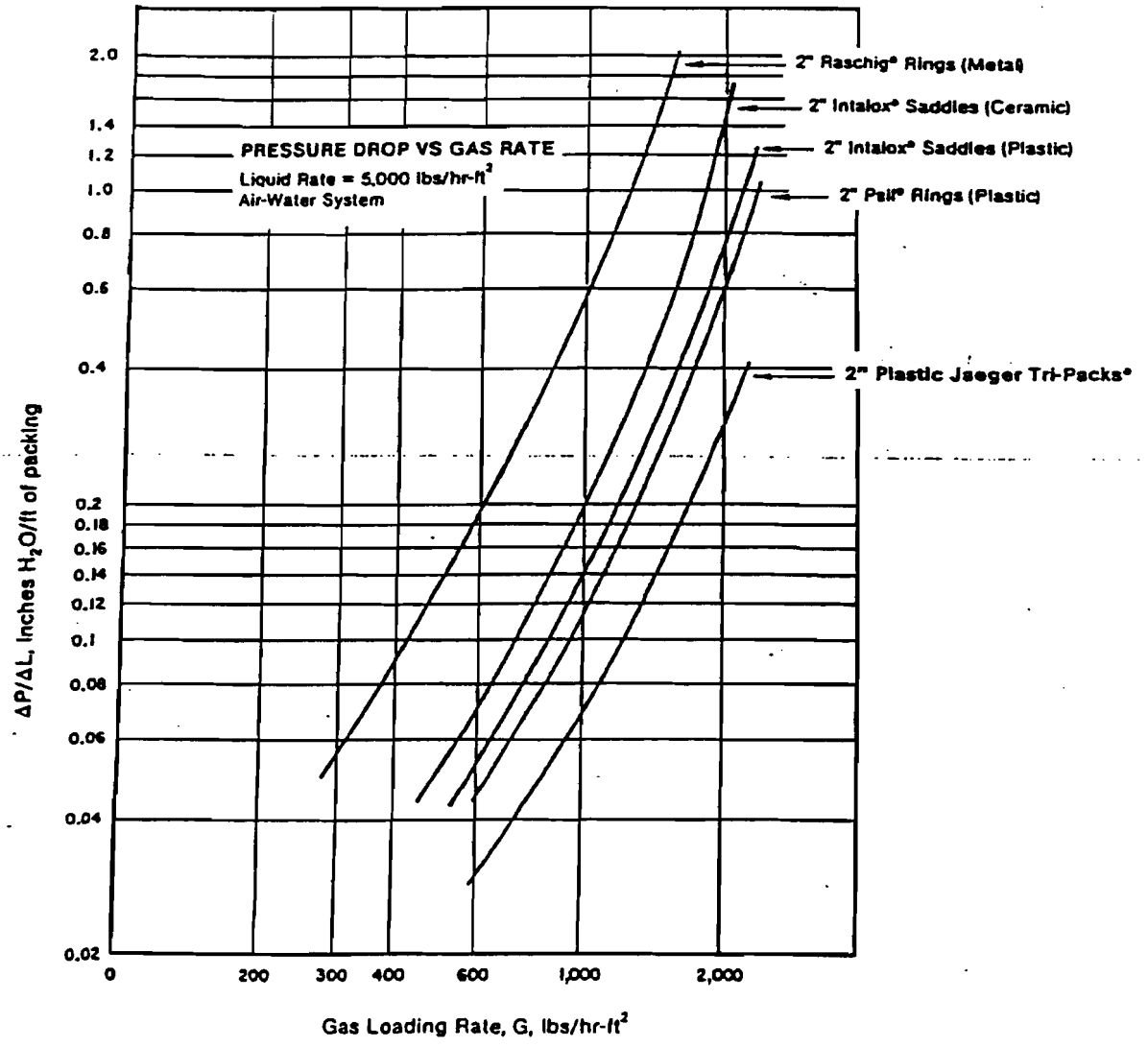
$K_G a$ for CO_2 Absorption in NaOH Solution



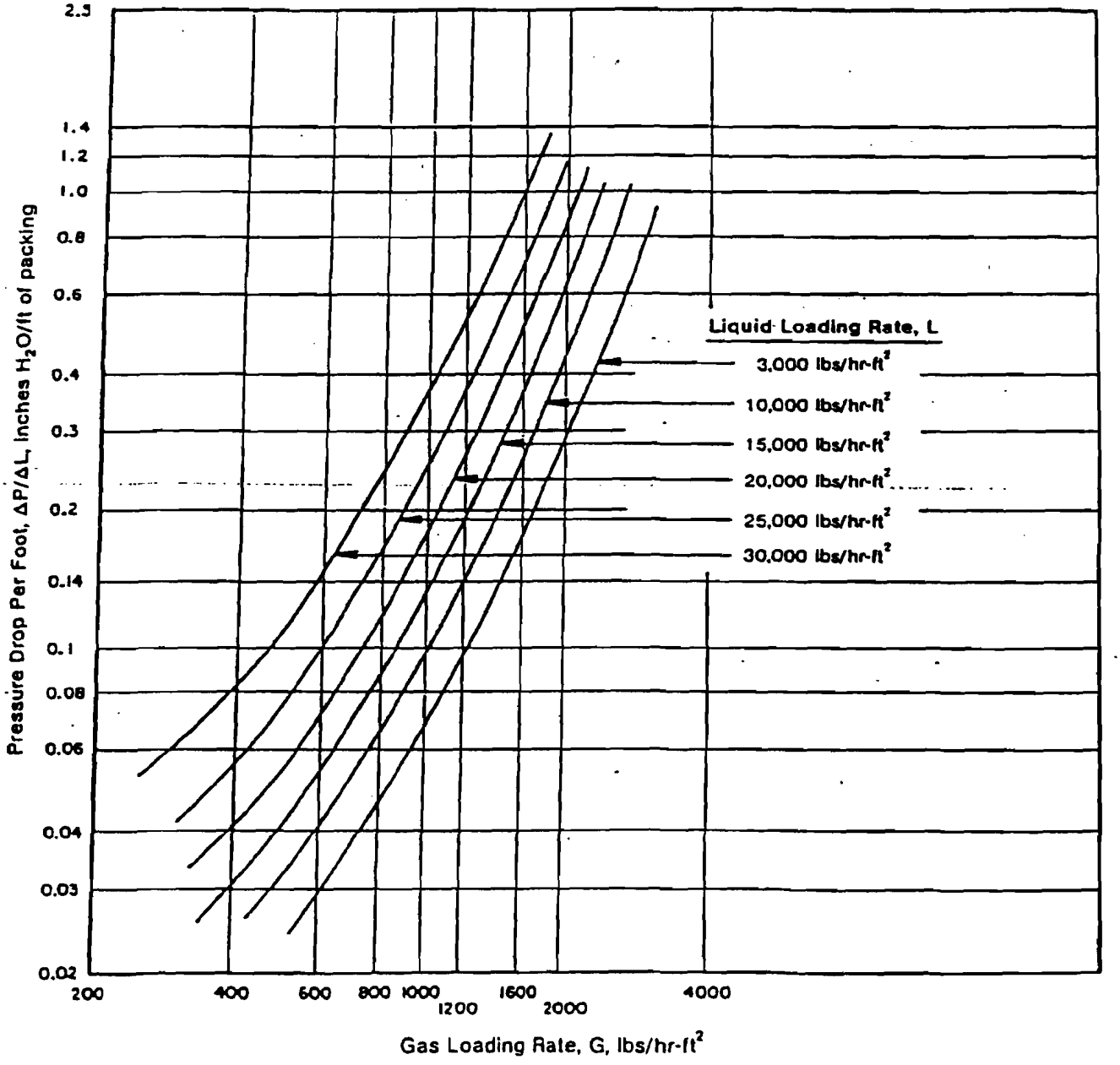
Liquid Hold-Up Data of 2" & 3½" Plastic Jaeger Tri-Packs®



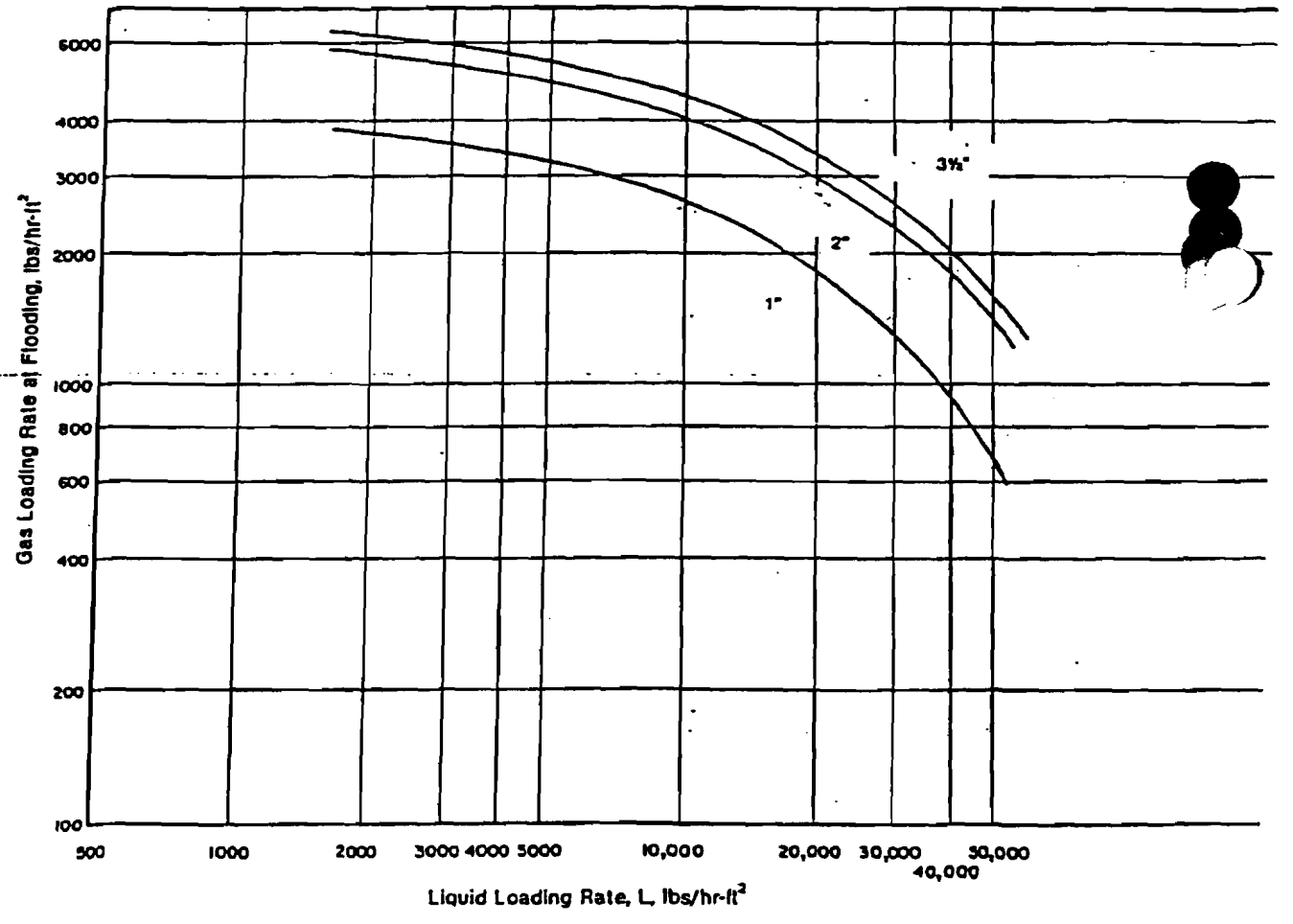
Column Packing Comparison
Pressure Drop vs Gas Rate



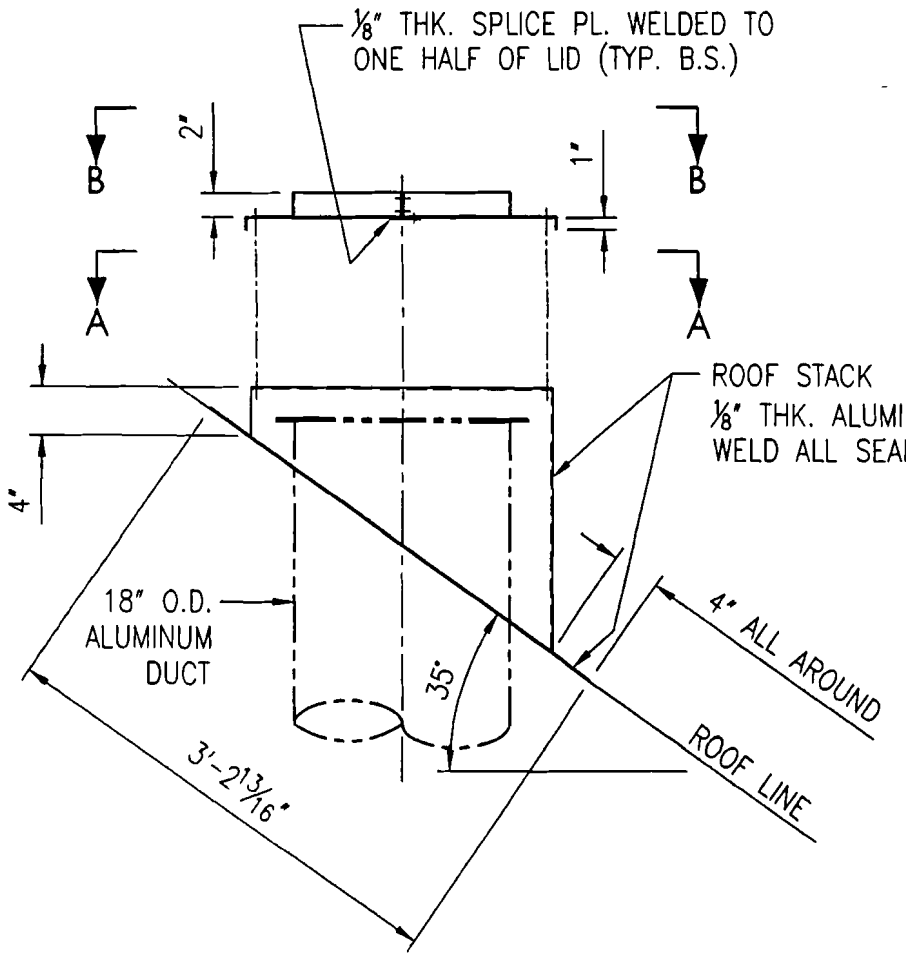
Pressure Drop of 2" Plastic Jaeger Tri-Packs®
Air-Water System, 1 atm, 70°F



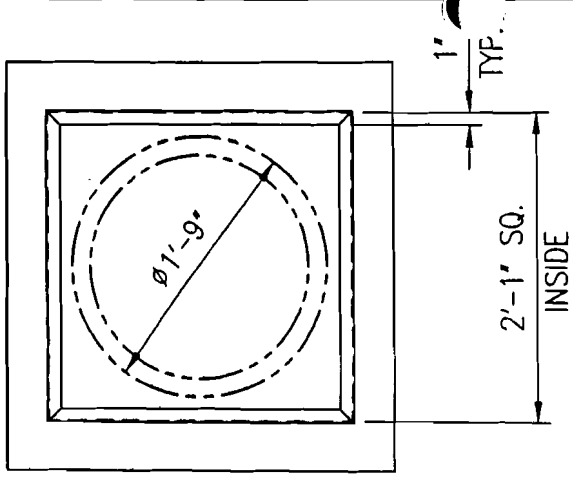
Flooding Points of Plastic Jaeger Tri-Packs®
Air-Water System, 1 atm, 70°F



Duct Waterstop Drawings

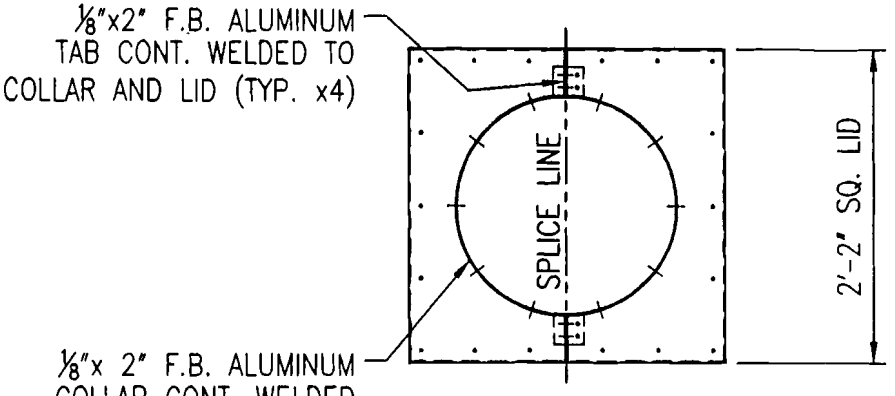


ELEVATION



VIEW "A-A"

(ROOF STACK)



VIEW "B-B"

(STACK LID)

INSTALLATION INSTRUCTIONS:

1. ATTACH "ROOF STACK" TO ROOF AND FLASH ACCORDINGLY.
2. INSERT DUCT THROUGH "ROOF STACK".
3. ATTACH "LID" TO "ROOF STACK", DUCTWORK AND "LID" SPLICE TABS WITH S.S. SELF-TAPPING SCREWS.
4. SILICONE CALK AT ALL JOINTS.

REV: 1	"AS-BUILT"	DATE: 09/08/04

Layne

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
(800) 269-4590
(732) 469-7966

LAYNE CHRISTENSEN CO. - WATER TREATMENT DIVISION

TITLE: **DUCT WATERSTOP AND SUPPORT AT ROOF PENETRATIONS TREATMENT PLANT MODIFICATIONS GREAT NECK, NEW YORK**

JOB NUMBER:	70-1458	SCALE: N.T.S.	
DRN: PMD	DATE: 03/15/2004	DRAWING NUMBER	REV.
CHK:	DATE:	176A5436	1

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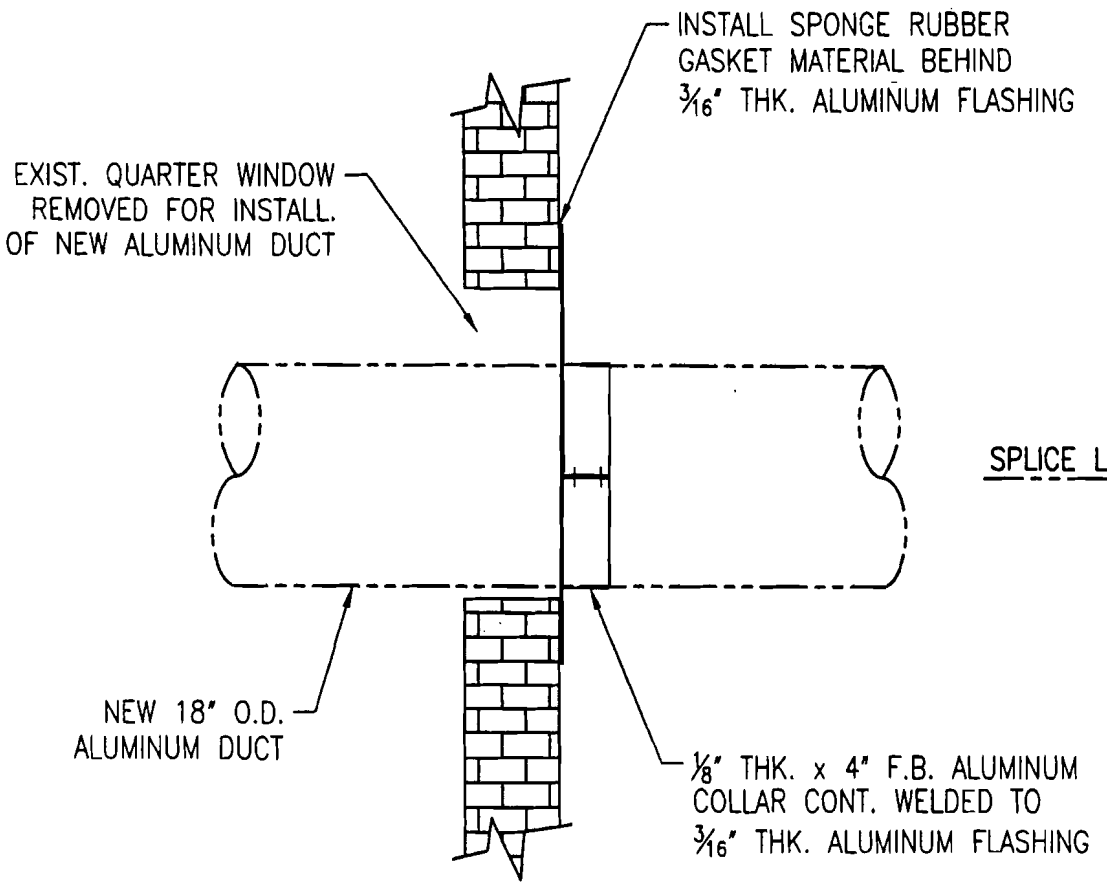

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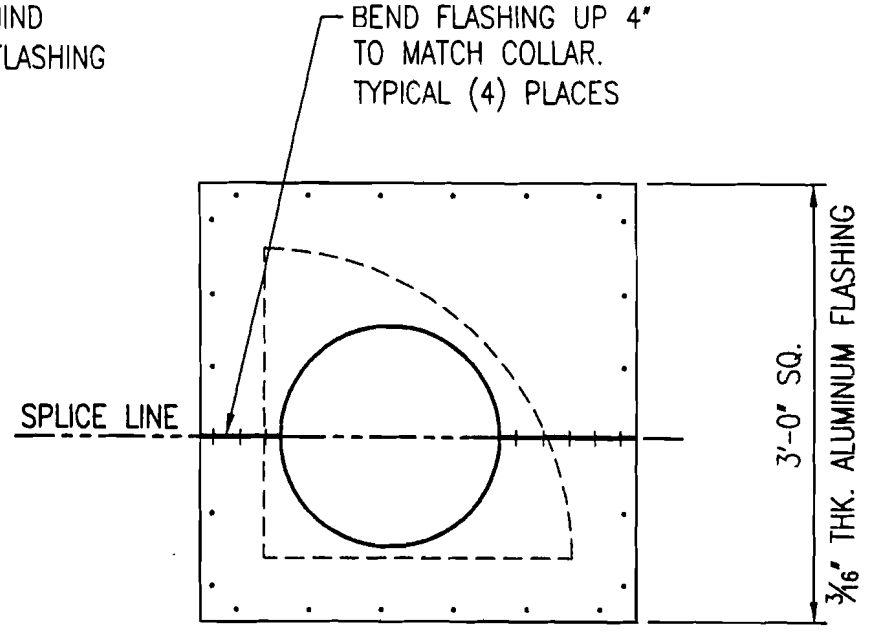


INSTALLATION INSTRUCTIONS:

1. INSERT NEW DUCT THROUGH EXIST. QUARTER WINDOW.
2. ATTACH SPONGE RUBBER GASKET MATERIAL TO BACK OF FLASHING ALL AROUND.
3. POSITION DUCT THEN LAG SCREW FLASHING INTO BUILDING WALL.
4. ATTACH FLASHING HALVES TO EACH OTHER AT SPLICE COLLAR WITH S.S. SELF-TAPPING SCREWS.
5. SEAL ALL JOINTS WITH "SIKAFLEX" 1a.

REV: 1	"AS-BUILT"	DATE: 09/08/04

Layne
97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
(800) 269-4590
(732) 469-7966
LAYNE CHRISTENSEN CO. - WATER TREATMENT DIVISION

TITLE: DUCT WATERSTOP AT WINDOW PENETRATION TREATMENT PLANT MODIFICATIONS GREAT NECK, NEW YORK

JOB NUMBER:	70-1458	SCALE:	N.T.S.
DRN: PMD	DATE: 03/15/2004	DRAWING NUMBER	REV.
CHK:	DATE:	176A5438	1

ID - S:\DRAWINGS\DWGS\100 - Aeration Equipment\170 - Air Stripper Components\176 - Custom Details and Parts\176A5438.dwg - Fri, 1 Oct 2004 - 11:51

ASME "U" Stamp Certificate

CERTIFICATE OF AUTHORIZATION

This certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the Code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY:

LAYNE CHRISTENSEN COMPANY
WATER TREATMENT DIVISION
97 CHIMNEY ROCK ROAD
BRIDGEWATER, NEW JERSEY 08807

SCOPE:

MANUFACTURE OF PRESSURE VESSELS AT THE ABOVE LOCATION AND FIELD SITES CONTROLLED BY THE ABOVE LOCATION

AUTHORIZED: **JUNE 24, 2002**

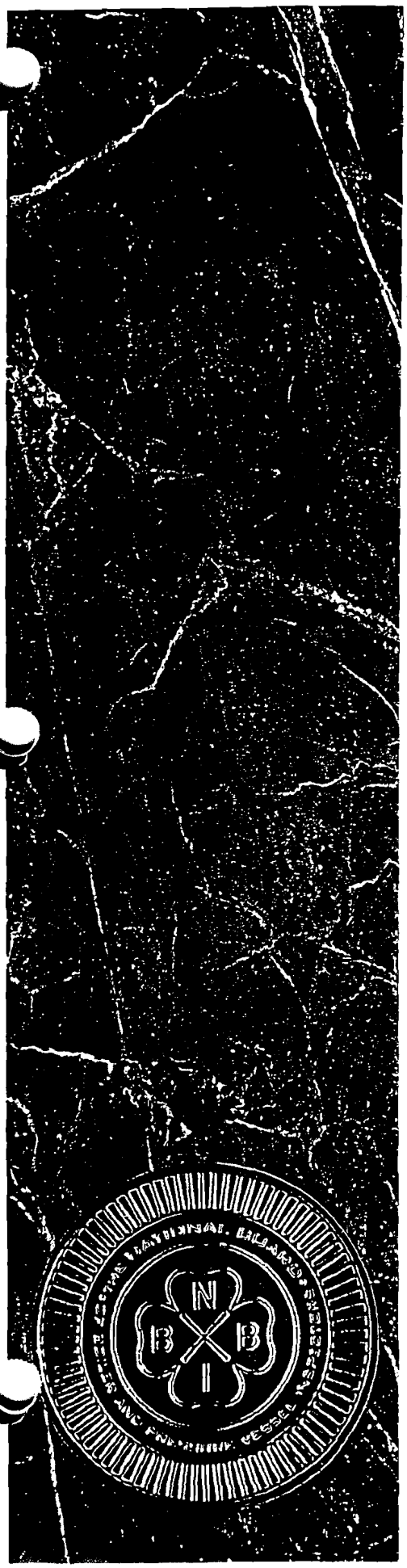
EXPIRES: **JUNE 24, 2005**

CERTIFICATE NUMBER: **21,998**

CHAIRMAN OF THE BOILER
AND PRESSURE VESSEL COMMITTEE

DIRECTOR, ACCREDITATION AND CERTIFICATION

The American Society of Mechanical Engineers



THE NATIONAL BOARD
OF
BOILER & PRESSURE VESSEL INSPECTORS

Certificate of Authorization

This is to certify that

Layne Christensen Company
Water Treatment Division
97 Chimney Rock Road
Bridgewater, NJ 08807

is authorized to apply the "NB" mark and register boilers, pressure vessels, or other pressure retaining items with the National Board in accordance with its provisions.
The scope of Authorization is limited to items manufactured in accordance with:

ASME *Stamp(s): U*

ISSUE DATE: June 24, 2002

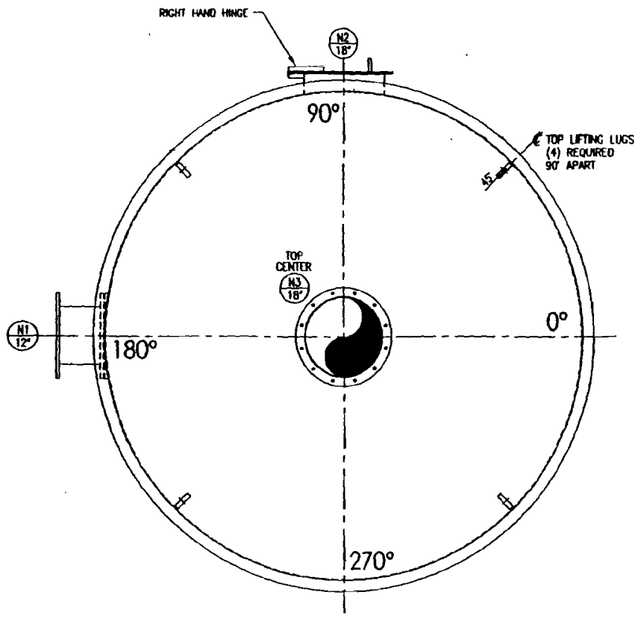
EXPIRATION DATE: June 24, 2005

Executive Director

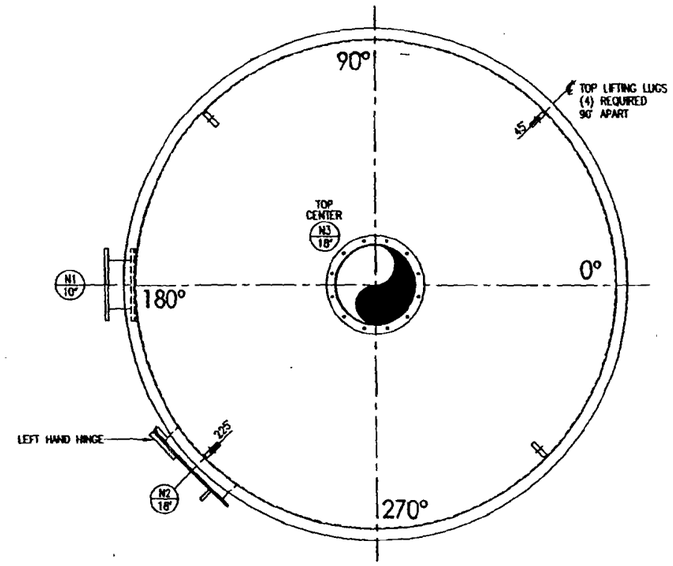
NB 137 Rev. 6

Section V
Drawings

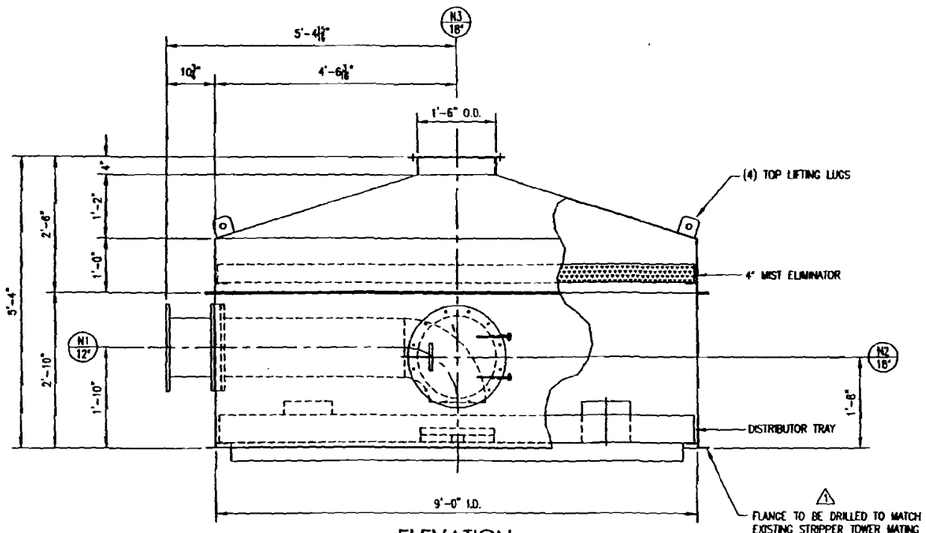
AND PLAN VIEW FOR FITTING ORIENTATION.



PLAN AND TRUE ORIENTATION
TOWER 1

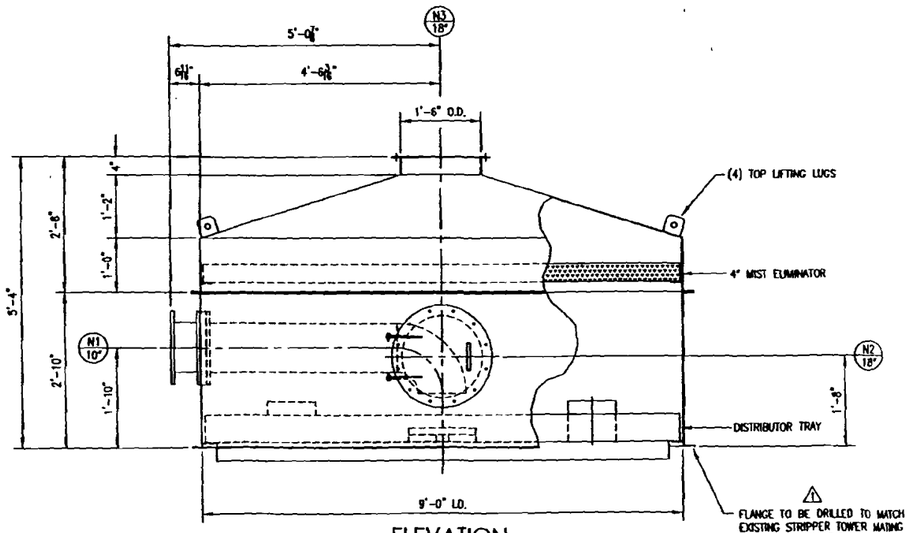


PLAN AND TRUE ORIENTATION
TOWER 2



ELEVATION
TOWER 1 TOP SECTION

SCALE: ¾"=1'-0"
(1 REQUIRED)



ELEVATION
TOWER 2 TOP SECTION

SCALE: ¾"=1'-0"
(1 REQUIRED)

MATERIAL SPECIFICATION

DESCRIPTION		ALUMINUM	STAINLESS STEEL
TOWER SHELL 3/16" THICK		5052-H32	
INTERNAL STRUCTURAL		6063-T5	
EXTERNAL STRUCTURAL		6061-T6	
NOZZLE NECKS		6063-T5	
NOZZLE FLANGES		6061-T6	
REDISTRIBUTION RINGS		N/A	
BOLTING			304
AFFLUENT PIPING			304
DUCTWORK	TOWER OUTLET	5052-H32	
	FLEX-DUCT	REINFORCED NEOPRENE	
DISTRIBUTOR TRAY			304
BASE RING		N/A	
GASKETS	PIPE	RED RUBBER	
	ALL OTHER	NEOPRENE	
MIST ELIMINATOR		POLYPROPYLENE	
PACKING SUPPORT		N/A	
SURFACE PREP. AND PAINTING	EXTERIOR	MILL FINISH	
	INTERIOR	NONE	

NOTES

1. TWO (2) AIR STRIPPING TOWER REPLACEMENT SECTION ASSEMBLIES REQUIRED.
2. ALL WELDS FORMING THE BASIC CYLINDER SHALL BE WATERTIGHT.
3. TOWER TO BE PRESSURE TESTED TO THREE (3) TIMES THE RATED BLOWER STATIC PRESSURE. TOWER SHALL HOLD THE REQUIRED PRESSURE FOR A PERIOD OF ONE (1) HOUR. A SOAP SOLUTION SHALL BE USED TO POSITIVELY LOCATE IMPERFECTIONS.
4. ALL FLANGE BOLT HOLES TO STRADDLE TOWER CENTERLINES.
5. ALL TOWER CONNECTIONS SHALL HAVE PROTECTIVE COVERS PRIOR TO SHIPMENT.

NOZZLE SCHEDULE - TOWER 1

TAG	SIZE	SERVICE	TYPE	PROJ.	ORIENT.	REMARKS
N1	12"	INFLUENT	150#	–	180°	
N2	18"	MANWAY	CUSTOM	4"	90°	
N3	18"	AIR OUTLET	CUSTOM	4"	TOP CENTER	

NOZZLE SCHEDULE - TOWER 2

TAG	SIZE	SERVICE	TYPE	PROJ.	ORIENT.	REMARKS
N1	10"	INFLUENT	150#	–	180°	
N2	18"	MANWAY	CUSTOM	4"	225°	
N3	18"	AIR OUTLET	CUSTOM	4"	TOP CENTER	

NO.	REVISIONS	BY	DATE
1	"AS-BUILT"	PMB	9/28/04
0	ISSUED FOR APPROVAL	PMB	06/01/04

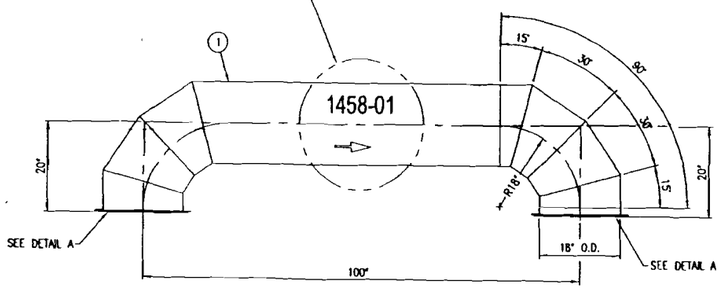
Layne
87 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8726
FAX: (732) 469-7944
LAYNE CHRISTENSEN/WATER TREATMENT DIVISION

OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NY
EQUIPMENT TYPE: AIR STRIPPER PLANT MODIFICATION
MODEL NO.: PCS-108.24
TITLE: STRIPPER TOWER REPLACEMENT CAP SUBMITTAL DRAWING TREATMENT PLANT MODIFICATIONS, OU-2, SOUTH IRM

PROCESS CHK'D. BY / DATE
VESSEL CHK'D. BY / DATE
DRAWN BY / DATE 10/13/04
MECH. CHK'D. BY / DATE
PIPING CHK'D. BY / DATE
APPROVED BY / DATE

JOB NO 70-1458
DRAWING NO. 163D5412
SHEET 1 | TOTAL 1 | REV. 1

ALL ITEMS TO BE LABELED WITH PART NUMBER & FLOW ARROW. LABELING TO BE DONE WITH 1" HIGH STENCILING WITH MEDIUM GRAY SPRAY PAINT.



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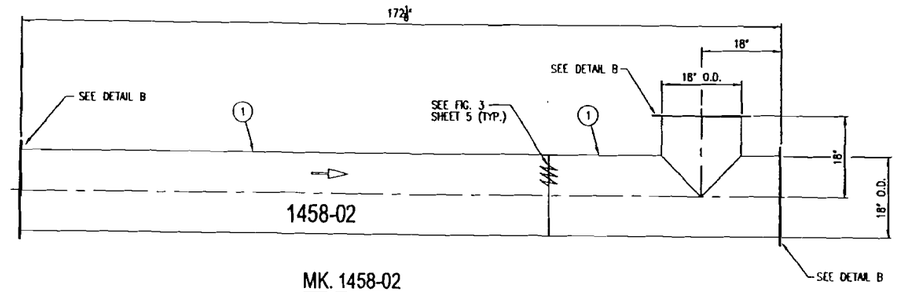
(1 REQUIRED)



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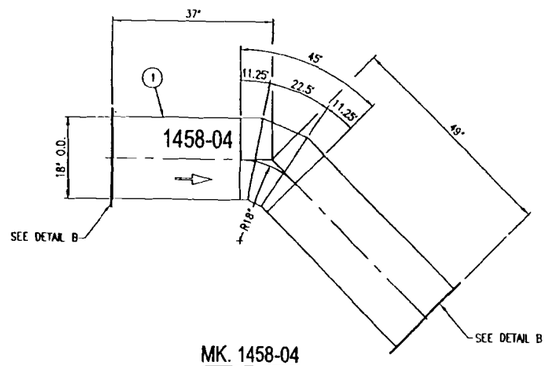
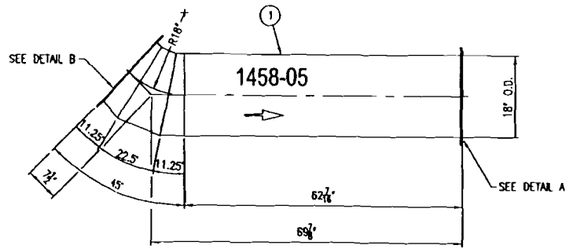


MK. 1458-04
SCALE: 3/4"=1'-0"
(1 REQUIRED)

NOTE:

1. WELD CONTINUOSLY UNLESS OTHERWISE SPECIFIED.
2. ALL ITEMS TO BE LABELED WITH PART NUMBER & FLOW ARROW. LABELING TO BE DONE WITH 1" HIGH STENCILING WITH MEDIUM GRAY SPRAY PAINT.



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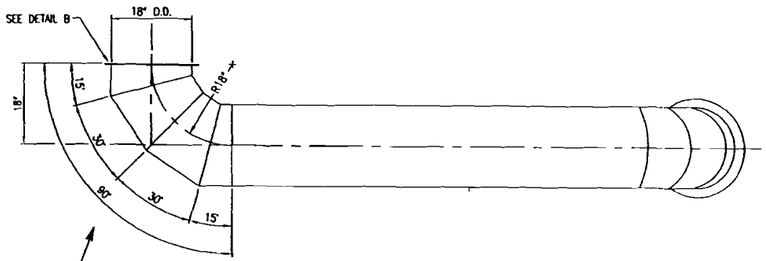

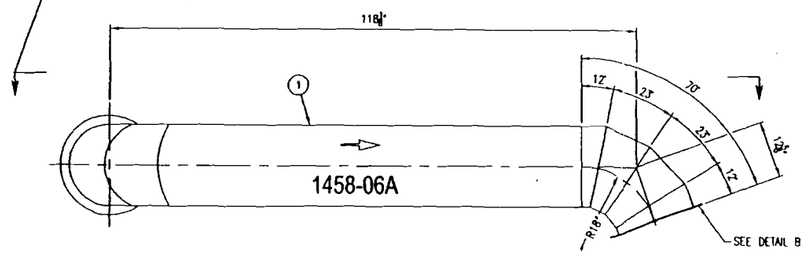

MK. 1458-06A
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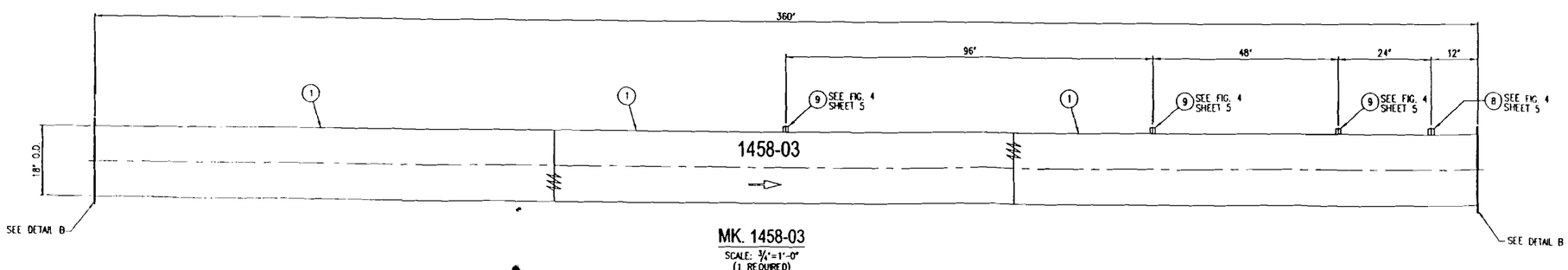


MK. 1458-03
SCALE: 3/4"=1'-0"
(1 REQUIRED)

BILL OF MATERIAL

MK.	QTY.	DESCRIPTION	LENGTH FT.	LENGTH IN.	MAT'L SPEC.	REMARKS
1	50	PLATE, 60" x 1/8" THK. x	10	0	ALUMINUM 5052-H32	
2	1	PLATE, 48" x 1/4" THK. x	12	0	ALUMINUM 5052-H32	
3	31	FLAT BAR, 2" x 1/4" THK.	12	0	ALUMINUM 6061-T6	ROUND FLANGES
4	3	FLAT BAR, 1¾" x 1/4" THK.	12	0	ALUMINUM 6061-T6	VANE-STONE FLANGE
5	9	FLAT BAR, 1½" x 1/4" THK.	12	0	ALUMINUM 6061-T6	ROUND FLANGES
6	3	FLAT BAR, ¾" x 1/4" THK.	12	0	ALUMINUM 6061-T6	VANE-STONE FLANGE
7	5	FLAT BAR, 1" x ⅜" THK.	12	0	ALUMINUM 6061-T6	FLEX BOOT
8	8	FULL COUPLING, 1" NPT - 150#			ALUMINUM	
2 9	20	FULL COUPLING, ¾" NPT - 150#			ALUMINUM	
10	6	FLEX BOOT - BLACK, 8" x 1/16" THK.	5	3	REINFORCED EPDM	FLEX BOOT
11	48	HEX HEAD BOLT, 1/4"-20	-	1	304 S/S	HEATER FLANGE
12	48	HEX NUT, 1/4"-20			304 S/S	
13	96	FLAT WASHER, 1/4" DIA.			304 S/S	
14	53	HEX HEAD BOLT, 5/16"-20	-	1	304 S/S	TIGG INLET FLANGE
15	53	HEX NUT, 5/16"-20			304 S/S	
16	106	FLAT WASHER, 5/16" DIA.			304 S/S	
17	612	HEX HEAD BOLT, 3/8"-16	-	1¼	304 S/S	STD. FLANGE
18	88	HEX HEAD BOLT, 3/8"-16	-	1½	304 S/S	VAN-STONE FLANGE
19	700	HEX NUT, 3/8"-16			304 S/S	
20	1400	FLAT WASHER, 3/8" DIA.			304 S/S	
21	12	HEX HEAD BOLT, 7/8"-9	-	2½	304 S/S	BLOWER INLET FLANGE
22	12	HEX NUT, 7/8"-9			304 S/S	
23	24	FLAT WASHER, 7/8" DIA.			304 S/S	
24	98	HEX HEAD BOLT,1⅛"-7	-	3	304 S/S	TIGG OULET FLANGE
25	98	HEX NUT, 1⅛"-7			304 S/S	
26	196	FLAT WASHER, 1⅛" DIA.			304 S/S	
27	100	POP RIVET, 1/8" DIA. x 3/8" GRIP			304 S/S	
28	1	GASKET, 1/4" THK. x 3/4" - PSA ONE SIDE	50	-	CLOSED CELL SPONGE BLACK	HEATER FLANGE
29	1	GASKET, 1/4" THK. x 1½" - PSA ONE SIDE	100	-	CLOSED CELL SPONGE BLACK	
30	1	GASKET, 1/4" THK. x 2" - PSA ONE SIDE	250	-	CLOSED CELL SPONGE BLACK	
31	6	GASKET, 25" O.D. x 18" I.D. x 1/4" THK.			CLOSED CELL SPONGE BLACK	TIGG OULET FLANGE
32	1	GASKET, 19" O.D. x 12¾" I.D. x 1/4" THK.			CLOSED CELL SPONGE BLACK	BLOWER INLET FLANGE
2 33	1	STREET ELBOW 90° - 150#			ALUMINUM	

NO.	DATE	BY	REVISIONS
1	04/26/04	MJD	"AS-BUILT"
2	5/18/04	RWH	ADDED ITEM #33 AND #9 QTY WAS 21
3	5/25/04	RWH	REVISED TO CUSTOMER'S HOR. LAYOUT
4	6/9/04	RWH	ISSUED FOR BIDS

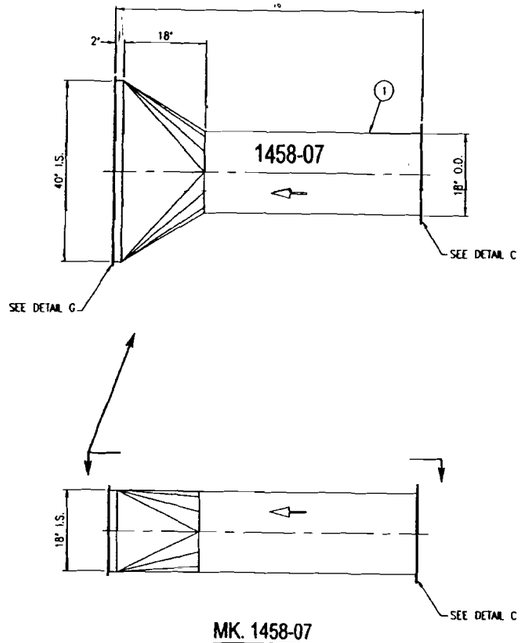
97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7868
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

PROCESS CHK'D BY DATE
VESSEL CHK'D BY DATE
DRAWN BY MJD DATE 4/26/04
JOB NO.
AIR CHK'D BY DATE
PIPING CHK'D BY DATE
APPROVED BY DATE

70-1458
DRAWING NO.
178D5437
SHEET 1 TOTAL 6 REV 3

D:\S\DRAWINGS\DWGS\100 - Aeration Equipment\170 - Air Stripper Expansion\178 - Custom Layne Units\178D5437.dwg



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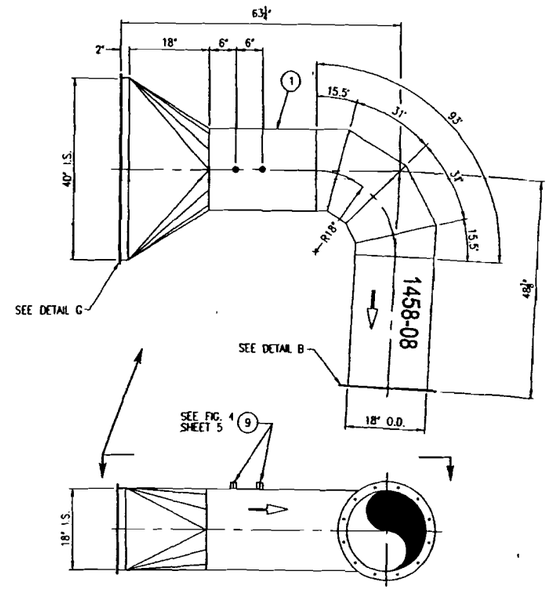

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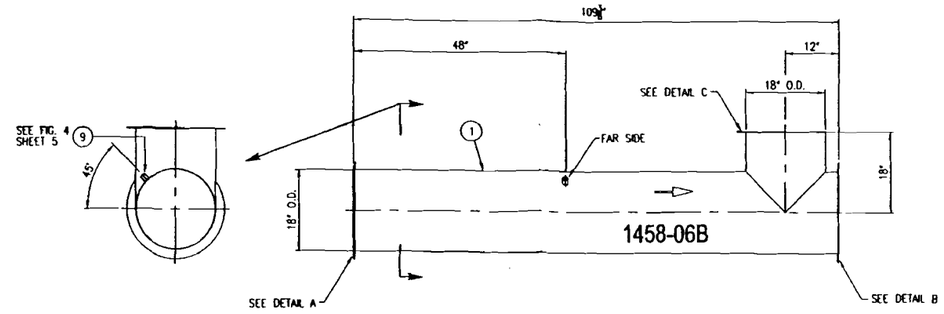
(1 REQUIRED)



MK. 1458-06B
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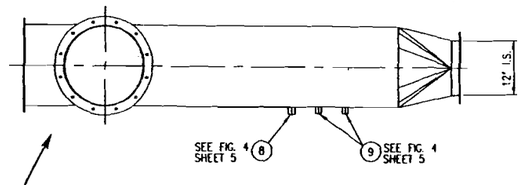

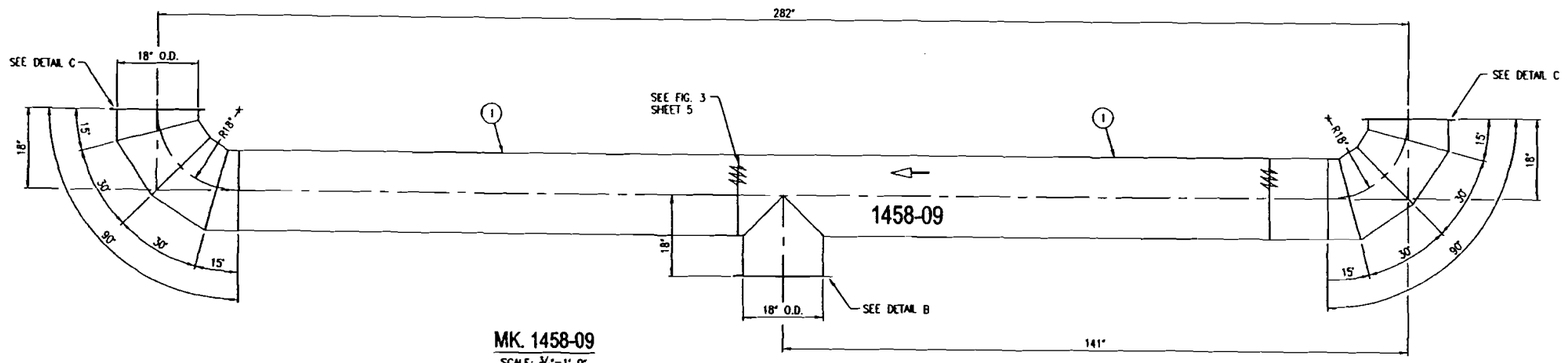

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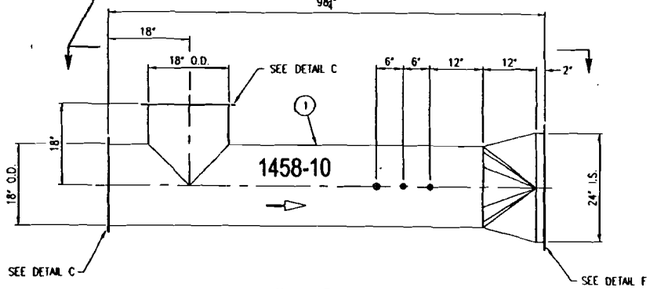
(1 REQUIRED)



MK. 1458-10
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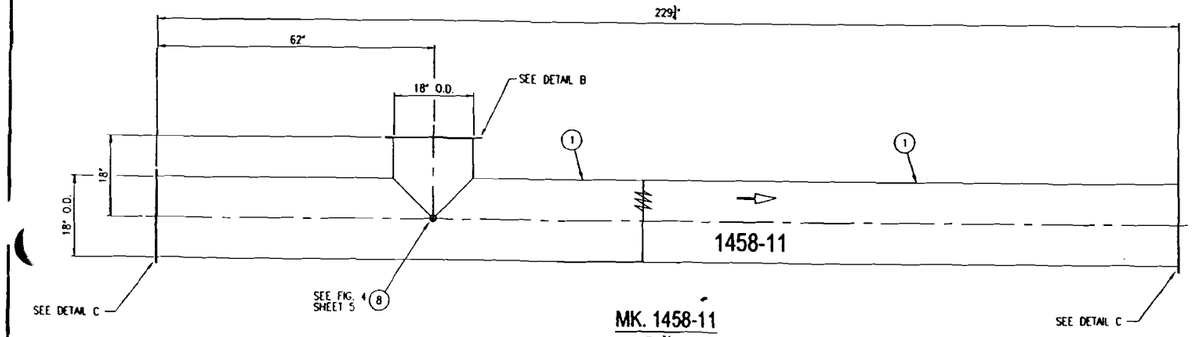
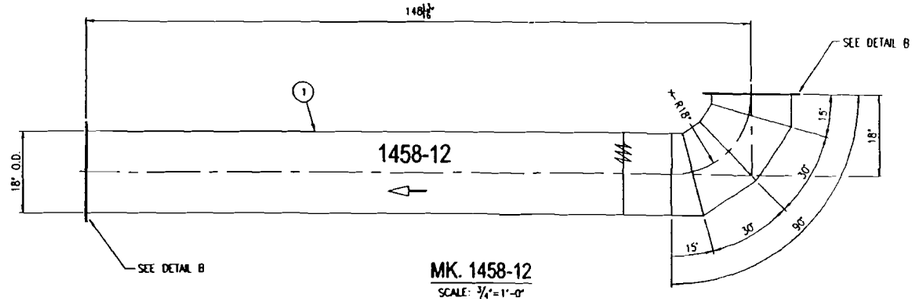
(2 REQUIRED)



MK. 1458-11
SCALE: 3/4"=1'-0"
(1 REQUIRED)



MK. 1458-12
SCALE: 3/4"=1'-0"
(1 REQUIRED)

NO	REVISIONS	DATE	BY
1	"AS-BUILT"	06/08/04	PMD
2	REVISED SHEET 1 AND 5	5/19/04	PMH
3	REVISED TO CUSTOMER'S HOR LAYOUT	9/5/04	PMH
4	ISSUED FOR BIDS	4/8/04	BMH

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-4770
FAX: (732) 469-7986

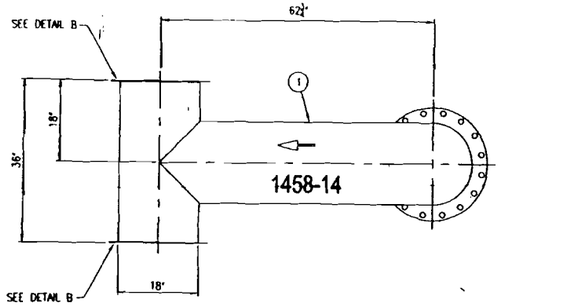
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

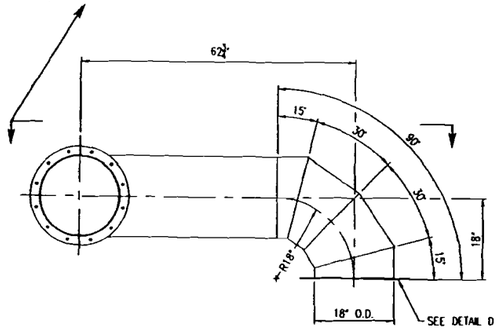
LOCKHEED MARTIN CORPORATION

CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
MODEL NO.: N/A
EQUIPMENT TYPE: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

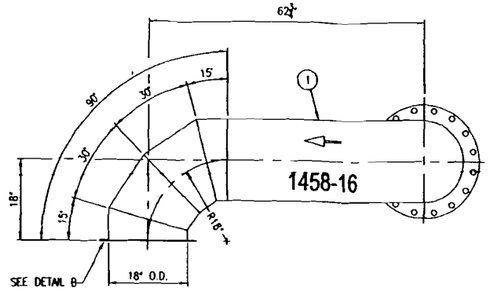
VESSEL CHK'D.	BY		MFG CHK'D.	BY			
	DATE			DATE			
PROCESS CHK'D.	BY		PIPING CHK'D.	BY			
	DATE			DATE			
DRAWN	BY	BMH	APPROVED	BY			
	DATE	3/3/04		DATE			

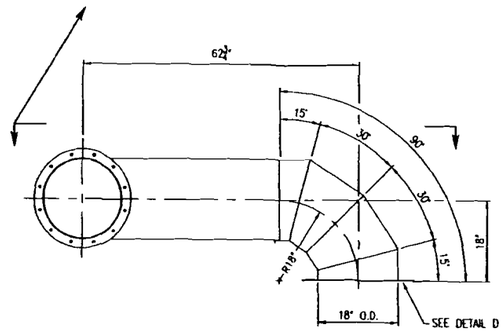
JOB NO: 70-1458
DRAWING NO: 178D5437
SHEET: 2 | TOTAL: 6 | REV: 3



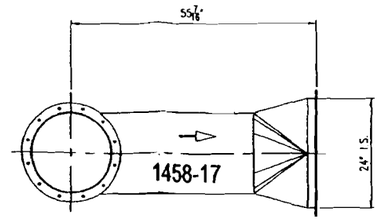


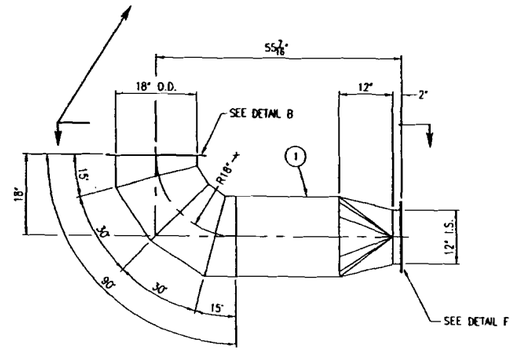
MK. 1458-14
SCALE: ¾"=1'-0"
(5 REQUIRED)





MK. 1458-16
SCALE: ¾"=1'-0"
(1 REQUIRED)





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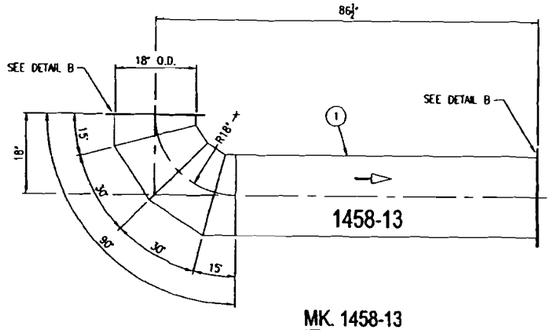
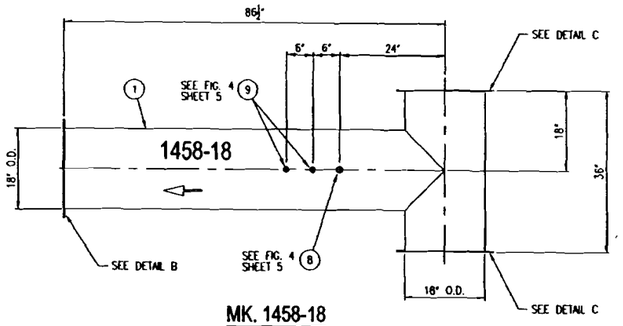
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-13
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-18
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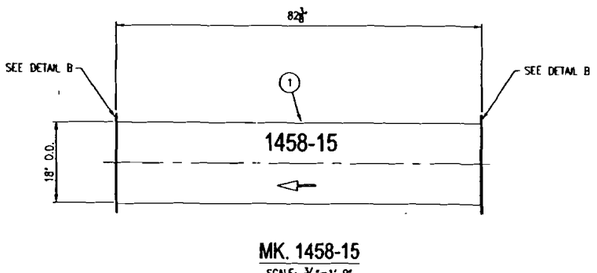

MK. 1458-15
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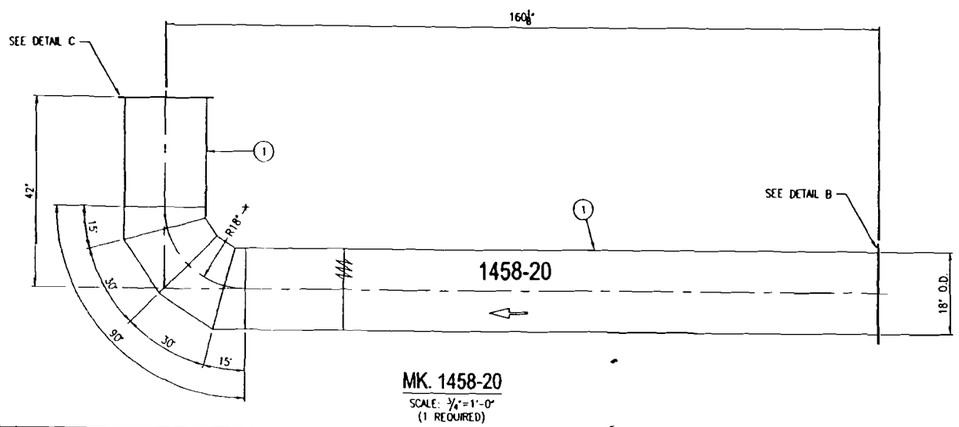
(3 REQUIRED)



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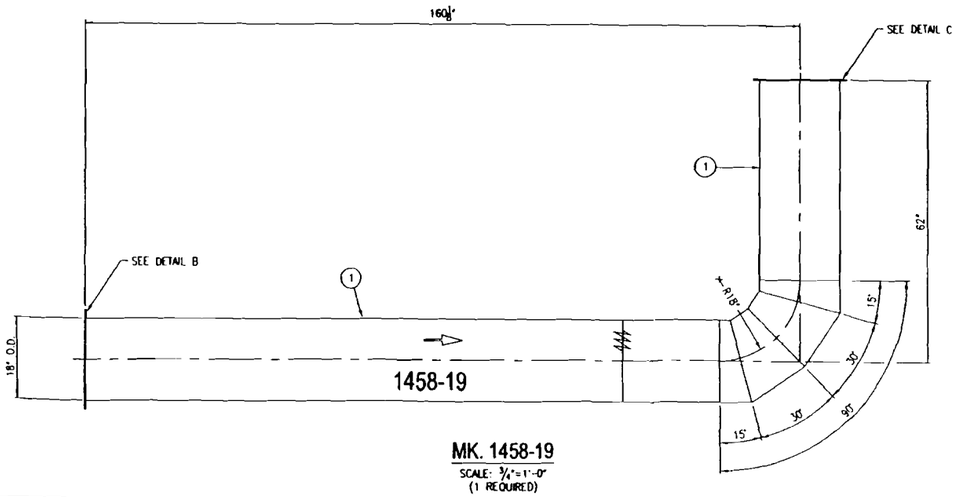
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-19
SCALE: ¾"=1'-0"
(1 REQUIRED)

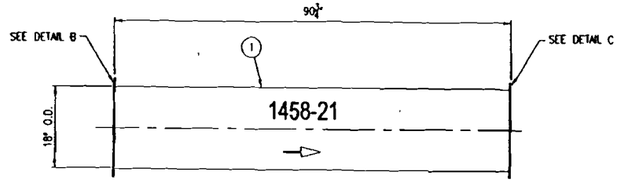
NO.	REVISIONS	BY	DATE
3	"AS-BUILT"	PMD	09/28/04
2	REVISED SHEET 1 AND 3	RBH	5/19/04
1	REVISED TO CUSTOMER'S HDP LAYOUT	RBH	5/5/04
0	ISSUED FOR BIDS	RBH	4/14/04

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-6720
FAX: (732) 469-7640
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

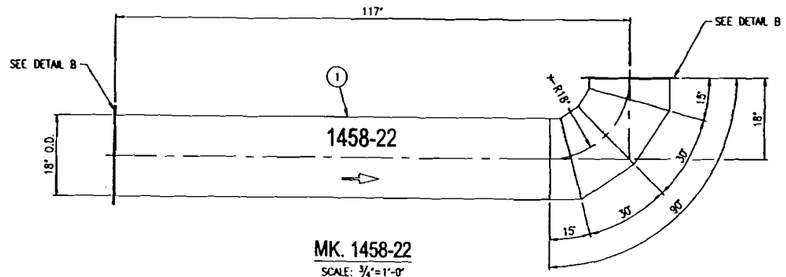
OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

PROCESS CHK'D.	BY		MEC. CHK'D.	BY	
	DATE			DATE	
VESSEL CHK'D.	BY		PIPING CHK'D.	BY	
	DATE			DATE	
DRAWN	BY	RBH	APPROVED	BY	
	DATE	1/1/04		DATE	

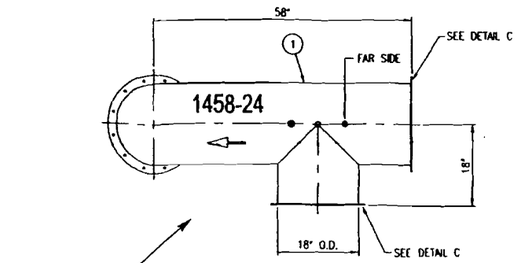
JOB NO: 70-1458
DRAWING NO: 178D5437
SHEET: 3 | TOTAL: 6 | REV: 3

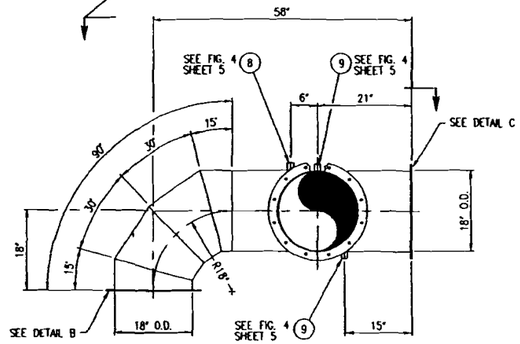


MK. 1458-21
SCALE: ¾"=1'-0"
(1 REQUIRED)

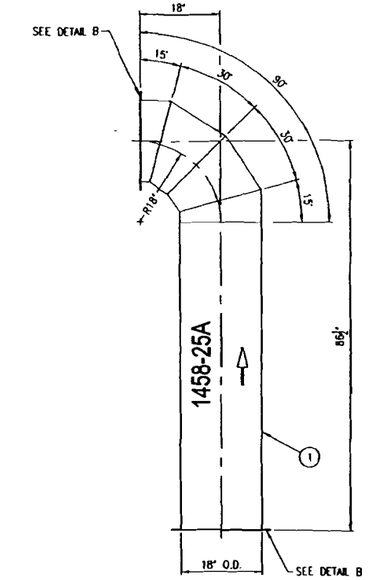


MK. 1458-22
SCALE: ¾"=1'-0"
(1 REQUIRED)

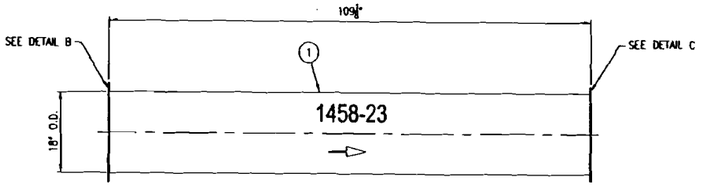




MK. 1458-24
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-25A
SCALE: ¾"=1'-0"
(1 REQUIRED)



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SCALE: ¾"=1'-0"
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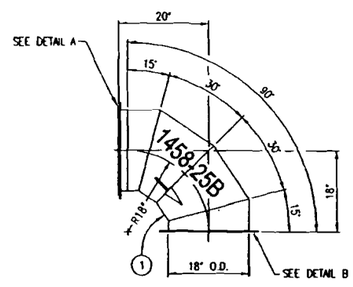
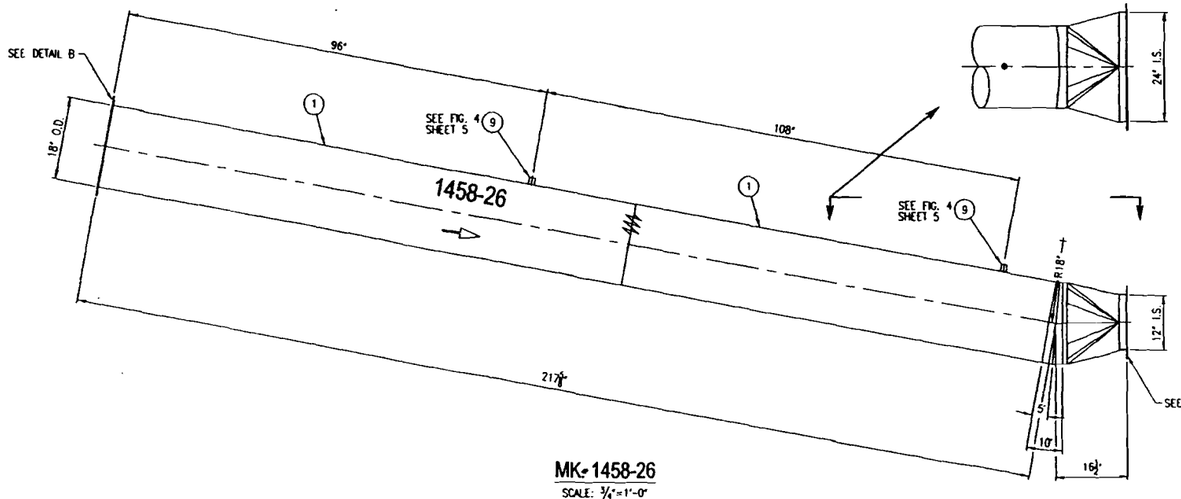
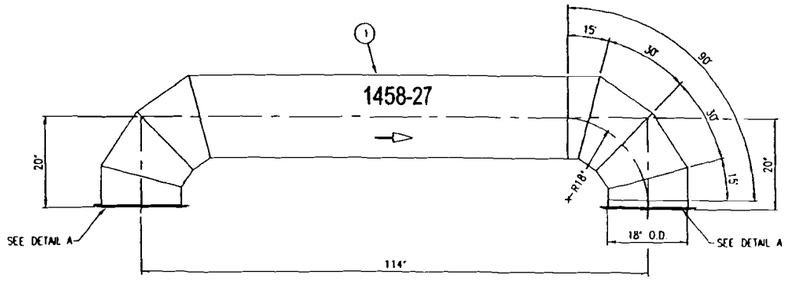


MK. 1458-25B
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-26
SCALE: ¾"=1'-0"
(1 REQUIRED)



MK. 1458-27
SCALE: ¾"=1'-0"
(1 REQUIRED)

NO.	REVISIONS	BY	DATE
1	ISSUED FOR BID	RBH	4/5/04
2	REVISED TO CUSTOMER'S NEW LAYOUT	RBH	5/3/04
3	REVISED SHEET 1 AND 5	RBH	5/18/04
4	"AS-BUILT"	PMD	08/06/04

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7686

LAYNE CHRISTENSEN WATER TREATMENT DIVISION

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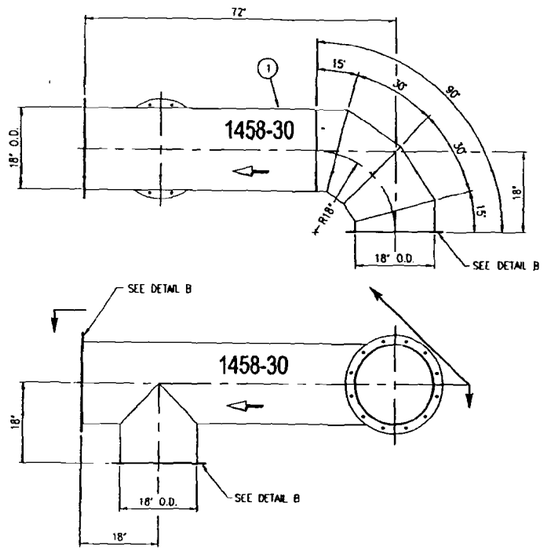
OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

PROCESS CHK'D. BY / DATE
VESSEL CHK'D. BY / DATE
DRAWN BY: RBH / DATE: 1/1/04
MEC CHK'D. BY / DATE
PIPING CHK'D. BY / DATE
APPROVED BY / DATE

JOB NO: 70-1458
DRAWING NO: 178D5437
SHEET: 4 | TOTAL: 6 | REV: 3



MK. 1458-30
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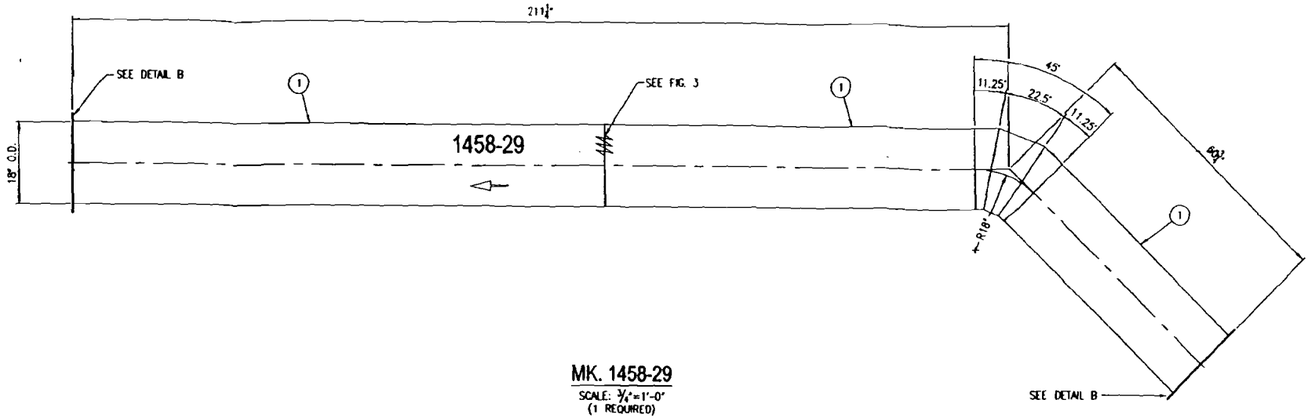
(1 REQUIRED)



MK. 1458-29
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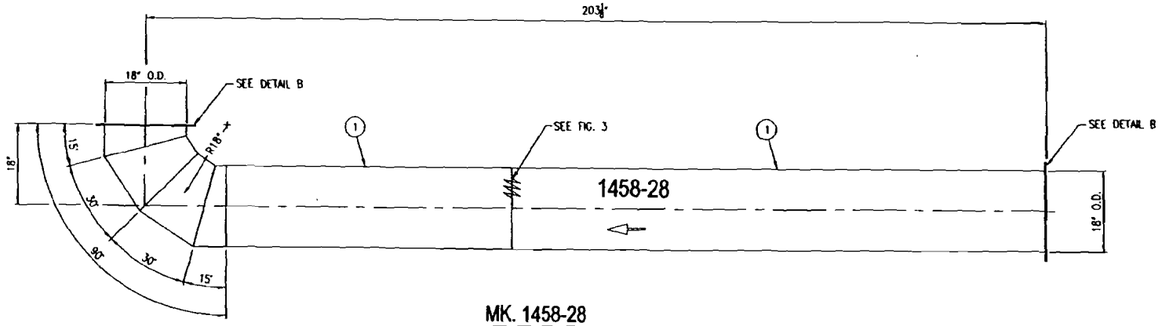
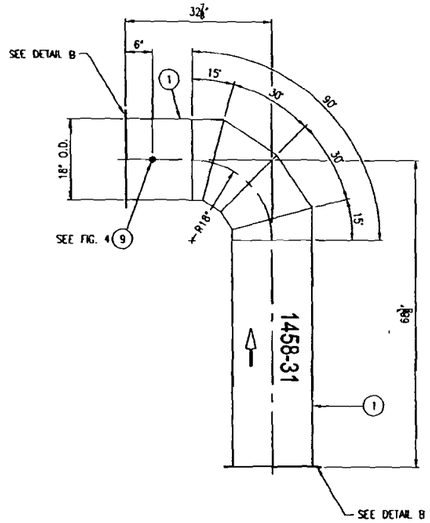
(1 REQUIRED)



MK. 1458-28
SCALE: 3/4"=1'-0"
(1 REQUIRED)



MK. 1458-31
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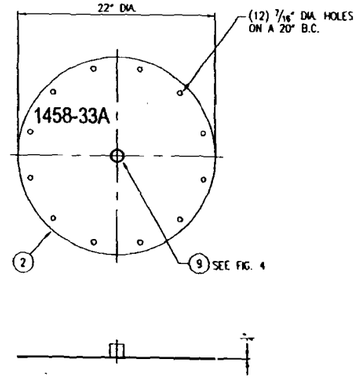
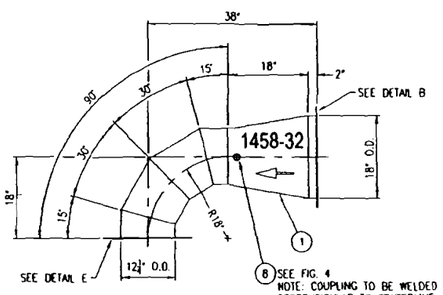
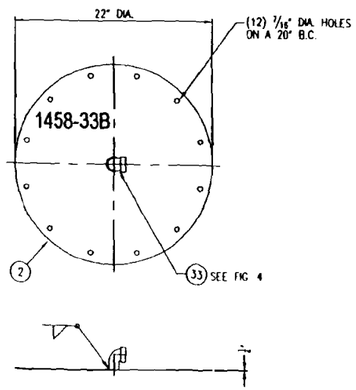


⚠MK. 1458-33A
SCALE: 1½"=1'-0"
(2 REQUIRED)



MK. 1458-32
SCALE: 3/4"=1'-0"
(1 REQUIRED)



⚠MK. 1458-33B
SCALE: 1½"=1'-0"
(1 REQUIRED)

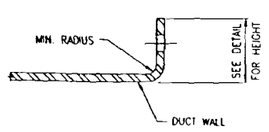


FIG. 1
TYPICAL FOR ALL FORMED FLANGES

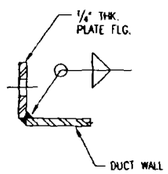


FIG. 2
TYPICAL FOR ALL ROUND FLANGES

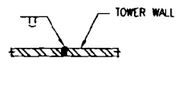


FIG. 3

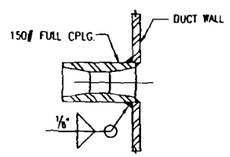


FIG. 4

REVISIONS				DATE	BY
1	ISSUED FOR BIDS			5/4/04	BMH
2	REVISED TO CUSTOMER'S NEW LAYOUT			5/5/04	BMH
3	REVISED SK-1458-33 TO (2) 1458-33A & (1) 1458-33B			5/10/04	BMH
4	"AS-BUILT"			08/06/04	PMD

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7686

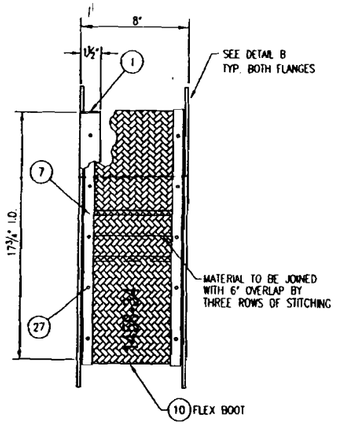
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

PROCESS CHK'D	BY			MECH CHK'D	BY		
	DATE				DATE		
VESSEL CHK'D	BY			MARINE CHK'D	BY		
	DATE				DATE		
DRAWN	BY	BMH		APPROVED	BY		
	DATE	5/3/04			DATE		

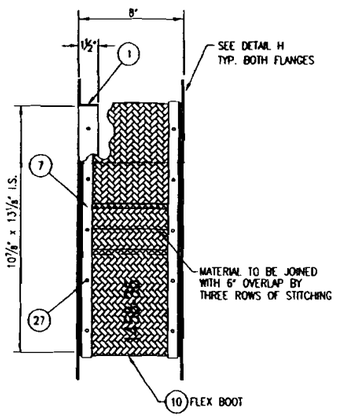
JOB NO: 70-1458
DRAWING NO: 178D5437
SHEET: 5 TOTAL: 6 REV: 3

ID - S:\DRAWINGS\DWGS\100 - Aeration Equipment\170 - Air Stripper Components\178 - Custom Outputs\178D5437.dwg - Mon 4 Oct 2004 - 11:51



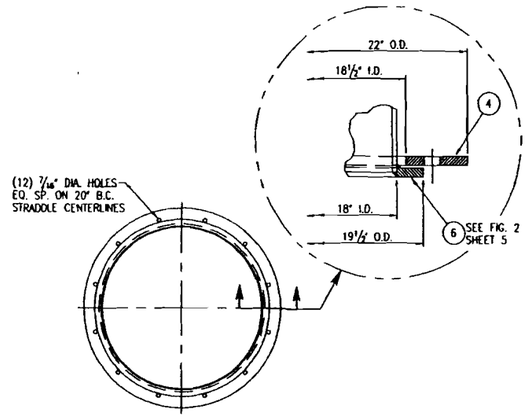
MK. 1458-34
ROUND FLEX BOOT ASSY.

(5 REQUIRED)
SCALE: NONE



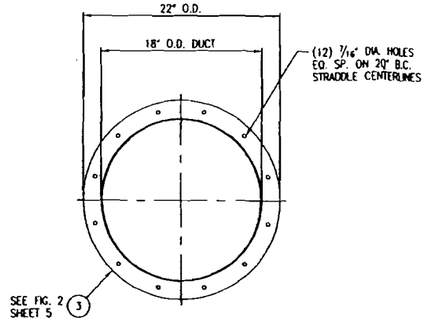
MK. 1458-35
RECTANGLE FLEX BOOT ASSY.

(1 REQUIRED)
SCALE: NONE



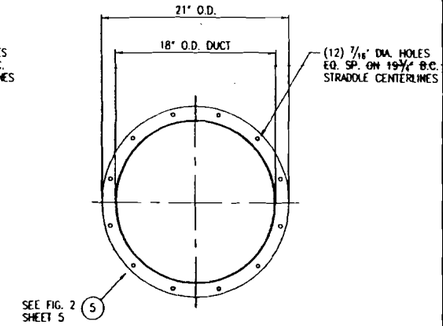
DETAIL A
VANE-STONE FLANGE

SCALE: 1½"=1'-0"
(7 REQUIRED)



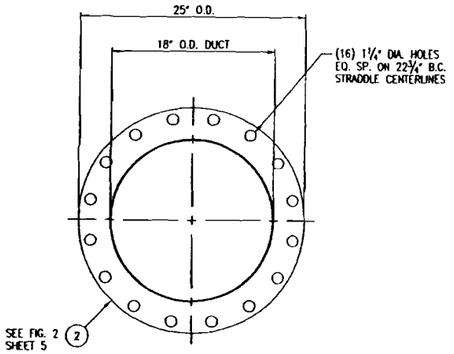
DETAIL B
STANDARD DUCT FLANGE

SCALE: 1½"=1'-0"
(68 REQUIRED)



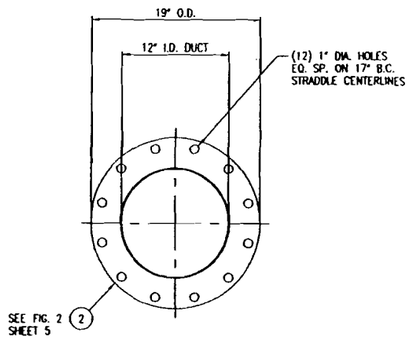
DETAIL C
FLANGE CONN. TO DAMPERS

SCALE: 1½"=1'-0"
(18 REQUIRED)



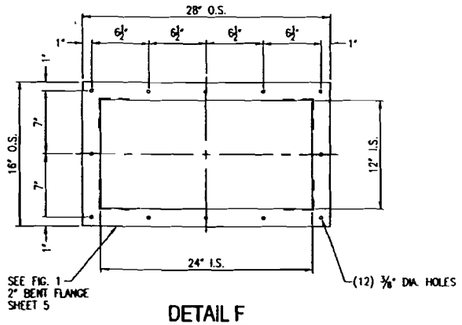
DETAIL D
TIGG OUTLET FLANGE

SCALE: 1½"=1'-0"
(6 REQUIRED)



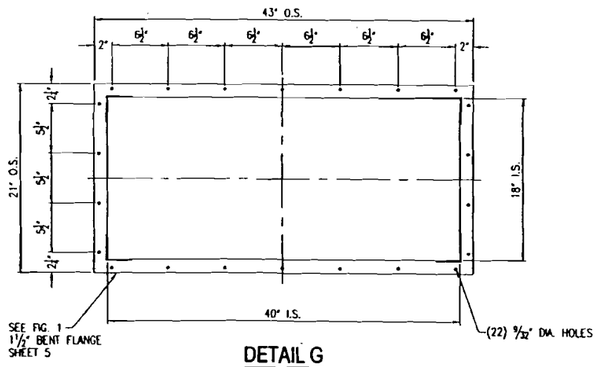
DETAIL E
BLOWER INLET FLANGE

SCALE: 1½"=1'-0"
(1 REQUIRED)



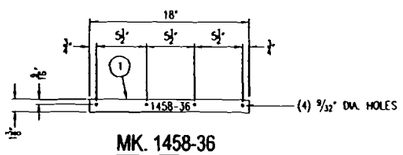
DETAIL F
TIGG INLET FLANGE

SCALE: 1½"=1'-0"
(4 REQUIRED)



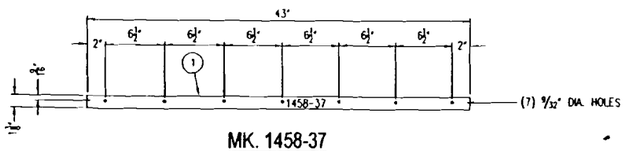
DETAIL G
HEATER FLANGE

SCALE: 1½"=1'-0"
(2 REQUIRED)



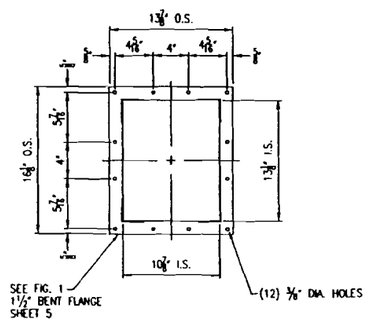
MK. 1458-36
HEATER CLAMP FLANGE BAR

SCALE: 1½"=1'-0"
(4 REQUIRED)



MK. 1458-37
HEATER CLAMP FLANGE BAR

SCALE: 1½"=1'-0"
(4 REQUIRED)



DETAIL H
BLOWER OUTLET FLANGE

SCALE: 1½"=1'-0"
(2 REQUIRED)

NO	DATE	REVISIONS	BY
3	09/08/04	AS-BUILT	PMD
2	5/19/04	REVISED SHEET 1 AND 5	RBH
1	4/5/04	REVISED TO CUSTOMER'S NEW LAYOUT	RBH
0	3/3/04	ISSUED FOR BIDS	RBH

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87 CHIMNEY ROCK ROAD
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PHONE: (732) 469-4720
FAX: (732) 469-7168
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
MODEL NO.: N/A
EQUIPMENT TYPE: N/A
TITLE: FABRICATION DRAWING PLANT DUCTWORK

PROCESS CHK'D.	BY		MEC. CHK'D.	BY	
	DATE			DATE	
VESSEL CHK'D.	BY		PIPING CHK'D.	BY	
	DATE			DATE	
DRAWN	BY	RBH	APPROVED	BY	
	DATE	3/3/04		DATE	

JOB NO: 70-1458
DRAWING NO: 178D5437
SHEET: 6 TOTAL: 6 REV: 3

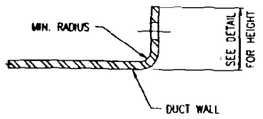


FIG. 1

TYPICAL FOR ALL FORMED FLANGES

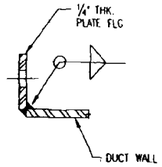


FIG. 2

TYPICAL FOR ALL ROUND FLANGES

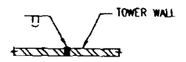


FIG. 3

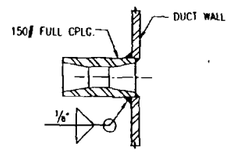
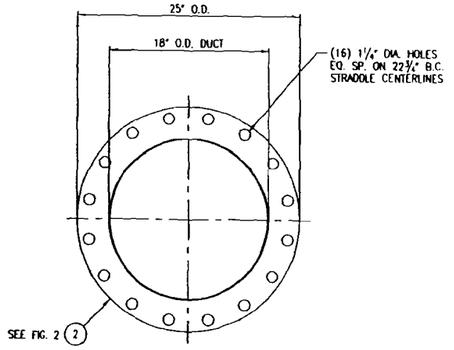


FIG. 4



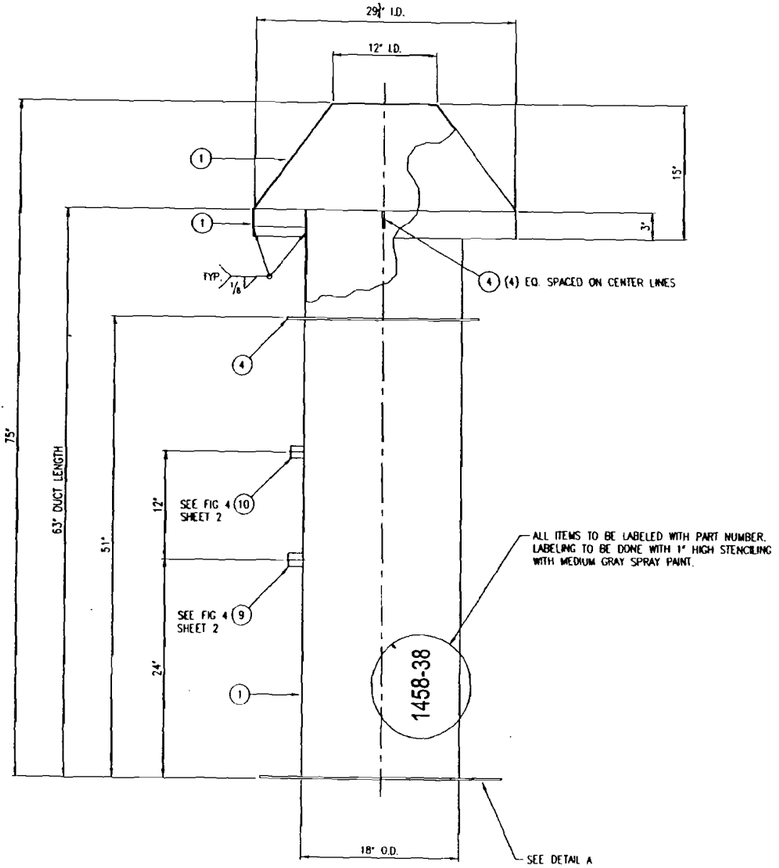
DETAIL A
TIGG OUTLET FLANGE
SCALE: 1½"=1'-0"
(6 REQUIRED)

BILL OF MATERIAL

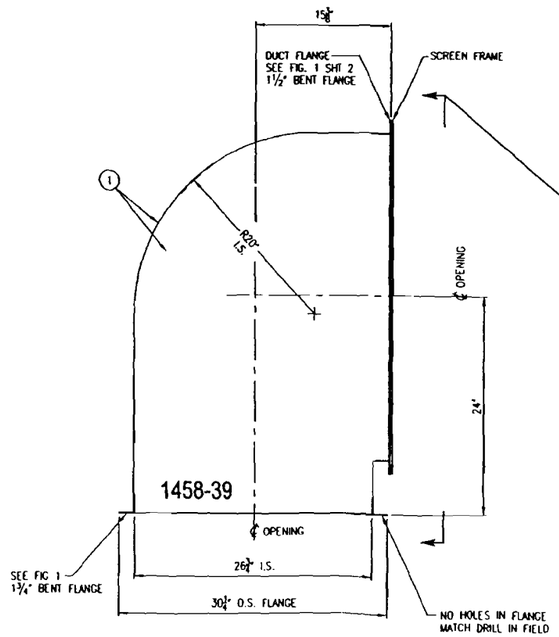
MK.	QTY.	DESCRIPTION	LENGTH FT.	LENGTH IN.	MAT'L SPEC.	REMARKS
1	2	PLATE, 60" x 1/8" THK. x	12	0	ALUMINUM 5052-H32	
2	1	PLATE, 60" x 1/4" THK. x	10	0	ALUMINUM 5052-H32	
3	1 SET	BLOWER ISOLATORS RD-3 (5 RED, 1 GREEN)				
4	1	FLAT BAR, 2" x ¼" THK.	12	0	ALUMINUM 6061-T6	
5	1	FLAT BAR, 1½" x ¼" THK.	12	0	ALUMINUM 6061-T6	SCREEN FRAME
6	1	ANGLE, 3" x 3" x ¼" THK.	25	0	304 S/S	BLOWER STAND
7	1	WIRE CLOTH, 20 x 20 x .014" WIRE, 48" x	3	0	304 S/S	
8	25	POP RIVET, 1/8" DIA. x ½" GRIP			304 S/S	
9	1	FULL COUPLING, 1" NPT - 150#			ALUMINUM	
10	1	FULL COUPLING, ¾" NPT - 150#			ALUMINUM	
11	125	HEX HEAD BOLT, 5/16"-18	-	1	304 S/S	TIGG INLET FLANGE
12	125	HEX NUT, 5/16"-18			304 S/S	
13	250	FLAT WASHER, 5/16" DIA.			304 S/S	
14	16	HEX HEAD BOLT, 1 1/8"-7	-	3	304 S/S	TIGG OUTLET FLANGE
15	16	HEX NUT, 1 1/8"-7			304 S/S	
16	32	FLAT WASHER, 1 1/8" DIA.			304 S/S	
17	1	GASKET, ¼" THK. x 1½" - PSA ONE SIDE	15	-	CLOSED CELL SPONGE BLACK	
18	1	GASKET, ¼" THK. x 2" - PSA ONE SIDE	50	-	CLOSED CELL SPONGE BLACK	
19	1	GASKET, 25" O.D. x 18" I.D. x ¼" THK.			CLOSED CELL SPONGE BLACK	TIGG OUTLET FLANGE
20	18	HEX HEAD BOLT, ½"-13	-	1½	304 S/S	
21	12	HEX NUT, ½"-13			304 S/S	
22	30	FLAT WASHER, ½" DIA.			304 S/S	
23	1	PLATE, 20" x ¼" THK. x	1	8	304 S/S	

NOTE:

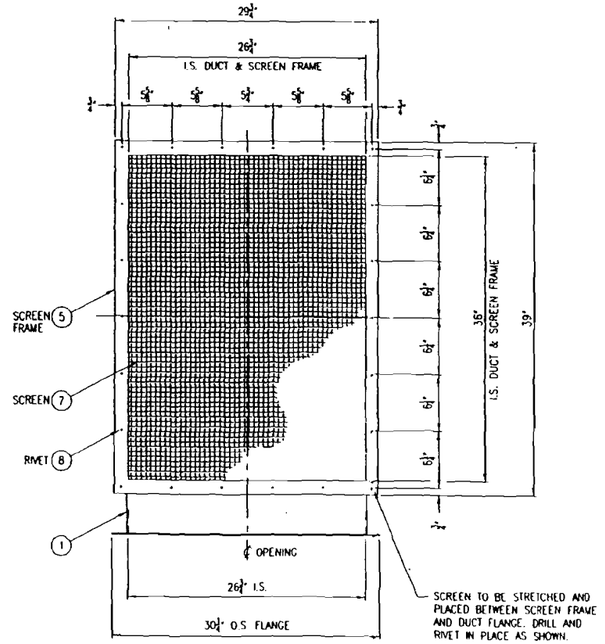
1. WELD CONTINUOSLY UNLESS OTHERWISE SPECIFIED.
2. ALL ITEMS TO BE LABELED WITH PART NUMBER. LABELING TO BE DONE WITH 1" HIGH STENCILING WITH MEDIUM GRAY SPRAY PAINT.



MK. 1458-38
SCALE: 1½"=1'-0"
(1 REQUIRED)



MK. 1458-39
SCALE: 1½"=1'-0"
(1 REQUIRED)



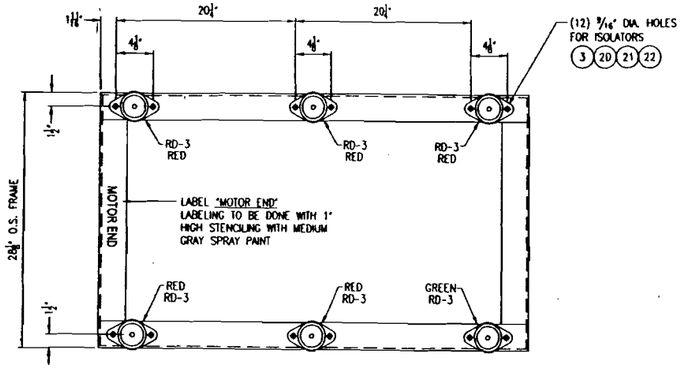
NO	REVISIONS	BY	DATE
1	AS-BUILT	PAD	1/08/04
2	ISSUED FOR FABRICATION	BRM	5/7/04

Layne
97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7988
LAYNE CHRISTENSEN/WATER TREATMENT DIVISION

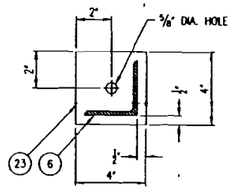
OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
MODEL NO.: N/A
EQUIPMENT TYPE: N/A
TITLE: FABRICATION DRAWING MISCELLANEOUS DUCTWORK

	BY	DATE
DRAWN	PAD	1/08/04
CHECKED		
APPROVED	BRM	5/7/04

JOB NO: 70-1458
DRAWING NO: 178D5486
SHEET: 1 | TOTAL: 2 | REV: 1

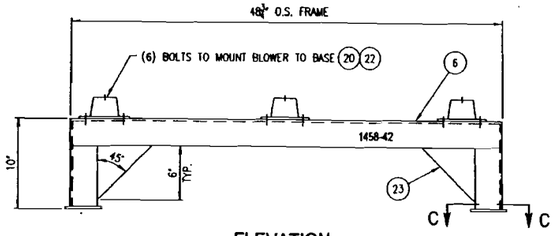


PLAN



SECTION C-C

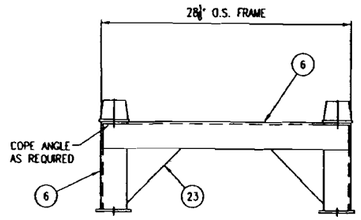
SCALE: 3"=1'-0"
(4 REQUIRED)



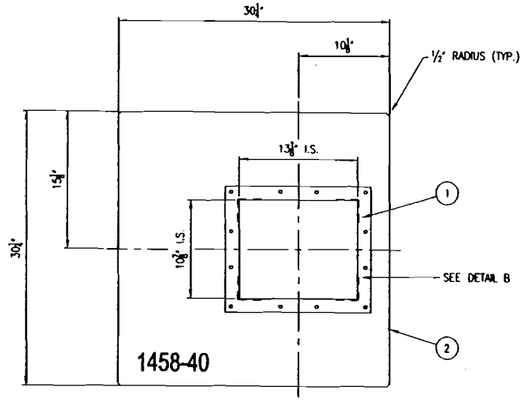
ELEVATION

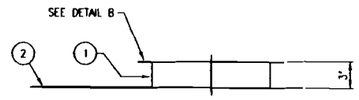
MK. 1458-42

SCALE: 1½"=1'-0"
(1 REQUIRED)



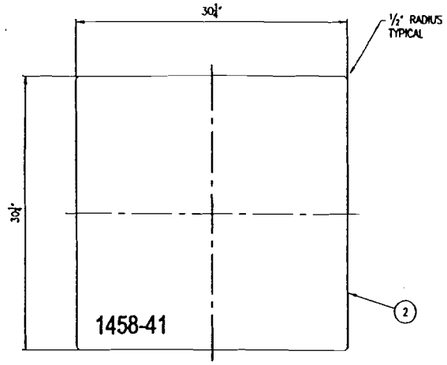
SIDE





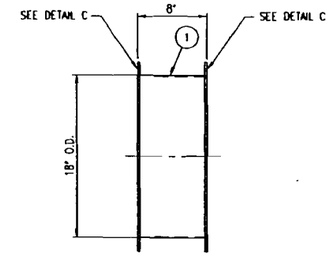
MK. 1458-40

SCALE: 1½"=1'-0"
(1 REQUIRED)



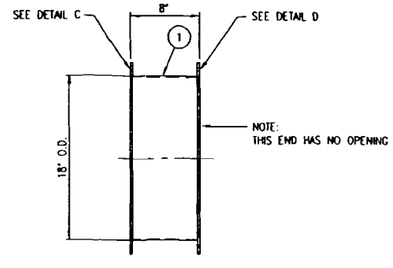
MK. 1458-41

SCALE: 1½"=1'-0"
(2 REQUIRED)



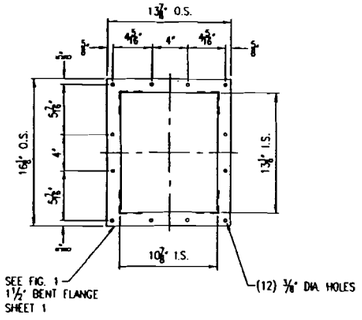
OPEN DAMPER SPOOL

SCALE: 1½"=1'-0"
(5 REQUIRED)



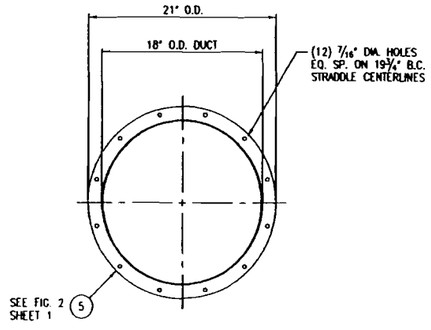
CLOSED DAMPER SPOOL

SCALE: 1½"=1'-0"
(4 REQUIRED)



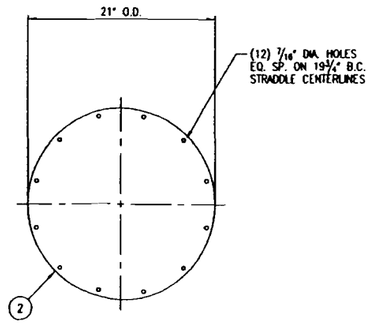
DETAIL B
BLOWER OUTLET FLANGE

SCALE: 1½"=1'-0"
(1 REQUIRED)



DETAIL C
FLANGE TO DAMPER

SCALE: 1½"=1'-0"
(14 REQUIRED)



DETAIL D
BLANK FLANGE TO DAMPER

SCALE: 1½"=1'-0"
(4 REQUIRED)

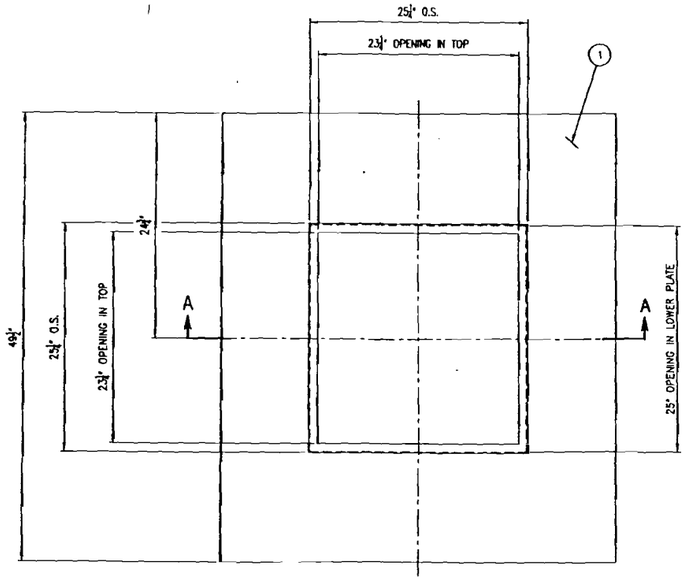
NO.	REVISIONS	BY	DATE
1	"AS-BUILT"	PMD	9/08/04
0	ISSUED FOR FABRICATION	RWH	5/7/04

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7966
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

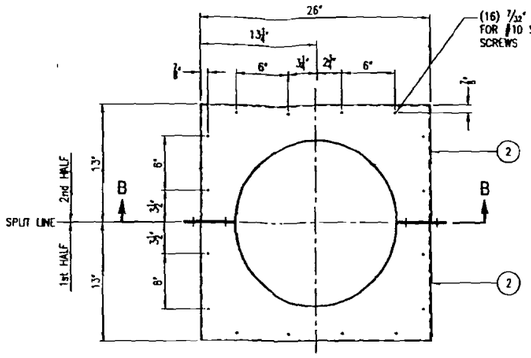
OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: FABRICATION DRAWING MISCELLANEOUS DUCTWORK

PROCESS CHK'D	BY		QAC CHK'D	BY	
	DATE			DATE	
VESSEL CHK'D	BY		PIPING CHK'D	BY	
	DATE			DATE	
DRAWN	BY	RWH	APPROVED	BY	
	DATE	5/7/04		DATE	

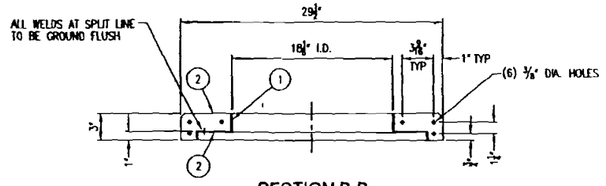
JOB NO: 70-1458
DRAWING NO: 178D5486
SHEET: 2 | TOTAL: 2 | REV: 1



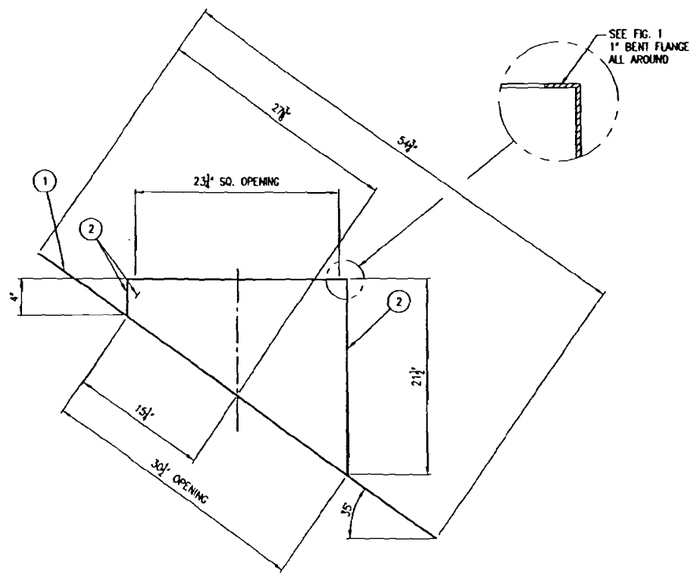
MK. 1458-50
SCALE: 1½"=1'-0"
(2 REQUIRED)



MK. 1458-51
SCALE: 1½"=1'-0"
2 REQUIRED (4 HALF SECTIONS)

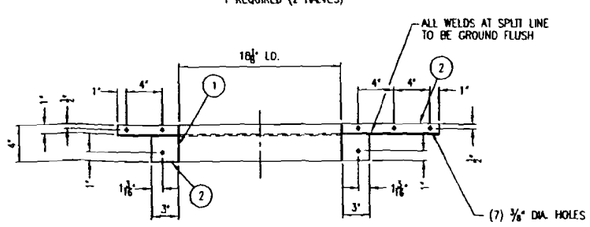


SECTION B-B



SECTION A-A

MK. 1458-52
SCALE: 1½"=1'-0"
1 REQUIRED (2 HALVES)



SECTION C-C

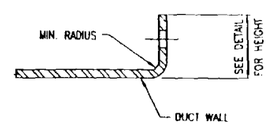


FIG. 1
TYPICAL FOR ALL FORMED FLANGES

BILL OF MATERIAL

MK.	QTY.	DESCRIPTION	LENGTH FT.	LENGTH IN.	MAT'L SPEC.	REMARKS
1	1	PLATE, 60" x 1/8" THK. x	10	0	ALUMINUM 5052-H32	
2	1	PLATE, 60" x 1/8" THK. x	8	0	ALUMINUM 5052-H32	
3	1	PLATE, 36" x 3/16" THK. x	4	0	ALUMINUM 5052-H32	
4	20	HEX HEAD BOLT, 5/16"-18	-	1	304 S/S	
5	20	HEX NUT, 5/16"-18			304 S/S	
6	40	FLAT WASHER, 5/16" DIA.			304 S/S	
7	50	SELF TAPPING SCREW #10	-	¾	304 S/S	
8	1	GASKET, ¼" THK. x 2" - PSA ONE SIDE	15	-	CLOSED CELL SPONGE, BLACK	MK. 1458-52 TO WALL

NOTE:

1. WELD CONTINUOSLY UNLESS OTHERWISE SPECIFIED.
2. ALL ITEMS TO BE LABELED WITH PART NUMBER.

NO.	REVISIONS	BY	DATE
1	ISSUED FOR FABRICATION	RWH	3/19/04
2	AS-BUILT	PMD	9/08/04

Layne
97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-4720
FAX: (732) 469-7948
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

DRAWN	BY	RWH	
	DATE	3/19/04	
JOB NO	70-1458		
DRAWING NO	178D5493		
SHEET	1		
TOTAL	1		
REV	1		

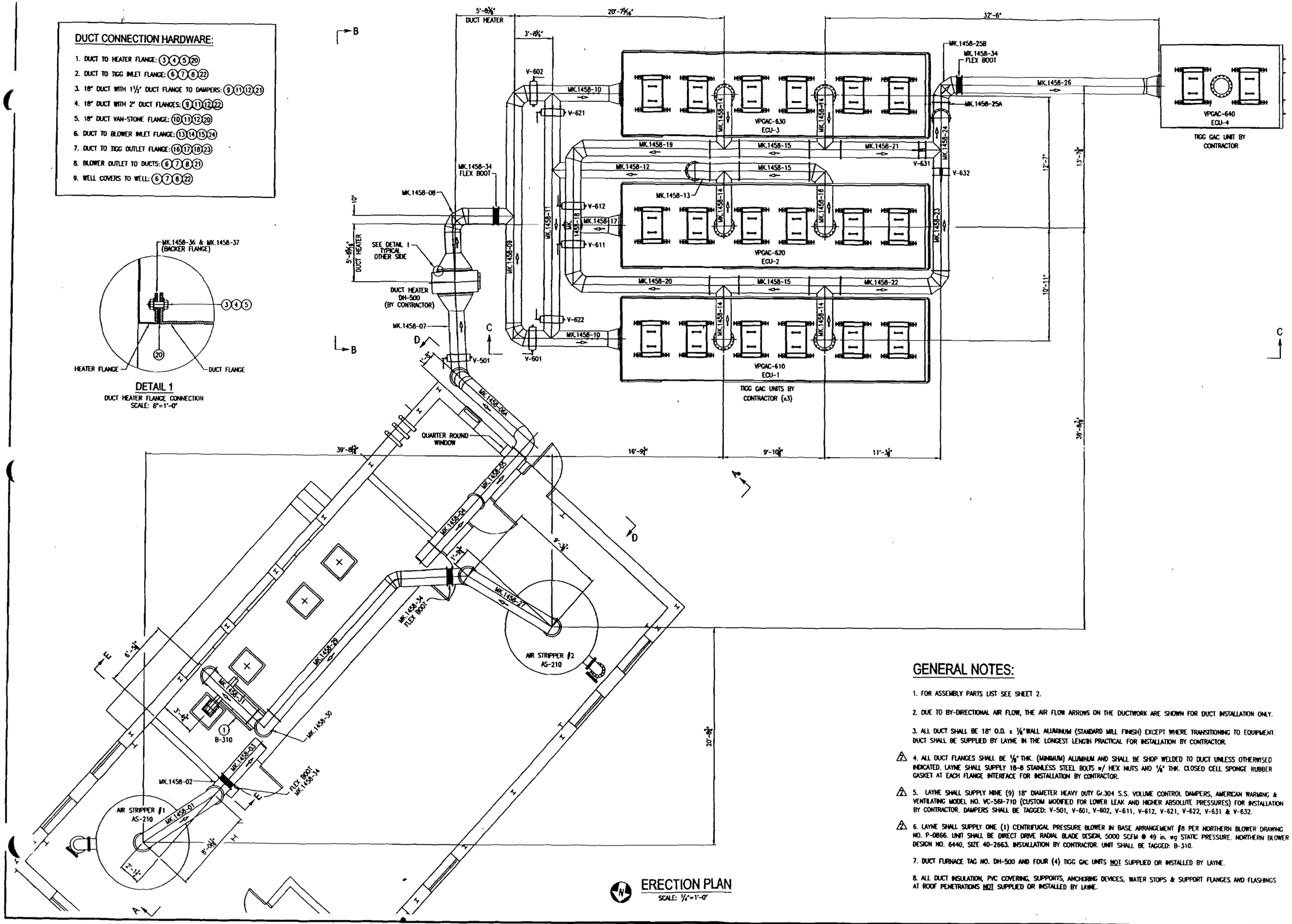
OWNER:	LOCKHEED MARTIN CORPORATION		
CUSTOMER:	CREAMER ENVIRONMENTAL, INC.	INSTALLATION LOCATION:	GREAT NECK, NEW YORK
EQUIPMENT TYPE:	N/A	MODEL NO.:	N/A
TITLE:	FABRICATION DRAWING DUCT WATERSTOP FLASHING		

ID = S:\DRAWINGS\DWGS\100 - Aeration Equipment\170 - Air Stripper Components\178 - [illegible]

DUCT CONNECTION HARDWARE:

1. DUCT TO HEATER FLANGE: (3)(4)(5)(20)
2. DUCT TO TIGG INLET FLANGE: (6)(7)(8)(22)
3. 18" DUCT WITH 1½" DUCT FLANGE TO DAMPERS: (9)(11)(12)(21)
4. 18" DUCT WITH 2" DUCT FLANGES: (9)(11)(12)(22)
5. 18" DUCT VAN-STONE FLANGE: (10)(11)(12)(20)
6. DUCT TO BLOWER INLET FLANGE: (13)(14)(15)(24)
7. DUCT TO TIGG OUTLET FLANGE: (16)(17)(18)(23)
8. BLOWER OUTLET TO DUCTS: (6)(7)(8)(21)
9. WELL COVERS TO WELL: (6)(7)(8)(22)

DETAIL 1
DUCT HEATER FLANGE CONNECTION
SCALE: 6"=1'-0"



ERECTION PLAN
SCALE: ¼"=1'-0"

GENERAL NOTES:

1. FOR ASSEMBLY PARTS LIST SEE SHEET 2.

2. DUE TO BY-DIRECTIONAL AIR FLOW, THE AIR FLOW ARROWS ON THE DUCTWORK ARE SHOWN FOR DUCT INSTALLATION ONLY.

3. ALL DUCT SHALL BE 18" O.D. x ⅛"WALL ALUMINUM (STANDARD MILL FINISH) EXCEPT WHERE TRANSITIONING TO EQUIPMENT. DUCT SHALL BE SUPPLIED BY LAYNE IN THE LONGEST LENGTH PRACTICAL FOR INSTALLATION BY CONTRACTOR.

⚠4 4. ALL DUCT FLANGES SHALL BE ⅛" THK. (MINIMUM) ALUMINUM AND SHALL BE SHOP WELDED TO DUCT UNLESS OTHERWISED INDICATED. LAYNE SHALL SUPPLY 18-8 STAINLESS STEEL BOLTS w/ HEX NUTS AND ⅛" THK. CLOSED CELL SPONGE RUBBER GASKET AT EACH FLANGE INTERFACE FOR INSTALLATION BY CONTRACTOR.

⚠5 5. LAYNE SHALL SUPPLY NINE (9) 18" DIAMETER HEAVY DUTY Gr.304 S.S. VOLUME CONTROL DAMPERS, AMERICAN WARMING & VENTILATING MODEL NO. VC-561-710 (CUSTOM MODIFIED FOR LOWER LEAK AND HIGHER ABSOLUTE PRESSURES) FOR INSTALLATION BY CONTRACTOR. DAMPERS SHALL BE TAGGED: V-501, V-601, V-602, V-611, V-612, V-621, V-622, V-631 & V-632.

⚠6 6. LAYNE SHALL SUPPLY ONE (1) CENTRIFUGAL PRESSURE BLOWER IN BASE ARRANGEMENT #8 PER NORTHERN BLOWER DRAWING NO. P-0866. UNIT SHALL BE DIRECT DRIVE RADIAL BLADE DESIGN, 5000 SCFM @ 49 in. wg STATIC PRESSURE. NORTHERN BLOWER DESIGN NO. 6440, SIZE 40-2663. INSTALLATION BY CONTRACTOR. UNIT SHALL BE TAGGED: B-310.

7. DUCT FURNACE TAG NO. DH-500 AND FOUR (4) TIGG GAC UNITS NOT SUPPLIED OR INSTALLED BY LAYNE.

8. ALL DUCT INSULATION, PVC COVERING, SUPPORTS, ANCHORING DEVICES, WATER STOPS & SUPPORT FLANGES AND FLASHINGS AT ROOF PENETRATIONS NOT SUPPLIED OR INSTALLED BY LAYNE.

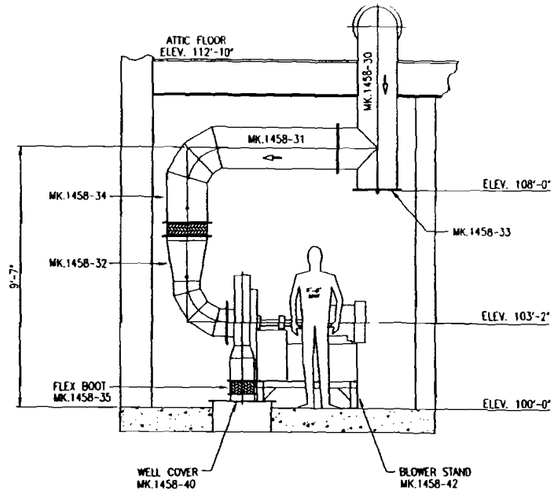
NO.	REVISIONS	BY	DATE
1	"AS-BUILT"	PSD	5/30/24
2	REVISED DUCTWORK TO BLOWER INLET	RRH	5/11/24
3	ADDED ASSEMBLY PART NUMBERS	RRH	4/13/24
4	ISSUED FOR APPROVAL	PSD	03/01/24

87 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7988
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

PROCESS CHK'D: BY / DATE
ISSUED CHK'D: BY / DATE
DRAWN: BY PMD, DATE 05/27/24
MEC CHK'D: BY / DATE
PHMC APPROVED: BY / DATE

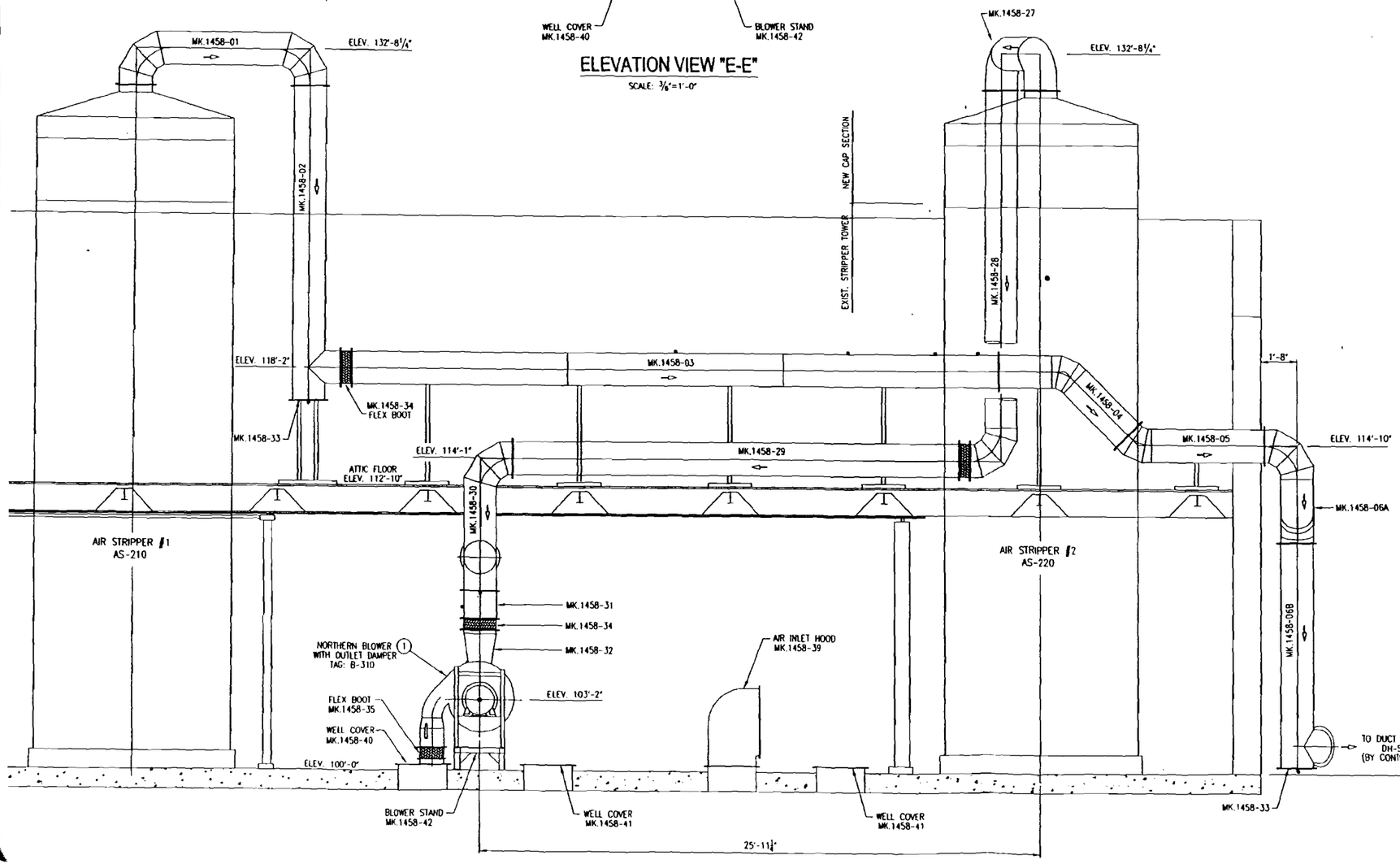
CUSTOMER: LOCKHEED MARTIN CORPORATION
INSTALLATION LOCATION: CREAMER ENVIRONMENTAL, INC. — GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: EQUIPMENT AND DUCT ERECTION PLAN
TREATMENT PLANT MODIFICATIONS, OU-2 SOUTH IRM

JOB NO: 70-1458
DRAWING NO.: 720D5424
SHEET: 1 | TOTAL: 3 | REV.: 3



ELEVATION VIEW "E-E"

SCALE: 3/8"=1'-0"



ELEVATION VIEW "A-A"

SCALE: 1/8"=1'-0"

ASSEMBLY PARTS LIST

MK	QTY.	DESCRIPTION	LENGTH FT.	LENGTH IN.	MAT'L SPEC.	REMARKS
1458-01	1	DUCT 18" DIA.			ALUMINUM	
1458-02	1	DUCT 18" DIA.			ALUMINUM	
1458-03	1	DUCT 18" DIA.			ALUMINUM	
1458-04	1	DUCT 18" DIA.			ALUMINUM	
1458-05	1	DUCT 18" DIA.			ALUMINUM	
1458-06A	1	DUCT 18" DIA.			ALUMINUM	
1458-06B	1	DUCT 18" DIA.			ALUMINUM	
1458-07	1	TRANSITION DUCT 18" DIA.			ALUMINUM	
1458-08	1	TRANSITION DUCT 18" DIA.			ALUMINUM	
1458-09	1	DUCT 18" DIA.			ALUMINUM	
1458-10	2	DUCT 18" DIA. WITH TRANSITION			ALUMINUM	
1458-11	1	DUCT 18" DIA.			ALUMINUM	
1458-12	1	DUCT 18" DIA.			ALUMINUM	
1458-13	1	DUCT 18" DIA.			ALUMINUM	
1458-14	5	DUCT 18" DIA.			ALUMINUM	
1458-15	3	DUCT 18" DIA.			ALUMINUM	
1458-16	1	DUCT 18" DIA.			ALUMINUM	
1458-17	1	DUCT 18" DIA.			ALUMINUM	
1458-18	1	DUCT 18" DIA.			ALUMINUM	
1458-19	1	DUCT 18" DIA.			ALUMINUM	
1458-20	1	DUCT 18" DIA.			ALUMINUM	
1458-21	1	DUCT 18" DIA.			ALUMINUM	
1458-22	1	DUCT 18" DIA.			ALUMINUM	
1458-23	1	DUCT 18" DIA.			ALUMINUM	
1458-24	1	DUCT 18" DIA.			ALUMINUM	
1458-25A	1	DUCT 18" DIA.			ALUMINUM	
1458-25B	1	DUCT 18" DIA.			ALUMINUM	
1458-26	1	DUCT 18" DIA. WITH TRANSITION			ALUMINUM	
1458-27	1	DUCT 18" DIA.			ALUMINUM	
1458-28	1	DUCT 18" DIA.			ALUMINUM	
1458-29	1	DUCT 18" DIA.			ALUMINUM	
1458-30	1	DUCT 18" DIA.			ALUMINUM	
1458-31	1	DUCT 18" DIA.			ALUMINUM	
1458-32	1	CONE REDUCER DUCT 18" DIA.			ALUMINUM	
1458-33	3	DUCT COVER WITH DRAIN			ALUMINUM	
1458-34	5	FLEX BOOT WITH 2" FLANGES			ALUMINUM	
1458-35	1	FLEX BOOT, BLOWER OUTLET			ALUMINUM	
1458-36	2	HEATER CLAMP FLANGE BAR	1	6	ALUMINUM	
1458-37	2	HEATER CLAMP FLANGE BAR	3	7	ALUMINUM	
1458-38	1	TIGG EXHAUST STACK			ALUMINUM	
1458-39	1	AIR INLET HOOD			ALUMINUM	
1458-40	1	WELL COVER WITH BLOWER INLET			ALUMINUM	
1458-41	2	WELL COVER			ALUMINUM	
1458-42	1	BLOWER STAND			ALUMINUM	
1	1	PRESSURE BLOWER				
2		---				
3	48	HEX HEAD BOLT, 1/4"-20	-	1	304 S/S	HEATER FLANGE
4	48	HEX NUT, 1/4"-20			304 S/S	
5	96	FLAT WASHER, 1/4" DIA.			304 S/S	
6	178	HEX HEAD BOLT, 5/16"-18	-	1	304 S/S	TIGG INLET FLANGE
7	178	HEX NUT, 5/16"-18			304 S/S	
8	356	FLAT WASHER, 5/16" DIA.			304 S/S	
9	612	HEX HEAD BOLT, 3/8"-16	-	1¼	304 S/S	STD. FLANGE
10	88	HEX HEAD BOLT, 3/8"-16	-	1½	304 S/S	VAN-STONE FLANGE
11	700	HEX NUT, 3/8"-16			304 S/S	
12	1400	FLAT WASHER, 3/8" DIA.			304 S/S	
13	12	HEX HEAD BOLT, 7/8"-9	-	2½	304 S/S	BLOWER INLET FLANGE
14	12	HEX NUT, 7/8"-9			304 S/S	
15	24	FLAT WASHER, 7/8" DIA.			304 S/S	
16	115	HEX HEAD BOLT,1 1/8"-7	-	3	304 S/S	TIGG OUTLET FLANGE
17	115	HEX NUT, 1 1/8"-7			304 S/S	
18	230	FLAT WASHER, 1 1/8" DIA.			304 S/S	
19		---				
20	1	GASKET, 1/4" THK. x 3/4" - PSA ONE SIDE	50	-	CLOSED CELL SPONGE, BLACK	HEATER FLANGE
21	1	GASKET, 1/4" THK. x 1 1/2" - PSA ONE SIDE	125	-	CLOSED CELL SPONGE, BLACK	
22	1	GASKET, 1/4" THK. x 2" - PSA ONE SIDE	300	-	CLOSED CELL SPONGE, BLACK	
23	7	GASKET, 25" O.D. x 18" I.D. x 1/4" THK.			CLOSED CELL SPONGE, BLACK	TIGG OUTLET FLANGE
24	1	GASKET, 19" O.D. x 12 3/4" I.D. x 1/4" THK.			CLOSED CELL SPONGE, BLACK	BLOWER INLET FLANGE

NO.	REVISIONS	BY	DATE
1	"AS-BUILT"	PMD	9/08/04
2	REVISED DUCTWORK TO BLOWER INLET	RWH	5/11/04
3	ADDED ASSEMBLY PART NUMBERS & PARTS LIST	RWH	4/13/04
4	ISSUED FOR APPROVAL	PMD	03/01/04

ISSUED FOR APPROVAL

RETURN BY _____

TO MAINTAIN FABRICATION SCHEDULE PLEASE RETURN ONE SET OF PRINTS WITH YOUR APPROVAL OR DATE SHOWN ABOVE OR SHIPMENT MAY BE DELAYED.

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7868

LAYNE CHRISTENSEN WATER TREATMENT DIVISION

LOCKHEED MARTIN CORPORATION

EQUIPMENT AND DUCT ERECTION PLAN
TREATMENT PLANT MODIFICATIONS, OU-2 SOUTH IRM

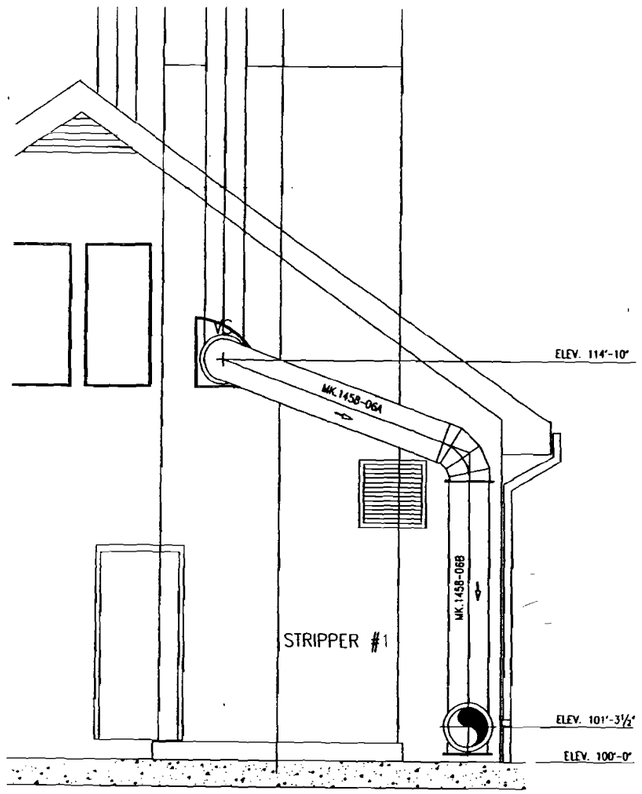
CUSTOMER:	CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION:	GREAT NECK, NEW YORK
EQUIPMENT TYPE:	N/A
MODEL NO.:	N/A

DRAWN	BY	PMD		CHKD	BY		
	DATE	07/27/04			DATE		
ENGR	BY			APPROVED	BY		
	DATE				DATE		
PROJECT MGR	BY						
	DATE						

JOB NO.: 70-1458

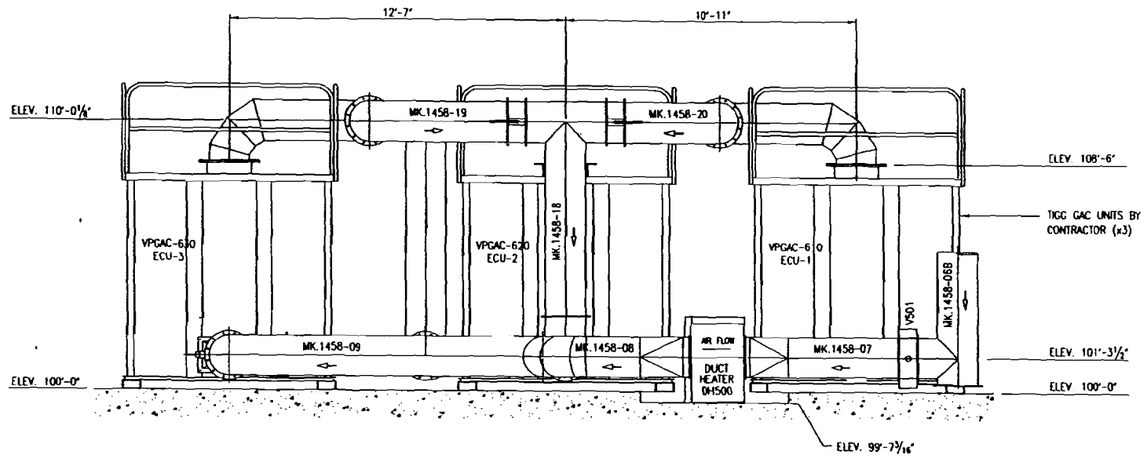
DRAWING NO.: 720D5424

SHEET	TOTAL	REV
2	3	3



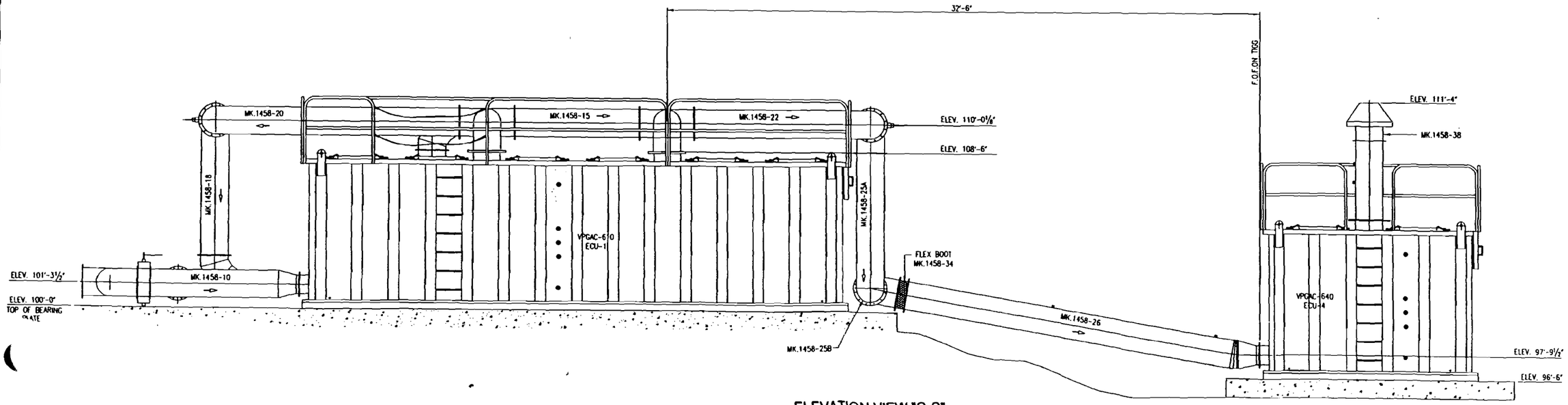
ELEVATION VIEW "D-D"

SCALE: ⅜"=1'-0"



ELEVATION VIEW "B-B"

SCALE: ⅜"=1'-0"



ELEVATION VIEW "C-C"

SCALE: ⅜"=1'-0"

NO.	DATE	REVISIONS	BY
1	9/28/04	"AS-BUILT"	PHD
2	5/11/04	REVISED DUCTWORK TO BLOWER INLET	RRH
3	4/13/04	ADDED ASSEMBLY PART NUMBERS	RRH
4	03/01/04	ISSUED FOR APPROVAL	PHD

97 CHIMNEY ROCK ROAD
BRIDGEWATER, N.J. 08807
PHONE: (732) 469-8720
FAX: (732) 469-7868
LAYNE CHRISTENSEN WATER TREATMENT DIVISION

PROJECT OWNER: LOCKHEED MARTIN CORPORATION
CUSTOMER: CREAMER ENVIRONMENTAL, INC.
INSTALLATION LOCATION: GREAT NECK, NEW YORK
EQUIPMENT TYPE: N/A
MODEL NO.: N/A
TITLE: EQUIPMENT AND DUCT ERECTION PLAN TREATMENT PLANT MODIFICATIONS, OU-2 SOUTH IRM

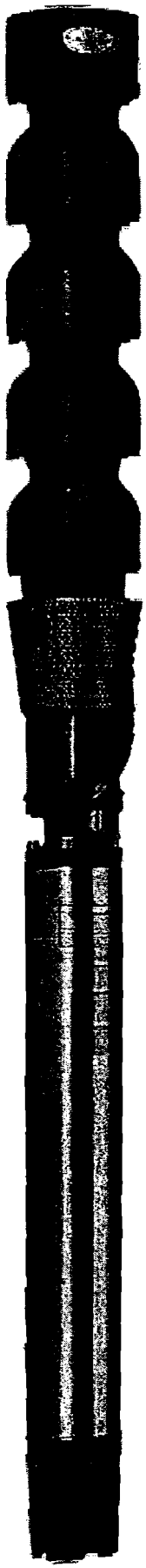
DRAWN	PHD	CHK'D	
DATE	8/17/04	DATE	
APPROVED		CHK'D	
DATE		DATE	

JOB NO: 70-1458
DRAWING NO: 720D5424
SHEET: 3 | TOTAL: 3 | REV.: 3

Section 3-C

Clearwell Pumps (P-211, P-225)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction



SUBMERSIBLE TURBINE PUMPS

VSP Series

Christensen

Christensen Pumps

A division of Layne Christensen Company

SUBMERSIBLE

Applications

Christensen Pumps combines the hydraulic engineering of turbine pumps matched to the hi-tech design of electric submersible motors. (Two types available)

Hermetically Sealed Type

A Hermetically Sealed Type motor utilizes windings of standard construction and insulation thickness. The *windings* are encased and Hermetically Sealed within the external *shell casing* on the outside and an *internal tube* or *liner inside the bore*. The Hermetically Sealed enclosure eliminates the possibility of water leakage into the winding. The liquid medium circulates between the rotor and stator liner providing lubrication and cooling to the bearings.

Wet Winding Type

A Wet Winding Type motor is one in which the motor windings are in direct contact with a *liquid medium. The medium is clean, clear water. A pressure balancing system prevents exchange of the motor liquid medium and well water due to thermal expansion and contraction when the motor is operating. The liquid medium fills the inside of the motor and surrounds both the stator windings and the rotor. A completely waterproof insulation is used on the magnet wire used for the stator windings. The liquid medium* inside the motor air gap and coils acts as a heat transfer device by circulating through the windings and transferring heat to the external casing. Dissipation of this heat occurs as the well water flows at a *required velocity* over the external case. As is the case in all submersible *type motors,* the internal *liquid* medium is also used for bearing lubrication.

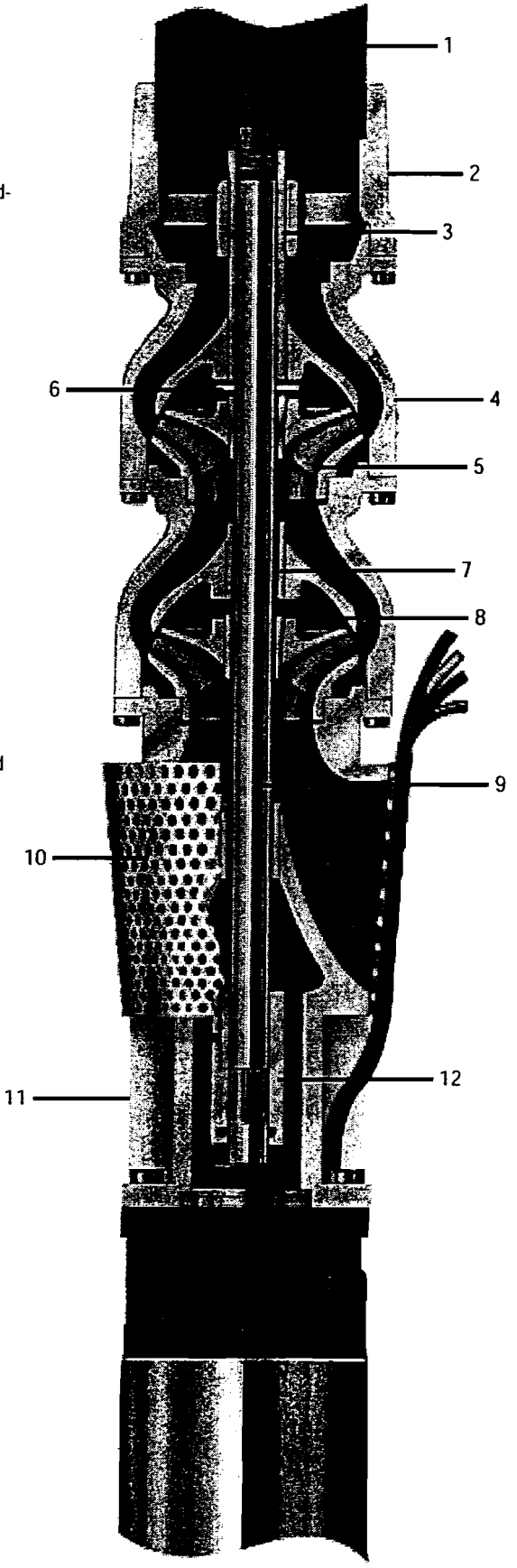
Submersible Options:

CHRISTENSEN can provide several options in pump and motor combinations to meet the exacting conditions of your applications:

- High horsepower, limited well diameters
- Motor sensing devices
- Water level indicators
- Special materials
- Special voltage motors

Submersible Accessories:

- Electrical Panels
  - V.F.D. Drives
- Pitless Adapters
- Wire
  - 12 to 0000
- Heat Shrinks
- Splice Kits
- Well Heads
  - Submersible Discharge Head



Features

1 Discharge Pipe
Properly sized for optimum water velocities to insure peak hydraulic performance.

2 Discharge Bowl
Several discharge sizes available for NPT or flanged pipe.

3 Discharge Bearing
Extra long top protected bronze bearing insures positive shaft alignment and stabilization for extended life.

4 Intermediate Bowl
Close grained Class 30 cast iron. Water passage glassed for maximum efficiency and abrasion resistance.

5 Impellers
Designed for maximum efficiency with wide range hydraulic cover age. Precision balanced for smooth operation.

6 Upthrust Collar
Designed for extra margin of safety against possible momentary upthrust occurring at startup.

7 Intermediate Bowl Bearings
Reliable long life bronze or rubber bearing.

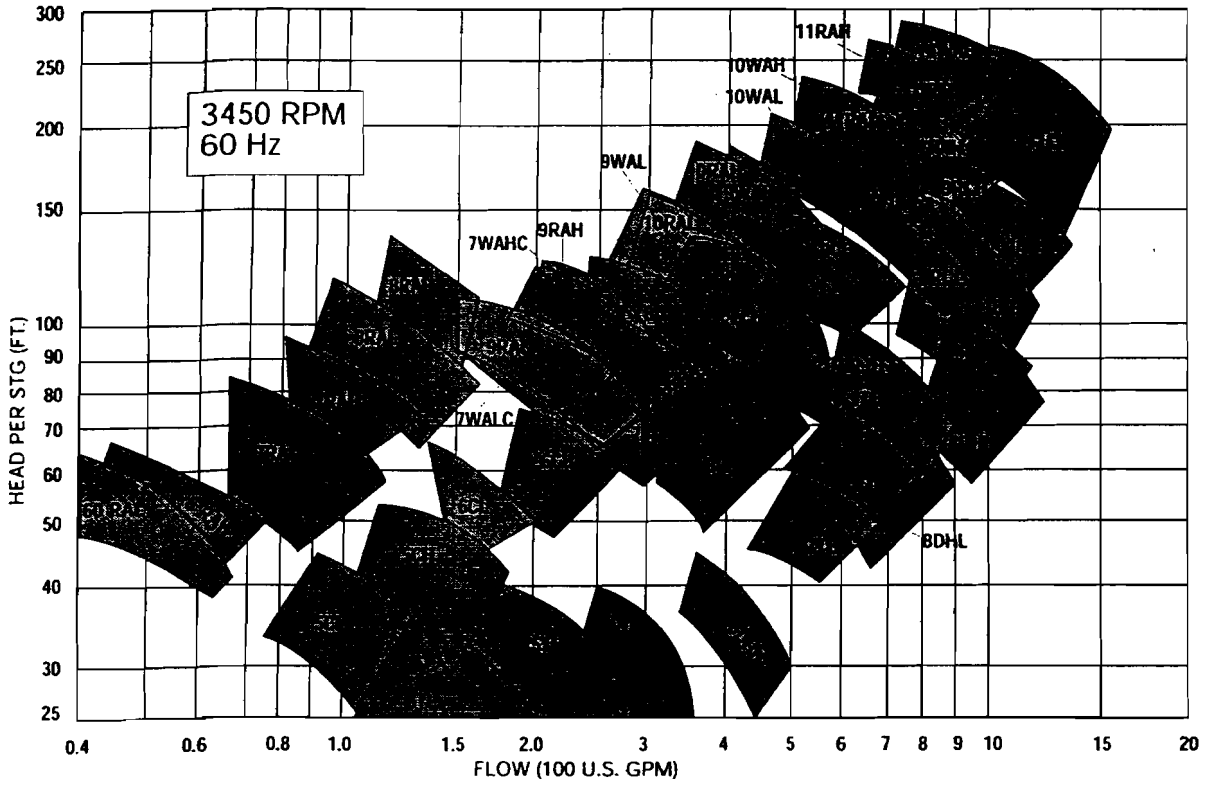
8 Lock Collets
Accurately machined to insure positive locking of pump impeller to shaft.

9 Pump Shaft
100,000 PSI high tensile stainless steel provides strength and excellent corrosion resistance. Ground and polished for smooth bearing surface.

10 Suction Inlet
Contoured for smooth flow entrance. Protected by an over sized stainless steel strainer to prevent entrance of damaging solids.

11 Suction Adapter
Ductile iron provides for increased strength and positive motor alignment. Open area permits easy access to pump/motor coupling.

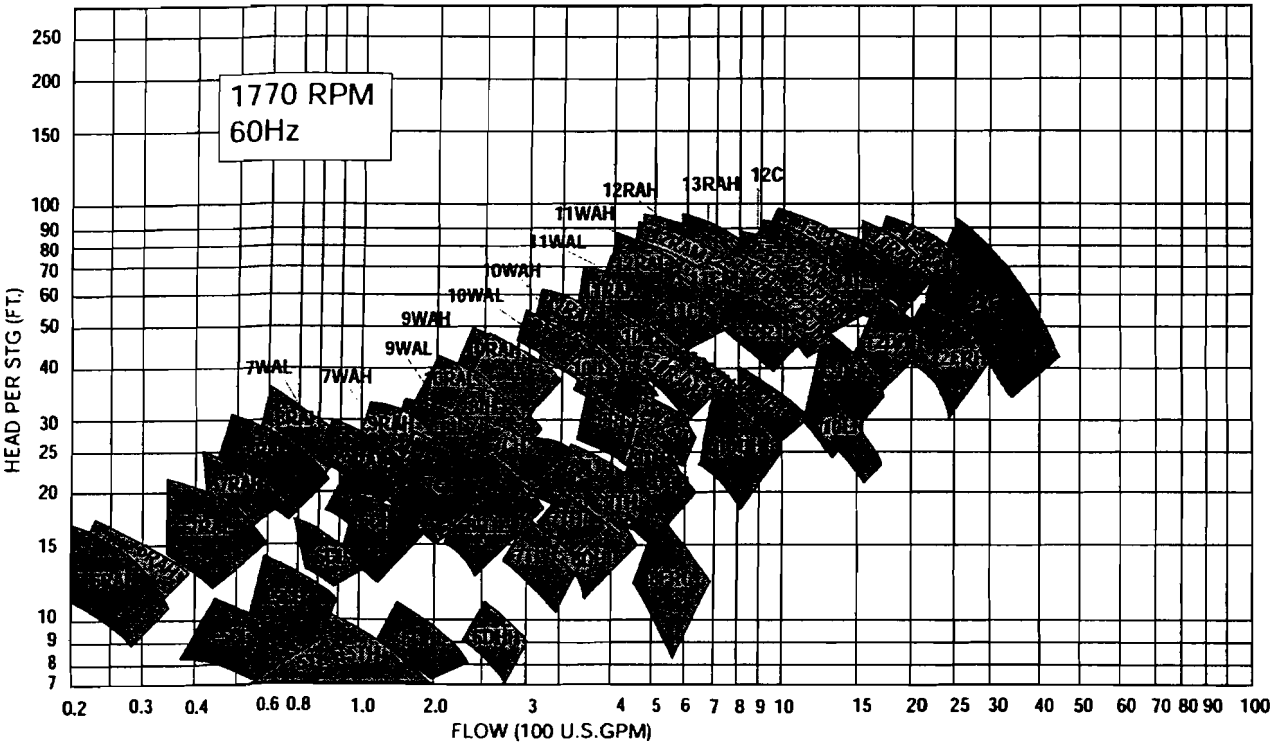
12 Pump/Motor Coupling
Large stainless steel coupling accurately machined for perfect alignment, balance, and power transmission.



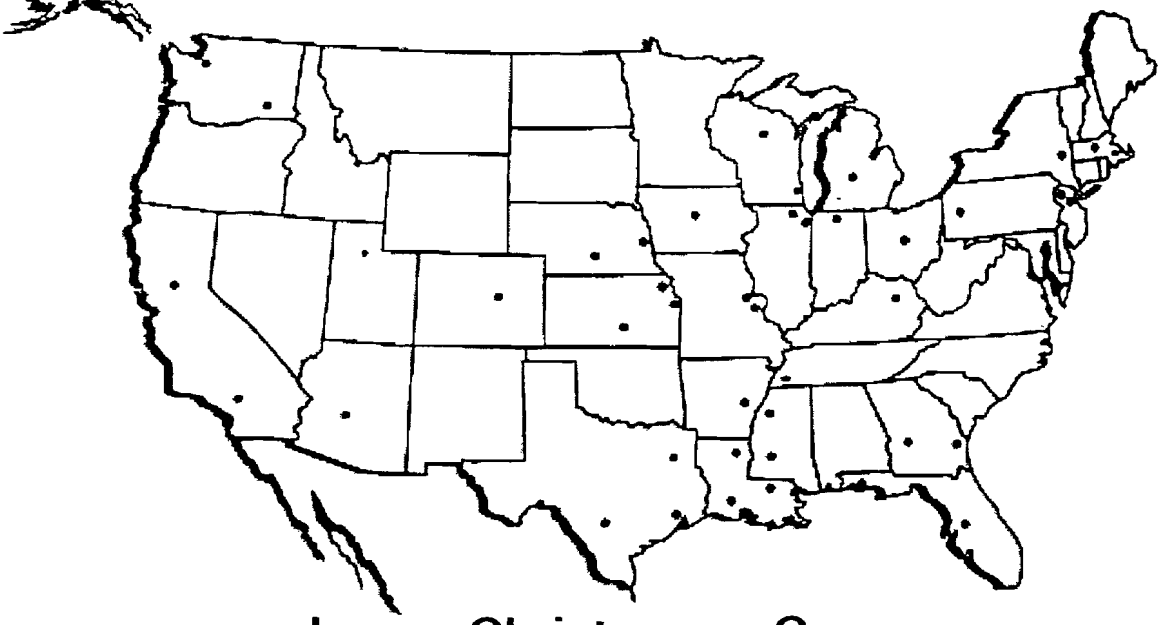
Hydraulic Performance

The system requirements can be met with a choice of pump sizes and selections for the best hydraulic performance. The choice of pump and motor diameters, voltage and speeds for varying hydraulic conditions provides additional opportunity to match the unit to all the requirements of the system. The availability of accessory items, cable and controls enables you to rely on Christensen for units that provide top service.

Submersibles for 1800 RPM through 14" are also available. See coverage chart below



The LAYNE CHRISTENSEN Network



Layne Christensen Company

Corporate Headquarters • 1900 Shawnee Mission Parkway • Mission Woods, KS 66205 •

For more information, call or write your nearest Christensen Pumps sales office or representative

OFFICE LOCATIONS

Layne Christensen Company

Fairbanks, AL	800/510-4069
Beverly, NJ	609/877-2700
Bridgewater, NJ	732/469-8720
Butler, PA	724/283-2262
Chandler, AZ	409/895-9404
Dracut, MA	978/937-2242
Fontana, CA	909/390-2833
Grayson, KY	606/474-6285
Holbrook, NY	631/218-0749
Irvine, CA	949/955-1122
Kennewick, WA	509/586-6947
Salt Lake City, UT	801/972-3333
Schoharie, NY	518/295-8288
Tacoma, WA	253/536-1161
Woodland,CA	530/662-2825

ChristensenPumps

Memphis, TN	901/276-6605

International Directional Services

Salt Lake City, UT	801/974-1030

Fonditek International

Boston, MA	888/735-0000

Layne-Atlantic

Albany, GA	912/438-8164
Lakeland, FL	863/666-2433
Bloomingdale, GA	912/748-9244

Layne Arkansas

Stuttgart, AR	870/673-1591

Layne - Central

Baton Rouge, LA	225/744-4899
Cleveland, MS	662/843-4075
Jackson, MS	601/922-4312
Memphis, TN	901/274-2324
Pensacola,FL	850/432-5101
West Monroe, LA	318/396-0678

Layne-Northern

Elkhart, IN	574/266-7346
Lansing, MI	517/323-4931

Layne-Northwest

Miilwaukee, WI	262/246-4646
Wausau, WI	715/359-4211

Layne Texas

Houston, TX	713/466-5001
San Antonio	210/651-3447
Tyler, TX	903/592-6176

Layne - Western

Aurora, IL	630/897-6941
Beecher, IL	708/946-2244
Denver, CO	303/755-1281
DesMoines, IA	515/986-3462
Kansas City, KS	913/321-5000
Kearney, NE	308/234-1914
Omaha, NE	402/359-2042
St. Louis, MO	636/343-3700
Wichita, KS	316/264-5365

Stamm-Scheele

Rayne, LA	337/334-3126

Christensen

Christensen Pumps

A division of Layne Christensen Company

1212 University Street - Memphis, TN 38108- 901/276-6605
christensenpumps@laynechristensen.com

ADDITIONAL PUMP COMPONENTS

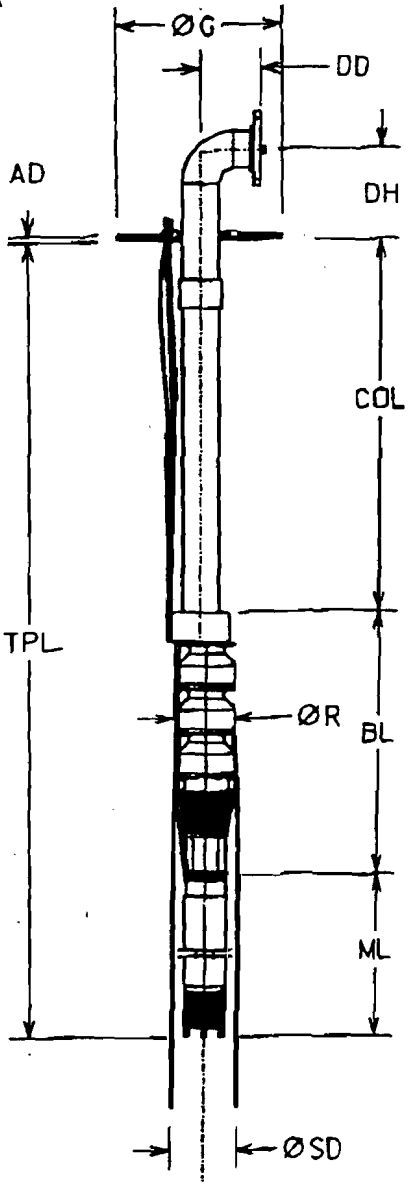
The following is a list of the additional components you ordered.
Consult factory for any other components or services.

Component
Motor Adapter
Shroud

Memphis Tennessee
Layne Holbrook

1 Stage 6x11CLC

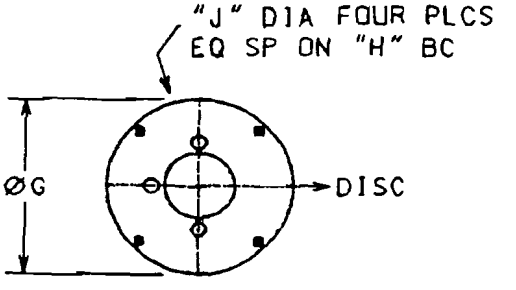
CLEARWELL No.1



AD:	1.63
AG:	
BL:	28.25
CAN:	N/A
CD:	
CL:	N/A
COL:	70.0'
DD:	10.88
DH:	16.50
G:	23.50
H:	21.25
HH:	
J:	1.25
R:	11.50
ML:	37.40
SL:	
TPL:	75.5'
UG:	N/A
V:	
W:	
X:	
SD:	15.00
Y:	
Z:	

Pump Data

Size:	11CLC
Stages:	1
Impellers:	Bronze
Bowl:	Cast Iron
BowlShaft:	416SS 1.69"
LineShaft Matl:	N/A
LineShaft Type:	N/A
Column:	Steel
Column:	6" Threaded
Bearing Spacing:	N/A
Section Length:	10 feet
Head:	Heavy Duty
Flange (Disch.):	6" 150#
Inlet:	
Lineshaft Coupling:	N/A
Seal:	N/A
Strainer:	N/A
SubBase:	N/A



WELL HEAD

Hydraulic Data

Flow (gpm):	600
Pump Head (ft):	22.6
TDH (ft):	50.5
Speed (rpm):	1770
Fluid:	Water
Temperature (F):	60
Viscosity:	1.105
Spec.Grav:	1

Miscellaneous

Thrust At Design:	418
Thrust At Shutoff:	558
Min Water Level(in):	300

Weight

Pump:	1678
Motor:	370
Total:	2048

Motor Data

Model:	S12931H
Make:	Hitachi
HP:	10
RPM:	1800
Type:	SUB
Efficiency:	80.9
Frame:	8"

ersion: 2.63P

Arcadis

Date: 12-08-2003

Memphis Tennessee
Layne Holbrook

1 Stage 6x11CLC

Overall Pump Parameters

[redacted] and Model:	11CLC	Pump Operating Speed, RPM:	1770
[redacted]acity, GPM:	600	Total Dynamic Head, Ft.:	50.5
[redacted]l Pump Length, In.:	905.7	Impeller Trim, In.:	7.4
Pump Type:	Submersible	Head Type:	Heavy Duty
Pump K-Factor:	7.9	Number of Stages:	1
		Pumping Level, In.:	300.0

Bowl Data

Total Bowl Length, In.:	28.25	Bowl Diameter, In.:	11
Bowl Shaft Dia, In.:	1.69	Bowl Shaft Limit, HP:	376
		Bowl Shaft Material:	416SS

Column Data

Column Diameter, In.:	6	Column Load, Lb.:	22.0
Wall Thickness, In:	0.280	Column Elongation, In.:	0.00

HorsePower Data

		Thrust Load Loss, Hp.:	0.00
Bowl HP At Design, Hp.:	9.1	Motor HorsePower, Hp.:	10

Head Data

[redacted]olumn Loss, Ft.:	2.39	Head Loss, Ft.:	0.53
		Total Loss, Ft.:	2.92

[redacted]Other Data

Hydraulic Thrust, Lb.:	399.0	Thrust at Design, Lb.:	418.0
Thrust at Shutoff, Lb.:	557.8	Design NPSH, Ft.:	7.0
Shutoff Lateral, In.:	0.00	Actual Head above Grade, Ft.:	22.58

Efficiency Data (Efficiencies estimated not guaranteed)

Bowl Efficiency:	83.60	Pump Efficiency:	78.77
Motor Efficiency:	80.90	Overall Efficiency:	63.73
		KWH/1000 gallons:	0.25

Component Weights

Bowl Weight, Lbs.:	285	Column Weight,Lbs.:	1191
Head Weight, Lbs.:	202	Can Weight,Lbs.:	0
Motor Weight, Lbs.:	370	Total Pump Weight,Lbs.:	2048

Version: 2.63P Arcadis Date: 12-08-2003

istensen Pumps
nphis Tennessee
ne Holbrook

Christensen Pumps

arch Criteria:
F[illegible] 600 US gpm
H[illegible]: 50 ft

[illegible]ster
Temperature: 60 °F
SG: 1
Viscosity: 1.105 cP
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

otor: 10 hp
Speed: 1800
Frame: "8"
Standard: NEMA
Enclosure: SUB
Sizing criteria: Max Power on Design Curve

Catalog: Ch Submersible 60HZ vers 2.03

Pump: 11CLC (1 stages)
Type: Submersible
Synch speed: 1800 rpm
Speed: 1770 rpm
Dia: 7.4375 in
Curve no.: E3142-2

Pump Notes for Standard Sizes:
Suction Size-8" Discharge Sizes-6",8"

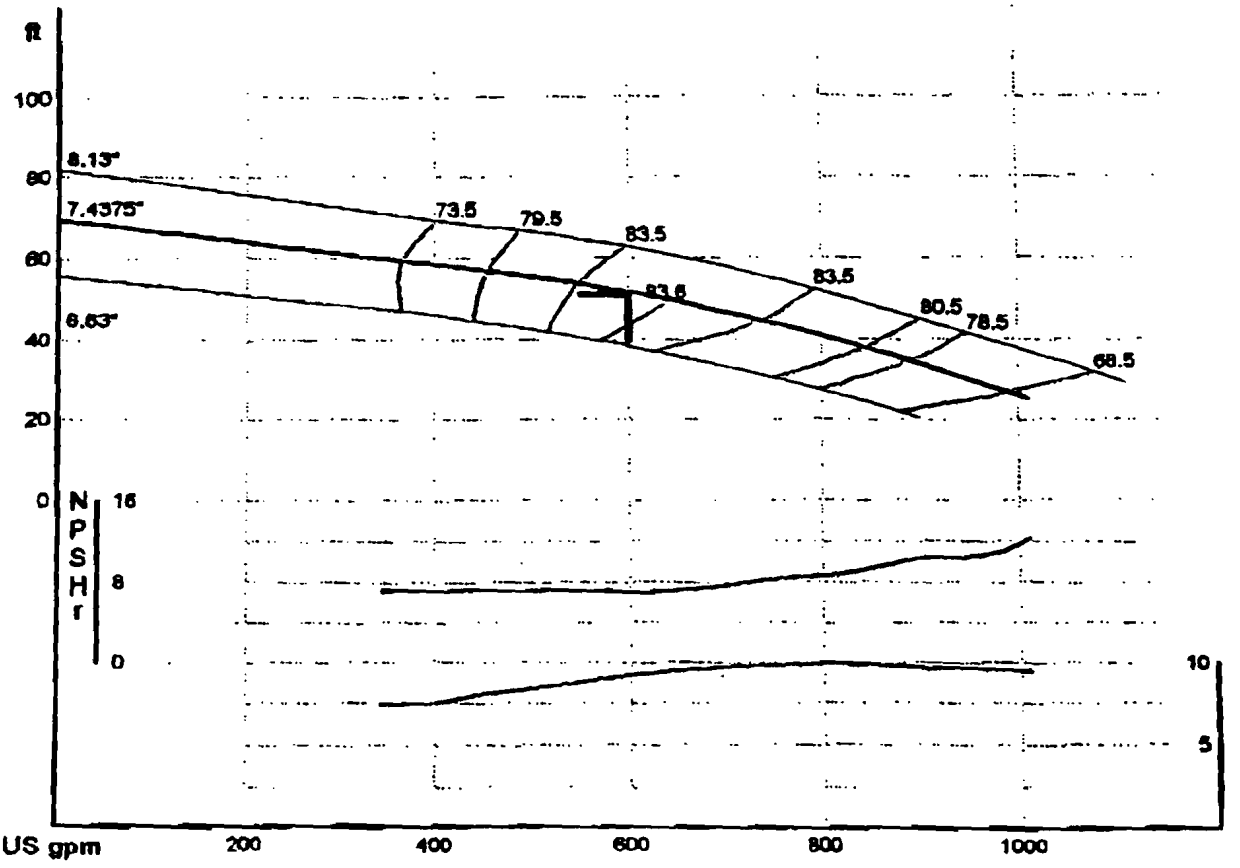
Vertical Turbine:
Bowl size: 11 in
Max lateral: 0.75 in
Thrust K factor: 7.9 lb/ft

Pump Limits for Standard Construction:
Pressure: 360 psi g
Sphere size: 0.68 in

— Data Point —
Flow: 600 US gpm
Head: 50.5 ft
Eff: 83.6%
Power: 9.1 bhp
NPSHr: 7 ft

— Design Curve —
[illegible]hutoff Head: 68.2 ft
Shutoff dP: 29.5 psi
Min Flow: — US gpm
BEP: 83.6% eff
@ 843 US gpm
NOL Pwr: 9.81 bhp
@ 846 US gpm

— Max Curve —
Max Pwr: 12.4 bhp
@ 901 US gpm



Performance Evaluation:

Flow	Speed	Head	Pump	Power	NPSHr	Motor	Motor	Hrs/yr	Cost
US gpm	rpm	ft	%eff	bhp	ft	%eff	kW		/kWh
720	1770	44.6	83.5	9.68	7.62				
600	1770	50.5	83.6	9.1	7				
480	1770	55	80.6	8.24	7				
360	1770	58.5	72.2	7.35	7				
240	Flow Rate is Out of Range for this pump								

[illegible]rbine Pump Selection vers 7.1a

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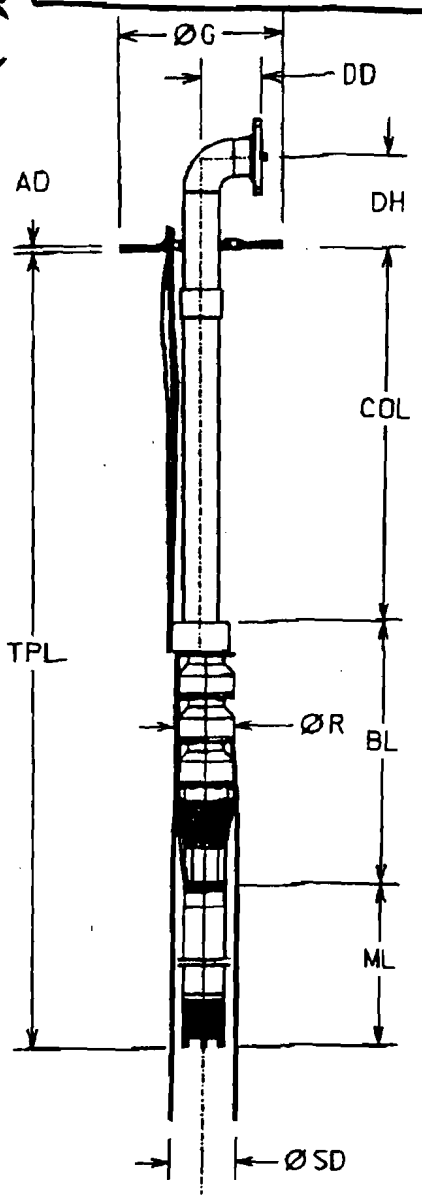
Memphis Tennessee
Layne Holbrook

2 Stage 6x11CLC

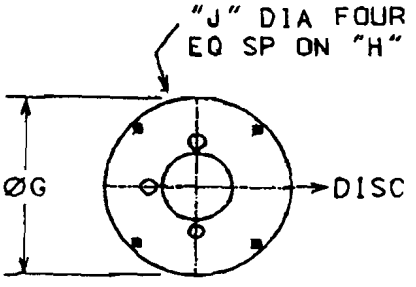
CLEARWELL No. 2



AD:	1.63
AG:	
BL:	38.13
CAN:	N/A
CD:	
CL:	N/A
COL:	70.0'
DD:	10.88
DH:	16.50
G:	23.50
H:	21.25
HH:	
J:	1.25
R:	11.50
ML:	44.09
SL:	
TPL:	76.9'
UG:	N/A
V:	
W:	
X:	
SD:	15.00
Y:	
Z:	

Pump Data

Size:	11CLC
Stages:	2
Impellers:	Bronze
Bowl:	Cast Iron
BowlShaft:	416SS 1.69"
LineShaft Matl:	N/A
LineShaft Type:	N/A
Column:	Steel
Column:	6" Threaded
Bearing Spacing:	N/A
Section Length:	10 feet
Head:	Heavy Duty
Flange (Disch.):	6" 150#
Inlet:	
Lineshaft Coupling:	N/A
Seal:	N/A
Strainer:	N/A
SubBase:	N/A



WELL HEAD

Hydraulic Data

Flow (gpm):	600
Pump Head (ft):	73.1
TDH (ft):	101.0
Speed (rpm):	1770
Fluid:	Water
Temperature (F):	60
Viscosity:	1.105
Spec.Grav:	1

Miscellaneous

Thrust At Design:	836
Thrust At Shutoff:	1120
Min Water Level(in):	300

Weight

Pump:	1775
Motor:	443
Total:	2218

Motor Data

Model:	S15931H
Make:	Hitachi
HP:	25
RPM:	1800
Type:	SUB
Efficiency:	82.1
Frame:	8"

ersion: 2.63P

Arcadis

Date: 12-08-2003

ristensen Pumps
mphis Tennessee
yne Holbrook

Christensen Pumps

arch Criteria:
Flow: 600 US gpm
d: 100 ft

Water
perature: 60 °F
SG: 1
Viscosity: 1.105 cP
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

Motor: 20 hp
Speed: 1800
Frame: "8""
Standard: NEMA
Enclosure: SUB
Sizing criteria: Max Power on Design Curve

Catalog: Ch Submersible 60HZ vers 2.03

Pump: 11CLC (2 stages)
Type: Submersible
Synch speed: 1800 rpm
Speed: 1770 rpm
Dia: 7.4375 in
Curve no.: E3142-2

Pump Notes for Standard Sizes:
Suction Size-8" Discharge Sizes-6",8"

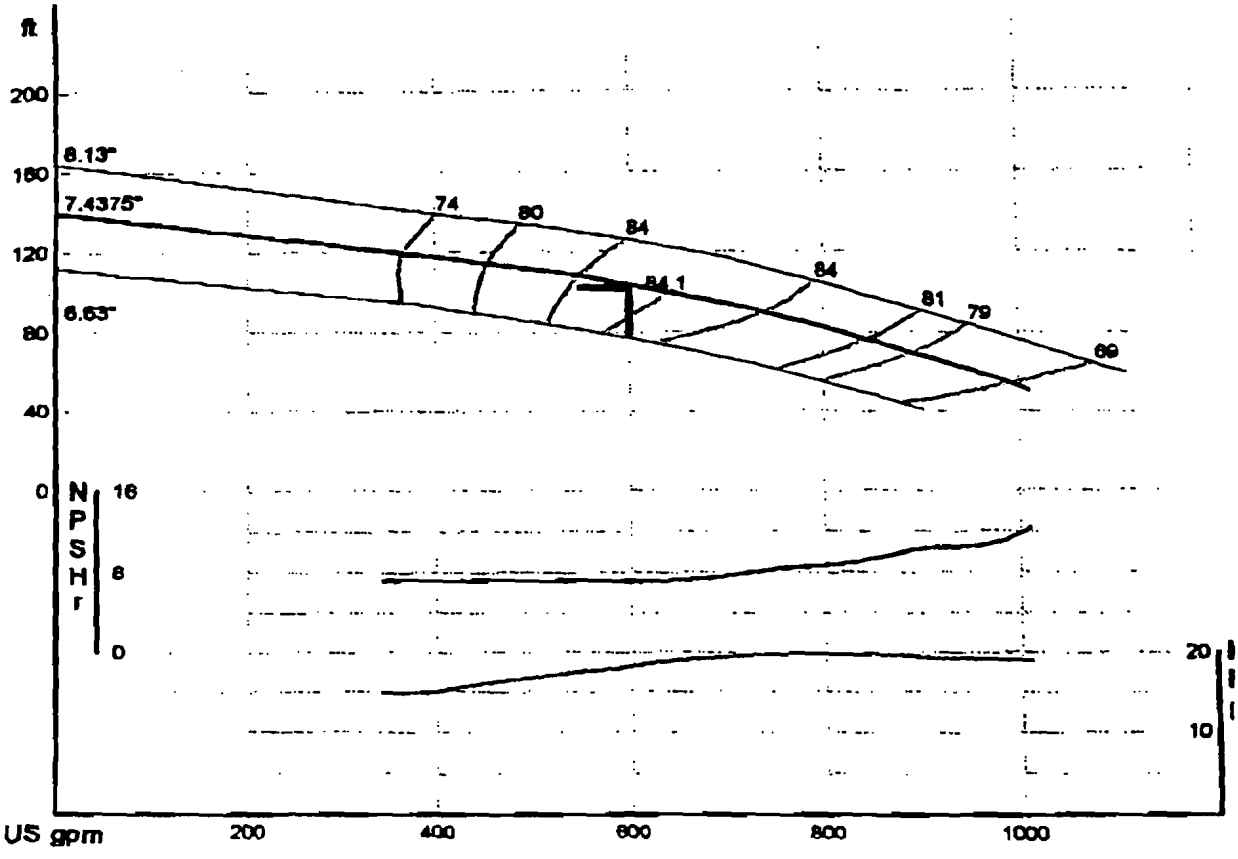
Vertical Turbine:
Bowl size: 11 in
Max lateral: 0.75 in
Thrust K factor: 7.9 lb/ft

Pump Limits for Standard Construction:
Pressure: 380 psi g
Sphere size: 0.68 in

— Data Point —
Flow: 600 US gpm
Head: 101 ft
Eff: 84.1%
Power: 18.2 bhp
NPSHr: 7 ft

– Design Curve –
Shutoff Head: 137 ft
Shutoff dP: 59.3 psi
Min Flow: — US gpm
BEP: 84.1% eff
@ 643 US gpm
NOL Pwr: 19.6 bhp
@ 846 US gpm

– Max Curve –
Max Pwr: 24.9 bhp
@ 901 US gpm



Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
720	1770	89.7	84	19.3	7.82				
600	1770	101	84.1	18.2	7				
480	1770	111	81.1	16.5	7				
360	1770	118	72.6	14.7	7				
240	Flow Rate is Out of Range for this pump								

rbine Pump Selection vers 7.1a

Arcadis

Memphis Tennessee
Layne Holbrook

2 Stage 6x11CLC

Overall Pump Parameters

[redacted] and Model:	11CLC	Pump Operating Speed, RPM:	1770
[redacted] city, GPM:	600	Total Dynamic Head, Ft.:	101.0
[redacted] Pump Length, In.:	922.2	Impeller Trim, In.:	7.4
Pump Type:	Submersible	Head Type:	Heavy Duty
Pump K-Factor:	7.9	Number of Stages:	2
		Pumping Level, In.:	300.0

Bowl Data

Total Bowl Length, In.:	38.13	Bowl Diameter, In.:	11
Bowl Shaft Dia, In.:	1.69	Bowl Shaft Limit, HP:	376
		Bowl Shaft Material:	416SS

Column Data

Column Diameter, In.:	6	Column Load, Lb.:	44.0
Wall Thickness, In:	0.280	Column Elongation, In.:	0.00

HorsePower Data

		Thrust Load Loss, Hp.:	0.00
Bowl HP At Design, Hp.:	18.2	Motor HorsePower, Hp.:	25

Head Data

[redacted] olumn Loss, Ft.:	2.39	Head Loss, Ft.:	0.53
		Total Loss, Ft.:	2.92

[redacted])ther Data

Hydraulic Thrust, Lb.:	797.9	Thrust at Design, Lb.:	835.9
Thrust at Shutoff, Lb.:	1120.3	Design NPSH, Ft.:	7.0
Shutoff Lateral, In.:	0.00	Actual Head above Grade, Ft.:	73.08

Efficiency Data (Efficiencies estimated not guaranteed)

Bowl Efficiency:	84.10	Pump Efficiency:	81.67
Motor Efficiency:	82.10	Overall Efficiency:	67.05
		KWH/1000 gallons:	0.47

Component Weights

Bowl Weight, Lbs.:	382	Column Weight,Lbs.:	1191
Head Weight, Lbs.:	202	Can Weight,Lbs.:	0
Motor Weight, Lbs.:	443	Total Pump Weight,Lbs.:	2218

Version: 2.63P

Arcadis

Date: 12-08-2003

[redacted]

Memphis Tennessee
Layne Holbrook

2 Stage 6x11CLC

ADDITIONAL PUMP COMPONENTS

Following is a list of the additional components you ordered.
Consult factory for any other components or services.

Component

Motor Adapter
Shroud

Section 3-D

Clearwell No. 1 Discharge Control Valve (FCV-211)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

DECK ACTUATOR # 11-157 4"ϕ FCV-211

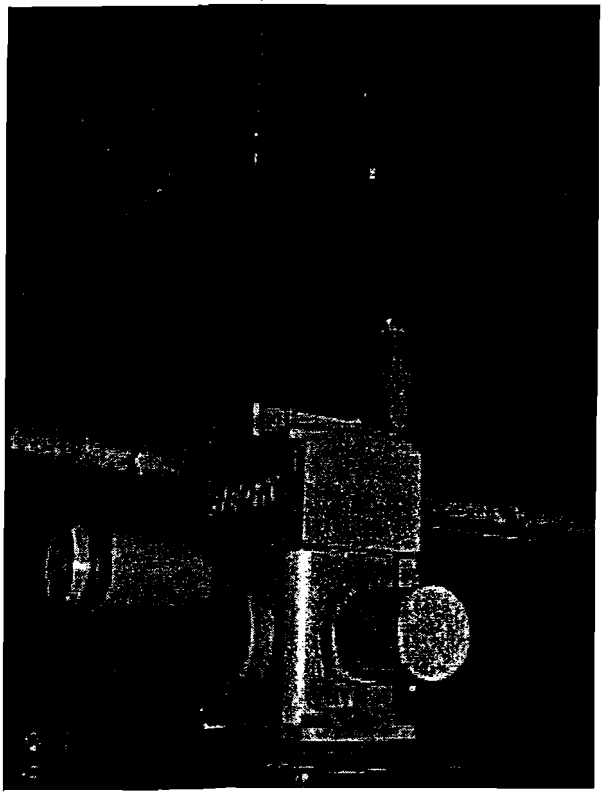
80-1102-01
Rev. 02

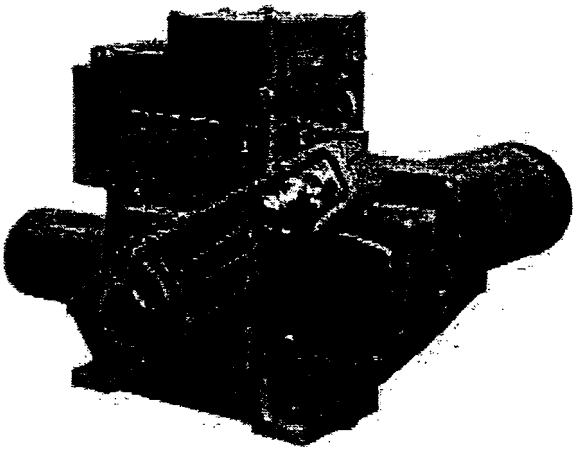
MODEL GROUP 11

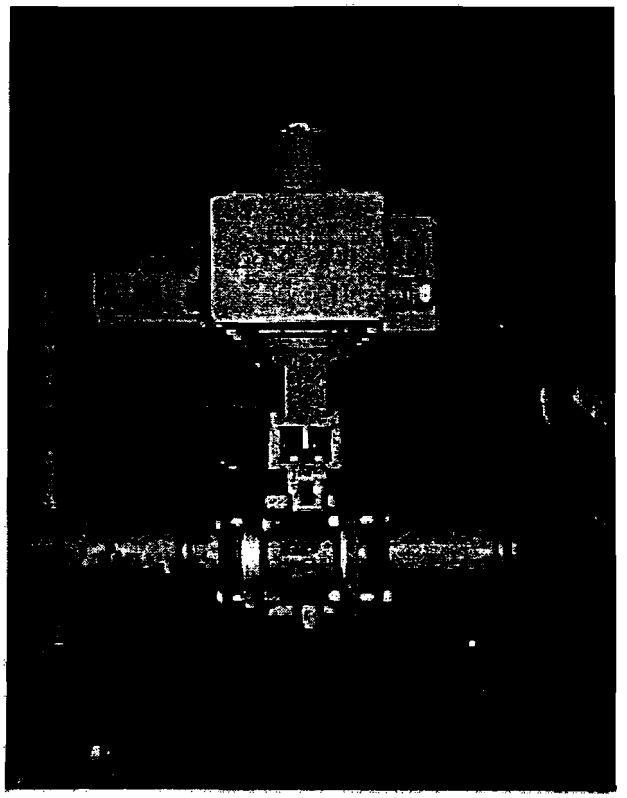
DCM-L EQUIPPED

BECK ELECTRONIC CONTROL DRIVES

INSTRUCTION MANUAL







BECK®

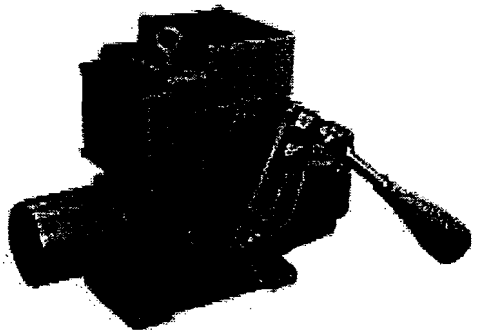
INTRODUCTION TO THE MANUAL

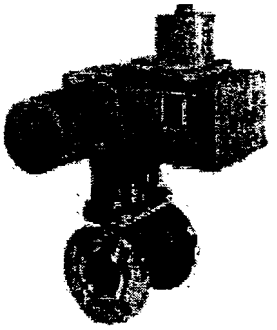
This manual contains the information needed to install, operate and maintain Beck Model Group 11 Electronic Control Drives equipped with the Local interface version of the Digital Control Module (DCM-L), manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

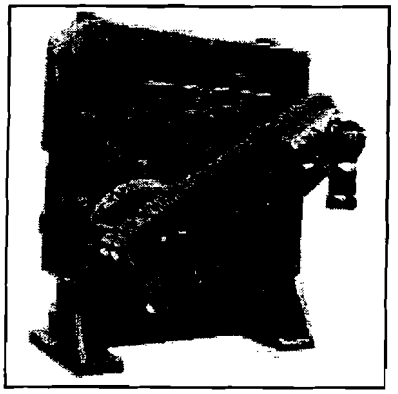
The Group 11 drive is a powerful control package designed to provide precise position control of dampers, valves, fluid couplings and other devices requiring up to 1,800 lb-ft of drive torque.

NOTICE: This manual contains information that will make installation simple, efficient and trouble-free. Please read and understand the appropriate sections in this manual before attempting to install or operate your drive.

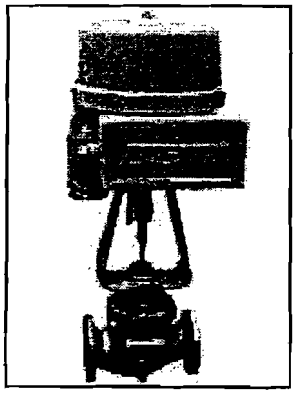
The Beck Group 11 fills an industry need for a reliable electronic control drive. Exceptionally stable and trouble-free, these rotary drives are in use throughout the world in valve and damper applications.







Group 22 digital control drives ... are designed for accurate, reliable, digital control in high torque applications. The drive is ideal for use in large boiler applications, such as ID/FD fan dampers.



Group 14 linear drives ... are ideally suited for globe valves from 1" to 8" diameter. Beck's unique "Tight-Seater™" coupling provides positive seating of valves.

CONTENTS

STORAGE INFORMATION

The drive should be stored in its shipping carton in a clean, dry area.

If it is necessary to store the drive outdoors for a long period of time, it should be removed from its shipping carton and stored above ground. A waterproof cover should be securely fastened over it. Do not stack drives on top of one another. Stored drives should be periodically checked to make sure no condensation has formed in the control compartments. Damage due to moisture while in storage is not covered by warranty.

UNPACKING

Beck drives are packed in standardized cardboard shipping containers. Drives mounted on valves are strapped to a skid and crated. After unpacking, the wooden platform may be used to transport the drive to the installation site.

PRODUCT DESCRIPTION

Beck control drives are engineered for precise, reliable operation of dampers, quarter-turn valves and fluid drives. The cool, stable operation of Beck's control motors coupled with the powerful gear train provide the tight, responsive control required by modern control loops to optimize output while keeping operating costs low.

The unique all spur gear construction used in the Beck control drive is designed for long term durability. Gear modules and motors can be interchanged in the field to alter the torque and timing as needed if the application requirements change. Mechanical stops in the gear train prevent overtravel.

An easy to turn, spoke-free Handwheel is incorporated into the design to allow manual operation during installation or power outages. The Handwheel can be used to move dampers and valves to any position smoothly and easily under full load conditions.

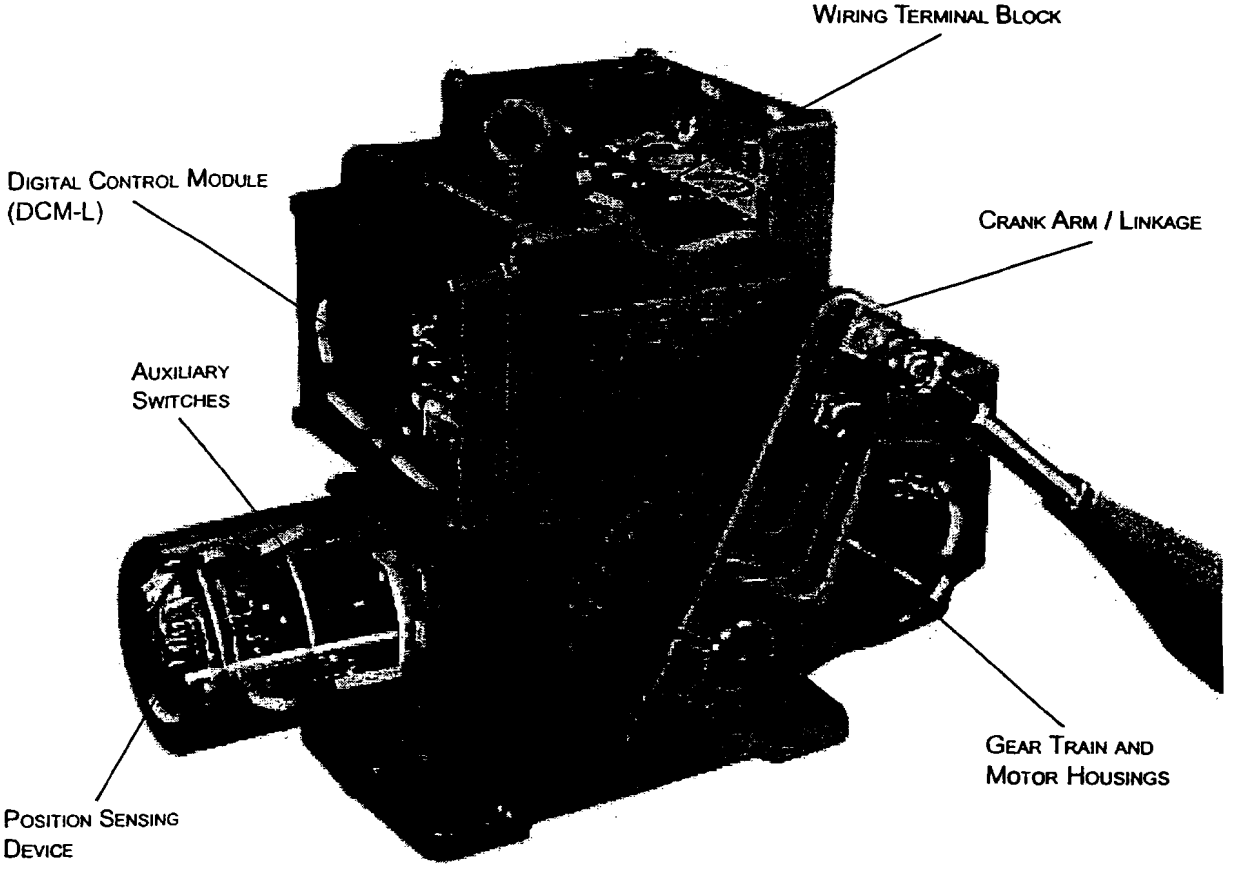
Dampers and valves may also be operated at their individual locations with built-in electric Handswitches.

The heavy-duty crank arm (if applicable) of these control drives can be field-adjusted to travel anywhere in the 360° range. The forged rod end fitting may be field-adjusted to any point in the cast slot of the crank arm. Special linkage arrangements allow total application versatility for connection directly on or remote from the driven load.

Beck's DCM-L provides precise drive control from either conventional analog or computer-based control systems. A serial interface is available to allow for drive configuration changes, drive information reporting and to assist in troubleshooting.

Beck's CPS-2 Contactless Position Sensor provides accurate position measurement in demanding environmental conditions, with no contacting or wiping surfaces to wear or intermittently lose contact. The CPS-2 provides infinite resolution with linearity error of less than ±1% of span over full control drive travel.

Beck electronic control drives are designed with individual weatherproof enclosures to protect the main components. The cutaway illustration below is intended to provide the user with a basic orientation to the product.

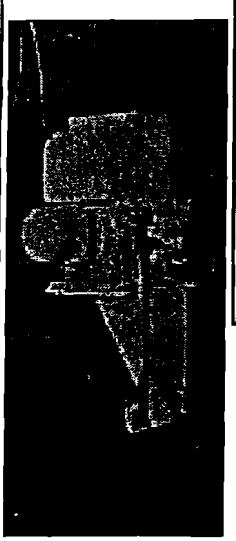


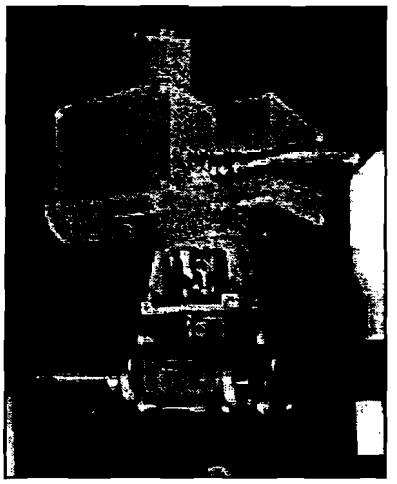
TYPICAL APPLICATIONS

Beck control drives are ideally suited for use on ball, plug and butterfly valves, as well as dampers and fluid drives. When equipped with a sheave and multi-turn option (consult your Beck Sales Engineer for details), the drive can be used to raise and lower a weight-balanced damper.

DCM-L equipped Beck drives are designed for precise position control in modulating applications. The drive is best utilized when its full travel is employed to achieve its greatest sensitivity and resolution, although the driven device may operate through a considerably smaller range. Beck drives can be configured with special linkage to deliver greater torque where needed, so that drive size and resultant cost can be minimized.

Valves can be furnished by Beck as unitized assemblies with control drives mounted and tested in the factory. Depending on the valve and application, valves can be mounted directly or using a bracket and linkage. Also, drives may be installed in the field with mounting hardware furnished by Beck or the customer. Drives for dampers are generally installed at the site on a mounting platform separate from the damper.

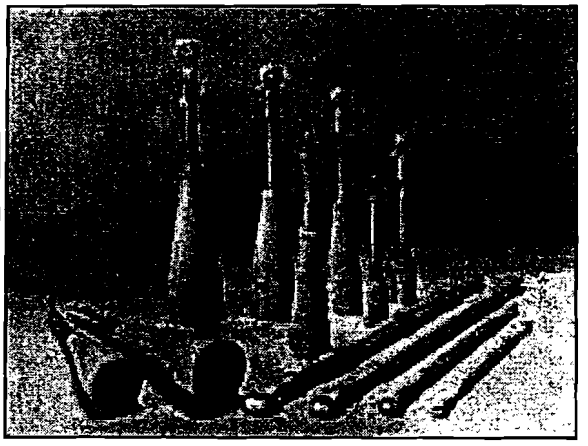




BECK LINKAGE KITS

Beck hex and pipe linkage kits are available for completing the mechanical connection from the drive crank arm to the load. Through the use of a standardized selection, the linkage can be ordered even if the exact length is not determined until the drive and driven device are installed.

All Beck foot-mounted drives are furnished with a crank arm and rod end (see pages 8–10 and 15 for dimensions). All rod ends furnished by Beck incorporate bearings to accommodate some lateral misalignment. Once the connection is made, linkage kits can be adjusted ±1 1/2" without removal of the crank arm or load lever, making final mechanical calibration simple.



PRODUCT DESCRIPTION

GENERAL SPECIFICATIONS—ALL MODELS

Input Power	120 V ac single-phase 50 or 60 Hz 240 V ac single-phase 50 or 60 Hz		Allowable Tolerance	+10% -15%

Model	Max. Current and Power			
	120 V ac		240 V ac	
11-159, -169	.40 A	48 W	.20 A	48 W
11-209, -269	.65 A	78 W	.33 A	78 W
11-309, -369	.65 A	78 W	.33 A	78 W
11-409, -469	3.10 A	400 W	1.55 A	400 W

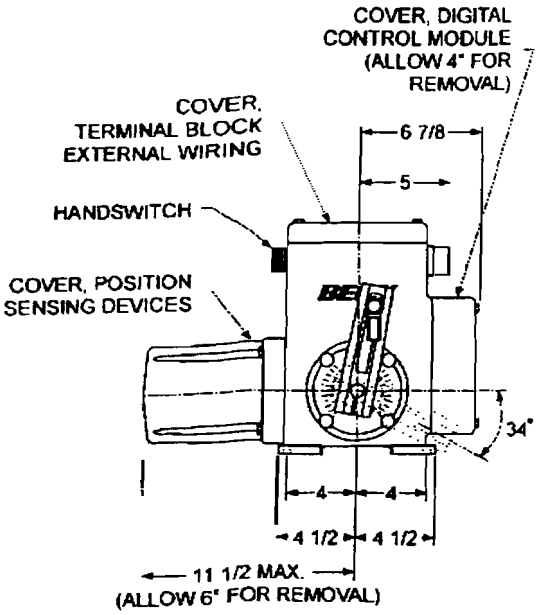
Operating Conditions	-40° to 85°C (-40° to 185°F) 0 to 99% relative humidity
Communication Interface	Local pushbutton/LED panel and RS-232 Serial commands.
Input Signal Options, with Digital Control Module (DCM-L)	4–20 mA 1–5 V dc
Adjustability for Split Range Operation	0%: 0.1 V to 4 V dc 100%: 0% + 1 V min. to 5 V max.
Deadband	0.6% of span. (Contact the factory if a different value is desired).
Minimum Step	0.1% typical.
Square Function	Drive output shaft moves proportionally to the square of the input signal. This function is factory set if specified at the time of order.
Position Feedback Signal for Remote Indication (Optional)	4–20 mA
Output Stability	0.25% of span from 102 to 132 V ac ±0.03% of span/°C for 0 to 50°C, ±0.05% of span/°C for -40° to 85°C
Linearity	±1% of span, max. independent error
Hysteresis	0.25% of span at any point
Isolation	Max. leakage of 10 µA at 60 V rms, 60 Hz from output to ground
Action on Loss of Power	Stays in place
Action on Loss of Input Signal (Power On)	Drives to any preset position—factory set according to customer specifications.

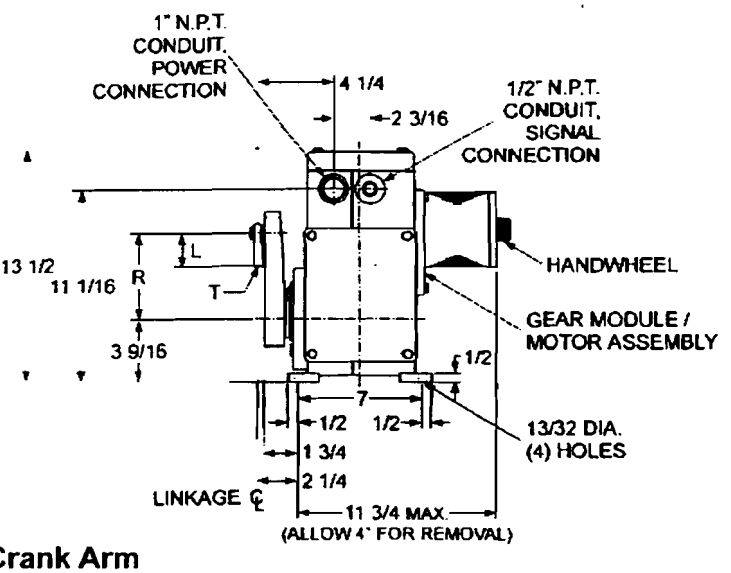
GENERAL SPECIFICATIONS—ALL MODELS (cont'd)

Stall Protection	If the motor tries to run in one direction for more than 300 seconds, the DCM will shut off power to the motor and an error light will activate indicating a stall. Time to stall indication can be factory configured down to 30 seconds according to specifications at time of order.
Alarm Annunciation	120 V, 1 A max. available at terminal E (not available on drives configured for 240V operation).
Over-travel Limit Switches	Two SPDT (CW and CCW) provide over-travel protection.
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1 to S4 and are cam-operated, field-adjustable. S1 and S4 are set to operate just before reaching the CCW travel limit. S2 and S3 are set to operate just before reaching the CW travel limit.
Handswitch	Permits local electrical operation, independent of controller signal. Standard on all units.
Handwheel	Provides manual operation without electrical power.
Motor	120 V ac, single-phase, no-burnout, non-coasting motor has instant magnetic braking. Requires no contacts or moving parts.
Gear Train	High-efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears. Interchangeable gear modules permit field change of timing.
Mechanical Stops	Prevent overtravel during automatic or manual operation.
Enclosure	Precision-machined aluminum alloy castings, painted with corrosion-resistant polyurethane paint, provide a rugged, dust-tight, weatherproof enclosure.

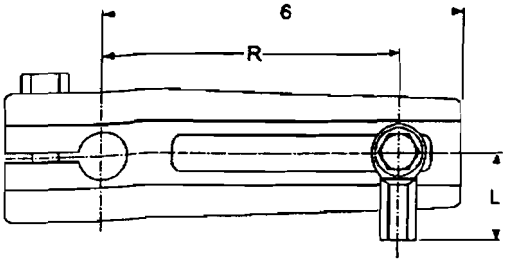
PRODUCT DESCRIPTION

MODEL 11-159 SPECIFICATIONS
(All Dimensions in Inches)

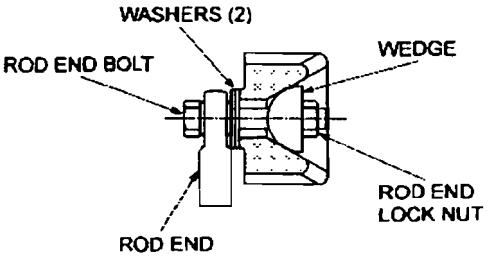




Crank Arm



ADJUSTABLE RADIUS "R" 1 1/2" TO 5 1/8"



Recommended Bolt Torques

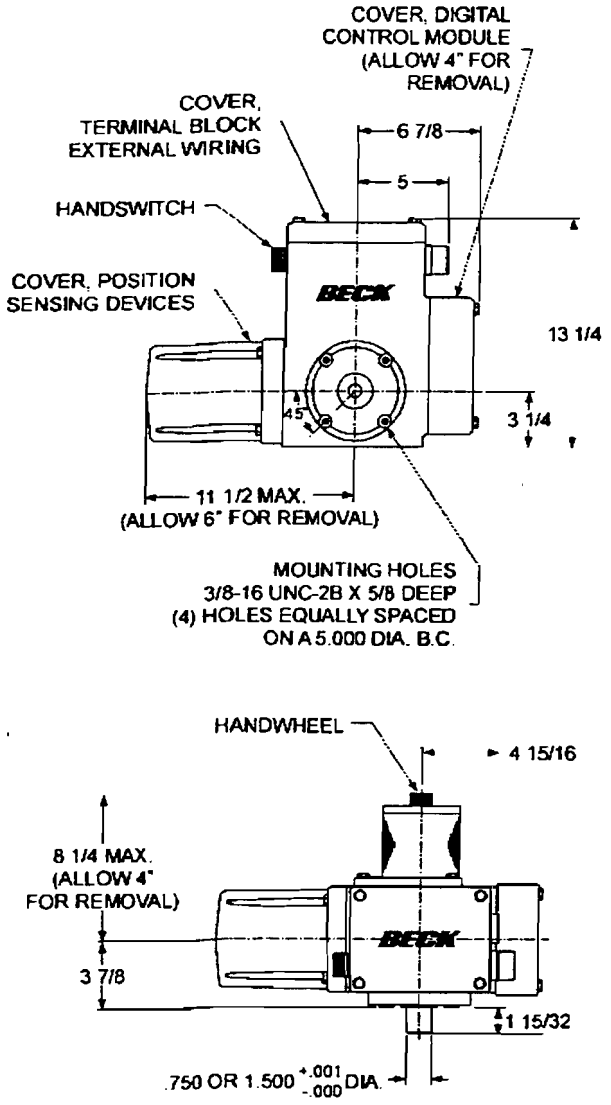
	Size (in.)	Torque (lb-ft)
Crank Arm Bolt	1/2-13	75
Rod End Bolt	1/2-13	35
Rod End Lock Nut	1/2-13	55
Cover Bolts	5/16-18	10
Motor/Gear Module Bolts	1/4-20	6
Body Bolts	3/8-16	20

NOTE: All dimensions subject to change.

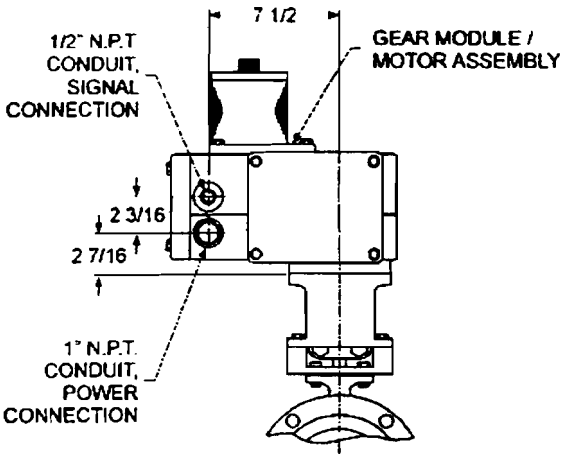
Model 11-159 Linkage Part Numbers & Model Information

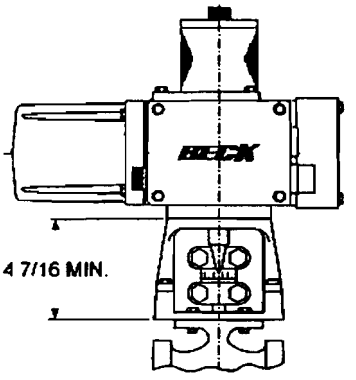
Crank Arm Assembly	10-3491-05
Crank Arm	10-3491-02
Crank Arm Bolt	30-0306-56
Washers (2)	30-0313-03
Wedge	11-8060-02
Rod End Bolt	30-0306-56
Rod End Lock Nut	30-0309-11
Rod End	12-2840-02
Dim. "L" (Length)	2.125"
Dim. "T" (Thread)	1/2-20 X 1-1/8"
Output Shaft Dia.	3/4"
Approx. Weight	60 lbs.
Max. Overhung Load	750 lbs.

MODEL 11-169 SPECIFICATIONS
(All Dimensions in Inches)



BASIC CONTROL DRIVE





TYPICAL VALVE MOUNTING

Model Information

Approx. Weight	55 lbs.
Max. Overhung Load	750 lbs.

NOTE: All dimensions subject to change.

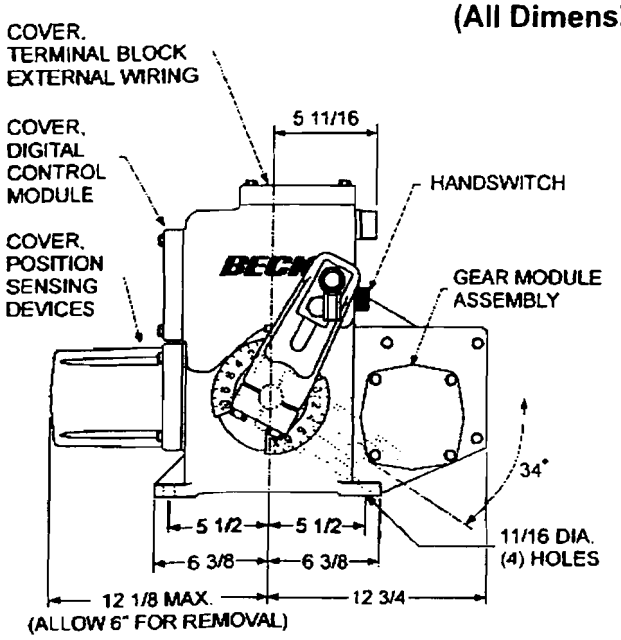
Recommended Bolt Torques

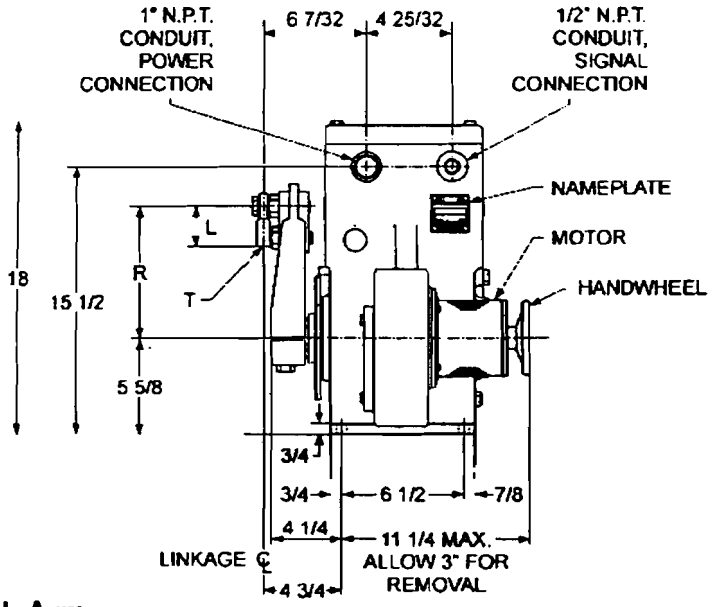
	Size (in.)	Torque (lb-ft)
Cover Bolts	5/16-18	10
Motor / Gear Module Bolts	1/4-20	6
Body Bolts	3/8-16	20
Control End Cover Bolts	5/16-18	10
Coupling Bolts	5/8-18	125
Mounting Bracket Screws (Flat Head)	3/8-16	23*

*May vary per application. Refer to valve mounting specification sheet shipped with your drive.

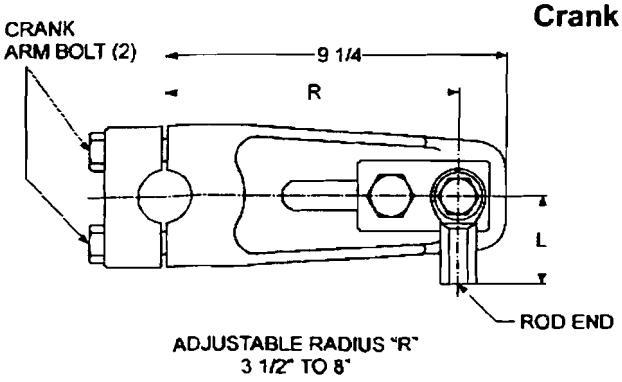
PRODUCT DESCRIPTION

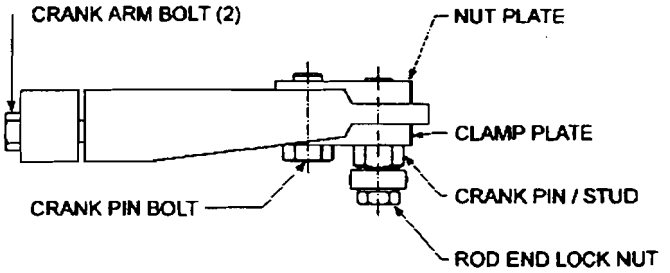
MODEL 11-209 & 11-309 SPECIFICATIONS
(All Dimensions in Inches)





Crank Arm





Recommended Bolt Torques

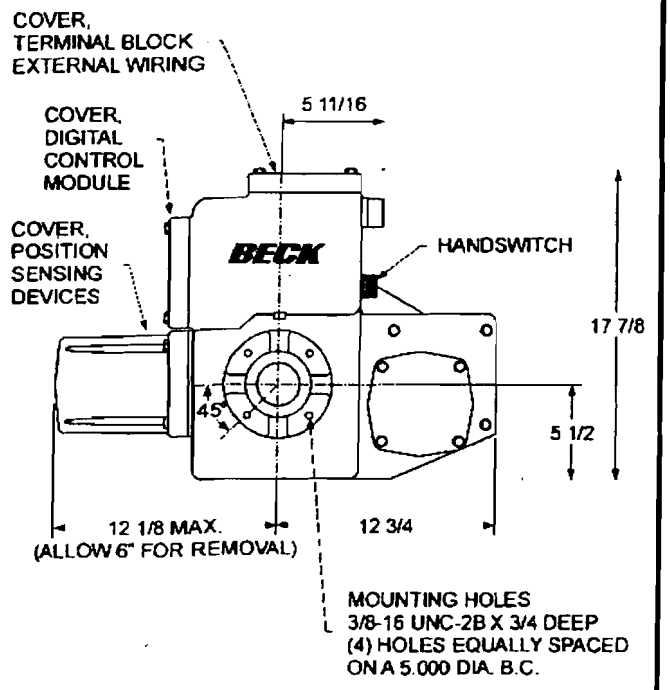
	Size (in.)	Torque (lb-ft)	
		11-209	11-309
Crank Arm Bolt	5/8-18	240	240
Crank Pin Bolt / Stud	3/4-16	300	300
Crank Pin Bolt	3/4-16	300	300
Rod End Lock Nut:			
(11-200)	1/2-20	35	—
(11-300)	5/8-18	---	65
Body Bolts	3/8-16	20	20
Body Bolts	1/2-13	50	50
Cover Bolts	5/16-18	10	10
Motor Bolts	1/4-20	6	6
Gear Module Bolts	5/16-18	10	10

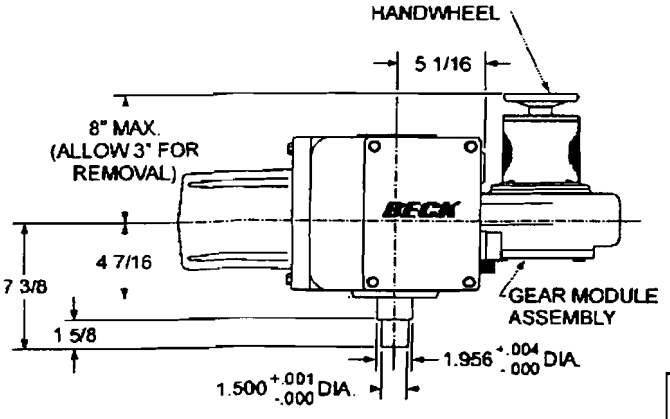
NOTE: All dimensions subject to change.

Model 11-209 / -309 Linkage Part Numbers & Model Information

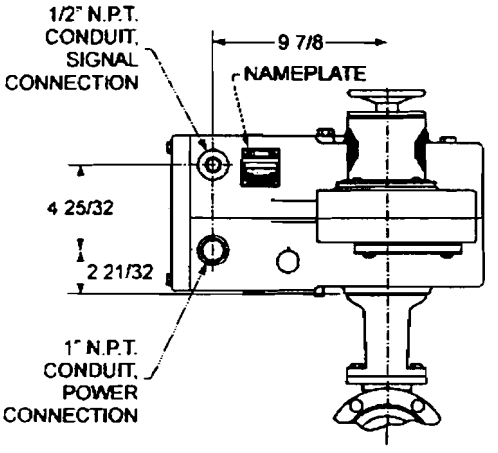
	11-209	11-309
Crank Arm Assembly	14-7330-26	14-8010-34
Crank Arm	14-8008-02	14-8008-01
Crank Arm Bolt (2)	30-0308-75	30-0308-75
Clamp Plate	14-9883-01	14-9883-01
Crank Pin / Stud	14-9920-06	14-9920-07
Crank Pin Bolt	30-0308-61	30-0308-61
Nut Plate	14-9883-02	14-9883-02
Rod End Lock Nut	30-0309-19	30-0309-23
Rod End	12-2840-02	12-2840-03
Dim. "L" (Length)	2 1/8"	2 1/2"
Dim. "T" (Thread)	1/2-20 X 1 3/16"	5/8-18 X 1 1/2"
Output Shaft Dia.	1 1/2"	1 3/4"
Approx. Weight	125 lbs.	125 lbs.
Max. Overhung Load	3,000 lbs.	4,500 lbs.

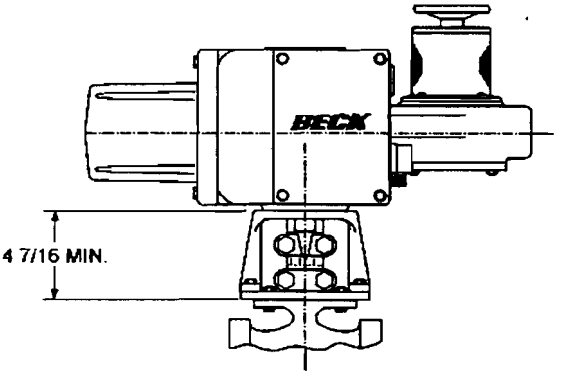
MODEL 11-269 SPECIFICATIONS
(All Dimensions in Inches)





BASIC CONTROL DRIVE





TYPICAL VALVE MOUNTING

Model Information

Approx. Weight	115 lbs.
Max. Overhung Load	3,000 lbs.

NOTE: All dimensions subject to change.

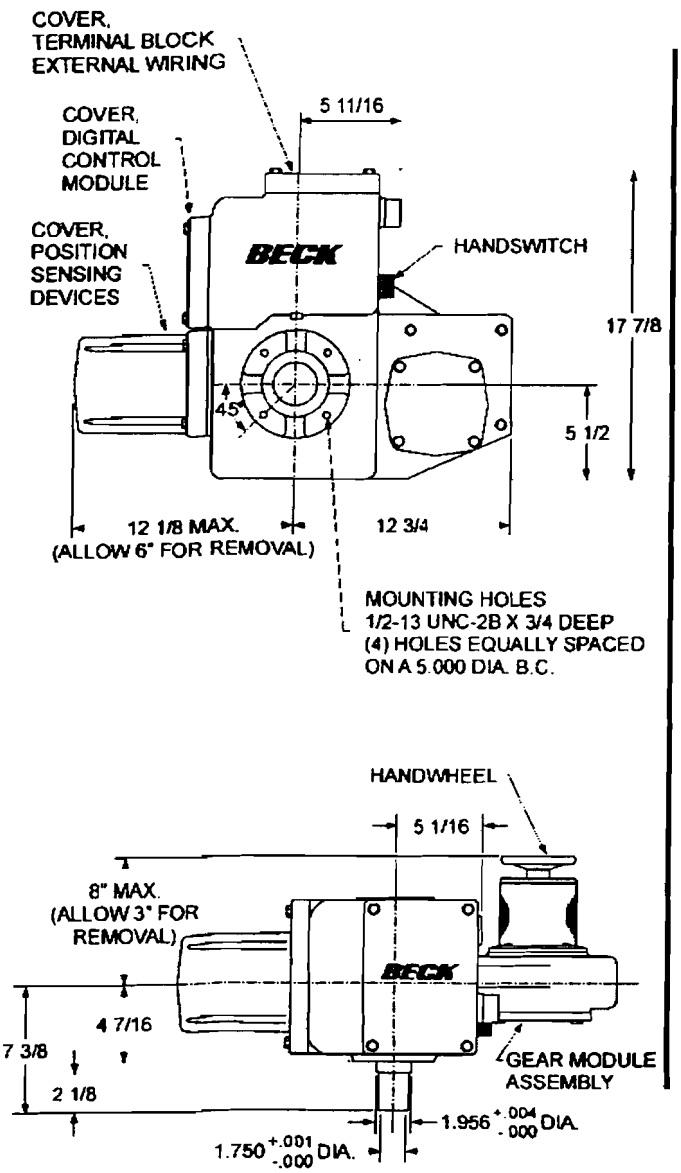
Recommended Bolt Torques

	Size (in.)	Torque (lb-ft)
Cover Bolts	5/16-18	10
Gear Module Bolts	5/16-18	10
Motor Bolts	1/4-20	6
Body Bolts	3/8-16	20
Body Bolts	1/2-13	50
Control End Cover Bolts	5/16-18	10
Coupling Bolts	5/8-18	125*
Mounting Bracket Screws (Flat Head)	3/8-16	23*

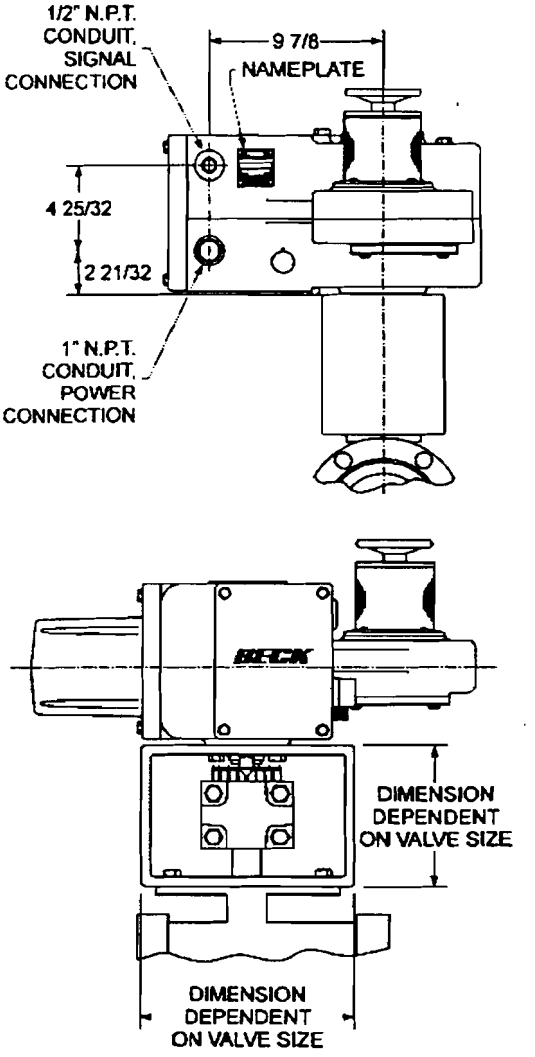
*May vary per application. Refer to valve mounting specification sheet shipped with your drive.

PRODUCT DESCRIPTION

MODEL 11-369 SPECIFICATIONS
(All Dimensions in Inches)



BASIC CONTROL DRIVE



TYPICAL VALVE MOUNTING

Model Information

Approx. Weight	115 lbs.
Max. Overhung Load	4,500 lbs.

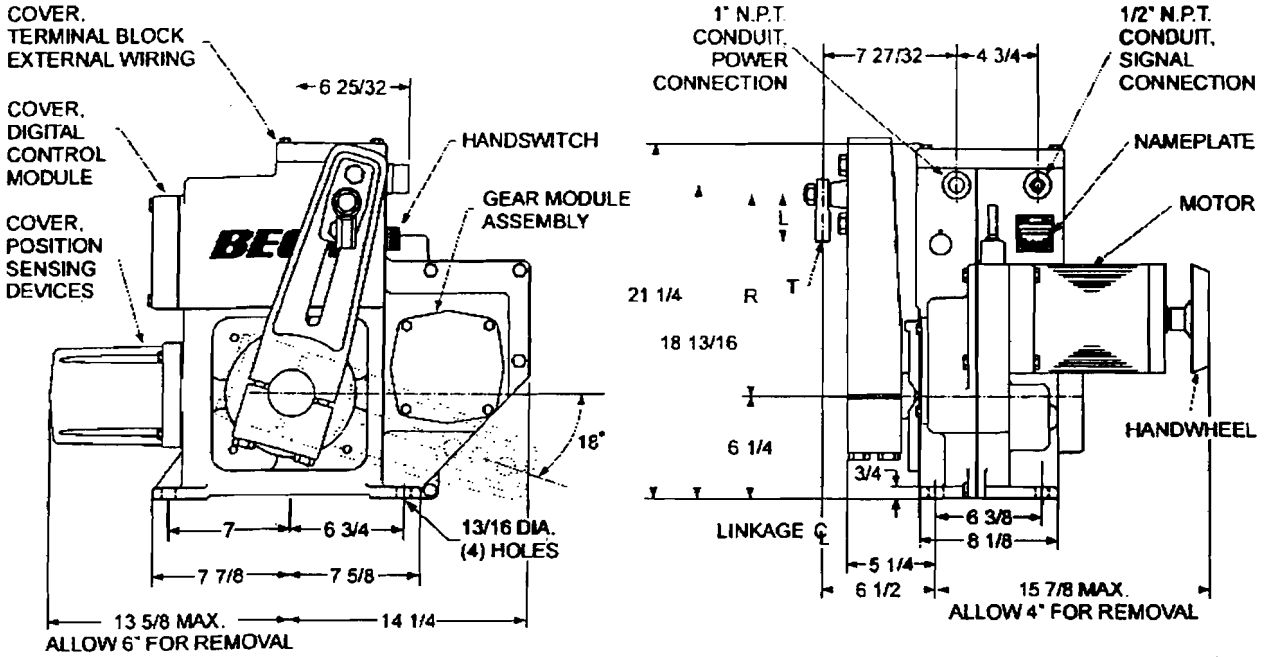
NOTE: All dimensions subject to change.

Recommended Bolt Torques

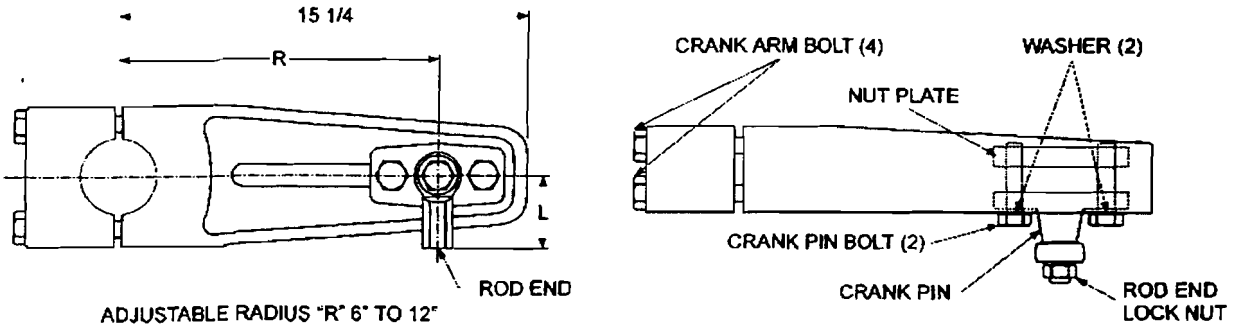
	Size (in.)	Torque (lb-ft)
Cover Bolts	5/16-18	10
Gear Module Bolts	5/16-18	10
Motor Bolts	1/4-20	6
Body Bolts	3/8-16	20
Body Bolts	1/2-13	50
Control End Cover Bolts	5/16-18	10
Coupling Bolts	5/8-18	125**
Mounting Bracket Bolts	1/2-13	50**

**May vary per application. Refer to valve mounting specification sheet shipped with your drive.

MODEL 11-409 SPECIFICATIONS
(All Dimensions in Inches)



Crank Arm



Model 11-409 Linkage Part Numbers & Model Information

Crank Arm Assembly	14-8018-02
Crank Arm	14-8018-01
Crank Arm Bolt (4)	30-0308-07
Washer (2)	30-0313-27
Crank Pin	14-9882-01
Crank Pin Nut Plate	20-2641-01
Crank Pin Bolt (2)	30-0308-03
Rod End Lock Nut	30-0309-24
Rod End	12-2840-04
Dim. "L" (Length)	2 7/8"
Dim. "T" (Thread)	3/4-16 X 1 3/4"
Output Shaft Dia.	2 3/4"
Approx. Weight	270 lbs.
Max. Overhung Load	9,000 lbs.

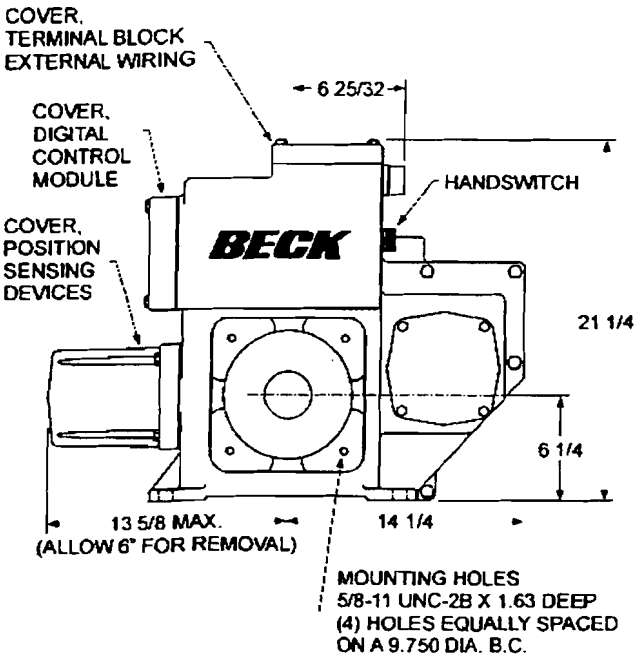
Recommended Bolt Torques

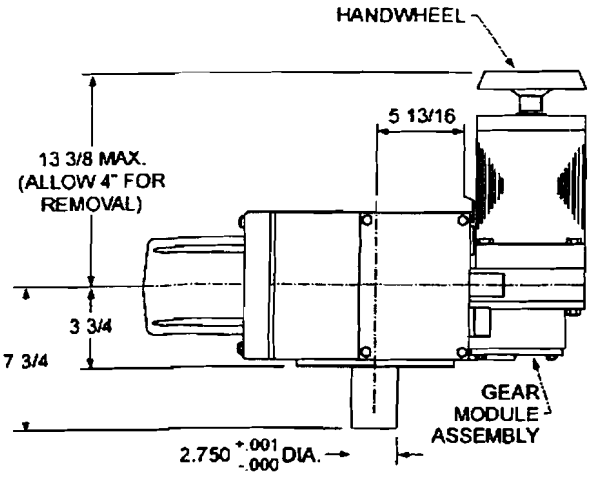
	Size (in.)	Torque (lb-ft)
Crank Arm Bolts	5/8-18	170
Crank Pin Bolt	3/4-16	300
Rod End Lock Nut	3/4-16	120
Body Bolts	3/8-16	20
Body Bolts	1/2-13	50
Cover Bolts	5/16-18	10
Motor Bolts	3/8-16	16
Gear Module Bolts	5/16-18	10

NOTE: All dimensions subject to change.

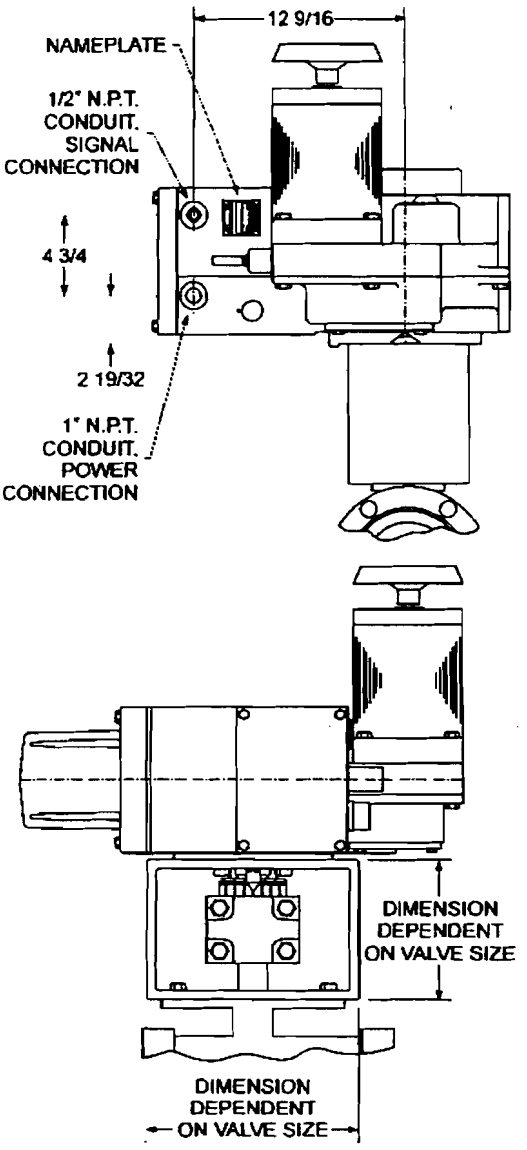
PRODUCT DESCRIPTION

MODEL 11-469 SPECIFICATIONS
(All Dimensions in Inches)





BASIC CONTROL DRIVE



TYPICAL VALVE MOUNTING

Model Information

Approx. Weight	216 lbs.
Max. Overhung Load	9,000 lbs.

NOTE: All dimensions subject to change.

Recommended Bolt Torques

	Size (in.)	Torque (lb-ft)
Cover Bolts	5/16-18	10
Gear Module Bolts	5/16-18	10
Motor Bolts	3/8-16	20
Body Bolts	3/8-16	20
Body Bolts	1/2-13	50
Control End Cover Bolts	5/16-18	10
Coupling Bolts	5/8-11	220**
Mounting Bracket Screws	5/8-11	150**

**May vary per application. Refer to valve mounting specification sheet shipped with your drive.

TABLE 1:
SUMMARY OF POPULAR[1] CONTROL OPTION 9, DCM-L BOARD OPTIONS AND PART NUMBERS

DCM-L Part Number	Demand Input Signal Range[2]	Contactless Position Sensor Part Number	External Position Feedback Signal	Torque Sensing	Auxiliary Switch Options
22-5009-35	4–20 mA	20-3400-09	Yes	No	None
22-5009-39	4–20 mA		Yes	Yes	2
22-5009-45	1–5 V dc		Yes	No	4
22-5009-49	1–5 V dc		Yes	Yes	

[1]Other options are available – consult with a Beck Sales Engineer for details.

[2]Boards of either input signal range are convertible from one range to the other by adding or removing a 250 ohm input resistor.

INSTALLATION

SAFETY PRECAUTIONS

WARNING

Installation and service instructions are for use by qualified personnel only. To avoid injury and electric shock, do not perform any servicing other than that contained in this manual.

INSTALLATION—MECHANICAL

Beck drives may be installed in any convenient orientation, because the gearing does not require an oil bath. Refer to the outline dimension drawings on pages 8–14 for physical dimensions and required clearances.

Installing a Drive with Linkage

When installing a Beck drive in a location remote from the damper or valve, be sure it is firmly bolted to a flat mounting surface that will not yield to the stresses created from operating the device. A rigid, vibration-free surface will generally prolong the life of the drive's components.

The output shaft of the drive should be parallel to the damper or valve shaft, and the linkage should be in a plane perpendicular to that of the two shafts. Small misalignments can be tolerated if a rod end fitting is used on the driven lever similar to that on the Beck crank arm. The drive's crank arm can be positioned at any angle on the shaft.

Beck drives can be furnished with valves mounted as unitized assemblies ready for pipeline installation. Beck linkage kits are available for convenient field installation (see page 5).

Installing a Direct-coupled Drive

CAUTION

Whenever a control drive is being mounted on a valve, it is good practice to remove the valve from service and observe these precautions:

- **Know what fluid is in the line.**
- **Wear proper protective equipment.**
- **Disconnect electrical power.**
- **Depressurize the pipeline.**
- **Refer to the valve maintenance manual for specific instructions.**

Consult the *Beck Valve Mounting Specification sheet* shipped with the drive for instructions.

Installing a Unitized Valve/Drive Assembly on a Pipeline

Inspect the valve and pipe flanges to ensure they are clean. Be certain that other pipelines in the area are free from pipe scale or welding slag that could damage the gasket surfaces.

Carefully lift the assembly and position the valve in the pipeline. Install and tighten the flange bolts according to the valve and/or gasket manufacturer's instructions.

NOTE: The valve may have undergone temperature variations in shipment. This could result in seepage past the stem seals. Refer to the valve manufacturer's maintenance instructions for packing adjustments.

INSTALLATION—ELECTRICAL

NOTE: All Beck drives are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each drive is set up and calibrated to the customer's specifications that were written into the equipment order.

Two N.P.T. conduit connections are provided for power and signal wiring to the drive. The 1/2" conduit is provided for signal wiring connections, and the 1" conduit is provided for power and auxiliary switch connections. A sealant must be used on threaded conduit connections to keep moisture out. Conduits should be routed from below the drive so that condensation and other contaminants entering the conduit cannot enter the drive.

A large, clearly labeled terminal block on the top of the drive is enclosed in a separate, gasketed metal enclosure. Terminals will accommodate up to 12 AWG wiring. See page 4 for location of the terminal block.

CAUTION

Always close covers immediately after installation or service to prevent moisture or other foreign matter from entering the drive.

Refer to the wiring diagram furnished with your Beck drive for proper AC power and signal connections. It is advisable to provide normal short circuit protection on the AC power line. A copy of the wiring diagram is shipped with each drive and is fastened to the inside of the terminal block cover. If there is no wiring diagram available, you may obtain a copy from Beck by providing the serial number of your drive.

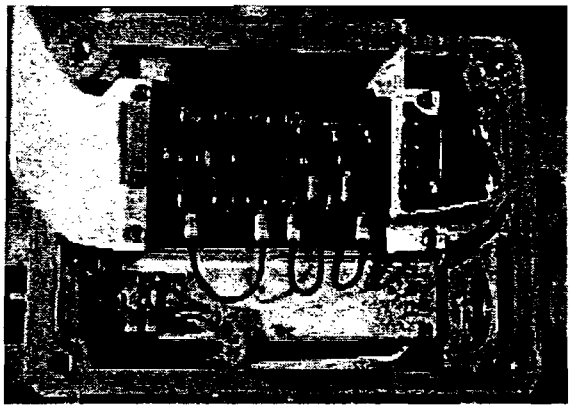
Your Beck drive has been supplied to match the signal source in your control loop. If it does not match, a 250 ohm input resistor may be added or removed to obtain the proper match. Consult the factory for details.

For maximum safety, the Beck drive body should be grounded. Use the grounding terminal in the wiring compartment of the drive.

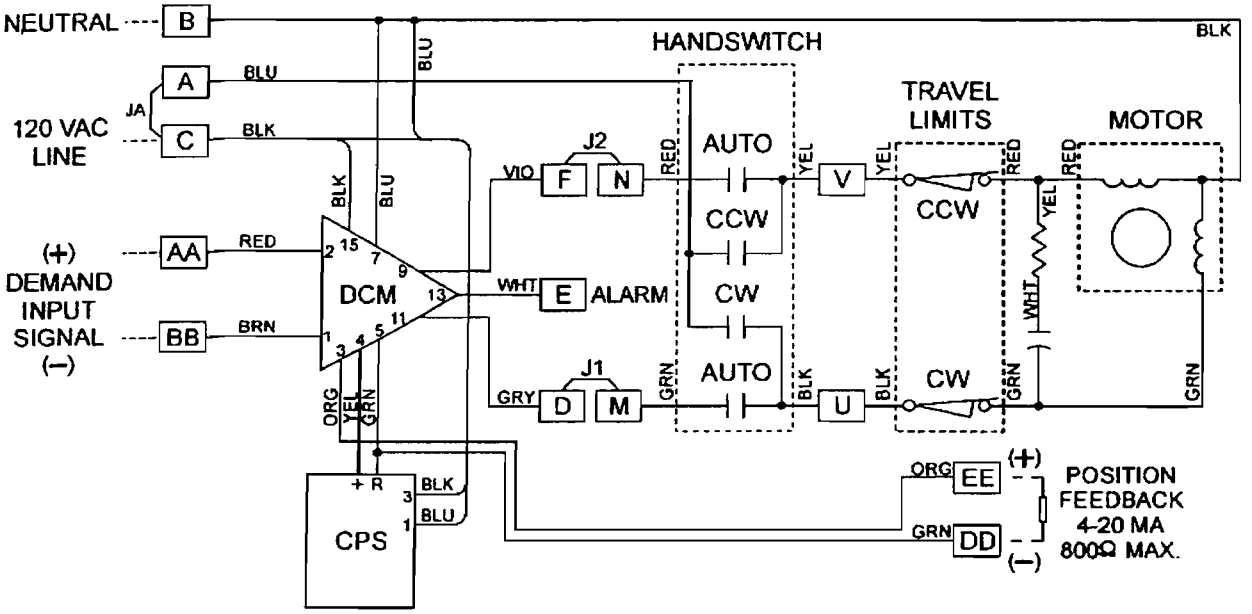
INSTALLATION *SIGNAL WIRING*

Each Beck drive is custom built to match the control requirements of your system specified at the time of order. Typical wiring connections are described below. Each drive has a specific wiring diagram attached to the inside of the wiring terminal cover.

A drive can be ordered with up to four optional auxiliary switches. Wiring connections for these are described on page 26.



Typical Wiring Connections



NOTE: Alarm indication at Terminal E is not available on drives configured for 240V operation.

LINKAGE REQUIREMENTS (If Applicable)

In most applications, the best control will result when the linkage is adjusted so that the full 100° angular travel of the Beck drive output shaft is used, even though the valve or damper may travel less than 100°.

The general requirements for a good linkage are:

1. It must be rigid enough to carry the link thrust without bending or deforming.
2. It must have a built-in means of adjustment so that the length of the connecting link can be changed a small amount.
3. Rod end bearings, similar to those furnished on the Beck crank arm, should be used at both ends of the connecting link. This type of device permits small angular misalignments and helps prevent binding of the linkage.
4. The radius of the Beck crank arm must be calculated so that it will move the valve or damper lever through the correct arc as it travels from 0° to 100°.
5. The drive and valve / damper shafts must be parallel and the linkage should be in a plane perpendicular to the shafts.

The following procedure is recommended to couple the linkage between the Beck drive and the driven shaft:

1. Position the driven shaft to the full counterclockwise (valve or damper closed) position.
2. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and output shaft centerline.
3. Remove the rod end from the Beck crank arm. Attach to the connecting link.
4. Adjust the connecting link to the predetermined length.
5. Connect the connecting link to the driven lever at the predetermined radius.
6. Loosen the Beck crank arm clamping bolts.
7. Position the drive's output shaft to its full counterclockwise limit.
8. Set the crank pin on the Beck crank arm to the predetermined radius.
9. Swing the crank arm into position to assemble the rod end to the crank arm crank pin.
10. Tighten the crank arm clamp bolts to the torque recommended on pages 8–10.
11. Tighten the coupling and rod end jam nuts.
12. Lubricate rod end bearings.

Carefully move the drive's output shaft to the full clockwise (maximum input signal) position. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also, observe that the driven shaft rotates the proper amount. Ensure that the drive reaches the clockwise limit and shuts off.

If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius on the Beck drive rather than adjusting the connecting link length. Return to step 5 and repeat adjustments.

To adjust the linkage length, alter the thread engagement in the couplings. The couplings have right- and left-hand threads, so it is not necessary to disconnect the ends to make a length adjustment. The stud threads must be engaged 1.2 diameters deep into the rod ends. Make adjustments by altering thread engagement in couplings only. Be careful not to expose more than 7" of stud between rod end and coupling.

Do not change limit switch settings to obtain desired valve or damper travel. This shortens the travel of the feedback device and reduces the control resolution, repeatability, accuracy of the drive, and available torque.

For an input control signal change, do not adjust the linkage. Refer to the Calibration section of this manual.

Once again, check operation to determine that no binding occurs between linkage and crank arm or valve / damper lever arm. Surrounding objects must not interfere.

Link-Assist™

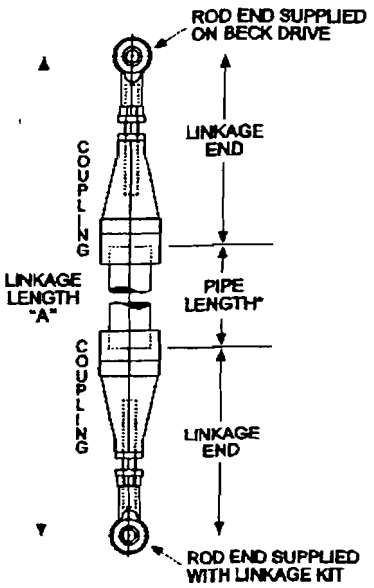
The Beck Link-Assist™ computer program optimizes the linkage configuration for your load's torque characteristics to help you select the minimum drive size for your application. Contact your Beck Sales Engineer to take advantage of Beck's Link-Assist™ program.

LINKAGE KITS AVAILABLE

Standard Beck linkage kits are made to accommodate a wide variation in linkage lengths without requiring modification of end fittings. This adaptability makes it possible to order the essential linkage end connections even though the exact linkage length may not be known until the valve / damper and drive are mounted in place.

Each linkage kit includes the essential pipe linkage end connections, rod end, and all necessary hardware. Schedule 40 pipe is not included and must be cut to length and threaded in the field (see Table 2, below, for instructions to calculate pipe length). To simplify installation of the pipe link, the kit accepts NPT right-hand threads on both ends of the pipe. Left-hand threads are internal to the linkage kit assembly, making final length adjustments quick and easy.

To order pipe linkage kits, first obtain the approximate overall linkage length "A" in the figure below. Select the kit part number from Table 2, below. For lengths beyond those listed in the table, contact your Beck sales engineer.



*NOTE: To calculate length of pipe required, subtract "Length of 2 Linkage Ends" (shown in Table 2) from Linkage Length "A" shown above.

START-UP INSTRUCTIONS

After the drive is mounted and its wiring connections are made, it is ready to be tested for proper operation.

NOTE: All Beck drives are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each drive is set up and calibrated to the customer's specifications that were written into the equipment order.

Turn on the power supply. Operate the drive with the Handswitch and run it through its full stroke, both directions. Observe that the driven device travels through its desired stroke. If satisfactory, set Handswitch to the "AUTO" position.

Turn on the controller and operate the drive by varying the control signal. Check that the damper or valve strokes in the proper direction for a change in control signal. If it does not, first check for proper wiring connections and verify control signal at the drive. If the wiring is correct, then change the direction of output shaft rotation (see page 32).

TABLE 2: PIPE LINKAGE KITS

BECK DRIVE MODEL NO.	LINKAGE LENGTH RANGE "A" (in.)	PIPE SIZE (in.)	MIN. PIPE NIPPLE LENGTH (in.)	ROD END THREAD	BECK PIPE LINKAGE KIT PART NO.	LENGTH OF 2 LINKAGE ENDS (TOTAL ADJUSTMENT ±1 1/2") (in.)	APPROX. WEIGHT (lbs.)
11-159	22 - 84	1	1 1/2	1/2-20	20-1730-05	20 1/2	6
	31 - 120	1 1/2	1 3/4		20-1740-06	29 1/4	9
11-209	22 - 45	1	1 1/2	1/2-20	20-1730-05	20 1/2	5
	31 - 84	1 1/2	1 3/4		20-1740-06	29 1/4	9
	33 1/4 - 120	2	2		20-1750-05	31 1/4	13
	37 - 120	2 1/2	2 1/2		20-1760-05	34 1/2	22
11-309	22 1/2 - 36	1	1 1/2	5/8-18	20-1730-06	21	5
	31 1/2 - 72	1 1/2	1 3/4		20-1740-07	29 3/4	9
	33 3/4 - 96	2	2		20-1750-06	31 3/4	13
	37 1/2 - 120	2 1/2	2 1/2		20-1760-06	35	22
11-409	23 1/4 - 34	1	1 1/2	3/4-16	20-1730-07	21 3/4	6
	32 1/4 - 48	1 1/2	1 3/4		20-1740-08	30 1/2	9
	34 1/2 - 72	2	2		20-1750-07	32 1/2	13
	38 1/4 - 120	2 1/2	2 1/2		20-1760-07	35 3/4	22

OPERATION

HOUSING

Beck electronic control drives have individual cast aluminum compartments for each of the five main components: The control motor, wiring terminal block, drive train, digital control module, and control end. Gasketed covers and sealed shafts make the drives ideally suited to outdoor and high humidity environments.

Heavy cast mechanical stops built into the housing are designed to prevent accidental over-travel damage during manual cycling, and ensure that proper orientation is maintained between the output shaft and the feedback system.

CONTROL MOTOR

The Beck control motor is a synchronous inductor motor which operates at a constant speed of 72 RPM or 120 RPM in synchronism with the line frequency.

Motors are able to reach full speed within 25 milliseconds and stop within 20 milliseconds; actual starting and stopping times will vary with load.

Beck motors have double grease-sealed bearings and require no maintenance for the life of the motor.

GEAR TRAIN

The gear train is a four-stage reduction, spur gear drive constructed with only heat-treated alloy steel and ductile iron gears for durability and long life.

The drive train consists of the control motor and Handwheel, reduction gears, main gear, output shaft, and crank arm. The main gear / output shaft and third stage gears are common to all units of a particular drive model. The second and first stage gears are part of the field-interchangeable gear module. Different combinations of gear modules and drive motors determine the drive's output torque and timing. See Table 9, page 40 for details.

On all models except the 11-169, the output shaft is limited by mechanical stops to 108° of rotation. On model 11-169 drives, the output shaft is limited by mechanical stops to 98° of rotation. Optional main gear / output shaft assemblies are available that permit multi-revolution output rotation. Mechanical stops are not included on these models. Mechanical transmission of output shaft position to the control end is provided by a right angle gear set driven directly by the output shaft.

SELF-LOCKING MECHANISM (SLM)

An integral part of every control motor is the self-locking mechanism. This mechanical device couples the motor to the gear train and transmits full motor torque when rotated in either direction. When the motor is de-energized, the SLM instantaneously locks and holds the output shaft in position.

HANDWHEEL

Every Beck control drive is furnished with a Handwheel to permit manual operation of the valve or damper without electrical power. Its solid construction design includes no spokes or projections, and turns at a safe, slow speed. The Handwheel is located at the rear of the control motor housing. The Handwheel is coupled directly to the motor shaft and rotates when the motor runs. Manual operation of the Handwheel (with electric Handswitch in "STOP" position) turns the motor and the rest of the drive train without incorporating a clutch.

HANDSWITCH

A local electric Handswitch is provided on Beck drives to permit operation at the valve or damper, independent of the controller. As a safety feature, the Handswitch is designed so that the controller can operate the drive only when it is in the "AUTO" position. The sequence of the Handswitch is: "AUTO", "STOP", "CW", "STOP", "CCW".

In the "AUTO" position, two contacts are closed and the DCM completes the control circuit.

In the "CW" or "CCW" positions, contacts are closed to operate the drive independently of the controller.

In the "STOP" position, all contacts remain open.

SWITCHES

Two over-travel limit switches and up to four optional auxiliary switches are provided on Beck drives. Switch cams are clamped onto the control shaft which rotates in relation to the output shaft. Cam position is field-adjustable. Switches are rated 6 A, 120 V ac. All auxiliary switch connections are made on the terminal block.

INPUT: DIGITAL CONTROL MODULE (DCM)

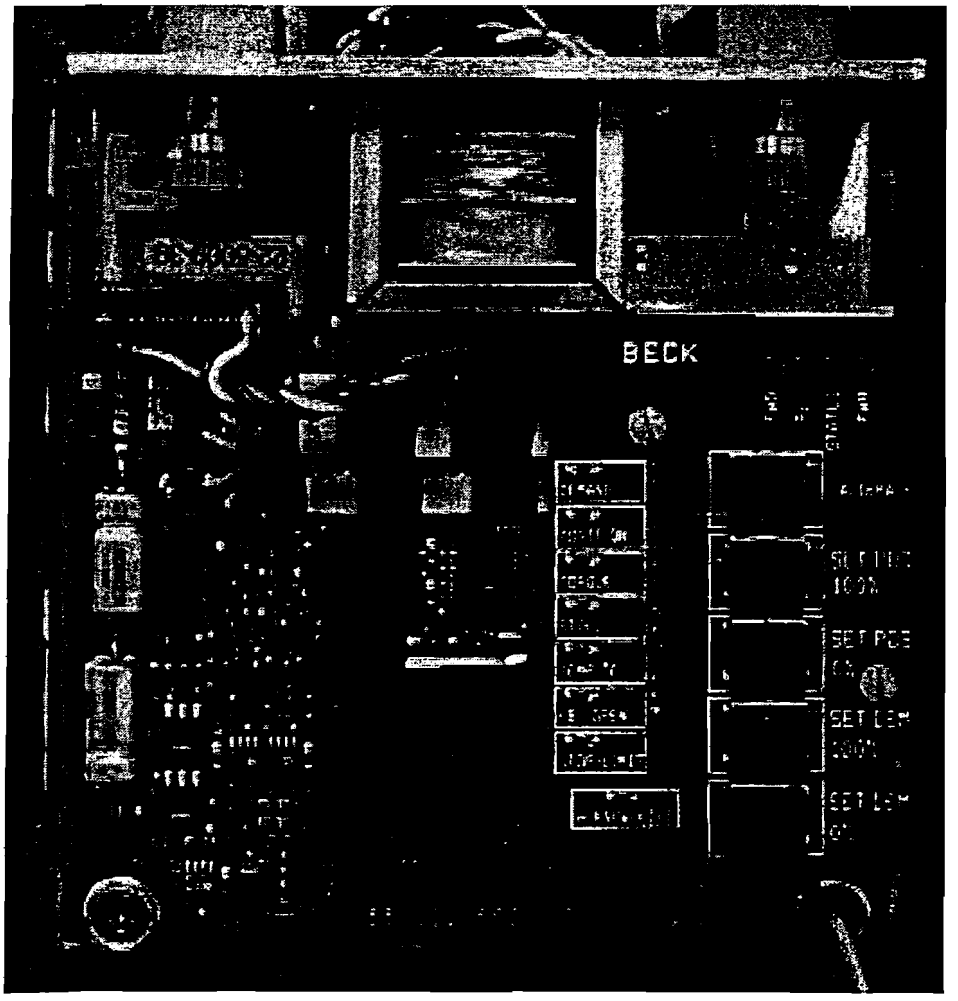
Beck modulating drives are equipped with a precision, digital control module (DCM) designed to receive conventional 4–20 mA or 1–5 V dc control signals directly—eliminating the need for contact protection devices, relays, switches and reversing starters.

The DCM modulates the drive output shaft in response to an analog demand input signal and is designed to operate continuously in temperatures up to 185°F.

The DCM permits two or more Beck drives to be operated by a single signal source. See page 29 for details on split range operation.

A square function is available to position the drive's output shaft proportionally to the square of the input signal—specify at the time of order (see page 29 for details).

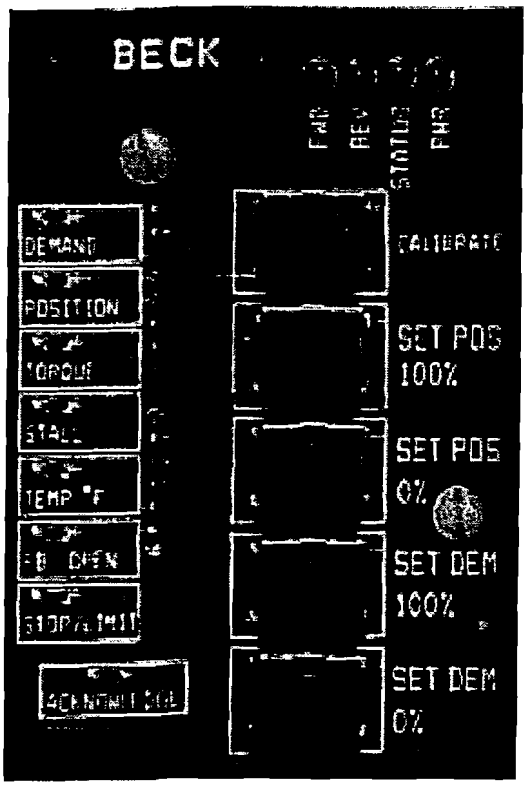
The DCM also allows direct communication with a computer through the use of a serial interface (see page 45).



OPERATION

DCM OVERVIEW

The DCM customer interface panel (pictured below) allows the user to easily calibrate the drive and troubleshoot conditions. The following information provides an overview of the DCM customer interface panel features.



NOTE: Beck drives are shipped from the factory set up and calibrated to customer specifications placed at the time of order and are ready for installation.

Overview LEDs

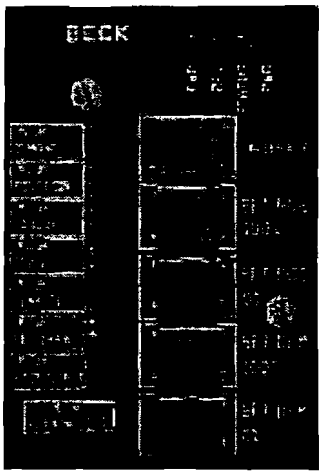
The four LEDs, as highlighted below, indicate the present state of the drive. Note that when the Handswitch is in the CW or CCW position, the FWD and REV LEDs represent the drive movement corresponding to the Handswitch position.

FWD
: This LED is lit when the Handswitch is in STOP or AUTO, and the drive is receiving a Demand signal greater than its position.

REV
: This LED is lit when the Handswitch is in STOP or AUTO, and the drive is receiving a Demand signal smaller than its position.

STATUS
: This LED is lit when additional status is available. For details regarding possible conditions, see "Status Indication LEDs" on page 23.

PWR
: This LED is lit when power is applied to the drive.



Status Indication LEDs

When the "STATUS" LED is lit, the applicable status indication LED(s) (pictured below) will light to reveal the condition(s) as described below. An alarm is also available at terminal E. When the condition is corrected, the status will automatically reset. Each status LED is described below, with a more detailed explanation of the function provided on page 24.

DEMAND
: Loss of the Demand input signal.

POSITION
: The CPS Position signal to the DCM is out of the calibrated range limits. The lower limit is –5% and the upper limit is 105% of the calibrated range. This LED may also indicate a CPS or internal wiring failure.

TORQUE
: This LED indicates that excessive torque is present (over 105% of the drive rating). This LED is functional only when the drive is equipped with optional torque sensing.

STALL
: The drive is in a stall condition and stall protection has been activated.

TEMP °F.
: Drive's internal temperature is outside of rating.

FB OPEN
: External position Feedback signal is enabled, but not wired to an external load or the wiring has failed between the drive and the monitoring device.

STOP/LIMIT
: Handswitch is in "STOP" position or the drive is at a limit and is not in balance.

Pushbutton Controls

The five pushbuttons (pictured below) on the DCM customer interface panel are used for calibration. When pressing a pushbutton, pressure should be maintained until the "ACKNOWLEDGE" LED lights; this confirms receipt of the pushbutton command. See the Calibration section, beginning on page 25, for further explanation of the calibration procedures. Pushbutton functions are as follows:

CALIBRATE
: A safety feature, this button must be pressed and held while pressing the pushbuttons described below to set the Position and Demand signal limits.

CAUTION

Pressing the following buttons may change calibration and cause the drive to reposition.

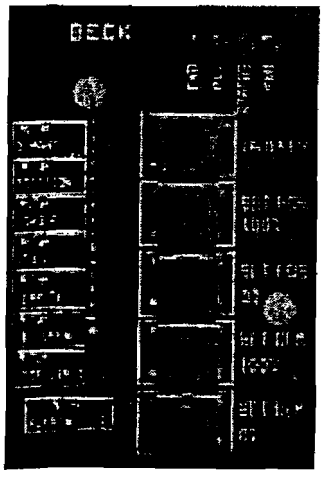
SET POS 100%
: Press to set the desired 100% position for drive movement (this will correspond to a 100% Demand signal).

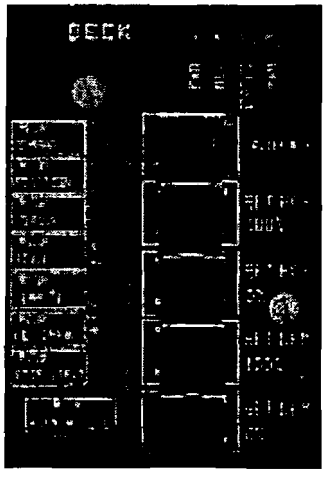
SET POS 0%
: Press to set the desired 0% position for drive movement (this will correspond to a 0% Demand signal).

SET DEM 100%
: Press to set the Demand input signal that corresponds to 100% Demand.

SET DEM 0%
: Press to set the Demand input signal that corresponds to 0% Demand.

Status Indication LEDs





Pushbutton Controls

OPERATION

LOSS OF DEMAND INPUT SIGNAL (L.O.S.)

When the Demand input signal drops to approximately 3.2 mA, the DCM considers the Demand input signal to be invalid. DCMs are typically configured to stop the drive during L.O.S. conditions, but may be factory configured to run the drive to a predetermined position. Under the L.O.S. condition, the "STATUS" and "DEMAND" LEDs will light. When the input signal is corrected, the drive will automatically resume normal operation. This function is configurable using the DCM serial interface (see page 45).

POSITION: CONTACTLESS POSITION SENSOR (CPS)

The CPS provides the DCM with a continuous feedback signal proportional to the position of the drive's output shaft.

The position sensing function of the CPS is provided by a ferrite magnetic sensing element. An electronic circuit translates the signal from the ferrite magnetic sensor into a position signal used by the DCM to control the drive. The typical output voltage of the CPS ranges from 1.0 V at the CCW end of travel, to 5.0 V at the CW end of travel. This specific signal is not available for external connections.

TORQUE PROTECTION (OPTIONAL)

DCMs may be equipped with a torque sensing module that will light the "STATUS" and "TORQUE" LEDs in the event excessive torque is detected. This alarm is normally set to activate when torque exceeds 105% of the drive rating. Torques above 150% of the drive rating will cause the DCM to stop trying to run in the direction of the high torque. When the over torque condition is corrected, the drive will automatically resume normal operation. Torque may be enabled or disabled using the DCM serial interface (see page 45).

STALL PROTECTION AND ANNUNCIATION

If the drive output shaft cannot reach a desired position within approximately 300 seconds, the DCM shuts off power to the motor and the "STATUS" and "STALL" LEDs will light. The stall condition timing is factory configurable from 300 seconds to as low as 30 seconds and is set according to the specification at time of order. This timing is also configurable using the DCM serial interface (see page 45).

A sensed stall condition is cleared by either reversing the Demand input signal from the controller (such that the drive tries to run in the direction opposite the blocked direction) or switching the drive power off and on.

TEMPERATURE

DCMs are equipped with a temperature sensing circuit. The "STATUS" and "TEMP °F" LEDs will light when the drive's ambient temperature exceeds the rating of the drive. Specific temperature readings are available using the DCM serial interface (see page 45).

FEEDBACK SIGNAL (OPTIONAL)

A feedback sourcing module may be installed in the DCM. This module provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full rotational travel (configurable via the serial interface, see page 45). This signal can be remotely monitored or used by a controller or indicator. The "STATUS" and "FB OPEN" LEDs will light if the function is enabled and there is no current in the loop. The Feedback signal can be factory configured as disabled.

STOP/LIMIT INDICATION

The "STATUS" and "STOP/LIMIT" LEDs will light if the Handswitch is in the "STOP" position. These LEDs will also light if the drive is at a limit and is not in balance.

CALIBRATION

All Beck drives are shipped completely calibrated to the customer's specifications and are ready to be installed. If the need arises to change the drive calibration, first confirm that the drive is installed as specified and operating properly before proceeding with the change.

Position reference and demand calibration are performed using the DCM customer interface panel, but may also be configured using the serial interface (see page 45). Calibration of over-travel limit and auxiliary switches must be performed using the procedure beginning on page 26.

CALIBRATION PRIORITY

Models 11-159, -209, -309 & -409

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are set approximately 108° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart then the drive's intended full range of electronic operation (typically 100°). The limit switches are positioned to provide an electrical overtravel protection (typically 101°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation (see page 31)—it may be desirable to reset the over-travel limit switches (see page 26). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. The switches should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

The auxiliary switches are also cam operated, but have no affect on drive and DCM operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

Models 11-169, -269, -369 & -469

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are set approximately 108° apart; except for the 11-169 stops, which are set 98° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart then the drive's intended full range of electronic operation (typically 90°). The limit switches are positioned to provide an electrical overtravel protection (typically 91°).

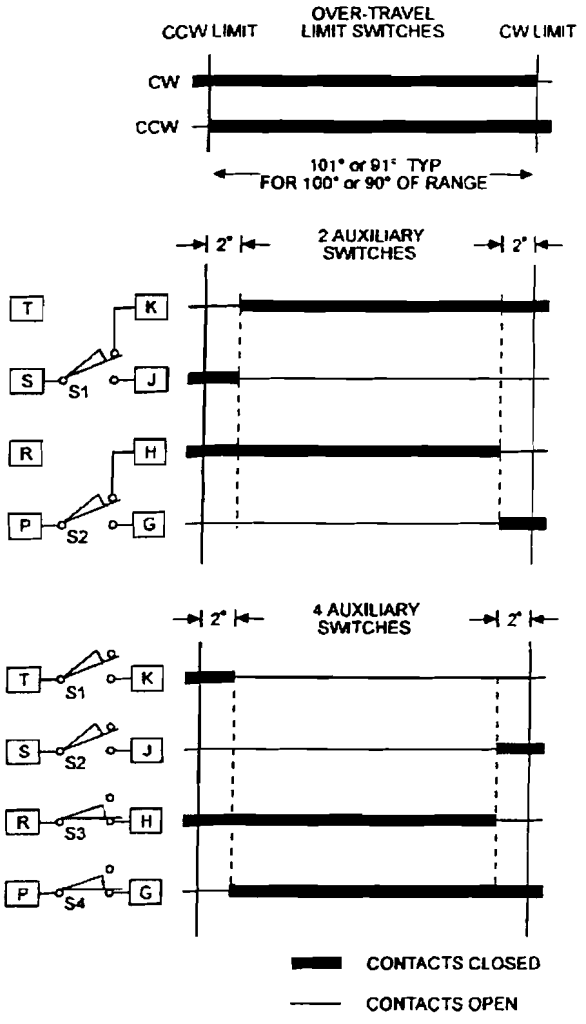
If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 90° rotation (see page 31)—it may be desirable to reset the over-travel limit switches (see page 26). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. Because the over-travel limit switches define the maximum electrical drive range, if they are to be reset, they should be adjusted before performing DCM (demand and position) calibration procedures.

The auxiliary switches are also cam operated, but have no affect on drive and DCM operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

CALIBRATION *SWITCHES*

NOTE: Your Beck drive was shipped from the factory ready for installation; no electrical adjustments are required before placing it in operation. Each drive is set up and calibrated to the specifications that were written into the equipment order.

Under normal operating conditions there is no need to recalibrate the control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the following procedures.



Standard Over-travel Limit and Auxiliary Switch Settings

SWITCH ADJUSTMENTS

Control drives are shipped with over-travel limit switches factory-set for either 101° or 91° of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the fixed, non-adjustable, built-in mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of 60°. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

NOTE: The over-travel limit switches are located next to the drive body. To adjust the over-travel limit switches, it is necessary to remove the control end cover.

Switches are operated by cams which are clamped onto the control shaft. Setting a switch involves loosening the cam, moving the output shaft to the desired position, and positioning the cam so that it just operates the switch at that point. In the following procedure, the use of a continuity meter is recommended to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

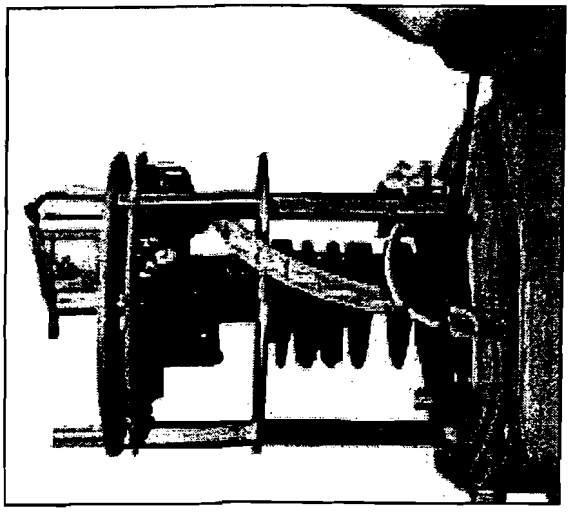
CAUTION

Do not attach the meter or attempt to move the switch cams until the drive is disconnected from the line voltage and auxiliary switches are disconnected from external power sources.

Setting Over-travel Limit Switches CW and CCW

This procedure should be used if the factory over-travel limit switch settings must be changed in the field. It is advisable to operate the drive fully in each direction, using the electric Handswitch to check switch settings before attempting to change them. Follow these instructions if they require adjustment:

1. Remove the control end cover and terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the CW switch cam screw is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft (see illustration below).
3. Move the output shaft clockwise to the desired CW limit.
4. Turn the Handswitch to the "STOP" position.
5. Disconnect power from the drive.
6. Connect the continuity meter across terminals B and U. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
7. Tighten the cam locking screw to 5 lb-in torque.
8. Disconnect meter and reconnect drive power.
9. Rotate the drive's output shaft in the CCW direction away from the CW travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If not correct, return to step 2 and reset the cam to the proper orientation.
10. Rotate the output shaft again to the desired CW travel limit. If the stopping point is reached, the switch is properly set.
11. Repeat instructions for setting CCW travel limit switch (noting that referenced directions of rotation should be opposite of those used for CW switch setting). Connect continuity meter across terminals B and V.
12. Replace covers and tighten cover bolts to 10 lb-ft torque.



Loosening Switch Cam

Setting Auxiliary Switches

Standard switch settings for drives with 2 or 4 auxiliary switches are shown on the diagram on page 26. The heavy line indicates a closed circuit. Follow these instructions to change the operating point of auxiliary switches:

NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved. If they are to be adjusted to close, it may be necessary to reverse the operating mode of the switch by moving the wire lead to the other terminal on the switch itself. Be sure to disconnect power from the switch terminals first.

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the shaft so that the switch cam is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the "STOP" position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 26 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in torque.
8. Disconnect the meter and reconnect power.
9. Move the drive's output shaft in the desired direction so that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
10. Replace covers and tighten cover bolts to 10 lb-ft torque.

CALIBRATION *DEMAND*

DCM boards are designed to accept a 4–20 mA (or 1–5 V dc) analog demand signal. Narrower spans within this range can also be accommodated for split range operation (see page 29). The input comes calibrated from the factory for the full range unless otherwise specified by the customer. It is not necessary to calibrate the demand input when the drive is installed; however, it can be easily accomplished using the DCM pushbutton controls (or serial interface, see page 45) and a signal source. Following this procedure is only necessary to compensate for slight differences between the signal source calibration and the DCM factory calibration, or if reduced range calibration is desired for special operating scenarios such as split ranging.

Calibration Procedure

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive (e.g., 4 mA for 4–20 mA input). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive (e.g., 20 mA for 4–20 mA input).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Turn the Handswitch to the "AUTO" position. NOTE: The drive may reposition.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the compartment covers and tighten the cover bolts to 10 lb-ft torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).

SPLIT RANGE OPERATION

In applications where it is necessary (or preferable) to have more than one final control element controlling a single process, two to four Beck drives may be set up to respond to different portions of the Demand signal from the control system. The most common arrangement involves two drives; each operating on different halves of the input signal range. For example, if a 4–20 mA control signal is used, the first drive would move 100% of its stroke on a signal range of 4–12 mA, while the second operates on the 12–20 mA range.

To set up a split range operation, follow the steps listed below (see page 22 for location of pushbutton controls).

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive. (Following the example above, the minimum signal for the first drive would be 4 mA. The second drive's minimum signal would be 12 mA). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive. (Following the example above, the maximum signal for the first drive would be 12 mA. The second drive's maximum signal would be 20 mA).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Repeat this process for the remaining drives to be split-ranged.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the DCM cover. Tighten the cover bolts to 10 lb-ft torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).

SQUARE FUNCTION

Beck drives can be set up to position the output shaft proportionally to the square of the input signal (see table below). This function is factory configurable, or may be configured using the DCM serial interface (see page 45).

Input Signal (mA)	Standard Output (% of Span)	Square Function Actual Output Position (% of Span)
4.0	0	0
5.6	10	1
12.0	50	25
15.2	70	49
18.4	90	81
20.0	100	100

CALIBRATION *POSITION*

In order to correctly position the drive output shaft in response to the Demand input signal, the DCM receives a position signal from the drive's position sensor and compares this actual position to the Demand input. This process requires that the DCM interprets the position signal appropriately for the full range of desired travel. This procedure will calibrate the DCM to accept the position signal and interpret the appropriate 0–100% range. Note that all drives come factory calibrated and there is no need to recalibrate unless changes in operation are desired.

It is also possible to calibrate the position signal using the DCM serial interface (see page 45).

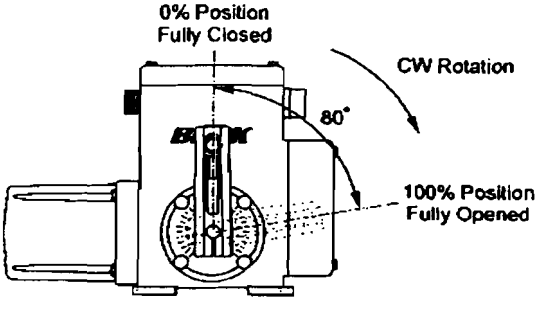
SHORT-STROKE OPERATION (Reducing Full Rotation)

Typically, it is best to use the full 100° (or 90° for quarter-turn valve drives) rotation of the drive in response to the 0–100% Demand input signal—this allows full flexibility in arranging the drive's torque to be distributed for the best mechanical advantage relative to the driven load.

In certain applications, as a last resort, it may become necessary to reduce the full rotation of the drive. In these applications, the DCM can be calibrated to accommodate reduced stroke. The minimum full stroke rotation is 60° (although travel this short is not recommended—it is ideal to make the range as close to 100° (or 90°) as possible for the highest position resolution attainable with the CPS and to avoid reduction in torque (linkage connected drives); if the driven element stroke rotation is less than 100° (where applicable), a linkage can be used to allow the driven element to move the correct rotation while still allowing the drive to rotate 100°).

Reducing the full rotation is referred to as "short-stroking" the drive. This can be accomplished by using the DCM customer interface panel or serial interface (see page 45).

The illustration below represents a Beck drive with linkage requiring an 80° full stroke rotation. (Please note that the crank arm may be adjusted to any start angle orientation).



Calibration Procedure

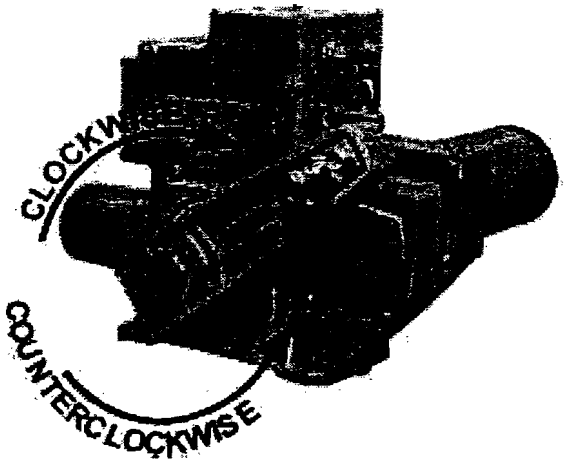
1. Remove the DCM cover (1/2" bolt heads).
2. Position the drive at the desired minimum position (i.e., the desired physical position of the drive's output shaft corresponding to the 0% Demand input signal).
3. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Position the drive at the desired maximum position (i.e., the desired physical position of the drive's output shaft corresponding to the 100% Demand input signal).
6. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
7. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
8. Optional: Adjust the over-travel limit switches (see p. 26) just outside the 0% and 100% limits.
9. Verify that the drive's 0% and 100% positions are correct. If not, repeat this procedure.
10. Replace the compartment cover and tighten the cover bolts to 10 lb-ft torque.

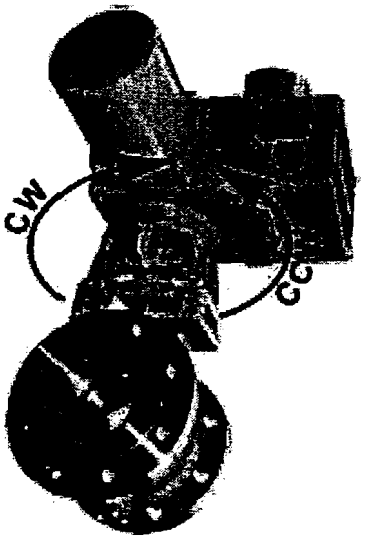
* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM.

CALIBRATION *DIRECTION CHANGE*

DIRECTION OF OUTPUT SHAFT ROTATION (CW vs. CCW)

Direction of output shaft rotation is determined by observing the end of the output shaft (see illustrations below). Direction of rotation is defined as the direction of output shaft rotation produced by an increasing Demand signal. Unless otherwise specified at the time of order, the output shaft is factory set to rotate clockwise in response to an increasing signal.





Changing the direction of output shaft rotation is easily accomplished using the DCM customer interface panel (see page 22 for location of pushbutton controls) or the serial interface (see page 45). Follow the steps below.

1. Remove the DCM cover (1/2" bolt heads).
2. Position the drive at the present 0% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*

—OR—

2. Position the drive at the present 100% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
4. Ensure the drive operates as desired.
5. Replace the DCM cover and tighten the cover bolts to 10 lb-ft torque.

* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM.

NOTE: When either of the above procedures is performed, the POS value (0% or 100%) is automatically set.

MAINTENANCE *ROUTINE*

Beck drives require only a minimum of routine maintenance. A visual inspection is in order to verify that the connection to the final control element is intact and operating normally. If vibration is present, check the electrical terminal connections and other hardware for tightness.

LUBRICATION

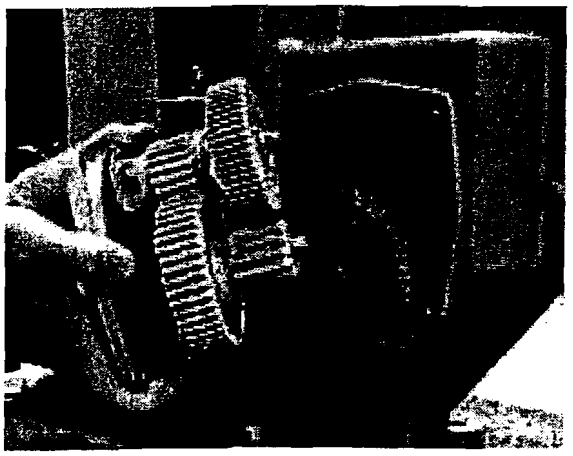
Periodic lubrication is not required on Beck control drives. However, it is recommended that during major shutdowns or outages, the drives in the most severe applications be inspected to determine the need to relubricate the drive gear train.

If your drive has a linkage, to extend the life of the linkage rod ends, they should be included in your scheduled lubrication program.

CAUTION

If your drive has a linkage, before removing the gear module assembly, block the control drive crank arm to prevent the crank arm and the gear train from moving when the change module is removed.

To inspect the gears, remove the gear module assembly on the 11-209/-269, -309/-369 and -409/-469. On Model 11-159/-169, the motor must be removed to access the gears. Clean the gears thoroughly, removing all old lubrication.



11-409 Gear Module

Examine the gear teeth, shaft bore, and gear shafts for signs of excessive wear, scoring, or other damage. If evidence of this damage is present, the drive should be returned to the factory for a detailed examination of the main gear, which requires complete disassembly of the drive. See "HOW TO OBTAIN SERVICE" on page 55.

If there is no evidence of damage to the gearing, recoat the teeth and shaft bores of all gears with a heavy layer of Fiske Lubriplate GR-132 or equivalent (GR-132 is an E.P. grease wtih polymer additives). The ball bearing on the output shaft and crown gear shaft have double grease seals and require no maintenance for the life of the bearings. Inspect all grease seals and replace any that show wear. Reassemble the drive.

This section covers replacement of many components of the drive. Note that some components are not field-repairable. Refer to the drive outline dimension drawings on pages 8–14 and to the cutaway illustration on page 4 for location of components on the drive.

If it should ever be necessary to replace the output gear, shaft, or output shaft bearings, a major overhaul is required and the drive should be returned to the factory. During a major overhaul, the factory repair department will update the drive to include all possible engineering improvements. See "HOW TO OBTAIN SERVICE" on page 55.

Gaskets

During routine service, inspect the cover, motor, and change gear plate gaskets for wear or damage. In order to protect internal components, worn or damaged gaskets and O-rings should be replaced.

To remove, scrape all of the old adhesive and gasket material from the body housing and cover. Cement the new gasket to the drive body using a gasket cement such as 3M #847 Rubber and Gasket Adhesive, or equivalent.

Seals

Worn or damaged output shaft, control end shaft, and motor shaft seals should be replaced to prevent damage to internal bearings and drive train parts.

To remove the shaft seal, push the blade of a small screwdriver along the shaft and under the seal lip. CAUTION: The seal is approximately 1/4" wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Pry up on the seal and force it out of the housing. Clean the shaft and housing then press in the replacement seal with the closed side facing outward.

Bearings

The Beck control drive contains ball bearings on the output shaft, control end shaft, and motor shaft. Bushings and thrust washers are used on combination gears. Field replacement of these components is not recommended.

Motor shaft bushings in the body of the 11-159/-169 and 11-409/-469 can be replaced. TIP: To remove, fill the bushing with a heavy grease. Select a drive pin that slip fits into the bushing. Insert the pin into the bushing and tap with a mallet. This will force the bushing out of the body casting.

Motor

The control motor is not field-repairable. Disassembly of the motor will result in a loss of torque that can only be restored by returning the motor to the factory for re-magnetizing.

CAUTION

If your drive has a linkage, before removing the control motor, block the control drive crank arm to prevent the crank arm and the gear train from moving when the motor is removed.

To remove the motor, first disconnect the motor wires in the terminal compartment of the control drive. In the 11-209/-269, -309/-369, and -409/-469 drives, remove the terminal block and plate as an assembly. Remove the black wire from the terminal post, cut the red motor wire near the red-yellow-red butt joint and disconnect the green wire from the motor capacitor. Remove the mounting bolts and motor. Carefully slide the motor out of the drive body.

To install the motor, insert the three-wire sleeve through the wire hole in the motor mount and into the terminal compartment. Carefully slide the motor into the drive body. Rotate the motor shaft, if necessary, to engage the pinion with the first combination gear. Install motor mounting bolts and torque to recommended values. See pages 8–14 for torque values. Reconnect the motor wires. See the following section for reinstalling the terminal plate.

Motor Resistor and Capacitor

The motor resistor and capacitor are located under the terminals in the terminal compartment. To replace a resistor or capacitor, remove the terminal cover. In the 11-209/-269, -309/-369, and -409/-469, remove the terminal plate. Remove the existing part and transfer the wires one at a time to the replacement part. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft.

Limit and Auxiliary Switches

Complete switch assemblies may be replaced. It is not possible to replace individual switches. To replace switch assemblies, remove the control end cover (1/2" bolt heads) and extensions, if applicable. Remove the screws holding the switch assembly to the plate and slide it out to the side.

Transfer the wires one at a time to the replacement assembly using the push-on lugs provided. Install the replacement assembly and note that it rotates around one screw to permit an adjustment of the cam-to-switch lever spacing and switch operating point. To set the switch, place a .030" shim between the cam and switch lever. The switch lever should be on the low or minimum radius portion of the cam when setting the switches. Position the switch assembly so that the switch is just actuated. DO NOT overstress the switch lever. Tighten both screws to 10 lb-in torque and remove the shim. When properly adjusted, the switch lever should remain in contact with the cam throughout the control drive travel.

Adding Switches

It is usually possible to add switches to a control drive in the field. Remove the control end cover (1/2" bolt heads). If the drive has no auxiliary switches, it is possible to add up to four switches. See Table 4, page 40, for switch assembly part numbers.

Install wiring onto the switch push-on lugs and route the wires into the control drive terminal area. Remove the terminal cover and solder wires to the underside of the terminal assembly according to the wiring diagram included with the new switch assembly. Install the new switch assembly and adjust according to the preceeding instructions.

SLM Friction Surface

In normal service, the SLM friction surface will last for five to ten years. Faster rates of wear can occur in any drive operating near its rated torque and with a high frequency or continuous rate of modulation. The following procedure can be used to determine if the wear life remaining on the friction surface is sufficient: Turn the Handswitch to STOP. Carefully turn the Handwheel back and forth. There should be free play before the motor pinion turns. If there is free play in the Handwheel (up to one tenth of a full Handwheel rotation), the SLM has sufficient wear life. If there is no free play in the Handwheel, the drive may not hold position and the friction surface should be replaced.

If the friction surface needs replacing, order the appropriate SLM Friction Kit as shown in Table 3, below. More severe damage may require the SLM Rebuild Kit, also shown in Table 3.

The SLM Friction Kit typically consists of friction material, spring pin, steel shims, control motor gasket, thrust washer, terminal joints, slip-on terminal and instruction sheet.

The SLM Rebuild Kit typically consists of friction material, spring, spring pin, thrust washer, pinion, steel balls, locking disc, steel shims, control motor gasket, terminal joints, slip-on terminal and instruction sheet.

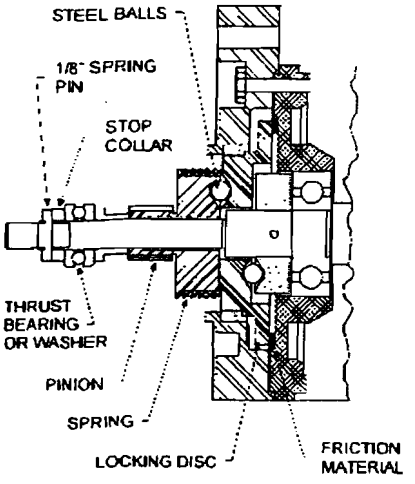
Continued

TABLE 3:
SLM PART NUMBERS

Motor Part Number	SLM Friction Kit	SLM Rebuild Kit	Instruction Sheet Only
11-159/-169			
20-2700-20	12-8060-05	12-8060-15	80-0016-05
20-2701-20	12-8060-05	12-8060-16	80-0016-05
11-209/-269, -309/-369			
20-2704-21	12-8060-07	12-8060-17	80-0016-07
20-2705-21	12-8060-07	12-8060-18	80-0016-07
11-409/-469			
20-2201-21, -22, -23	12-8060-01	12-8060-11	80-0016-01
20-2201-31, -32, -33	Please contact factory for assistance	12-8060-13	80-0016-02

SLM Friction Surface (cont'd)

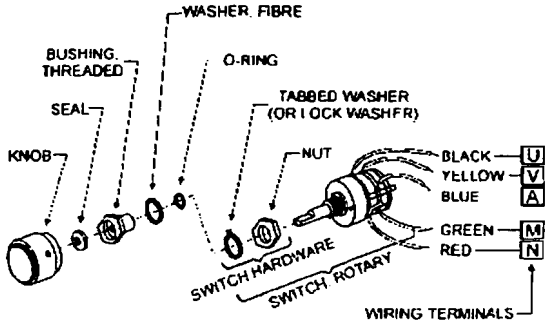
See illustration, below, for component identification.



Handswitch

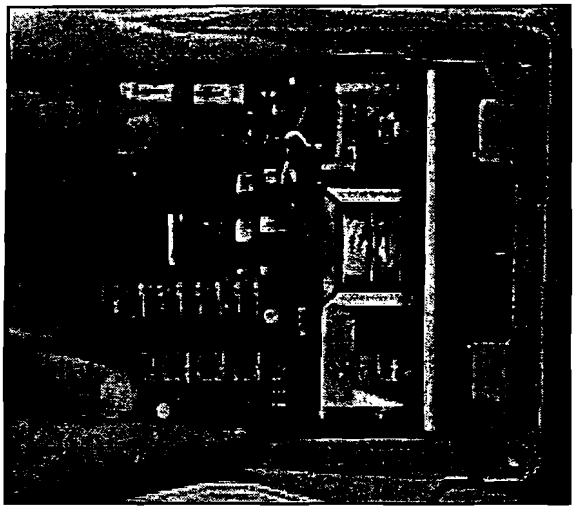
To replace the Handswitch, remove the terminal cover, and then remove the terminal plate (11-209/-269, -309/-369, and -409/-469 only). Clip the five wires from the old Handswitch. Remove the knob and the nut under the knob to remove the switch. Install the new Handswitch as shown below. Splice the wires color for color. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and the gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft. Do not over-torque. Replace the terminal cover. Torque bolts to 10 lb-ft.

NOTE: When the Handswitch is turned fully clockwise, "AUTO" should be indicated.



DCM Board

Field service of the DCM board is not recommended. The factory maintains a stock of replacement boards for immediate shipment. To replace the DCM board, remove the Digital Control Module compartment cover (1/2" bolt heads). If applicable, disconnect the torque sensing wires from the bottom of the customer interface panel by gently pulling on the connector. Loosen the four captive screws holding the board to its mounting pads. Note the "L" shaped mounting bracket on the end of the board. To remove the board, pull the mounting bracket away from its mating surface with a slight rocking motion. See illustration below.



To install a DCM board, lightly press the board connector into its receptacle until the mounting bracket is flush with its mounting surface. Tighten the four captive screws to 8 lb-in. If applicable, connect the torque sensing wires to the bottom of the customer interface panel by gently pressing the connector into its receptacle. Replace the compartment cover. Torque cover bolts to 10 lb-ft.

CPS-2

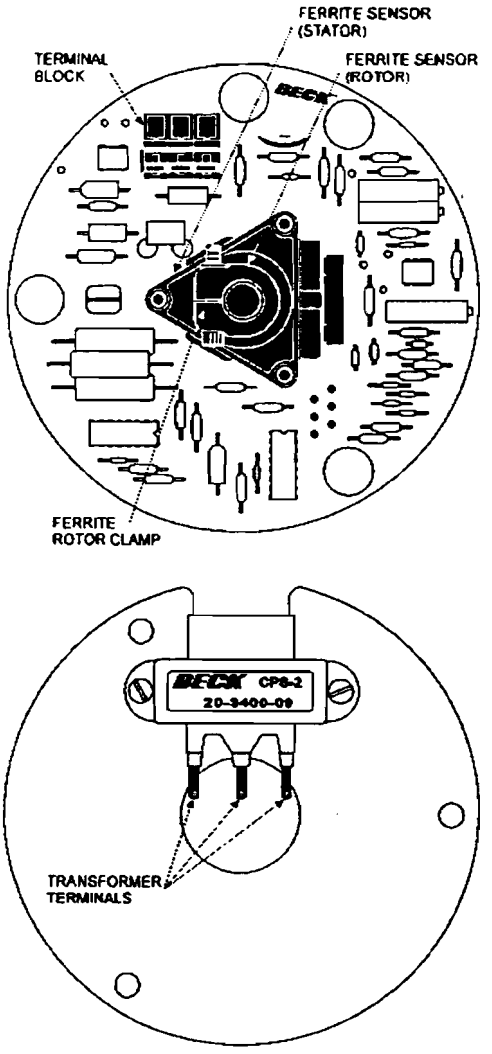
Field repair of the CPS-2 assembly is not recommended. The factory maintains a stock of replacement assemblies for immediate shipment. If it is necessary to replace the CPS-2, replace both the rotor and stator / circuit board assembly. When returning the CPS-2 to the factory for service, include the rotor and stator / circuit board assembly. Do not separate the stator or circuit boards from their mounting plates. The rotor should be held inside the stator with rubber bands and the hex studs reattached to the mounting plate for protection during shipment.

To remove the CPS-2:

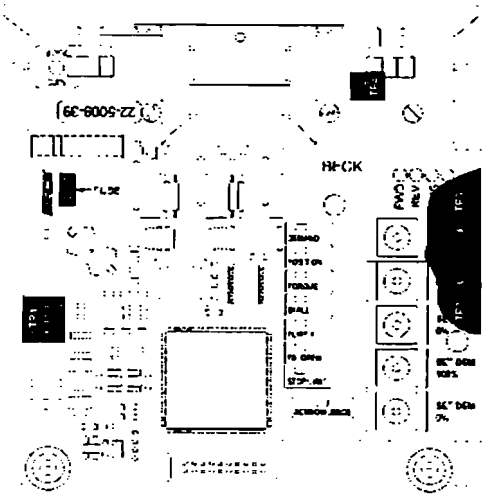
1. Run the control drive to its midpoint of travel with the local Handswitch. (If the standard rotation of 100° has been reduced to 80°, the midpoint of travel is 40°.)
2. Disconnect 120 V ac power to the drive. Remove the terminal, DCM compartment and control end covers (1/2" bolt heads).
3. Record the wire colors on the terminal block of the CPS-2 (see illustration at right), then disconnect the wires. The terminals are spring-loaded. To remove a wire, press the tip of a 3/32" screwdriver into the slot at the top of the small lever. Push down to open the spring-loaded contact and release the wire.
4. Pull the wires from the transformer (see illustration at right) back through the wire hole in the CPS-2.
5. Loosen and remove the 3 hex studs that clamp the CPS-2 in place. Ensure that the inboard hex stud is not loosened as the outboard stud is loosened.
6. Slide the CPS-2 stator assembly off the three mounting bolts.
7. Note the position of the rotor clamp, then loosen the rotor clamp screw and remove the rotor from the shaft.

To install the new CPS-2:

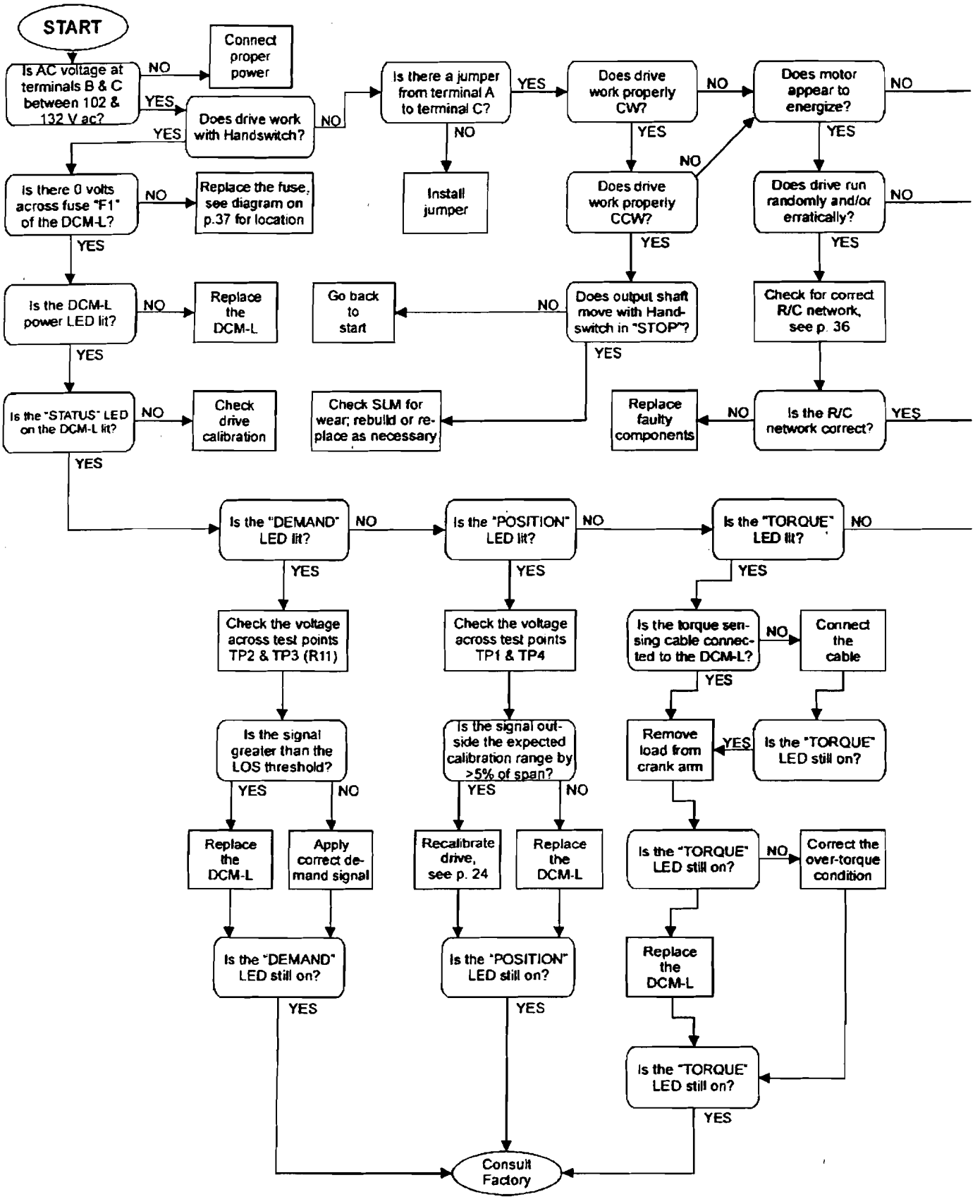
1. Remove the rotor from the replacement CPS-2 assembly. Slide the rotor, clamp end first, onto the control shaft as close to the mounting plate as possible. Leave the clamp loose. Position the clamp in the same general location as the one removed previously.
2. Slide the new CPS-2 assembly over the studs and rotor. Replace the hex nuts but do not tighten. Carefully slide the rotor back into the CPS-2 assembly. Twist the rotor while sliding to prevent damage to the assembly. Tighten hex nuts to 5 lb-ft.
3. Thread the wires through the wire holes in the CPS-2 and reconnect them to the transformer and terminal block.
4. Restore 120 V ac power to the drive and connect a meter to the output.
5. Insert a 0.031" feeler gauge between the rotor clamp and stator. Position the clamp 0.031" from the stator.
6. Rotate the rotor (only a minor adjustment should be necessary) on the control shaft until the output voltage measured across TP4 and TP1 (see illustration at right) reads 50% (approx. 3 volts) of the signal span. Tighten clamp to 5 lb-in torque.
7. Perform a position calibration procedure as described on page 30.

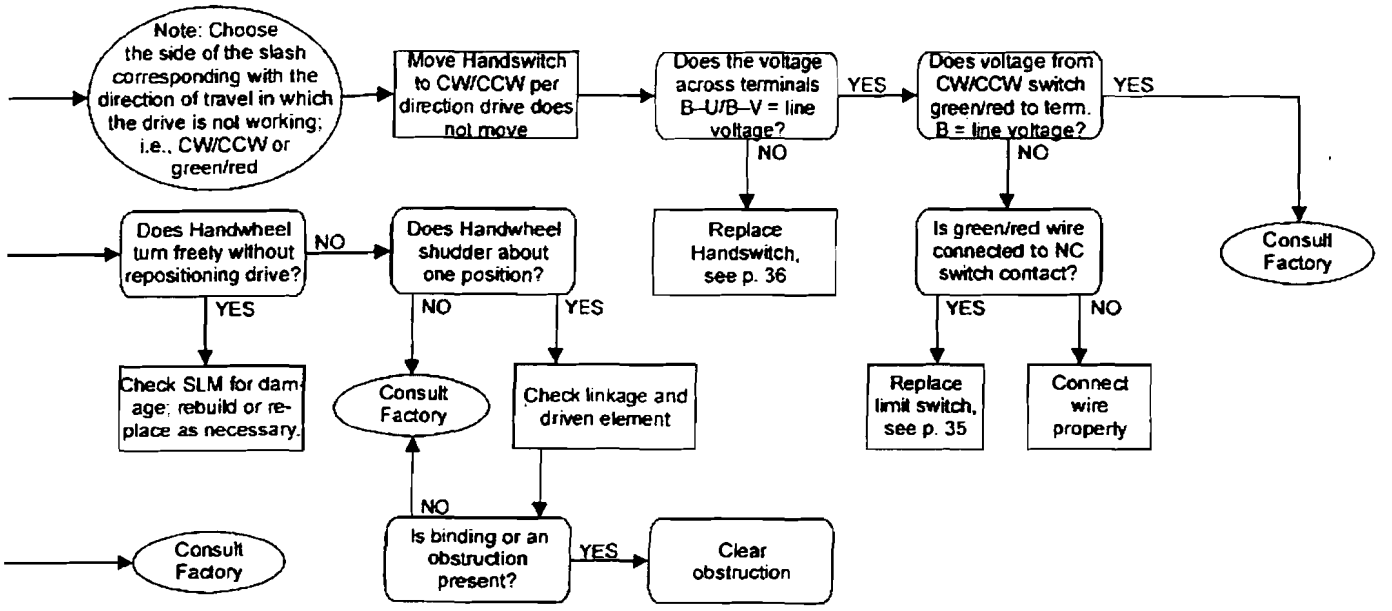


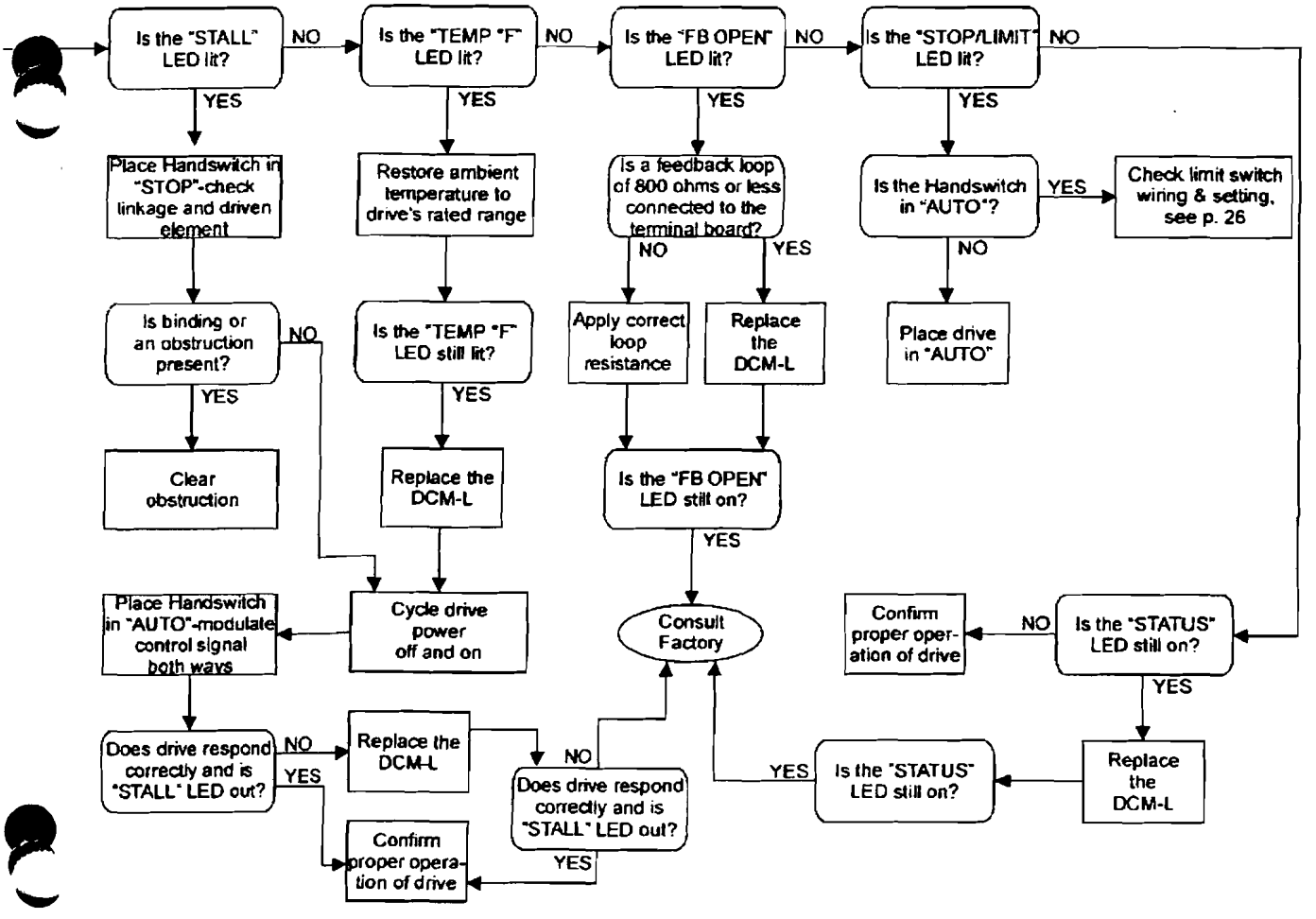
CPS-2 Components



DCM Test Points


START
Is AC voltage at terminals B & C between 102 & 132 V ac?
NO
Connect proper power
YES
Does drive work with Handswitch?
NO
YES
Is there a jumper from terminal A to terminal C?
YES
NO
Install jumper
Does drive work properly CW?
NO
YES
Does drive work properly CCW?
NO
YES
Does motor appear to energize?
NO
YES
Does drive run randomly and/or erratically?
NO
YES
Is there 0 volts across fuse "F1" of the DCM-L?
NO
Replace the fuse; see diagram on p.37 for location
YES
Is the DCM-L power LED lit?
NO
Replace the DCM-L
YES
Go back to start
NO
Does output shaft move with Hand-switch in "STOP"?
YES
Check for correct R/C network, see p. 36
Is the "STATUS" LED on the DCM-L lit?
NO
Check drive calibration
YES
Check SUM for wear; rebuild or re-place as necessary
Replace faulty components
NO
Is the R/C network correct?
YES
Is the "DEMAND" LED lit?
NO
YES
Is the "POSITION" LED lit?
NO
YES
Is the "TORQUE" LED lit?
NO
YES
Check the voltage across test points TP2 & TP3 (R11)
Check the voltage across test points TP1 & TP4
Is the torque sen-sing cable connec-ted to the DCM-L?
NO
Connect the cable
YES
Is the signal greater than the LOS threshold?
YES
NO
Is the signal out-side the expected calibration range by >5% of span?
YES
NO
Remove load from crank arm
YES
Is the "TORQUE" LED still on?
Replace the DCM-L
Apply correct de-mand signal
Recalibrate drive, see p. 24
Replace the DCM-L
Is the "TORQUE" LED still on?
NO
Correct the over-torque condition
Is the "DEMAND" LED still on?
YES
Is the "POSITION" LED still on?
YES
Replace the DCM-L
Is the "TORQUE" LED still on?
YES
Consult Factory


Note: Choose the side of the slash corresponding with the direction of travel in which the drive is not working; i.e., CW/CCW or green/red
Move Handswitch to CW/CCW per direction drive does not move
Does the voltage across terminals B–U/B–V = line voltage?
YES
NO
Does voltage from CW/CCW switch green/red to term. B = line voltage?
YES
NO
Consult Factory
Replace Handswitch, see p. 36
Is green/red wire connected to NC switch contact?
YES
NO
Replace limit switch, see p. 35
Connect wire properly
Does Handwheel turn freely without repositioning drive?
NO
YES
Check SLM for damage; rebuild or replace as necessary.
Does Handwheel shudder about one position?
NO
YES
Consult Factory
Check linkage and driven element
NO
Is binding or an obstruction present?
YES
Clear obstruction
Consult Factory


Is the "STALL" LED lit?
NO
YES
Is the "TEMP "F" LED lit?
NO
YES
Is the "FB OPEN" LED lit?
NO
YES
Is the "STOP/LIMIT" LED lit?
NO
YES
Place Handswitch in "STOP"-check linkage and driven element
Is binding or an obstruction present?
NO
YES
Clear obstruction
Restore ambient temperature to drive's rated range
Is the "TEMP "F" LED still lit?
YES
Replace the DCM-L
Is a feedback loop of 800 ohms or less connected to the terminal board?
NO
YES
Apply correct loop resistance
Replace the DCM-L
Is the "FB OPEN" LED still on?
YES
Consult Factory
Is the Handswitch in "AUTO"?
YES
NO
Check limit switch wiring & setting, see p. 26
Place drive in "AUTO"
Is the "STATUS" LED still on?
NO
YES
Confirm proper operation of drive
Replace the DCM-L
Is the "STATUS" LED still on?
YES
Does drive respond correctly and is "STALL" LED out?
NO
YES
Replace the DCM-L
Does drive respond correctly and is "STALL" LED out?
NO
YES
Confirm proper operation of drive
Cycle drive power off and on
Place Handswitch in "AUTO"-modulate control signal both ways

APPENDIX *SPARE PARTS*

RECOMMENDED SPARE PARTS

It is recommended that certain replacement parts be stocked for quick availability in the event that service of your Beck control drive is required. The types of parts are listed in Table 4, below.

HOW TO ORDER SPARE PARTS

Select the needed parts from the spare parts list given below. Specify the drive's model / serial number (e.g., 11-308-031891-01-02) given on the nameplate to allow the factory to verify the part selection. Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover).

TABLE 4: RECOMMENDED SPARE PARTS

DESCRIPTION	PART NO.	DESCRIPTION	PART NO.
Limit switch assembly	20-3202-10	Motor resistor	See Table 5, below
Auxiliary switch assembly		Motor capacitor	See Table 5, below
(2 switches)	20-3202-11		
(4 switches)	20-3202-12	DCM Board	22-5009-XX. See Table 1, page 15
Gasket set:			
Model 11-159, -169	20-3110-01	Fuse, 7A, 125V	11-1373-01
Model 11-209, -269	20-3110-02		
Model 11-309, -369	20-3110-02	CPS-2	20-3400-09
Model 11-409, -469	20-3110-03		
		SLM Friction Kit:	See Table 3, page 35
Control motor	See Table 5, below		

TABLE 5: MOTORS, CAPACITORS AND RESISTORS

USED ON MODEL NO.	MOTOR PART NO.	VOLTAGE	HERTZ	AMP.	CAPACITOR PART NO.	VALUE	RESISTOR PART NO.	VALUE
11-159/-169	20-2700-20	120	60	.17	14-2840-02	2 µf	11-5802-03	500Ω
			50	.17	14-2840-13	3 µf	11-5802-03	500Ω
	20-2701-20	120	60	.32	14-2840-11	4 µf	11-5802-02	475Ω
			50	.32	14-2840-11	4 µf	11-5802-02	475Ω
11-209/-269 and 11-309/-369	20-2704-21	120	60	.35	14-2840-16	5 µf	20-1971-13	220Ω
			50	.35	14-2840-19	7 µf	20-1971-13	220Ω
	20-2705-21	120	60	.56	14-2840-05	8 µf	20-1971-12	110Ω*
			50	.56	14-2840-06	10 µf	20-1971-12	110Ω*
11-409/-469	20-2201-21, -31	120	60	1.25	14-2840-17	15 µf	20-1971-03	75Ω*
			50	1.25	14-2840-16	5 µf	20-1971-03	75Ω*
					14-2840-17	15 µf		
	20-2201-22, -32	120	60	2.20	14-2840-15	25 µf	20-1971-04	37.5Ω*
			50	2.20	14-2840-05	8 µf	20-1971-04	37.5Ω*
					14-2840-15	25 µf		
	20-2201-23, -33	120	60	3.00	14-2840-15	25 µf	20-1971-06	18Ω*
					14-2840-09	6 µf		
			50	3.00	14-2840-15	25 µf	20-1971-10	24Ω*
					14-2840-05	8 µf		
					14-2840-09	6 µf		

*This is a resistor assembly.

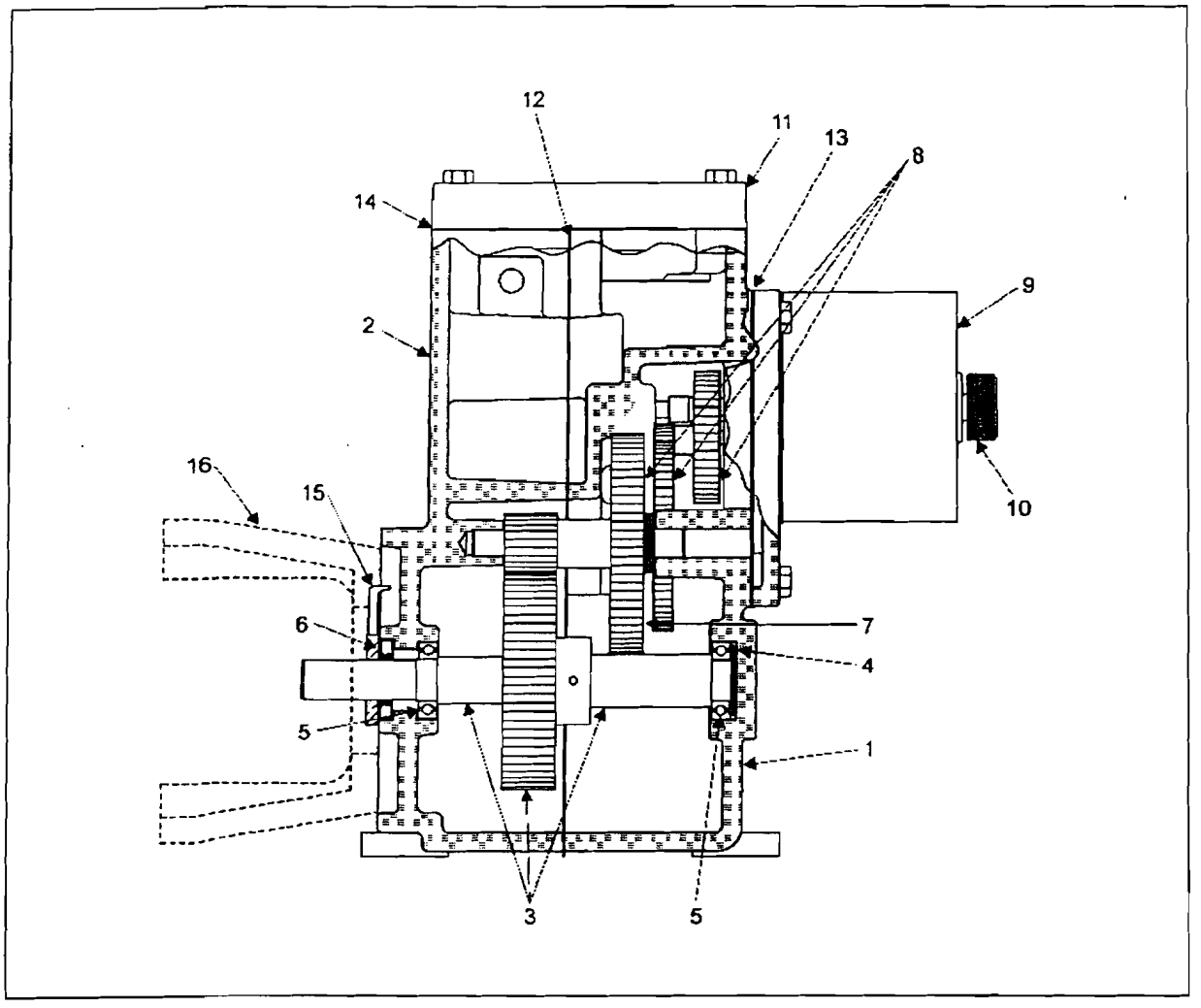


TABLE 6:
DRIVE COMPONENTS FOR MODEL 11-159 / -169

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	11	Terminal / DCM compartment cover
2	Body front	12	Gasket, body
3	Output shaft assembly and main gear	13	Gasket, control motor
4	Spring washer	14	Gasket, terminal cover
5	Ball bearing, output shaft		Gasket, DCM cover
6	Seal, output shaft		Gasket, control end cover
7	Gear, 3rd combination		Control end cover
8	Gear module assembly, see Table 9, page 44, for part number		Control end cover extension
			Terminal block
9	Control motor, see Table 5, page 40, for part number		Barrier, insulator, terminal compartment
		15	Index pointer (-159 only)
10	Handwheel	16	Bracket (-169 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

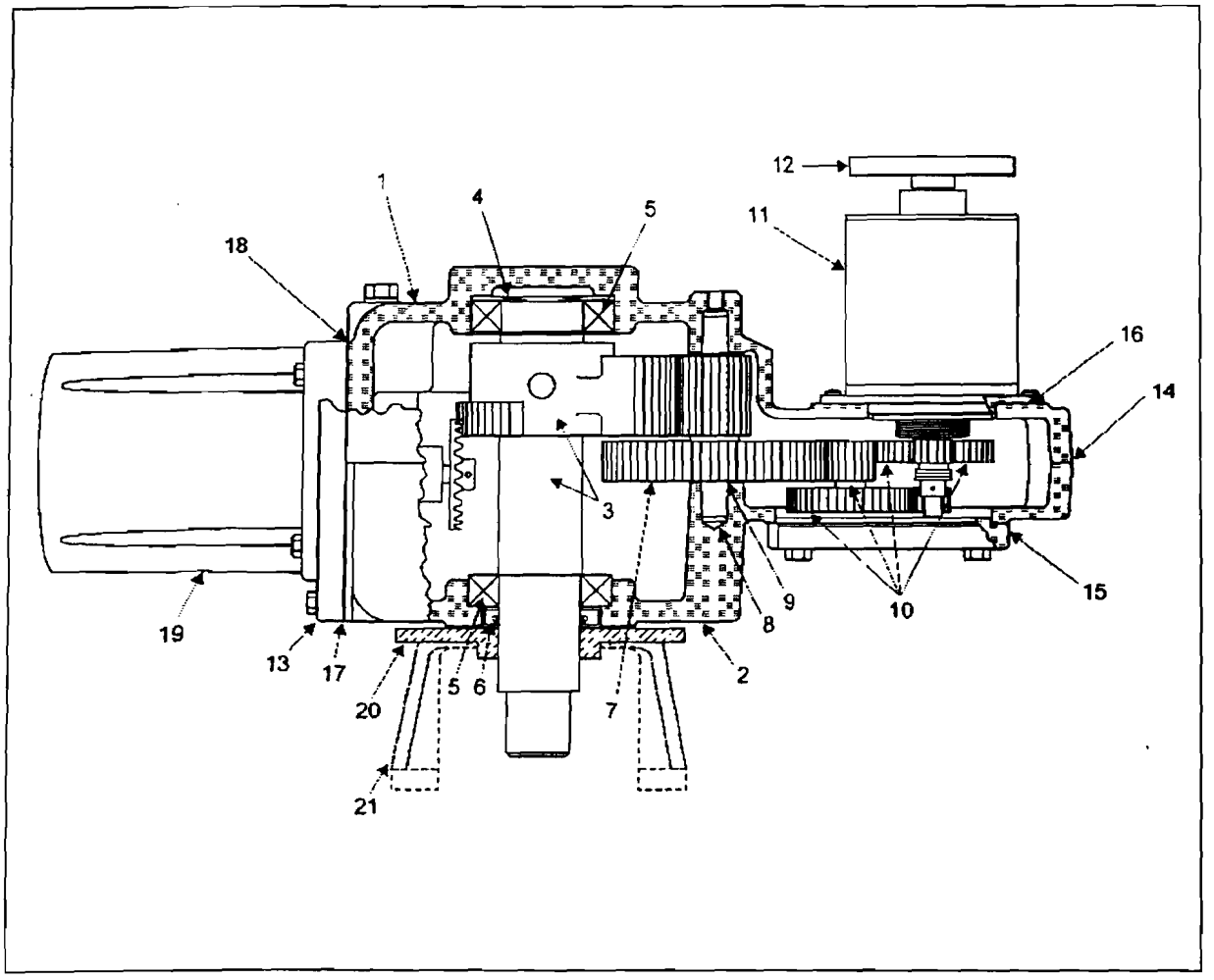


TABLE 7:
DRIVE COMPONENTS FOR MODEL 11-209 / -269 / -309 / -369

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	13	Terminal / DCM compartment cover
2	Body front	14	Gasket, body
3	Output shaft assembly and main gear	15	Gasket, gear module
4	Spring washer	16	Gasket, control motor
5	Ball bearing, output shaft	17	Gasket, DCM & terminal cover
6	Seal, output shaft	18	Gasket, control end cover
7	Gear, 3rd combination	19	Control end cover
8	Pin, 3rd combination gear		Control end cover extension
9	Thrust washer		Terminal block
10	Gear module assembly, see Table 9, page 44, for part number		Barrier, insulator, terminal compartment
			Barrier plate
11	Control motor, see Table 5, page 40, for part number		Gasket, barrier plate
		20	Index (-209 / -309 only)
12	Handwheel	21	Bracket (-269 / -369 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

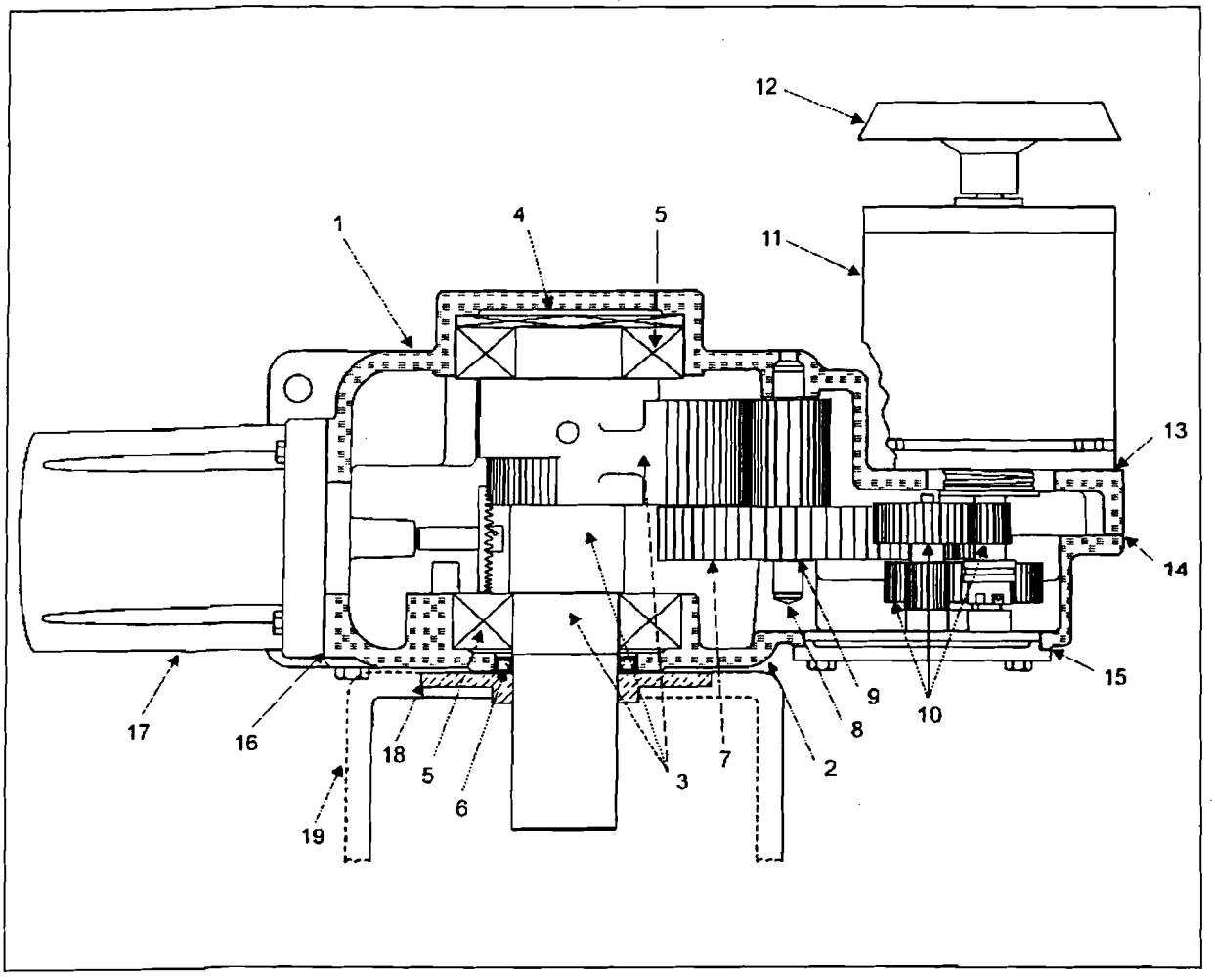


TABLE 8:
DRIVE COMPONENTS FOR MODEL 11-409 / -469

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	12	Handwheel
2	Body front	13	Gasket, control motor
3	Output shaft assembly and main gear	14	Gasket, body
4	Spring washer	15	Gasket, gear module
5	Ball bearing, output shaft	16	Gasket, control end cover
6	Seal, output shaft	17	Control end cover
7	Gear, 3rd combination		Control end cover extension
8	Pin, 3rd combination gear		Terminal block & barrier plate
9	Thrust washer		Gasket, barrier plate
10	Gear module assembly, see Table 9, page 44, for part number		DCM & terminal compartment cover
			Gasket, DCM & terminal cover
11	Control motor, see Table 5, page 40, for part number		Barrier, insulator, terminal compartment
		18	Index (-459 only)
		19	Bracket (-469 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

TABLE 9:
GEARS, TORQUE AND TIMING OPTIONS

Drive Model Number	Approx. Weight (lbs)	Maximum Overhung Load (lbs)	Motor Part Number	Motor Current @ 120 V ac, 60 Hz*	Gear Module Number	Torque (lb-ft)	Models -159 & -X09 Timing (sec / 100°) @ 60 Hz**	Models -X69 Timing (sec / 90°) @ 60 Hz**
11-159	60	750	20-2700-20	.17	14-9733-01	80	90	81
					14-9733-02	60	60	54
11-169	55				14-9733-03	40	40	36
					14-9733-04	20	20	18
			20-2701-20	.32	14-9733-03	80	40	36
					14-9733-04	40	20	18
					14-9733-05	15	11	10
11-209	125	3000	20-2704-21	.35	14-9730-04	125	40	36
					14-9730-05	175	60	54
11-269	115				14-9730-08	250	75	68
			20-2705-21	.56	14-9730-02	125	20	18
					14-9730-04	250	40	36
11-309	125	4500	20-2704-21	.35	14-9730-09	300	100	90
11-369	115		20-2705-21	.56	14-9730-04	300	40	36
					14-9730-05	400	60	54
					14-9730-08	550	75	68
					14-9730-09	650	100	90
11-409	270	9000	20-2201-21, -31	1.25	14-9732-02	800	60	54
					14-9732-03	1500	100	90
11-469	216				14-9732-04	1000	75	68
					14-9732-05	350	24	22
					14-9732-07	550	40	36
			20-2201-22, -32	2.20	14-9732-02	1800	60	54
					14-9732-05	650	24	22
					14-9732-07	1000	40	36
			20-2201-23, -33	3.00	14-9732-02	1800	36	32
					14-9732-07	1000	24	22

CAUTION: Use only the motor and gear housing combinations listed above. Other combinations may cause internal damage to the drive and/or damage to external equipment.

*50 Hz motor currents do not exceed 110% of 60 Hz levels.

**50 Hz timing = 1.2 x 60 Hz timing.

APPENDIX *SERIAL COMMANDS*

Communications

The Beck Digital Control Module (DCM) is equipped with a serial interface which allows for direct communication with a computer. Using a communication cable, connect the DCM to the computer using the DCM's RS-232 (J20) connector (see illustration on this page) and the computer's COM port. Ensure that the COM port on the computer is active, and that the cable is plugged into the proper COM port if more than one is present (e.g., COM1, COM2, etc.). Note that a plug end adapter may be necessary for connection to the computer's COM port.

Once connected, communication can be established between the DCM and the computer using a terminal emulation program, such as HyperTerminal. This method of communication will allow for configuration, calibration and verification of drive DCM settings without the use of custom software applications.

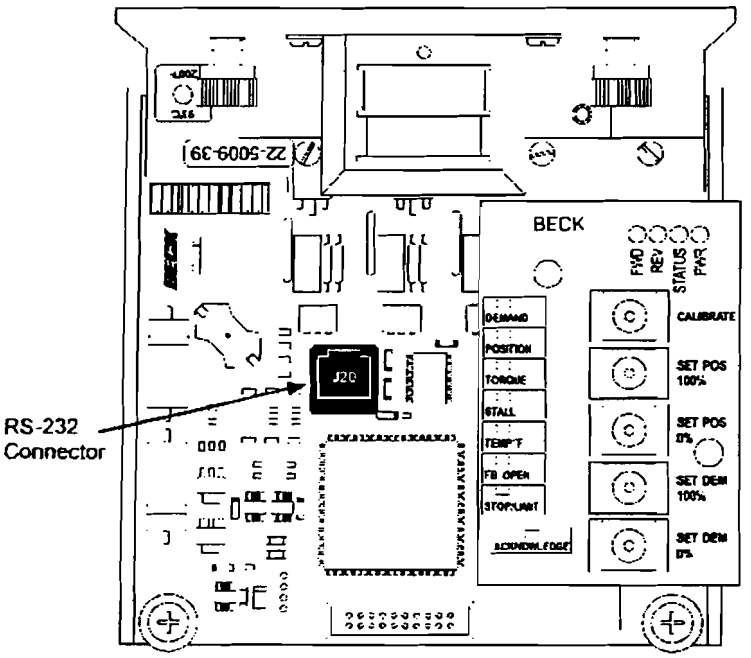
HyperTerminal Software

HyperTerminal is the standard ASCII terminal emulation software provided with Microsoft® Windows®. If using HyperTerminal, the following instructions will assist in setup. Note that some variation to these instructions may be necessary depending on the version of HyperTerminal being used.

Once the computer has been connected to the DCM, access HyperTerminal by clicking first on "Start", then "Programs", then "Accessories", then "Communications", then "HyperTerminal".

Double-click on the "Hypertrm.exe" icon to start the program. Once HyperTerminal is running, it is necessary to set up a file with the proper settings to communicate with the DCM. Proceed as follows:

1. If prompted to install a modem, answer "no". Proceed to enter a name (e.g., "DCM") and select an icon (any will suffice) in the "Connection Description" box. Click the "OK" button.
2. The "Connect to" box should open next. At the bottom of the box, set the "Connect using" selection to the computer COM port that has been connected to the DCM. Click the "OK" button.
3. The COM port properties box should open next. This is where the communication settings are established. The correct settings are:
   a. Bits per second = "1200"
   b. Data bits = "8"
   c. Parity = "none"
   d. Stop bits = "1"
   e. Flow control = "none"
4. With the appropriate settings entered from Step 3, above, click "OK". Communications should now be enabled.
5. Press the "Enter" key twice. "Ok" should be displayed indicating that HyperTerminal is communicating with the DCM.



APPENDIX *SERIAL COMMANDS*

Commands and Arguments

Commands can be used for a variety of functions including changing the operating configuration of the drive, verifying operation settings, calibration and accessing diagnostic information. There are essentially four different types of commands:

1. Dual-purpose commands. These commands can be used to either modify drive configuration settings or display the settings already set in the drive. In order to set or make a change to the settings, the command requires an argument (*n*). If the command is used for display purposes only, the argument is omitted. Examples of these commands include "deadband" and "demlos".
2. Display only commands. These commands are used to display diagnostic or operating information like present signal values. No arguments are required. Examples include the "stat" command and the "signals" command.
3. Set only commands. These commands serve only to make a parameter change. Typically, they apply to the drive calibration. This type of command requires an argument, but unlike dual-purpose commands, they return an error message when entered without an argument. Examples include the "demis" and "posis" commands.
4. Execute action commands. These commands serve to reset, enable or disable features and do not require an argument. Entering these commands produces an immediate action. Examples include the "revert" and "torqen" command.

The available commands are listed on page 47 and each is described in more detail on pages 48 through 52. The command description explains the use or uses of the command, while the argument column describes the applicable arguments for those commands that require them. In the command tables, arguments are denoted as *n*. Note that the commands described as "sets and/or displays" signify dual purpose commands that can be used with or without an argument for setting or verifying configuration settings.

SERIAL COMMANDS

The following is a list of serial commands available through the RS-232 interface. Error codes associated with these commands are listed on page 53.

APPENDIX *SERIAL COMMANDS*

Note: For specific information on the following functions, see the appropriate sections of the manual.

General Configuration Commands

Command	Description	Argument *n* and Information
deadband *n*	Sets and/or displays the drive deadband in % of Demand signal span.	*n* = deadband in % x 100 (e.g., the standard deadband is 0.6%, thus *n* = "60" (0.6 x 100)). Valid *n* values range from "25" to "500" (0.25% to 5% deadband).
drvrotation *n*	Sets and/or displays the direction of drive output shaft rotation resulting from an increasing Demand signal (as viewed) looking into the end of the drive output shaft).	*n* = "0" (indicates clockwise rotation); or *n* = "1" (indicates counterclockwise rotation).
stalltime *n*	Sets and/or displays the time allowed for the drive to reach its Demand target. If the drive cannot reach the target in the allotted time, a stall condition is initiated.	*n* = number of line cycles. This number is calculated by multiplying the desired stall activation time in seconds by the line power cycles of the drive (50 or 60 Hz). For example, if the desired time to stall activation is 200 seconds and the drive operates at 60 Hz, *n* = "12000" (200 x 60). Time to stall is configurable from approx. 30 seconds ("1800") to 300 seconds ("18000"). The default value is "18000" (300 sec.).

Reset Factory Settings Commands

Command	Description	Argument *n* and Information

resettrim *n*	Resets any of the four drive calibration trims to the original factory settings. An argument is required to select the desired calibration. This will overwrite any calibration performed by the user. WARNING—Implementing this command may cause the drive to reposition.	*n* = "0" (Drive position calibration, see "posis");
		n = "1" (Demand signal calibration, see "demis");
		n = "3" (Torque calibration (optional), see "torqis", "torq0 0", & "torq 100");
		n = "32" (Feedback signal calibration, see "fbis").

revert	Resets all the configurable drive features back to the factory settings, returning the drive to as-shipped operation. WARNING—This overwrites any configuration changes made by the user and can cause the drive to reposition and function differently.	No argument required.

Demand Signal Commands

Command	Description	Argument *n* and Information
demis *n*	Calibrates the DCM's interpretation of the analog Demand signal to the drive, and requires an argument indicating the signal level in terms of percent of signal span. This command also requires the application of a signal to the drive when the command is used. This command must be applied twice to allow the DCM to fit a straight-line function. One entry must be for a signal level below 50% of span and the second must be for a signal level greater than 50% of span. If only one end point needs to be changed for purposes such as split ranging, this can be achieved implementing the command only once.	*n* = the Demand signal level as a percentage multiplied by a factor of 100. For example, calibrating a drive with a 4–20 mA Demand signal would first require setting the Demand signal to a level less than 50% of span (i.e., less than 12 mA, preferably 4 mA). The demis command should then be entered with the argument *n* equal to the percent of the signal span x 100. For example, with the Demand signal at 4 mA, *n* is calculated by 0% x 100 = 0; therefore *n* = "0". If the signal was at some other level below 50%, such as 8 mA, the argument *n* will equal 25% x 100 or *n* = "2500". The demis command should then be reapplied with the Demand signal now set for a value greater than 50% of span (i.e., greater than 12 mA, preferably 20 mA). For example, 20 mA would be 100% x 100, thus *n* = "10000"; or 16 mA would be 75% x 100, thus *n* = "7500".
demfunc *n*	Sets and/or displays the Demand signal input characterization function. The DCM provides either linear or square function characterization.	*n* = "linear"; or *n* = "square".
demlos *n*	Sets and/or displays the Demand signal threshold level below which the DCM recognizes that the signal is lost. The threshold level is described in terms of mV for the DCM-L or percentage of signal span for the DCM-H. This command also sets and/or displays the LOS (Loss Of Signal) action the drive inititiates when the Demand signal drops below the threshold value. The options for the LOS action include stay in place ("sip") or go to a predetermined position ("gtp"). Note that the command always reports both settings, but only sets one argument at a time. The command must be used twice if both the threshold and action need to be set.	*n* = the threshold value. For drives equipped with the DCM-L, this value is in mV and must be greater than or equal to 0. With a 4–20 mA drive (1–5 Volt Demand signal dropped across the board input resistor), the threshold could be set between 0 and 1 Volt. For example, if 0.5 Volts (500 mV) is selected as the threshold, then *n* = "500". The default value for *n* = "850" (850 mV). For drives equipped with the DCM-H, the threshold value is expressed as a percentage of demand signal span, and must be a negative number. For example, with a 4–20 mA drive, and a desired threshold of 3.2 mA, which is 5% below the 0% demand (-5%) signal value, then *n* = "-500" (-5 x 100). — OR — *n* = "sip" or "gtp", and must be entered separately from *n*.
demlosgtp *n*	Sets and/or displays the position (in terms of a percentage of full drive travel) that the drive will run to upon loss of the demand signal if the drive is set to "gtp" (go to position) (see "demlos" above). This command has no effect when the drive is set to "sip" (stay in place). See "demlos" command.	*n* = desired position of the drive when the demand signal is lost. The position is expressed as a percentage of full drive travel x 100. For example, if the desired position is 50% of full travel, then *n* = "5,000" (50 x 100).

APPENDIX *SERIAL COMMANDS*

Note: For specific information on the following functions, see the appropriate sections of the manual.

Position & Feedback Signal Commands

Command	Description	Argument *n* and Information
posis *n*	Calibrates the DCM interpretation of the position reference signal from the drive's position sensor (CPS) to the DCM. Calibrating this enables the DCM to determine the travel limits of the drive. This command must be used twice to establish the drive's travel range (i.e., at a position less than 50% of travel, and at a position greater than 50% of travel). The drive must be positioned at a known point when entering this command. If only one end of travel needs to be modified for short stroke operation, then the command need be applied only once for that end of travel.	*n* = the present drive position as a percentage of full drive travel x 100. For example, if the drive is to be calibrated for 100° of travel, the drive should first be positioned at the 0° or 0% travel position. Once at this position, the "posis" command should be executed with *n* = "0" (0% x 100). In this example, the position of the drive could be anywhere less than 50%, with that percentage multiplied by 100. Next, the drive should be run to the 100% position (100° away in the example above). Once at this position, the "posis" command should be executed with *n* = "10,000" (100% x 100). The position of the drive could be anywhere greater than 50%, with that percentage multiplied by 100.
fbis *n*	Trims the drive's 4–20 mA position Feedback signal calibration. Implementing this command is normally not necessary, since the signal is factory calibrated to 4–20 mA; however, it allows the user to compensate for minor calibration differences between the signal and the display instrumentation calibrations. It can be applied to either or both ends of the signal range, but should only be used if a Demand signal calibration has been performed. This ensures that slight Feedback signal display errors are not a result of Demand signal calibration errors. The recommended way to use this command is to apply it at the drive's 0% travel position and again at its 100% position.	*n* = the measured Feedback signal as a percentage of the signal range. For example, if the drive is positioned to its 0% position, the position Feedback signal should be very close to 4 mA (± 0.06 mA). However, calibration differences between the Feedback signal and the measuring/display instruments may result in a more sizable difference. For example, assume that the drive is at 0% position, but the Feedback displayed is 3.9 mA. *n* is calculated by first finding the percent signal represented by 3.9 mA and multiplying by 100. That is, –0.1 mA (3.9 – 4.0) divided by 16 mA (signal span), which is –0.635%, multiplied by 100. Therefore, *n* = –63.5. Similarly, the 100% travel point can be trimmed by positioning the drive at its 100% position and performing the same calculation. For example, if at 100% the Feedback measured is 19.9 mA instead of the desired 20.0 mA, "fbis" should be implemented with n = 99.375% ({19.9 – 20.0} ÷ 16 x 100).
iomode *n*	Sets the Feedback option for the drive. This is a hardware configuration command that enables/disables the external position Feedback or is used to configure the drive for retrofit into an older, control option 7 drive.	*n* = the number representing the Feedback source: "0" = none (disables external position feedback), "1" = Feedback (enables external position feedback sourced by the DCM), "2" = Potentiometer (provides power for feedback pot. used in option 7 drives).

Torque Function Commands (if applicable—torque sensing is an option)

Command	Description	Argument *n* and Information
torqis *n*	Calibrates the torque signal in the drive based on the application of known loads to the drive. This method of calibrating torque should only be used if known loads can be applied to the drive. This command must be used twice to establish the torque range (i.e., at a percentage less than 50%, and at a percentage greater than 50%). See "torq0" and "torq100" for an alternate method of calibrating torque using constant calibration factors.	*n* = the percentage of torque applied x 100. For example, if the drive is rated for 40 lb-ft, first remove the load from the drive. Execute the "torqis" command with *n* = "0" (0% x 100). This lower torque percentage could also be any known load resulting in less than 50% torque (with the value of *n* changing accordingly). Next, a known load should be applied resulting in the maximum rated torque of the drive (in this example, 40 lb-ft). Execute the "torqis" command once again with *n* = "10,000" (100% x 100). This higher torque percentage could also be any known load resulting in greater than 50% torque.
torq0 0	Used in conjunction with "torq100 *n*", calibrates the torque signal in the drive based on constant calibration factors. The "torq0 0" command calibrates 0% torque.	When the drive is at 0% torque (no load applied), "torq0 0" should be executed to set the current torque value to 0%.
torq100 *n*	Used in conjunction with "torq0 0", calibrates the torque signal in the drive based on constant calibration factors. The "torque100 *n*" comand calibrates 100% torque.	*n* = the calibration factor as noted in the table below. The factor used is dependent upon the drive model and torque rating of the drive. For example, for an 11-159 control drive rated at 40 lb-ft of torque, *n* = "401".

TORQUE CALIBRATION FACTORS

Drive Model	Torque Rating (lb-ft)	Calibration Factor
11-159	15	150
	20	200
	40	401
	60	602
	80	803
11-169	15	80
	20	106
	40	213
	60	318
	80	426
11-209, -269	125	80
	175	112
	250	160

Drive Model	Torque Rating (lb-ft)	Calibration Factor
11-309, -369	300	192
	400	257
	550	353
	650	417
11-409, -469	350	79
	550	125
	650	148
	800	182
	1,000	228
	1,500	342
	1,800	411

torqdis	Disables the drive's torque measurement (if applicable).	No argument required.
torqen	Enables the drive's torque measurement (if applicable).	No argument required.

APPENDIX *SERIAL COMMANDS*

Note: For specific information on the following functions, see the appropriate sections of the manual.

Diagnostic and Information Commands

Command	Description	Argument *n* and Information
signals	Displays the current value of the Position signal and the Demand signal. When executed, the "signals" command will return the current value of the Position signal in millivolts (mV) followed by the current value of the Demand signal in microamps (µA).	No argument required.
stat	Displays information on the status of the drive. Information displayed includes: Position (% x 100) Demand (% x 100) Deadband (% x 100) Motor starts, reversals and stalls (hexadecimal) Total run time (hexadecimal-seconds) Overtorques (hexadecimal) Maximum Torque (%) Alarm codes (none or alarm code) Position LOS, Demand LOS and Stalled motor, if currently applicable Operational mode Current drive travel direction or stop Line power cycles (Hz) Demand or Position error, if applicable	No argument required.
tempf	Displays measured temperatures in the drive. Information is displayed in °F. and includes: Low temperature extreme recorded by the DCM Current temperature High temperature extreme recorded by the DCM	No argument required.
torq	Displays torque settings and current torque measurement. Information displayed includes: Current torque value (in counts) 0% torque setting (in counts) 100% torque setting (in counts) Current torque value (percentage) Over range alarm if the current torque value exceeds the alarm threshold.	No argument required.

Command Error Codes

When an error is encountered using the serial commands, an "ERROR XX" message is returned. The table below provides a description of the error codes ("XX").

Code	Description	Information
2	Invalid selection	Displayed when an unknown command has been entered.
3	Value too big	Displayed when an entered numeric value exceeds expected parameters.
4	Value too small	Displayed when an entered numeric value is less than expected parameters.
5	Data length error	Displayed when the wrong number of arguments is entered.
6	General error	Displayed when a combination of circumstances prevents a better description of the error.
9	Process too high	Displayed when the entered value exceeds acceptable parameters when calibrating a 0% value.
10	Process too low	Displayed when the entered value is less than acceptable parameters when calibrating a 100% value.
14	Span too small	Displayed when entered values for a 0% point and a 100% point are too close.
32	Busy	Displayed when a memory store is requested and another memory store is already in process.
64	Not implemented	Displayed when an entered command is defined, but cannot be implemented.

INDEX

SERVICES

PRODUCT DEMONSTRATIONS

Each of Beck's Sales Engineers has access to a complete set of drive models so that he can demonstrate virtually any of their features at your location. In order to arrange to see a Beck drive in your plant or office, contact Beck's Sales Department.

SITE SURVEYS

Beck Sales Engineers are available to discuss your process control requirements. Often a visit to your location is the best way to gain a thorough understanding of your needs, in order to meet them most accurately and completely.

Mounting hardware, torque requirements, linkage, control signal information, and optional equipment can be analyzed most effectively at the work site. Beck's analysis at the job site can help ensure that specifications are accurate, especially in the case of complex applications.

APPLICATION REVIEWS

By sharing your needs with a Beck Sales Engineer you can take advantage of the best application advice for the type of control you need. This review will yield a better understanding of the versatility of Beck drives for your installations, as well as complete details on options and accessories to make the process as effective as possible.

SPECIFICATION WRITING

Beck provides specification writing assistance in order to help you specify and order the right drives for your applications. Beck Sales Engineers will work with you to make it easier for you to obtain the proper equipment and give you confidence that no details are overlooked.

HOW TO OBTAIN SERVICE

Factory repair of drives or subassemblies is available for both normal and emergency service. To assure prompt processing, contact the factory to receive a Returned Material Authorization (RMA) number. If a repair estimation is desired, please send the name and phone number of your contact for service authorization. It is helpful to include a description of the work desired with the shipment or, in the event of a problem, the malfunction being experienced.

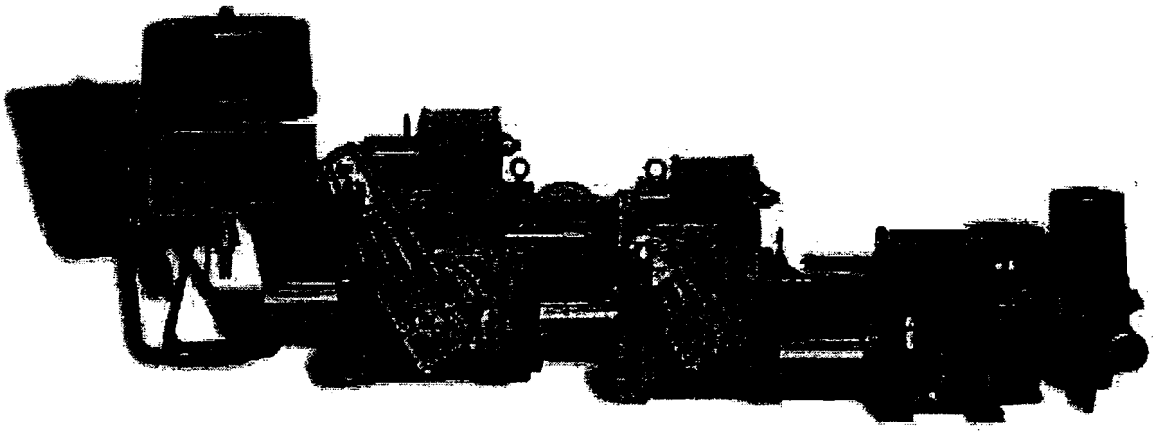
WARRANTY STATEMENT

The Seller warrants that the equipment sold hereunder shall conform to Seller's standard specifications. The Seller warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for one year from the date on which the equipment is shipped. The Seller's obligation under this warranty, and Buyer's exclusive remedy, will be the repair or replacement, without charge, at the Seller's factory, of any defective equipment covered by this warranty. In no event will the Seller's liability exceed the contract price for the goods claimed to be defective.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF THE SELLER INCLUDING INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES.

Buyer acknowledges its responsibility under OSHA, related laws and regulations and other safety laws, regulations, standards, practices or recommendations which are principalty directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which such equipment will be used, its use or combination with, or proximity to, other equipment, and other circumstances of the operation of such equipment are matters beyond Seller's control. BUYER HEREBY AGREES TO INDEMNIFY SELLER AGAINST ALL CLAIMS, DAMAGES, COSTS OR LIABILITIES (INCLUDING, BUT NOT LIMITED TO, ATTORNEYS' FEES AND OTHER LEGAL EXPENSES), WHETHER ON ACCOUNT OF NEGLIGENCE OR OTHERWISE, EXCEPT THOSE CLAIMS BASED SOLELY UPON THE NEGLIGENCE OF SELLER AND THOSE CLAIMS ASSERTED BY SELLER'S EMPLOYEES WHICH ARISE OUT OF OR RESULT FROM THE OPERATION OR USE OF THE EQUIPMENT BY SELLER'S EMPLOYEES.

Beck Control Drives are covered by the following patents: 3,667,578; 4,690,168; and 6,563,412 with other patents pending.



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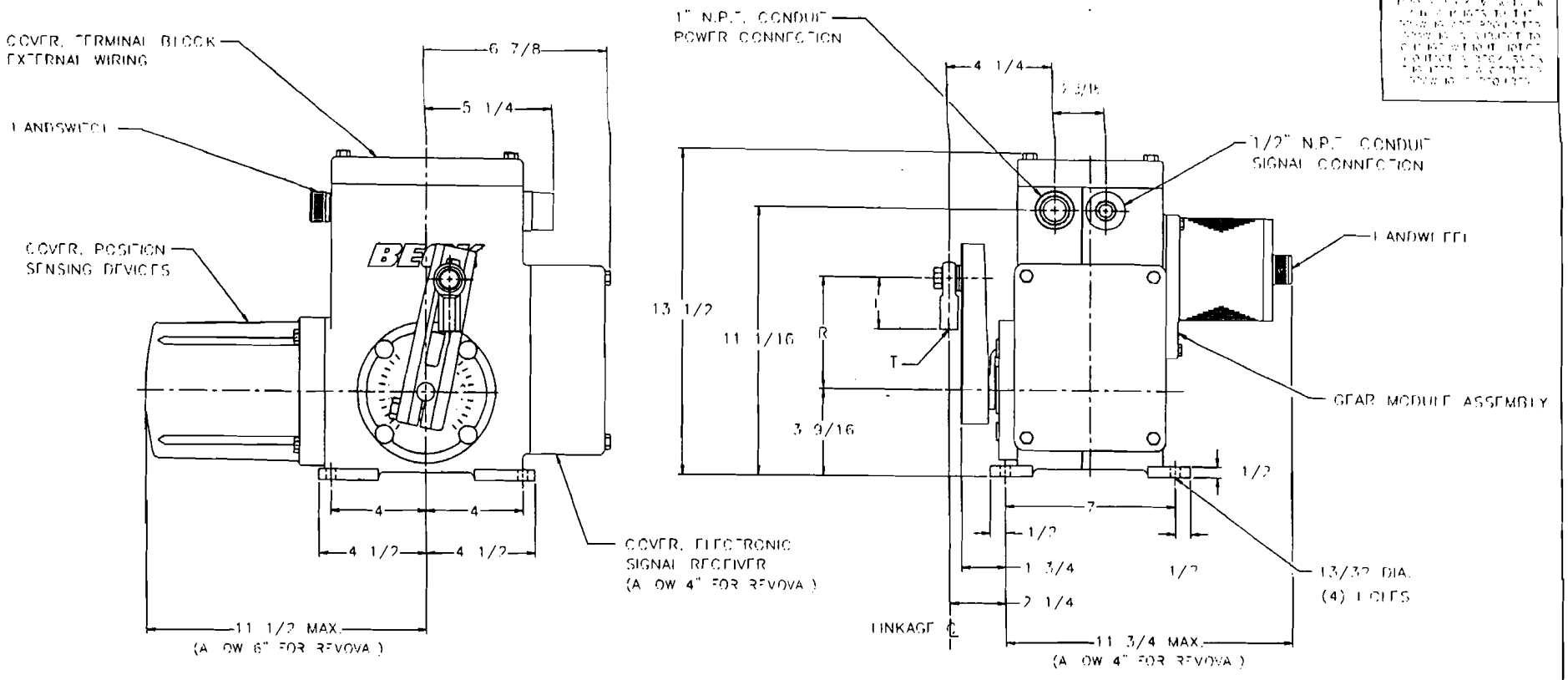
04/03

BECK



BECK DRIVE MODEL NO.	TORQUE RANGE (LB. FT.)	APPROX. WT. (LBS.)	OUTPUT SHAFT DIA.	CRANKARM & SWIVEL SUPPLIED AS STANDARD				MAXIMUM OVERHUNG LOAD (LBS.)
				CRANKARM PART NO.	CRANKARM RADIUS (ADJUSTABLE)	SWIVEL LENGTH	SWIVEL INTERNAL THREAD	
					R DIM.	L DIM.	T DIM.	
11-150	15 TO 80	50	3/4	10-3491-05	1-1/2 TO 5-1/8	2-1/8	1/2-20X1-1/8	750

RECOMMENDED BOLT TORQUES		
	SIZE	TORQUE (LB. FT.)
CRANK ARM BOLT	1/2-13	75
ROD END BOLT	1/2-13	55
ROD END LOCK NUT	1/2-13	55
COVER BOLTS	5/16-18	15
MOTOR/GEAR MODULE BOLTS	1/4-20	7
BASE BOLTS	5/16-18	15
BASE BOLTS	3/8-16	30

TOLERANCES:
OUTLINE DIMENSIONS ±1/4
MOUNTING DIMENSIONS ±1/16

ALL DIMENSIONS ARE IN INCHES
METRIC DIMENSIONS AVAILABLE UPON REQUEST

18-0150-01

D

HAROLD BECK & SONS INC

OUTLINE DIMENSIONS
BECK 11-150 DRIVE

18-0150-01 C

HAROLD BECK & SONS INC

Thank you for the opportunity to furnish this price quotation. Orders are subject to the following terms and conditions.

ice and Delivery

The prices and estimated delivery on the face of this quotation are valid for the periods stated, provided Buyer's order, release for production, and requested delivery date are all within the dates shown on the face of this quotation. Additional extended price protection is not available unless specifically so stated on the face of the quotation.

Prices are subject to correction for errors, and are in accordance with price control regulations of the U.S. Government.

Changes to Quantities and Specifications

Changes in quantities and specifications requested or approved by Buyer after receipt of the Buyer's order will be invoiced at the price in effect at the time the change is received

Delivery and Risk of Loss

Shipment shall be FOB Seller's factory, Newtown, Pennsylvania USA. Buyer hereby grants to Seller a security interest in the equipment purchased to secure payment of the purchase price invoiced to Buyer. Risk of loss or damage in transit shall be upon Buyer even if the equipment is shipped FOB place of destination.

Payment and Credit Terms

Unless otherwise specified on the face of this quotation, terms of payment are net cash 30 days from date of invoice, subject to approval and continuation of approval of credit by the Seller. All payments are to be made at par in U.S. currency through a U.S. bank to the address stated in Seller's invoice.

If at any time after any approval of credit the financial conditions of the Buyer shall be determined or believed by the Seller, in its sole judgment, to be or to have become such as not to justify the continuation of the above credit terms by the Seller to the Buyer, terms of payment shall be or become COD or immediate partial or full advance payment, or a combination of the foregoing methods, or as the Seller may then or thereafter from time to time elect and specify.

Remedies upon Default in Payment

In the event of default by Buyer in making payment when due, the Seller, its agents or assigns, is authorized to take possession and remove the equipment from the Buyer's premises, or elsewhere, without demand or other cause or notice of any kind, and all rights for action of trespass or other causes are waived by Buyer, Buyer will pay to Seller reasonable charges for its use of the equipment and reimburse Seller for its expenses or repossession.

ipping Dates

Shipping dates are approximate and are based upon prompt and timely receipt of all necessary information from the Buyer. Orders which require approval prior to release for production, or which are placed on hold any time after receipt of order, but prior to shipment, will be subject to revised delivery dates. Such delivery dates shall be the estimated delivery dates in effect at the time the release for production or release from hold is received by Seller.

The Seller shall not be liable for delays in delivery or failure to manufacture or deliver due to: (1) causes beyond its reasonable control, (2) acts of God, acts of the Buyer, acts of civil, or military authority, priorities, fires, strikes, floods, epidemics, war, riot, delays in transportation, (3) inability to obtain necessary labor, materials, components, or manufacturing facilities, or (4) changes in specifications, directions, or design requested by Buyer or agreed to by Buyer. In the event of such delay, the delivery date shall be extended for that length of time as may be reasonable necessary to compensate the delay.

Invoicing

The Seller reserves the right to invoice when orders are ready for shipment and are held past the scheduled delivery date by Buyer's request, or any other reason beyond the Seller's control. Terms of payment for invoices issued under such circumstances will be the same as though the invoice were prepared at the time of shipment. Buyer will be liable for actual costs of storage and transportation resulting from said deferral of delivery.

Maintenance and Installation; Instruction Manual

Unless otherwise specified on the face of this quotation, installation and maintenance of the equipment is the responsibility of the Buyer.

One instruction manual including installation, maintenance, and parts information is included for each Model type in the shipment. Additional copies requested will be shipped separately unless otherwise instructed. There may be a charge for requested quantities that are large relative to number of units shipped.

Three Year Limited Warranty Statement

Harold Beck & Sons, Inc. (Beck) warrants that our equipment shall conform to Beck's standard specifications. Beck warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for three years from the date on which the equipment is shipped. Improper installation, misuse, improper maintenance, and normal wear and tear are not covered.

The Buyer must notify Beck of any warranty issues within 37 months of original shipment date and return the goods in question, at Buyer's expense, to Beck for evaluation. If the product fails to conform to the warranty, Beck's sole obligation and the Buyer's exclusive remedy will be: 1) the repair or replacement, without charge, at Beck's factory, of any defective equipment covered by this warranty, or 2) at Beck's option, a full refund of the purchase price. In no event will Beck's liability exceed the contract price for the goods claimed to be defective.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF BECK. In no case shall Beck be liable for any special, incidental or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. Such damages include, but are not limited to, loss of profits, loss of revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of any substitute equipment, facilities or service, downtime, the claims of third parties including customers and injury to property.

Buyer acknowledges its responsibilities under OSHA, related laws and regulations, and other safety laws, regulations, standards, practices or recommendations that are principally directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which the equipment will be used, its use or combination with, or proximity to, other equipment, and other circumstances of the operation of such equipment are matters beyond Beck's control. **Buyer hereby agrees to indemnify Beck against all claims, damages, costs or liabilities (including but not limited to, attorney's fees and other legal expenses), whether on account of negligence or otherwise, except those claims based solely upon the negligence of Beck and those claims asserted by Beck's employees which arise out of or result from the operation or use of the equipment by Beck's employees.**

Return of Equipment for Repair

Authority for return of equipment for repair, whether under the warranty clause or otherwise, must be obtained from the Seller in advance. Equipment returned for repair must be carefully packed so as to reach the Seller's factory without damage. Buyer shall pay shipping costs.

Service

Field service to be performed at the Buyer's plant or construction site can be arranged separately from this quotation, unless specifically included on the face thereof. Under such service arrangements, the Seller provides qualified technical personnel to provide field installation services, field repair and modernization services, or technical field assistance.

Dates for such service, and the scope of the service required, must be arranged for in advance. Buyer will be responsible for all travel and living expenses of Seller's personnel, as well as service time on the job, all in accordance with then current rates.

Terms and conditions for service agreements are specified in Beck's Selling Policy L-5526.

Return of Equipment for Credit

Unused equipment which has been invoiced to Buyer within one year may be returned for credit, if consent is first obtained. Such consent will not be unreasonably withheld. Consent for return will not be given with respect to equipment not currently manufactured by Seller at the time of the request. Equipment returned for credit must be carefully packed so as to reach the Seller's factory without damage. Buyer shall pay all shipping costs. Returns will be subject to restocking and handling charges.

Should the equipment or any interest in the equipment supplied under this contract be transferred to another party, all the terms and conditions of this contract shall apply to that other party. It is Buyer's responsibility to take such measures as are necessary to ensure that the terms and conditions of this contract apply to such other party.

Cancellation

Any order placed with the Seller can be canceled by the Buyer subject to payment of reasonable cancellation charges, which will normally include the following: (a) work completed; (b) work-in-progress; (c) raw materials and purchased parts, at cost to Seller plus handling charges; and (d) any other expenses or charges, including engineering and overhead charges incurred by Seller up to date of cancellation.

Buyout Items

Buyout equipment is any device not manufactured by the Seller, but which may be mounted on, shipped with, or shipped separately from the Seller's products. Any increase in price from the Seller's source of buyout items that is received from the time an order is received until it is shipped, will be passed on to the Buyer in the final invoice of the order.

Seller makes no warranty, express or implied, with respect to buyout equipment.

Taxes

The Seller's prices do not include sales, use, excise, or similar taxes, or import duties. Consequently, in addition to the price specified herein, the amount of any present or future sales, use, excise, or other similar tax or import duty applicable to the sale or use of the equipment hereunder shall be paid by the Buyer, or in lieu of thereof the Buyer shall provide the Seller with a tax exemption certificate acceptable to the taxing authorities. Buyer will indemnify and hold Seller harmless against any loss, expense, or payment occasioned by collection of any such tax or duty from Seller by any taxing authority.

Contract

The terms on this and the face side of this quotation will become our entire contract. If Buyer's order includes any different or additional terms, our acceptance of Buyer's order and supplements thereto is made conditional on Buyer's consent to the terms and conditions hereof (which may be evidenced by Buyer's acceptance of delivery of the equipment sold hereunder). Seller will not be bound by any different or additional terms and conditions contained in Buyer's order, or in any other document delivered to us by Buyer, unless such terms and conditions are expressly agreed to in writing by the Seller. This contract is to be construed according to the laws of the Commonwealth of Pennsylvania.

HAROLD BECK & SONS INC

4 Φ LD 2000-3W / [illegible]

NIBCO

DUCTILE IRON BUTTERFLY VALVES

LD/WD 1000 AND 2000

APPLICATIONS

For use in Commercial Construction and General Utility Service:

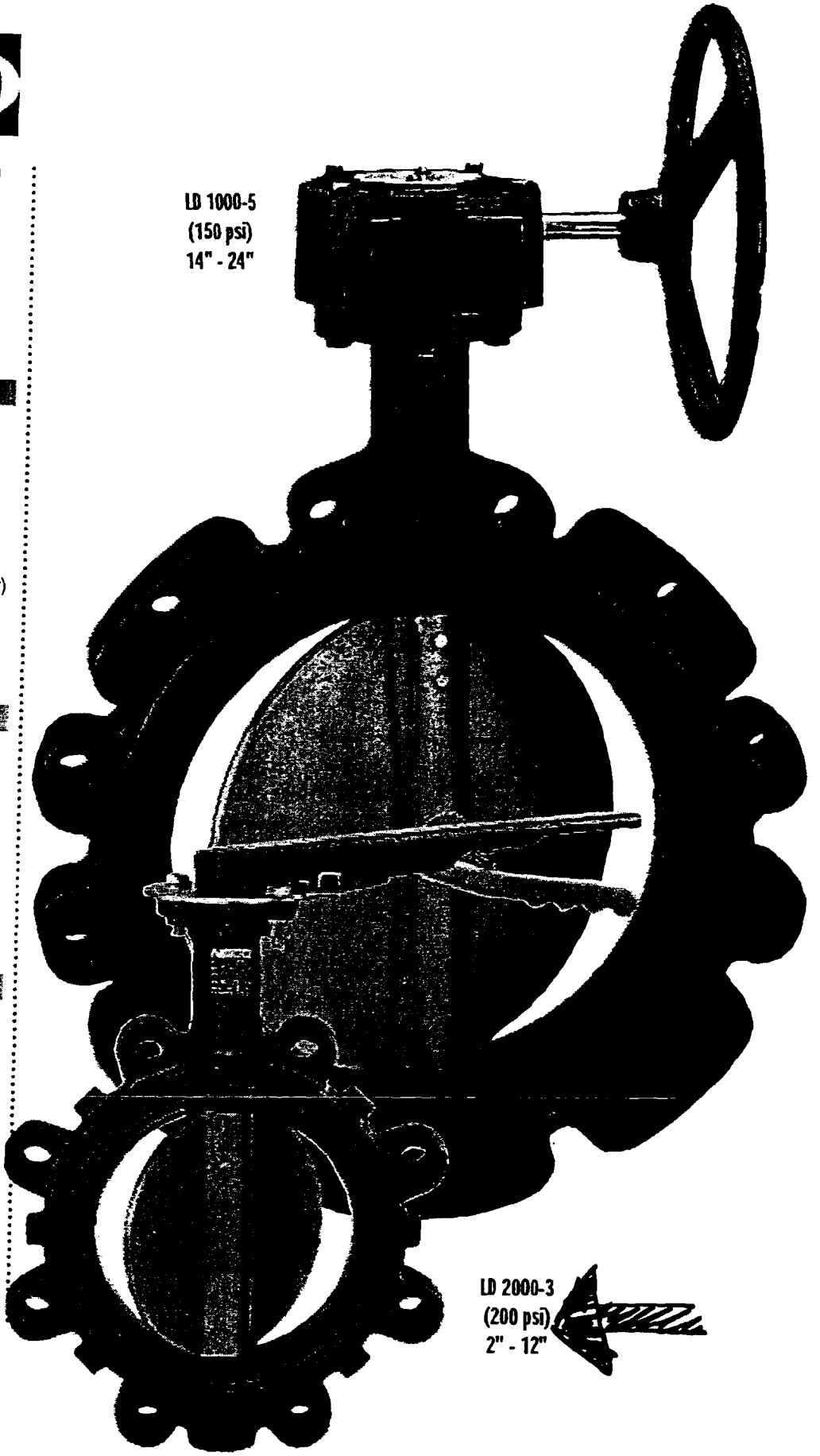
- HVAC (Condenser, Chilled Water, Hot Water Heating
- Hot and Cold Domestic Water
- Compressed Air (BUNA liner)
- Vacuum Service
- End of Line Service (Dead End)
- Modulating Control Services

MATERIALS & CONSTRUCTION

- Molded in Liner (2" - 12")
- Internal Stem/Disc Drive
- Ductile Iron Body
- Streamlined Spherical Disc
- Upper and Lower Bushings
- High Strength 416SS Stem
- Extended Neck
- Threaded Double Seal Collar Bushing (2" - 12")

DESIGN CRITERIA

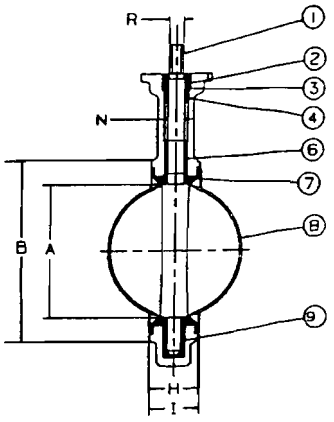
- Meets or exceeds requirements of MSS SP-67.
- United States Coast Guard Approval.
- Suitable for use with ANSI Class 125 and 150 flanges.
- Pressure rating 200 psi (2"-12") and 150 psi (14"-24")
- Vacuum to 28" mercury
- Bubble tight shutoff at full pressure
- Wide choice of seat and disc combinations to suit customer application.

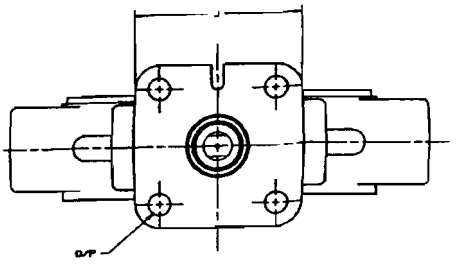


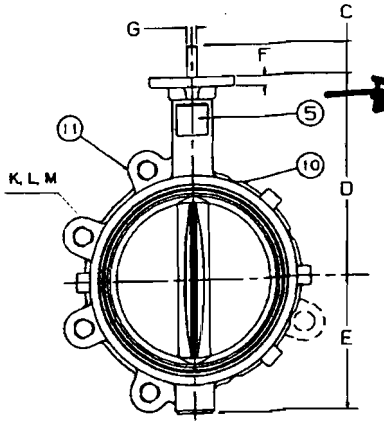
Printed in the U.S.A.

LD/WD 2000 SERIES 200 PSI

SPECIFICATIONS







LD/WD2000 SERIES Material List

PART		SPECIFICATION
1.	Stem	Stainless Steel, ASTM A-582 type 416, ASTM A564 Type 17.4 PH*
2.	Collar Bushing	Brass, ASTM B-124
3.	Stem Seal	EPDM Ruber
4.	Body Seal	EPDM Rubber
5.	Nameplate	Aluminum
6.	Upper Bushing	Copper CDA 122
7.	Liner	EPDM Rubber, BUNA (NBR), Fluoroelastomer
8.	Disc	Aluminum, Bronze, ASTM B-148 Alloy 954/955 † Ductile Iron, ASTM A395 (Plated) † Stainless Steel, ASTM A743 Grade CF8M
9.	Lower Bushing	Copper CDA 122
10.	Body (Wafer)	Ductile Iron, ASTM A-536
11.	Body (Lug)	Ductile Iron, ASTM A-536

* Optional Stem Material
† LD 3000 Series only

LD/WD2000 SERIES Dimensions

SIZE	A	B	C	D	E	F	G Flat	METAL H	RUBBER I	J Square
2"	2.53	4.00	1.25	5.38	2.62	.38	.312	1.688	1.812	3.25
2.5"	2.90	4.75	1.25	5.88	3.12	.38	.370	1.812	1.938	3.25
3"	3.15	5.25	1.25	6.12	3.38	.38	.370	1.812	1.938	3.25
4"	4.15	6.75	1.25	6.88	4.00	.38	.403	2.062	2.188	3.25
5"	5.15	7.62	1.25	7.38	4.75	.38	.496	2.188	2.312	3.25
6"	6.15	8.62	1.25	8.00	5.25	.38	.496	2.188	2.312	3.25
8"	8.15	10.87	1.25	9.25	6.50	.50	.560	2.375	2.500	3.25
10"	10.15	13.25	1.25	10.50	8.00	.50	.686	2.688	2.812	4.75
12"	12.15	16.00	1.25	12.00	9.25	.50	.748	3.000	3.125	4.75

LD/WD2000 SERIES Dimensions

SIZE	N Dia.	O B. C.	P Dia.	R Dia.	Capscrew Data/Stud Data K No.	Capscrew Data/Stud Data L Dia.	Capscrew Data/Stud Data Wafer Length	Capscrew Data/Stud Data Lug Length	M B.C.	Lug Approx. Net Wt. (lbs.)	Wafer Approx. Net Wt. (lbs.)
2"	.500	3.25	.437	.437	4	5/8-11unc	4	1 1/2	4 3/4	7	6
2.5"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 1/2	5 1/2	9	8
3"	.562	3.25	.437	.500	4	5/8-11unc	4 1/4	1 5/8	6	9 1/2	8 1/2
4"	.625	3.25	.437	.562	8	5/8-11unc	5	1 7/8	7 1/2	15	12
5"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	8 1/2	19	15
6"	.750	3.25	.437	.656	8	3/4-10unc	5 1/4	2	9 1/2	24	18
8"	.875	3.25	.437	.781	8	3/4-10unc	5 3/4	2 1/4	11 3/4	35	29
10"	1.125	5.00	.562	1.000	12	7/8-9unc	6 1/4	2 1/4	14 1/4	56 1/2	45 1/2
12"	1.250	5.00	.562	1.062	12	7/8-9unc	6 3/4	2 1/2	17	87	72

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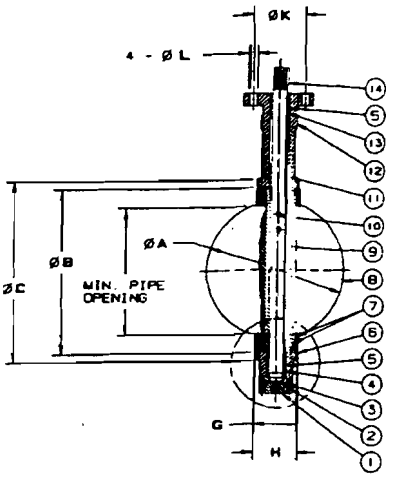
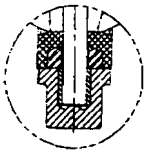
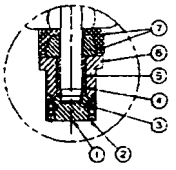
www.nibco.com

LD1000 SERIES 150 PSI

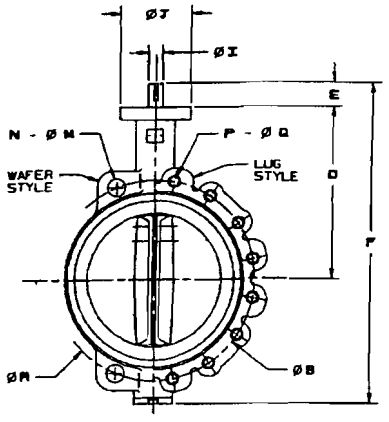



Size 14"


Size 16" - 24"

LD1000 SERIES Material List

PART	SPECIFICATION
1. Bottom Plate	Steel, ASTM A 108 grade 1035
2. Bolt (2 for 14"-20"; 4 for 24")	Steel, ASTM A307
3. O-Ring	Nitrile (Buna-N)Rubber
4. Bushing	Bronze, ASTM B 584 grade C83600
5. O-Ring (2)	Nitrile (Buna-N) Rubber
6. Body	Ductile Iron, ASTM A 536
7. Seat	EPDM Rubber Nitrile (Buna-N) Rubber
8. Disc	Al. Bronze, ASTM B 148 Alloy C95400 Ductile Iron, ASTM A 536 grade 65-45-12 (plated) Stainless Steel ASTM A351 Grade CF8M
9. Stem	Stainless Steel, ASTM A 582 Type 416
10. Taper Pin (2)	Stainless Steel, ASTM A 582 Type 416
11. Bushing	Bronze, ASTM B 584 grade C83600
12. Nameplate	Aluminum
13. Bushing	Bronze, ASTM B 584 grade C83600
14. Key	Steel, ASTM A 108 grade 1045

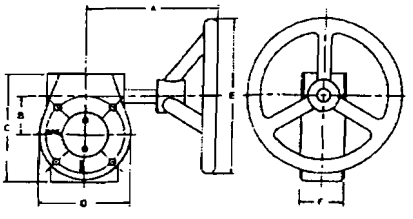


LD1000 SERIES Dimensions

SIZE	A DIA	MIN. Pipe I.D.	B DIA	C DIA	D	E	F	G Body	H Seat	I DIA
14"	13.1	13.0	14.8	17.2	14.5	1.77	26.77	3.01	3.13	1.244
16"	15.3	15.2	17.8	19.2	15.7	2.02	29.94	3.38	3.54	1.305
18"	17.3	17.1	19.3	21.2	16.6	2.02	31.55	4.12	4.29	1.496
20"	19.4	18.9	21.1	23.3	18.9	2.53	35.65	5.14	5.31	1.632
24"	23.3	23.1	25.7	32.1	22.1	2.76	40.20	5.98	6.14	1.994

LD1000 SERIES Dimensions

SIZE	J Dia.	K Dia.	L Dia.	P	Q Dia.	S Dia.	Lug Wt. Lbs.
14"	5.50	4.25	0.56	12	1-8UNC	18.75	121
16"	7.75	6.25	0.81	16	1-8UNC	21.25	211
18"	7.75	6.25	0.81	16	1¼-7UNC	22.75	268
20"	7.75	6.25	0.81	20	1¼-7UNC	25.00	444
24"	10.87	8.50	0.87	20	1¼-7UNC	29.50	594



GEAR OPERATOR DETAIL FOR SIZES 2" THRU 24"

VALVE SIZE	OPERATOR NO.	RATIO	DIMENSIONS (IN) A	B	C	D	E	F	WEIGHT LBS.
2 - 5"	46691	28:1	4.25	1.83	5.19	4.75	6	2.36	5.4
6"	T115971	28:1	7.88	1.83	5.19	4.75	9	2.36	8.1
8"	46692	28:1	7.88	1.83	5.19	4.75	9	2.36	8.4
10" - 12"	46693	40:1	7.88	2.36	5.93	5.25	9	2.36	9.3
14"	XJ50	50:1	8.94	3.15	7.83	6.38	12	3.25	33.0
16"- 20"	XJ80	80:1	11.82	4.72	11.42	10.24	12	4.53	70.0
24"	XJ300	290:1	13.78	4.72	12.32	10.87	12	6.26	110.0

2" - 12" Adapter Bushing Required

For other large diameter BFV configurations and sizes, see N150 or LC/WC series.

SPECIFICATIONS AND TECHNICAL DATA

TORQUE is the rotary effort required to operate a valve. This turning force in a Butterfly Valve is determined by three factors. (1) Friction of the disc to seat for sealing (2) bearing friction and (3) dynamic torque.

BREAKAWAY TORQUE is the total of the torques resulting from bearing friction and seat/disc interference friction at a given pressure differential. This value is normally the highest required torque to operate a valve and is used in sizing actuators. The torques listed are valid for water and lubricating fluids at ambient temperature.

LD/WD 2000 SERIES Torque Data

SIZE	100 PSI	200 PSI
2"	140	180
2½"	190	235
3"	230	300
4"	430	530
5"	580	700
6"	795	1,035
8"	1,850	2,350
10"	2,350	2,900
12"	3,875	5,390

LD/WD 1000 SERIES Torque Data

SIZE	75 PSI	150 PSI
14"	3,837	4,870
16"	5,003	6,685
18"	6,367	8,958
20"	8,540	11,950
24"	13,220	18,680

NOTE: Torque data shown is for general service (clean water, ambient temperatures). For non-lubricating, high temperatures or aggressive media, consult NIBCO Technical Service. Torque listed for EPDM. When calculating torque for Buna or Fluorocarbon, multiply by 1.25

SAMPLE BUTTERFLY VALVE SPECIFICATION

Line Control Valves 2" and Larger:

BUTTERFLY VALVES: Valve shall be full lug or wafer body style. Valves to be manufactured in accordance with MSS SP-67. The valves shall be rated at least 200 psi (2" - 12") and 150 psi (14" - 36") bi-directional differential pressure. **Body** to have 2" extended neck for insulation and to be **shock resistant ductile iron.** Valves to have aluminum bronze disc and **molded in or cartridge seat** of EPDM rubber. Stem shall be 400 series stainless steel. Top and bottom stem bushings of dissimilar material are required with a positive stem retention mechanism. Sizes 2" to 6" shall be lever operated with 10 position throttling plate; sizes 8" and larger shall be gear operated. **Lug style valves shall be capable of providing bi-directional "Dead End Service" at full pressure without the need for a down stream blind flange.**

ACCEPTABLE VALVES:
NIBCO - LD2000 (2" - 12"), LD1000 (14" - 24") and N150235G0 (30" - 36").

Key to Butterfly Valve Figure Number System*

L	D	-	2	0	0		0	-	0
BODY TYPE	BODY MATERIAL		PRESSURE RATING	SEAT MATERIAL	DISC MATERIAL	STEM & BUSHING COMBINATIONS Stem	Upper & Lower	Collar	OPERATING MECHANISM
L- Lug W- Wafer G- Grooved	D- Ductile Iron C- Cast Iron		L- Actuated 1- 150 PSI 2- 200 PSI 3- 250 PSI 4- 300 PSI	0- EPDM 1- Buna-N (Nitrile) 2- Fluoroelastomer 5- UL/FM 7- Polymid	0- Alum. Bronze 1- Ductile Iron[1] 2- CF8M 6- EPDM Coated Brass or D.I.[2] 7- Buna-N Coated Brass or D.I.[2]	0- 416 S.S. 1- 416 S.S. 2-17-4 PH 7- 416 S.S. 8- 316 S.S.	Copper Alloy 316 S.S. 316 S.S. TFE TFE	Brass Brass 316 S.S. — —	0- Bare Stem 3- L/Lock (Std.) 5- Gear op.

* *This key is a guide only; it is not intended to infer that all combinations can or will be produced.*
1. Electro Nickel Plated. 2. Grooved end only.

NIBCO INC., World Headquarters
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Section 3-E

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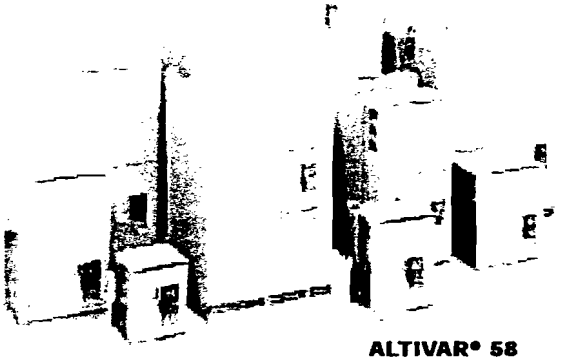
VFD-225

ALTIVAR® 58 TRX AC Drives



ALTIVAR® 58 *TRX* Family

ALTIVAR® 58 *TRX* AC Drives

The ALTIVAR 58 TRX drive is the next generation of the ALTIVAR 58 family of AC drives. Extending the horsepower range to 500 hp, this drive builds on the functionality of the current product line and meets the most demanding commercial and industrial applications.

In addition to offering extended power ratings and functionality, the ALTIVAR 58 TRX is also "Transparent Ready," so that the drive connects directly to an Ethernet-based network. This allows the drive, along with the appropriate Ethernet option card, to become a building block for Schneider Electric's Transparent Ready initiative.

Using a standard Web browser, embedded Web pages on the option card allow access to real-time information from anywhere around the world. This communication network provides a flexible, cost-effective solution for communicating drive information to various layers of an integrated building or manufacturing facility.

The family of ALTIVAR 58 TRX AC drives is also available with a variety of operator interface options, I/O extension cards and communication cards. Mounting kits, ventilation and conduit entry options combined with Type 1 construction provide flexibility for OEMs and users installing AC drives. All ALTIVAR 58 TRX drives are also available with POWERSUITE™ products for easy start-up and testing.

Ratings available for the ALTIVAR 58 TRX AC drive include:

1–500 variable torque (75 hp constant torque) 400/460 VAC, three-phase input.

0.5–30 variable torque (7.5 hp constant torque) 208/230 VAC, single-phase input.

2–50 variable torque (40 hp constant torque) 208/230 VAC, three-phase input.

Key Benefits

Ease of use

- Selectable macro-configurations for ease of programming.
- POWERSUITE™ software package creates configurations, modifies parameters, saves, uploads/downloads and allows fault history viewing on a PC or Hewlett Packard Jornada.
- Adaptive tuning to motor characteristics for easy set-up.

Reliability

- Random switching frequency modulation reduces motor noise.
- Wide speed range meets the needs of most applications.
- Produces acceleration torque for difficult-to-start loads.
- Laminated bus reduces the number of internal connections.
- ASICs eliminate complicated circuits and reduce parts count.

Functionality

- "No load" feature provides automatic energy savings when machine demand is low.
- Quiet motor operation is ideal for HVAC applications.
- Built-in RS485 port
  - MODBUS® protocol
  - Multi-drop
- Newest generation sensorless vector control (SVC) provides superior motor speed and torque performance.

Options

- POWERSUITE software available for easy testing and commissioning.
- Operator interface, developed for quick and easy drive programming and real-time monitoring of motor and drive performance:
  - Keypad
  - Remote mount kit for keypad
  - PC or Hewlett Packard Jornada

continued

Options, continued

Option cards available for increased input and output capability or communications:

- Analog I/O card
- Digital I/O card
- General purpose I/O card
- Communications options: Ethernet, DEVICENET™, MODBUS® Plus, MODBUS/ Unitelway, Landis and Staefa/ Siemens P1, Johnson Controls N2, Interbus S, LonWorks®, Profibus DP and FIPIO

Peripheral components available to increase application performance and environmental requirements:

- Ventilation kit for enclosed mounting
- Dynamic brake resistors
- EMC wiring plates
- Conduit entrance kits
- Mounting kits

Details Make a Difference — ALTIVAR® 58 *TRX* AC Drive

Transparent Ready design

Programmable analog output included

Superior open loop motor speed and torque performance

Plug-in options

PI control for automatic speed adjustment based on real-time process feedback

Eight pre-set speeds

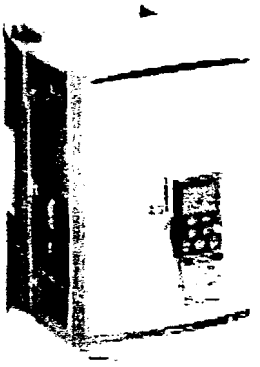
Selectable switching frequency from 0.5 to 16 kHz

Able to fold back switching frequency if thermal state is exceeded

Optional speed feedback with tachometer or encoder

General purpose option card

DC injection, fast stop and freewheel stop modes



Catch-on-the-fly with automatic speed search

Analog and digital I/O extension cards

Faster adaptation to changes in load conditions

Built-in RS485/MODBUS protocol

Energy economy algorithm reduces excess magnetizing current

Selection Guide — ALTIVAR® 58 *TRX* AC Drive

	Part Number	HP	kW	Output Current	Dimensions (in.) W	H	D	Weight lb.
208/230 Volt 50/60 Hz	ATV58HU09M2ZU (1)	.5	0.37	2.3	4.5	8.1	6.6	5
	ATV58HU18M2ZU (1)	1	0.75	4.1	4.5	8.1	6.6	5
	ATV58HU29M2ZU (2)	2	1.5	7.8	5.9	9.1	7.3	8
	ATV58HU41M2ZU (2)	3	2.2	11.0	5.9	9.1	7.3	8
	ATV58HU72M2ZU (3)	5	4	18.2	6.9	11.3	7.3	15
	ATV58HU90M2ZU (3)	7.5	5.5	24.2	9.1	12.8	8.3	26
	ATV58HD12M2ZU (3)	10	7.5	31.0	9.1	12.8	8.3	26
	ATV58HD16M2XZU (3)	15	11	47	9.6	22	11.3	75
	ATV58HD23M2XZU (3)	20	15	60	9.6	22	11.3	75
	ATV58HD28M2XZU (3)	25	18.5	75	14	26	12.1	126
	ATV58HD33M2XZU (3)	30	22	88	14	26	12.1	126
	ATV58HD46M2XZU (3)	40	30	116	14	26	12.1	126
400/460 Volt 50/60 Hz	ATV58HU18N4ZU	1	0.75	2.3	5.9	9.1	7.3	8
	ATV58HU29N4ZU	2	1.5	4.1	5.9	9.1	7.3	8
	ATV58HU41N4ZU	3	2.2	5.8	5.9	9.1	7.3	8
	ATV58HU72N4ZU	5	4	10.5	6.9	11.6	7.3	15
	ATV58HU90N4ZU	7.5	5.5	13.0	6.9	11.6	7.3	15
	ATV58HD12N4ZU	10	7.5	17.6	9.1	12.8	8.3	26
	ATV58HD16N4ZU	15	11	24.2	9.1	12.8	8.3	26
VFD-22S →	ATV58HD23N4ZU	20	15	33.0	9.1	16.4	8.3	31
	ATV58HD28N4XZU	25	18.5	40.7	9.6	22	11.3	75
	ATV58HD33N4XZU	30	22	48.4	9.6	22	11.3	75
	ATV58HD46N4XZU	40	30	66	9.6	22	11.3	75
	ATV58HD54N4XZU	50	37	79.2	14	26	12.1	126
ASD-3/0 →	ATV58HD64N4XZU	60	45	99.5	14	26	12.1	126
	ATV58HD79N4XZU	75	55	115.5	14	26	12.1	126
400/460 Volt 50/60 Hz	ATV58HC10N4XZU (4)	125	90	156	14.6	25.2	14.2	108
	ATV58HC13N4XZU (4)	150	110	180	18.9	27.2	15.7	169
	ATV58HC15N4XZU (4)	200	132	240	18.9	27.2	15.7	169
	ATV58HC19N4XZU (4)	250	160	302	18.9	27.2	15.7	169
	ATV58HC23N4XZU (4)	300	200	361	26	37.6	17.3	370
	ATV58HC25N4XZU (4)	350	220	414	26	37.6	17.3	370
	ATV58HC28N4XZU (4)	400	250	477	26	37.6	17.3	370
	ATV58HC31N4XZU (4)	450	280	515	26	37.6	17.3	370
	ATV58HC33N4XZU (4)	500	315	590	26	37.6	17.3	370

(1) Single phase input (2) Single phase or three phase input (3) Single or three phase – single phase input requires separate line reactor (4) Variable torque ratings

Environmental Specifications

Enclosure type	ATV58HU09M2 to U90N4: IP20/open type controllers according to Standard EN50178 ATV58HU90M2 to D46M2, ATV58HD12N4 to D79N4: Type 1 with conduit connection kit ATV58HC10N4X to C33N4X: IP20 on all surfaces except the bottom IP00 on the bottom due to the power connections
Resistance to vibrations	According to IEC 60068-2-6: 1.5 mm zero to peak from 3 to 13 Hz, 1 gn from 13 to 200 Hz ATV58HC10N4X to C33N4X: 0.6 gn from 10 to 55 Hz
Resistance to shocks	According to IEC 60068-2-27: 15 g, 11 ms
Ambient pollution degree	ATV58HU09M2 to D12M2 and ATV58HU18N4 to D23N4: Pollution degree 2 conforming to IEC 600664-1, EN50718 and NEMA ICS-1 ATV58HD16M2 to D46M2 and ATV58HD28N4 to D79N4: Pollution degree 3 according to IEC 600664-1, EN50718 and NEMA ICS-1 ATV58HC10N4X to C33N4X: Pollution degree 2 conforming to IEC 60664-1, EN 50718 and NEMA ICS-1 Protect the drive controller against dust, corrosive gas and falling liquid
Max. relative humidity	95% maximum, non-condensing and without dripping according to IEC 60068-2-3. Provide heating system if there is condensation
Maximum ambient temperature	Storage: -25 to +65 °C (–13 to +149 °F) temperature Operation: Drive controllers ATV58HU09M2 to U72M2 and ATV58HU18N4 to U90N4:■ –10 to +50 °C (+14 to 122 °F) without derating –10 to +60 °C (+14 to 140 °F) with fan kits and derating of the current 2.2% per °C above 50 °C Drive controllers ATV58HU90M2 to D46M2 and ATV58HD12N4 to D79N4: –10 to +40 °C (+14 to 104 °F) without derating –10 to +50 °C (+14 to 122 °F) with fan kits and derating of the current 2.2% per °C above 40 °C Drive controllers ATV58HC10N4X to C33N4X: –10 to +40 °C (+14 to 104 °F) without derating –10 to +50 °C (+14 to 122 °F) with fan kits and derating of the current 2.2% per °C above 40 °C
Altitude	3300 ft (1000 m) maximum without derating; derate the output current by 1% for each additional 330 ft (100 m)
Operational position	Vertical, = or ±10° with power terminals at the bottom

■ ATV58HU54N4X, ATV58HU72N4X, and ATV58HU90N4X can be used at their highest variable torque rating in a 40 °C (104 °F) ambient environment.
NOTE: Discoloration of drive controller plastic pieces will occur if exposed to direct sunlight.

Electrical Specifications

Input voltage	208 V –15% to 230 V +15% single phase input 208 V –15% to 230 V +15% three phase input 400 V –15% to 460 V +20% three phase input ▼
Input frequency	50/60 Hz = or ±5%
Output voltage	Three-phase output, maximum voltage equal to input voltage
Galvanic isolation	Galvanic isolation between power and control (inputs, outputs, supplies)
Output frequency	0.1 to 60 Hz (configurable to 500 Hz with programming options)
Switching frequency	4 kHz, configurable with programming options ATV58HU09M2 to D12M2 and ATV58HU18N4 to D23N4: 0.5 - 1 - 2 - 4 - 8 kHz without derating 12 - 16 kHz with derating in steady state 12 - 16 kHz without derating and with reduced duty cycle ▲ ATV58HD16M2 to D23M2 and ATV58HD28N4 to D46N4: 0.5 - 1 - 2 - 4 kHz without derating 8 - 12 kHz with derating in steady state 8 - 12 kHz without derating and with reduced duty cycle▲ ATV58HD28M2 to D46M2 and ATV58HD54N4 to D79N4: 0.5 - 1 - 2 kHz without derating 4 - 8 kHz with derating in steady state 4 - 8 kHz without derating and with reduced duty cycle▲ ATV58HC10N4X to C33N4X: 0.5 - 1 - 2 kHz without derating 4 kHz without derating and with reduced duty cycle▲ 4 kHz with derating of one hp rating in steady state
Speed range	1:100 open loop (for example 0.6 Hz to 60 Hz) 1:10 open loop for ATV58HC10N4X to C33N4X
Speed regulation	1% of rated motor speed without adjustments or feedback ±0.1% of rated motor speed with optional analog I/O card and appropriate tachometer feedback ±0.02% of rated motor speed with optional digital I/O card and appropriate encoder feedback 3% for ATV58HC10N4X to C33N4X
Efficiency	97% at full load typical
Displacement power factor	98% through speed range
Motor control algorithm	Sensorless flux vector control with a pulse width modulated (PWM) output wave form
DC injection braking	Automatically on stopping as soon as frequency drops below 0.1 Hz for 0.5 seconds
Braking torque	30% of nominal motor torque without dynamic braking (typical value). Up to 150% with dynamic braking option

▼ Input voltage is 460 VAC (-10%, +15%) on ATV58HU54N4XZU through ATV58HUD23N4XZU. Input voltage is 400 VAC -15% to 460 +10% on ATV58HC10N4X to ATV58HC33N4X.
▲ The drive controller can be configured to reduce switching frequency if the drive thermal state reaches 95%. When the drive thermal state returns to 70%, the switching frequency returns to the set value. If the duty cycle (drive controller run time) does not exceed 60% (36 second maximum for a 60 second cycle) derating is not required.

continued

Electrical Specifications, continued

Transient output current	160% of nominal NEC rated motor current for 60 seconds (for constant torque ratings) 110% of nominal motor current for 60 seconds (for variable torque ratings)
Transient motor torque	200% of nominal motor torque (typical value at = or ±10%) for 2 seconds 170% of nominal motor torque (typical value at = or ±10%) for 60 seconds
Drive controller protection	Protection against short circuits: between output phases between output phases and ground on outputs of internal supplies Thermal protection against overheating and overcurrent Undervoltage and overvoltage faults Protection against single-phase input operation on the three-phase drive controllers
Motor protection	Thermal protection integrated in the drive controller by continuous calculation of I^2t, taking motor speed into account■ Motor thermal state is retained during loss of power Motor thermal protection can be modified with a programming option to correspond to the type of motor cooling Protection against motor phase loss Protection by motor thermal sensors with analog option card
Electrical isolation	Electrical isolation between power and control (inputs, outputs, supplies)
Available internal supplies	Protected against short-circuits and overloads One (+)10 V = or ±1% supply for the reference potentiometer (1-10 kΩ), maximum current 10 mA One (+)24 V supply (min 20 V, max 30 V) for control inputs, maximum current 200 mA
Analog inputs AI	One analog voltage input AI1: range 0-10 V, impedance 30 kΩ One analog current input AI2: range 0-20 mA, impedance 100 Ω (reassignable to x-y mA by programming x and y, with a definition of 0.1 mA) Frequency resolution in analog reference: 0.1 Hz for 100 Hz (10 bits). Accuracy = or ±1%, linearity ±0.5% of the maximum output frequency Sampling time: 4 ms maximum Other inputs on option cards
Logic inputs LI	Four assignable logic inputs with impedance 3.5 kΩ, compatible with PLC level 1, standard IEC 60065A-68 Maximum length of shielded cable: 100 m (328 ft) Power supply + 24 VDC (minimum 11 VDC, maximum 30 VDC). State 0 if < 5 VDC, state 1 if >11 VDC Sampling time: 2 ms maximum Other inputs on option cards
Analog outputs	Analog current output X to Y mA analog output, with X and Y being programmable from 0 to 20 mA Maximum load impedance = 500 Ω Resolution: 0.04 mA (9 bits) Linearity: ±0.1 mZ Accuracy: ±0.2 mA The analog output is updated every 2ms maximum Other outputs on option cards
Logic outputs	Two relay logic outputs for R1 (fault relay) and R2 (assignable) Form C, 1 N.O., 1 N.C. contact protected against overvoltages (relay R1). 1 N.O. contact protected against overvoltages (relay R2) Minimum switching capacity: 10 mA for 24 VDC Maximum switching capacity: on a resistive load (cos j = 1): 5 A for 250 VAC or 30 VDC on an inductive load (cos j = 0.4 and L/R = 7 ms): 1.5 A for 250 VAC or 30 VDC Other outputs on option cards
Communication	RS 485 multi-drop serial link with simplified MODBUS® protocol as part of the standard product Transmission speed: 4800, 9600 and 19200 bps, no parity Use: connecting a terminal (option), microprocessor card, a PC (option) or connecting one or more PLCs
Codes and standards	UL Listed per UL 508C as incorporating electronic overload protection: UL File E164874, CCN NMMS ATV58HU09M2 to D46M2 ATV58HU18N4 to D79N4 ATV58HC10N4X to C33N4X CSA Certified to CSA C22.2 No. 14. CSA File LR96921, Class 3211 06 ATV58HU09M2 to D46M2 ATV58HU18N4 to D79N4 CE Marked Conforms to applicable NEMA ICS, NFPA, IEC and ISO 9001 standards

■ Motor power rating must be between 25% minimum, 136% maximum, of drive controller rating.

Visit the SQUARE D Web site at www.SquareD.com

Order Number 8800SM0101D

SQUARE D
Schneider Electric

Section 3-F

Air Stripper Blower (B-310)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BLOWER SPECIFICATION for BLOWER TAG: B-310

Project No. 70-1458
Revision 1 (03/15/2004)

1. Type: Centrifugal Radial Blade Pressure Blower rated for 5000 SCFM @ 49" WG Total Pressure Drop (-6" WG at Influent, +35" WG Effluent and 20% Safety Factor) and 55°F w/ Outlet Damper (Manual Actuator included), Vibration Isolation Base and 12"-125# Flanged Inlet and Outlet.

2. Motor: 75 HP, 3600 RPM, 460V, Rated for 5000 SCFM @ 49" WG Total. TEFC Inverted Duty.

3. The Blower Blade shall be manufactured of Corten material and therefore capable of handling and passing limited amounts of entrained water droplets without adverse impact to the Blower.

4. The Blower shall be direct drive, radial blade design, single width single inlet configuration.

6. Materials of Construction: The Blower housing and base shall be heavy gauge commercial quality carbon steel suitable for temperatures up to 250°F. The housing and wheels shall be continuously welded in accordance with ASME Section IX. The wheels shall be commercial quality carbon steel with single thickness blades and have non-overloading horsepower characteristics. The wheel shall be mounted to the fan shaft with a split taper bushing. The shafts shall be ground and polished. The fan bearings shall be heavy duty, self aligning ball type depending on fan size, motor HP, and performance and shall be re-lubricable for continuous service. They shall have a minimum L10 life of 50,000 hours minimum. The Blower shaft shall be medium carbon steel (ie 1040-45 SAE) and shall not operate above 70% of the first critical speed. Lifting lugs shall be provided for ease of handling and installation. The Blower shall be supplied with a weather cover which combines guarding of the drive as well as protection from the weather, a drain connection, outlet flanges, adjustable motor baseplate, intake guard and inlet flange.

7. The Blower assembly shall be dynamically balanced at the factory prior to shipping. The Blower shall meet the balance requirements of the Acoustical Society of America, Standard ASA STD2-1975 (ANSI S2 19-1975) Grade G2.5. The fan performance shall be based on tests conducted in the manufacturer's AMCA certified laboratory, and conducted in accordance with the latest Revision of AMCA Test Codes #210 (Air) and AMCA #300 (Sound).

8. The Blower interior and exterior shall be furnished with a rust-preventative primer only.

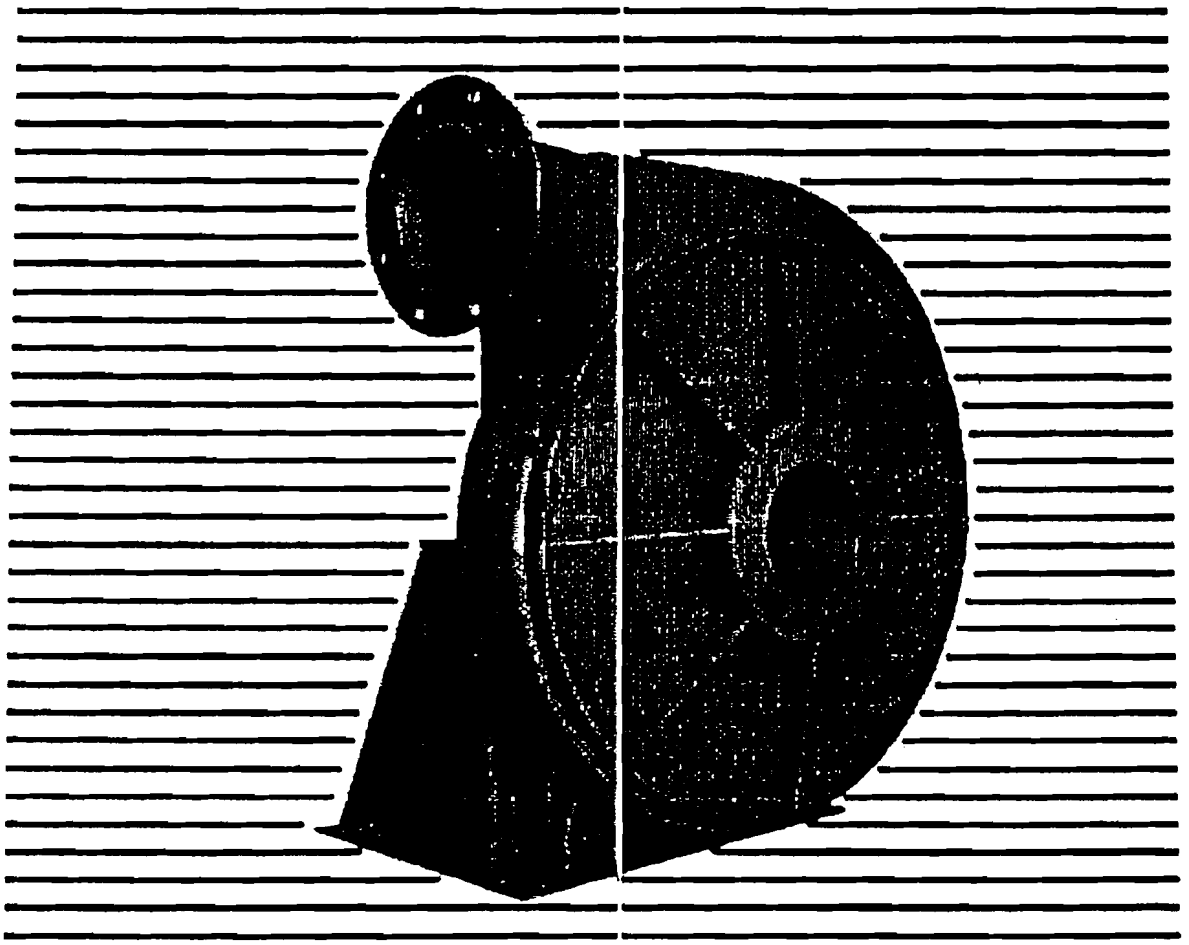
9. The Blower shall be equipped with and an Outlet Damper (Manual Actuator included) on the effluent side to control the air flow rate and shall be mounted on a Vibration Isolation Base.

10. The Blower Motor shall be squirrel cage induction type electrical motor of an appropriate horsepower. The motor shall be designed for 460 volt, three phase, 60 Hz service. The motor shall be a TEFC motor with a service factor of not less than 1.5. The motor shall be high efficiency and energy conserving design manufactured in accordance with NEMA specifications, NEMA B torque requirements, and Class F non-hydroscopic insulation. The Motor shall be manufactured by a recognized domestic manufacturer.

Layne Christensen Company ■ 97 Chimney Rock Road ■ Bridgewater NJ 08807 ■ Phone: (800) 269-4590

Series 6400
Centrifugal RB Pressure Blowers

Designs 6410, 6420, 6430, 6440 & 6450

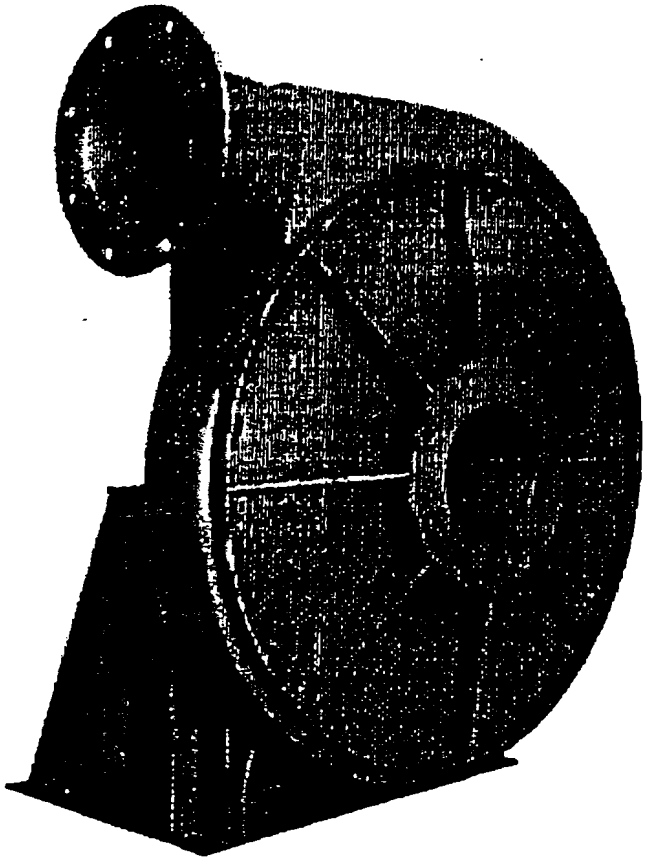


NORTHERN BLOWER®

Flanged Inlet and Outlet
Round punched flanges to facilitate the bolting of duct connections. Inlets and outlets are the same size, and match ANSI 125/250 # drilling.

Radial Blade
Superior combination of efficient operation and rugged, dependable service.

Bearings
Heavy duty ball or split pillow-block spherical roller bearings sized for a generous B-10 life.



Shaft
Turned ground and polished or fully machined to close tolerance.

Shaft Seal
Used to reduce leakage through the shaft hole in the housing.

Heavy Duty
Structural Bearing Pedestal

Housing
Rugged heavy gauge all welded steel housing with substantial framing sections for maximum rigidity. Standard features include flanged inlet, flanged outlet, shaft seal, gasketted inlet and gasketted housing split (where applicable).

Balancing
Wheel and shaft assemblies are dynamically balanced to ANSI S2.19-1989 specifications and are either interference fit or have taper-lock bushings on all models.

Shafts and Bearings

Shafts

Selected to have suitable strength and operate well below the first critical speed for each maximum class condition.

Bearings

Anti-friction, grease lubricated, roller type split housing, manufactured to internationally adopted standards by companies having worldwide acceptance and support services. Bearings are selected for continuous operation with a generous bearing life.

Capacities and Pressures

Catalogued up to 50,000 CFM. Available to 100,000 CFM.
Catalogued up to 70" WG. Available to 145" WG.

Temperatures

High Temperature Operating Limits		
Arrangement	Without Cooling Wheel	With Cooling Wheel
1 & 8 SISW	300°F	800°F
4 SISW	150°F	—
9F SISW	300°F	850°F

Arrangements

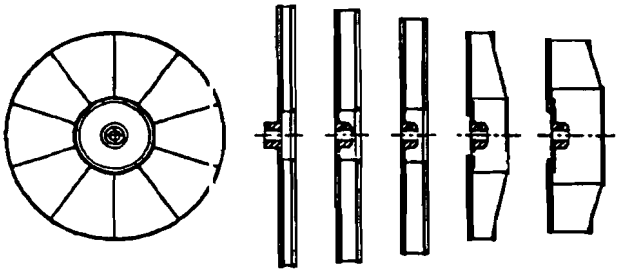
Arrangement	Design	Fan Size Range
A/1, 8 & 9 - SISW	All Designs	25 - 75
A/4 - SISW	Designs 6410 & 6420	25 - 50
A/4 - SISW	Design 6430	25 - 55
A/4 - SISW	Design 6440	25 - 60
A/4 - SISW	Design 6450	25 - 65

Series 6400
RB Pressure Blower Wheel

The Northern Blower Radial Blade (RB) Pressure Blower wheel is designed to generate high pressure in a single-stage blower. Blades are formed from heavy gauge high strength low alloy steel, stainless steel or other special metal construction.

The fans are offered in a family of wheel designs with overlapping performance ranges. The wheels progress from large diameters with narrow blades to small diameters with wide blades, so that a perfectly sized fan can be supplied for the job. The impellers are available from 85 to 100% of nominal diameter in a fixed width housing.

Performance for these diameters is determined using Northern Blower's FanFinder™ computer program.



Radial Blade 6410 6420 6430 6440 6450

Standard Fan Features

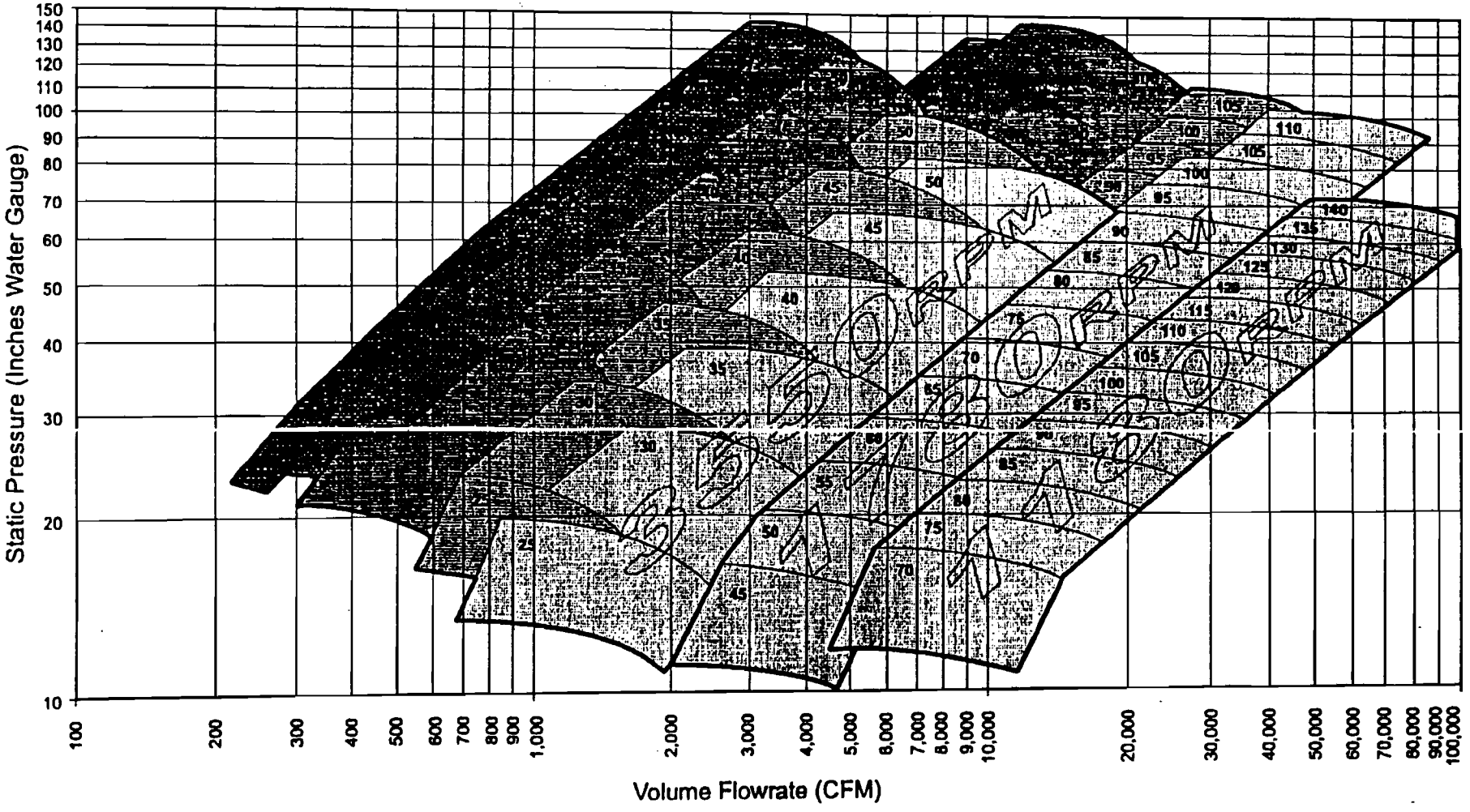
- Heavy Duty Ball or Split Pillow Block Spherical Roller Bearings
- Integral Bearing Pedestal
- Shaft Seal
- Hinged, flush mounted access door
- Punched, flanged inlet and outlet to match ANSI 125/250# drilling
- Continuous welded housing
  - 3/16" thick for sizes 25 to 35
  - 1/4" thick for sizes 40 to 70
  - 3/8" thick for sizes 75 and larger

NORTHERN BLOWER®
CML Northern Blower Inc.
901 Regent Avenue West
Winnipeg, MB, Canada R2C 2Z8
204.222.4216 204.222.7601
www.northernblower.com

Performance Range

Standard Conditions

Design 6410 ■ 6420 ■ 6430 ■ 6440 ■ 6450 □



NORTHERN BLOWER

FAN SERIAL NO.: Prop.#

DRAWN: 1/19/2004

SALES OFFICE:

CUSTOMER: F.O. No.:

PROJECT:

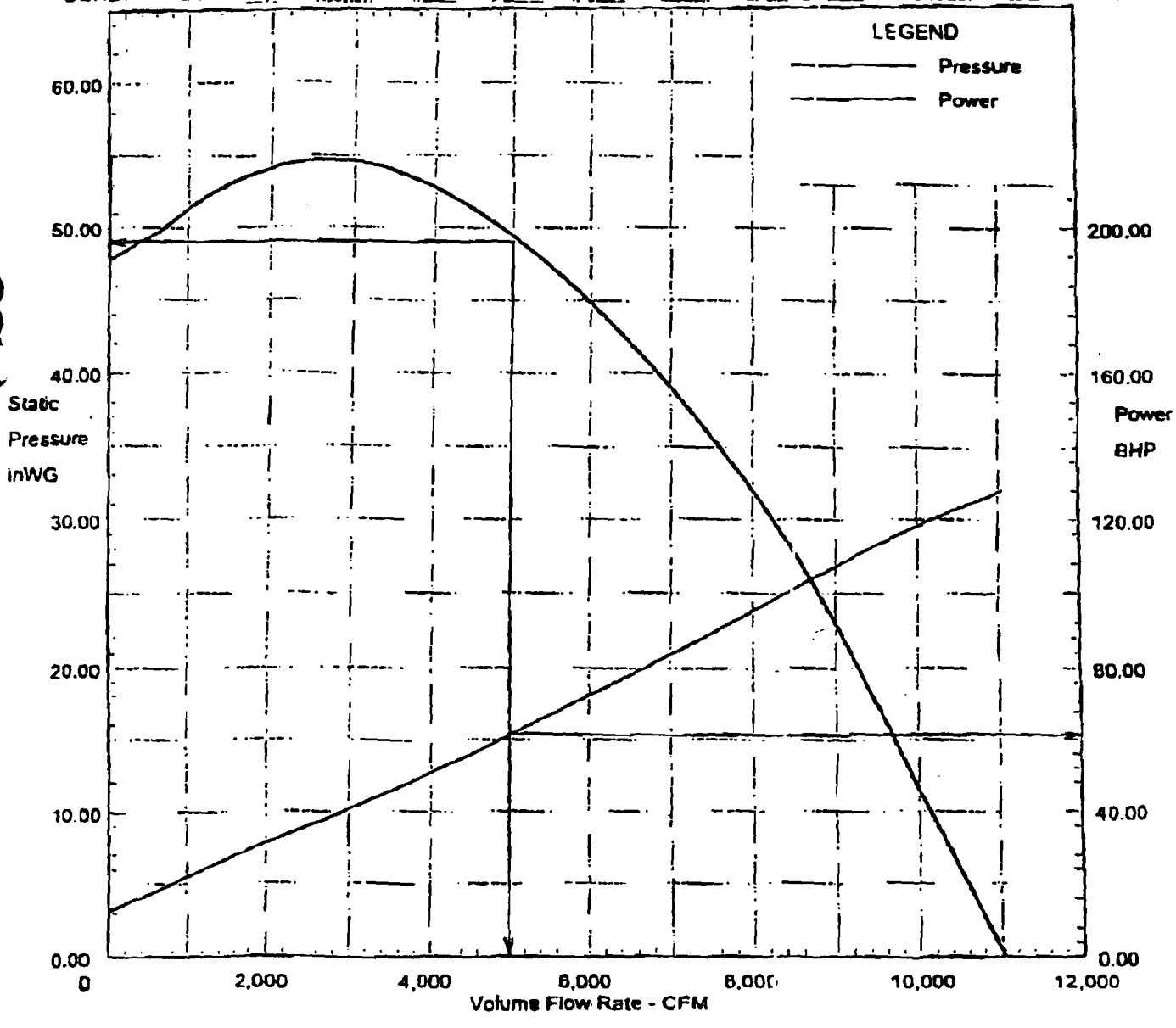
ENGINEER:

TAG:

FAN - DESCRIPTION: Design No. 6440 Size 40-2663 SISW Centrifugal

SELECTION: 5,000 CFM, 49.000 inWG SP, 61.38 BHP

CONDITIONS: Operating: 0.0746 lb/cu.ft, 70.0 F, 3500 RPM [6440_404Min_16146A1]



NORTHERN BLOWER®

Sound Performance

Fan Serial No. : Prop.# 39-04-001
Date : January 19, 2004

CML Northern Blower Inc.
901 Regent Avenue W., Winnipeg, Manitoba, R2C 2Z8, Telephone: 204 222-4216 Telefax: 204 222-7801

CUSTOMER : P.O. NO.

TAG :

PROJECT

SUBMITTED BY ENGINEER

Design	6440		Inlet Pressure	2.0	
Width	SISW		Temperature	70.0	
Percent Width	100	%	Fan Speed	3500	RPM
Volume Flow Rate	5000		Altitude	0	
Pressure	49.000		Inlet Air Density	.075	
			Power	61.38	BHP
Nominal Fan Size	40 - 2663				
Wheel Diameter	26.63	in			
Duct Diameter	12.000	in			

Sound Data

Octave Band

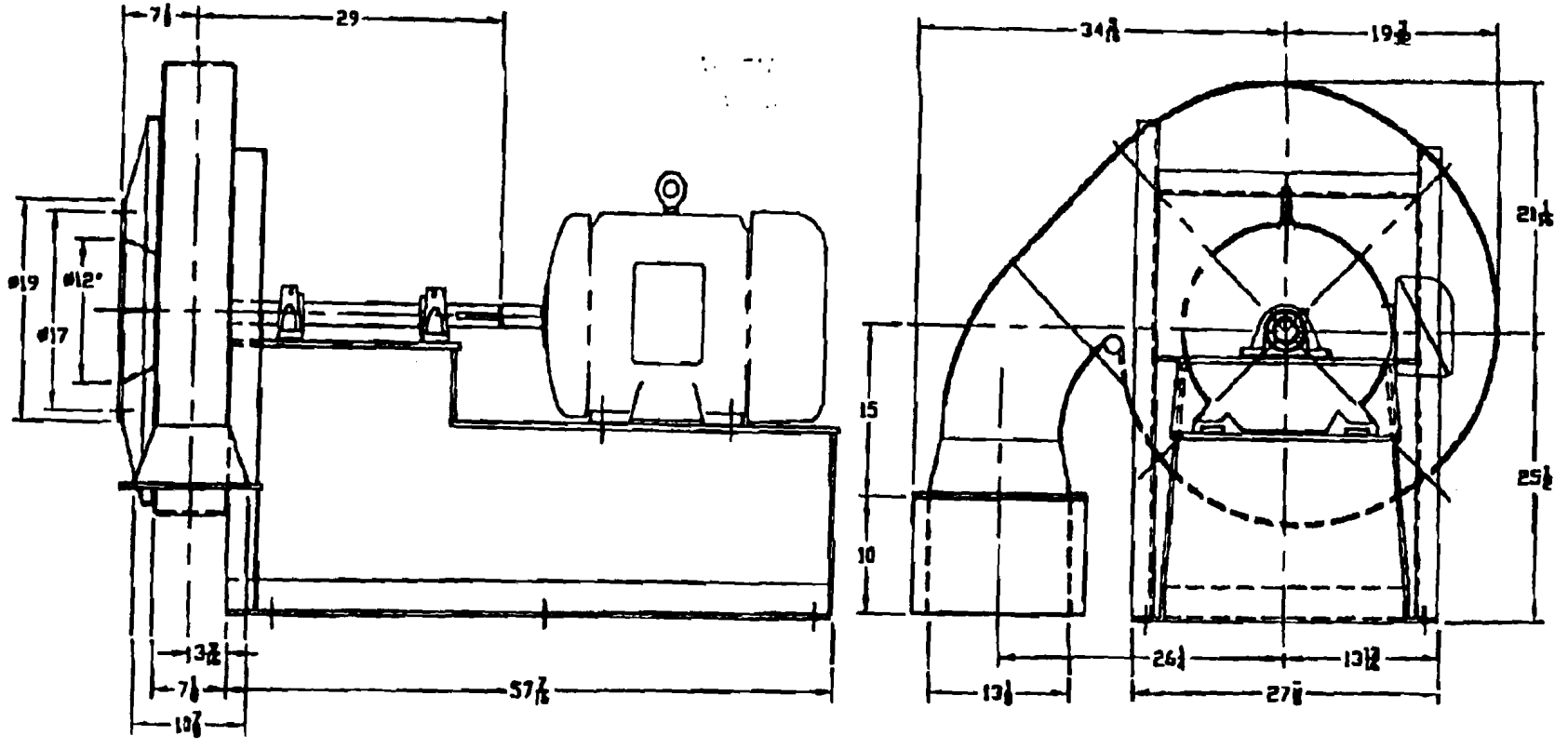
	1	2	3	4	5	6	7	8
Center Frequency	63	125	250	500	1000	2000	4000	8000
Power Level dB	98	106	113	109	110	103	96	92
Pressure Level dB re 20 µPa at 5.00 feet	86	94	101	97	98	91	84	80
Attenuator Correction	0	0	0	0	0	0	0	0
Pressure Level dBA	61	79	93	94	98	92	85	79
Total Log Sum dBA	101							

The Sound Power level ratings shown are in decibels, referred to 10 ^-12 watts.

Values shown for Sound Power levels are for :
- Installation Type B: Free inlet, Ducted outlet. Ratings include the effects of end reflections.

The sound level of fan equipment outside the laboratory may vary widely from those levels stated above.

Version 2003-1



NOT CERTIFIED

FOR SALES PURPOSES ONLY
DO NOT USE FOR CONSTRUCTION

NORTHERN BLOWER

981 REGENT AVENUE WEST, WINNIPEG, MANITOBA R2C 2Z8

TITLE:

DESIGN 6440, SIZE 40, 3600 RPM
CCW-DB, A8, 75 HP (365TS MTR)
REF: PROP 39-04-001

DRAWN LF	DATE 04.01.20	REV.
CHK'D LF	DATE 04.01.20	SCALE NTS
DWG. NO. P-0866		

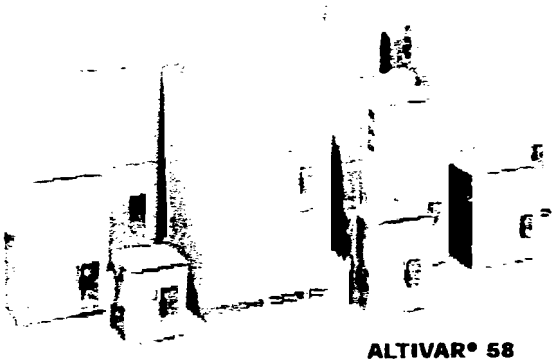
Section 3-G

Air Stripper Blower Variable Speed Drive (VFD-310)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

DRIVE ONLY W/O ENCLOSURE
VFD-310

ALTIVAR® 58 TRX AC Drives



ALTIVAR® 58
TRX Family

ALTIVAR® 58 TRX AC Drives

The ALTIVAR 58 TRX drive is the next generation of the ALTIVAR 58 family of AC drives. Extending the horsepower range to 500 hp, this drive builds on the functionality of the current product line and meets the most demanding commercial and industrial applications.

In addition to offering extended power ratings and functionality, the ALTIVAR 58 TRX is also "Transparent Ready," so that the drive connects directly to an Ethernet-based network. This allows the drive, along with the appropriate Ethernet option card, to become a building block for Schneider Electric's Transparent Ready initiative.

Using a standard Web browser, embedded Web pages on the option card allow access to real-time information from anywhere around the world. This communication network provides a flexible, cost-effective solution for communicating drive information to various layers of an integrated building or manufacturing facility.

The family of ALTIVAR 58 TRX AC drives is also available with a variety of operator interface options, I/O extension cards and communication cards. Mounting kits, ventilation and conduit entry options combined with Type 1 construction provide flexibility for OEMs and users installing AC drives. All ALTIVAR 58 TRX drives are also available with POWERSUITE™ products for easy start-up and testing.

Ratings available for the ALTIVAR 58 TRX AC drive include:

1–500 variable torque (75 hp constant torque) 400/460 VAC, three-phase input.

0.5–30 variable torque (7.5 hp constant torque) 208/230 VAC, single-phase input.

2–50 variable torque (40 hp constant torque) 208/230 VAC, three-phase input.

Key Benefits

Ease of use

Selectable macro-configurations for ease of programming.

POWERSUITE™ software package creates configurations, modifies parameters, saves, uploads/downloads and allows fault history viewing on a PC or Hewlett Packard Jornada.

Adaptive tuning to motor characteristics for easy set-up.

Reliability

Random switching frequency modulation reduces motor noise.

Wide speed range meets the needs of most applications.

Produces acceleration torque for difficult-to-start loads.

Laminated bus reduces the number of internal connections.

ASICs eliminate complicated circuits and reduce parts count.

Functionality

"No load" feature provides automatic energy savings when machine demand is low.

Quiet motor operation is ideal for HVAC applications.

Built-in RS485 port

- MODBUS® protocol
- Multi-drop

Newest generation sensorless vector control (SVC) provides superior motor speed and torque performance.

Options

POWERSUITE software available for easy testing and commissioning.

Operator interface, developed for quick and easy drive programming and real-time monitoring of motor and drive performance:

- Keypad
- Remote mount kit for keypad
- PC or Hewlett Packard Jornada

continued

Options, continued

Option cards available for increased input and output capability or communications:

- Analog I/O card
- Digital I/O card
- General purpose I/O card
- Communications options: Ethernet, DEVICENET™, MODBUS® Plus, MODBUS/ Unitelway, Landis and Staefa/ Siemens P1, Johnson Controls N2, Interbus S, LonWorks®, Profibus DP and FIPIO

Peripheral components available to increase application performance and environmental requirements:

- Ventilation kit for enclosed mounting
- Dynamic brake resistors
- EMC wiring plates
- Conduit entrance kits
- Mounting kits

Details Make a Difference — ALTIVAR® 58 *TRX* AC Drive

Transparent Ready design

Programmable analog output included

Superior open loop motor speed and torque performance

Plug-in options

PI control for automatic speed adjustment based on real-time process feedback

Eight pre-set speeds

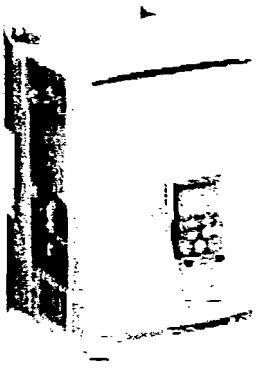
Selectable switching frequency from 0.5 to 16 kHz

Able to fold back switching frequency if thermal state is exceeded

Optional speed feedback with tachometer or encoder

General purpose option card

DC injection, fast stop and freewheel stop modes



Catch-on-the-fly with automatic speed search

Analog and digital I/O extension cards

Faster adaptation to changes in load conditions

Built-in RS485/MODBUS protocol

Energy economy algorithm reduces excess magnetizing current

Selection Guide — ALTIVAR® 58 *TRX* AC Drive

	Part Number	HP	kW	Output Current	Dimensions (in.) W	H	D	Weight lb.
208/230 Volt 50/60 Hz	ATV58HU09M2ZU (1)	.5	0.37	2.3	4.5	8.1	6.6	5
	ATV58HU18M2ZU (1)	1	0.75	4.1	4.5	8.1	6.6	5
	ATV58HU29M2ZU (2)	2	1.5	7.8	5.9	9.1	7.3	8
	ATV58HU41M2ZU (2)	3	2.2	11.0	5.9	9.1	7.3	8
	ATV58HU72M2ZU (3)	5	4	18.2	6.9	11.3	7.3	15
	ATV58HU90M2ZU (3)	7.5	5.5	24.2	9.1	12.8	8.3	26
	ATV58HD12M2ZU (3)	10	7.5	31.0	9.1	12.8	8.3	26
	ATV58HD16M2XZU (3)	15	11	47	9.6	22	11.3	75
	ATV58HD23M2XZU (3)	20	15	60	9.6	22	11.3	75
	ATV58HD28M2XZU (3)	25	18.5	75	14	26	12.1	126
	ATV58HD33M2XZU (3)	30	22	88	14	26	12.1	126
	ATV58HD46M2XZU (3)	40	30	116	14	26	12.1	126
400/460 Volt 50/60 Hz	ATV58HU18N4ZU	1	0.75	2.3	5.9	9.1	7.3	8
	ATV58HU29N4ZU	2	1.5	4.1	5.9	9.1	7.3	8
	ATV58HU41N4ZU	3	2.2	5.8	5.9	9.1	7.3	8
	ATV58HU72N4ZU	5	4	10.5	6.9	11.6	7.3	15
	ATV58HU90N4ZU	7.5	5.5	13.0	6.9	11.6	7.3	15
	ATV58HD12N4ZU	10	7.5	17.6	9.1	12.8	8.3	26
VFD-22T →	ATV58HD16N4ZU	15	11	24.2	9.1	12.8	8.3	26
	ATV58HD23N4ZU	20	15	33.0	9.1	16.4	8.3	31
	ATV58HD28N4XZU	25	18.5	40.7	9.6	22	11.3	76
	ATV58HD33N4XZU	30	22	48.4	9.6	22	11.3	75
	ATV58HD46N4XZU	40	30	66	9.6	22	11.3	75
	ATV58HD54N4XZU	50	37	79.2	14	26	12.1	126
ASD-310 →	ATV58HD64N4XZU	60	45	93.5	14	26	12.1	126
	ATV58HD79N4XZU	75	55	115.5	14	26	12.1	126
400/460 Volt 50/60 Hz	ATV58HC10N4XZU (4)	125	90	156	14.6	25.2	14.2	108
	ATV58HC13N4XZU (4)	150	110	180	18.9	27.2	15.7	169
	ATV58HC15N4XZU (4)	200	132	240	18.9	27.2	15.7	169
	ATV58HC19N4XZU (4)	250	160	302	18.9	27.2	15.7	169
	ATV58HC23N4XZU (4)	300	200	361	26	37.6	17.3	370
	ATV58HC25N4XZU (4)	350	220	414	26	37.6	17.3	370
	ATV58HC28N4XZU (4)	400	250	477	26	37.6	17.3	370
	ATV58HC31N4XZU (4)	450	280	515	26	37.6	17.3	370
	ATV58HC33N4XZU (4)	500	315	590	26	37.6	17.3	370

(1) Single phase input (2) Single phase or three phase input (3) Single or three phase – single phase input requires separate line reactor (4) Variable torque ratings

Environmental Specifications

Enclosure type	ATV58HU09M2 to U90N4: IP20/open type controllers according to Standard EN50178 ATV58HU90M2 to D46M2, ATV58HD12N4 to D79N4: Type 1 with conduit connection kit ATV58HC10N4X to C33N4X: IP20 on all surfaces except the bottom IP00 on the bottom due to the power connections
Resistance to vibrations	According to IEC 60068-2-6: 1.5 mm zero to peak from 3 to 13 Hz, 1 gn from 13 to 200 Hz ATV58HC10N4X to C33N4X: 0.6 gn from 10 to 55 Hz
Resistance to shocks	According to IEC 60068-2-27: 15 g, 11 ms
Ambient pollution degree	ATV58HU09M2 to D12M2 and ATV58HU18N4 to D23N4: Pollution degree 2 conforming to IEC 600664-1, EN50718 and NEMA ICS-1 ATV58HD16M2 to D46M2 and ATV58HD28N4 to D79N4: Pollution degree 3 according to IEC 600664-1, EN50718 and NEMA ICS-1 ATV58HC10N4X to C33N4X: Pollution degree 2 conforming to IEC 60664-1, EN 50718 and NEMA ICS-1 Protect the drive controller against dust, corrosive gas and falling liquid
Max. relative humidity	95% maximum, non-condensing and without dripping according to IEC 60068-2-3. Provide heating system if there is condensation
Maximum ambient temperature	Storage: -25 to +65 °C (-13 to +149 °F) temperature Operation: Drive controllers ATV58HU09M2 to U72M2 and ATV58HU18N4 to U90N4:■ –10 to +50 °C (+14 to 122 °F) without derating –10 to +60 °C (+14 to 140 °F) with fan kits and derating of the current 2.2% per °C above 50 °C Drive controllers ATV58HU90M2 to D46M2 and ATV58HD12N4 to D79N4: –10 to +40 °C (+14 to 104 °F) without derating –10 to +50 °C (+14 to 122 °F) with fan kits and derating of the current 2.2% per °C above 40 °C Drive controllers ATV58HC10N4X to C33N4X: –10 to +40 °C (+14 to 104 °F) without derating –10 to +50 °C (+14 to 122 °F) with fan kits and derating of the current 2.2% per °C above 40 °C
Altitude	3300 ft (1000 m) maximum without derating; derate the output current by 1% for each additional 330 ft (100 m)
Operational position	Vertical, = or ±10° with power terminals at the bottom

■ ATV58HU54N4X, ATV58HU72N4X, and ATV58HU90N4X can be used at their highest variable torque rating in a 40 °C (104 °F) ambient environment.

NOTE: Discoloration of drive controller plastic pieces will occur if exposed to direct sunlight.

Electrical Specifications

Input voltage	208 V –15% to 230 V +15% single phase input 208 V –15% to 230 V +15% three phase input 400 V –15% to 460 V +20% three phase input ▼
Input frequency	50/60 Hz = or ±5%
Output voltage	Three-phase output, maximum voltage equal to input voltage
Galvanic isolation	Galvanic isolation between power and control (inputs, outputs, supplies)
Output frequency	0.1 to 60 Hz (configurable to 500 Hz with programming options)
Switching frequency	4 kHz, configurable with programming options ATV58HU09M2 to D12M2 and ATV58HU18N4 to D23N4: 0.5 - 1 - 2 - 4 - 8 kHz without derating 12 - 16 kHz with derating in steady state 12 - 16 kHz without derating and with reduced duty cycle ▲ ATV58HD16M2 to D23M2 and ATV58HD28N4 to D46N4: 0.5 - 1 - 2 - 4 kHz without derating 8 - 12 kHz with derating in steady state 8 - 12 kHz without derating and with reduced duty cycle▲ ATV58HD28M2 to D46M2 and ATV58HD54N4 to D79N4: 0.5 - 1 - 2 kHz without derating 4 - 8 kHz with derating in steady state 4 - 8 kHz without derating and with reduced duty cycle▲ ATV58HC10N4X to C33N4X: 0.5 - 1 - 2 kHz without derating 4 kHz without derating and with reduced duty cycle▲ 4 kHz with derating of one hp rating in steady state
Speed range	1:100 open loop (for example 0.6 Hz to 60 Hz) 1:10 open loop for ATV58HC10N4X to C33N4X
Speed regulation	1% of rated motor speed without adjustments or feedback ±0.1% of rated motor speed with optional analog I/O card and appropriate tachometer feedback ±0.02% of rated motor speed with optional digital I/O card and appropriate encoder feedback 3% for ATV58HC10N4X to C33N4X
Efficiency	97% at full load typical
Displacement power factor	98% through speed range
Motor control algorithm	Sensorless flux vector control with a pulse width modulated (PWM) output wave form
DC injection braking	Automatically on stopping as soon as frequency drops below 0.1 Hz for 0.5 seconds
Braking torque	30% of nominal motor torque without dynamic braking (typical value). Up to 150% with dynamic braking option

▼ Input voltage is 460 VAC (-10%, +15%) on ATV58HU54N4XZU through ATV58HUD23N4XZU. Input voltage is 400 VAC -15% to 460 +10% on ATV58HC10N4X to ATV58HC33N4X.

▲ The drive controller can be configured to reduce switching frequency if the drive thermal state reaches 95%. When the drive thermal state returns to 70%, the switching frequency returns to the set value. If the duty cycle (drive controller run time) does not exceed 60% (36 second maximum for a 60 second cycle) derating is not required.

continued

Electrical Specifications, continued

Transient output current	160% of nominal NEC rated motor current for 60 seconds (for constant torque ratings) 110% of nominal motor current for 60 seconds (for variable torque ratings)
Transient motor torque	200% of nominal motor torque (typical value at = or ±10%) for 2 seconds 170% of nominal motor torque (typical value at = or ±10%) for 60 seconds
Drive controller protection	Protection against short circuits: between output phases between output phases and ground on outputs of internal supplies Thermal protection against overheating and overcurrent Undervoltage and overvoltage faults Protection against single-phase input operation on the three-phase drive controllers
Motor protection	Thermal protection integrated in the drive controller by continuous calculation of I^2t, taking motor speed into account■ Motor thermal state is retained during loss of power Motor thermal protection can be modified with a programming option to correspond to the type of motor cooling Protection against motor phase loss Protection by motor thermal sensors with analog option card
Electrical isolation	Electrical isolation between power and control (inputs, outputs, supplies)
Available internal supplies	Protected against short-circuits and overloads One (+)10 V = or ±1% supply for the reference potentiometer (1-10 kΩ), maximum current 10 mA One (+)24 V supply (min 20 V, max 30 V) for control inputs, maximum current 200 mA
Analog inputs AI	One analog voltage input AI1: range 0-10 V, impedance 30 kΩ One analog current input AI2: range 0-20 mA, impedance 100 Ω (reassignable to x-y mA by programming x and y, with a definition of 0.1 mA) Frequency resolution in analog reference: 0.1 Hz for 100 Hz (10 bits). Accuracy = or ±1%, linearity ±0.5% of the maximum output frequency Sampling time: 4 ms maximum Other inputs on option cards
Logic inputs LI	Four assignable logic inputs with impedance 3.5 kΩ, compatible with PLC level 1, standard IEC 60065A-68 Maximum length of shielded cable: 100 m (328 ft) Power supply + 24 VDC (minimum 11 VDC, maximum 30 VDC). State 0 if < 5 VDC, state 1 if >11 VDC Sampling time: 2 ms maximum Other inputs on option cards
Analog outputs	Analog current output X to Y mA analog output, with X and Y being programmable from 0 to 20 mA Maximum load impedance = 500 Ω Resolution: 0.04 mA (9 bits) Linearity: ±0.1 mZ Accuracy: ±0.2 mA The analog output is updated every 2ms maximum Other outputs on option cards
Logic outputs	Two relay logic outputs for R1 (fault relay) and R2 (assignable) Form C, 1 N.O., 1 N.C. contact protected against overvoltages (relay R1). 1 N.O. contact protected against overvoltages (relay R2) Minimum switching capacity: 10 mA for 24 VDC Maximum switching capacity: on a resistive load (cos j = 1): 5 A for 250 VAC or 30 VDC on an inductive load (cos j = 0.4 and L/R = 7 ms): 1.5 A for 250 VAC or 30 VDC Other outputs on option cards
Communication	RS 485 multi-drop serial link with simplified MODBUS® protocol as part of the standard product Transmission speed: 4800, 9600 and 19200 bps, no parity Use: connecting a terminal (option), microprocessor card, a PC (option) or connecting one or more PLCs
Codes and standards	UL Listed per UL 508C as incorporating electronic overload protection: UL File E164874, CCN NMMS ATV58HU09M2 to D46M2 ATV58HU18N4 to D79N4 ATV58HC10N4X to C33N4X CSA Certified to CSA C22.2 No. 14. CSA File LR96921, Class 3211 06 ATV58HU09M2 to D46M2 ATV58HU18N4 to D79N4 CE Marked Conforms to applicable NEMA ICS, NFPA, IEC and ISO 9001 standards

■ Motor power rating must be between 25% minimum, 136% maximum, of drive controller rating.

Visit the SQUARE D Web site at www.SquareD.com

Order Number 8600SM0101D

SQUARE D
Schneider Electric

Graybar

789 EDWARDS ROAD
PARSIPPANY, NJ 07054
Phone: 973-227-4040 Fax: 973-227-0244

Fax

To:	Konrad Kuc – Arcadia G&M	**From:**	Joseph Passetti
Fax:	631-249-7610	**Pages:**	3 Including cover
Phone:	631-391-5246	**Date:**	11/4/2003
Re:	75 HP Altivar 58 AC Drive	**CC:**	Rob Miller – Graybar Hauppauge

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

• **Comments:**

Attached is the pricing for a 75 HP, Variable Torque (VT) Rated, Square D, Altivar 58 AC drive as requested. I have quoted it two ways.

1. Class 8839 Econoflex – This is a NEMA 12 wall mounted enclosure. Standard features are found on page 187 of the Altivar 58 TRX AC Drives catalog I mailed to you. Optional features, not included in the pricing, are found on pages 188 – 190. The Econoflex package is designed for typical HVAC and pump applications with limited options. Rating information is found on pages 194 – 198. Weights and dimensions are on page 200.

   Option for Bypass.....Add $952.00 to quoted price

2. Class 8839 58M AC Enclosed Drive – This is a NEMA 12 floor mounted enclosure. Standard features are found on page 146 of the Altivar 58 TRX AC Drives catalog. Optional features, not included in the pricing, are found on pages 147 – 162. The 58M package is designed for maximum flexibility and includes a wide range of options to meet all applications. Weights and dimensions are on page 164.

   ~~Option for Bypass.....Add $1255.00 to quoted price~~

LOWER SD-310

Both drive packages are based on the Altivar 59 TRX drive starting on page 3 of the catalog and have the same current rating of 96 amps.

Please contact me if you have any questions or would like pricing on any of the options.

Graybar Electric, CO. standard terms and conditions of sale apply.

Joseph Passetti

PARSIPPANY, NJ 07054
Phone: (973)227-4040 Fax: (973)227-0244

ect Name: ARCADIS
ect Location: MELLEVILLE
omer Name: GRAYBAR
Q2C Number: 18537369
Quote Number: 1

Accessories
Fuses NOT Included
Overloads NOT Included
Lamps NOT Included
Lug Kits NOT Included

Item Number	Quantity	Catalog Number / Details	Unit Price	Extended Price
002-00	1	Designation: 58M 883958MRA4VWA07 Class 8839 58M AC Enclosed Drive CONSISTING OF Class 8839 Type 58M Enclosed AC Drive Selected for: 75 Horsepower 460 VAC motor Type 12 Enclosure Color - ANSI 49 dark gray enclosure Variable Torque Disconnect means - circuit breaker Heavy duty mechanism disconnect with lock-out/tag-out provisions Power Circuit W: Drive controller package - 65 kAIC UL coordinated rating Meets UL508C includes Auto Start relay (115 volt control) Control options: Keypad included as standard Hand-Off-Auto selector switch Speed potentiometer Pilot light options: None Auxiliary contacts: 1 Form C drive run contact (STD) 1 Form C drive fail contact (STD) Includes the following standard features: Remote fault condition reset in Auto mode with transition of auto start contact Manual Fault condition reset in OFF positio of H-O-A selector switch Safety interlock/Run permissive location wired to customer terminal strip Wire identification markers White component mounting plate Conduit knockouts on wall mounted enclosure Removable conduit entry plates on floor mount enclosures Delivery schedule is based upon an APPROVED RELEASE with acceptance by factory personnel. For large quantities, please contact the Enclosed Drives Customer Service group for confirmed lead times. Sel. version code: 3SE26 **Estimated Ship Days (ARO): 20 Working Days**	$9,204.63	$9,204.63

BLOWER
ASD-310

PRINTED 11/4/2003 11:17 AM

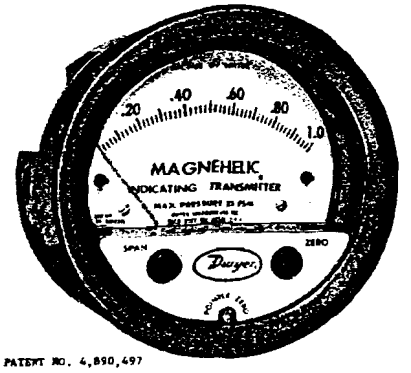
Section 3-H

Air Pressure Indicating Transmitters (PIT-311, PIT-312)

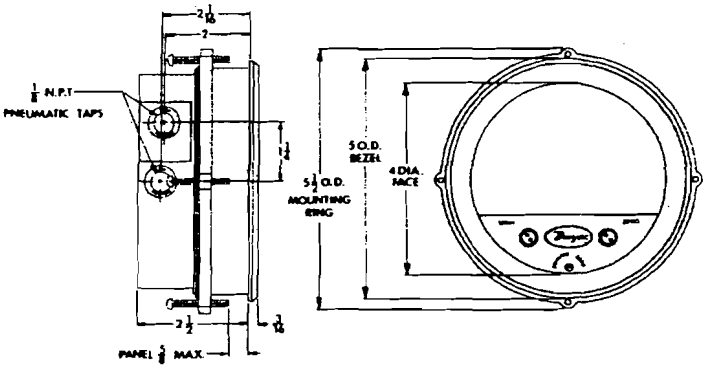
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

SERIES 605 MAGNEHELIC®
DIFFERENTIAL PRESSURE INDICATING TRANSMITTER

Specifications - Installation and Operating Instructions



PATENT NO. 4,890,497



The Dwyer Series 605 Magnehelic® indicating transmitter simultaneously provides local indication on a large, easily read analog scale while also converting that pressure into a standard two-wire, 4-20 mA signal for ranges from 0-0.5 to 0-50" w.c. Positive, negative or differential air and compatible gas pressure can be measured with an accuracy of ± 2% of full scale. The basic mechanical components of the Series 605 Magnehelic® indicating transmitter are similar to those used in the popular, time-proven Magnehelic® differential pressure gage. However, the Series 605 models add electrical conditioning and amplification of a resistance change produced by a silicon strain gage which is cemented to the range spring. This resistance change is the result of the slight flexing which results from spring deflection as pressure is applied to the diaphragm which is directly linked to the spring. Refer to bulletin E-50 for additional information on the design, operation and construction of the Magnehelic® indicating transmitter.

SERIES 605 MODELS & RANGES

MODEL NUMBER	RANGE, INCHES W.C.	MINOR DIVS.
605-0	0-.5	.01
605-1	0-1.0	.02
605-2	0-2.0	.05
605-3	0-3.0	.10
605-6	0-6.0	.20
605-10	0-10	.20
605-20	0-20	.50
605-30	0-30	1.0
605-50	0-50	1.0
MODEL NUMBER	**RANGE, PASCALS**	**MINOR DIVS.**
605-250Pa	0-250	5
605-500Pa	0-500	10
MODEL NUMBER	**RANGE, KILO PASCALS**	**MINOR DIVS.**
605-1.5kPa	0-1.5	.05

SPECIFICATIONS

GENERAL

Maximum Pressure:	25 PSIG
Media Compatibility:	Air & noncombustible, noncorrosive gases

ELECTRICAL

Power Supply:	12.3 to 35 VDC.
Connections:	2 screw terminal block, positive and negative.
Output Signal:	4 to 20 mA DC. (limited at 38 mA)
Loop Resistance:	0 to 1135 ohms $R_{Load} = \frac{V_{ps} - 12.3V}{20mA}$
Warm-up Time:	5-10 Minutes
Current Consumption:	38 mA max. DC

PERFORMANCE AT ROOM TEMPERATURE

Zero Output:	4 mA
Full Scale Span:	16 mA
Static Accuracy:	± 2% Span
Span & Zero:	Adjustable to 0.05%
Repeatability:	0.5% Span
Resolution:	Infinitesimal

ENVIRONMENTAL

Operating Temperature:	20 to 120°F (dry air)
Compensated Temperature:	30 to 120°F
Thermal Errors:	± 1%/50°F

MECHANICAL

Weight:	1 lb. 10 oz.
Span & Zero Adjustments:	Protected potentiometers, externally accessible.
Pressure Connections:	⅛-27 NPT female

STANDARD ACCESSORIES

Mounting ring
Snap ring
(4) 6-32 x 1-1/4 screws (panel mtg.)
(3) 6-32 x 5/16 screws (surface mtg.)
(2) Tubing to 1/8" NPT adapters
(2) 1/8" NPT plugs
Adjustment key

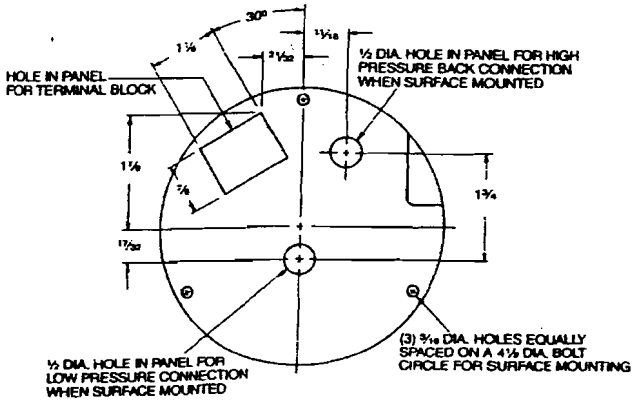
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360 U.S.A.
Telephone: 219/879-8000
Fax: 219/872-9057

INSTALLATION

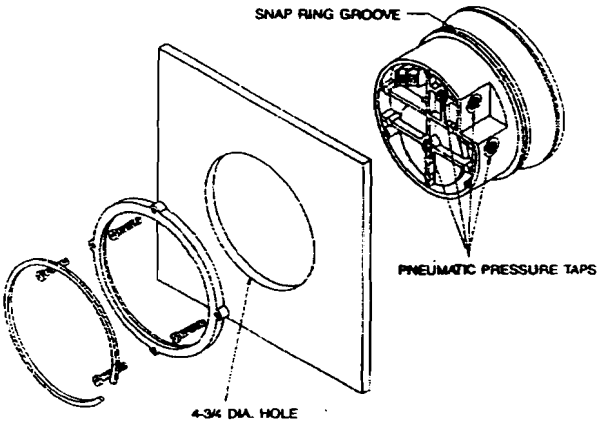
1. **LOCATION:** Select a location where the temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tubing feeding pressure to the instrument can be run practically any length required but long lengths will increase response time slightly. Avoid surfaces with excessive vibration.

2. **POSITION:** All standard models are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If your application requires mounting in other than a vertical position, be sure to specify this when ordering.

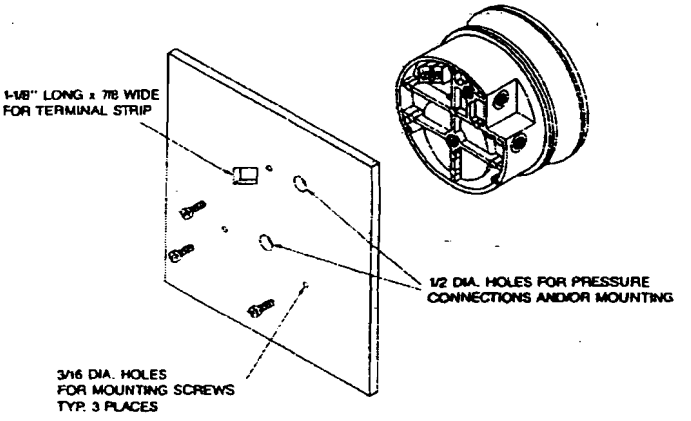
3. **PRESSURE CONNECTIONS:** For convenience, two sets of 1/8" NPT female ports are available. Plug the unused set with pipe plugs provided. Attach tubing from positive pressure source to port marked "HI" or from negative (Vacuum) source to port marked "LOW". In either case, opposite port must be vented to atmosphere. In dusty environments, we recommend use of an A-331 Filter Vent Plug to keep interior of instrument clean. For differential pressures the higher source is connected to the "HI" port and lower to the "LOW" port.



4. **MOUNTING:** The Series 605 Transmitter may be either panel mounted or surface mounted.



A. **PANEL MOUNTING:** Cut a 4¾" or 120mm dia. hole in panel and insert the complete unit from the front. Slip on the mounting ring and install the split snap ring in the groove on the bezel. Seat the mounting ring against the snap ring and thread the four screws through the tapped holes. Tighten screws against rear of panel.



B. **SURFACE MOUNTING:** Drill (3) 3/16" dia. holes for mounting screws and cut (1) 7/8" x 1-1/8" hole for access to terminal strip as shown in hole location drawing. Insert screws from rear of panel and thread into tapped holes on back of transmitter case. If rear pressure connections are to be used, make 1/2" dia. holes located as shown in hole location drawing in left column.

5. **ZEROING:** Once gage/transmitter is mounted in its final position, check to be sure pointer aligns with zero on scale, when no pressure is applied and both low and high pressure ports are vented to atmosphere. To adjust, turn small slotted screw at center-bottom of gage face. Do not move the larger black knobs labeled SPAN and ZERO. These are for use only if a calibration check shows the 4-20 mA output signal to need adjustment. See page 3 under heading OUTPUT RANGING.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 605 Transmitter are made to the two-screw terminal strip on the rear of the case. Polarity is indicated by + and − signs stamped on side. The schematic diagram of the Series 605 transmitter is illustrated in Figure B.

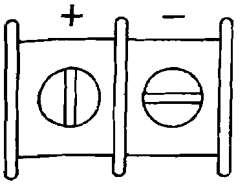


FIG. A

An external power supply delivering 12.3 to 35 VDC with a minimum current capability of 40 milliamps must be used to power the control loop in which the Series 605 transmitter is connected. Refer to Fig. B for connection of the power supply, transmitter and receiver. The range of appropriate receiver load resistances (R_L) for the power supply voltage available is given by the formula and graph in Fig. C. Shielded two wire cable is recommended for control loop wiring and the negative side of the loop may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient. Should polarity of the transmitter or receiver be inadvertantly reversed, the loop will not function properly but no damage will be done to the transmitter.

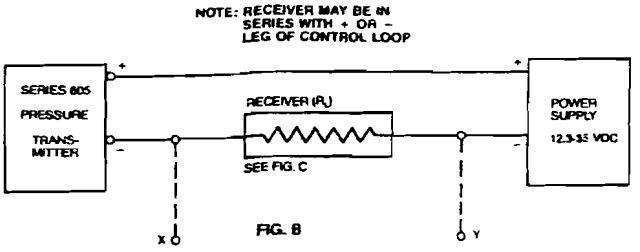


FIG. B

The maximum length of connecting wire between the transmitter and the receiver is a function of wire size and receiver resistance. That portion of the total current loop resistance represented by the resistance of the connecting wires themselves should not exceed 10% of the receiver resistance. For extremely long runs (over 1,000 feet), it is desirable to select receivers with higher resistances in order to keep the size and cost of the connecting leads as low as possible. In installations where the connecting run is no more than 100 feet, connecting lead wire as small as No. 22 Ga. can be used.

The Series 605 transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, ½ watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (−) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 r, ½ watt, ± 1% tolerance metal film resistor which is adequate for this application.

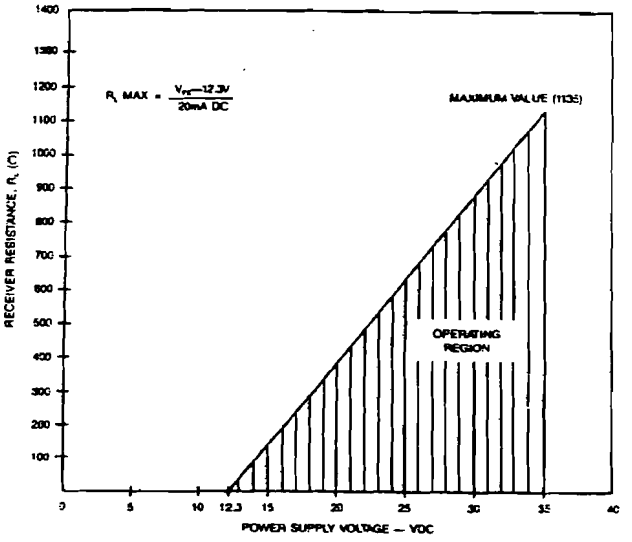


FIG. C

OUTPUT RANGING

Each Series 605 Magnehelic® indicating transmitter is factory calibrated to produce 4 mA at zero scale reading and 20 mA at full scale reading. The following procedure should be used if the pressure versus output signal relationship needs to be checked.

1. With unit connected to the companion receiver per preceding instructions, insert an accurate milliammeter with a full scale reading of approximately 30 mA in series with the current loop.
2. Vent both pressure ports to atmosphere and, if necessary, adjust pointer zero screw to align pointer with zero on scale. A controllable pressure source capable of reaching the full scale range should be connected to either high pressure port. Plug the other high pressure port and vent one or both low pressure ports to atmosphere. The instrument must be ranged in the same position in which it will be used. Standard factory calibration and ranging is done with unit vertical.
3. Apply electrical power to the system and check for proper operation by slowly increasing pressure and observing whether the loop current increases above the 4 mA zero pressure reading.
4. A spanner type key is supplied to adjust span and zero. This helps to reduce unauthorized tampering. Apply pressure until pointer aligns with full scale reading and adjust the SPAN knob for a 20 mA reading.
5. Relieve all pressure, allow a few seconds for settling and adjust the ZERO knob for a 4 mA current loop reading.
6. The SPAN and ZERO controls are slightly interactive so steps 4 & 5 should be repeated a few times until readings of 4 and 20 mA are obtained consistently.
7. Remove the milliammeter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE UNITS WITH COMMON POWER SUPPLY

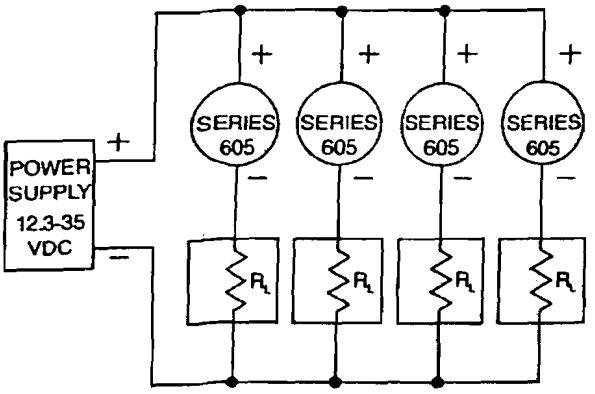


FIGURE D

Several Series 605 transmitters can be operated with a single power supply as depicted above in Figure D. Be careful to specify a supply with sufficient capacity. The minimum current requirement at a given voltage can be calculated by multiplying the number of units x 20 mA. In the example shown this would be 4 x 20 or 80 mA minimum.

MAINTENANCE

Upon final installation of the Series 605 Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 605 Differential Pressure Transmitter is not field serviceable and should be returned to the factory if service is required. The A-701 Digital Readout should be returned to the manufacturer if service is required. Refer to the A-701 instruction sheet.

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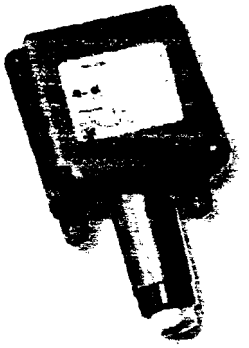
FR NO. 01-440559-00

DWYER INSTRUMENTS, INC.
P.O. Box 373 • Michigan City, Indiana 46360-0373 USA
Phone: 219/879-8000 Fax: 219/872-9057

Section 3-I

Air Stripper Blower Pressure Switch (PSL-313)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction



100 Series Pressure Switch

Types H100, H100K (Differential Pressure)

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

BEFORE INSTALLING, CHECK THE SENSOR MODEL SELECTED FOR COMPATIBILITY TO THE PROCESS MEDIA IN CONTACT WITH THE SENSOR AND WETTED PARTS.

The H100 and H100K differential pressure switches are activated when a bellows, diaphragm or piston sensor responds to a pressure change. This response, at a pre-determined set point, actuates a single snap-acting switch, converting the pressure signal into an electrical signal. Control set point may be varied by turning the internal adjustment hex. (See Adjustment -PART II).

PROOF PRESSURE* LIMITS STATED IN THE LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED, EVEN BY SURGES IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO PROOF PRESSURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD NOT EXCEED THE DESIGNATED OVER RANGE PRESSURE.

*Proof Pressure

The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage (e.g., start-up, testing). The unit may require re-gapping.

Part I - Installation

Tools Needed

Adjustable Wrench
Screwdriver
Hammer (for alternate wire knockouts)

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE. IF UNIT IS BEING INSTALLED WHERE HEAVY CONDENSATION IS EXPECTED, VERTICAL MOUNTING (PRESSURE CONNECTION DOWN) IS REQUIRED. DO NOT MOUNT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

Controls may be mounted and operated in any position. They may be surface mounted via the two mounting ears on either side of the enclosure, or directly to a rigid pipe by using the pressure connection. Low pressure and differential pressure units, models 520-535, 540-543, 544-548, are also available with an optional surface mounting bracket. Should the control be installed where condensation is expected, vertical mounting is recommended as a means of keeping water away from switch terminals.

Never use the enclosure for leverage to hand tighten the pressure connection. Always use a wrench to tighten the pressure connection to the pipe.To prevent damaging the pressure sensor, use a back-up wrench to hold the hex nut in place when surface mounting.

On models supplied with an external manual reset button, be sure to leave sufficient finger space over the reset button for the operator to reset the control. See Mounting Diagram.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATES SHOULD NEVER BE EXCEEDED. OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Remove the two screws retaining the cover and cover gasket. Two cast-in knockouts for 1/2" conduit are located on the side and back of enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and tapping sharply with a hammer. A 1/2" NPT conduit connection is also provided on the left hand side of the enclosure. The three switch terminals are clearly labeled "common", "normally open" and "normally closed". For switches supplied with leadwires, the following color coding applies:

	Manual Reset SPDT	**DPDT (Option 1010) SWT1**	**SWT2**
Common	Violet	Violet	Yellow
Normally Open	Blue	Blue	Orange
Normally Closed	Black	Black	Red

A grounding screw and clamp (cast in symbol) is provided which meets a 35 lb. pull test. Keep the wire as short as possible to prevent interface with the plunger and the adjustable differential switch wheel, if applicable.

Part II - Adjustments

Tools Needed
5/8" Open End Wrench

SOME MODELS HAVE A TWO-PIECE, ADJUSTABLE PLUNGER. THIS FEATURE IS CHARACTERIZED BY A 3/16" HEX HEAD SCREW INSTALLED IN THE 1/4" HEX PLUNGER. THE LENGTH OF THIS ASSEMBLY IS ADJUSTED AT OUR FACTORY AND IS CRITICAL TO THE FUNCTION OF THE CONTROL.

H100 and H100K

Remove pressure switch cover. Loosen Phillips screw adjustment lock. Adjust set point by turning 5/8" hex adjustment screw clockwise (in) to raise set point, or counter clockwise (out) to lower set point. Tension on adjustment screw can be increased by tightening adjustment lock onto it. (See diagram 1). Controls include uncalibrated reference scales for high, low or mid range settings.

Adjustable Differential Models

Model 15623 and control types with option code 1519 incorporate a snap switch with internal adjustment wheel. Turning this wheel raises or lowers the pressure rise set point. The fall set point remains constant. Consult factory for additional information.

Manual Reset Button

Control types with option code 1530 incorporate a snap switch which when actuated, remains actuated until the pressure drops sufficiently to allow the reset button (located on top of the control) to be manually depressed to reset the switch.

Gapping

1) Loosen adjustment lock.
2) Turn 5/8" hex adjustment screw in, to approximately mid range. This puts a load on the sensor and exposes the plunger flats. Using a 1/4" wrench on the plunger and a 3/16" wrench on the plunger hex screw, turn hex screw out from plunger until switch actuates. If switch is already actuated, turn plunger hex screw in, until switch deactuates. Turn hex screw in from this point. (See chart 1 for Flats and approximate Gap.)
3) Check set point according to Part II Adjustments.
4) Connect wires and replace cover securely.

Models	Flats	Approx. Gap
171-174	2-2 1/2	.0085 to .0105"
183-194	1-1 1/2	.004 to .006"
483-494	1-1 1/2	.004 to .006"
358-376	5-6	.020 to .025"
700-706	3 1/2 - 4	.014 to .017"
521-525	2-2 1/2	.0085 to .0105"
531-535	2-2 1/2	.0085 to .0105"
540-548	2-2 1/2	.0085 to .0105"
560-567	1-1 1/2	.004 to .006"
15623	5-6	.020 to .025"

Chart 1

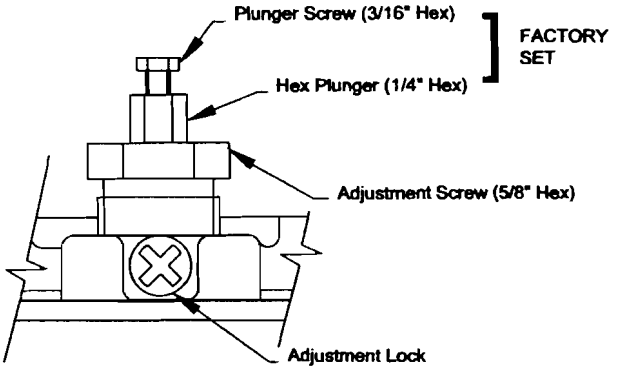
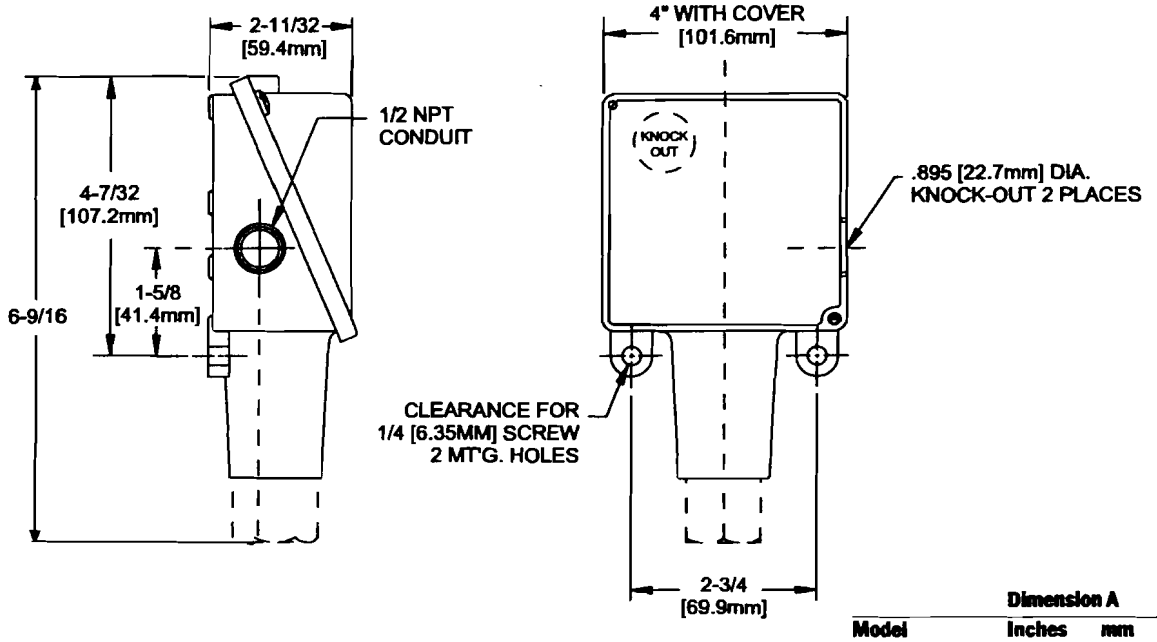
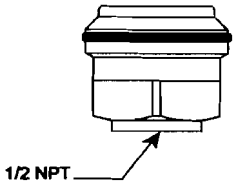


Diagram 1

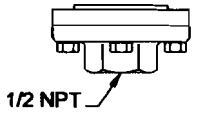
Dimensions



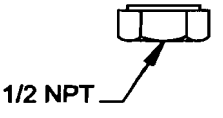
Model	Dimension A Inches	mm	NPT
171-174	7.50	190,5	1/2"
183-186	7.56	192,0	1/2"
188,189	6.62	168,1	1/2"
190-194	6.63	168,4	1/2"
218-274	6.56	166,6	1/4"
358-376	7.03	178,6	1/4"
483-486	7.56	192,0	1/2"
488,489	6.62	168,1	1/2"
490-494	6.63	168,4	1/2"
520-525	8.44	214,4	1/2"
530-535	8.00	203,2	1/2"
540-548	8.34	211,8	1/8"
560-564	6.62	168,1	2" Sanitary fitting
565-567	6.62	168,1	1 1/2" Sanitary fitting
610-616	7.00	177,8	1/4"
680	6.97	177,0	1/4"
701-706	6.57	166,9	1/4"
15623	6.57	166,9	1/4"



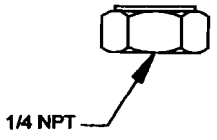
Models 171-174, 471-474



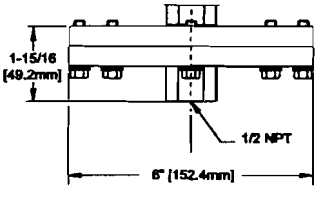
Models 183-186, 483-486



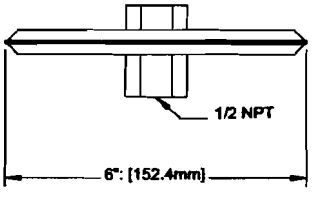
Models 188-194, 488-494



Models 218-376, 610-706, 15623

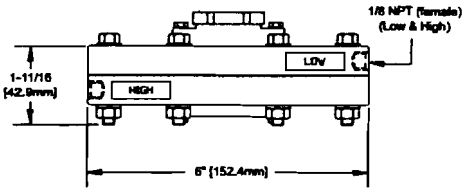


Models 520-525

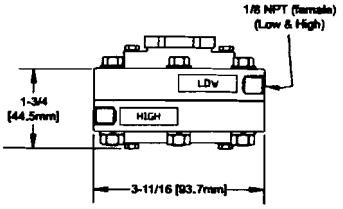


Models 530-535

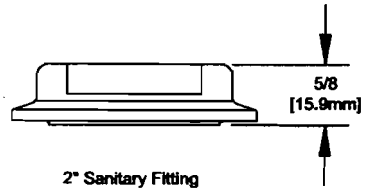
Dimensions



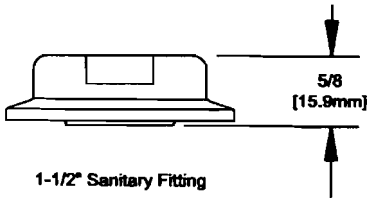
Model 540-543



Models 544-548



Models 560-564



Models 565-567

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum temperature is acceptable on a limited basis (i.e., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- For all applications, a factory set unit should be tested before use.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

UNITED ELECTRIC CONTROLS

180 Dexter Ave. P.O. Box 9143, Watertown, MA 02472-9143 USA
617 926-1000 Fax 617 926-2568
www.ueonline.com

Section 3-J

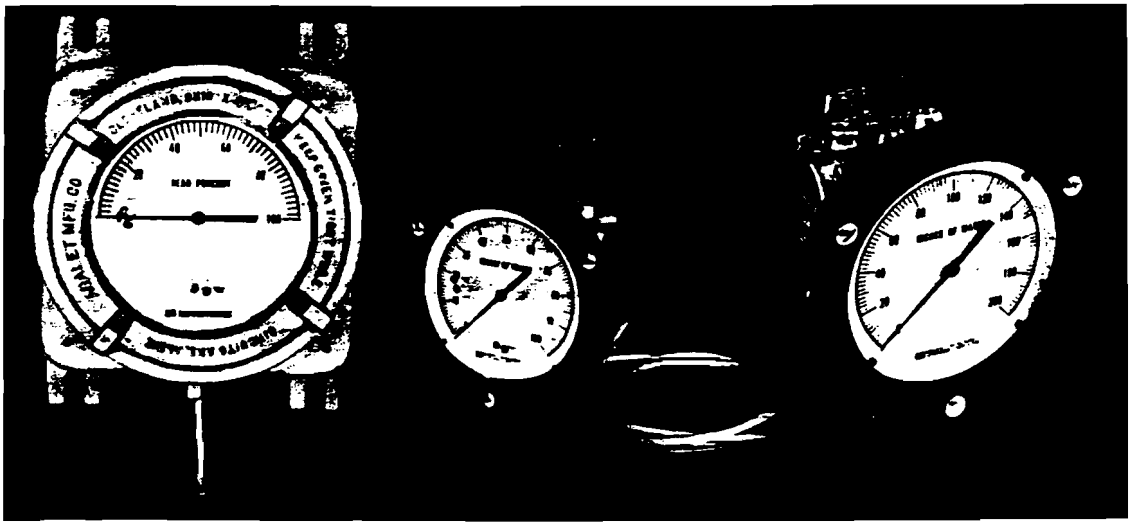
Air Filter Differential Pressure Indicator Switches (PDIS-301, PDIS-302, PDIS-303)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

FILE No. 1100:440-6

Meriam Instrument
a Scott Fetzer company
10920 Madison Avenue • Cleveland, Ohio 44102
(216) 281-1100 • FAX (216) 281-0228 • RCA212526

INSTALLATION & OPERATING INSTRUCTIONS



MERIAM SERIES 1120 BELLOWS D/P INDICATORS AND SERIES 1220 BELLOWS D/P INDICATING SWITCHES

TABLE OF CONTENTS

TERMS AND CONDITIONS OF SALE

All orders are subject to the terms and conditions contained on the face and the reverse side hereof. No acceptance by the Company of any order from buyer shall be deemed to be an acceptance of any provision of buyer's order form and the terms and conditions contained herein shall govern. Upon acceptance of buyer's order by the Company, the provisions of these terms and conditions shall apply regardless of any different or conflicting provisions in any order or other communication from buyer and shall constitute the entire agreement and understanding between buyer and the Company. No waiver or modification of said provisions shall be binding upon the Company unless set forth in a writing executed by a person duly authorized by the Company to execute the same. The provisions of any contract between the Company and buyer shall be interpreted and construed in accordance with the laws of the State of Ohio.

PAYMENT TERMS — Cash in full net thirty (30) days from invoice date. Any invoice payment forty (40) days in arrear is subject to a finance charge of 1-½% per month on the outstanding balance.

MINIMUM BILLING CHARGE — $50.00 per order or individual blanket order release.

SHIPPING TERMS — All material is sold F.O.B. Factory, Cleveland, Ohio.

CLAIMS FOR LOSS OR DAMAGE IN TRANSIT — All shipments are made F.O.B. Factory, Cleveland, Ohio. Title and risk of loss shall pass to and be borne by the buyer upon delivery of the products to the first carrier or shipper. The Company shall not be responsible for any damage to products which occur during the shipment, and no such damage shall relieve buyer of any obligation to the Company. The purchaser shall file with the transportation company for any claim for loss or damage in transit.

CARTAGE — No charge will be allowed for any cartage at destination.

PRICES — Meriam cannot be responsible for the accuracy of any prices, discounts or terms shown on customer's orders. Orders will be priced at current applicable prices and terms regardless of what might appear on customer's orders. Also, all orders will be invoiced at prices prevailing at time of shipment if the shipment is deferred or otherwise delayed at the buyer's request beyond six months from the purchase date.

TAXES — All prices are for domestic shipments and liability for all taxes, duties, imposts, revenues, excise taxes, licenses or other fees imposed upon the production, sale, shipment, or use of the Company's products or services shall be assumed and paid for by buyer, and buyer shall indemnify the Company against any such liability. Applicable sales and/or use taxes will be billed by the Company unless suitable exemption certificate is furnished by buyer at time of placing order.

SHIPMENT — The Company shall attempt to make shipment within the time specified after acceptance of buyer's order. Buyer agrees to furnish complete shipping instructions to the Company within a reasonable period of time prior to the requested delivery date. In no event shall the Company be responsible for any delay in or failure to manufacture or deliver arising out of acts of the public enemy, fire, flood, or any disaster, labor trouble, riot or disorder, delay in the supply of materials or any other cause, whether similar or dissimilar, beyond the control of the Company. In no event shall the Company be liable for any incidental or consequential loss or damage whatsoever resulting from any delay in or failure to manufacture or deliver.

CANCELLATION AND RETURNS — Orders may not be cancelled without the prior written consent of the Company. Products may not be returned without the prior written consent of the Company. Cancellation and restocking charges will be assessed to the buyer where applicable.

SPECIAL ORDERS — Orders for special items not listed in our current catalog, catalog items modified to customer's specifications and unusual quantities of standard catalog items made especially for an order are accepted only on a NON-CANCELLABLE, NON-RETURNABLE basis.

FINANCIAL RESPONSIBILITY OF BUYER — If at any time before the shipment the financial responsibility of buyer becomes impaired, or unsatisfactory to the Company, cash payment or satisfactory security may be required by the Company before shipment. Buyer will cooperate with the Company in complying with any applicable conditional sale or security law and will furnish the Company such other assurances, including financing statements, as the Company may reasonably request. If Buyer shall fail to make payments in accordance with the terms and provisions hereof, Seller, in addition to its other rights and remedies, may at its option terminate shipment hereunder or under any other contract with Buyer. In the event of bankruptcy or insolvency of buyer, or in the event any proceeding is brought by or against buyer under any bankruptcy or insolvency laws, the Company shall be entitled to cancel any order then outstanding and shall receive reasonable and proper cancellation charges.

ASSIGNMENT — No rights or obligations arising under any contract between the Company and buyer may be assigned or transferred by buyer without the prior written consent of the Company.

TENDER — In the event of failure or refusal of buyer to accept delivery, no physical tender of the products by the Company shall be necessary, but written notice of the Company's readiness and willingness to deliver any quantity of the equipment or materials at any time specified shall be equivalent to physical tender thereof.

RECORDS, AUDITS AND PROPRIETARY DATA — Unless otherwise specifically agreed in writing signed by an authorized officer of the Company, neither buyer nor any representative of buyer, nor any other person, shall have the right to examine or audit the Company's cost accounts, books or records of any kind or any matter, or be entitled to, or have control over, any engineering or production prints, drawings, or technical data which the Company, in its sole discretion, may consider to be, in whole or in part, proprietary.

LABOR STANDARDS — The Company represents and warrants that all products and services will be manufactured or furnished by the Company in accordance with all applicable standards, provisions, and stipulations of the Fair Labor Standards Act of 1938, the Walsh-Healey Act, the Work Hours Act, and Section 202 of Executive Order No. 12246 as to non-discrimination in employment, and any amendments thereto.

WARRANTY, DISCLAIMER, AND REMEDIES — Our products are warranted to conform to the applicable description in our catalog and are free from defects in material and workmanship at the date of shipment. NO OTHER WARRANTY, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL EXIST IN CONNECTION WITH THE SALE OR USE OF SUCH PRODUCTS. All claims under this warranty must be made in writing and delivered to the Company prior to the expiration of one year from the date of shipment from the factory or be barred. Upon receipt of a timely claim, the Company shall inspect the part or parts claimed to be defective, and the Company shall repair, or at its option, replace, free of charge, any part or parts which the Company determines to have been defective at the time of shipment from the factory; provided, however, that if circumstances are such as to preclude the remedying of warranted defects by repair or replacement, the Company shall, upon return of the products, refund to buyer any part of the purchase price of the products theretofore paid to the Company. Inspection may be performed at the Company's plant, and in such event freight for returning products to the plant for inspection shall be paid by buyer. The foregoing states the sole and exclusive remedy for any breach of warranty or for any other claim based on any defect in, or non-performance of, the products, whether based upon contract, warranty or negligence. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THE COMPANY SHALL UNDER NO CIRCUMSTANCES, BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE WHATSOEVER, ARISING OUT OF, OR IN ANY WAY RELATING TO, ANY SUCH BREACH OF WARRANTY OR CLAIMED DEFECT IN, OR NON-PERFORMANCE OF, THE PRODUCTS.

ASSISTANCE — We may, but shall have no obligation to furnish Buyer with recommendations, engineering and technical information and advice and other assistance. All such assistance is furnished without charge solely as an accommodation to buyer and we shall have no liability for inaccurate, incomplete or faulty recommendations, information, advice and assistance, whether or not negligent.

Meriam Instrument
a Scott Fetzer company
10920 Madison Avenue • Cleveland, Ohio 44102
(216) 281-1100 • FAX (216) 281-0228 • RCA212526

Fragile — UNPACK WITH CARE

Thank you for buying Meriam products. We appreciate your business. We have packed this shipment with care to be certain you receive what you ordered in good condition. Carefully remove all packing material and thoroughly inspect contents to be positive all items shown on the packing list are included and not damaged. Check contents for:

- Differential Pressure Indicator or Indicating Switch
- Service Manual
- Accessories supplied per customer purchase order

Precautions:

If the instrument was ordered for service in a critical medium requiring special cleaning (e.g. oxygen) remove the plastic bag only under controlled cleanliness conditions.

Your Meriam instrument was inspected during manufacture and prior to shipping. However, an inspection should be performed at the time of unpacking to detect any damage that may have occurred during shipment. If any irregularities are found:

1. Report damage to carrier.
2. Claims to trucking, express, or air carriers are to be filed by the customer.
3. Claims to United Parcel Service must be filed by Meriam.
4. Advise Meriam of damage and obtain authorization to return for repair or replacement. Do this promptly to assure coverage and avoid delay.

Thank you again for your order. If applied to designed specifications, these products will provide you with many years of service. We look forward to serving you again.

PRINCIPLE OF OPERATION

The Meriam Model 1020 Differential Pressure Unit is a proven and reliable sensing element. Available in ranges from as low as 0-30" H_2O to 0-500 PSI. It is especially adaptable where size and weight are critical factors. The light weight and compact differential pressure unit incorporates a rupture-proof and leak-proof bellows plus other construction features that make it second to none. This unit is suitable for activating indicators, recorders, transmitters, switches, and controllers and is available as a separate assembly for that purpose.

The basic D/P unit consists of a high and a low pressure bellows, both liquid filled and connected to a center plate. The bellows are enclosed in the high and low pressure end housings which in turn are bolted to the center plate. When differential pressures are applied to the high and low pressure connections, the high pressure bellows contracts forcing the fill fluid through the center plate into the low pressure bellows causing it to expand.

The resulting linear motion of the low pressure bellows is converted to a 6° rotary motion of the output shaft through a temperature compensated linkage. Overrange protection is provided by two opposed valves located on this linkage allowing the unit to withstand overranging up to the full static pressure rating of the housing without damage. The interior of the bellows and center plate are completely filled with a clean, non-corrosive, low freezing point liquid. This output shaft is part of a low friction, "O" ring sealed shaft and bearing assembly which carries the rotary motion to the external area of the bellows unit and into the instrument case.

In the Meriam bellows unit all of the fill fluid must pass through the Meriam Pulsation Dampening valve in the center plate. This valve is field adjustable so that the desired dampening effect can be obtained. Because of this Meriam design, other types of external dampening devices are not required on services involving measurement of fluctuating differential pressures. The Meriam bellows D/P unit incorporates a special design which completely isolates the process fluid from the center plate.

CONSTRUCTION SPECIFICATIONS

MODEL	1123	1124	1126	1224-1	1224-2	1226-1	1226-2	1124-P-3	*1124-P-4	1126-P-2	SERIES 1020
DIAL SIZE	3"	4½"	6"	4½"	4½"	6"	6"	4½"	4½"	6"	Basic D/P Unit For All Models
HOUSING MATERIAL & PRESSURE RATING	ALL MODELS ENDHOUSINGS: Brass; Steel; 316 Stainless Steel CENTERPLATE: Brass; Steel or Brass (1000 SWP only); 316 SS, Steel or Brass (1000 SWP only) S.W.P.: 500 or 1000 p.s.i.; 1000, 1500, 3000 or 6000 p.s.i.; 1000, 1500, 3000 or 6000 p.s.i. PROCESS CONNECTIONS: 1/4" & 1/4" NPT; 1/4" & 1/2" NPT; 1/4" & 1/2" NPT										
BELLOWS MATERIAL	ALL MODELS Beryllium Copper (30" W.C. Minimum) or 316 Stainless Steel (50" W.C. Minimum)										
MOUNTING STYLES	ALL MODELS (except 1124P & 1126P) FLUSH PANEL using indicator case for mounting — WALL or ¾" NPT using universal mounting bracket PIPE SADDLE or WALL using "H" mounting bracket and 2" U-Bolts — 2" Ell Pipe Stand										
SPECIAL FEATURES	ALL MODELS Range Variations 270° Pointer Travel, 6° Shaft Rotation Temperature Compensation for Varying Ambients Built-In Pulsation Dampening (Field Adjustable) Lo-Torque Instrument Shaft & Bearing Break-Resistant Acrylic Viewing Window Die-Cast Aluminum Case With Gasketed Cover Simple Zero, Span and Linearity Adjustment										

* Available in Brass Construction Only

PERFORMANCE SPECIFICATIONS

INDICATORS

Accuracy:
- 0 to 30" W.C. range ..... 1.50% FS
- 0 to 50" thru 0 to 500 PSID range ..... 0.75% FS
- Optional ±0.50% FS for ranges 100" W.C. to 50 PSID .... Consult Factory
- Linearity ..... Within above stated accuracy

Zero Elevation:
Maximum 100% of range

Suppression:
Maximum 15% of range with 270° pointer travel

Operating Temperature Limits ..... -60° to +200° F

Full Scale Displacement:
- 0 to 30" thru 0 to 130" W.C. range ..... .19 Cu. In.
- 0 to 135" W.C. thru 0 to 60 PSID range .... .12 Cu. In.
- 0 to 75 PSID thru 0 to 500 PSID range .... .06 Cu. In.

INDICATING SWITCHES

Accuracy	Before activation, ±¾% of full diff. At activation point, ±2% of full diff. After activation point, switch activated, ±1½% of full diff.
Linearity, Suppression & Displacement	Refer to "Indicators"
Switch Dead Band	10% of full diff. Maximum (7% nominal).
Switch Setting	Increasing 10 to 100% of differential or 10" of water whichever is greater. Decreasing: 5% or 5" of water whichever is greater. 15% of F.S. minimum between set points.
Switch Type	Snap action SPDT.
Switch Rating	5 amperes at 125 or 250 V.A.C. 3 amperes inductive or 5 amperes resistive at 30 V.D.C.

OPERATING LIMITATIONS

The One-Year Warranty of the Differential Pressure Unit will not apply if the following limitations are exceeded:

Useful Temperature:
−60°F. to +200°F.
(−35°F. with oil fill)

Pressure: Units are capable of line pressures up to the SWP stamped on the I.D. Tag (located on the bottom of the centerplate) without damage. Zero reset or recalibration may be required.

Pulsation: If the meter body is to be subjected to pulsation, make sure the externally adjustable pulsation dampener is adjusted correctly to prevent damage to the instrument. All instruments are shipped with the dampener valve 1/4 turn open. Use a screwdriver to adjust the dampener valve until the proper dampening effect is obtained. Approximately 1-1/2 turns is fully open. Severe pulsations will affect the accuracy of the instrument; when pulsation is severe, the installation of a pulsation damping device upstream of the meter run is recommended.

Vibration and Shock: Do not subject instrument to severe mechanical vibration or hydraulic shock, unless the unit has been specially ordered for such severe operating conditions.

Corrosion: The bellows of the Differential Pressure Unit are made either of beryllium copper or of type 316L stainless steel. The bellows material must be compatible with the process medium to be measured.

LOCATION

1. Locate the indicator's meter body so it will be easily accessible from ground level.
2. Select a reasonably vibration-free location where ambient temperature does not exceed operating temperature limits. Do not locate the instrument near vents or bleed holes discharging corrosive vapors or gases.
3. In Liquid Measurement (Figs. 7-9) locate the meter body below the primary element to permit entrapped air or gas to be vented into the flow line.

   For Steam and Gas Measurement (Figs. 2-7) place the meter body above the flow line to facilitate condensate draining.
4. The distance between the primary device and the DPU shall be as short as possible. For distances up to 50 feet use 1/4 inch or 3/8 inch pipe or tubing. For runs 50 to 100 feet use 1/2 inch pipe or tubing. Distances exceeding 100 feet are not recommended. The recommended distance limitation does not apply if an air-purge system is used.

MOUNTING: Refer to Pgs. 4 & 5 for dimensions.

The instrument must be approximately level for proper operation.

Wall Mtg. — Universal Bracket or 2" Pipe Saddle.

Drill four mounting holes on wall to match the "H" mounting bracket.

Secure instrument with bolts and nuts.

Pipe Mtg.

1. Universal Bracket: Place a suitable length of 3/4 inch threaded pipe into a well-secured floor or wall flange. Thread instrument onto pipe and properly orient meter with wrench or bar on meter body bracket.

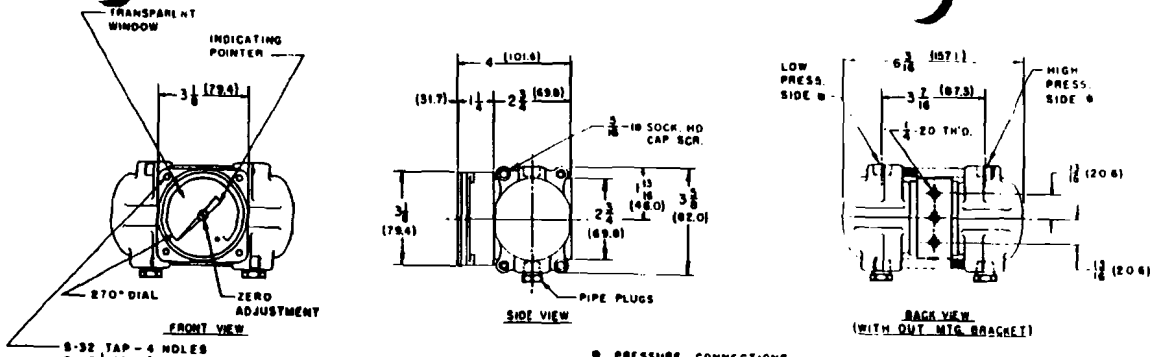
   CAUTION: Do not orient by turning or grasping the indicator case.
2. Pipe Saddle or Stand: Attach to existing 2" piping, or to a 2" pipe secured in a manner similar to (1.) above by means of the "U" bolts or Ell supplied.

Flush or Panel Mtg.

1. Remove the gauge cover and provide a hole in the panel per the mounting dimensions. Insert the gauge and install washers and retaining nuts on the four mounting bolts.
2. Orient the axes of the dial for readability and appearance and wrench tighten the retaining nuts. Replace the gauge cover to complete the installation.

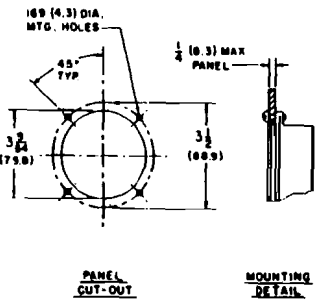
   On Models 1124 and 1224, the washers will overhang onto the panel, retaining and locking the gauge in place. If holes are felt necessary for the retaining bolts of Models 1124 and 1224, a more comcomplex cutout may be used in the panel (refer to the drawing). This cutout will also pass the DPU.

NOTE: ALL DIMENSIONS ARE IN INCHES AND (MM)
FINISH: BLACK POLYURETHANE ENAMEL ON INDICATOR HOUSING

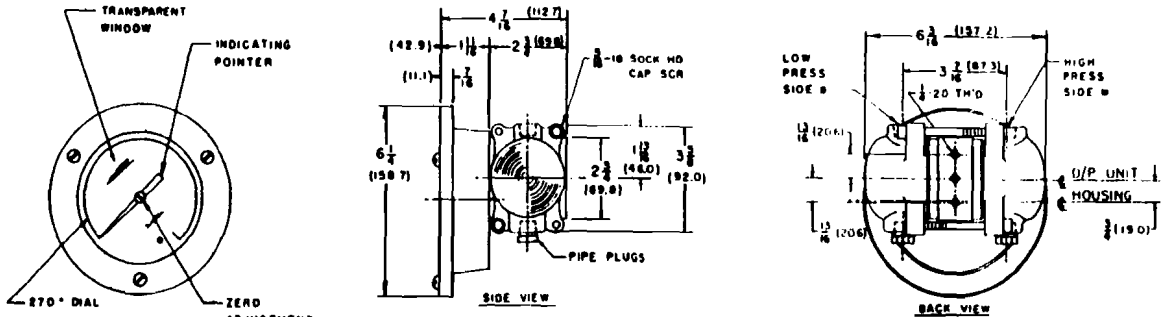


⊕ PRESSURE CONNECTIONS
BRASS UNIT: 1/4 NPT (TOP AND BOTTOM)
STEEL OR STAINLESS UNITS: 1/2 NPT (TOP), 1/4 NPT (BOTTOM)
OPTIONAL 1/4 NPT (TOP), 1/2 NPT (BOTTOM)

MODEL 1123 BELLOWS DIFFERENTIAL PRESS. INDICATOR

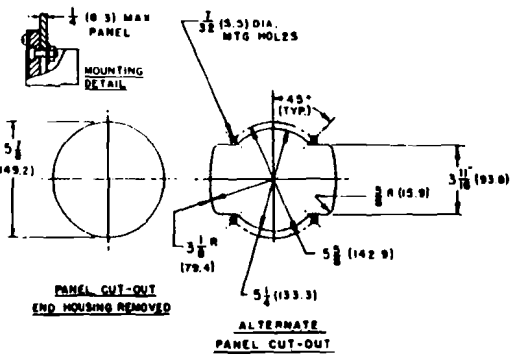


FLUSH PANEL MOUNTING

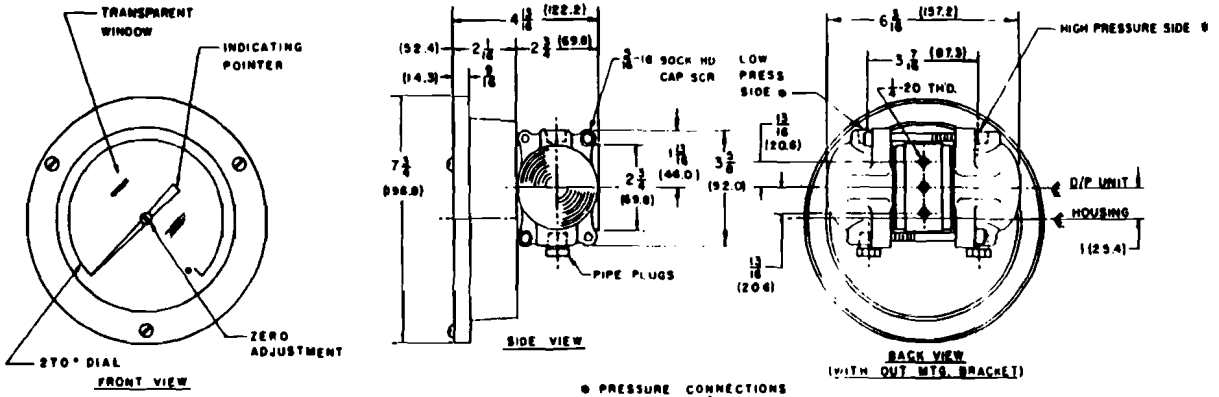


⊕ PRESSURE CONNECTIONS
BRASS UNIT: 1/4 NPT (TOP AND BOTTOM)
STEEL OR STAINLESS UNITS: 1/2 NPT (TOP), 1/4 NPT (BOTTOM)
OPTIONAL 1/4 NPT (TOP), 1/2 NPT (BOTTOM)

MODEL 1124 AND 1224 BELLOWS DIFFERENTIAL UNIT

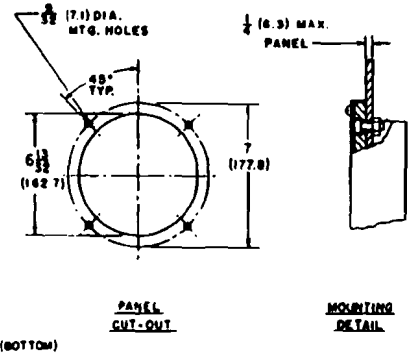


FLUSH PANEL MOUNTING



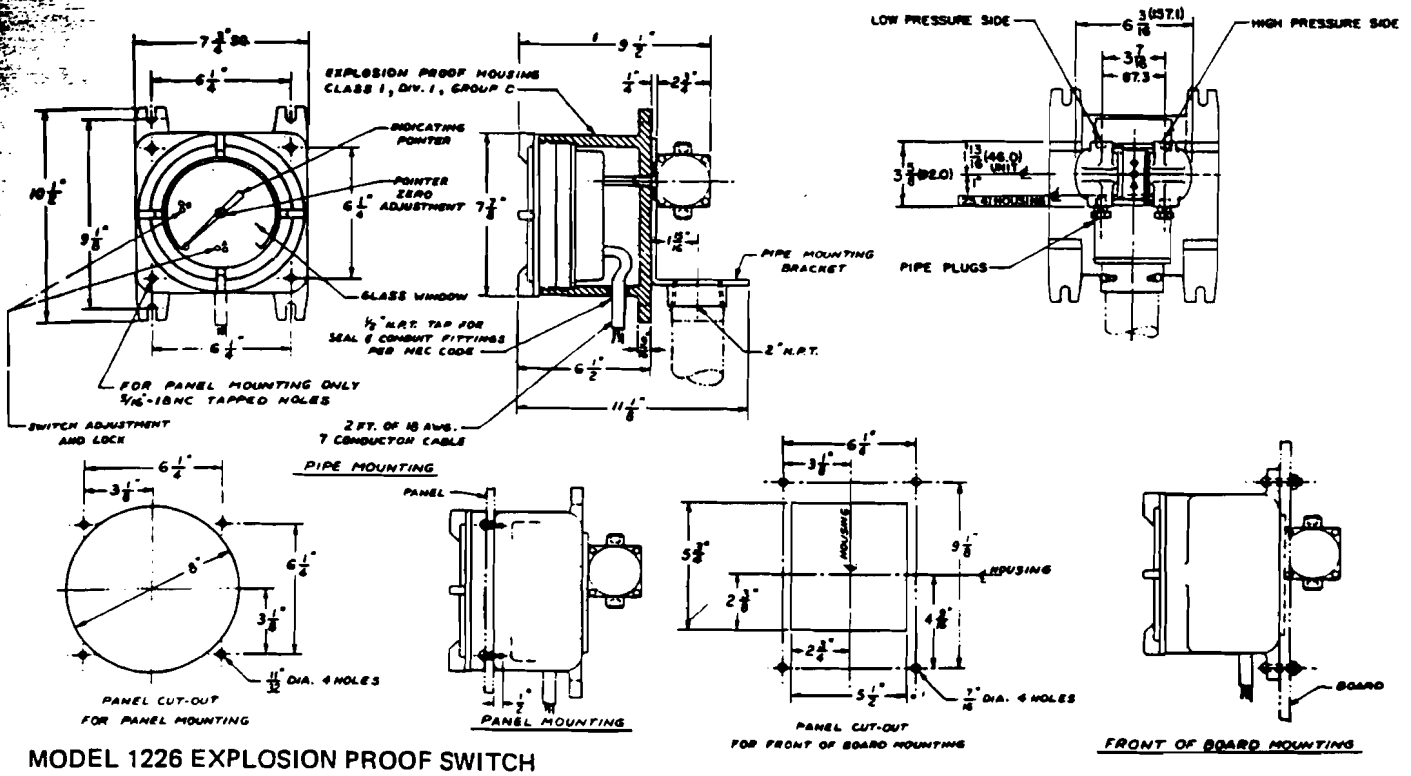
⊕ PRESSURE CONNECTIONS
BRASS UNIT: 1/4 NPT (TOP AND BOTTOM)
STEEL OR STAINLESS UNITS: 1/2 NPT (TOP) 1/4 NPT (BOTTOM) - OPTIONAL 1/4 NPT (TOP) 1/2 NPT (BOTTOM)

MODEL 1126 AND 1226 BELLOWS DIFFERENTIAL UNIT

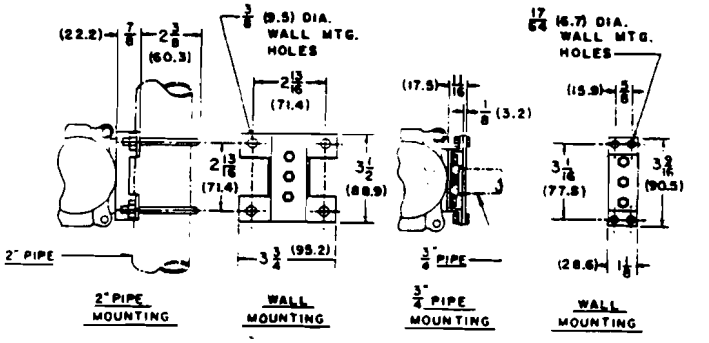


FLUSH PANEL MOUNTING

MOUNTING DIMENSIONS (Cont.)

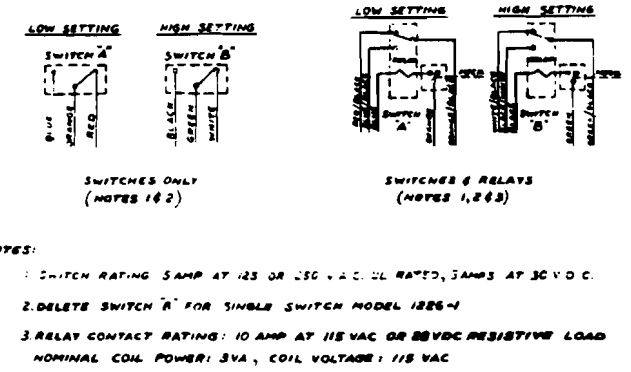


MODEL 1226 EXPLOSION PROOF SWITCH



SADDLE MOUNTING — UNIVERSAL MOUNTING

ALL MODELS



SCHEMATIC WIRING DIAGRAMS

PIPING

Refer to Figs. 2 through 15 for typical piping arrangements.

Certain practices should be followed on all flow and liquid level DPU piping:

1. Locate piping per pg. 3 "location" para. 4.
2. Make up all joints using a suitable pipe joint compound to reduce measurement errors caused by leaks in the pipe joints.
3. Slope all piping at least 1 inch per linear foot to avoid liquid or gas entrapment.
4. If process media exceeding 200° F (93° C) is to be measured, provide 2 feet of uninsulated piping between the primary device and the DPU for each 100° F (37.8° C) in excess of 200° F.
5. Install a valve manifold connecting the DPU and the differential pressure source to facilitate operation and checking of the DPU. Locate shutoff and bypass valves to be readily accessible to the operator from the front of the instrument. The shutoff valve should be the first valve from the process line or vessel.
6. Steel and Stainless Steel DPU's have two pressure connections in each housing, one ¼" and one ½" NPT. If necessary, rotate the housings 180 degrees to place the connections in the desired position.

IMPORTANT: PRIOR TO PLACING THE INSTRUMENT IN SERVICE, PERFORM THE FOLLOWING OPERATIONS:

1. Since the bellows may have taken a slight "set" due to possible extended periods of storage prior to installation, it is advised that the first time the DPU is used and prior to actual operation, the unit be exercised to ensure correct indications. To exercise the unit, sequentially apply maximum and minimum differential pressure to the high pressure side for at least ten cycles.

2. Check manifold and piping for leakage by opening the block valves, one shutoff valve, and the bypass valve to pressurize the instrument. Then close the shutoff valve and bypass valve. If pointer travels upscale, leak in low pressure piping; pointer travels downscale, leak in high pressure piping.

3. Zero check the instrument. To do this, close the block valves and open the bypass valve(s). This equalizes the pressure on both sides of the instrument. If the instrument does not indicate zero, set pointer by holding pointer hub with the screwdriver and turning pointer to zero reference.

4. Check Calibration: First zero the instrument at atmospheric pressure and connect a calibration instrument such as a Meriam 35JA10 Portable Manometer to the high pressure connection of the meter. The low pressure connection is vented to atmosphere. Turn meter valves to use flowing gas pressure, or use pressure source such as Meriam 961AB2 aspirator bulb, to apply increasing pressures of 20, 50, 80 and 100 percent of full-scale differential to the HP housing. Exercise care to <u>always</u> approach the desired scale reading from the low D/P side; if you overshoot and drop back to the reading, your calibration will be incorrect. Reverse the procedure, bleeding pressure and stopping at the same scale readings, now taking care to always approach readings from the high D/P side. Compare DPU readings with the calibration instrument.

Inconsistent readings may be the result of the pointer dragging against the scale plate. To inspect for this condition, remove the lens as described under "Complete Calibration." The end of the pointer should be no closer to the scale plate than 1/32 inch throughout its arc of travel. If necessary, bend the pointer away from the scale by gently pulling on the outer end.

If indications are within specified tolerances, no further calibration is required.

If instrument readings are outside specified tolerances, refer to "Complete Calibration".

After instrument has been checked to read correctly, replace lid and/or glass assembly.

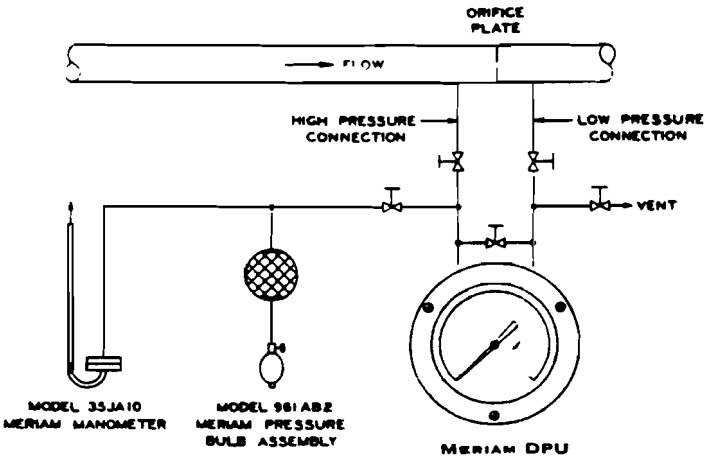


FIG. 1 Typical Schematic Arrangement For Calibration Of Bellows D/P Meter

CAUTION: Although the Meriam DPU is a seamless rupture-proof bellows type instrument, care should be taken not to subject the DPU to unnecessary shock or over-range pressure during startup.

Make sure block and bypass valves are closed when beginning start-up procedures.

METER PIPING DIAGRAMS

FIG. 2

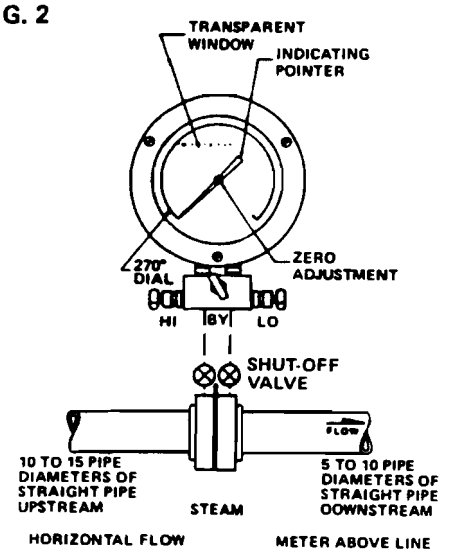


FIG. 3

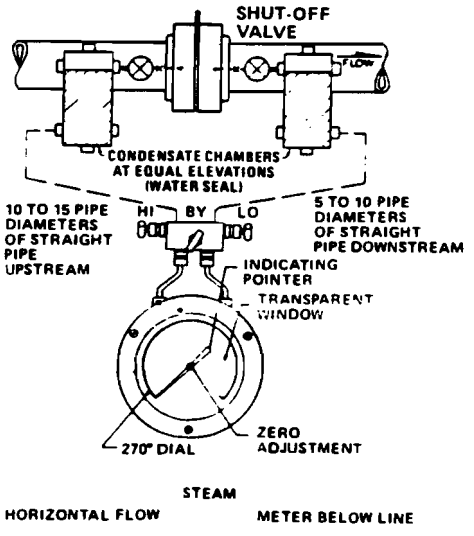
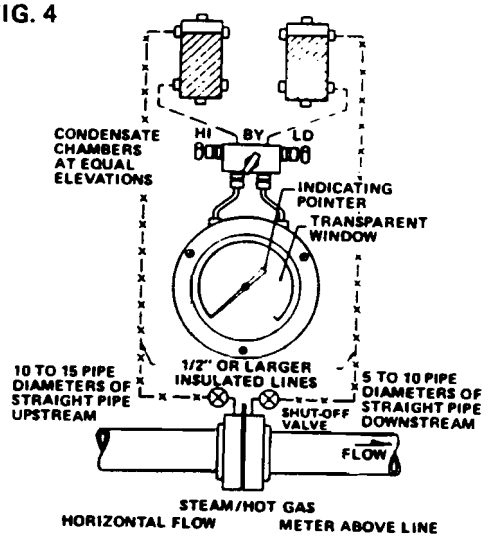


FIG. 4



Diagrams for typical and special installations are presented in Figures 2 through 15. The start-up procedure for each installation is presented with the respective piping diagram. Use the diagram most applicable to your specific requirement as a guide.

STEAM

START-UP

Recommended for use whenever possible to realize self-draining of DPU. If DPU must be located below the primary element, see Fig. 3.

CAUTION: Maximum DPU operating temperature is 200°F. For higher temperatures, see Fig. 4.

1. Whatever the location of the meter body, make all primary element taps at or near top of pipe.
2. Close block valves and vent valves (if used). Open bypass valve and shut-off valves.
3. Slowly and simultaneously open block valves, then close shut-off valves. Check for leaks (see #2 pg. 6).
4. Slowly and simultaneously open shut-off valves.
5. Close bypass valve for D/P reading.

STEAM

START-UP

Used if DPU must be located below primary element.

NOTE: To prevent overheating during instrument blowdown, monitor the temperature by placing your hand on the pipe between the DPU and the vent valves.

1. Close shut-off valves and vent valves (if used). Open bypass valve and block valves.
2. Remove side and fill plugs from condensate chambers.
3. Fill piping and meter body chambers with water by pouring into fill port in both condensate chambers to the level of the side plugs. Meter chambers and piping must be free of bubbles. When instrument and piping are completely full, pointer will rest at zero.
4. Install plugs in ports of condensate chambers.
5. Slowly and simultaneously open shut-off valves then close. Check for leaks (see #2 pg. 6).
6. Slowly and simultaneously open shut-off valves.
7. Close bypass valve for D/P reading.

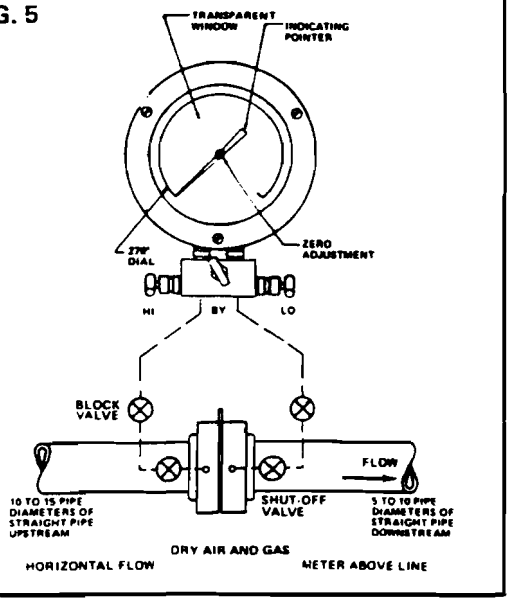
STEAM or HOT GASES

START-UP

Recommended for use when process temperature exceeds 200°F.

See "Piping" #3 pg. 5; then follow steps in Fig. 3.

FIG. 5



GASES

START-UP

Recommended for use whenever possible, as DPU is self-draining. NOT recommended when hydrates are present. If hydrates are present, or the meter body must be located below the primary element, See Fig. 6.

1. Whatever the location of the meter body, make all primary element taps at or near the top of the pipe.
2. Open manifold valves and bypass valve, open one block valve and one shutoff valve to pressurize meter.
3. Then close block valve and bypass valve and check for leaks (see "Instrument Start-up" #2, pg. 6).
4. Open bypass valve, open block valves and slowly open both shutoff valves simultaneously.
5. Close bypass valve for D/P reading.

GASES

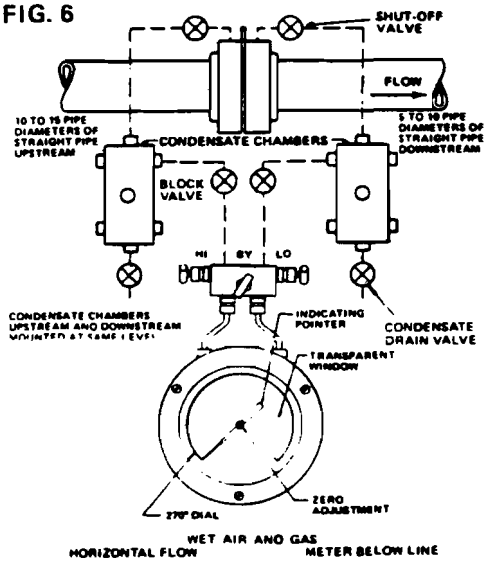
START-UP

Used if hydrates or heavy solids are present. Piping diameter not less than 1/2". Drain valves are required.

through 5. Follow steps in Fig. 5.

Drain condensate chambers of hydrates at regular intervals.

FIG. 6



CORROSIVE FLUIDS

START-UP

When the flowing medium is highly corrosive, contains solids in suspension, is highly volatile, or for some other reason would damage the meter body, install liquid or chemical seals to prevent its entering the meter body.

In selecting a location for seals:

Place as close as possible to the primary element to reduce the length of piping filled with process fluid.

On high temperature applications, locate the seal at least 36" from the primary element shutoff valves to prevent overheating.

NOTE: When measuring liquids, locate pressure taps at or near BOTTOM of pipe. Diaphragm type seals can be used in place of condensate chambers (eliminate Steps 2 through 6).

1. Close shutoff valves; open manifold valves and block valves.
2. Remove fill and side plugs from seal pots.
3. Fill seal pots, piping and meter housings with the immiscible seal fluid by pouring into upper fill ports. Meter housings, tubing and seal pots must be filled to seal pot side ports with bubble-free liquid. Pointer will indicate zero when both high and low pressure chambers are filled equally.
4. Install side plugs and close all valves.
5. Slowly open each shutoff valve alternately until bubble-free process liquid spills from upper fill port (skip this step in gas applications).

Replace fill plugs.

Check piping for leaks (see #2 pg. 6).

8. Open manifold valves and block valves, then SLOWLY open both shutoff valves simultaneously.
9. Close bypass valve for D/P reading.

FIG. 7

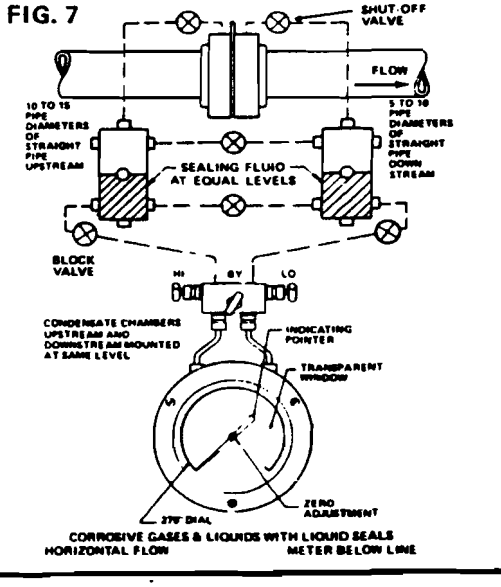
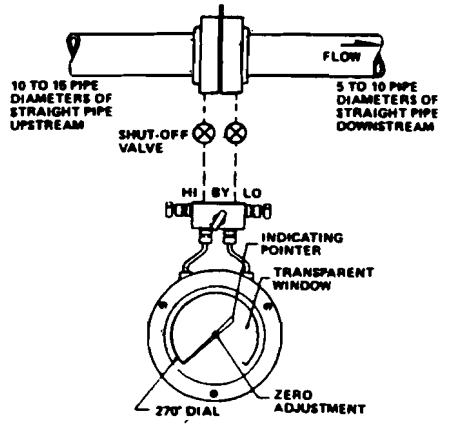
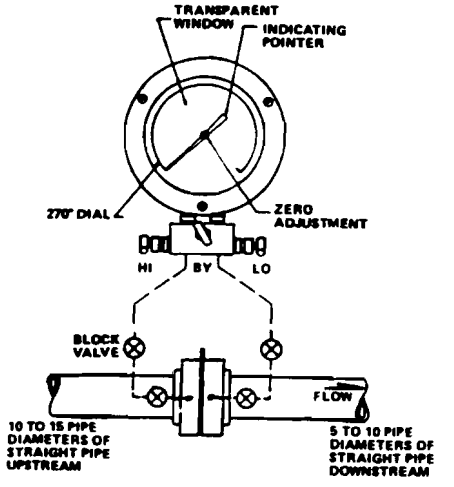


FIG. 8



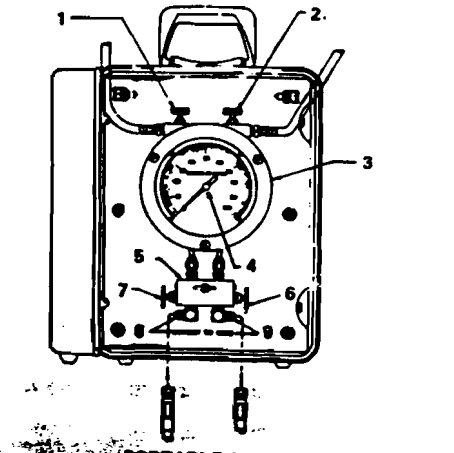
LIQUID
HORIZONTAL FLOW METER BELOW LINE

FIG. 9



LIQUID
HORIZONTAL FLOW METER ABOVE LINE

FIG. 10



PORTABLE METER
FOLLOW APPLICABLE DIAGRAM FOR HOOK-UP

LIQUIDS

START-UP

Recommended for use in all liquid flow applications, especially volatile or gassy liquids. Make all primary element taps at or near bottom of pipe.

CAUTION: Maximum meter operating temperature is 200°F (93°C). For higher temperature media, first see "Piping" #3, page 5. With hot or gassy fluids, disconnect meter and fill both housings and piping through manifold with process fluid cooled to below 200°F, then reconnect.

1. Open block valves, bypass valve, and one shutoff valve.
2. Alternately crack drain valves (connected to lower meter body ports) until liquid, free of bubbles, spills out both ports.
3. Close both drain valves and shutoff valve.
4. Pointer should indicate zero. If not, and no leaks are detected, the housings and/or piping are not completely full of bubble-free liquid. Repeat steps 1 through 4 until pointer remains stationary at zero.
5. Open both block valves and shutoff valves; close bypass valve for D/P reading.

LIQUIDS

START-UP

Recommended for use when sediments are present or when meter cannot be mounted below line. Where sediments are NOT present, make primary element taps at or near bottom of pipe. Periodically inspect and clean instrument lines.

NOTE: Where process fluid is gassy or system is subject to numerous no-flow conditions and meter cannot be mounted below line, install automatic air bleed fittings in top meter body ports or at high point of instrument lines.

1. Open both block valves, bypass valve, and one shutoff valve.
2. Alternately crack vent valves or loosen plugs from top ports of meter body housings until liquid, free of bubbles, spills out of both upper meter body ports.
3. Close vent valves or replace plugs and close shutoff valve.
4. Pointer should indicate zero. If not, and no leaks are detected, the housings and/or piping are not completely full of bubble-free liquid. Repeat steps 1 through 4 until pointer remains stationary at zero.
5. Open both shutoff valves, close bypass valve for D/P reading.

PORTABLE METER

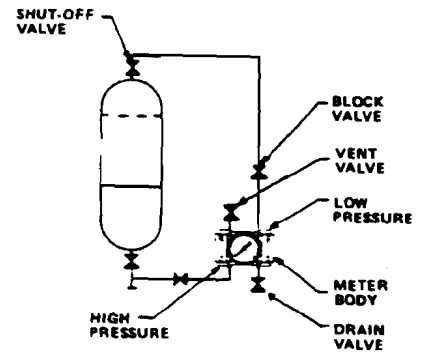
START-UP

NOTE: Hose pressure and temperature limits: Brass units — 500 psi at 160°F; Steel and SS — 3000 psi at 200°F.

CAUTION: Maximum temperature of meter body is 200°F; for higher temperatures, see "Piping" #3, page 5.

1. Place instrument with dial face vertical (or horizontal in case of 1124P-4 only). Open vent valves (1 and 2). Zero pointer as necessary; remove cover and glass (3); turn screw (4) until pointer reads zero; replace glass and cover.
2. Close vent valves (1 and 2). Open bypass valve (5). Close block valves (6 and 7).
3. Connect high pressure fitting (8) to upstream primary device tap and connect low pressure fitting (9) to downstream primary device tap using hoses provided.
4. Open valves at primary device. For gas or steam measurement, go to step 7.
5. For liquid measurement, open block valves (6 and 7) and partially open vent valves (1 and 2) until all air has been expelled from instrument and hoses.
6. Close vent and block valves, keeping bypass valve open; pointer should indicate zero; if not, air is trapped in the system. Repeat step (5), opening block valves alternately until all air is removed.
7. Open block valves, close bypass valve; read pressure differential.
8. When through with test, open bypass valve, close valves at primary device, and remove hoses.
9. Open vent valves and drain instrument hoses.

FIG. 11



TANK LEVEL NON-CONDENSING LIQUIDS
METER LEVEL WITH TANK BOTTOM

COOL LIQUIDS

START-UP

Recommended for use with water, oil, or other media which will not condense in low pressure piping. For hot (volatile) liquids, see Fig. 12.

Mount meter body centerline level with lower tank reading point. If meter is mounted below lower tank reading point, install a reference leg per Fig. 9, a bubbler system per Fig. 13, a Meriam 961C4 hand pump, or order special D/P and dial range from factory.

NOTE: Do not share fill or vapor return lines with meter piping.

1. Close all valves; open high pressure block valve and crack high pressure vent valve.
2. Slowly open bottom (high pressure) shut-off valve. When bubble-free liquid spills from high pressure vent valve, close vent valve.
3. Open low pressure block valve; slowly open top (low pressure) shutoff valve.
4. Crack low pressure drain valve to drain any condensation and reclose.

COOL or HOT LIQUIDS

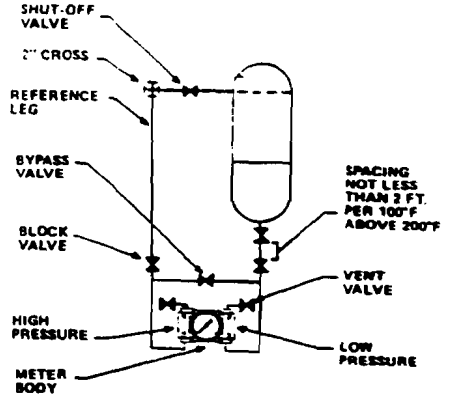
START-UP

Recommended for use to cancel out the "dead leg" (piping from tank bottom to centerline of meter body) when meter is mounted below tank. Process medium can be used as reference leg seal fluid if it will condense in the leg under all conditions. Otherwise, a non-miscible seal fluid must be used.

CAUTION: If bypass valve is opened at any time when the tank liquid level is below maximum, the reference leg must again be filled.

NOTE: Do not share fill or vapor return lines with meter piping.

FIG. 12



TANK LEVEL COOL OR VOLATILE LIQUIDS
METER BELOW TANK WITH REFERENCE LEG

COOL LIQUIDS

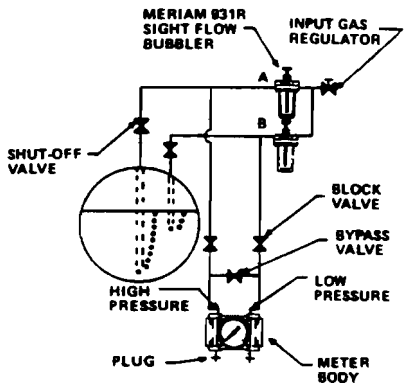
1. Partially fill reference leg by opening bottom shutoff valve, both block valves and bypass valve.
2. Crack vent valves on meter body housings; close when clear, bubble-free liquid flows out.
3. Close bypass and block valve on reference leg.
4. Remove plug from side port in 2 inch pipe cross connection used for reference level reservoir, and fill the leg by opening block valve and cracking the bypass valve until bubble-free liquid spills out.
5. Close bypass valve. Replace plug in cross.
6. Slowly open upper shutoff valve.

HOT (VOLATILE) LIQUIDS

CAUTION: Maximum meter operating temperature is 200°F. See "Piping" #3, page 5, before proceeding.

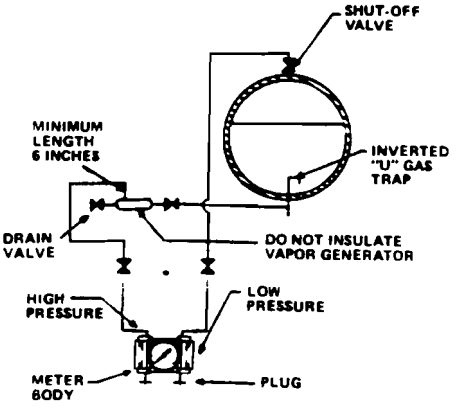
1. Close shutoff valves; open both block valves, vent valves, and bypass valve.
2. Remove plug from top port in 2" pipe cross. Use process liquid (cooled to below 200°F) or other suitable seal fluid, and fill both high and low pressure meter housings through cross until it runs out vent valves bubble-free.
3. Close HP vent valve and bypass valve. Fill reference leg and replace plug.
4. Crack LP (bottom) shutoff valve until fluid flows bubble-free from LP vent, and reclose. AVOID danger of scalding from hot liquid.
5. Slowly open both shutoff valves.

FIG. 13



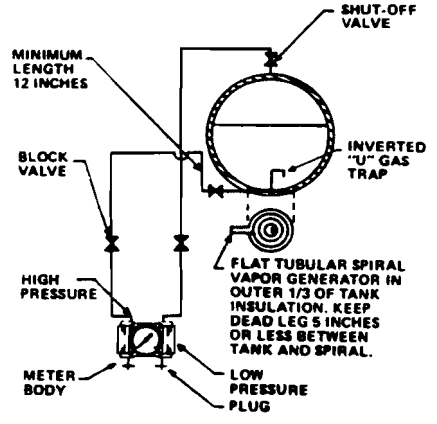
SPECIFIC GRAVITY/TANK LEVEL COOL LIQUIDS
METER INSTALLED WITH BUBBLER SYSTEM

FIG. 14



TANK LEVEL LIQUIFIED GAS

FIG. 15



TANK LEVEL CRYOGENIC LIQUIDS

COOL (NON-VOLATILE) LIQUIDS

START-UP

NOTE: Do not share fill or vapor return lines with meter piping.

SPECIFIC GRAVITY

For use to determine specific gravity changes in a process medium.

1. Set bubbler input gas regulator at a pressure slightly higher than process vessel pressure.
2. Open shutoff valves and block valves. Close bypass valve.
3. Adjust sight bubblers for equal gas flow to each tube, approximately one bubble per second. Continuous bubbling is necessary.

LIQUID LEVEL

Recommended for use whenever solids or sludge are present, or when meter must be mounted above tank bottom.

1. Delete LP sight flow bubbler (B).
2. On a pressurized tank, pipe the LP meter housing directly to upper tank connection. On a vented tank, vent the LP meter housing to atmosphere.
3. Follow steps 1 through 3 under "Specific Gravity" above.

LIQUIFIED GASES

START-UP

Recommended for use with CO_2, Butane, Propane, Freon, and other liquified gases warmer than −150°F (−101°C). Meter may be mounted above or below tank.

Vapor generator is a 12-inch length of 1" to 1-1/2" diameter pipe; avoid traps or pockets between vapor generator and tank. Install inverted "U" gas trap inside tank. Do not insulate piping below lower shutoff valve. Do not share fill or vapor return lines with meter piping.

1. Close block valves.
2. Open drain valve and loosen meter housing drain plugs to remove all liquid from system. Replace plugs.
3. Close drain valve and slowly open bottom shutoff valve to allow liquid to enter gas generator.
4. Open upper shutoff valve and block valves.

CRYOGENIC LIQUIDS

START-UP

Recommended for use with Oxygen, Nitrogen, and Argon. Meter may be mounted above or below tank. Vapor generator is a spiral of 3/8" tubing. Install an inverted "U" gas trap inside tank. Do not share fill and vapor return lines with meter piping.

CAUTION: Meters designed for use with Oxygen are specially cleaned and packaged, and MUST be kept clean. No organic compounds, oil, grease, dirt, or scale of any kind can be tolerated in an oxygen installation.

1. Close block valves. Loosen meter body drain plugs to remove all liquid from system. Replace plugs.
2. Slowly open HP (bottom) shutoff valve to allow liquid to flow through gas generator.
3. Open LP (top) shutoff valve, and open block valves.

FINAL ADJUSTMENT

It is advisable to recheck instrument zero and to test the operation of the bypass valve after the DPU has been placed in service and fully subjected to differential pressure, line pressure, and process/ambient temperature.

CAUTION: Never zero check when only one block valve is shut.

Where seal pots are used, it is possible to lose or displace some of the sealing fluid. In gas flow service, a standing wave effect in the process line can displace the indicator; the displacement could be assumed to be an erroneous reading.

1. With the meter body subjected to differential pressure and in service, observe the position of the pointer on the scale and use this reading as a reference for checking the effectiveness of the bypass valve on the meter body piping manifold.

   Close the H.P. meter body block valve. (Note that when checking instrument zero where seal pots are involved, the primary element shutoff valve is used instead of the meter body valve on the piping manifold). If the pointer moves from the reference position towards zero, the bypass valve on the piping manifold is leaking and must be replaced. If the pointer remains in the reference position, the bypass valve is functioning properly.

2. Open the bypass valve on the meter body piping manifold. The pointer should go to zero on the scale. If the instrument does not indicate zero, check for gas or liquid entrapment in the lines or in the DPU (depending on the orientation of the piping layout and service). If necessary, adjust the pointer by holding the pointer hub with a screwdriver and turning the pointer to zero reference.

3. <u>Adjustment of the Pulsation Dampener</u>

CAUTION: Never try to remove the pulsation dampener adjusting screw. Meter body fill fluid will be lost. Serious injury can result if adjustment screw is removed with the meter under pressure.

When an increase in dampening is required, as indicated by a quivering movement of the instrument pointer, turn the damping screw clockwise until the pointer just stops its oscillation. Do not over-adjust. (See "Operating Limitations — Pulsation" pg. 3) Further damping will decrease the speed of response and introduce unnecessary time lag into the measuring system. Recheck instrument zero.

TROUBLESHOOTING

If trouble occurs, it is recommended that the routine shown below in tabular form be followed:

TROUBLE	POSSIBLE SOURCES	MALFUNCTION	REMEDY
LOW OR NO INDICATION	Primary element or differential pressure source	Orifice installed backwards, or oversize.	Replace orifice, or install properly.
		Flow blocked upstream from run.	Clean out run or open valve.
		Loss of liquid in reference leg (liquid level).	Refill reference leg.
		Density changes in process medium or reference leg.	Refill reference leg with liquid of same density as process medium.
	Piping from primary element to meter	Pressure tap holes plugged.	Clean out piping.
		Piping plugged	Clean out piping.
		Bypass valve open or leaking.	Close bypass valve(s) or replace.
		Liquids or gases trapped in piping.	Vent piping.
		Block or shutoff valves closed.	Open block or shutoff valves.
		Piping leaks, high pressure side.	Repair leaks.
	Bellows unit	End housings filled up with solids restricting bellows movement.	Clean out housing.
		Gas trapped in housing in liquid service or liquid trapped in housing in gas service.	Vent or drain housing.
		High pressure housing gasket leaks.	Replace gasket.
		Meter body tampered with.	Return bellows unit assembly for repairs.
	Movement mechanism	Loose linkage arms or movement.	Tighten or replace.
		Out of calibration.	Recalibrate.
		Corrosion or dirt in mechanism.	Clean or replace.
		Pointer loose.	Tighten or replace.
HIGH INDICATION	Primary element	Orifice partially restricted or too small.	Clean out or replace.
	Piping from primary element to meter	Leak in low pressure piping.	Repair.
		Incorrect hook-up for tank level indication.	See "Meter Piping Diagrams" and "Final Adjustment".
	Bellows unit	Gas trapped in low pressure housing in liquid service or liquid trapped in high pressure housing in gas service.	Vent or drain housing.
		Low-pressure housing gasket leaks.	Replace gasket.
		Range spring broken.	Replace range spring.
		Meter body tampered with.	Return bellows unit assembly for repair.
	Movement mechanism	Loose linkage arms or movement.	Repair or replace.
		Out of calibration.	Recalibrate.
ERRATIC INDICATION	Primary element	Flow pulsating.	Adjust pulsation dampener.
	Piping from primary element to meter	Liquid trapped in gas piping or gas bubble in liquid piping.	Remove (See startup instructions).
		Vapor generator incorrectly installed.	Repipe.
		Reference leg gassy or liquid vaporizing.	See piping instructions and diagrams.
	Bellows unit	Obstructed bellows travel.	See "Meter Body Inspection and Cleaning."
		Gas trapped in high-pressure or low-pressure housing.	Remove (See "Meter Piping Diagrams").
		Loose range spring.	Tighten and adjust (See "Range Changes").
	Mechanism	Movement dragging or dirty.	Adjust and clean.
		Pointer dragging on scale plate.	Adjust.

If you have any questions not answered in this chart, contact your local Meriam Representative, or the factory direct. See listing on page 21.

MAINTENANCE

Periodic inspection and cleaning of the DPU is standard recommended practice. Recalibration, unless required because of a defective component or workmanship, is also considered a normal maintenance function.

REMOVING THE METER BODY FROM SERVICE

1. Close the H.P. primary element shutoff valve.
2. Open bypass valve in the line between the seals (where applicable).
3. Close the low pressure primary element shutoff valve.
4. Close the high pressure meter body shutoff valve on the piping manifold.
5. Open the bypass valve on the piping manifold.
6. Close the low pressure meter body shutoff valve on the piping manifold.

METER BODY INSPECTION AND CLEANING TOOLS

	Tool	Purpose
1.	Allen wrench, 1/8 in.	To remove mounting bracket
2.	Small screwdriver	Calibration adjustment
3.	Medium screwdriver	Bezel (case lid)
4.	Allen wrench, 5/64 in.	For Model 1123 (case lid and dial)
5.	Allen wrench, 3/32 in.	Calibration adjustment
6.	Allen wrench, 1/4 in.	Housing bolts
7.	Soft bristle brush	To clean bellows
8.	A 3-, 4-1/2-, or 6-in. dial, as applicable with the center cut out, showing only the numbers and graduations	Calibration
9.	Manometer or sensitive test gauge	Calibration

METER BODY INSPECTION AND CLEANING

When instruments are used in services where solids or semi-solids can accumulate, the meter body housing and bellows will require periodic inspection and cleaning. This can be performed as follows:

1. Remove meter from service and remove housing bolts.
2. Carefully and slowly remove end housings. If accumulation of material is extensive, removing the housings too rapidly can damage bellows convolutions.
3. Use a solvent, if possible, to remove accumulations from between bellows convolutions and end housings. A soft bristle brush can also be used.

   CAUTION: Do not use a sharp instrument between the convolutions.
4. After cleaning, check condition of range springs and bellows.
5. Replace end housings (new gaskets are recommended). Lubricate housings bolt threads, and secure housings. Torque end housing bolts to 60/80 in. lbs.

RANGE CHANGES

1. There is ample adjustment in the indicator linkage and movement for a range change of ±5% of the full range of the instrument.
2. Bellows assemblies with ranges from 0-30 in. W.C. to 0-139 in. W.C. range cannot be changed in the field. (Range springs are internal to the bellows.)
3. Bellows assemblies available in ranges from 0-140 in. W.C. to 0-60 PSID may be changed by changing only the range spring, providing the new range is confined between 0-140 in. W.C. and 0-60 PSID.
4. Bellows assemblies available in ranges from 0-61 PSID to 0-500 PSID may be changed by changing only the range spring, providing the new range is confined between 0-61 PSID and 0-500 PSID.
5. Calibration range of your DPU was carefully set at the factory; follow this procedure to maintain the original settings while changing the range spring. Zero the DPU, then remove the LP housing, range spring lock nut, and four retaining screws.
6. Unscrew the old range spring assembly and carefully thread the replacement assembly onto the bellows fitting. Occasionally pressing the range spring ring against its seat on the bellows isolation ring (see pg. 17 for part identification), thread the spring assembly to where, when the spring ring is against the bellows ring, the pointer indicates zero.
7. Rotate the spring assembly to align with screw holes in ring, add and tighten spring assembly lock nut, and replace four retaining screws.
8. Adjust pointer as necessary, and check calibration (see #4, pg. 6).

REPLACING BELLOWS UNIT ASSEMBLY

When removing mounting bracket, do not loosen the fill plug, which is located in the top of the bellows unit assembly. If plug is loosened, the bellows fill fluid will be lost, and the instrument warranty will be void. To replace the bellows unit assembly:

1. Remove instrument from service.
2. Remove indicator lid, glass, pointer and scale plate.
3. Loosen drive arm screw, and slip drive arm rod off the bearing shaft.
4. Remove movement mounting screws, and lift movement assembly, drive arm, and linkage from the indicator case.
5. Remove the screws securing the case to the meter body and remove case from meter body.
6. Remove end housing bolts and the end housings.
7. Carefully unpack replacement bellows unit assembly and O-rings. To reassemble, follow steps 1 through 6 in reverse.
8. After assembly, calibrate the instrument in accordance with the procedure outlined.

COMPLETE CALIBRATION

Normally, to restore an instrument to factory set tolerances, only a calibration check is required per #4 page 6.

Complete calibration may be required when the differential range has been changed, or when the meter body assembly has been replaced.

If a calibration check shows an indicator to be out of tolerance or if a complete calibration is required, remove the cover glass scale plate and pointer.

For the Model 1123, remove the cover glass, pointer and scale as follows:

1. Remove exterior face lid.
2. Remove cover glass and cover glass gasket.
3. Carefully remove pointer.
4. Using a 5/64 in. Allen wrench, remove scale retaining screws and scale.

For Series 1120 and 1220 (4½" & 6" only) remove lid, pointer and scale as follows:

1. Loosen the three lid screws and remove the face lid.
2. Carefully remove the pointer.
3. Use a 3/32 in. Allen wrench to remove dial mounting screws and scale.

At this point, the movement and all calibration adjustments will be accessible.

1. Vent low-pressure connection of meter body to atmosphere by removing the pipe plug.
2. Connect standard pressure source to high-pressure connection.
3. Apply 100 percent of full-scale differential pressure to high-pressure connection and release, to exercise bellows. Repeat exercise twice.
4. Check instrument to make sure there is no excessive play in pivots, that pivots are free of dirt, and that there are no loose screws or nuts.
5. Set movement; if movement is not clean, immerse in cleaning solution. Align movement in case by projecting a line through top left and bottom right dial mounting screws (Fig. 16, points 6 and 7) and resting extreme lower edge of brass bushing in sector gear (Fig. 16, Point 5) on that imaginary line. Proper hairspring tension is obtained by disconnecting gear sector from pinion (after unfastening movement linkage arm) and unwinding the spring (counterclockwise) approximately 1 turn; engage sector to pinion and release (pinion should rest at upper spline of sector). Refasten to linkage; point 3 should be in the center of sector slot, and point 2 should be 1-3/4 – 2" from point 1.
6. Apply 50 percent of full-scale differential pressure to the high pressure connection, with the low-pressure connection left open to atmosphere. A line connecting points 1 and 2 should be parallel to a line from thru points 3 and 4. (See Fig. 16). Alternately, a line from point 1 to 2 should be at 90° to a line from point 2 to 3. DO NOT change these angles unless they are set.
7. Install a calibration scale ring and set the indicating pointer at 50% of full scale.

   NOTE: Dials graduated for tank curve or flow (i.e., square-root scale), are furnished with dots on the dial at 20%, 50% and 80% of full-scale for calibration purposes.
8. Increase pressure to 80% of maximum differential pressure. Note if pointer is fast or slow (high or low).
9. Decrease pressure to 20%. Note if pointer is fast or slow (high or low).
10. Decrease pressure to 0. Note if pointer is fast or slow (high or low).

    NOTE: At all times that corrections are being made, pointer must be reset at 50% of range.
11. If fast at 80%, fast at 20% and above zero, adjust movement counterclockwise. If slow and below zero, rotate movement clockwise.
12. If fast at 80%, slow at 20% and below zero, move sector gear linkage (See Fig. 16, Point 2) out. If slow at 80%, fast at 20%, and above zero, move linkage in. Only very slight movements are required.
13. If indicator reads correctly at 20%, 50%, and 80% but above zero, apply more tension on the hairsprings, or adjust movement counterclockwise; if below zero, decrease tension or adjust clockwise. (Disconnect the linkage on Fig. 16 at Point 2, rotate the sector gear until clear of the pinion gear; then, by rotating the pinion gear slightly, increase or decrease the tension as needed, clockwise to increase and counterclockwise to decrease (See #5).
14. After calibration has been completed, remove pointer, calibration scale ring, and reassemble case parts. When replacing pointer, position it as close as possible to zero and make final adjustment with zero adjust pointer gear.

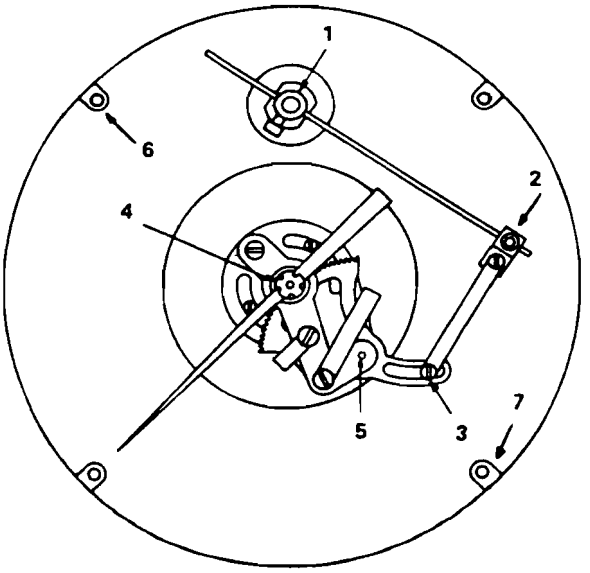


FIG. 16 INDICATOR ASSEMBLIES

SWITCH ADJUSTMENTS

NOTE: Calibrate the indicator portion of Models 1224 and 1226 separately from switches and prior to adjusting switches by disconnecting Switch Linkage Arm (#34 on Parts List page 20 at Pt. #32). After adjusting switches, reconnect linkage and check calibration.

The switches used in the Meriam switch indicator are single pole double throw. Multiple Pole Double Throw is available through the use of externally-mounted relays. The set point of the individual switch is adjustable over the span of the dial from 10% increasing and 5% decreasing (or 10" W.C. and 5" W.C. respectively, whichever is greater) to 100% scale. That is, switch A or B may be set at the high or low end of the scale to open or close on increasing or decreasing rotation of the pointer.

Two circuits can be actuated at the same point under different voltage conditions by using an external relay which in turn is activated by one switch. The open – closed mode is determined by the external wiring hookup.

The set points of both switches are adjusted by removing the indicator bezel ring and lens. The switch locking screws and adjustment screws are located in the lower left hand quadrant of the dial face.

1. Unlock the switch set point location by turning the lock screws (slotted shaft) counterclockwise; only one-half turn is needed. (See Fig. 17).

2. Apply a differential pressure across the D/P unit to indicate the desired value at which the switch is to be set.

3. Rotate the "Inc." adjustment screw next to the locking screw slowly and at the same time turn the locking screw clockwise to provide a slight friction to the adjustment screw. Continue to rotate the Inc. adjustment screw slowly until the circuit responds to the "make" or "break" of the switch.

NOTE: "Increase" rotation direction on dial means the set point will move up scale.

Only slight turning is needed; full-scale adjustment equals 1/3 turn.

If the pointer seems to hesitate and "jump" excessively at switch activation, check whether the switch arm linkage block (#36 on page 20) is within 1/2-3/4" of the meter body shaft, and adjust as necessary.

4. Lock switch in place by turning the locking screw clockwise while holding the adjustment screw in place. Decrease pressure to zero and then increase pressure slowly and observe "make" or "break" point. If the set point has changed from the desired set point, repeat steps 2, 3, and 4.
5. It may be necessary to repeat the adjustment procedure two or three times to obtain a set point at the exact desired point. However, a precise non-changing set point can be achieved when the locking screw is adjusted to apply slight friction to the adjustment screw.

6. Repeat steps 2, 3 and 4 for second switch.

7. Replace bezel and lens assembly and return instrument to service.

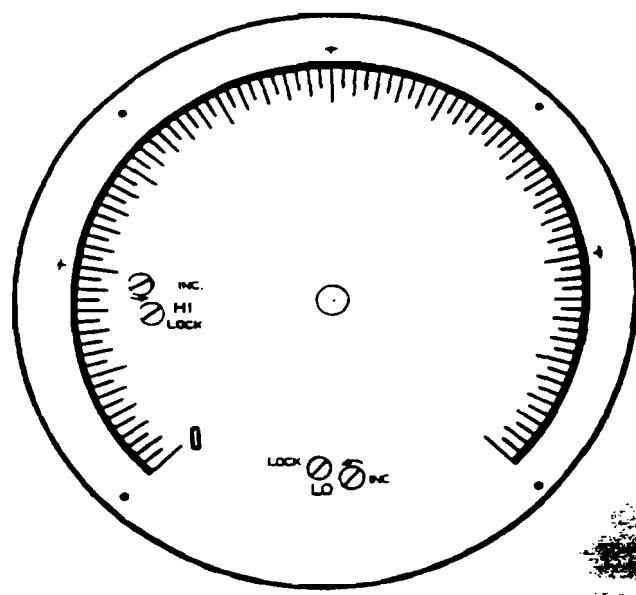


FIG. 17 SWITCH DIAL FACE

REPLACEMENT PARTS FOR MERIAM MODEL 1020 BELLOWS DIFFERENTIAL PRESSURE UNIT

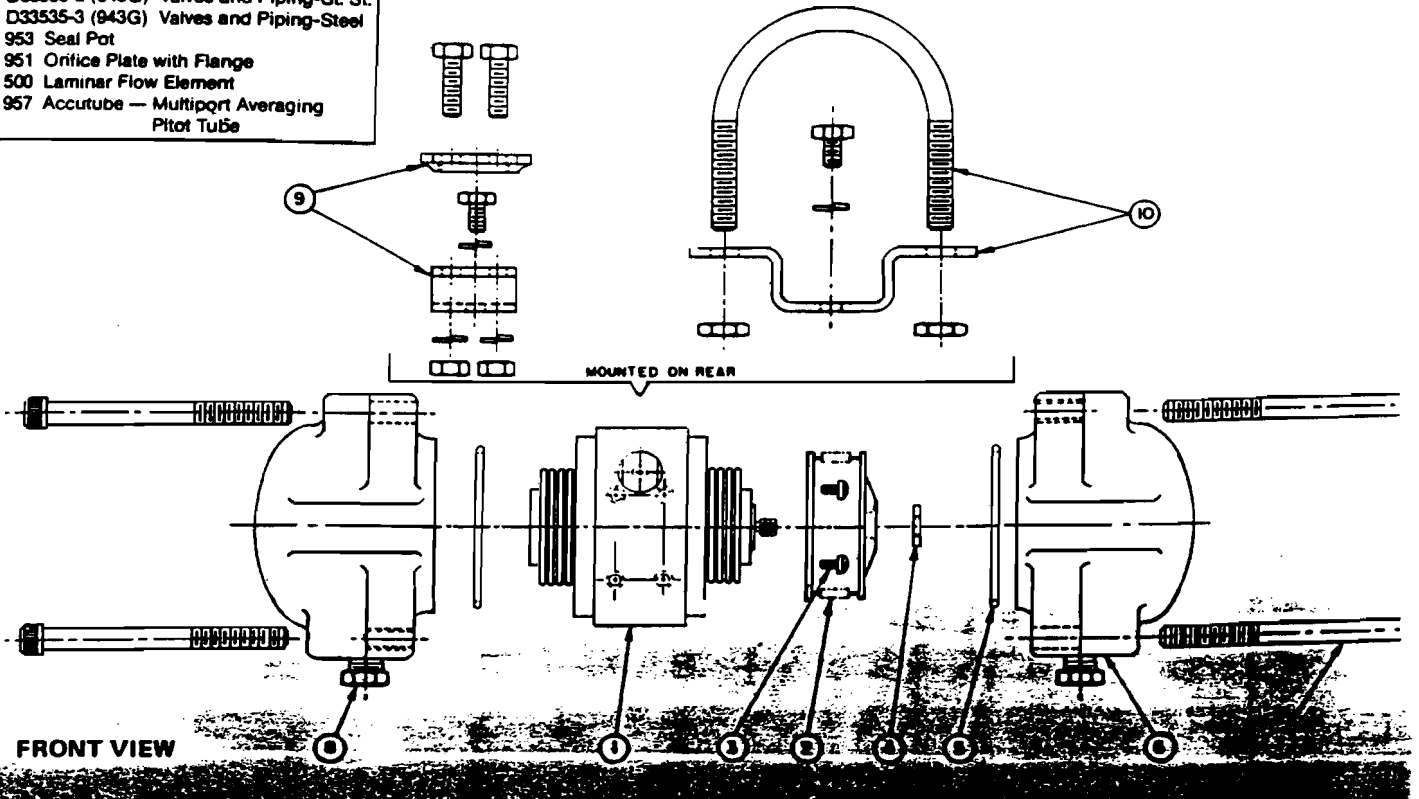
WHEN ORDERING:
SPECIFY: QTY., PART NO., D/PU SERIAL NO., RANGE, CONSTRUCTION, SWP, MOUNTING STYLE

ITEM	DESCRIPTION	QTY. REQ'D.	Brass Body PART NO.	Steel Body PART NO.	SS Body PART NO.	Monel PART NO.	NACE MR-01-75 PART NO.
1	Bellow Unit Assy.	1	CONSULT FACTORY — FILE NO. 1020:110				
2	Range Spring Assy.	1	CONSULT FACTORY — FILE NO. 1000:413				
3	Screw Range Assy.	4	C80006-17	C80006-17	C80006-17	C80006-119	C80006-119
4	Hex Nut, Range Spring	1	A1060-1	A1060-2	A1060-2	A1060-3	A1060-3
5	O-Ring, Housing	1					
	Buna-N		A50862-1	A50862-1	A50862-1	A50862-1 (STD)	A50862-1
	Viton		A50862-2 (STD)	A50862-2 (STD)	A50862-2 (STD)	A50862-2	A50862-2
	Teflon		A50862-3	A50862-3	A50862-3	A50862-3	A50862-3
	Ethylene-Propylene		A50862-4	A50862-4	A50862-4	A50862-4	A50862-4
	Neoprene		A50862-5	A50862-5	A50862-5	A50862-5	A50862-5 (STD)
6	End Housing	2					
	SWP 500BR/1000BR/ 1500/3000 STL & SS		C-51468-4	C-51468-1 C-50645-1	C-51468-2 C-50645-2	C-51468-3 C-50645-3	C-51468-2 C-50645-2
*7 (2)	Bolt End Housing						
	SWP 500BR/1000BR/ 1500/3000 STL & SS	4 8	A-50863-3 (A-50863-2)	A-50863-3 (A-50863-1) A-50710	A-50863-3 (A-50863-1) A-50710	A-50863-3 (A-50863-1) A-50710	A-51144-2 (A-51144-1) A-51150
	SWP 6000 STL & SS	4					
*8	Plug, End Housing						
	SWP 500 to 6000						
	1/4" Hex Head	2	D1560-1	D1560-2	D1560-4	D1560-6	D1560-4
	1/2" Sq. Head	2	D5118-4	D5118-2	D70136-8	D70136-17	D70136-8
9	Mounting Kit	1					
	Universal (STD)		A50505	A50505	A50505	A50505	A50505
10	Pipe Saddle		A50506	A50506	A50506	A50506	A50506
	Not Shown						
	Tank Hardware (Ryan Bracket)		A50550	A50550	A50550	A50550	A50550
	Pipe Stand		C50625	C50625	C50625	C50625	C50625

(1) Parts are listed in correct assembly sequence.
(2) Part numbers in parenthesis are for end housing bolts which bolt to center plate. These bolts changed with end housings in 1985-86.
*Recommended spare parts for two years of operation per 10 units. Combined with replacement parts for Model 1020 DPU. (See file no. 1020:460)

SUGGESTED ACCESSORIES

D33535-1 (943G) Valves and Piping-Brass
D33535-2 (943G) Valves and Piping-St. St.
D33535-3 (943G) Valves and Piping-Steel
953 Seal Pot
951 Orifice Plate with Flange
500 Laminar Flow Element
957 Accutube — Multiport Averaging Pitot Tube



REPLACEMENT PARTS FOR MERIAM 1100 SERIES
BELLOWS D/P INDICATOR

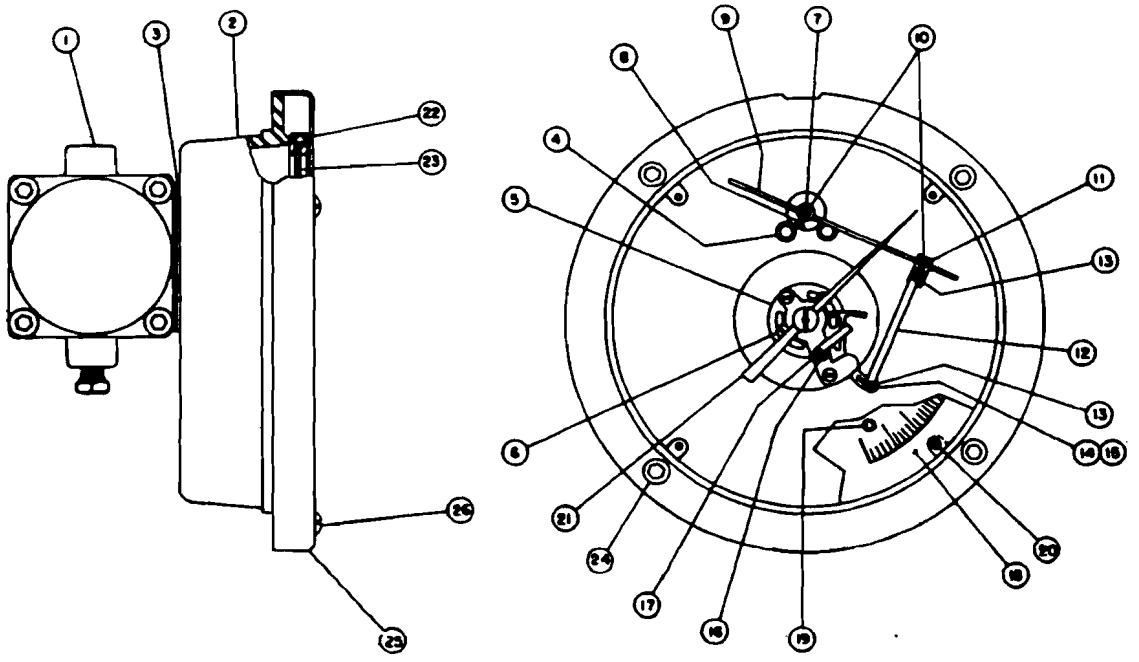
WHEN ORDERING:
SPECIFY — QTY., PART NO., D/PI SERIAL NO., RANGE, CONSTRUCTION, SWP, MOUNTING STYLE

INDEX ITEM (1)	DESCRIPTION	QTY. REQ'D.	1123 (not shown) PART NO.	1124 PART NO.	1126 PART NO.
1	Bellow D/P Unit	1	REFER TO FILE NO. 1020:460		
2	Indicator Case				
	Bracket Mounting	1	B2038-2	C50001-1	C50046-1
	Flush Panel Mounting	1	B2038-2	C50001-2	C50046-2
3	Case Mounting Gasket	1	A50085	A50085	A50085
4	Case Mounting Screws	4	A3748-2	C80012-160	C80012-160
5	Indicator Movement	1	B2074	B2074	B2073
6	Movement Screws	2	C80002-8	C80002-8	C80002-15
7	Drive Arm Boss	1	A50419	A50038	A50038
8	Drive Arm Boss Screw	1	C80012-8	C80012-8	C80012-8
9	Drive Arm Rod	1	A50342	A50337	A50045
10	Drive Arm Screws	2	C80014-92	C80014-92	C80014-92
11	Linkage Block	1	A50037	A50037	A50037
12	Movement Linkage Arm	1	A50221	A50220	A50220
13	Linkage Arm Screws	2	A3304	A3304	A3304
14	Linkage Arm Spacer	1	A3301	A3301	A3301
15	Linkage Arm Nut	1	A3302	A3302	A3302
16	Movement Stop	1	A51203	A51203	A50479
17	Stop Movement Screw	1	C80002-13	C80002-13	C80002-13
18	Aluminum Dial				
	Standard — Furnish Full Description			CONSULT FACTORY — FILE NO. 1100:461	
	Special — Furnish Full Description			CONSULT FACTORY — FILE NO. 1100:461	
19	Rubber Bumper	1	A51146	A51146	A51146
*20	Dial Mounting Screws	4	C80012-1	C80012-161	C80012-161
*21	Aluminum Pointer (STD)	1	A50450-3	A50450-4	A50450-6
OPT.	Red Set—Assy. (Incl. Window)	1	B50767	C50768	C50769
OPT	Micrometer Adjustable	1	N/A	A51180-6	A51180-6
22	Window Gasket	1	A3094	A50637	A51315
*23	Plexiglas Window	1	A50019	A3227	A50671
24	Screw for FF Mtg.	4	N/A	C80012-40	C80012-162
25	Case Cover Bezel	1	A3154-2	B2042-2	B50038
*26	Cover Screw	3	C80000-4	C80000-171	C80021-3

(1) Parts are listed in correct assembly sequence.

*Recommended spare parts for two years of operation per 10 units. Combined with replacement parts for Model 1020 DPU. (See file no. 1020:460)

SUGGESTED ACCESSORIES
D33535-1 (943G) Valves & Piping-Brass
D33535-2 (943G) Valves & Piping-St. St.
D33535-3 (943G) Valves & Piping-Steel
953 Seal Pot
951 Orifice Plate with Flange
500 Laminar Flow Element
957 Accutube-Multiport Averaging Pitot Tube

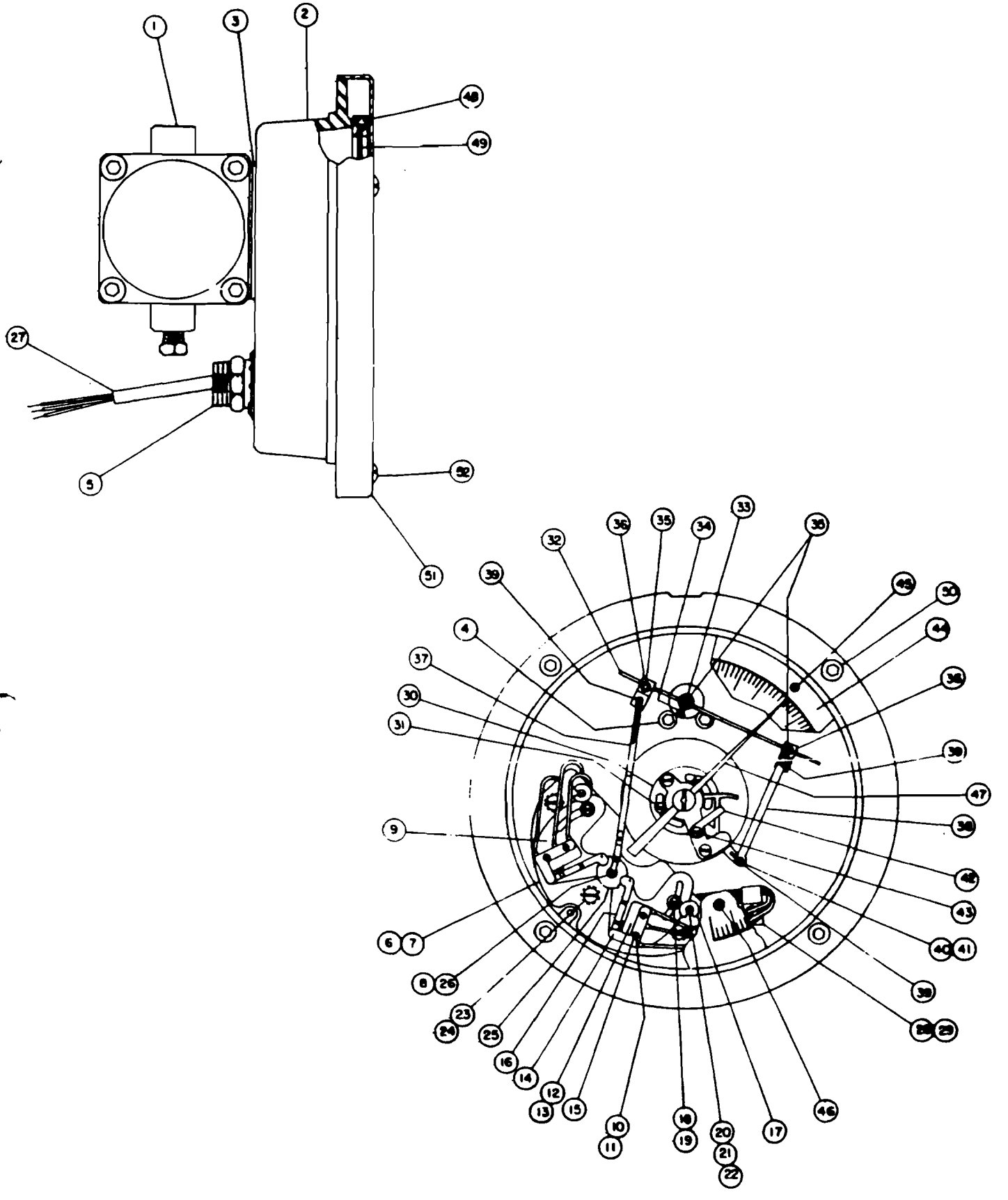


REPLACEMENT PARTS FOR MERIAM 1200 SERIES
BELLOWS D/P INDICATING SWITCH

WHEN ORDERING:
SPECIFY — QTY., PART NO., D/PI SERIAL NO., RANGE, CONSTRUCTION, SWP, MOUNTING STYLE, RATINGS

INDEX ITEM (1)	DESCRIPTION	QTY. REQ'D. (2)	1224 PART NO.		1226 PART NO.	
1	Bellow D/P Unit	1	REFER TO FILE NO. 1020:460			
2	Indicator Switch Case					
	a. Bracket Mounting	1	C50057-1		C50050-1	
	b. Flush Panel Mounting	1	C50057-2		C50050-2	
	c. Panel Mounting Screws	4	C80012-76		C80012-76	
3	Case Mounting Gasket	1	A50085		A50085	
4	Case Mounting Screws	4	C80012-160		C80012-160	
5	Box Spacer	1	A51330-1		A51330-1	
6	Switch Assembly					
	a. Single Switch-Standard	1	B50079-2		B50079-2	
	b. Single Switch-CSA Approved	1	B50079-3		B50079-3	
	c. Double Switch-Standard	1	B50080-2		B50080-2	
	d. Double Switch-CSA Approved	1	B50080-3		B50080-3	
	PARTS INCLUDED IN ABOVE SWITCH ASSEMBLIES:					
	7. Switch Sub-Plate	1	A3541-2		A3541-2	
	8. Post Adj. Sw. Plate & Cam Assy.	1	A3610		A3610	
	9. Adjustable Switch Plate	1 or 2	A3542-1		A3542-1	
	10. Microswitch Mounting Post	1 or 2	A3176		A3176	
	11. Microswitch Post Spacer	1 or 2	A3692		A3692	
	12. Insulating Barrier (CSA Units Only)	1 or 2	A50508		A50508	
	13. Micro Switch	1 or 2	A3758		A3758	
	14. Switch Holder Plate	1 or 2	A3167		A3167	
	15. Switch Holder Nut	2 or 4	C80019-1		C80019-1	
	16. Roller Arm Assembly					
	a. R.H., Low Set, Single Sw.	1	A50256		A50256	
	b. L.H., High Set, #2 Sw.	OPT.	A50314		A50314	
	17. Retaining Ring-Adj. Switch Plate & Adj. Screw	2 or 3	A50229		A50229	
	18. Switch Plate Lock Screw					
	a. Standard	1 or 2	A3547-1		A3547-1	
	b. CSA Approved	1 or 2	A3547-2		A3547-2	
	19. Threaded Brad	1 or 2	A3727		A3727	
	20. Switch Adjustment Screw	1 or 2	A3735		A3735	
	21. Adjustment Screw Spacer	1 or 2	A3736		A3736	
	22. Adjustment Scr. Tension Spring	1 or 2	A3576		A3576	
	23. Switch Sub-Plate Mtg. Screw	3	C80000-152		C80000-147	
	24. Switch Sub-Plate Spacer	3	A50042		A50042	
	25. Cam Assembly	1	A50200		A50200	
	26. Cam Screw	1	C80002-1		C80002-1	
27	Wiring Cable-Indicate Lenoth In Ft.					
	a. Std. Sheathed, Single Switch	1	B50078-1-LG		B50078-LG	
	b. Std. Sheathed, Double Switch	1	B50078-3-LG		B50078-2-LG	
	c. Separate Leads, CSA Approved	3 or 6	A51043-LG		A51043-LG	
28	Cable Clamp	1	A50515		A50515	
29	Clamp Screw	1	C80002-24		C80002-24	
30	Movement	1	B2074		B2073	
31	Movement Screws	2	C80002-8		C80002-15	
32	Drive Arm Rod	1	A50337		A50045	
33	Drive Arm Boss	1	A50038		A50038	
34	Drive Arm Screw-Boss	1	C80012-8		C80012-8	
35	Drive Arm Screw	2	C80014-92		C80014-92	
36	Linkage Block	2	A50037		A50037	
37	Adjustable Switch Linkage Arm	1	B50878-1		B50878-2	
38	Movement Linkage Arm	1	A50220		A50220	
39	Linkage Arm Screw	3	A3304		A3304	
40	Linkage Arm Spacer	1	A3301		A3301	
41	Linkage Arm Nut	1	A3302		A3302	
42	Movement Stop	1	A51203		A50479	
43	Movement Stop Screw	1	C80002-13		C80002-13	
*44	Aluminum Dial-Furnish Full Description	1				
	a. STD.-Indicate Single or Double Switch		CONSULT FACTORY — FILE NO. 1100:461			
	b. Special		CONSULT FACTORY — FILE NO. 1100:110S			
45	Dial Mounting Screws	4	C80012-161		C80012-161	
46	Rubber Bumper	1	A51146		A51146	
47	Pointer-Standard	1	A50450-4		A50450-6	
47	Pointer-Red Set Assy. & Window Optional	1	C50768		C50769	
47	Micrometer Adjustable Pointer Optional	1	A51180-6		A51180-6	
48	Window Gasket	1	A50637		A3300	
49	Plexiglass Window	1	A3227		A50671	
50	Screws for Flush Front Mtg.	4	C80012-40		C80012-162	
51	Case Cover (Bezel	1	B2042-2		B50038	
52	Cover Screw	3	C80021-3		C80021-3	
	INDICATOR PARTS NOT INDEXED		REFER TO FILE NO. 1100:460			
Not Shown	Explosion-Proof Housing, Cl. 1,	OPT.				
	Group B — Pipe Panel & Front of Board Mtg.		N/A		C50930	
	Group D — Pipe Mounting		N/A			
	— Standard				C50016-1	
	— CSA Approved				C50016-3	
	Panel & Front of Board Mtg.					
	— Standard				C50016-2	
	— CSA Approved				C50016-4	

(See next page for "Footnotes" and "Suggested Accessories".)



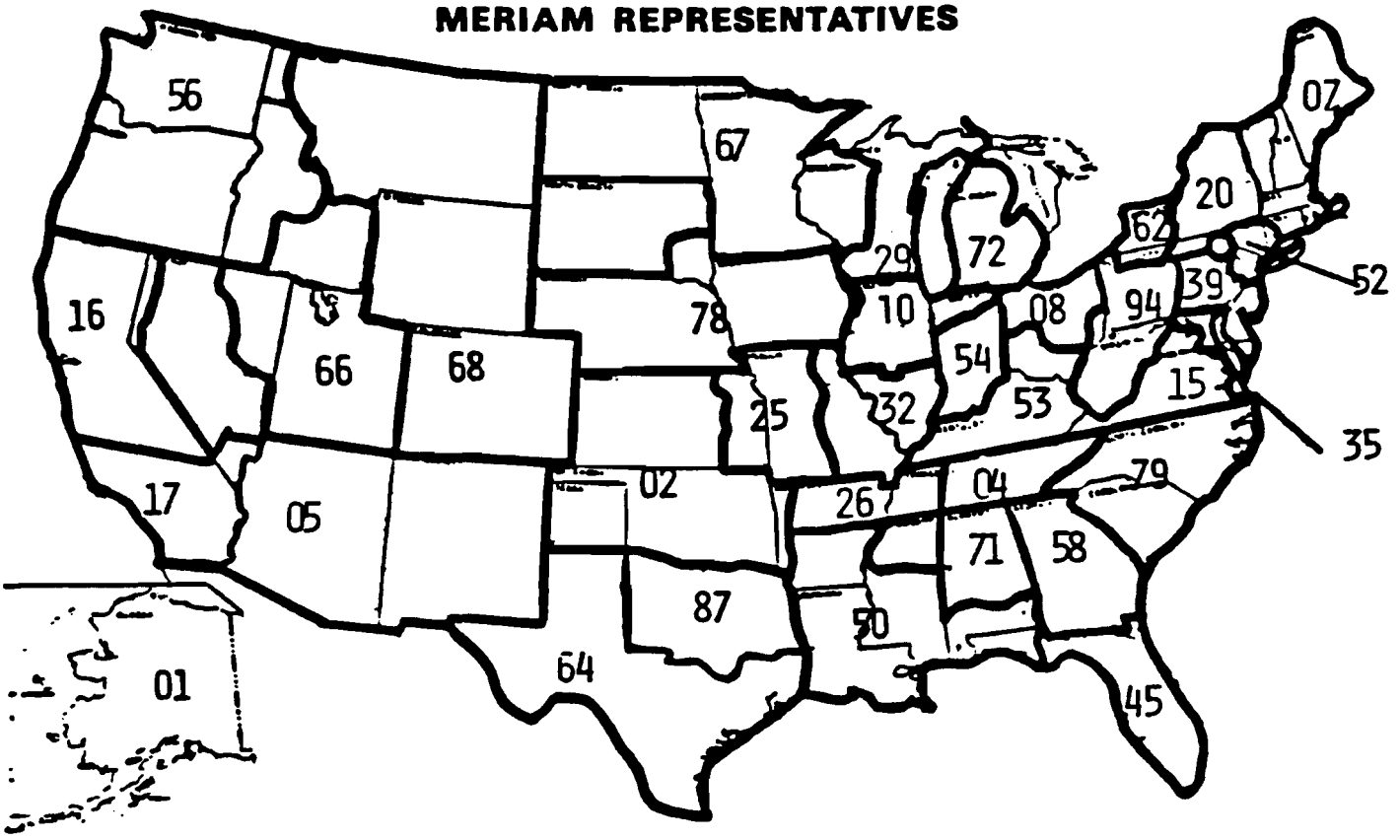
SUGGESTED ACCESSORIES
B33535-1 (943G) Valves and Piping-Brass
B33535-2 (943G) Valves and Piping-St. St.
B33535-3 (943G) Valves and Piping-Steel
953 Seal Pot
951 Orifice Plate with Flange
500 Laminar Flow Element
957 Accutube — Multiport Averaging Pitot Tube

(1) Parts are listed in correct assembly sequence.

(2) Where two quantities are listed, the lesser quantity refers to single switch units and the greater quantity to dual switch units.

*Recommended spare parts for two years of operation (per 10 units). Combine with replacement parts for Model 1020 DPU. (See file no. 1020:460)

MERIAM REPRESENTATIVES



01. ALASKA CONTROLS
Anchorage, AK
907-561-4900

02. *CANADA COMPANY
Tulsa, OK
918-622-5400

04. *AUTOMATIC CONTROL TECH
Knoxville, TN
615-966-0969

05. ARID ASSOCIATES
Scottsdale, AZ
602-947-4379

07. *BORDEWIECK ENGRG SALES
Boston, MA
617-659-4915

08. H. R. BOWERS CO.
Cleveland, OH
216-221-8442

10. *CARRIER-OEHLER CO.
Chicago, IL
312-339-8200

15. *CAROTEK, INC.
Richmond, VA
804-323-0312

16. *G. M. COOKE ASSOC.
San Francisco, CA
415-845-5110

17. *CONTROL SPECIALISTS, INC.
El Monte, CA
818-443-3294

20. DARRELL CONTROLS CO.
Syracuse, NY
315-472-8815

Albany, NY
518-489-1012

25. *ECONOMY POWER & INSTRUMENTS
LENEXA, KS.
913-469-1111

26. *ENGINEERED INSTRUMENTS
Memphis, TN
901-382-7768

29. FLOW, INC.
Milwaukee, WI
414-367-1055

32. *CARL F. GAST CO.
St. Louis, MO
314-993-2870

35. FLOW-TECH, INC.
Towson, MD
301-321-6565

39. *IVES EQUIPMENT CORP.
King of Prussia, PA
215-337-4660

45. *MALCOLM D. DUNCAN & ASSOC. INC.
Orlando, FL
305-295-2432

50. *MOODY-PRICE, INC.
Baton Rouge, LA
504-344-0511

Mobile, AL
205-666-9200

New Orleans, LA
504-393-0220

Houma, LA
504-868-9297

Lafayette, LA
318-837-3391

LaKe Charles, LA
318-436-4323

Monroe, LA
318-323-4400

No. Little Rock, AR
501-371-0909

52. *J. ARTHUR MOORE CO.
New York, NY
201-440-5600

53. *MYERS & HENLEY, INC.
Cincinnati, OH
513-772-8100

54. *NATIONAL ENGINEERING
Indianapolis, IN
317-251-1132

56. *NORTHWEST CONTROLS
Seattle, WA
206-367-2900

58. *BARNETT + COMPANY
Atlanta, GA
404-925-7150

62. *PERRY INSTRUMENTATION
Buffalo, NY
716-947-4311

Rochester, NY
716-586-7405

64. *PSA, INC.
Houston, TX
713-879-0350

Corpus Christi, TX
512-289-1711

66. *PROCESS INSTRUMENTS & CONTROLS
Salt Lake City, UT
801-262-5806

67. *R. G. READ & CO.
Eden Prairie, MN
612-934-5100

68. *ROSS EQUIPMENT CO.
Denver, CO
303-740-9400

71. *CONTROL TECHNOLOGIES
Birmingham, AL
205-988-4090

72. *SMITH INSTRUMENT & EQUIPMENT
Detroit, MI
313-755-3110

Midland, MI
517-496-9250

SMITH INSTRUMENT GRAND RAPIDS
Grand Rapids, MI
616-245-1195

78. R. S. STOVER CO.
Marshalltown, IA
515-753-5557

Davenport, IA
319-386-5676

Des Moines, IA
515-225-3763

Omaha, NE
402-339-4210

79. *SYSTEM SERVICE CORP.
Charlotte, NC
704-377-3407

Greenville, SC
803-244-9894

87. *PHILIP VICKERY CO.
Arlington, TX
817-640-4333

94. *HAROLD A. WOOLMAN CO.
Pittsburgh, PA
412-922-2420

*STOCKING REPRESENTATIVES

– NOTES –

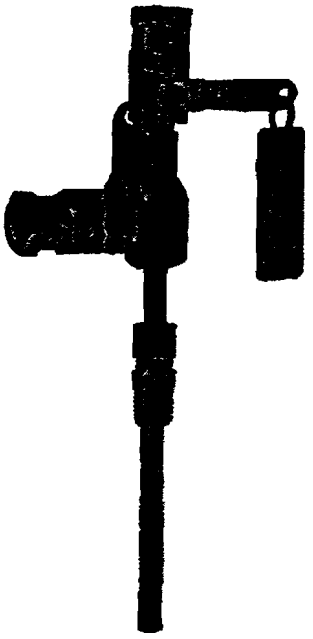
Section 3-K

Clearwell No. 1 Effluent Water Flow Rate Indicator (FE/FI-211)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

SERIES DS-300 FLOW SENSORS

Installation and Operating Instructions, Flow Calculations



INSPECTION

Inspect the sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General – The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location – The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. This will provide a flow profile as ideal as possible. A rule of thumb is to allow 10-15 pipe diameters upstream and 5 down. The table below lists recommended up and down piping:

PRESSURE AND TEMPERATURE

Maximum 200 psig at 200°F.

UPSTREAM AND DOWNSTREAM DIMENSIONS IN TERMS OF INTERNAL DIAMETER OF PIPE

*SEE NOTE #1

UPSTREAM CONDITION	MINIMUM DIAMETER OF STRAIGHT PIPE		
	UPSTREAM		DOWNSTREAM
	IN-PLANE	OUT OF PLANE	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves *See Note 2	24	24	5

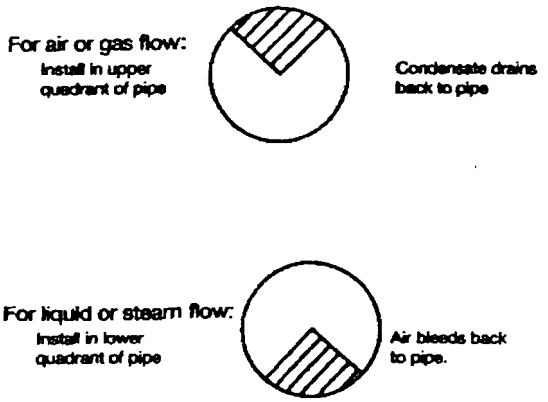
*Note #1: Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

*Note #2: Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.

POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow Sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.



INSTALLATION

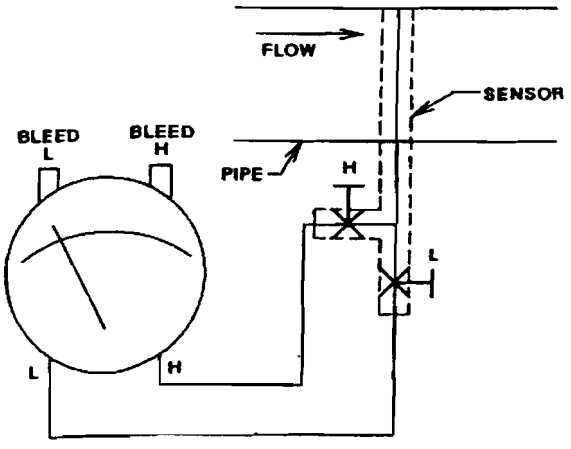
1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4"×3/8") will be needed.
2. Drill through the center of the thred-o-let into the pipe, with a drill that is slightly larger than the flow sensor diameter.
3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.
4. Insert the sensor until it bottoms against the opposite wall of the pipe, then withdraw 1/16" to allow for thermal expansion.
5. Tighten packing gland nut finger tight. Then tighten the nut with a wrench an additional 1 1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

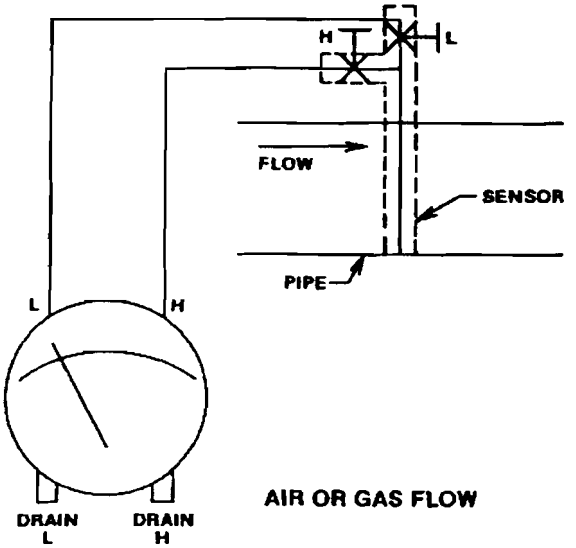
Connect the side pressure tap to the high pressure port of the Magnehelic (air only) or Capsuhelic gage or transmitting instrument and the top connection to the low pressure port. See the connection schematics below.

Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

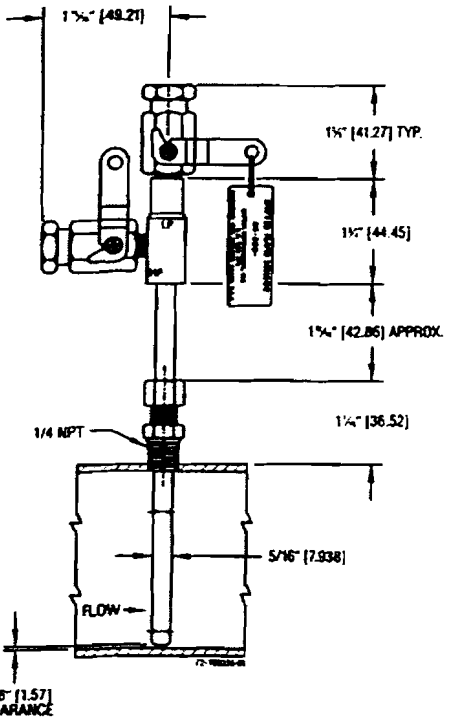


WATER FLOW



AIR OR GAS FLOW

SERIES DS-300 FLOW SENSORS



FLOW CALCULATIONS AND CHARTS

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. Where direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic or Capsuhelic gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic and Capsuhelic gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following reference is recommended: Crane Valve Co. Technical Paper No. 410 "Flow of Fluids Through Valves, Fittings and Pipe." It is available from Crane Valve Co., 104 N. Chicago St., Joliet, IL 60431. Phone 815/727-2600. Price including shipping is $20.00

Using the appropriate differential pressure equation from page 4, calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges for other gases, liquids and/or operating conditions, consult the factory.

Note the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient "K"	Operating Ranges Air @ 60°F & 14.7 psia (D/P Inches W.C.)	Operating Ranges Water @ 70°F (D/P Inches W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1¼	0.58	1.15 to 157	4.18 to 568	113 to 170
1½	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2½	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid
$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas
$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas
$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T+460) \times S_S}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid
$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas
$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas
$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_S \times (T+460)}{K^2 \times D^4 \times P \times 16{,}590}$$

TECHNICAL NOTATIONS

The following notations apply:

ΔP = Differential pressure expressed in inches of water column.
Q = Flow expressed in GPM, SCFM or PPH as shown in equation.
K = Flow coefficient — See Values Tabulated on page 3.
D = Inside diameter of line size expressed in inches. For square & rectangular ducts use $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460=°Rankin)
ρ = Density of medium in pounds per cubic foot
S_f = Sp Gr at flowing conditions
S_S = Sp Gr at 60°F

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520^\circ}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520}{460 + °F}\right)$$

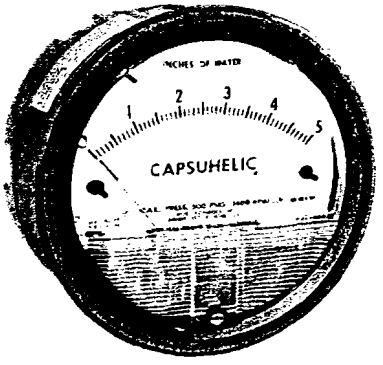
1 CUBIC FOOT OF AIR — 0.076 POUNDS PER CUBIC FOOT AT 60°F AND 14.7 PSIA

*(520 — 460 + 60°) Std. Temp. Rankine

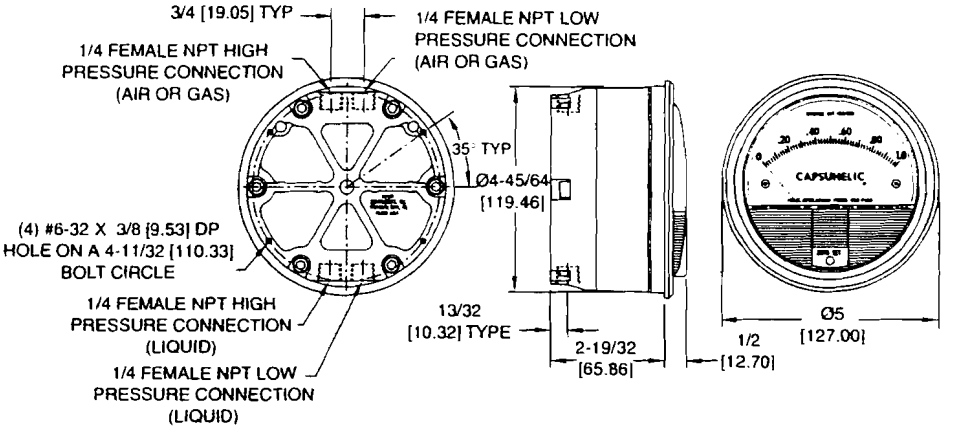
Printed in U.S.A. 6/96 FR 72-440451-01

Series 4000 Capsuhelic® Differential Pressure Gages

Measures pressure, vacuum or differential, suitable for internal pressures to 500 psig.



Capsuhelic® Pressure Gage has a large, easy-to-read 4" (102 mm) dial.



Dimensions, Series 4000 Capsuhelic® Pressure Gages.

The Capsuhelic® gage is designed to give fast, accurate indication of differential pressures. The gage may be used as a read-out device when measuring flowing fluids, pressure drop across filters, liquid levels in storage tanks and many other applications involving pressure, vacuum or differential pressure.

Using the basic design of Dwyer's time-proven Magnehelic® gage, the Capsuhelic® contains a simple, frictionless movement that permits full scale readings as low as 0.5 inch water column. The pressure being measured is held within a capsule which is an integral part of the case. This containment of the pressure permits the use of the gage on maximum pressures of up to 500 psig, even when differentials to be read are less than 0.1 inch W.C.

The diaphragm-actuated Capsuhelic® gage requires no filling liquid which might limit its outdoor applications. Zero and range adjustments are made from outside the gage, and there is no need to disassemble the gage in normal service. **NOTE: DO NOT use with hydrogen gas. Toxic and/or explosive gas may form due to reaction with rare earth magnet.**

SPECIFICATIONS

Temperature Limits: 20° to 200°F (-7° to 93°C).

Pressure Limits: -20" Hg to 500 psig (-68 kPa to 34 bar).

Standard Ranges: See facing page.

Accuracy: ±3% of full scale at 70°F (21°C). (2% on 4000S models, ±4% on 4200, 4210, 4215, 4220, 4300, 4400, and 4500).

Housing: Die cast aluminum with impregnated hard coating, standard. Optional forged brass housing is required for water or water based fluids. For corrosive gases or liquids and for special diaphragms, contact the factory.

Exterior Finish: Dark gray.

Connections: ¼" female NPT high and Low pressure taps, duplicated —one pair top for air and gas, and one pair bottom for liquids.

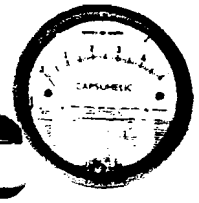
Standard Accessories: Two ¼" NPT plugs for duplicate pressure taps, four flush mounting adapters with screws and four surface mounting screws.

Dimensions: 5" (127 mm) diameter x 3⅜" (78 mm) length.

Weight: 3 lbs., 3 oz. (1.4 kg) aluminum case; 7 lbs., 13 oz. (3.5 kg) brass case.

MOUNTING

Capsuhelic® gages may be flush mounted in a panel or surface mounted. Hardware is included for either. For flush mounting, a 4⅛" diameter cutout in panel is required. Where high shock or vibration are problems, order optional A-496 Heavy Duty flush mount bracket. Optional A-610 kit provides simple means of attaching gage to 1¼"-2" horizontal or vertical pipe. Installation is same as Magnehelic® gage shown on page 5. All standard models are calibrated for vertical mounting. Gages with ranges above 5 in. w.c. can be factory calibrated for horizontal or inclined mounting on special order.

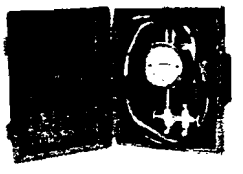


Flush mounted in panel.

Back view shows flush mounting adapters.

Back view for surface mounting.

OPTIONS AND ACCESSORIES



Adjustable signal flag — Integral with plastic gage cover; has external reset screw. May be ordered factory installed on gage or separately for field installation. Specify ASF suffix after model number. **$14.25**

A-314 bleed fitting — For easier, safer purging of trapped air when using gage with liquids. Also useful for draining condensate when installed in lower ports. To open, simply loosen hex nut. Solid brass. **6.00**

Forged brass case — For applications involving water or water based liquids. To order, add suffix "B" after model number. Example: 4205B. . . . . add **92.50**

Transparent scale overlays — Available in bright red or green to accent critical pressure zones. Specify which color and portion of scale to be covered with each. . . . . add **$12.50 net**

A-471 portable kit — Includes plastic case, mounting bracket, A-309 3-way manifold valve, (2) A-230 high pressure hoses and all necessary fittings. Assembly required. Gage not included **$323.00**

Diaphragm/Bellows design assures maintenance-free performance

Top low pressure connection *(for Air or Gas)* connects to chamber in back of diaphragm. High pressure air or gas port (cut away; not shown) connects with chamber in front of diaphragm through passageways in case.

Precision made case is offered in two materials. Standard is die cast aluminum coated inside for resistance to most oils and similar fluids. Optional forged brass case is recommended when using water or water based liquids. One case size for all pressure ranges — can be either surface or flush mounted.

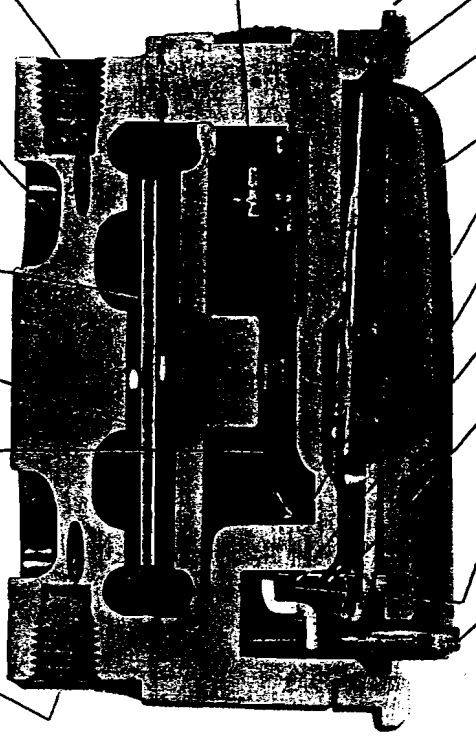
Silicone rubber diaphragm with integrally molded O-ring is sealed between the case and backplate. Diaphragm motion is restricted to prevent damage due to over-pressure.

Diaphragm support plate of stainless steel minimizes position or attitude sensitivity.

Calibrated range spring is a flat leaf of nickel plated spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length factory adjusted for calibration.

Bottom high pressure connection *(for Liquids)* connects to chamber in front of diaphragm. Low pressure liquid connection (not visible) connects with chamber in back of diaphragm through passageways in case.

Range spring calibration is set by custom camlock. Rate adjust and rate adjust lock are coaxial and are factory set and sealed.



Bezel provides flange for flush mounting in panel.

O-ring seal for cover assures dust tight integrity of case.

Clear plastic front cover is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision scale, screen printed on aluminum, is accurate and easy to read.

Samarium cobalt magnet mounted at end of range spring rotates helix without mechanical linkages.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Thin wall magnetic "window" is well braced and of minimum area for maximum pressure capability.

Jeweled bearings for helix are shock resistant mounted. They provide virtually friction-free rotation for helix. Rotation is damped with high viscosity silicone fluid.

Helix is precision milled from an alloy of high magnetic permeability, mounted in jeweled bearings, and rotates to align with magnetic field of magnet and transmit pressure indication to pointer.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "O" ring seal provides dust seal.

Patent Nos. 4,011,759
4,030,365

SERIES 4000 CAPSUHELIC® — MODELS AND RANGES

Scales reading directly in flow, heights, etc., are also available.

STOCKED MODELS in bold

Model Number	Range, Inches of Water	Price
*4000-0	0-.50	$258.00
*4001	0-1.0	258.00
*4002	0-2.0	258.00
*4003	0-3.0	258.00
*4004	0-4.0	258.00
*4005	0-5.0	258.00
4006	0-6.0	258.00
4008	0-8.0	258.00
4010	0-10	258.00
4015	0-15	258.00
4020	0-20	258.00
4025	0-25	258.00
4030	0-30	258.00
4040	0-40	258.00
4050	0-50	258.00
4060	0-60	258.00
4080	0-80	258.00
4100	0-100	258.00
4150	0-150	258.00
4200	0-200	258.00
4300	0-300	258.00
4400	0-400	258.00
4500	0-500	258.00

Model Number	Range Zero Center Inches of Water	Price
*4302	1-0-1	$265.00
*4304	2-0-2	265.00
4310	5-0-5	265.00
4320	10-0-10	265.00
4330	15-0-15	265.00

Model Number	Range PSI	Price
4201	0-1	$258.00
4202	0-2	258.00
4203	0-3	258.00
4204	0-4	258.00
4205	0-5	258.00
4210	0-10	258.00
4215	0-15	258.00
4220	0-20	258.00
†4230S	0-30	258.00
†4240S	0-40	258.00
†4260S	0-60	258.00
†4280S	0-80	258.00
†42100S	0-100	258.00
†42200S	0-200	258.00
†42300S	0-300	258.00

Model Number	Range MM of Water	Price
*4000-25MM	0-25	$258.00
*4000-50MM	0-50	258.00
4000-80MM	0-80	258.00
4000-100MM	0-100	258.00

Special Purpose Ranges

Scale No. 4401
Square Root
Specify Range

Scale No. 4402
Blank Scale
Specify Range

Model Number	Range, CM of Water	Price
4000-15CM	0-15	$258.00
4000-20CM	0-20	258.00
4000-25CM	0-25	258.00
4000-40CM	0-40	258.00
4000-50CM	0-50	258.00
4000-80CM	0-80	258.00
4000-100CM	0-100	258.00
4000-150CM	0-150	258.00
4000-200CM	0-200	258.00
4000-250CM	0-250	258.00
4000-300CM	0-300	258.00
Zero Center Ranges		
*4300-4CM	2-0-2	$265.00
4300-10CM	5-0-5	265.00
4300-30CM	15-0-15	265.00

Model Number	Range, Pascals	Price
*4000-125 Pa	0-125	$258.00
*4000-250 Pa	0-250	258.00
*4000-500 Pa	0-500	258.00
4000-750 Pa	0-750	258.00
Zero Center Ranges		
*4300-500 Pa	250-0-250	$ 265.00

Model Number	Range, Kilopascals	Price
4000-1 kPa	0-1	$258.00
4000-1.5 kPa	0-1.5	258.00
4000-2 kPa	0-2	258.00
4000-3 kPa	0-3	258.00
4000-4 kPa	0-4	258.00
4000-5 kPa	0-5	258.00
4000-8 kPa	0-8	258.00
4000-10 kPa	0-10	258.00
4000-15 kPa	0-15	258.00
4000-20 kPa	0-20	258.00
4000-25 kPa	0-25	258.00
4000-30 kPa	0-30	258.00
Zero Center Ranges		
4300-1 kPa	.5-0-.5	$265.00
4300-3 kPa	1.5-0-1.5	265.00

Model Number	Range Feet of Water	Price
4616B	0-16	$350.50
4635B	0-35	350.50

Available with brass case only

Accessories

A-309 3-way manifold valve	$177.00
A-314 Bleed Fitting	$6.00
A-471 Portable Kit	323.00
A-496 Flush Mount Bracket	6.70
A-610 Pipe Mount Kit	13.75

Options

Add Options as Suffix, Example 4001-ASF

-ASF (Adjustable Signal Flag)	add $14.25
B (Brass Case)	add $92.50

Scale Overlays - Red, Green, Mirrored or combination. Specify Locations.....add $12.50 net

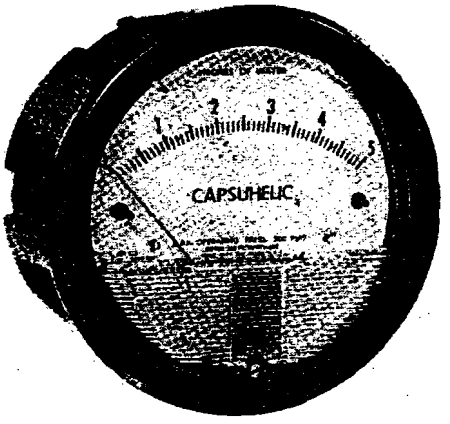
*These ranges available for vertical scale position only. †These ranges use Spiralhelic® movement.

Model # 4010-B

BULLETIN NO. A-32

OPERATING INSTRUCTIONS and PARTS LIST

CAPSUHELIC® Differential Pressure Gage



CAUTION: Use of a line filter (Dwyer model A-391 or equivalent) is recommended to prevent entry of liquid borne particles into gage. Dwyer Instruments cannot assume responsibility for failure of gages due to clogging of internal passages.

SPECIFICATIONS

Dimensions: 5" diameter x 3 3/32" length

Weight: 3 lb., 3 oz. (Brass-7 lb., 13 oz.)

Finish: Baked dark gray hammerloid except for optional brass case which is uncoated

Housing: Die cast aluminum with Teflon® impregnated hard coat anodizing, standard or optional forged brass housing, (series 4000B).

Connections: ¼ NPT high and low pressure taps, duplicated — one pair top and one pair bottom

Accuracy: Plus or minus 3% of full scale at 70°F. (2% on 4000S models, 4% on 4215, 4220, and 4500).

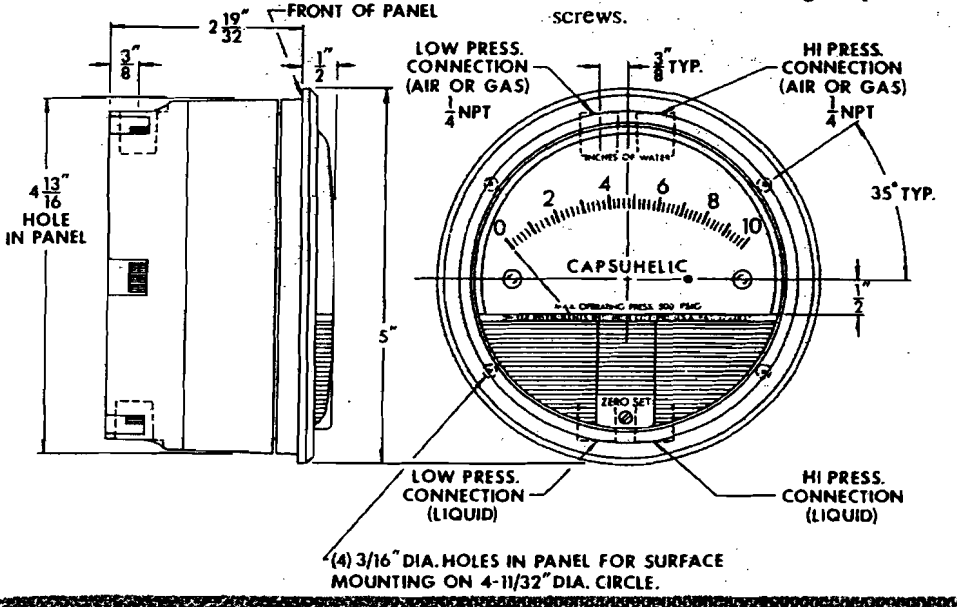
Pressure Rating: −20" Hg. to 500 psig.

Differential Pressure (Scale) Ranges: ½" W.C. To 100 psi full scale.

Ambient Temperature Range: 20° to 200°F.

Service: Compatible gases or liquids. For water or water based liquids, use only series 4000B models with brass case. DO NOT use with hydrogen gas. Toxic and/or explosive gas may form due to reaction with rare earth magnet.

Standard gage accessories include two ¼" NPT plugs for duplicate pressure taps and four flush mounting adapters with screws.

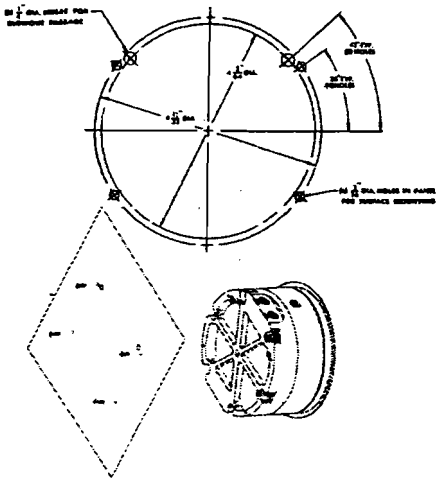


CAPSUHELIC® INSTALLATION

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 200°F. Sensing lines may be run any necessary distance. For example, 250 foot lines will not affect accuracy but will damp the reading slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult factory for means of providing additional damping.

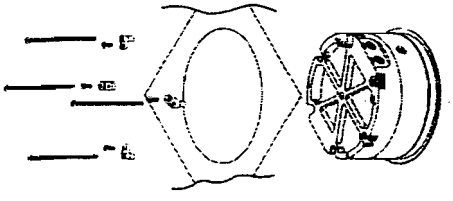
2. All standard models are calibrated for use with the diaphragm and scale in a vertical position. Special factory calibration is necessary for operation in an inclined or horizontal position. The exceptions are ranges under 5 in. w.c., (or metric equivalents) which can only be calibrated for vertical operation.

3. Surface Mounting



Locate 4 mounting holes, 35° from horiz. centerline on a $4^{11}/_{32}$" dia. circle. Use No. 6-32 machine screws of appropriate length.

Be sure to drill ¼" holes for blowout protection as shown in the diagram.



4. Flush Mounting

Provide a $4^{13}/_{16}$" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with mounting lugs firmly secured in place.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Caution

Note location of blowout or vent holes in the surface mounting diagram. Do not block these holes as their function is to vent overpressure failure out the back of the gage rather than blowing off the front cover.

Important Notes:

Two pairs of high and low pressure taps are provided, one pair on the top and a duplicate pair on the bottom. These fittings may be utilized according to the type of service for which the gage will be used. For gas or vapor service the gage should be connected from the pressure source to the top pressure fittings so that any accumulation of condensate may be drained or bled out the bottom fittings. For liquid service the pressure source should be connected to the bottom taps so that any trapped gas may be vented out the top fittings. Optional bleed fittings may be obtained to replace the standard ¼ NPT plugs for installations requiring frequent draining or venting of the gage. Note that the unused pair of pressure taps must be plugged in order for the gage to operate. For straight pressure or vacuum applications where only one of a pair of high and low pressure taps are being utilized, the other tap must be open to atmosphere.

For portable use or temporary installation use ¼ male NPT to male flare fitting and connect to pressure source with high pressure hose or tubing with flare nut connectors.

For permanent installation ¼" OD copper or stainless steel tubing is recommended.

Proper installation of fittings and plugs is important. Sparingly apply pipe thread sealant to threads. Excessive amounts can fall into pressure passages and cause blockage. We recommend Loctite® 69-31 Hydraulic Sealant. Install using torque wrench. Tighten only to 20 ft/lbs. Over-tightening can damage case.

CAPSUHELIC® MAINTENANCE

Note: Capsuhelic® differential pressure gages are high precision instruments assembled and calibrated in a modern factory. If trained instrument mechanics are not available, we recommend that any instruments requiring repair be returned to the factory.

1. No lubrication or periodic servicing is required. If the interior is protected from dust, dirt, corrosive gases and fluids, years of trouble free service may be expected.

2. For service requiring a high degree of continued accuracy, periodic calibration checks are recommended, using the following procedure.

   a. As a comparison gage, use a hook gage, micromanometer or inclined gage of known accuracy.

   b. Connect the Capsuhelic® gage and test gage together with two legs from a "T" or "Y" fitting. Connect tubing to the third leg and impose the pressure, slowly.

   c. Be certain no leaks exist in the system and provide adequate time for comparison gages to reach equilibrium, since fluid drainage and different dynamic characteristics can affect the reading.

3. To recalibrate:

   Note: Capsuhelic gages in ranges of 30 PSI and above are not field adjustable and must be returned to the factory if recalibration is required.

   a. Remove ⅛ NPT hex plug located on top of gage exposing coaxial rate adjust/clamp screws.

   b. Insert $^{5}/_{32}$ hex driver and turn hex screw counterclockwise until resistance is felt (approximately four turns).

   c. Adjust rate by turning coaxial slotted screw with a .10 inch diameter jeweler's screwdriver. Clockwise rotation of rate adjust screw will decrease gage rate and counterclockwise rotation will increase the pressure rate.

   d. Reclamp system by turning hex screw clockwise until firm, taking care not to overtighten system.

   e. Replace ⅛ NPT plug to leak tight position.

   f. Check calibration as described in preceding comments.

   g. Repeat a. through f. until desired calibration is reached.

4. Trouble shooting.

   a. Gage sluggish or fails to indicate.

      1. Sensing lines may be plugged or leaking.

      2. Pressure ports plugged by particulate.

      3. Pointer may be touching scale.

      4. Jewels supporting helix over tightened.

   b. Gage fails to indicate zero properly.

      1. See comments above regarding sluggish readings.

      2. Iron particles in strong magnetic field between helix and pressure wall. If found, they may be removed by touching each particle and withdrawing it with a small screwdriver.

      3. Magnet shifted and touching inside of pressure wall.

   c. Apparent inaccuracy.

      1. See preceding comments.

      2. Improper connections to pick up desired pressure differential. For example, static pressure connections also sensing velocity pressure, pitot tube improperly located, etc.

      3. Gage connections leaking.

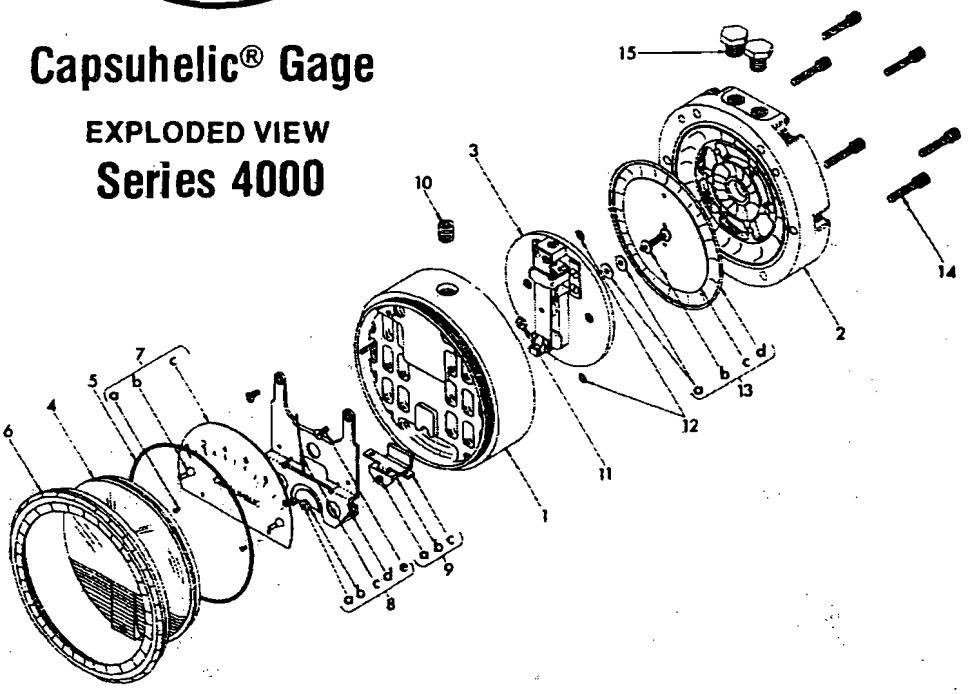
   d. Consult factory for unusual conditions of temperature, pressure, etc., and the effect on gage operation and accuracy.

Litho in U.S.A. 4/89 FR-440306-00

Dwyer

Capsuhelic® Gage

EXPLODED VIEW
Series 4000



1. Case
2. Back plate
3. Range spring assembly
4. Cover with zero adjust assembly
5. "O" ring seal
6. Bezel
7. Scale assembly — consists of:
   a. Mounting Screws
   b. Bumper pointer stop
   c. Scale
8. Wishbone assembly — consists of:
   a. Front jewel
   b. Locking nut
   c. Pointer
   d. Wishbone
   e. Mounting screws
   f. Helix assembly
   g. Pivots
   h. Rear jewel
9. Zero adjust assembly
   a. Adjust screw
   b. Foot
   c. Bracket
10. Rate adjust plug
11. Connecting link nut
12. "O" ring
13. Diaphragm assembly — consists of:
   a. Washers
   b. Linkage assembly, complete
   c. Front plate
   d. Diaphragm
   e. Back plate (not shown)
14. Case bolts
15. Mounting hardware kit
   a. Pipe plug ¼ NPT
   b. Mounting lug
   c. Long screws
   d. Short screws

When corresponding with the factory regarding Capsuhelic® gage problems refer to the call out numbers in this view. Be sure to include the model number and range. Field repair is not recommended; contact the factory for repair service.

Note: The exploded view above depicts only Capsuhelic gages with ranges up to 20 PSI. Higher range gages employ a spirally wound Bourdon tube movement.

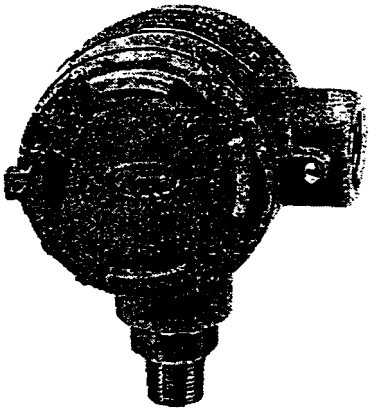
Section 3-L

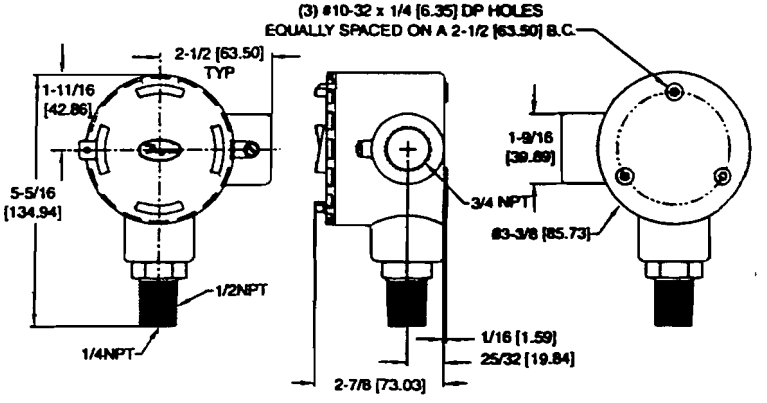
Clearwell Pump Head Pressure Transmitters (PT-211, PT-225)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions





The **Series 634ES Pressure Transmitter** senses a single air, compatible gas or liquid pressure and converts it into a standard 4-20 mA output signal. Ranges are available from 0-10 through 0-6000 psi. All models are field adjustable so any range within these limits can be achieved by recalibration using the easily accessible span and zero potentiometers.

Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. The signal is conditioned and converted into a 4-20 mA output signal.

For applications requiring direct pressure or percent of full span readings, the optional A-701 digital readout makes an ideal companion device, providing a bright .6" high, 3-1/2" digit LED and supplying power to the Series 634ES Transmitter.

Model Number	Series 634ES Models and Ranges in PSI (bar)			
	As Stocked	Min. Range	Max. Range	Max Pressure
634ES-0	10 (.69)	10 (.69)	20 (1.38)	30 (2.07)
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	60 (4.14)
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	100 (6.9)
634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	200 (13.8)
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	400 (27.6)
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	500 (34.5)
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	1000 (69)
634ES-7	1000 (69)	600 (41.4)	1250 (86)	2000 (138)
634ES-8	2000 (138)	1250 (86)	2500 (172)	4000 (276)
634ES-9	4000 (276)	2500 (172)	6000 (414)	7500 (517)

PHYSICAL DATA

GENERAL

Maximum Pressure: See chart on this page.
Wetted Parts: 316, 316L Stainless Steel.
Housing: Designed to meet NEMA-4X.

ELECTRICAL

Power Supply: 12.3-35 VDC-2 wire.
Output Signal: 4-20 mA DC (limited at 38 mA DC).
Loop Resistance: 0 - 1100 ohms from 12.3 to 35 VDC.

$$R_{L\ max} = \frac{V_{ps}-12.3V}{20\ mA}$$

Current Consumption: DC: 38 mA max.

MATERIALS

Housing: Cast aluminum; textured gray polyurethane finish.
Pressure Connection: Stainless Steel.

MECHANICAL

Weight: 1 lb., 12 oz. (.8 kg).
Span and Zero Adjustments: Protected potentiometers, located in auxiliary housing.
Pressure Connection: 1/4" female NPT x 1/2" male NPT.

PERFORMANCE AT 70°F (21.1°C)

Zero Output: 4 mA DC.
Full Span: 16 mA DC.
Accuracy: ±0.5% of span.
Warm-up Time: 10 minutes.

STABILITY/ENVIRONMENTAL

Operating Temperature: 20 to 120°F (- 6.7 to 48.9°C).
Thermal Errors: ± 0.02%/°F typical.
Stability: 1% F.S./yr.

STANDARD ACCESSORIES

(3) "Z" mounting brackets.
(3) 10-32 x 4" RH machine screws.

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Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

INSTALLATION

LOCATION: Select a location where temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See "Electrical Connections." The tube feeding the pressure to the instrument can be run practically any length required, but long lengths will slightly increase response time. Avoid surfaces with excessive vibration.

POSITION: A vertical position is recommended, as all stocked models are spanned and zeroed at the factory in this position. They can be used at other angles, but final spanning and zeroing must be done while transmitter is in the alternative position.

PRESSURE CONNECTIONS: A single pressure connection is provided at the bottom of the transmitter housing. It has1/4" female NPT and 1/2" male NPT threads. Attach positive pressure to this port.

MOUNTING: The Series 634ES Transmitter can be mounted three ways:

(A) Supported directly by pipe providing pressure.

(B) Attached to a mounting surface with 10-32 x 1/4" machine screws (included). The machine screws are installed through the mounting surface into tapped holes on back of unit.

(C) Mounted with "Z" brackets (included). Attach "Z" brackets to tapped holes on back of unit and fasten to front of mounting surface.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR AC VOLTAGE OPERATION.

Electrical connections to the Series 634ES Transmitter are made inside the enclosure. Remove the cover, feed stripped and tinned leads through the conduit opening and connect to terminal block screws marked + and -. See Figure A for locations of terminal block, span and zero adjust potentiometers. See Figure B (Pg. 3) for schematic diagram.

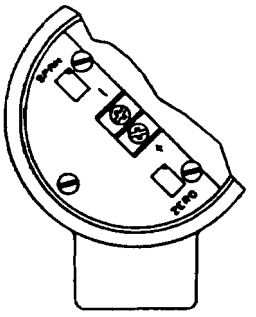

FIG. A

An external power supply delivering 12.3 to 35 VDC with minimum current capability of 40 mA must be used to power the control loop in which the Series 634ES Transmitter is connected. See Figure B for connection of the power supply, transmitter and receiver.

The range of appropriate receiver load resistance (R_L) for the power supply voltage available is given by the formula and graph in Figure C on Pg. 3.

Shielded 2-wire cable is recommended for control loop wiring, and the cable shielding may be grounded if desired. Note also that the receiver may be connected in either the negative or positive side of the loop, whichever is most convenient.

Should polarity of the transmitter or receiver inadvertently become reversed, the loop will not function properly, but no damage will be done to the transmitter.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

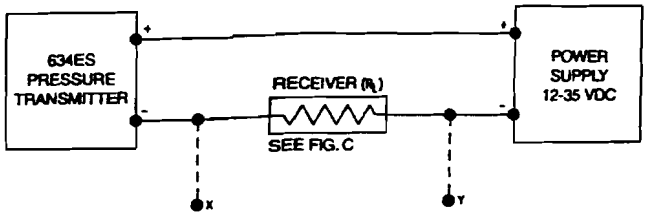

FIG. B

Series 634ES Transmitters can be used with receivers requiring 1-5 volt input rather than 4-20 mA. If the receiver requires a 1-5 volt input, insert a 250 ohm, 2 watt resistor in series with the current loop but in parallel with the receiver input. Referring to Figure B, R_L becomes the 250 ohm resistor and points X and Y are connected to the receiver input, point X being positive (+) and point Y negative (-) or ground. The resistor should be connected at the panel end of the transmitter current loop close to the receiver input to take advantage of the immunity of the current loop to electrical noise pickup. Most electronic component distributors stock a 249 Ω, 2 watt, ± 1% tolerance metal film resistor which is adequate for this application.

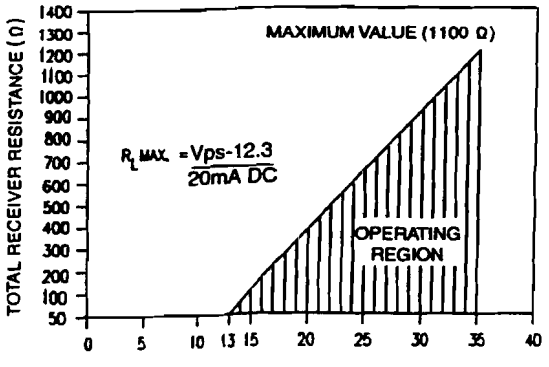

FIG. C

WIRE LENGTH - The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of receiver resistance to total loop resistance. For extremely long runs (over 1000 feet) choose receivers with higher resistances to minimize size and costs of connecting leads. When wiring length is under 100 feet, lead wire as small as 22 AWG can be used.

PRESSURE RANGING - Each Series 634ES Transmitter is factory-calibrated to the range given in the model number chart. However, special calibration is also available. If this is the case, the transmitter will be so marked. For purposes of clarification in these instructions, range is defined as that pressure which, applied to the transmitter, produces 20 mA of current in the loop. Zero pressure is always assumed to be 4 mA. If a transmitter pressure range other than that supplied is required, follow the re-ranging procedure described on Pg. 4.

Series 634ES Pressure Transmitter

Specifications - Installation and Operating Instructions

PRESSURE RE-RANGING PROCEDURE

1. With the transmitter correctly connected to the companion receiver, an accurate milliameter with a full scale reading of approximately 30 mA should be inserted in series with the current loop. A controllable pressure source capable of achieving the desired range should be connected to the pressure port of the transmitter and teed into an accurate reference pressure gauge or manometer. The instrument must be ranged in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust "zero" control so that loop current is 4 mA.

4. Apply full range pressure and adjust loop current to 20 mA using "span" control.

5. Relieve pressure and allow transmitter to stabilize for two minutes.

6. Zero and span adjustments may be interactive, so repeat steps 3 through 5 until zero and full range pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove the milliameter from the current loop and proceed with final installation of the transmitter and receiver.

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA output signal provided by the Series 634ES Pressure Transmitter is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is only necessary that these devices all be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading, this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 634ES Transmitter and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of system calibration is recommended. The Series 634ES Pressure Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

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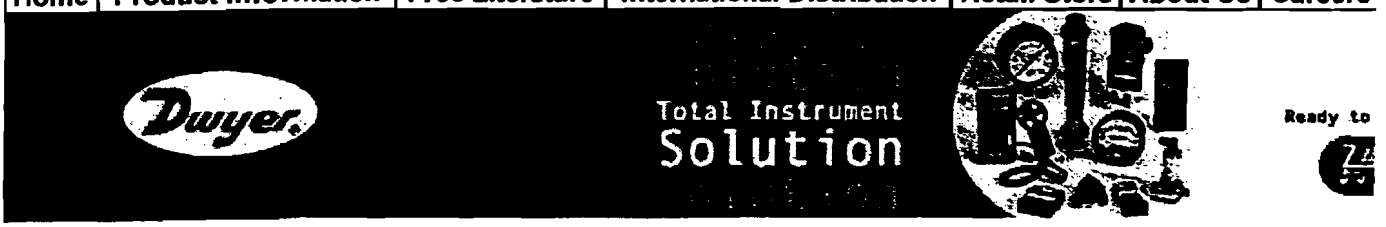
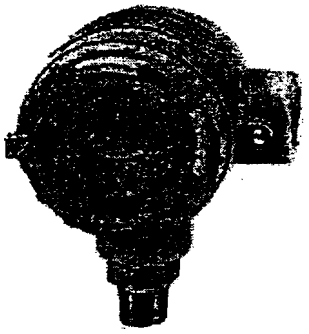


Series 634ES

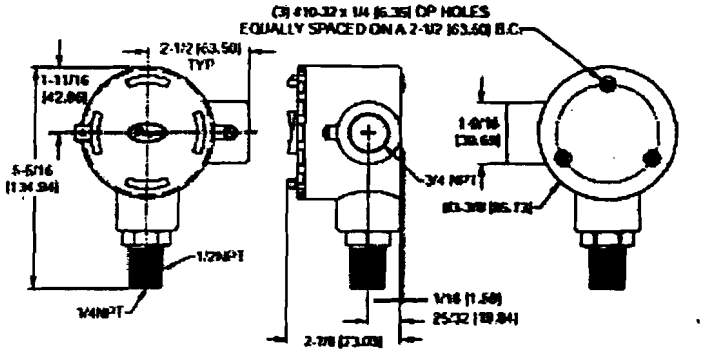
Adjustable Range Pressure Transmitter

CE

0.5% Full Span Accuracy, Ranges to 5000 psi



Service Manual
Catalog Page



Dimensional Enlargement

Series 634ES Transmitters sense a single pressure for air, compatible gas or liquid and provide 4-20 mA output signal. Positive pressure can be measured within an accuracy of ±0.5% of span. The Series 634ES uses an isolated piezoresistive pressure sensor to produce a resistance change across a wheatstone bridge. Convenient 2-wire operation simplifies installation. Zero and span adjustments are fully protected inside a rugged die cast aluminum housing with durable gray polyurethane finish. Enclosure is designed to meet NEMA 4X requirements.

POPULAR MODELS

Model Number	Range in psi (bar)	Min. Range in psi (bar)	Max. Range in psi (bar)	Price	Discount Schedule
634ES-0	10 (.69)	10 (.69)	20 (1.38)	$198.50	Standard
634ES-1	30 (2.07)	20 (1.38)	40 (2.76)	$198.50	Standard
634ES-2	50 (3.45)	40 (2.76)	60 (4.14)	$198.50	Standard

SPECIFICATIONS

Service: Compatible, non-combustible gases & liquids.
Wetted Materials: Types 316, 316L SS.
Accuracy: ±0.5% F.S.
Stability: ±1% F.S./yr.
Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Pressure Limit: 1.5x maximum pressure range.
Thermal Effect: ±0.025% F.S./°F (0.045% F.S./°C).
Power Requirements: 10 to 35 VDC (2 wire).
Output Signal: 4 to 20 mA.
Zero and Span Adjustments: Protected potentiometers located in auxiliary housing.
Loop Resistance: 1250 ohms DC max.
Current Consumption: 38 mA DC max.
Electrical Connections: Terminal block.
Process Connection: 1/4" (6.35 mm) female NPT x 1/2" (12.7 mm) male

634ES-3	100 (6.9)	60 (4.14)	120 (8.3)	$198.50	Standard
634ES-4	200 (13.8)	100 (6.9)	250 (17.2)	$198.50	Standard
634ES-5	300 (20.7)	250 (17.2)	350 (24.1)	$198.50	Standard
634ES-6	500 (34.5)	350 (24.1)	600 (41.4)	$198.50	Standard
634ES-7	1000 (69)	600 (41.4)	1250 (86)	$198.50	Standard
634ES-8	2000 (138)	1250 (86)	2500 (172)	$198.50	Standard
634ES-9	4000 (276)	2500 (172)	5000 (414)	$198.50	Standard

***Prices are based in US currency and may change for international customers due to and not limited to customs brokerage fees, export packing and documentation, tariffs, duty and taxes.**

Click the **Model Number** of the item to add the item to your shopping cart.

VIEW YOUR SHOPPING CART

NPT.
Enclosure Rating: Designed to meet NEMA 4x.
Mounting Orientation: Not position sensitive.
Weight: 1 lb, 10.6 oz (754 g).
Agency Approvals: CE.

Section 3-M

Clearwell Pump Head Pressure Indicators (PI-211, PI-225)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Bourdon Tube Pressure Gauges

Forged Brass Case / Copper Alloy Wetted Parts

Industrial Series Liquid Filled • Type 213.40

Pressure Gauges

Application
Heavy-duty instrument intended for adverse service conditions where pulsation or vibration exists. Fluid medium which does not clog connection port or corrode copper alloy.

Sizes
2½" and 4" (63 and 100 mm)

Accuracy
2½" ±1.5% of span
4" ±1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)
Vacuum / Compound to 30"HG / 0 / 200 PSI
Pressure from 10 PSI to 15,000 PSI
or other equivalent units of pressure or vacuum

Working Range

2½"	Steady:	3/4 of full scale value
	Fluctuating:	2/3 of full scale value
	Short time:	full scale value
4"	Steady:	Full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating Temperature

Ambient:	-4°F to 140°F (-20°C to 60°C) - glycerine
	-40°F to 140°F (-40°C to 60°C) - silicone
Media:	max. 140°F (+60°C) - soldered
	max. 212°F (+100°C) - brazed

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM) 2½"
Lower back mount (LBM) 4"
1/4" NPT or 1/2" NPT limited to wrench flat area
(7/16"-20 SAE thread for **Type 213.40S**)

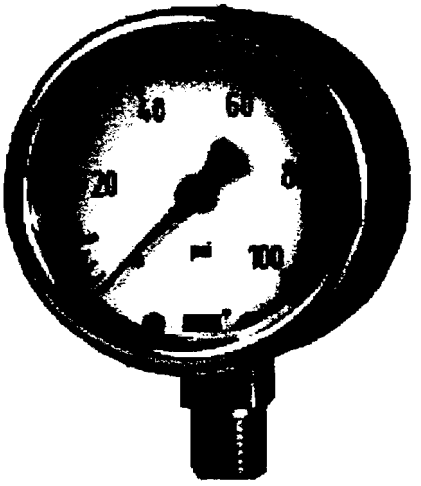
Bourdon Tube
2½" Size - Material: Copper alloy
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (soldered)

4" Size - Material: Copper alloy < 1000PSI
316 stainless steel > 1500 PSI
30"Hg (Vac) to 1000 PSI - C-type (soldered)
1500 PSI to 15,000 PSI - helical type (brazed)

Movement
Copper alloy

Dial
White aluminum with stop pin and black and red lettering

Pointer
Black aluminum



Case
Gold painted forged brass with integral connection and vent plug with high gloss brass plated ABS cover ring (2½"). Silver painted forged brass with integral connection and blow-out plug with chrome plated brass cover ring (4").

Standard Scales
2½": PSI, PSI/KPA, PSI/BAR
4": PSI

Weather Protection
Weather tight (NEMA 4X / IP 65)

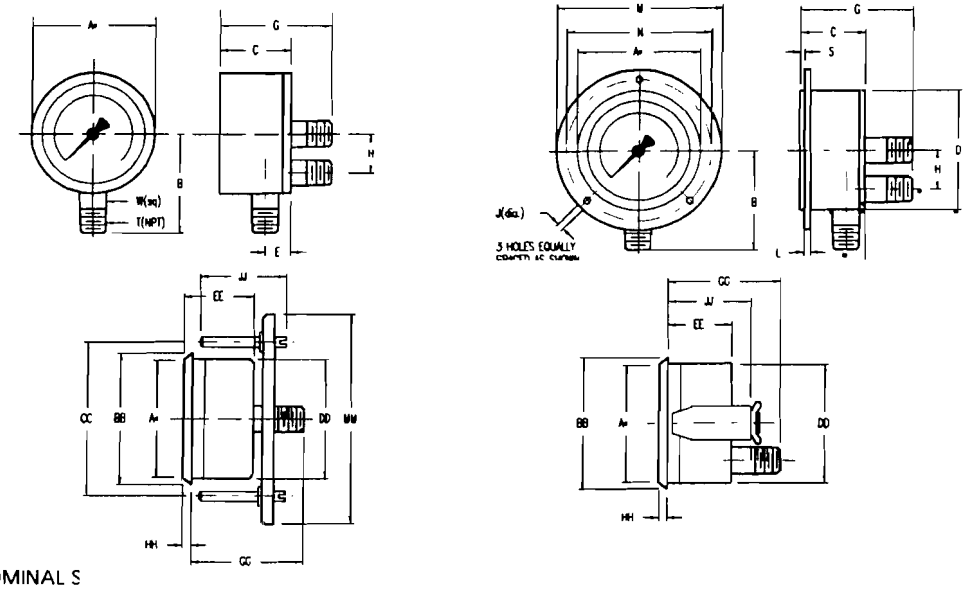
Window Gasket
Buna-N

Window
Acrylic

Liquid Filled
213.40 - Glycerine 99.7%

Order Options (min. order may apply)
Front or rear flange
U-Clamp
Brass threaded or press-fit restrictor
Front flange for 4½" panel cutout for 4" gauge
Plastic adaptor ring for 2½" non-metric panel cutout
Special case colors
Safety glass window
Externally adjustable red drag pointer (max. hand)
Externally adjustable red mark pointer (set pointer)
Glass window
Special connections, limited to wrench flat area
Custom dial layout
DIN standards
Other pressure scales available:
Bar, kPa, MPa, Kg/cm² and dual scales
Silicone or fluorocarbon fill

Dimensions:



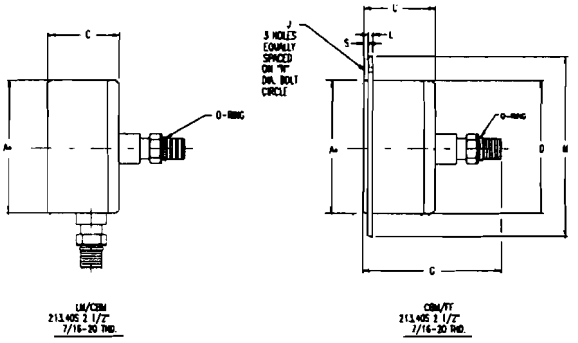
A* NOMINAL S

TYPE/SIZE	WEIGHT	KEY	A*	B (1)	C	D	E	G	H	J	K	L	M
213.40 2.5"	0.66 lbs.	mm	63	53	37	63	11	63	--	3.5	14	2	85
		in	2.5	2.09	1.46	2.48	.43	2.48	--	.14	.55	.08	3.35
213.40 4"	2.43 lbs.	mm	100	80	49	101	13.5	74	30	5	17	2	132
		in	4.0	3.15	1.93	3.98	.53	2.91	1.18	20	67	.08	5.2

KEY	N	O	P	R	S	T	W	BB	CC	DD	EE	GG	HH	JJ	MM
mm	75	79	39	5.5	2	--	14	68	72	63	36.5	61	3	50	91
in	2.95	3.11	1.54	.22	.08	1/4"	.55	2.68	2.83	2.48	1.44	2.4	.12	1.97	3.58
mm	115	122	52.5	5.5	3.5	--	22	107	--	101	48	75.5	5	59	--
in	4.35	4.80	2.07	.22	.14	1/2"	.87	4.21	--	3.98	1.89	2.97	.20	2.32	--

(1) For 4" gauges with 1/2" NPT connection, B dimension changes to 85mm/3.35in.

Optional Type 213.40S - 7/16"-20 SAE connection



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	F	G	J
213.40S 2.5"	0.68 lbs.	mm	63	55	37	6.2	63	3.5
		in	2.5	2.17	1.46	.25	2.48	.14
		KEY	L	M	N	S	W	
		mm	2.0	85	75	2.0	22	
		in	.08	3.35	2.95	.08	0.87	

T=7/16"-20 SAE connection with hex nut, Viton o-ring, and zinc-plated steel washer

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/01

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
http://www.wika.com e-mail: info@wika.com

Section 3-N

Clearwell Pump Head Pressure Switches (PDS-211, PDS-225)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

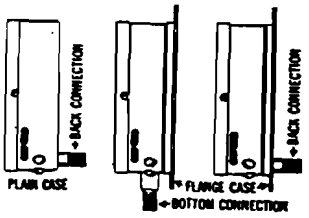
INSTALLATION INSTRUCTIONS

MERCOID SERIES "D" PRESSURE CONTROLS

WITH HERMETICALLY SEALED MERCURY SWITCHES & BOURDON TUBE POWER ELEMENTS

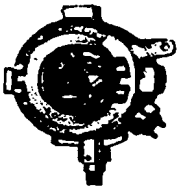
(The following instructions apply to Mercoid Pressure Controls prefixed by the letter "D" except Series "DP" Differential Pressure Controls.)

Bulletin No. IN-0118
Supersedes 0-0118R
Revised 1/86



GENERAL PURPOSE Prefixed by DA, DAF, DL, DR, DS, DRF, DSF

WATERTIGHT OR WEATHER-RESISTANT Prefixed by DAW, DRW, DSW, N3-DAW, N3-DRW, N3-DSW



EXPLOSION PROOF Prefixed by DAH, DAHF, DLH, DRH, DSH

EXPLOSION PROOF Prefixed by DAE, DLE, DRE, DSE

CONTROL NUMBERS

Part of the control number identifies the type of control case. The digit 1 of 21, 31, 41, 81, 221, 231, 241, 251, 261, 281, 421, 431, 441, 521, 531, 541, 581, denotes a plain case with bottom connection.

The digit 2 of 22, 32, 222, 232, 242, 422, 432, 522, 532, denotes a plain case with back connection

The digit 3 of 23, 33, 43, 83, 223, 233, 243, 283, 423, 433, 443, 523, 533, 543, 583, denotes a flanged case with bottom connection.

The digit 4 of 24, 34, 54, 224, 234, 524, denotes a flanged case with back connection.

CIRCUIT SUFFIX NUMBERS (SWITCH OPERATION)

Suffix number after control number denotes whether circuit is to open or close on increase or decrease of pressure, etc. Examples: Type DA-21-2 -suffix -2 indicates circuit is to open on pressure increase. Type DSW-221-3 -suffix -3 indicates circuit is to close on pressure increase. FOR EXPLANATION OF CIRCUIT NUMBERS AND VARIATIONS SEE PAGE 4.

LOCATION AND MOUNTING

Select a location recommended by equipment manufacturer. Note: Vibration causes erratic operation of any instrument and shortens its life. It is important that a location be selected that is reasonably free from vibration caused by reciprocating or rotating machinery. Where excessive vibration occurs, use a remote connection and mount by means of a mounting bracket or separable flange (available on order). Where pulsations, pressure surges or water hammer are present, protect the control with a surge tank or snubber.

MOUNT ALL CONTROLS VERTICALLY AND LEVEL

GENERAL PURPOSE CONTROLS: Prefixed by letters DA, DAF, DRF, DL, DS, DSF. Install control firmly in a LEVEL POSITION. Do not mount control by twisting the case, use wrench on the square part of the ¼" bottom pipe connection. To level, sight across the two cover screws or check the lower end of the glass opening in cover to see that the control is lined up horizontally. (On controls with an operating range of 500-3,000 psi. be sure that the special sealing nut (with Teflon insert) is turned to the uppermost threaded section of the ½" pressure connection. Apply a flat open-end wrench to the flat side of the bottom pressure connection when piping the control. After it has been properly connected, be sure to tighten the sealing nut in order to assure a leak-proof connection).

On general purpose controls provided with a flange, mount by means of the three holes in flange - see drawing No. 1000B page 4.

WATERTIGHT OR WEATHER RESISTANT TYPES: Prefixed by letters DAW, DRW, DSW, DLW, N3-DAW, N3-DRW, N3-DSW, N3-DLW: Supplied with flanged case, bottom connection only, for surface mounting. (see drawing No. 1062, page 4) Install firmly in a LEVEL POSITION. Do not mount control by twisting the case, use wrench on the square part of the ¼" bottom pipe connection. Be sure pipe connection is in a vertical position. After cover is properly attached with name plate on bottom of cover, sight across the lower end of the glass opening in cover to see that control is lined up vertically.

EXPLOSION PROOF TYPES: Prefixed by letters DAH, DAHF, DRH, DSH, DAE, DRE, DSE: (see drawings No. 1350 and 1062, page 4) Mount control level by means of mounting lugs attached to control housing. Line up horizontally by sighting across the left and right conduit hubs.

WHEN IN DOUBT AS TO EXCESSIVE VIBRATION USE A REMOTE CONNECTION.

NOTE:
SERIES D-30, D-230, D-430, D-530 (i.e., DA-31-3, etc.) when used for steam with operating ranges 35 psi or higher, must be siphoned to prevent live steam entering the Bourdon tube. On high pressure steam in excess of 100 psi, use a remote connection (see illustration, page 1).
SERIES D-20, D-220, D-420, D-520 (i.e., DA-21-2, etc.) incorporate an orifice as standard in the bottom stem to dampen out surges or pulsations.

ACCESSORIES

Remote Connection No.49-62 (300 psi. No.49-62HP (to 2500 psi.)

MOUNTING BRACKET No.33-25

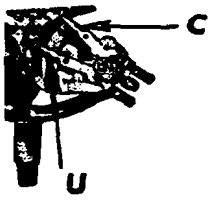
Pigtail Siphon No. 42-51 (300 psi.) No.42-56-57 (2,000 psi.)

WIRING

Wire in accordance with local electrical codes or equipment manufacturer's instructions.
For general purpose controls use a short piece of BX between the rigid conduit and the control so that it will not be subjected to conduit expansion and contraction. Where control is directly connected into load circuit it should be connected into hot side of line. For electrical rating see nameplate attached to control case.

ADJUSTMENTS
HOW TO SET OPERATING POINT

DOUBLE ADJUSTMENT TYPES-FULLY AUTOMATIC:



Prefixed by DA, DAF, DAE, DAW, DAH, DAHF - provided with double adjustments. Adjust the upper pointer "C" to set the HIGH PRESSURE POINT for switch operation. Adjust the lower pointer "U" to set the LOW PRESSURE OPERATING POINT. The difference between the HIGH and LOW pointers is the operating differential between "on-off" switch operation. Minimum differential for each respective range is shown on page 3.

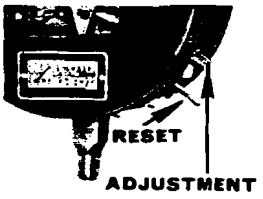
SINGLE ADJUSTMENT TYPES-FULLY AUTOMATIC:

Single Adjustment

Prefixed by DS, DSE, DSF, DSH - equipped with a single adjustment. The single pointer on the scale sets the pressure where switch operation occurs. Differential is fixed (not adjustable). Example setting: Type DS-21-2 range 0-60 psi. circuit opens on pressure rise. If pointer is set at 40 psi., the control will operate to OPEN circuit at 40 psi and RE-CLOSE CIRCUIT AT THE FIXED DIFFERENTIAL OF 4 PSI.
For fixed differential of each range see page 3.

(Continued on page two)

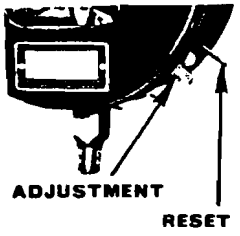
SEMI-AUTOMATIC CONTROL WITH MANUAL RESET



Prefixed by DR, DRF, DRH, DRE, DRW-with suffix -L or -U. Example: DR-21-2U. A single adjustment sets the operating point for automatic operation. A push button reset must be operated manually to restore the circuit to the original position after automatic operation. Example: Type DA-21-2L - circuit will open automatically on a pressure rise to the pressure indicated by the pointer on the scale - no matter how much the pressure drops, the circuit will not reclose until the reset button is operated.

Suffix -L denotes control will operate automatically on an increase.
Suffix -U denotes control will operate automatically on a decrease.

MANUAL LOCK TYPE RESET CONTROL



Operates automatically on a decrease of pressure with provision for manual reset when pressure is below set point.
Prefixed by DL, DLW, DLE, DLH: a single adjustment sets the low pressure operating point of control at any value on scale range.
The control will operate automatically at the set point only on a drop of pressure. The lock type feature permits the circuit to be reset and locked in position when pressures are below control setting.

The lock remains in effect until the pressure has risen to a value above the control setting. Lock then releases and the circuit is held in the reset position due to the pressure rise. It will remain in the reset position until it is called on to again operate automatically on a pressure drop to the selected setting.

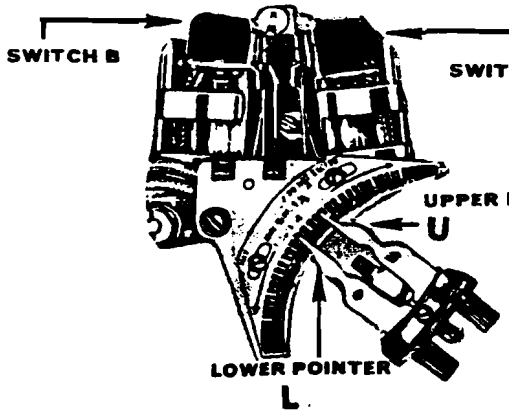
TWO-STAGE PRESSURE CONTROLS
SERIES D-400

Types DA, DAW, DAH, DAE - with suffixes 421, 423, 431, 433, etc. Followed by specification numbers 4122, 4123, 4129, 4132.

This series incorporates two single pole, single throw, magnetic mercury switches, actuated by the same Bourdon tube. The operating point of each switch is adjustable thru an outside adjustment.

The change in pressure which opens and closes each switch at its respective setting is the fixed differential of the switch. The pressure represented by the difference between the two adjustment pointers is the pressure "spread" between operation of the two switches (see illustration).

Upper pointer "U" indicates the operating point of the HIGH pressure circuit. Lower pointer "L" indicates the operating point of the LOW pressure circuit. See switch operating specification chart on this page.



EXAMPLE SETTING: - Type DA-421. Specification No. 4122, range 0-60 psi. With lower pointer "L" set at 25 psi. and upper pointer "U" at 50 psi., both circuits will be closed when the pressure is 25 psi and lower. When pressure rises to 26 psi. mercury switch "A" will open its circuit. When pressure rises to 50 psi. mercury switch "B" will open its circuit; both switches remain open above this setting. The fixed differential (sensitivity) of each switch for this particular range is 1 psi and upon a drop in pressure, mercury switch "B" will close its circuit at 49 psi and mercury switch "A" will close its circuit at 25 psi.

TWO-STAGE PRESSURE CONTROLS
SERIES D-400
RANGES AND DIFFERENTIALS

Range No.	Adj. Working Range	Bourdon Tube Material	Minimum Pressure Spread Between Switch Operation	Fixed Differential Each Switch (Sensitivity)
For Steam and Other Applications: DA-431, DAW-433, DAH-431				
1	1/8-15 psig	Brass	2½ psig	½ psig
2	0-30 psig	Brass	4" Hg.	1" Hg. Vac.
3	10" Vac 12 psig	Brass	2½ psig	½ psig
3A	1/8-20 psig	Brass	2½ psig	½ psig
4	1-35 psig	Brass	3½ psig	¾ psig
5	2-60 psig	Brass	5 psig	¾ psig
6	5-100 psig	Brass	7 psig	1 psig
7	5-150 psig	Brass	10-5/8 psig	1-1/8 psig
8	5-200 psig	Brass	15 psig	1¼ psig
9	10-300 psig	Brass	25 psig	2 psig
27	25" Vac 50 psig	Brass	7 psig	1 psi
For General Pressure Applications: DA-421, DAW-423, DAH-421				
5S	2-50 psig	Steel	6 psig	1¼ psig
6S	5-100 psig	Steel	8 psig	2 psig
8S	10-200 psig	Steel	10 psig	2 psig
9S	10-300 psig	Steel	20 psig	4 psig
9AS	40-350 psig	Steel	20 psig	4 psig
10S	25-600 psig	Steel	40 psig	7 psig
11S	50-1000 psig	Steel	100 psig	10 psig
12S	100-1500 psig	Steel	150 psig	12 psig
13S	300-2500 psig	Steel	250 psig	20 psig
15S	500-5000 psig	Steel	600 psig	150 psig
25S	0-30" Vac 60 psig	Steel	5 psig	1 psig
26S	30" Vac 75 psig	Steel	10 psig	2 psig
316 S. S. Bourdon Tubes: DA-441, DAW-443, DAH-441				
26E	30" Hg. Vac 75	316 S.S.	12 psig	2 psig
23E	5-75 psig	316 S.S.	12 psig	2 psig
6E	10-100 psig	316 S.S.	12 psig	2 psig
24E	10-150 psig	316 S.S.	13 psig	3 psig
9E	10-300 psig	316 S.S.	35 psig	6 psig
21E	30-400 psig	316 S.S.	40 psig	8 psig
22E	75-800 psig	316 S.S.	85 psig	15 psig
11E	100-1000 psig	316 S.S.	125 psig	22 psig
13E	200-2500 psig	316 S.S.	275 psig	75 psig

ELECTRICAL RATINGS D-400

AC 120V 0.3A, 240V. 0.15A; (24V 0.9A) DC 120V 0.15A, 240V 0.07A For higher electrical capacities use compatible relay. (Not available for 440V serv

SWITCH OPERATING SPECIFICATIONS

In ordering, select operation desired, add suffix number of specification to the type number of control. EXAMPLE: Type DA-431-4122.

Specification No.	Switch Mk.	CONTACT POSITION: Low Pressure Hi-Vac.	Intermediate Pressure	High Pressure Lo Vac.
—4122	"A"	ON	OFF	OFF
	"B"	ON	ON	OFF
—4129	"A"	OFF	ON	ON
	"B"	OFF	OFF	ON
—4132	"A"	ON	OFF	OFF
	"B"	OFF	OFF	ON
—4123	"A"	OFF	ON	ON
	"B"	ON	ON	OFF

SPECIFICATION NO. 4122. One circuit opens on increase of pressure—second circuit opens on further increase of pressure

SPECIFICATION NO. 4129. One circuit closes on increase of pressure—second circuit closes on further increase of pressure.

SPECIFICATION NO. 4132. Both circuits open at intermediate pressure. One circuit closes on increase of pressure above neutral zone—second circuit closes on decrease in pressure below neutral zone.

SPECIFICATION NO. 4123. Both circuits close at intermediate pressure. One circuit opens on increase of pressure above neutral zone—second circuit opens on decrease in pressure below neutral zone.

PRESSURE CHART FOR SERIES "D" MERCOID PRESSURE CONTROLS

OPERATING RANGES – ADJUSTMENT – DIFFERENTIALS – ELECTRICAL RATINGS

CONTROLS WITH BOURDON TUBE POWER ELEMENTS AND MERCURY SWITCH CONTACTS

CONTROLS WITH MERCURY SWITCHES -2 (SP-ST) OPENS on increase -3 (SP-ST) CLOSES on increase -153 (SP-DT) One opens as other closes			ADJUSTABLE DIFFERENTIAL DOUBLE ADJUSTMENT for setting both 'on' and 'off' operating points Maximum Differential – full scale. Minimum Differential listed below.		FIXED DIFFERENTIAL SINGLE ADJUSTMENT Adjustable operating point. Differential fixed NOT ADJUSTABLE
APPLICATION Bourdon tube material	ADJUSTABLE OPERATING RANGE PSIG	RANGE NO.	SEE CODE A DA-31	SEE CODE B DA-531	SEE CODE C DS-231
FOR GASES, STEAM OR LIQUIDS NOT INJURIOUS TO BRASS BOURDON TUBES	0-30 Hg Vac	2	2" Hg.	1" Hg.	0.2" Hg.
	10" Hg Vac 12	3	1 psig	0.5 psig	2 oz.
	1/8-15 psig	1	1 psig	0.5 psig	2 oz.
	1/8-20 psig	3A	1 psig	0.5 psig	2 oz.
	1-35 psig	4	1.75 psig	0.75 psig	4 oz.
	25" Hg Vac 50	27	3.5 psig	2 psig	7 oz.
	2-60 psig	5	3 psig	1 psig	6 oz.
	5-100 psig	6	3.75 psig	2 psig	7 oz.
	5-150 psig	7	6 psig	3 psig	8 oz.
	10-200 psig	8	8 psig	3.5 psig	12 oz.
	10-300 psig	9	14 psig	6 psig	16 oz.
FOR GASES OR LIQUIDS NOT INJURIOUS TO 403 STAINLESS STEEL BOURDON TUBES			DA-21	DA-521	DS-221
	30" Hg Vac 60	25S	6 psig	3 psig	12 oz.
	30" Hg Vac 75	26S	8 psig	4 psig	12 oz.
	2-60 psig	5S	4 psig	2.5 psig	0.5 psig
	5-100 psig	6S	6 psig	3 psig	0.75 psig
	10-200 psig	8S	8 psig	4 psig	0.75 psig
	10-300 psig	9S	14 psig	7 psig	1 psig
	40-350 psig	9AS	14 psig	7 psig	1 psig
	25-600 psig	10S	25 psig	15 psig	2.5 psig
	50-1000 psig	11S	60 psig	40 psig	10 psig
	100-1500 psig	12S	90 psig	50 psig	12 psig
	300-2500 psig	13S	150 psig	100 psig	15 psig
	500-5000 psig	15S	450 psig	200 psig	150 psig
	800-8000 psig	16S	750 psig	400 psig	200 psig
FOR MEDIUMS NOT INJURIOUS TO 316 STAINLESS STEEL BOURDON TUBES			DA-41	DA-541	DS-241
	30" Hg Vac 75	26E	7 psig	3.5 psig	14 oz.
	5-75 psig	23E	3 psig	2 psig	0.4 psig
	10-100 psig	6E	7 psig	3.5 psig	14 oz.
	10-150 psig	24E	6 psig	3 psig	0.75 psig
	10-300 psig	9E	18 psig	5 psig	3 psig
	30-400 psig	21E	30 psig	15 psig	5 psig
	75-800 psig	22E	75 psig	35 psig	12 psig
	100-1000 psig	11E	100 psig	45 psig	18 psig
	200-2500 psig	13E	210 psig	110 psig	50 psig

ELECTRICAL RATINGS

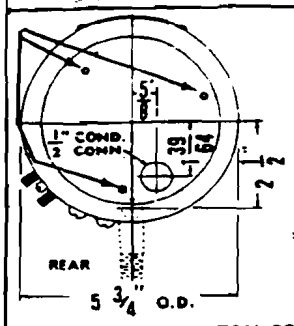
CIRCUIT SUFFIX NOS.
-2 SP-ST OPENS ON INCREASE
-3 SP-ST CLOSES ON INCREASE
-153 SP-DT ONE OPENS AS OTHER CLOSES

CODE	CIRCUIT SUFFIX	AC CAPACITY 120V.	AC CAPACITY 240V.	AC CAPACITY 440V.	DC CAPACITY 120V.	DC CAPACITY 240V.	HORSEPOWER AC	HORSEPOWER DC
A	-2, -3 -153	10A. 4A.	5A. 2A.	3A. ①	10A. 4A.	5A. 2A.	3/4 1/8	1/3 NA
B	-2, -3	5A.	2A	NA	2½A.	1A.	1/8	1/10
C	-2, -3	0.3A.	0.15A.	NA	0.15A.	0.07A.	NA	NA

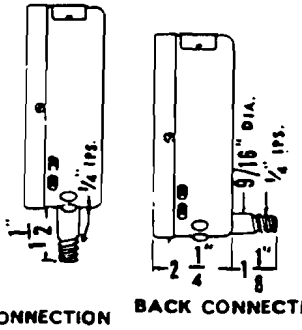
NOTE:- Differentials listed above are for SP-ST operation only. When controls incorporate two mercury switches for double throw or two pole operation, the differentials are approximately double those shown for standard single pole, single throw controls.

FOR MULTIPLE CIRCUITS SEE PAGE 4.

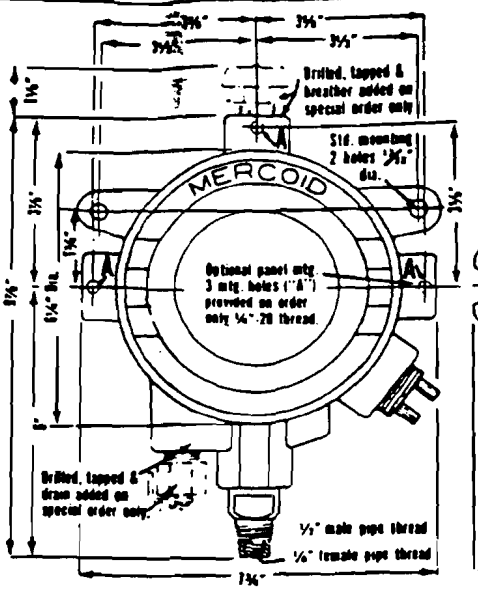
Suffix No.	CIRCUIT		Circuit Response to Pressure Increase
-2		SP-ST	Opens
-3		SP-ST	Closes
-4		DP-ST	Closes
-5		3 Pole, ST	Closes
-26		SP-ST	Closes
-36		SP-ST	Opens
-54		DP-ST	Opens
-55		3 Pole, ST	Opens
-103		DP-ST	Closes
-113		DP-ST	Closes
-127		DP-ST	Opens
-152		SP-DT	One Closes as Other Opens
-153		SP-DT	One Closes as Other Opens
-154		2 CIRCUITS 1 CIRCUIT	CLOSE OPENS
-155		1 CIRCUIT 2 CIRCUITS	CLOSES OPEN
-156		SP-DT	One Closes as Other Opens
-160		ALARM SP-ST	CLOSES 9-61 OPENS 9-51
-705		SP-DT SP-ST	One Opens as Other Closes CLOSES
-729		SP-DT ST-ST	One Closes as Other Opens OPENS
-804		DP-DT	TWO CLOSE TWO OPEN
-815			4P-ST CLOSE (2)9-67
-816			4P-ST OPEN (2)9-67

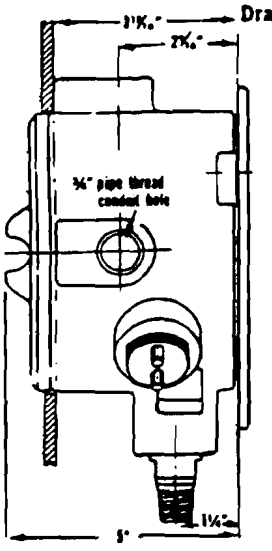


PLAIN CASE — BOTTOM CONNECTION



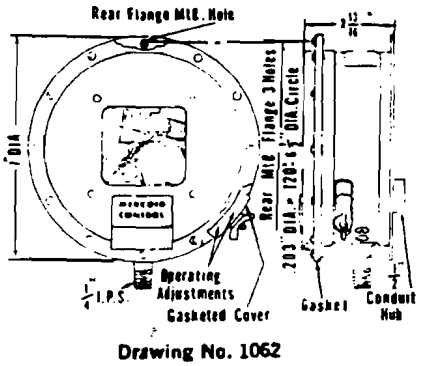
BACK CONNECTION





Drawing No. 1350

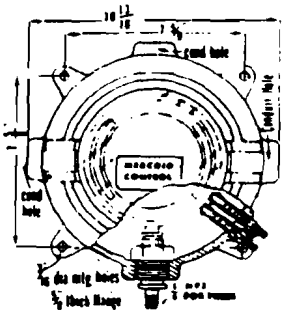
EXPLOSION PROOF PREFIXED BY DAH DAHF DRH DSH DSHF



Drawing No. 1062

Watertight NEMA 2,3,4-

PREFIXED BY DAW, DRW, DSW, DLW



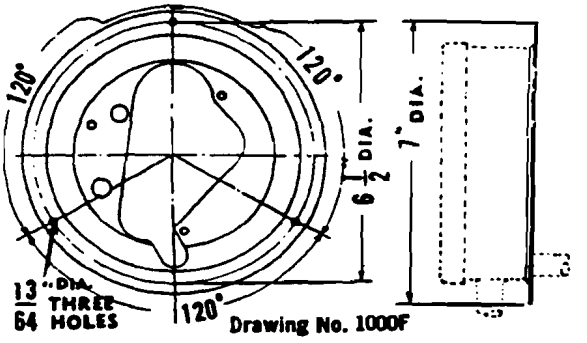
EXPLOSION-PROOF

Drawing No. 98

PREFIXED BY DAE, DLE, DRE, DSE

Drawing No. 1000B

GENERAL PURPOSE PREFIXED BY DA, DAF DR, DL DS, DSF DRF



Drawing No. 1000F

FLANGE FOR SURFACE MOUNTING

GENERAL PURPOSE CONTROLS—CATALOG No. 17-26

LOCKING DEVICE

When the control has been adjusted to desired range, the locking bar may be inserted between the adjustment screws with slot passing over the projecting lug. By placing a sealing wire between the locking bar and the hole in the lug protruding from adjustment assembly, adjustments cannot be tampered with.

For DAF, DRF, DSF, DAW, DRW, DSW, adjusting knob cover may be sealed in place with sealing wire through cover bolt hole. For DAH, DSH, sealing wire may pass through locking bar and hole in hub above adjusting knobs.

CAUTIONS

When testing a boiler or system, never exceed maximum pressure rating on control or it may be seriously damaged. Remove control if higher pressures are required.

Do not fail to use a siphon on steam where range is 35lbs. or more. Control movement must not be oiled.

Do not overload - note electrical rating on nameplate and be sure total current passing through switch is within specified rating.

MERCOID CONTROL

THE MERCOID CORPORATION, 4201 BELMONT AVE., CHICAGO, ILL. 60641

628 Davisville Road, Willow Grove, Penna. 19090

Printed in U.S.A.

PART NO. 76-441852-00

Section 3-O

Clearwell No. 2 Discharge Water Regulating Valve (PCV-P5/ZS-225)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

EXISTING VALVES FCV 2, 4, 5

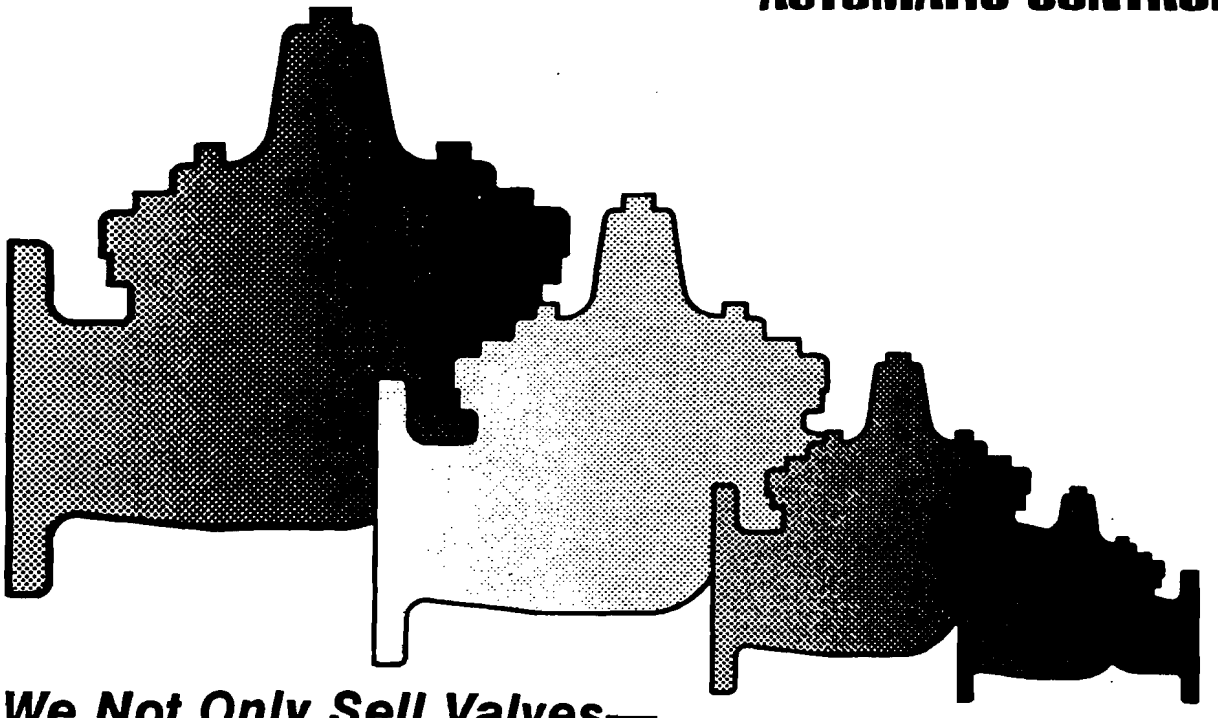
Place this manual with personnel responsible for maintenance of this valve.

TM 51-01

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

CLA-VAL

AUTOMATIC CONTROL VALVES



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C	CLA-VAL CO.	INSTALLATION / OPERATION / MAINTENANCE
	PRESSURE SUSTAINING & CHECK VALVE	MODEL 51-01 SERIES

INTRODUCTION

This manual titled the 51-01 Series Pressure Sustaining and Check Valve contains information for installation, operation and maintenance of the valve and control system. The Clayton 51-01 is an automatic valve designed to maintain upstream pressure to close limits and prevent reverse flow. It is a hydraulically operated, pilot controlled, diaphragm type globe or angle valve. The pilot system includes a pressure relief control and auxiliary check valves. Operation is completely automatic and pressure setting may be changed easily.

In operation the valve performs two important functions:

1. Maintains a constant back pressure by relieving excess pressure downstream. When the inlet pressure tends to be higher than the set pressure the valve modulates to maintain the set inlet pressure.
2. Positively prevents a return flow when pressure reverses. If the pressure reverses the valve closes.

INSTALLATION

1. Allow sufficient room around the valve assembly to make adjustments and for disassembly.
2. It is recommended that gate or block valves be installed upstream and downstream of the 51-01 to facilitate isolating the valve for preventive maintenance.
   NOTE: BEFORE THE VALVE IS INSTALLED, PIPE LINES SHOULD BE FLUSHED OF ALL CHIPS, SCALE AND FOREIGN MATTER.
3. Place the valve in the line with flow through the valve in the direction indicated on the inlet plate or by flow arrows. Check all fittings and hardware for proper makeup and that no apparent damage is evident. Be sure main valve cover nuts/bolts are tight.
4. Clayton Hytrol Valves operate with maximum efficiency when mounted in horizontal piping with the cover UP; however, other positions are acceptable. Due to size and weight of cover and internal components of six inch and larger, installation with the cover up is advisable. This makes periodic inspection of internal parts readily accessible.

OPERATION AND START-UP

1. Prior to pressurizing the valve assembly make sure the necessary gauges to measure pressure in the system are installed as required by the system engineer. A Clayton X101 Valve Position Indicator may be installed in the center cover port to provide a visual indication of the valve stem position during start-up adjustment.
   CAUTION: During start-up and test a large volume of water may be discharged downstream. Check that the downstream venting is adequate to prevent damage to personnel and equipment. All adjustments in pressure should be made slowly. If the main valve closes too fast it may cause surging in upstream piping.
2. If shutoff cocks (isolation valves) are installed, open cocks (see schematic).
3. Loosen jam nut on strainer valve assembly and turn adjusting stem clockwise until it seats. Turn stem counterclockwise ¼ to ½ turn and tighten jam nut.
4. Remove cap on the CRL Pressure Relief Control, loosen jam nut and turn adjusting screw clockwise until spring is fully compressed. This puts the control in full closed mode and will cause the main valve to close when system is pressurized.
5. Close the downstream block valve and slowly open the upstream block valve. The main valve should close. If it does not close adjust strainer valve stem another ⅛ turn counterclockwise. This controls the main valve closing speed.
6. Slowly open the downstream gate valve. The main valve should stay in the closed position. If the valve begins to open, readjust the strainer valve stem in ⅛ turn increments clockwise to close valve.
7. Carefully loosen tube fittings at highest points and bleed air from system. Carefully loosen the plug at top of cover assembly, or if an Indicator is installed loosen the pipe plug at top of Indicator. Bleed air from cover and tighten plug. Tighten tube fittings.
8. Turn the CRL adjusting screw slowly counterclockwise unt you begin to hear a flow through the control. The main valv should start to open. If the pressure is below the required relie setting refer to the spring chart (Drawing No. 47117) and tur the adjusting screw clockwise the number of turns require for the proper setting. Lock the jam nut and replace cove An observation of the pressure relief setting should be mad during a usage cycle or artificially induced cycle and the cor trols readjusted if required.
9. To test the function of the check valve feature be sure that th CK2 Cock located between the main valve outlet and the chec valve is open (see schematic). With flow through the mai valve lower the pressure at the valve inlet and the main valv should go closed.

MAINTENANCE

1. Clayton Valves and Controls require no lubrication or packing and a minimum of maintenance. However, a periodic inspection schedule should be established to determine how the fluid handled is affecting the efficiency of the valve assembly
2. Repair and adjustment procedures of the main valve and control components are included in separate sections of this manual. Accessory components are listed for reference.
3. Refer to the Service Suggestions Chart to identify operation symptoms.

SERVICE SUGGESTIONS

SYMPTOM	PROBABLE CAUSE	REMEDY
Main valve won't open	Inlet pressure below setting of pilot valve.	Reset pilot valve. If change in setting by tampering, seal cap with wire and lead seal.
	Pilot valve stuck closed. Mineral deposit or foreign material between disc retainer and power unit body.	Disassemble and clean.
	Pilot valve diaphragm ruptured or diaphragm nut loose. Water coming out of the vent hole in cover.	Disassemble and replace diaphragm. Tighten nut.
	Main valve stuck closed. Mineral buildup on stem. Stem damaged.	Disassemble main valve, clean parts and/or replace damaged parts.
Main valve won't close	Inlet pressure above setting of pilot valve.	Reset pilot valve.
	Clogged needle valve.	Disassemble and clean.
	Pilot valve stuck open. Mineral deposit or foreign material under disc retainer or under diaphragm assembly.	Disassemble and clean.
	Main valve stuck open. Mineral buildup on stem. Foreign material between seat and disc assembly.	Disassemble and clean.
	Main valve diaphragm ruptured.	Disassemble and replace.
	Check valves clogged or positioned incorrectly in line.	Clean or replace. Reinstall in correct flow position.
	Isolation valves closed in tubing control lines.	Open valves.
Valve leaks continuously	Pilot valve disc worn out.	Disassemble and replace.
	Main valve disc worn out or small break in main valve diaphragm.	Disassemble and replace.

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

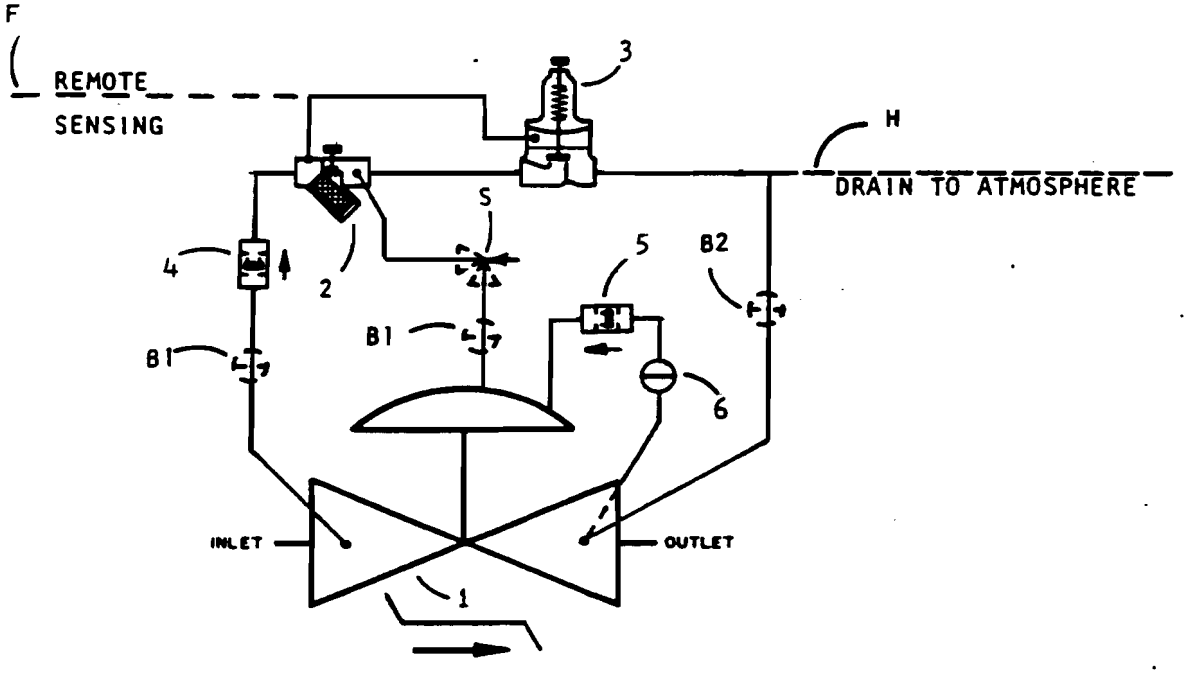
CATALOG NO.	DRAWING NO.	REV.
51-01	76570	H

TYPE OF VALVE AND MAIN FEATURES

COMBINATION PRESSURE RELIEF AND CHECK VALVE

DESIGN	
DRAWN 11-30-78	JD
CHK'D 11-30-78	CM
APP'D 11-30-78	

——— NOT FURNISHED BY CLA-VAL CO. - - - - - - - - - OPTIONAL FEATURES



ITEM NO.	BASIC COMPONENTS	QTY.
1	100-01 HYTROL (MAIN VALVE)	1
2	X42N-2 STRAINER & NEEDLE VALVE	1
3	CRL PRESS. REL. CONTROL	1
4	CDC CHECK VALVE	1
5	CDC/CSC CHECK VALVE	1
6	CK2 COCK	1

	OPTIONAL FEATURE SUFFIX	ADD TO CATALOG NUMBER		
B	CK2 COCK (ISOLATION VALVES)	3		
F	REMOTE SENSING			
S	CV FLOW CONTROL (OPENING)	1		
H	DRAIN TO ATMOSPHERE			

REVISION RECORD

LTR	DESCRIPTION	BY	DATE
E	REVISED & REDRAWN. ECO 26826	JH	11-30-78
F	REINSTATED. ECO 3181		11/25/81
H	ADDED OPTIONAL FEATURE "H" (ECO 5864)	BH	3-19-84

B 3-29-77

CLA-VAL CO. NEWPORT BEACH CALIFORNIA CVCL 1 2 3 4

CATALOG NO.	DRAWING NO.	REV
51-01	76570	H

COMBINATION PRESSURE RELIEF AND CHECK VALVE

DESIGN		
DRAWN	11-30-78	CH
CHK'D.	11-30-78	DF
APP'D.	11-30-78	
SCALE	DIST. CODE 002	

OPERATING DATA

I. PRESSURE RELIEF FEATURE:
PRESSURE RELIEF CONTROL (3) IS A "NORMALLY CLOSED" CONTROL THAT RESPONDS TO MAIN VALVE INLET PRESSURE CHANGES. AN INCREASE IN INLET PRESSURE TENDS TO OPEN CONTROL (3) AND A DECREASE IN INLET PRESSURE TENDS TO CLOSE CONTROL (3). THIS CAUSES MAIN VALVE COVER PRESSURE TO VARY AND THE MAIN VALVE MODULATES (OPENS AND CLOSES) MAINTAINING A RELATIVELY CONSTANT PRESSURE AT THE MAIN VALVE INLET. WHEN INLET PRESSURE IS LOWER THAN THE SET POINT OF CONTROL (3), CONTROL (3) CLOSES. THIS PRESSURIZES THE MAIN VALVE COVER CHAMBER AND THE MAIN VALVE CLOSES.
PRESSURE RELIEF CONTROL (3) ADJUSTMENT: TURN THE ADJUSTING SCREW CLOCKWISE TO INCREASE THE SETTING.

II. CLOSING SPEED CONTROL
NEEDLE VALVE (2) CONTROLS THE CLOSING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE CLOSE SLOWER. DO NOT CLOSE VALVE (2) COMPLETELY OR THE MAIN VALVE WILL NOT CLOSE. (SUGGESTED INITIAL SETTING OF NEEDLE VALVE IS 1/4 TO 1/2 TURN OPEN.)

III. CHECK VALVE FEATURE:
WHEN OUTLET PRESSURE IS HIGHER THAN INLET PRESSURE, CHECK VALVE (5) OPENS AND (4) CLOSES. THIS DIRECTS THE HIGHER OUTLET PRESSURE INTO THE MAIN VALVE COVER AND THE MAIN VALVE CLOSES.

IV. OPTIONAL FEATURE OPERATING DATA:
SUFFIX "B" (ISOLATION VALVES)
CK2 COCKS (B1) AND (B2) ARE USED TO ISLOATE THE PILOT SYSTEM FROM THE MAIN LINE PRESSURE. THESE VALVES MUST BE OPEN DURING NORMAL OPERATION.
SUFFIX "F" (REMOTE PILOT SENSING)
REMOTE SENSING PRESSURE IS OBTAINED FROM A POINT UPSTREAM OF THE MAIN VALVE INLET. (SENSING PRESSURE IS OBTAINED FROM THE MAIN VALVE INLET IF SUFFIX "F" IS NOT SPECIFIED).
SUFFIX "H" (ATMOSPHERIC DRAIN)
PILOT SYSTEM DRAIN LINE IS DISCHARGED TO ATMOSPHERE. (PILOT SYSTEM DRAIN LINE IS CONNECTED TO THE MAIN VALVE OUTLET BOSS IF SUFFIX "H" IS NOT SPECIFIED.)
SUFFIX "S" (OPENING SPEED CONTROL)
FLOW CONTROL (S) CONTROLS THE OPENING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE OPEN SLOWER.

V. CHECK LIST FOR OPERATION:
[ ] SYSTEM VALVES OPEN UPSTREAM AND DOWNSTREAM.
[ ] AIR REMOVED FROM THE MAIN VALVE COVER AND PILOT SYSTEM AT ALL HIGH POINTS.
[ ] CK2 COCKS (B1) & (B2) OPEN (OPTIONAL FEATURE).
[ ] PERIODIC CLEANING OF STRAINER (2) IS RECOMMENDED.
[ ] NEEDLE VALVE (2) OPEN 1/4 TO 1/2 TURN.
[ ] REMOTE CONTROL LINE PROPERLY CONNECTED (OPTIONAL FEATURE).
[ ] CK2 COCK (6) OPEN DURING NORMAL OPERATION.

REVISION RECORD
LTR | DESCRIPTION | BY | DATE

SEE SHEET 1

CLA-VAL CO.

INSTALLATION/OPERATION/MAINTENANCE

HYTROL REMOTE CONTROL VALVE

GLOBE	ANGLE
Model 100-01	*Model* 100-01

DESCRIPTION

The Hytrol Valve is the basis for most Cla-Val Co. Automatic Control Valves. It is a hydraulically operated, diaphragm-actuated, globe or angle pattern valve. This valve consists of three major components, the body, diaphragm assembly and cover. The diaphragm assembly is the only moving part.

The body contains a seat insert that forms a tight seal with the body. The diaphragm assembly uses a diaphragm of nylon fabric bonded with synthetic rubber. A synthetic rubber disc, contained on three and one half sides by a disc retainer and disc guide, forms a seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly forms a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

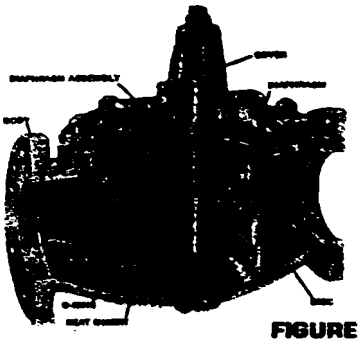


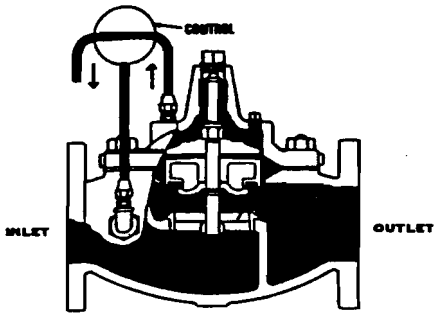
FIGURE 1

INSTALLATION

1. Before valve is installed, pipe lines should be flushed of all chips, scale and foreign matter.
2. It is recommended that either gate or block valves be installed on both ends of the Hytrol Valve to facilitate isolating the valve for preventive maintenance and repairs.
3. Place the valve in the line with flow through the valve in the direction indicated on the inlet name plate or by flow arrows.
4. Allow sufficient room around valve to make adjustments, and for disassembly.
5. Cla-Val Co. Hytrol Valves operate with maximum efficiency when mounted in horizontal piping with the cover UP, however, other positions are acceptable. Due to size and weight of the cover and internal components of 6 inch and larger valves, installation with the cover UP is advisable. This makes periodic inspection of internal parts readily accessible.
6. If a pilot control system is installed on the Hytrol Valve, use care to prevent damage. If it is necessary to remove fittings or components, be sure they are kept clean and replaced exactly as they were.
7. After the valve is installed and the system is first pressurized, vent air from the cover chamber and tubing by loosening fittings at all high points.

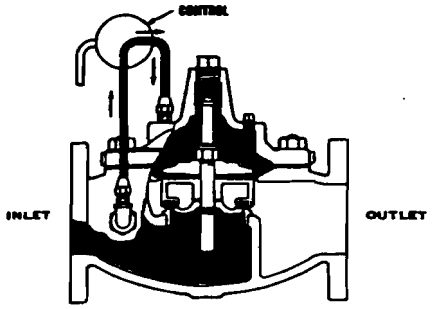
OPERATION OPEN-CLOSED SERVICE

When equipped with a three-way control valve the Hytrol Valve either opens wide or closes tight.



VALVE OPEN

The Hytrol Valve opens fully when there is no pressure in the cover chamber above the diaphragm, and there is at least five psi line pressure at the valve inlet.



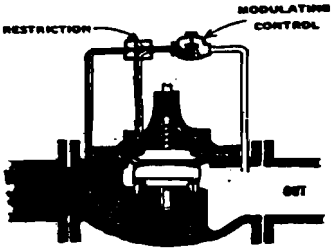
VALVE CLOSED

The Hytrol Valves close when the line pressure is directed into the cover chamber above the diaphragm. An independent operating supply may be used if its pressure is equal to, or greater than, pressure at the valve inlet.

FIGURE 2

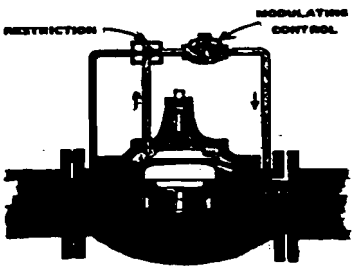
OPERATION MODULATING SERVICE

Modulating action can be obtained by installing a factory designed control system to the basic Hytrol Valve. Various types of modulating control systems are available to control pressure, flow rates and liquid levels.



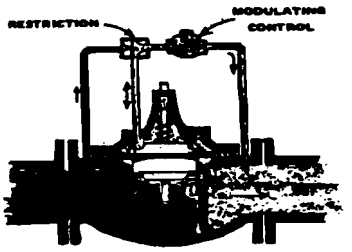
VALVE CLOSED

When the modulation control closes sufficiently to direct a great enough pressure into the cover chamber to overcome opening forces of line pressure, the main valve closes.



VALVE OPEN

When the modulating control opens to a point where more pressure is relieved from the cover chamber than the restriction can supply, cover pressure is reduced and the valve opens.



VALVE MODULATING

The main valve modulates to any degree of opening in response to changes in the modulating control. At an equilibrium point the main valve opening and closing forces hold the valve in balance. This balance holds the valve partially open, but immediately responds and readjusts its position to compensate for any changes in the controlling condition.

FIGURE 3

TROUBLE SHOOTING

The following trouble-shooting information deals strictly with the "Hytrol Valve". This assumes that everything but the main valve elf has been completely isolated, i.e. each part of the control stem is hydraulically blocked from the main valve. All trouble shooting is possible without removing the valve from the line.

SERVICE SUGGESTIONS

SYMPTOM	*PROBABLE CAUSE	REMEDY
Fails to close	Closed cocks in control system, or in main line.	Open cocks.
	Lack of cover chamber pressure.	Check upstream pressure, strainer, tubing, cocks, needle valves for restriction.
	Diaphragm damaged. (See note)	Replace diaphragm.
	Diaphragm assembly inoperative. Corrosion or excessive scale build up on valve system.	Clean and polish stem. Replace any defective part, damaged, badly eroded.
	Mechanical obstruction. Object lodged in valve.	Remove obstruction.
	Worn disc.	Replace disc.
	Badly scored seat.	Replace seat.
Fails to open	Closed isolation valves or cocks in pilot system, or in main line.	Open valves or cocks.
	Insufficient line pressure.	Check pressure.
	Diaphragm assembly inoperative. Corrosion on valve stem.	Clean and polish stem. Replace any defective part, damaged, badly eroded.
*Assuming control system is functioning properly.		

NOTE: The following method will determine if there is a damaged diaphragm without removing the valve cover: Put pressure into the valve and close all control lines to the valve cover chamber. Loosen a fitting on the valve cover; if there is continuous flow out of the cover chamber through this opening, the diaphragm is damaged, or the diaphragm assembly on the stem is loose. Replacement of the diaphragm or tightening of the stem nut may be needed. Refer to the maintenance section for procedure.

Freedom of Movement

1. Shut off pressure to the control system. On larger valves this can be done simply by closing cocks in the control system. On the smaller valves without shutoff cocks, it is necessary to shut off the main line pressure before disconnecting and blocking off the control system.

   CAUTION: Care should be taken when doing the above since removal of pressure from the cover chamber while pressure exists in the valve body will permit the valve to open wide. This will either permit a high flow rate through the valve, or the downstream pressure will quickly increase to a point close to or equal to the inlet pressure. In some cases, this can be very harmful. Where this is the case, and there are no block valves in the system to protect the downstream piping, it should be realized that the valve cannot be serviced under pressure. Steps should be taken to remedy this situation before proceeding any further.

   Usually, there is a block valve within close proximity downstream which can be closed to prevent the high inlet pressure from getting into the downstream piping even though the Hytrol valve is permitted to go wide open. Once it is clear that a wide open valve can be tolerated, then the trouble shooting can proceed.

2. Disconnect all control lines to the valve cover and leave fittings in cover open to atmosphere.

3. With the cover vented to atmosphere and pressure in the valve body, observe the open cover tapping for signs of continous flow. If the fluid appears to flow continuously there is a good reason to believe the diaphragm is either damaged, or it is loose on the stem. In either case, this is sufficient cause to remove the valve cover and investigate the leakage. Caution—make sure upstream block valve is closed before cover is removed. If there is no continuous flow, you can be quite certain the diaphragm is sound and the diaphragm assembly tight.

4. If the valve has a Cla-Val Co. X101 position indicator, observe the indicator to see that the valve opens wide. Mark the point of maximum opening.

5. If the valve isn't equipped with an X101 valve position indicator, the trouble shooter should install one. This is part of the indispensable equipment the service man should have.

6. Re-connect enough of the control system to permit the application of inlet pressure to the cover. Open cock or valve so pressure flows from the inlet into the cover.

7. While pressure is building up in the cover, the valve should close smoothly without any hesitations. There is a hesitation in every Hytrol valve closure, however, which can be mistaken for a mechanical bind. The stem will appear to stop moving very briefly before going to the closed position. This slight pause is caused by the diaphragm flexing at a particular point in the valve's travel and is not caused by a mechanical bind.

8. When closed, a mark should be made on the X101 valve position indicator corresponding to the "closed" position. The distance between the two marks should be approximately .28 x valve size.

   EXAMPLE: The stroke on a 4" valve is 4 x .28 or 1.12 inches from full open to full close.

STEM TRAVEL
(fully open to fully closed)

VALVE SIZE		TRAVEL	
INCHES	MM	INCHES	MM
1	25	0.3	8
1¼	32	0.4	10
1½	40	0.4	10
2	50	0.6	15
2½	65	0.7	18
3	80	0.8	20
4	100	1.1	28
6	150	1.7	43
8	200	2.3	57
10	250	2.8	71
12	300	3.4	86
14	350	3.9	100
16	400	4.5	114

If the stroke is different than that calculated, there is a good reason to believe something is mechanically restricting the stroke of the valve at one end of its travel. If the flow doesn't stop through the valve when in the indicated "closed" position, the obstruction probably is between the disc and the seat. If the flow does stop, then the obstruction is more likely in the cover. In either case, operation of the valve two or three times by alternately applying and relieving pressure is a good idea. Sometimes this will serve to dislodge a foreign object from the seat, or clear whatever is obstructing the valve movement. If this is not successful, then the cover must be removed, and the obstruction located and removed. The stem should also be checked for scale build-up. Refer to maintenance section for procedure to remove lime

Tight Sealing

If the trouble-shooting to this point has disclosed no problems relative to freedom of movement or a damaged diaphragm, the only other problem of any concern is whether or not the valve shuts off tight under the conditions of operation. If it does not shut off tight, check disc and seat for wear.

MAINTENANCE

Preventive Maintenance

Cla-Val Co. Hytrol Valves require no lubrication or packing and a minimum of maintenance. However, a periodic inspection schedule should be established to determine how the fluid velocity as well as the substances occurring in natural waters, such as dissolved minerals, colloidal and suspended particles, are affecting the valve. The effect of these actions or substances must be determined by inspection.

Disassembly

Inspection or maintenance can be accomplished without removing the valve from the line. Shut off all pressure to the valve, both line and independent operating pressure when used.

WARNING Maintenance personnel can be injured and equipment damaged if disassembly is attempted with pressure in the system.

1. Loosen a tube fitting to remove cover chamber pressure. After pressure has released from the valve and cover chamber, remove the controls and tubing. Obtain a schematic of the assembly or note and sketch position of tubing and controls for reassembly.
2. Remove cover nuts Figures 6 through 9 and remove cover. If the valve has been in service for any length of time, chances are the cover will have to be loosened by driving upward along the edge of the cover with a dull cold chisel. See Figure 4. When block and tackle or a power hoist is to be used to lift valve cover, insert proper size eye bolt in place of the center cover plug (1) Figure 9 Pull cover straight up to keep from damaging the integral seat bearing and stem.

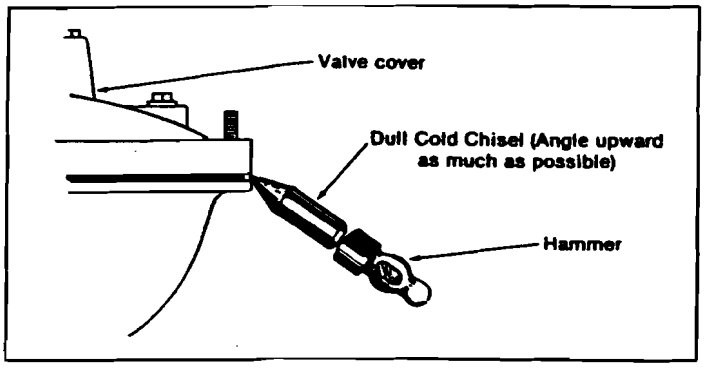


FIGURE 4

3. Remove the diaphragm and disc assembly from the valve body. With smaller valves this can be accomplished by hand, pulling straight up on the stem so as not to damage the seat or stem. On large valves, an eye bolt of proper size can be installed in the stem and the disc assembly can be then lifted with a block and tackle or power hoist.
4. The next item to remove is the stem nut. Examine the stem threads above the nut for signs of mineral deposits or corrosion deposits. If the threads are not clean, use a wire brush to remove as much of the residue as possible. Attach a good fitting wrench to the nut and give it a sharp "rap" rather than a steady pull. Usually this is sufficient to loosen the nut for further removal. On smaller valves where the entire diaphragm assembly can be removed, holding the stem in a vice equipped with soft brass jaws and following the same suggestion outlined above for removing the stem nut.

CAUTION: DO NOT USE A PIPE WRENCH OR VICE WITHO SOFT BRASS JAWS ON THE UPPER OR LOWER END OF T VALVE STEM. This practice scars the fine finish on the stem, a no amount of careful dressing can restore the stem to its origi condition. This will cause the stem to bind in the bearings and t valve will not open or close.

5. After the stem nut has been removed, the diaphragm assemt breaks down into its component parts quite easily. Removal the disc from the disc retainer can be a problem if the valve h been in service for a long time. Using two screwdrivers i serted along the outside edge of the disc usually will a complish its removal. Care should be taken to preserve t space washers particularly if no new ones are available f reassembly.
6. The only part left in the valve is the seat ring which ordinari does not require removal. If, however, it is badly worn and r placement is necessary, it can be removed using the followir tools: Seats in valve sizes ½" and ¾" can be removed with a h socket wrench. (Seats in stainless steel valves sizes ½" and ¾ are integral seats and cannot be removed.) Seats in valve siz 1" through 6" should be removed with accessory X-109 Se Removing Tool available from the factory. Seats in valve siz 8" and larger are held in place by flat head machine screws. upon removal of the screws the seat cannot be lifted out, it w be necessary to use a piece of angle or channel iron with a ho drilled in the center. Place it across the body so a long stud c be inserted through the center hole in the seat and the hole the angle iron. By tightening a nut an upward force is exerted c the seat. See Figure 5.

NOTE: Do not lift up on the angle iron as this may force the int gral bearing out of alignment, causing the stem to bind.

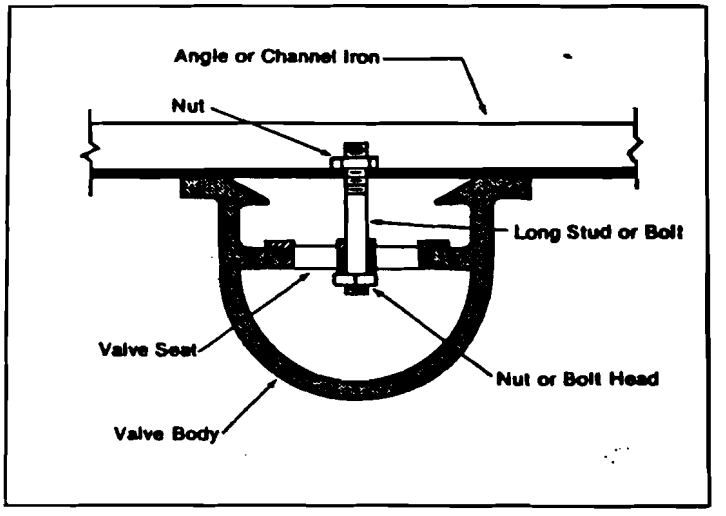


FIGURE 5

Lime Deposits

One of the easiest ways to remove lime deposits from the valv stem is to dip it in a 5-percent muriatic acid solution just lon enough for the deposit to dissolve. This will remove most of th common types of deposits. CAUTION: USE EXTREME CAR WHEN HANDLING ACID. RINSE PARTS IN WATER BEFOR HANDLING. If the deposit is not removed by acid, then a fine gr (400) wet or dry paper can be used with water. If the build-up o deposits on the valve stem is a consistent problem, there ar stems that have been sleeved with a plastic material called Delri that have been very successful in eliminating lime deposits tha tend to form on the valve stem. These stems are available in nev valves and as a replacement part for existing valves. Contact you Cla-Val Co. representative for complete details.

Inspection of Parts

After a valve has been disassembled, each part should be examined carefully for signs of wear, corrosion, or any other abnormal condition. Usually, it is a good idea to replace the resilient parts (diaphragm and disc) unless they are free of signs of wear. Any which appear doubtful should be replaced.

NOTE: If a new disc isn't available, the existing disc can be turned over, exposing the unused surface for contact with the seat.

Reassembly

1. Reassembly is the reverse of the disassembly procedure. If a new disc (*) has been installed, it may require a different number of spacer washers (*) to obtain the right amount of "grip" on the disc. When the diaphragm assembly has been tightened to a point where the diaphragm cannot be twisted, the disc should be compressed very slightly by the disc guide. Excessive compression should be avoided. Use just enough spacer washers to hold it firmly.

2. Make sure the stem nut is made up very tight. Failure to do so could allow the diaphragm to pull loose and tear when subjected to pressure.

3. Carefully install the diaphragm assembly by lowering the stem through the seat bearing. Take care not to damage the stem or bearing. Line up the diaphragm holes with the stud or bolt holes on the body. On larger valves with studs, it may be necessary to hold the diaphragm assembly up while stretching the diaphragm over the studs.

4. Put spring in place and replace cover. Make sure diaphragm is lying smooth under the cover.

5. Tighten cover nuts firmly using a cross-over pattern until all nuts are tight.

6. Re-install the pilot system and tubing exactly as it was prior to removal.

Test Procedure for Valve Assembly

There are a few simple tests which can be made in the field to make sure the valve has been assembled properly.

1. It is possible to check the diaphragm assembly for freedom of movement by inserting a rod into the threaded hole in the top of the valve stem and lifting the diaphragm assembly manually. The rod should be threaded on one end and have a "T" bar handle of some kind on the other end for easy gripping. The diaphragm assembly should move freely without any signs of sticking or grabbing. Due to the weight of the diaphragm assembly this procedure is not possible on valves larger than 10".

2. On the larger valves, the same determination can be made by carefully introducing a low pressure (less than five psi) into the valve body with the cover vented. The diaphragm assembly should lift easily without hesitation, and then settles back easily when the pressure is removed.

3. To check the valve for drip-tight closure, a line should be connected from the inlet to the cover, and pressure applied at the inlet of the valve. If properly assembled, the valve should hold tight with as low as ten psi at the inlet.

4. With the line still connected from the inlet to the cover, apply full working pressure to the inlet. Check all around the cover for any leaks. Re-tighten cover nuts if necessary to stop leaks past the diaphragm.

* Refer to Figure 9.

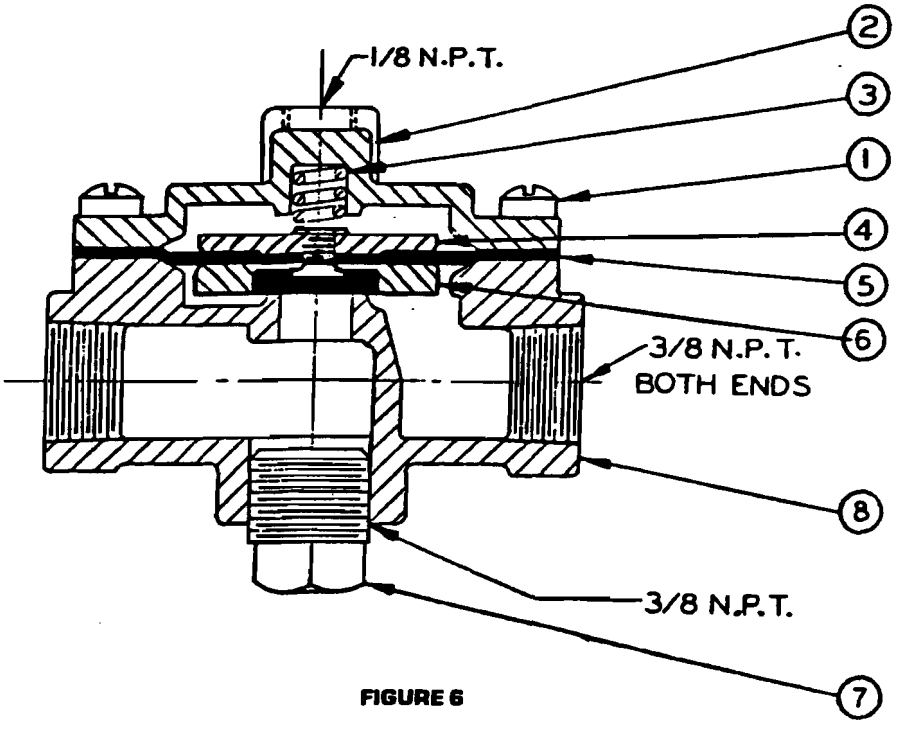


FIGURE 6

3/8" HYTROL

PARTS LIST

ITEM	DESCRIPTION
1	Machine Screw
2	Cover
3*	Spring
4	Diaphragm Washer
5*	Diaphragm
6*	Disc Retainer Assembly
7	Body Plug (¾" NPT)
8	Body

*RECOMMENDED SPARE PARTS

1/2" & 3/4" HYTROL

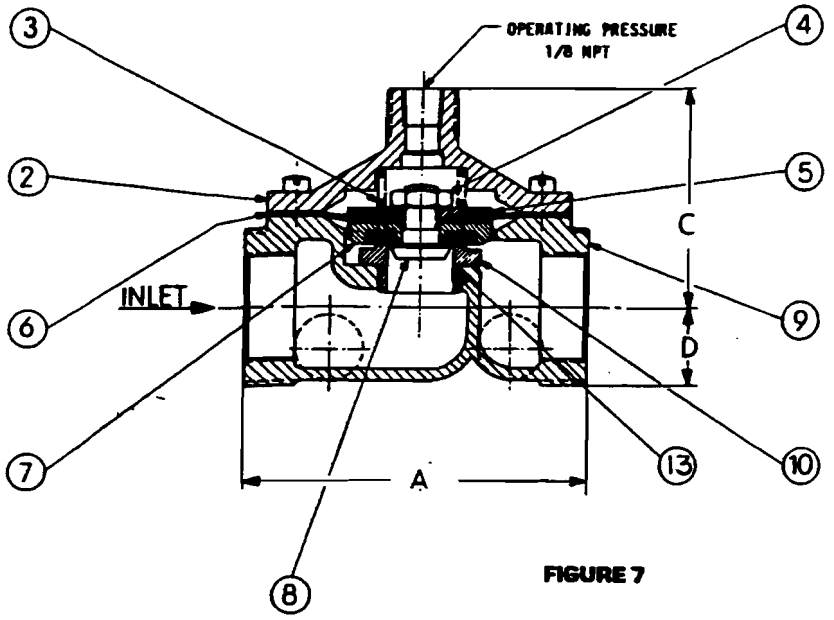
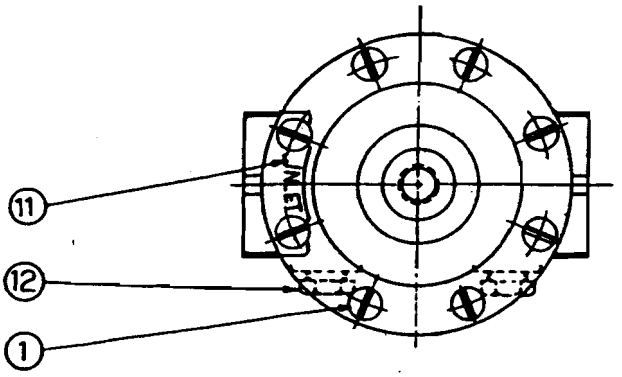


FIGURE 7

PARTS LIST

ITEM	DESCRIPTION
1	Cover Screw
2	Cover
3*	Spring
4	Stem Nut
5	Diaphragm Washer
6*	Diaphragm
7*	Disc Retainer Assembly
8	Disc Guide & Stem
9	Body
10	Seat (Stainless Steel Valves have integral seat
11	Nameplate
12	Body Plug Hex Head
13*	O-Ring, Seat (not used with integral seats)

*RECOMMENDED SPARE PARTS



1" HYTROL

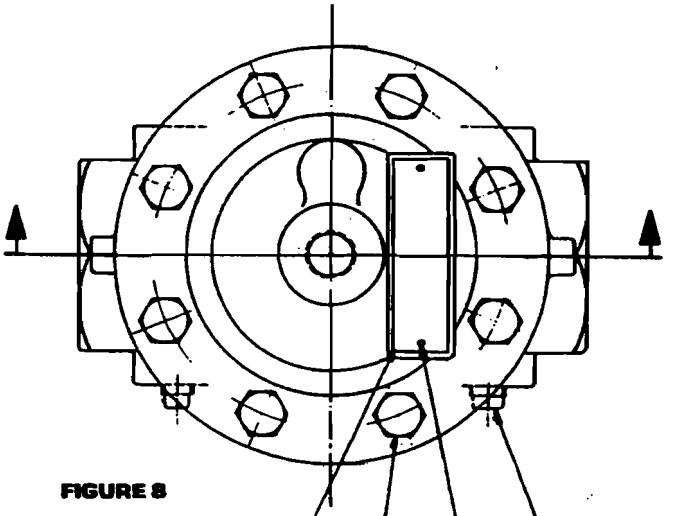
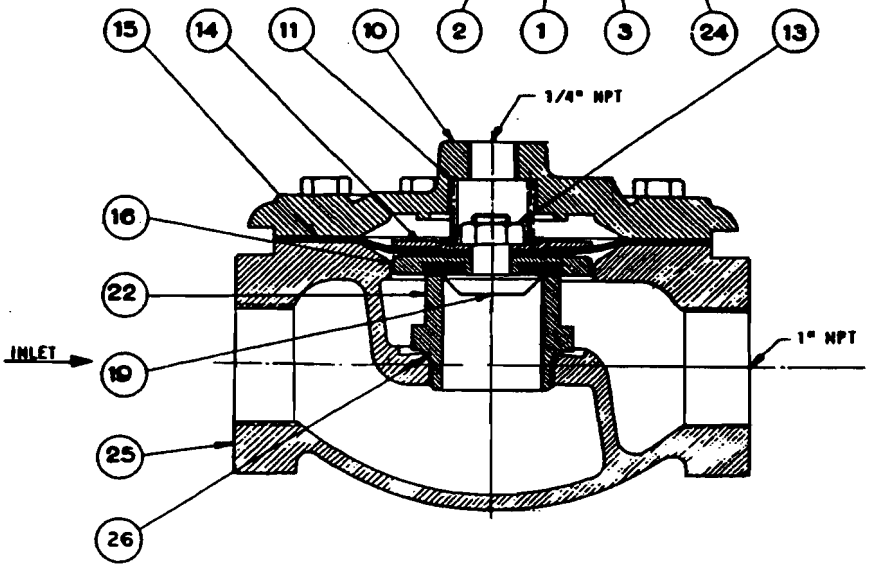


FIGURE 8

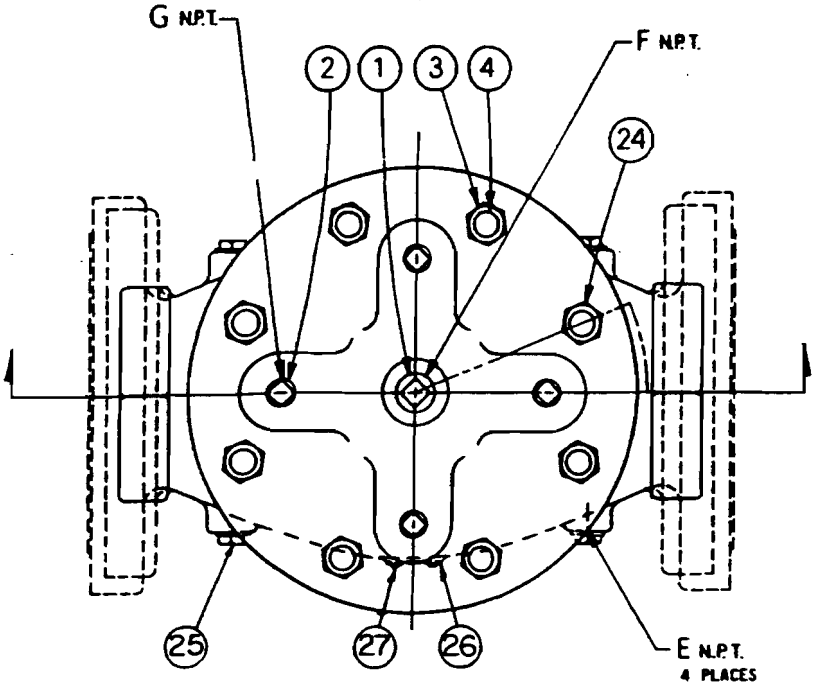


PARTS LIST

ITEM	DESCRIPTION
1	Cover Screw
2	Nameplate
3	Nameplate Screw
10	Cover
11*	Spring
13	Stem Nut
14	Diaphragm Washer
15*	Diaphragm
16*	Disc Retainer Assembly
19	Disc Guide
22	Seat
24	Body Plug
25	Body
26*	O-Ring Seat

*RECOMMENDED SPARE PARTS

1-1/4" thru 16" HYTROL



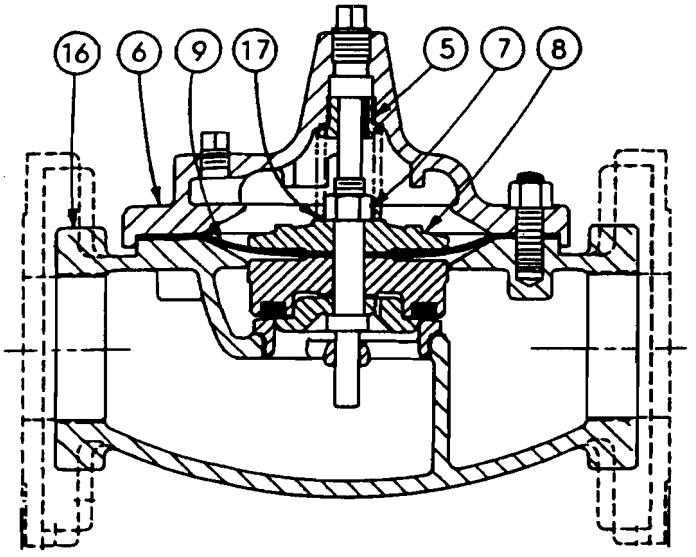


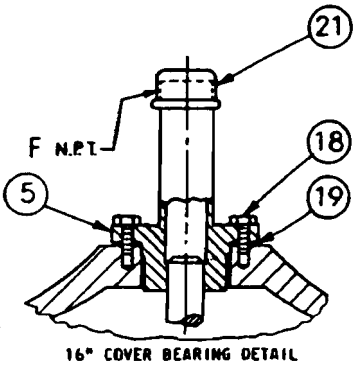
FIGURE 8

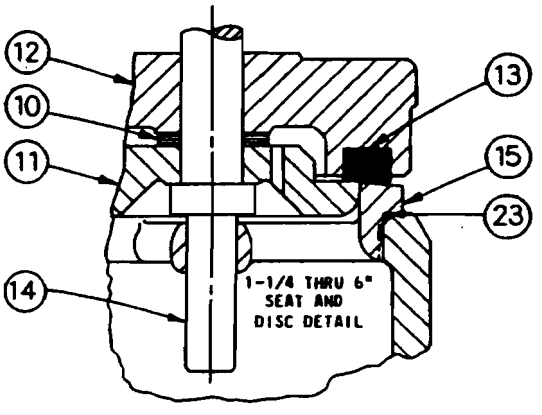
PARTS LIST

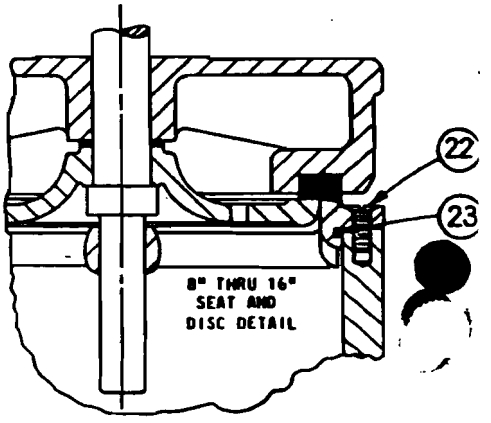
ITEM	DESCRIPTION
1	Center Cover Plug
2	Cover Plug
3	Stud Nut
4	Stud
5	Cover Bearing
6	Cover
7	Stem Nut
8	Diaphragm Washer
9*	Diaphragm
10	Space Washer
11	Disc Guide
12	Disc Retainer
13*	Disc
14	Stem
15	Steat
16	Body
17	Spring
18	Cover Bearing Screw (16" only)
19*	Cover Bearing Gasket (16" only)
21	Pipe Cap (16" only)
22	Seat Screw (8" - 16" only)
23*	O-Ring, Seat
24	Bolt, Cover (4" and smaller)
25	Plug, Body
26	Nameplate
27	Screw, Drive

*RECOMMENDED SPARE PARTS

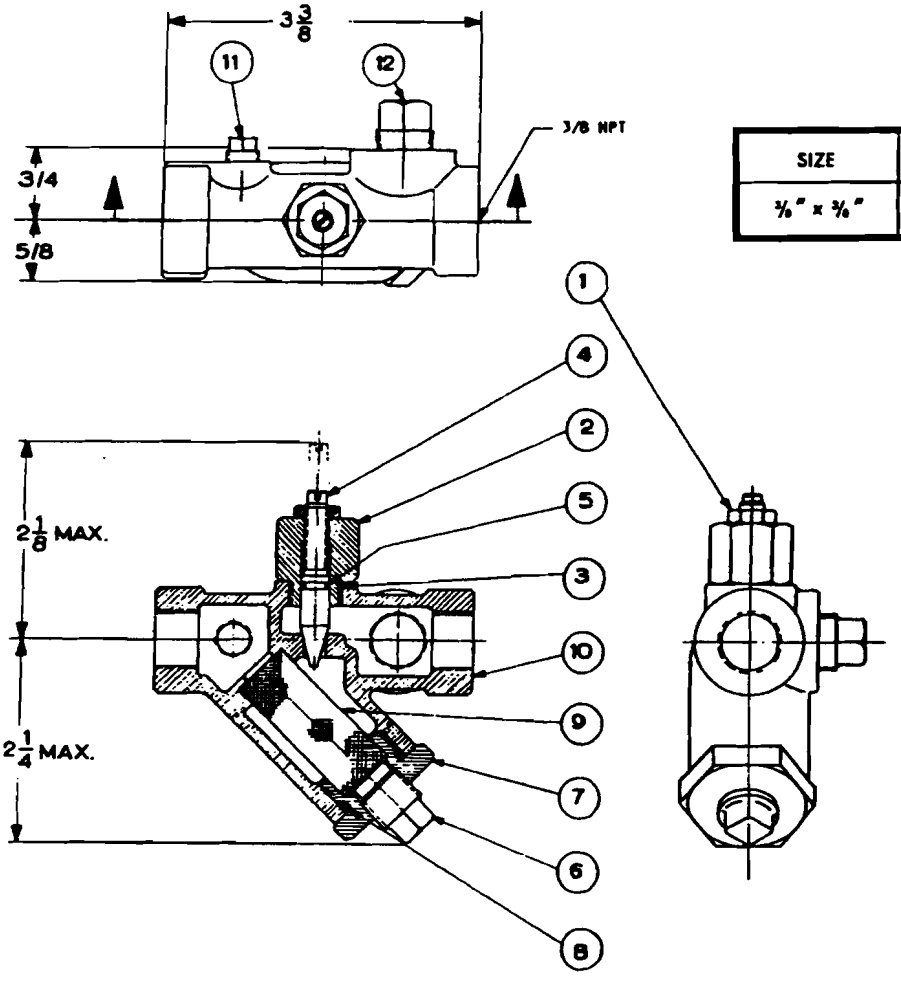
NO. 100 HYTROL VARIATIONS	
CATALOG NO.	DESCRIPTION
100	NORMAL FLOW HYTROL AS SHOWN (FLOW UNDER THE SEAT)
100KR	REVERSE FLOW HYTROL (FLOW OVER THE SEAT)
100KZ	OMIT SPRING (ITEM 17)
100KH	WITH HEAVY SPRING
100KT	WITH HIGH TEMPERATURE DIAPHRAGM (250° F. MAXIMUM)







C	CLA-VAL CO.	PARTS LIST
	STRAINER AND NEEDLE VALVE ASSEMBLY	X-42N-2



SIZE	STOCK NUMBER
⅜" x ⅜"	68372

ITEM	DESCRIPTION	MATERIAL	PART NO.
1	Jam Nut—Hex	Sil Brz	67798-01
2	Bonnet	S.S.	67910
3	"O" Ring—Bonnet	Syn Rub	00713
4	Stem	S.S.	67907
5	"O" Ring—Stem	Syn Rub	00708
6	Plug—Pipe 1/4		
7	Strainer Plug		
8	"O" Ring—Plug		
9	Screen	Monel	68373
10	Body	Rd Brs	67905
11	Plug—Pipe 1/8	Brass	67660-01
12	Plug—Pipe 3/8	Brass	67660-03

When ordering parts specify: • All nameplate data • Description • Item Number

CLA-VAL CO.

INSTALLATION / OPERATION / MAINTENANCE

PRESSURE RELIEF CONTROL

Model CRL

DESCRIPTION

Model CRL Pressure Relief Control is a direct-acting, spring-loaded, diaphragm type relief valve. It may be used as a self-contained valve or as a pilot control for a Cla-Val Hytrol valve. It opens and closes within very close pressure limits.

INSTALLATION

The pressure Relief Control may be installed in any position. The control body (7) has one inlet and one outlet port with a side pipe plug (24) at each port. These plugs are used for control plumbing or gauge applications. The inlet in the power unit body (6) is the sensing line port. A flow arrow is marked on the body casting.

OPERATION

The pressure Relief Control is normally held closed by the force of the compression spring above the diaphragm; control pressure is applied under the diaphragm.

When the controlling pressure exceeds the spring setting. The disc is lifted off its seat, permitting flow through the control.

When controlling pressure drops below spring setting, the spring returns the control to its normally closed position.

ADJUSTMENT

The pressure Relief Control can be adjusted to provide a relief setting at any point within the range stamped on the data plate.

Pressure adjustment is made by turning the adjustment screw (9) to vary the spring pressure on the diaphragm. Turning the adjustment screw clockwise increases the pressure required to open the valve. Counterclockwise decreases the pressure required to open the valve.

When pressure adjustments are complete the jam nut (10) should be tightened and the protective cap (1) replaced. If there is a proble of tampering, lock wire holes have been provided in cap and cover. Wire the cap to cover and secure with lead seal.

DISASSEMBLY

The Pressure Relief Control does not need to be removed from the line for disassembly. Make sure that pressure shut down is accompanied prior to disassembly. If the Pressure Relief Control is removed from the line for disassembly be sure to use a soft jawed vise to hold body during work.

Refer to Parts List Drawing for item numbers.

1. Remove cap (1), loosen jam nut (10) and turn adjusting screw counterclockwise until spring tension is relieved.
2. Remove the eight screws (4) holding the cover (3) and powerunit body (6). Hold the cover and powerunit together and place on a suitable work surface. See NOTE under REASSEMBLY.
3. Remove the cover (3) from powerunit body (6). The spring (12) and two spring guides (11).
4. Remove nut (13) from stem (19) and slide off the belleville washer (14), the upper diaphragm washer (15) and the diaphragm (16).
5. Pull the stem (19) with the disc retainer assembly (21) through the bottom of powerunit. The lower diaphragm washer (17) will slide off of stem top.
6. Remove jam nut (23) and disc retainer assembly (21) from stem. Use soft jawed pliers or vise to hold stem. The polished surface of stem must not be scored or scratched.
7. The seat (22) need not be removed unless it is damaged. If removal is necessary use proper size socket wrench and turn counterclockwise.
   Note: Some models have an integral seat in the body (7)

See PL-CRL on reverse side for PART ITEM Reference

INSPECTION

Inspect all parts for damage, or evidence of cross-threading. Check diaphragm and disc retainer assembly for tears, abrasion or,other damage. Check all metal parts for damage, corrosion, or excessive wear.

REPAIR AND REPLACEMENT

Minor nicks and scratches may be polished out using fine emery or crocus cloth. Replace all "O" rings and any damaged parts.

When ordering replacement parts, be sure to specify parts list item number and all name plate data.

REASSEMBLY

In general, reassembly is the reverse of disassembly, however, the following steps should be observed:

1. Lubricate the "O" ring (18) with a good grade of waterproof grease, Dow Corning 44 medium grade or equal. Use grease sparingly and install "O" ring in powerunit body (6).
2. Install stem (19) in powerunit body (6). Use a rotating motion with minimum pressure to let stem pass through "O" ring.
3. Install "O" ring (5) at top of stem (19). Place lower diaphragm washer (17) on the stem with the serrated side up. Position diaphragm (16), upper diaphragm washer (15), with serrations down, and belleville washer (14) with concave side down.
4. Position powerunit body (6) as shown on parts list drawing (top view).
5. Continue reassembly as outlined in disassembly steps 1 through 3.
   Note: Item (4) will have a quantity of 8 for the 0-75 and 20-200psi design and a quantity of 4 for the 100-300psi design. Item (25) is used on the 100-300psi design only. Install item (25), before item (4) for preload of item (12) spring.

SERVICE SUGGESTIONS

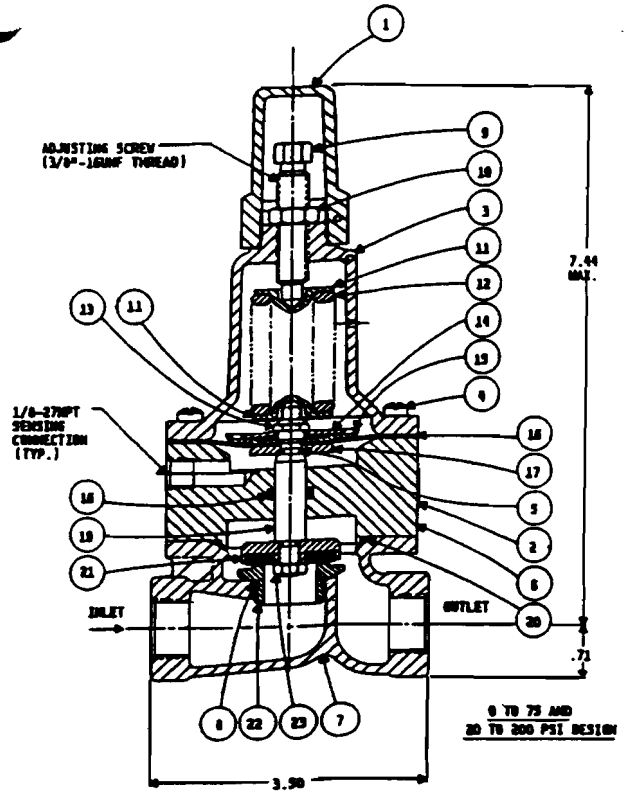
SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open.	Controlling pressure too low.	Back off adjusting screw until valve opens.
Fails to open with spring compression removed.	Mechanical obstruction, corrosion, scale build-up on stem.	Disassemble, locate, and remove obstruction, scale.
Leakage from cover vent hole when controlling pressure is applied.	Diaphragm damage.	Disassemble, replace damaged diaphragm.
	Loose diaphragm assembly.	Tighten upper diaphragm washer.
Fails to close.	No spring compression.	Re-set pressure adjustment.
Fails to close with spring compressed.	Mechanical obstruction.	Disassemble, locate and remove obstruction.

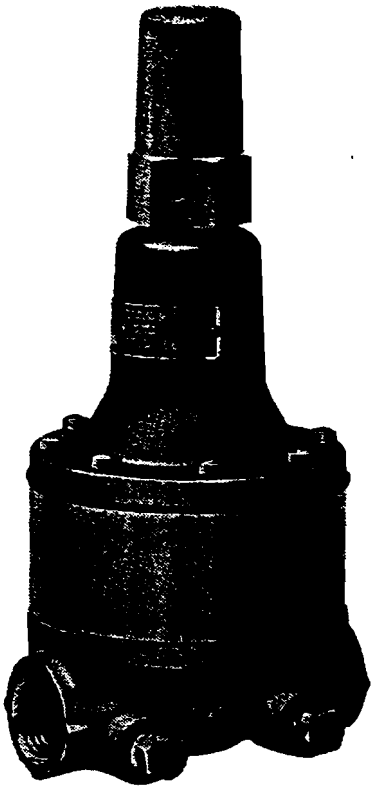
CLA-VAL CO.

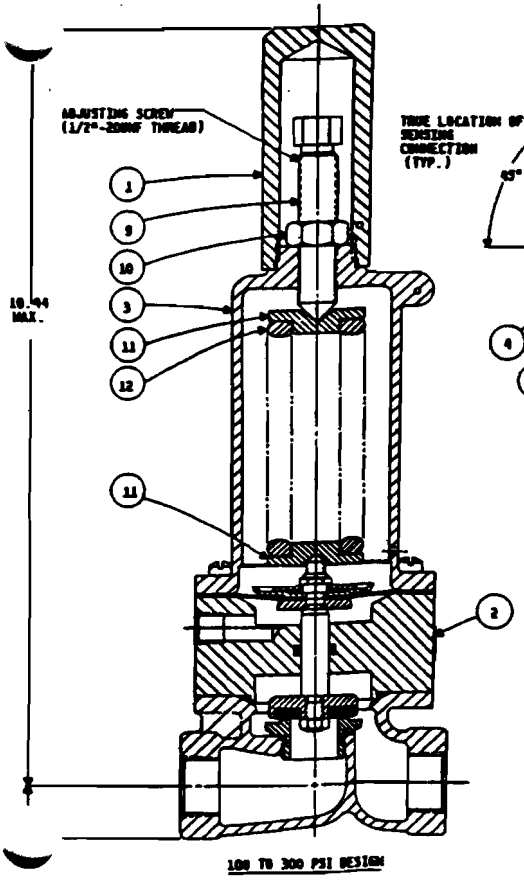
PRESSURE RELIEF CONTROL

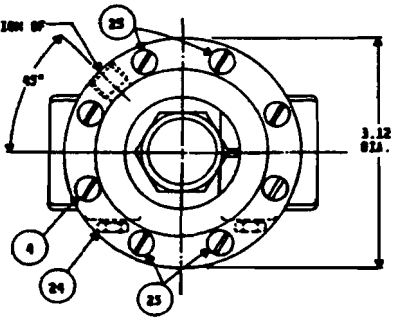
PARTS LIST

1/2" & 3/4" Model CRL

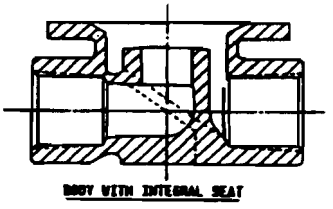








CRL RANGE PSI	APPROXIMATE INCREASE FOR EACH CLOCKWISE TURN OF ADJUSTING SCREW
0 TO 75	6.3 PSI
20-TO 200	28.0 PSI
100 TO 300	18.0 PSI



ITEM NO.	DESCRIPTION	QTY.
1	CAP	1
2	NAMEPLATE	1
3	COVER	1
4	SCREW FIL.HD.#10-32 X 100 LG. SEE NOTE ⚠	A/R
* 5	O-RING	2
6	BODY , POWERUNIT	1
7	BODY	1
* 8	O-RING , SEAT	1
9	SCREW , ADJUSTING	1
10	NUT , HEX	1
11	GUIDE , SPRING	2
12	SPRING	1
13	NUT , STEM	1
14	WASHER , BELLEVILLE	1
15	WASHER , DIAPHRAGM (UPPER)	1
* 16	DIAPHRAGM	1
17	WASHER , DIAPHRAGM (LOWER)	1
* 18	O-RING	1
* 19	STEM	1
20	O-RING	1
21	RETAINER ASSEMBLY , DISC	1
22	SEAT	1
23	NUT , HEX	1
24	PLUG , PIPE SR. HD.	2
25	SCREW FIL.HD. #10-32 X 2.25 LG. SEE NOTE ⚠	4

* • RECOMMENDED SPARE PARTS

NOTES:
1. INSTALL ITEM NO.25 (SCREW) BEFORE ITEM NO.4 (SCREW) FOR PRELOAD OF ITEM NO.12 (SPRING).
⚠ ITEM NO.4 WILL HAVE A QUANTITY OF 8 FOR THE 0-75 & 20-200 PSI DESIGN AND A QUANTITY OF 4 FOR THE 100-300 PSI DESIGN. ITEM NO.25 IS USED ON THE 100-300 PSI DESIGN ONLY.

When ordering parts specify:

- All nameplate data
- Item Number
- Description
- *Recommended Spare Parts

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA CVCL 1 2 3 4

CATALOG NO.	DRAWING NO.	REV
DATA	47117	R

DIST. CODE 027

DESIGN	
DRAWN 9/7/63	NC
CHK'D. 9/9/63	JM
APP'D. 9/9/63	HWE
SCALE	

REGULATOR SPRING COLOR CODING CHART

*THESE FIGURES ARE ONLY APPROXIMATE. FINAL ADJUSTMENTS SHOULD BE MADE WITH A PRESSURE GAGE.

WIRE SIZE (REF.)	SPRING NO.	COLOR	WIRE MATERIAL	CATALOG NO	RANGE PSI	*PSI PER TURN
.080 DIA.	C492	BLUE	STAINLESS STEEL	CDB-7	0-7	.75
				CRL5	0-7	.75
.120 DIA.	TV5654	GREEN	CHROME VANADIUM	CRD	10-40	4
				CRL5	5-25	4
.162 DIA.	32447	NATURAL	STAINLESS STEEL	CDB-7	10-60	12.0
				CRD	20-80	10.5
				CRL5	10-60	12.0
.162 DIA.	TV5695	YELLOW	MUSIC WIRE	CDB-7	20-80	14.5
				CRD	30-110	13.0
				CRL5	20-80	14.5
.207 DIA.	C1124	CAD PLATE	MUSIC WIRE	CDB-7	50-150	29.5
				CRD	50-150	30
				CRL5	50-150	29.5
.225 DIA.	TV6515	RED	MUSIC WIRE	CDB-7	65-180	44
				CRD	90-200	47
				CRL5	65-180	44
.225x.350	44591	CAD PLATE	CHROME VANADIUM	CRD18	30-300	14.5
.115x.218	71884	RED	CHROME VANADIUM	CRD	15-75	9.0
				CRL	0-75	8.5
				CRD10A	15-75	7.2
.188x.225	71885	GREEN	CHROME VANADIUM	CRD	30-300	27.0
				CRL	20-200	28.0
				CRD10A	30-300	22.4

REVISION RECORD

DESCRIPTION	BY	DATE
UPDATE CATALOG NO. FROM CDB TO CDB-7;ECO1467	BR	4/24/80
ECO 00719 ADD PST RANGE P/N 48211	WW	9/4/81
THRU M SEE REVISION FILE		

DRAWN ECO 3143 -81

M U.S.A.

M F-4 REV

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA CVCL 1 2 3 4

CATALOG NO.	DRAWING NO.	REV
DATA	47117	E

DIST. CODE 027

DESIGN	9/7/63	NC
DRAWN	9/9/63	JM
CHK'D.	9/9/63	HWE
APP'D.		
SCALE		

REGULATOR SPRING COLOR CODING CHART

*THESE FIGURES ARE ONLY APPROXIMATE. FINAL ADJUSTMENT SHOULD BE MADE WITH A PRESSURE GAGE.

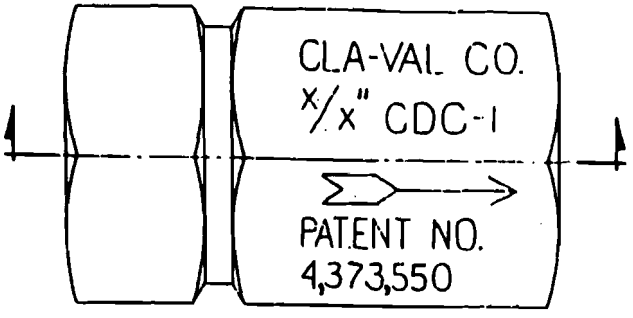
WIRE SIZE (REF)	SPRING NO.	COLOR	WIRE MATERIAL	CATALOG NO	RANGE PSI	*PSI PER TURN
.080 DIA.	82575		ST. STEEL	CRD	1.9-6.5	.61
				CRD10A	1.9-6.5	.49
.116 DIA.	81594		ST. STEEL	CRD	2-30	3.0
				CRD10A	2-30	2.4
.225X.295	82813	CAD PLT	CHROME VANADIUM	CRL	100-300	18.0

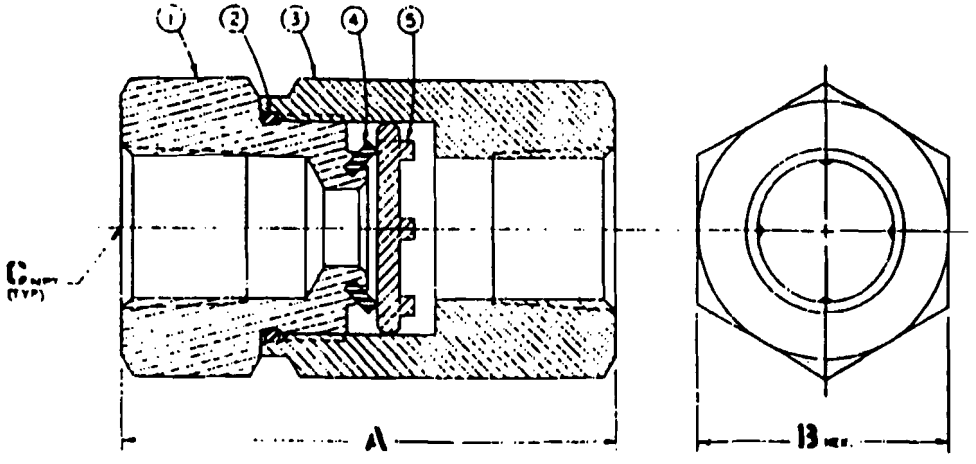
WIRE SIZE (REF.)	SPRING NO.	COLOR	WIRE MATERIAL	CATALOG NO.	RANGE FEET	*FEET PER TURN
.080 DIA.	C492	BLUE	ST. STEEL	CRD2	4.5-15	.82
.120 DIA.	TV5654	GREEN	CHR. VAN.	CRD2	10-70	7.00
.162 DIA.	TV5695	YELLOW	MUS. WIRE	CRD2	50-170	26.00
.688	81617	EPOXY COAT	A1515160	CDS-4	5-100	1.68
.875	81618	EPOXY COAT	A1515160	CDS-4	50-225	5.8

WIRE SIZE	SPRING NO.	COLOR	WIRE MATERIAL	CATALOG NO.	PSI RANGE	PSI PER TURN
.312 DIA.	31554	CAD PLATE	CHR. VAN.	CRL-4A	30-300	10.0
.44 X .219	48211	CAD PLATE	STEEL	CRD-22 CRA-1B	200-450	17.0
				CRL-4A	100-450	
.148	C7549		302 SS	CRL-4	0-35 0-23	.82
.207	C8575	CAD PLATE	CHR. VAN.	CRL-4	5-85	4.1

DATE | BY | DESCRIPTION | REVISION RECORD

PARTS LIST		
NO.	DESCRIPTION	QTY
1	RETAINER, SEAL	1
2	O-RING	1
3	RETAINER, VALVE	1
4	SEAL, VALVE RING	1
5	PLATE, VALVE	1





DESCRIPTION	A	B	C
3/8" CHECK VALVE	2 1/8	3/4	3/8
1/2" CHECK VALVE	2 1/2	1	1/2

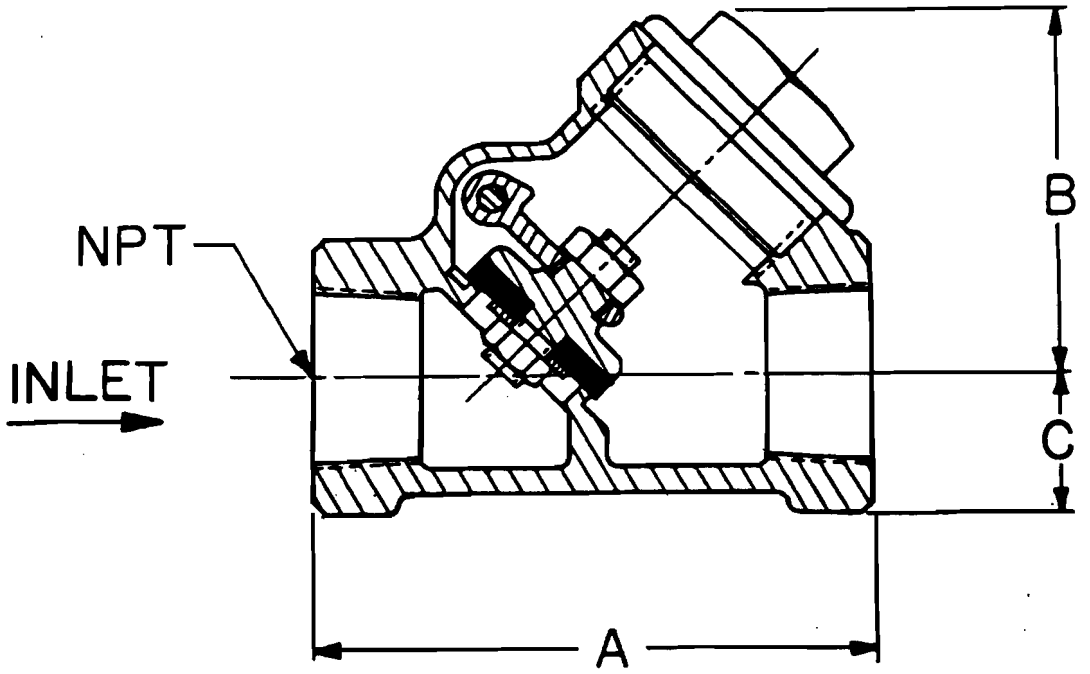
CLA-VAL CO.

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

CATALOG NO.	DRAWING NO.
CSC	92667

DESIGN	
DRAWN 11-5-76	CH
CHK'D. 11-8-76	M.
APP'D. 11.9.76	J.A.
SCALE DIST. CODE --	

CSC SWING CHECK VALVE



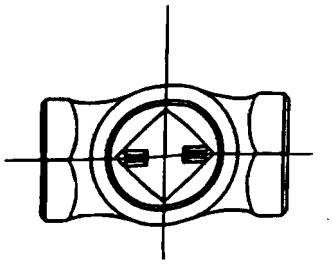
PIPE SIZE N.P.T.	A	B	C
1/4	2-1/8	1-5/8	1/2
3/8	2-1/8	1-5/8	1/2
1/2	2-7/16	1-11/16	5/8
3/4	2-15/16	1-7/8	3/4
1	3-3/16	2-3/32	15/16

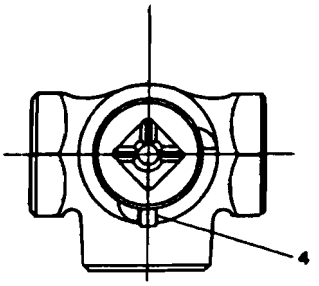
REVISION RECORD

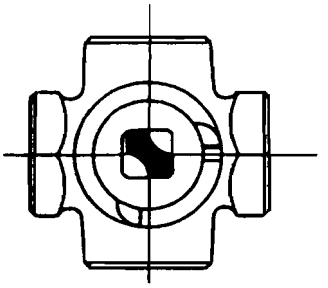
DESCRIPTION	BY	DATE

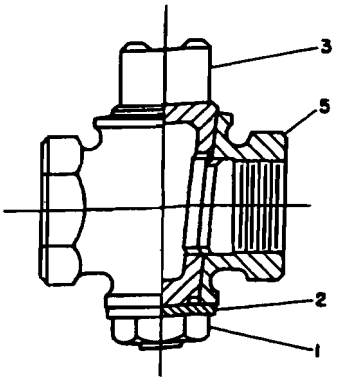
92667

C	CLA-VAL CO.	PARTS LIST
	SHUTOFF COCKS	CK SERIES

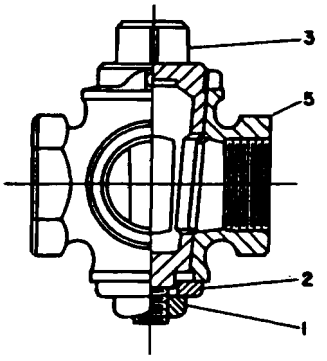




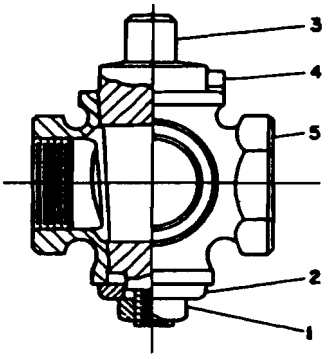




CAT. NO. CK2
(2 WAY)



CAT. NO. CK3
(3 WAY)



CAT. NO. CK4
(4 WAY)

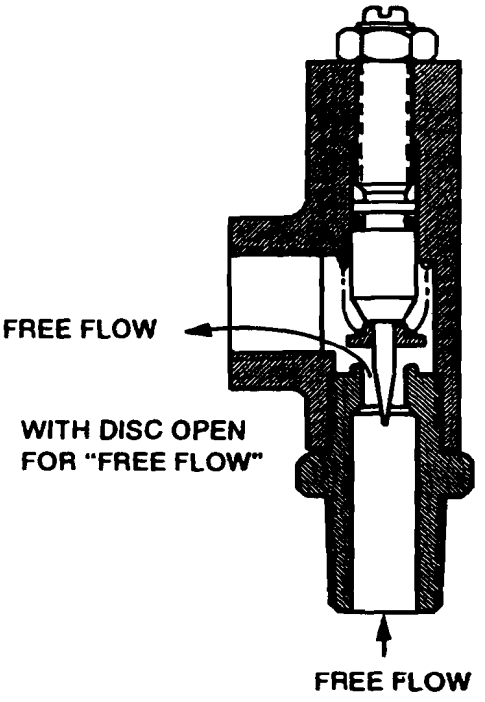
ITEM NO.	DESCRIPTION
1	Nut
2	Washer
3	Plug
4	Stop Pin
5	Body

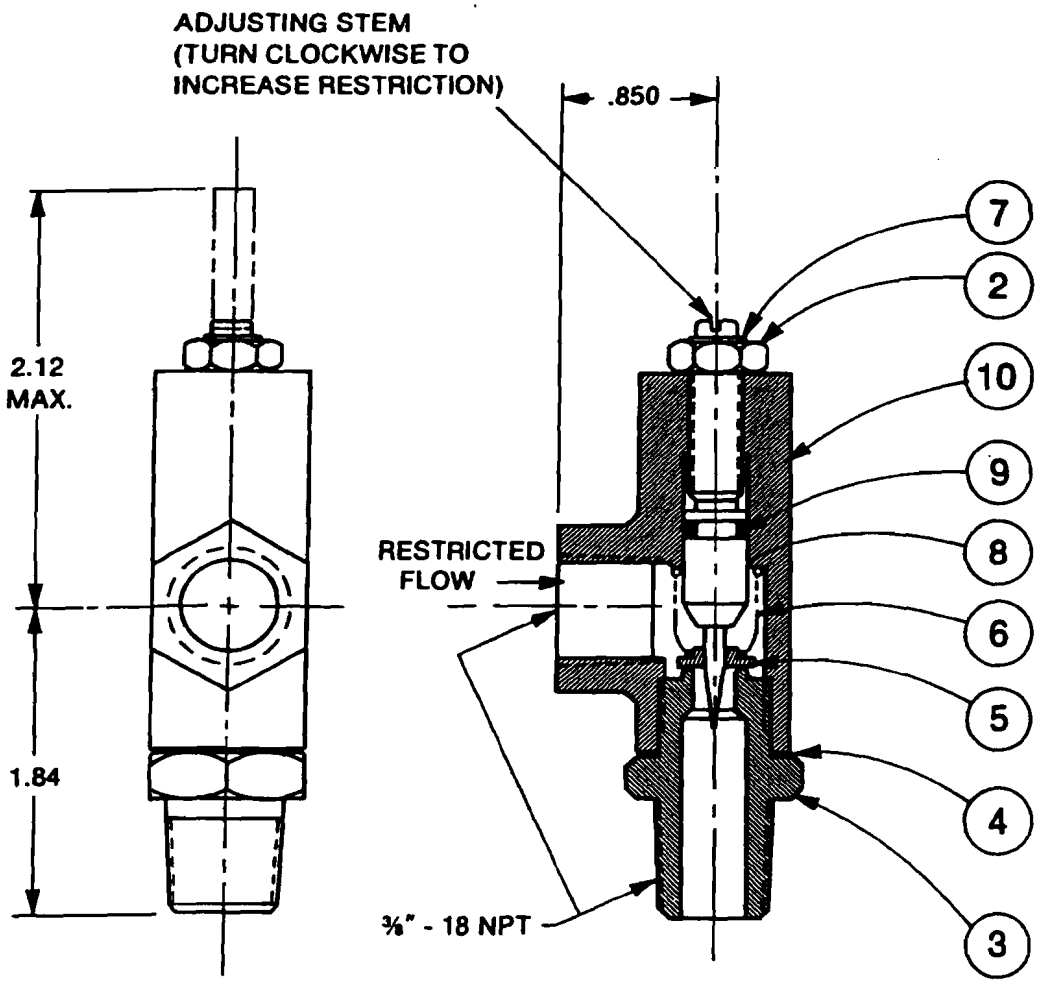
When ordering parts specify:

- All nameplate data
- Item Number
- Description

C	CLA-VAL CO.	PARTS LIST
	FLOW CONTROL	CV 3/8"

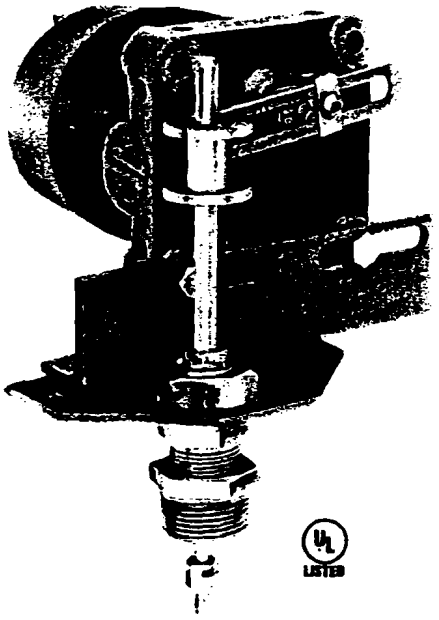
ITEM	DESCRIPTION	QUAN.
2	NUT, JAM	1
3	SEAT	1
4	GASKET	1
5	DISC	1
6	SPRING	1
7	RING, RETAINING	1
8	STEM	1
9	O-RING	1
10	HOUSING	1





CLA-VAL™

Valve Position Transmitter



- **Accurately Monitors Valve Position**
- **Weather-Sealed and Explosion-Proof**
- **Used on 131 Electronic Control Valves**
- **Easy Field Adjustments**
- **Compact and Rugged Construction**

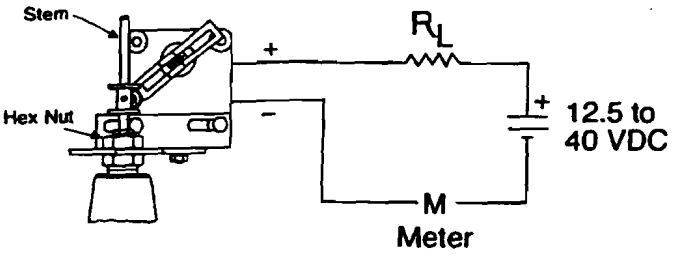
The Cla-Val Model X117C Valve Position Transmitter is an accurate monitor of valve position. Through an industry standard 4-20 mA output, the X117C delivers the level of accuracy required for computer-guided control valve systems (SCADA type). The electronic components are enclosed in a rugged, sealed aluminum housing. The assembly is mounted externally on the cover of the Cla-Val main valve. An extension of the valve stem projects outside of the cover at the center boss and is mechanically linked to the electronic components. As the valve stem rises and lowers, the X117C provides an output signal in direct proportion to the valve's position. The X117C is available with optional switches for additional signal functions as Model X117CLS.

Wiring Diagram

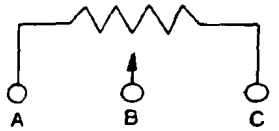
The signal from the position sensing mechanism is converted to a two-wire 4 to 20 mA current output. The voltage compliance range is 12.5 to 40 VDC (12.5 is transmitter voltage consumption). The required, but not supplied, maximum load resistance can be calculated using the following formula:

$$R_L \text{ Max.} = \frac{\text{Vsupply} - 12.5}{.020}$$

Current Output

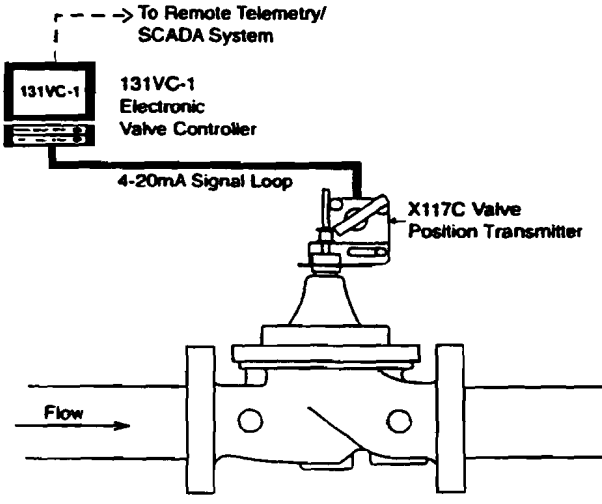


Resistive Output (Optional)
A variable voltage signal using terminals A,B and C is available with the resistive output option.

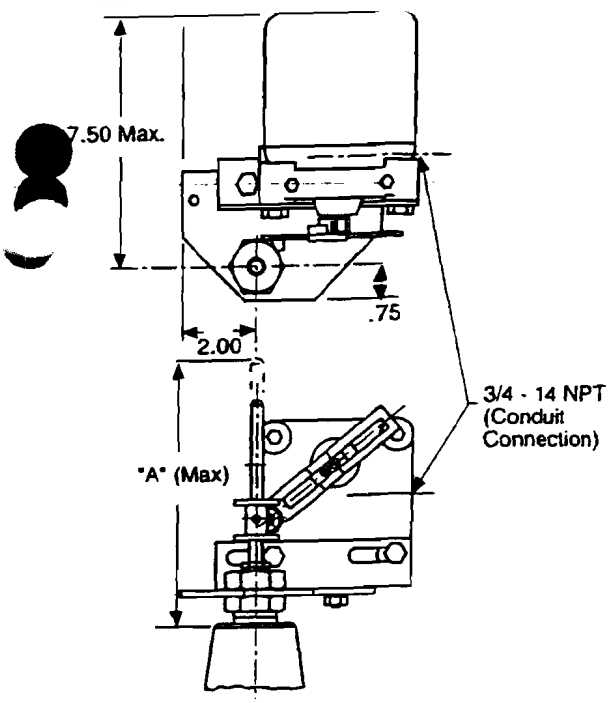


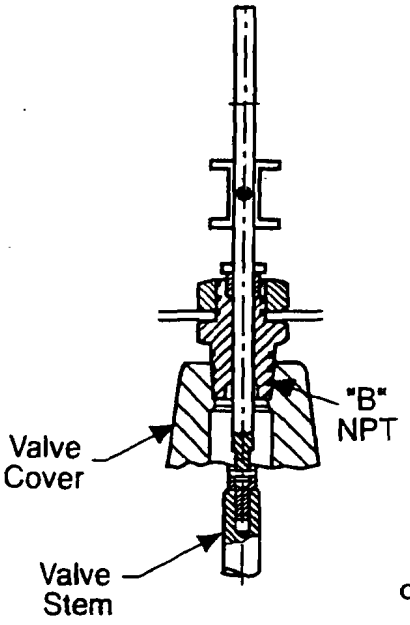
Typical Installation

The X117C Valve Position Transmitter can be used to transmit valve position to the optional 131VC-1 Electronic Valve Controller.

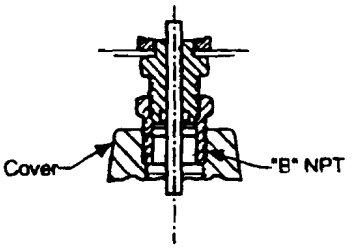


CLA-VAL

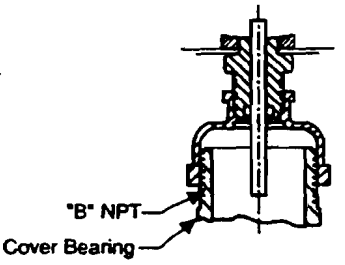




1 1/4" 6" Sizes Only



8",10",12"&14" Sizes Only



16",20" & 24" Sizes Only

Pilot System Dimensions (In Inches)

VALVE SIZE	1 ¼" & 1½"	2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	20" (600)	24" (600)	24"
A (MAX.)	10.19	7.16	7.16	7.34	7.00	6.69	6.91	9.88	9.09	9.16	10.78	10.78	10.78	19.12
B NPT	.25	.50	.50	.50	.75	.75	1.00	1.00	1 .25	1 .50	2.00	2.00	2.00	1.00

Specifications

s Valve Sizes
-1/4" thru 24"

ssure Rating
,00 psi Max.

Temperature
-13° to 185° F

Materials
Cast aluminum housing
Steel bracket
Brass adapter
Stainless steel stem
Buna-N® synthetic rubber seals
Other materials available
as extra cost option

Electrical

Housing, weather sealed and explosion proof to NEMA Standards:
1, 3, 4, 7, 9, and 13
UL Listed:
Class I, Groups C and D.
Class II, Groups E, F and G
CSA Certified:
Class I, Groups C and D
Class II, Groups E, F and G

Output
Current: 4-20 mA
Span: Adjustable from 15° to 90° of angular rotation
Null: 4mA position may be set at any angular position

Optional
Resistive Output:
500 ohms ± 10% in center (free position)
975 ohms max. at 105°
rotation clockwise (CW)
25 ohms min. at 105° rotation CCW
2 watts power at 70° C/105° F at full scale.
Switches:
2 SPDT
UL/CSA rating
15 amps,120, 240 or 480 VAC
.5 amp 125 VDC
.25 amp 250 VDC

When Ordering, Please Specify

1. For New Valves – At time of order specify: "With X117C Installed".
2. For Retrofitting Existing Valves specify: all nameplate data of valve to which X117C will be installed.
3. Current or resistive output.
4. Add LS to model number for optional limit switches, ie: X117CLS.
5. When Vertically Installed.

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA, LTD.
4687 Christie Drive
Beamsville, Ontario
Canada LOR 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL SA
Chemin des Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50

www.cla-val.com

Represented By:

Section 3-P

Clearwell No. 1 Water Discharge Check Valve (V-211)

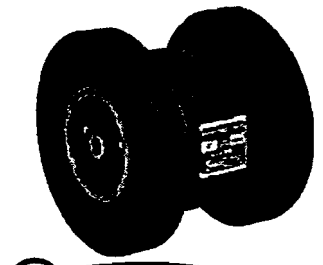
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Class 125/250 Iron Body Silent Check Valves

Flanged • Globe Style • Renewable Seat and Disc • Spring Actuated

Class 125, 200 PSI/13.8 Bar Non-Shock Cold Working Pressure
Class 250, 400 PSI/27.6 Bar Non-Shock Cold Working Pressure
Maximum Temperature to 200° F/93° C*

CONFORMS TO MIL-V-18436F
FM APPROVED



F-910, 125 lb. Class
F-960, 250 lb. Class
Flanged

MATERIAL LIST

PART	SPECIFICATION
1. Body	Cast Iron ASTM A 48 Class 35
2. Seat	Bronze ASTM B 584 Alloy C83600 (B)
2a. Seat	Buna-N Bonded to Bronze (W)
3. Disc	Bronze ASTM B 584 Alloy C83600
4. Spring	Stainless Steel Type 302 ASTM A 313
5. Bushing	6" and smaller ASTM B 16 8" and larger ASTM B 584 C83600
6. Set Screws	Stainless Steel Type 304 ASTM A 276

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions A		F-910		F-960	
In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.
2½	65	5.50	140	24	11	24	11
3	80	6.00	152	28	13	36	16
4	100	7.25	184	43	20	59	27
5	125	8.50	216	55	25	78	35
6	150	9.75	248	71	32	103	47
8	200	12.50	318	123	56	179	81
10	250	13.50	343	183	83	253	115
12	300	14.25	362	306	139	401	182
14	350	15.75	400	410	186	511	232
16	400	17.63	448	501	227	697	316
18	450	18.75	476	725	329	960	435
20	500	20.63	524	890	404	1180	535
24	600	24.00	610	1220	553	x	x
30	750	29.25	743	2000	907	x	x
36	900	45.00	1143	4425	2007	x	x

x Not available these sizes.

NOTE: F-910 made to 125 lb. Flange dimensions.
F-960 made to 250 lb. Flange dimensions.

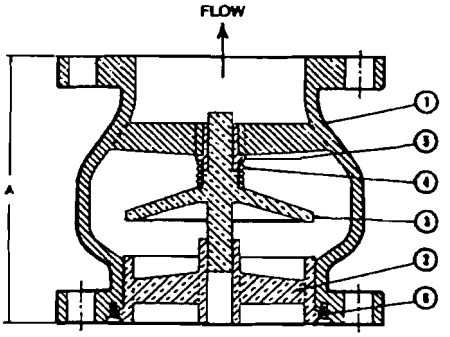
A Wafer Style Butterfly Valve can be mated on the down stream side of the F-910 2½"–10" sizes without use of spacers or adapters.

316 Stainless Steel Trim available – Consult Factory.

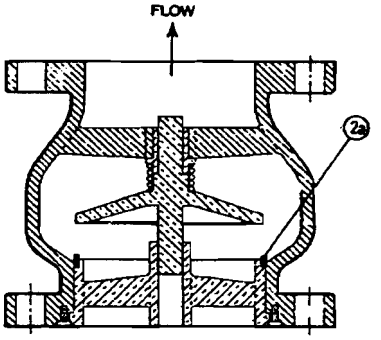
USE THIS VALVE ONLY WITH FLAT FACE FLANGE AND FULL FACE GASKET.

WARNING: 1. Seat end of valve must be mated to a standard flat faced metal flange. Rubber flanges not acceptable.
2. These are not to be used as steam valves.
3. Valves are not to be used near a reciprocating air compressor.
4. Install 5 pipe diameters minimum downstream from pump discharge or elbows to avoid flow turbulence. Flow straighteners may be required in extreme cases.

NOTE: On pump discharge, the preferred check valves are in-line spring loaded, swing design with lever and weight or lever and spring.



F-910-B or F-960-B
Flg x Flg Flg x Flg



F-910-W or F-960-W
Flg x Flg Flg x Flg

* For detailed Operating Pressure, refer to Pressure Temperature Chart on page 107.

NIBCO INC. WORLD HEADQUARTERS • 1516 MIDDLEBURY ST. • ELKHART, IN 46516-4740 • USA • PH: 1.800.234.0227
TECH SERVICES PH: 1.888.446.4226 • FAX: 1.800.234.0557 • INTERNATIONAL OFFICE PH: +1.574.295.3221 • FAX: +1.574.295.3455
www.nibco.com

Section 3-Q

Clearwell Water Level Sensors (LE/LIT-211, LE/LIT-221)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

HYDRORANGER

PROGRAMMABLE LEVEL SYSTEM

Instruction Manual

PL-444

June 1995

MILLTRONICS

33454440
PRR 1.0

Table of Contents

GENERAL INFORMATION

IMPORTANT

First and foremost it is essential that this manual be read and understood before installation and start up of the HydroRanger.

"Applications" provides a general description of the common applications found in industry and illustrates them with examples. It is suggested that you refer to the sub-section which most suits your application. The programming of the HydroRanger can be optimized by referring to Parameter Description or Appendices \ Alphabetical Parameter Listing.

THE HYDRORANGER

The HydroRanger is a multi-purpose liquid level monitoring system consisting of a HydroRanger in a CSA type 4 enclosure, a programmer and an ultrasonic transducer.

The HydroRanger emits an ultrasonic pulse via the transducer. The echo is reflected from the material and received by the transducer. The echo is processed by the HydroRanger and the time at which the ultrasonic pulse hits the level or target is extracted and compared to the time at which it was sent. The time differential is then converted into distance, material level, volume, flow or differential level as a basis for display, relay control, analog output and totalling.

As well as simple level measurement, the HydroRanger was designed to handle specific applications such as: pumped volume totalling, differential level and open channel flow measurement.

SPECIFICATIONS

HYDRORANGER

Power:		» 100/115/200/230 V ±15%, stab selective » 50/60 Hz, 15 VA » optional: » 12 V dc model, 10 to 18 V dc » 24 V dc model, 18 to 36 V dc
Fuse:		» 1/4 amp MDL Slo-Blo or equivalent
Range:		» 0.3 to 15 m (1 to 50 ft)
Accuracy:		» 0.25% of range or 6 mm (0.24"), whichever is greater
Resolution:		» 0.1% of range or 2 mm (0.08"), whichever is greater
Memory:		» EEPROM (non-volatile) no back-up battery required
Display:		» Liquid Crystal Display of 4 digits, 18mm (0.7") high
Operating Temperature:		» – 20 to 60 °C (– 5 to 140 °F)
Outputs:	transducer drive:	» 41 KHz, 400 V peak pulses of 1 msec max duration at a max repetition rate of 300 msec
	analog:	» 0 - 20 or 4 - 20 mA
		» max loading: » 350 ohms, return to ground » 750 ohms, return to –12 V
		» resolution: 0.1% of range
		» optional mA isolator
	relays:	» 5 multipurpose relays (for alarms, pump control,...)
		» 1 Form "C" SPDT contact per relay, rated 5 A at 220 V ac non-inductive
		» adjustable deadband

All relays are certified for use in equipment where the short circuit capacity of the circuits in which they are connected is limited by fuses having ratings not exceeding the rating of the relays.

Enclosure	» CSA enclosure type 4 (similar to NEMA 4) » 160 mm W x 250 mm H x 82 mm D (6.3" W x 9.5"H x 3.2"D) » polycarbonate
Weight	» 1.8 kg (4lb)

PROGRAMMER

Enclosure:	» general purpose » 67 mm W x 100 mm H x 25mm D (2.6" W x 4" H x 1" D) » ABS plastic
Operating Temperature:	» – 20 to 50 °C (– 5 to 122 °F)
Power:	» 9 V battery (style - ANSI/NEDA 1604)

TRANSDUCER

Refer to associated Transducer manual.

TEMPERATURE SENSOR

Refer to associated Temperature Sensor manual.

CURRENT OUTPUT ISOLATOR (Optional, refer to PL-293)

Model:	» LIs-1 loop isolator
Input:	» 4 - 20 mA dc (from HydroRanger)
Output:	» 4 - 20 mA dc into 600 ohm max
Isolation:	» 300 V ac continuous
Common Mode Rejection	» 100 dB at 60Hz

CABLING

Optional:	» RG-62A/U coax
	» max distance to electronics: 365 m (1200 ft)
	» must be run in grounded metal conduit
Temperature Sensor:	» Belden 8760, 2 wire shielded
	» max distance to electronics: 365 m (1200 ft)
	» can be run with transducer cable

INSTALLATION

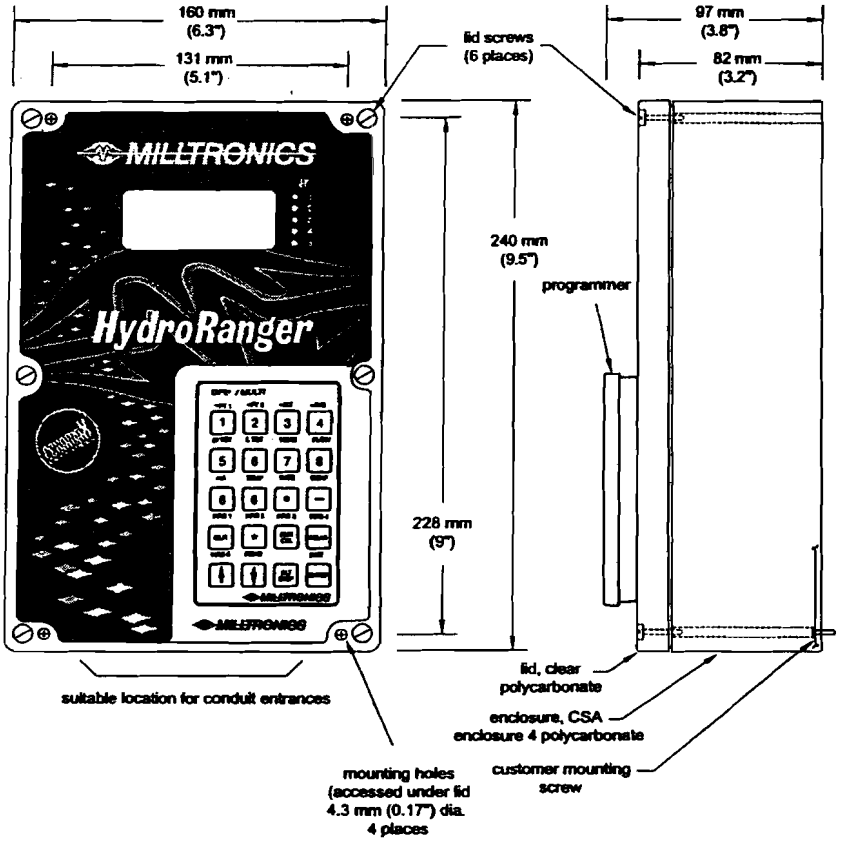
HYDRORANGER

The HydroRanger should be mounted in an area that is within the unit's ambient temperature range, and is suitable for CSA type 4 enclosures and polycarbonate material. The front cover should be accessible for programming and viewing.

It is advisable to keep the HydroRanger away from high voltage or current runs, contactors and SCR control drives.

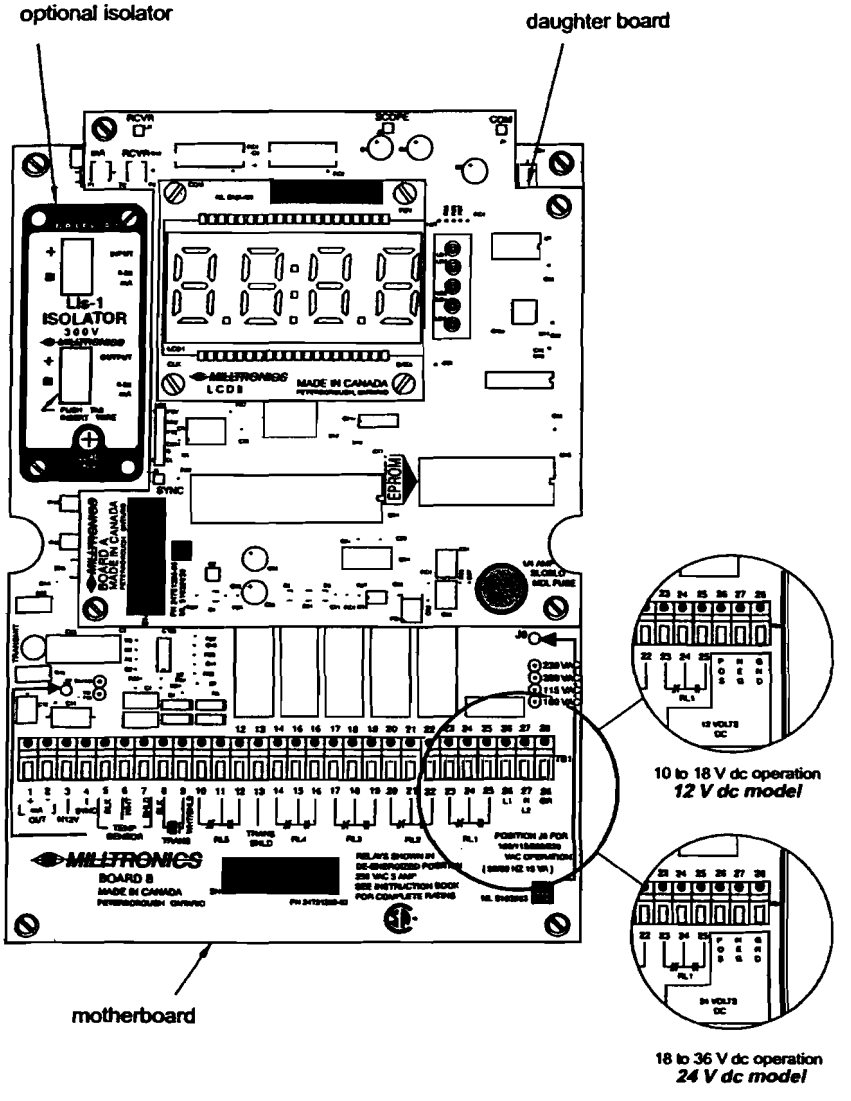
Do not mount the HydroRanger in direct sunlight without the use of a sun shield.

OUTLINE AND MOUNTING



Milltronics recommends using a punch for making holes in enclosure.

CIRCUIT BOARD LAYOUT



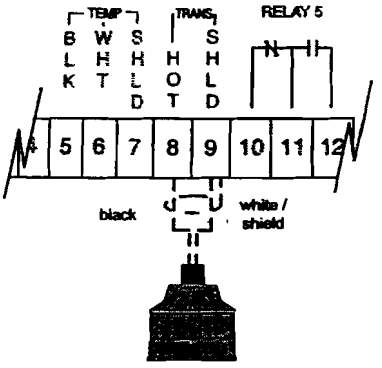
INTERCONNECTION

All wiring must be done in conjunction with approved condult, boxes and fittings and to procedures in accordance with all governing regulations.

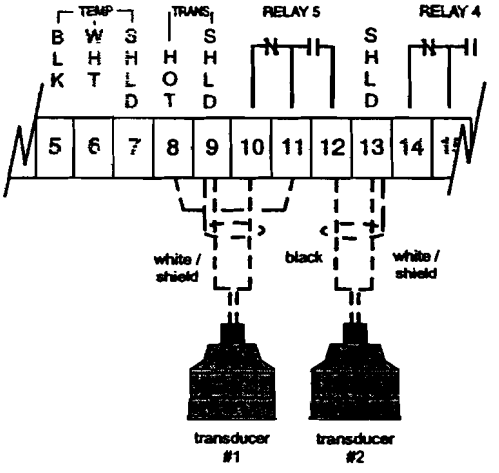
Note : — — — — indicates customer wiring in all diagrams.

INSTALLING THE TRANSDUCER

Basic Wiring



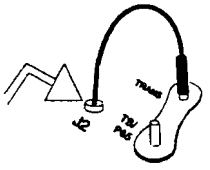
Differential Level - Basic Wiring



refer to transducer manual
for wiring details

SELECTING TEMPERATURE SOURCE

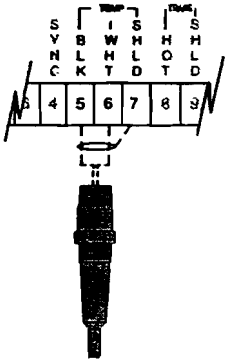
Integral Sensor (transducer)



board 'B'

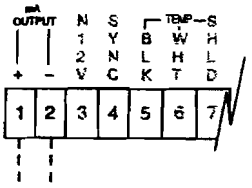
TS-3 or Program

board 'B'



CURRENT OUTPUT

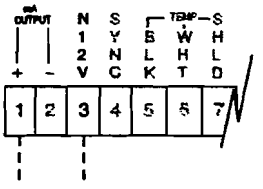
mA Output - GROUNDED
(additional to basic wiring)



Note : TB1-2 is internally connected to electrical ground TB1-28.

to customer's equipment
maximum loading 350 Ω

mA Output - FLOATING
(additional to basic wiring)



mA output wiring into floating input ONLY.
750 Ω max. Do Not Ground!

CURRENT OUTPUT ISOLATOR

If the isolator has not been factory installed, mount it on the upper left hand corner of the motherboard using the two long machine screws provided. The input terminals of the isolator are then connected to the motherboard output terminals,TB-1, using twisted pair maximum 16 gauge wire.

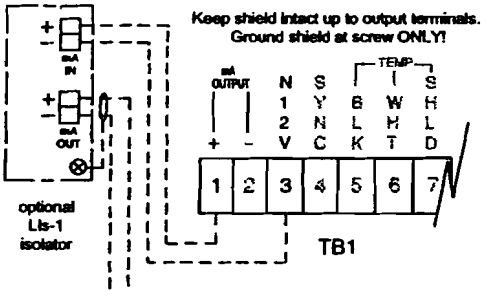
Proper shielding and grounding are required in order to minimize noise levels that could otherwise affect weak receiver signals by introducing false echoes.

The isolator enclosure is grounded by the mounting bolts to the motherboard. This can be checked with an ohmmeter if a poor connection is suspected.

The isolator output wiring must be a shielded twisted pair. The shield must be intact up to the isolator and the shield grounded at the isolator mounting screw only. Do not ground shield at any other point as this will void isolation.

mA Output - Optional Isolation
(additional to basic wiring)

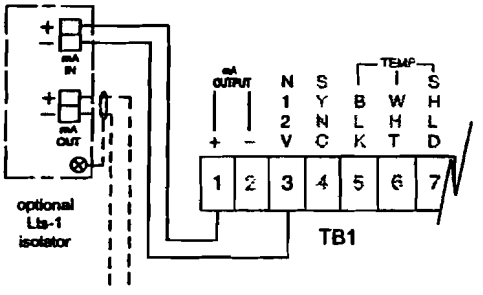
Customer Wired



isolated 4 - 20 mA output wiring into 600 Ω max

Route output wiring cable in separate conduit, entering enclosure as near as possible to isolator. Keep wiring as short as possible. Do not route cable along terminal board.

Factory Wired



isolated 4 - 20 mA output wiring into 600 Ω max

SYNCHRONIZATION

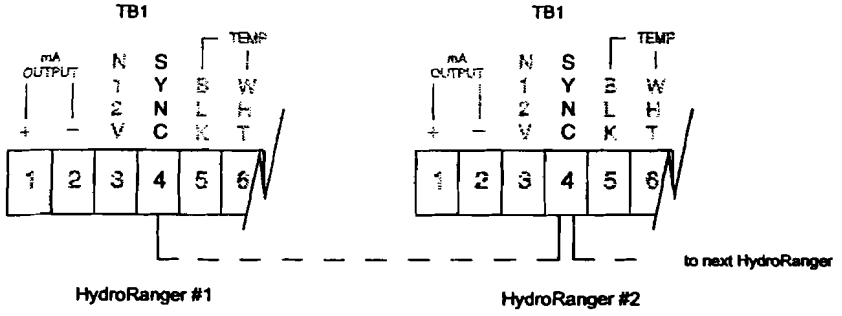
In applications where more than one HydroRanger, up to a maximum of 8, are going to be used or where their transducers will be sharing a common conduit, synchronization is required. When synchronized, no HydroRanger(s) will transmit within 180 msec of the prior one(s).

To synchronize HydroRanger's, interconnect the SYNC terminals TB1-4 of all motherboards and ensure that there is a common hydro ground interconnecting all units.

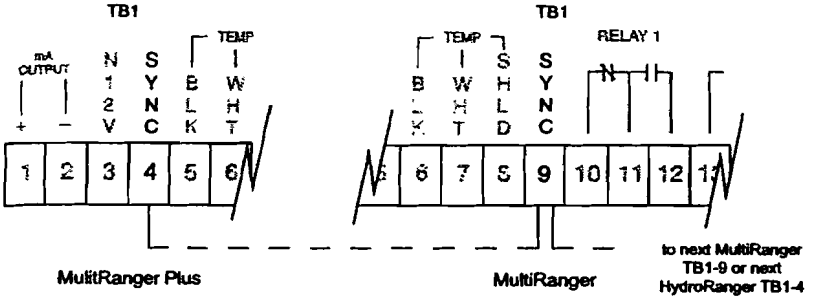
To synchronize HydroRanger's and MultiRangers, interconnect the SYNC terminal TB1-4 of the HydroRanger to the SYNC terminal TB1-9 of the MultiRanger.

To synchronize more than 8 HydroRangers or HydroRangers with other Milltronics ultrasonic level detection models (e.g. MicroRanger, AirRanger, etc...) consult Milltronics or your distributor.

Synchronization of 2 to 8 HydroRanger's
(additional to basic wiring)



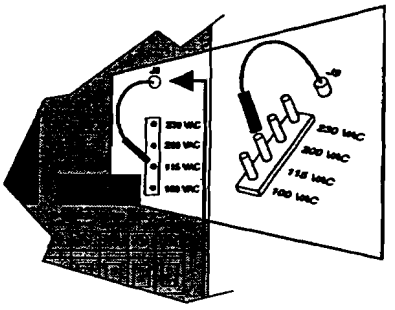
Synchronization of 2 to 8 MultiRanger / HydroRanger's
(additional to basic wiring)



All units to be synchronized must be interconnected by a common hydro ground.

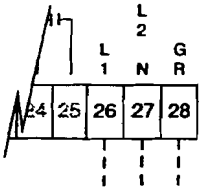
POWER CONNECTIONS

ac Volage Selection



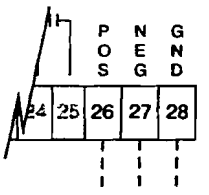
The HydroRanger accepts 100, 115, 200 or 230 V ac per jumper 'J9' (board B) selection or 10 to 36 V dc.

ac Power



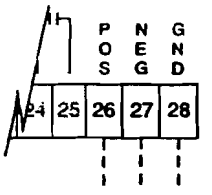
select voltage via J9 on board B

12 V dc Model



10 to 18 V dc

24 V dc Model



18 to 36 V dc

PROGRAMMER

In order to program the HydroRanger, a programmer (which has a magnetic back plate) must be placed into the front cover recess on the HydroRanger. Be sure to keep it away from objects such as floppy disks that are susceptible to damage from magnetic fields.

A programmer need not be ordered with each unit.
Check your order if you think that the programmer is missing.

START UP

GENERAL

The HydroRanger has two modes of operation: Run and Program (Cal). When the unit is powered up, after installation procedures have been completed, it is factory set to start up in the run mode, to detect the distance from the transducer face to the target in meters. This is the normal mode of operation, which can be programmed to display level, volume, totals or flow readings and yield corresponding mA output and relay closures for alarms, pump controls, etc.

The program mode is selected by pressing the *Run/Cal* key. This mode will enable the user to program the HydroRanger to suit his preference and to the particular application to which the HydroRanger is being applied.

The first step when programming is to reset all parameters to their factory setting by using the master reset P-99

After having entered all required parameters, the HydroRanger can be made to simulate its operation within the particular application giving display, relay operation and analog output. Refer to parameters P-76 through P-78.

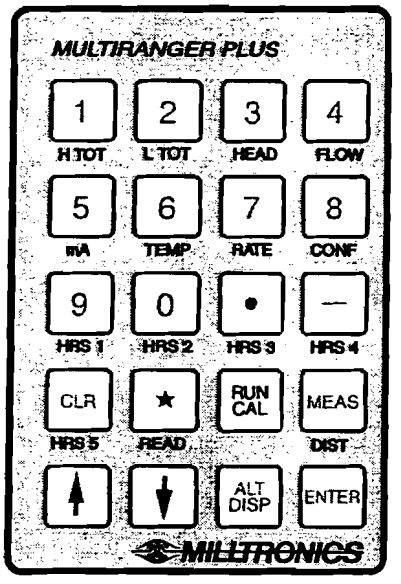
When programming has been completed, the HydroRanger can be put into normal operation by pressing the *Run/Cal* key.

PROGRAMMER KEYPAD

All entries are made via the programmer keypad.

Run Mode

Press the associated key to view.



H TOT • high total; P-2 = 4 or 5 (P-55)
• PT 1; press to view level at DLD transducer #1 P-2 = 3

L TOT • low total; P-2 = 4 or 5 (P-54)
• PT 2; press to view level at DLD transducer #2, P-2 = 3

HEAD head reading, P-2 = 5

FLOW flow rate, P-2 = 5

mA mA output

TEMP temperature (P-65)

RATE rate of level change (P-70)

CONF echo confidence (P-80)

HRS 1 pump 1 service hours (P-24)

HRS 2 pump 2 service hours (P-25)

HRS 3 pump 3 service hours (P-26)

HRS 4 pump 4 service hours (P-27)

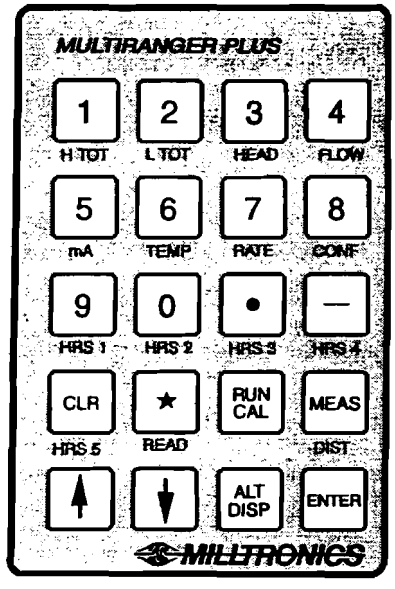
HRS 5 pump 5 service hours (P-28)

READ reading (P-76)

RUN CAL initiates access into program mode

DIST press to view distance (P-78)

Program Mode



1 to 9 numeric entry

• decimal point entry

— negative entry

CLR clear display

★ completes access into program mode

RUN CAL enter run mode

MEAS press to make a measurement

▲ increments display to show the next parameter

▼ decrements display to show the preceeding parameter

ALT DISP alternates display to show either the parameter number or parameter value

ENTER enters display as contents of selected parameter

LEGEND

Press the associated key on programmer: 

Display shown on HydroRanger: 

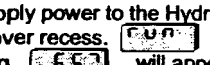
Display appears for a short time: 

Programmer key: 

PARAMETER ENTRY

Initial start up

All entries are made via the programmer keypad. All programmers are interchangeable, thus any programmer can be used in conjunction with any HydroRanger.

Apply power to the HydroRanger and place the programmer in its front cover recess.  will be momentarily displayed and then a distance reading e.g.  will appear. This is a space or distance reading of up to approximately 12 m.

If   is alternately displayed, an open or short circuited transducer connection is being indicated.

If  is displayed rather than a continuous numeric reading the actual material distance may be beyond 12 m. Proceed with the programming and if  persists, consult Troubleshooting guide.

To enter Program mode

The user may now program the HydroRanger starting at parameter P-1.

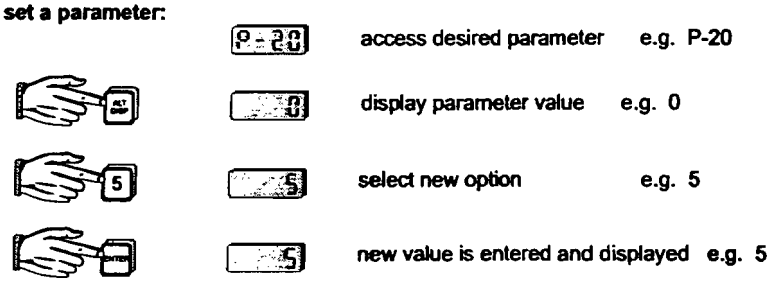
To direct access a parameter:

The display should have a ' P- ' and the number of the currently selected parameter.

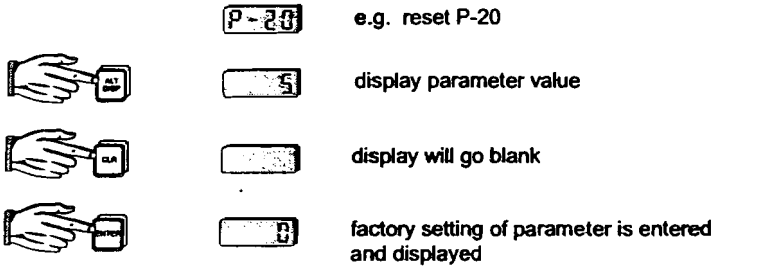
Current parameter selection 

Select desired parameter.   e.g. select parameter P-20

To set a parameter:

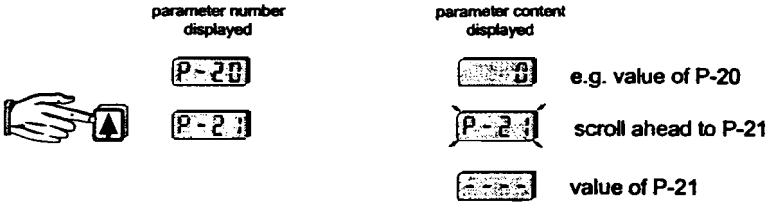


To reset a parameter to its factory value:

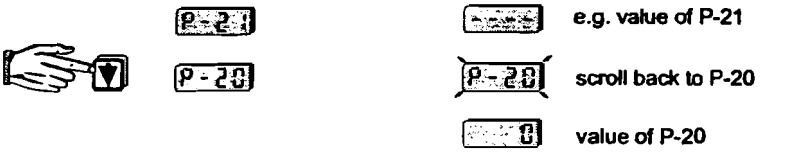


After a minute and a half, the content display will revert to the parameter number if the keypad is not used further. Press again if it is desired to return to a display of the content.

To access the next parameter:



To access the previous parameter:



COMMON DISPLAY MESSAGES

	cable loss of echo	» messages CAbL and LOE will alternately flash, indicating open or short circuited transducer connection
	have entered program mode	» appears after pressing "RUN/CAL" key
	clear all parameters - return factory setting	» P-99
	overflow	» reading is larger than display capabilities
	loss of echo	» displayed in run mode to indicate loss of echo
	percent	» appears when programming units of measurement in percent
	parameter number	» indicates which parameter is being displayed
	have entered run mode	» appears after pressing "RUN/CAL" key
	no value	» contents of parameter empty or no reading display
	invalid request	» application does not yield requested reading option or spare parameter

FUNCTIONAL

TRANSCEIVER

The HydroRanger transceiver will transmit via the transducer, a set of long and/or short pulses per measurement. The number and duration of the pulses is dependent upon P-88.

A short pulse has a maximum measurement range of 2 m (6.6 ft) from the transducer face.

A long pulse has a measurement range of 2 m (6.6 ft) from the transducer face out to its maximum setting (P-3, empty distance to transducer plus P-87, range extension).

DAMPING AND PROCESS RATE

The HydroRanger provides damping to control the maximum rate of change of the displayed material level, volume or flow rate and of the mA output signal. As most relay functions respond to the dampened level reading, they indirectly fall under the control of the damping function. Damping may be set within the range of 0.001 to 9999 in units selected per minute (eg. if P-1 = 3 and P-68 = 15, then the fill damping rate is 15 ft/min). P-68 is set to provide damping specifically for filling conditions while P-69 is set to provide damping specifically for emptying conditions.

The required damping may be estimated by filling and emptying the vessel at its normal rate. The rate of material level change can be viewed via the process rate display parameter, P-70 or by pressing "7" while in the run mode. The value of P-68 and P-69 should be equal to or greater than the rates of level change encountered in P-70. The process rate averaging parameter P-71 selects the method of averaging used to determine the process rate display, however it has no bearing on the damping function.

Damping is often used to slow down the rate of response of the display especially where liquid surfaces are in agitation or material falls into the sound path during filling.

When in the program mode, the damping is automatically overridden to give fast response when "MEAS" is pressed. In the run mode, the response can be further increased by turning the fuzz filter (P-72) and agitator discriminator (P-73) off - ONLY if they are not required.

If the transducer aiming is being adjusted while in the run mode, it is suggested that damping be at its factory setting of 10 to start. The damping can later be changed to suit prevailing conditions.

Upon a loss of echo condition and after the fail-safe timer (P-75) expires, the display will go to fail-safe high at the fill damping rate if P-74 = 1 or to fail-safe low at the empty damping rate if P-74 = 2.

TEMPERATURE COMPENSATION

In order to provide compensation for uniform temperature variances of the sound medium, temperature compensation is provided. Temperature compensation consists of on board circuitry in the HydroRanger and the integal (transducer) temperature sensor. The integral temperature sensor uses the transducer's wiring and input terminals (TB1 - 8/9) to interface with the on board circuitry.

Note: board 'B' jumper 'J2' must be set to 'TRANS'.

Optionally, the alternate TS-3 Temperature Sensor can be used to provide a temperature input, rather than by using the integral temperature sensor.

In order to do this:

» set board 'B' jumper 'J2' to 'TS/P65'

» optional TS-3 Temperature Sensor must be connected to TB1 - 5/6/7

If the temperature of the sound medium is to remain constant, compensation may be programmed into the HydroRanger instead of using the remote sensor input by one of the following methods:

1. » set board 'B' jumper 'J2' to 'TS/P65'
   » insure that the temperature sensor input TB1 - 5/6 is left open/unconnected
   » select P-65
   » enter temperature in °C

2 » set board 'B' jumper 'J2' to 'TS/P65'
   » insure that the temperature sensor input TB1 - 5/6 is left open/unconnected
   - select P-61
   - perform an empty calibration

The following temperature functions (in °C) can be viewed:

P-65 air temperature » present temperature at sensor
or
» programmed temperature, if sensor not used

P-66 max. air temperature » highest temperature encountered during operation

P-67 min. air temperture » lowest temperature encountered during operation

SOUND VELOCITY

The HydroRanger can be calibrated for transducer operation in homogeneous vapours with sound velocities other than that of air.

The basis is to physically measure the level (measuring tape or sight glass) and enter this value via P-61. The HydroRanger then calculates the sound velocity by comparing the entered physical measurement to its own ultrasonic measurement (empty calibration, P-61).

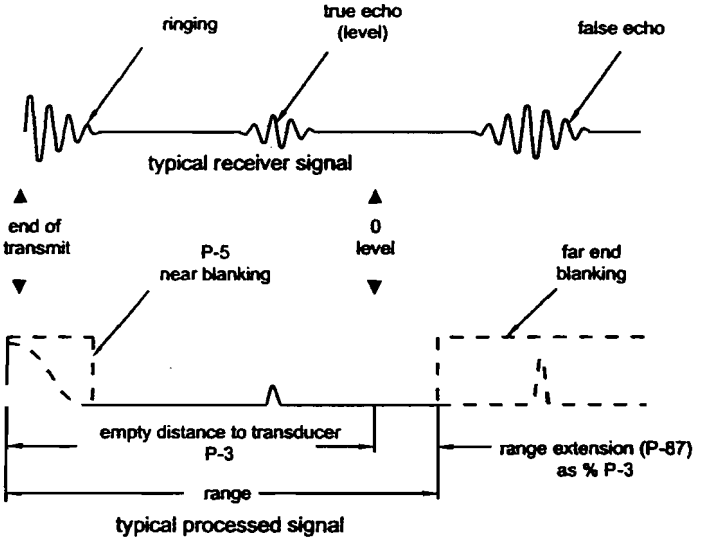
P-63, velocity at 20 °C can be used to enter the known velocity at 20 °C of sound in a particular gas or vapour to view the resultant velocity of a sound velocity compensation, normalized to 20 °C.

P-64, velocity at P-65, can be used to enter the known velocity of sound in a particular gas or vapour, or to view the resultant velocity of a sound velocity compensation, at the temperature of P-65.

Refer to Appendices/Sound Velocities, for typical sound velocities in various gases and vapours.

BLANKING

Near blanking (P-5) is used to ignore the zone in front of the transducer where ringing or other false echo is at a level with the processing of the true echo.



Ringing is the inherent nature of the transducer mass to continue vibrating after the transmit pulse has ceased. The amount of ringing varies with the type of transducer used and decays to acceptable levels in the order of milliseconds. Excessive cold and overtightening of the transducer mounting will increase the ring time such that it may appear as an echo during the receive cycle. This is usually indicated by an incorrect high level reading. This condition may be verified with the use of an oscilloscope and may be overcome by increasing the near blanking (refer to Troubleshooting).

Far end blanking is a design function that ignores the zone below the zero or empty level where false echoes may appear at levels that interfere with the processing of true echo.

In applications where the zero level is above the bottom of the vessel and it is desired to monitor the zone below the normal zero, range extension (P-87) may be used to extend the range into the far end blanking. Range extension is entered as a percent of P-3. As range extension reduces the protection afforded by the far end blanking, it should be used judiciously. Avoid excessive range extension as this may reduce the

measurement's reliability and accuracy. If it is found that false echoes are appearing ahead of the blanking zone, P-87 should be reduced accordingly.

Blanking is automatically corrected for sound velocity change where temperature and velocity compensation is used, keeping the blanking at the distance at which it was entered.

AGITATOR DISCRIMINATION

In applications where there is an agitator operating in the vessel, the blades may interfere with level readings when the material level is lower than the blades. In such a case, the agitator discriminator (P-73) can be turned on (factory setting).

With the agitator turned on, the reading will not change unless the echo is closer for at least 5 consecutive measurements nor will it change unless the echo is farther for at least 2 consecutive measurements.

This feature allows the HydroRanger to remain locked on the true echo, even if there are occasional false echoes due to the agitator blades, electrical noise or crosstalk from other ultrasonic units.

Agitator discrimination, however, slows down the HydroRanger's speed of response. Therefore, if fast response is required, especially when aiming the transducer while in the run mode, and there is no agitator involved, the discriminator should be turned off.

Agitator discrimination will not work if the blades are stationary and in the transducer's beam path.

RELAYS

General

Five onboard multi-purpose relays are provided on the HydroRanger. Each relay may be independently assigned to one function and has a corresponding status LED, visible through the front cover.

The relay functions fall under three modes of operation :

- alarm : alarm ON = LED ON = relay coil de-energized
- pump : pump ON = LED ON = relay coil energized
- miscellaneous : contact closed = LED ON = relay coil energized

Complete programming of each relay requires two steps. Refer to the Relay Programming Chart Relays.

1 - select a relay function

2 - enter relay ON/OFF setpoints for function options 1-6 and 8-10.

OR

- set control parameters for function options 7,11,12,13 and 14.

Function

Alarm

level : - in high alarm, the function goes on when the level rises to the ON setpoint and goes off when the level lowers to the OFF setpoint. In low alarm, the function goes on when the level lowers to the ON setpoint and goes off when the level rises to the OFF setpoint.

in bounds : - the relay will be in alarm if the level is inside the zone between the setpoints.

out of bounds : - the relay will be in alarm if the level is outside the zone between the setpoints.

differential : - the high alarm function goes on when differential level increases to the ON setpoint and goes off when the differential level decreases to OFF setpoint. The low alarm function goes on when the differential level decreases to the ON setpoint and goes off when the differential level increases to the OFF setpoint.

rate of change : - in filling alarm, the function goes on when the rate of filling increases to the ON setpoint and goes off when the rate of filling drops to the OFF setpoint. In emptying alarm, the function goes on when the rate of emptying increases to the ON setpoint and goes OFF when the rate of emptying drops to the OFF setpoint. For emptying alarm, the setpoints must be entered as negative values.

temperature : - in high alarm, the function goes on when the temperature rises to the ON setpoint and goes off when the temperature lowers to the OFF setpoint. In low alarm, the function goes on when the temperature lowers to the ON setpoint and goes off when the temperature rises to the OFF setpoint.

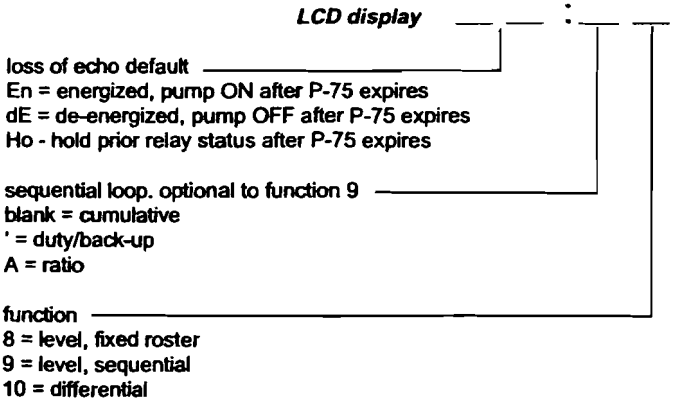
loss of echo : - the function goes on when the fail-safe timer expires. The function goes OFF when a valid echo is received (fail-safe timer is reset).

Pump

level : - in pump down, the function goes on when the level rises to the ON setpoint and goes off when the level lowers to the OFF setpoint. In pump up, the function goes on when the level lowers to the ON setpoint and goes off when the level rises to the OFF setpoint.

sequential : - refer to Applications\Pump Control. Select function option 8, 9 or 10 and press "*" to scroll through the loss of echo defaults. For option 9, pressing "*" will also scroll through the cumulative, ratio or duty/back-up mode of pump up operation.

differential : - the pump down function goes on when differential level increases to the ON setpoint and goes off when the differential level decreases to OFF setpoint. The pump up function goes on when the differential level decreases to the ON setpoint and goes off when the differential level increases to the OFF setpoint.



e.g. dE : '9 = duty/back up sequential pumping
de-energize under loss of echo

Miscellaneous

totalizer and samplers : - refer to Application Pump Totalizer and OCM . Relays are normally de-energized, contact closure is approximately 200 mSec duration.

scanner : - this function is specific to relay 5 and the DLD mode of operation. The transducer hot is wired to the common terminal of the relay so that when switched, the transceiver may alternately access transducer #1and #2.

Refer to Applications \ Differential Level Application.

Setpoint - ON / OFF

If the ON setpoint is higher than the OFF setpoint, the relay operates as :

- high alarm
- pump down control
- high differential alarm

If the ON setpoint is lower than the OFF setpoint, the relay operates as :

- low alarm
- pump up control
- low differential alarm

The ON and OFF setpoints can not be the same on an individual relay but may be common to other relays. The dead band or hysteresis is the difference between the ON and OFF setpoints. For in and out of bounds level alarms, the hysteresis is set ±2 % of span from either boundary.

The setpoints for alarm functions 1 - 4 and pump functions 8 - 10 are always entered in the P-1 units of measurement selected (but not %). The setpoints are measured from the bottom up, referenced to zero or empty except for the differential functions, 4 and 10. There the setpoints represent the absolute differential between levels, regardless of the level with respect to zero.

Relay status - non run modes

When the fail-safe timer expires, pump control relays respond as previously described. However, alarm relays will respond in the following manner.

FAIL-SAFE MODE	RELAY STATUS	
P-74	high alarm	low alarm
fail-safe high	on	off
fail-safe low	off	on
fail-safe hold	hold	hold

Upon entering the program mode, all pump control relays will be turned OFF. Alarm relays will hold their prior status, but will respond to measurements take when "MEAS" is pressed.

Simulation

Parameters P-76 through P-78 can be used to simulate relay operation in the program mode. Pump relays will be held OFF during simulation, however their corresponding LED's will respond. Remote totalizer and flow sampler relay operation do not apply to simulation. Refer to Parameter Description.

If the relay status can affect plant operation or personnel safety, it is advisable to override the relay functions or disconnect the relay wiring during calibration or simulation

Keep power disconnected at main breaker when HydroRanger cover is opened.

Relay Function Vs Mode of Operation

It should be noted that some relay functions can not be used in certain modes of operation. The following table shows the valid functions for the five modes of operation.

Function	Mode of Operation				
	Mat'l (P2 = 1)	Space (P2 = 2)	DLD (P2 = 3)	Pump Vol. (P2 = 4)	OCM (P2 = 5)
0	off	off	off	off	off
1	level	level	level	level	level
2	in bounds	in bounds	off	in bounds	in bounds
3	out of bounds	out of bounds	off	out of bounds	out of bounds
4	off	off	differential level	off	off
5	rate	rate	off	rate	rate
6	temp.	temp.	temp.	temp.	temp.
7	L.O.E.	L.O.E.	L.O.E.	L.O.E.	L.O.E.
8	pump	pump	pump	pump	pump
9	sequential	sequential	off	sequential	sequential
10	off	off	pump on differential	off	off
11	off	off	off	totalizer	totalizer
12	off	off	off	flow sampler	flow sampler
13	time sampler	time sampler	time sampler	time sampler	time sampler
14	off	off	scanner	off	off

RELAY PROGRAM CHART

Relay Function	Relay 1 Fctn P-8	Relay 1 Setpoints ON	Relay 1 Setpoints OFF	Relay 2 Fctn P-11	Relay 2 Setpoints ON	Relay 2 Setpoints OFF	Relay 3 Fctn P-14	Relay 3 Setpoints ON	Relay 3 Setpoints OFF	Relay 4 Fctn P-17	Relay 4 Setpoints ON	Relay 4 Setpoints OFF	Relay 5 Fctn P-20	Relay 5 Setpoints ON	Relay 5 Setpoints OFF	Units
Alarm : Level	1	P-9	P-10	1	P-12	P-13	1	P-15	P-16	1	P-18	P-19	1	P-20	P-21	P-1
In bounds	2	"	"	2	"	"	2	"	"	2	"	"	2	"	"	"
Out of bounds	3	"	"	3	"	"	3	"	"	3	"	"	3	"	"	"
Differential	4	"	"	4	"	"	4	"	"	4	"	"	4	"	"	"
Rate of Change	5	"	"	5	"	"	5	"	"	5	"	"	5	"	"	P-1/min
Temperature	6	"	"	6	"	"	6	"	"	6	"	"	6	"	"	°C
Loss of Echo	7	set	P-75	7	set	P-75	7	set	P-75	7	set	P-75	7	set	P-75	n/a
Pump : Level En:	8*	P-9	P-10	8*	P-12	P-13	8*	P-15	P-16	8*	P-18	P-19	8*	P-21	P-22	P-1
dE:	8*	"	"	8*	"	"	8*	"	"	8*	"	"	8*	"	"	"
Ho:	8*	"	"	8*	"	"	8*	"	"	8*	"	"	8*	"	"	"
Sequential cumulative En:	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
cumulative dE:	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
cumulative Ho:	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
duty / backup En:'	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
duty / backup dE:'	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
duty / backup Ho:'	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
ratio En:A	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
ratio dE:A	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
ratio Ho:A	9*	"	"	9*	"	"	9*	"	"	9*	"	"	9*	"	"	"
Differential En:	10*	"	"	10*	"	"	10*	"	"	10*	"	"	10*	"	"	"
dE:	10*	"	"	10*	"	"	10*	"	"	10*	"	"	10*	"	"	"
Ho:	10*	"	"	10*	"	"	10*	"	"	10*	"	"	10*	"	"	"
Miscellaneous :																
Totalizer	11	set	P-56	11	set	P-56	11	set	P-56	11	set	P-56	11	set	P-56	vol.P-43
Flow Sampler	12	set	P-57 & P-58	12	set	P-57 & P-58	12	set	P-57 & P-58	12	set	P-57 & P-58	12	set	P-57 & P-58	volume
Time Sampler	13	set	P-59	13	set	P-59	13	set	P-59	13	set	P-59	13	set	P-59	hr
Scanner	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a		14	set	P-2	n/a

* = Press ★ to select LOE default (En, dE & Ho) and sequential option (cumulative, duty / backup or ratio).

ANALOG OUTPUT

The HydroRanger can be programmed to provide analog output (P-6) of 0 or 4 - 20 mA, proportional or inverse span.

The 4 and 20 mA levels can be trimmed slightly via P-97 and P-98 respectively to compensate for any offset between the HydroRanger and the customer's equipment.

The analog output feature can be turned OFF by setting P-6=0. The output and alternate displays(5 &P-92) will immediately drop to 0 mA after a new measurement is processed. The output will remain disabled during simulation (P-76,77, & 78) However, the test routine of P- 92 and the trim parameters will remain active. If P-60 = 0, then the analog output will return to its programmed output after a new measurement is processed.

If the analog output must be isolated, the optional LIs-1 mA isolator must be mounted on the motherboard and wired. When using the isolator, the load adjust can be done via P-97 and 98 rather than via the load adjust potentiometer.

The analog output responds in the following manner :

		MODES					
		P2 = 1 LEVEL	P2 = 2 SPACE	P2 = 3 DLD	P2 =1 VOLUME	P2 = 4 PUMP TOTAL	P2 = 5 OCM
ANALOG OUTPUT	responds to	material level	material distance	• differential (if P-32 = 1) • level on xdcr 1 (if P-32 = 2)	volume	• level (if P-34 = 0) • volume (if P-34 ≠ 0)	• head 1 (if P-50 = 1) • flow (if P-50 = 2)
	if P-6 = 1 or 2, reads 20 mA when	full	empty	maximum differential or level	full	full	at max. head or flow
	if P-6 = 3 or 4, reads 20 mA when	empty	full	0 differential or level	empty	empty	at 0 head or flow

APPLICATIONS

This section highlights the most common applications for which the HydroRanger can be applied. Other applications not listed here may be similar to those listed or a combination thereof.

When programming, refer to the application which is most similar to yours. A practical example has been given to further expand on the programming features. As the example may not cover all facets of the particular application, the user should become familiar with the parameters available. Refer to Parameter Description or Appendices \ Alphabetical Parameters Listing.

For ease of reference and programming, parameters have been organized into groups relating to their function or application.

P-0	security
P-1 to P-7	general
P-8 to P-22	relays
P-23 to P-33	pump control
P-34 to P-39	volume and display conversion
P-40 to P-50	OCM
P-51 to P-59	OCM and pump totalizer
P-60 to P-67	custom calibration
P-68 to P-75	filters
P-76 to P-78	measurement and display
P-79 to P-88	echo processing and analysis
P-89 to P-98	testing
P-99	master reset

The minimum distance from the transducer face to the target is limited by the minimum near blanking value, P-5, of 30 cm (1 ft).

SIMPLE LEVEL
APPLICATION PARAMETERS

General		Relays		Pump Control		Vol. & Disp. Conversion		OCM		Totalizer		Custom		Filter	
P-1	**units**	P-8	1 function	P-23	submers.	P-34	tank	P-40	primary	P-51	OCM sim.	P-60	full	P-68	fil damp
P-2	**mode**	P-9	1 on	P-24	1 hrs.	P-35	dim. A	P-41	time	P-52	factor	P-61	empty	P-69	empty damp
P-3	**empty dist.**	P-10	1 off	P-25	2 hrs.	P-36	dim. L	P-42	expon.	P-53	decimal	P-62	offset	P-70	rate disp.
P-4	**span**	P-11	2 function	P-26	3 hrs.	P-37	convert	P-43	flume dim.	P-54	low tot.	P-63	vel. 20 °C	P-71	rate avg.
P-5	near blank	P-12	2 on	P-27	4 hrs.	P-38	disp. offset	P-44	spare	P-55	high tot.	P-64	vel. P-65	P-72	fuzz filter
P-6	mA out	P-13	2 off	P-28	5 hrs.	P-39	disp. opt'n	P-45	max. head	P-56	remote tot.	P-65	temp.	P-73	agitator
P-7	decimal	P-14	3 function	P-29	run-on			P-46	max. flow	P-57	flow samp.	P-66	max. temp	P-74	f-s mode
		P-15	3 on	P-30	run-on			P-47	auto zero	P-58	flow samp.	P-67	min. temp	P-75	f-s timer
		P-16	3 off	P-31	spare			P-48	cutoff	P-59	time samp.				
		P-17	4 function	P-32	DLD mA out			P-49	decimal						
		P-18	4 on	P-33	totaling			P-50	mA out						
		P-19	4 off												
		P-20	5 function												
		P-21	5 on												
		P-22	5 off												

P-# required parameters

P-# optional parameters

P-# parameters not required

SIMPLE LEVEL APPLICATION

The most common application of a Milltronics ultrasonic level measuring system is for simple level monitoring, whereby the material level or space measurement is displayed. This may or may not include alarms and mA output.

When in the program mode, alarm relays hold their contact state. However, they will respond to measurements taken when "MEAS" is pressed.

Simple Level Example

The application is to obtain a level measurement and corresponding 4-20 mA output of a 30 ft high vessel. The transducer face is level to the top of the vessel, the empty level will be at 0 ft (bottom) and the full level will be at 28 ft from the bottom (span). A high alarm is required at 4 ft from the top (26 ft from the bottom) and a low alarm is required at 5 ft from the bottom. The maximum emptying rate is 1 ft / min, a rate greater than this should set an alarm. In the event of a loss of echo, the HydroRanger is to go into fail-safe hold after 2 minutes.

select:

P-1	enter option "3",	units in feet

advance to:

P-2	enter option "1",	material level
P-3	enter "30",	empty distance to transducer
P-4	enter "28",	span
P-5	enter ".984",	blanking distance , (use factory setting)
P-6	enter option "2",	4 – 20 mA output
P-7	enter "2",	display max 2 digits after decimal
P-8	enter option "1",	relay 1 - alarm function
P-9	enter "26",	relay 1 - alarm ON (30' – 4' = 26')
P-10	enter "25.5",	relay 1 - alarm OFF deadband = 0.5', arbitrary setting
P-11	enter option "1",	relay 2 - alarm function
P-12	enter "5",	relay 2 - alarm ON
P-13	enter "5.5",	relay 2 - alarm OFF
P-14	enter option"5",	relay 3 - rate of change function
P-15	enter "–1",	relay 3 - alarm ON 9 '–' denotes emptying
P-16	enter "– 0.9",	relay 3 - alarm OFF
P-37	enter "1",	convert display (x1)
P-68	enter "1",	maximum fill damping 1 ft / min
P-69	enter "1",	maximum empty damping 1 ft / min
P-74	enter option "3",	fail-safe hold
P-75	enter "2",	fail-safe timer - 2 min.

to re-enter run mode

PUMP CONTROL
APPLICATION PARAMETERS

General	Relays	Pump Control	Vol. & Disp. Conversion	OCM	Totalizer	Custom	Filter
P-1 units	**P-8 1 function**	P-23 submers.	P-34 tank	P-40 primary	P-51 OCM sim.	**P-60 full**	**P-68 fil damp**
P-2 mode	**P-9 1 on**	P-24 1 hrs.	P-35 dim. A	P-41 time	P-52 factor	**P-61 empty**	**P-69 empty damp**
P-3 empty dist.	**P-10 1 off**	P-25 2 hrs.	P-36 dim. L	P-42 expon.	P-53 decimal	**P-62 offset**	**P-70 rate disp.**
P-4 span	P-11 2 function	P-26 3 hrs.	P-37 convert	P-43 flume dim.	P-54 low tot.	**P-63 vel. 20 °C**	**P-71 rate avg.**
P-5 near blank	P-12 2 on	P-27 4 hrs.	P-38 disp. offset	P-44 spare	P-55 high tot.	**P-64 vel. P-65**	**P-72 fuzz filter**
P-6 mA out	P-13 2 off	P-28 5 hrs.	P-39 disp. opt'n	P-45 max. head	P-56 remote tot.	**P-65 temp.**	**P-73 agitator**
P-7 decimal	P-14 3 function	P-29 run-on		P-46 max. flow	P-57 flow samp.	P-66 max. temp	**P-74 f-s mode**
	P-15 3 on	P-30 run-on		P-47 auto zero	P-58 flow samp.	P-67 min. temp	**P-75 f-s timer**
	P-16 3 off	P-31 spare		P-48 cutoff	P-59 time samp.		
	P-17 4 function	P-32 DLD mA out		P-49 decimal			
	P-18 4 on	P-33 totaling		P-50 mA out			
	P-19 4 off						
	P-20 5 function						
	P-21 5 on						
	P-22 5 off						

P-# required parameters

P-# optional parameters

P-# parameters not required

PUMP CONTROL APPLICATIONS

The basic difference between a simple level application and a pump control application is that the relays assigned to pump functions are normally in a de-energized state and are energized when pumping is required.

The HydroRanger can be programmed to control up to 5 pumps. Each may be configured in one of the following ways.

1. Fixed roster: (P-8,11,14,17& 20 = 8)

   selected pump relays 1-5 always operate in conjunction with their respective relay setpoints. i.e. relay 1's operation is always subject to relay 1's setpoints (P-9 & P-10). Any combination of the selected pumps can be operating at a time.

2. Sequential loop: (P-8,11,14,17& 20 = 9)

cumulative	selected pump relays 1 - 5 sequentially rotate through the associated relay setpoints changing pump / setpoint assignment each time the lead pump is turned off. The lead pump is defined as the pump responding to the first ON setpoint.
duty / back-up	similar to the cumulative sequential loop except that only one of the pumps designated as duty/back-up can be on at a time. This feature is useful in older installations where the discharge main cannot tolerate excessive pressure. If the lead pump, through wear or blockage, cannot keep up with the inflow, the next pump in sequence will come on and the lead pump will be turned off. The ON setpoints are generally in close proximity, but the OFF setpoints must be common for all pumps on the loop.

   Sequential operation can be programmed as either cumulative or duty/back-up, but not both. The HydroRanger will take the last mode entered as the common choice for all sequenced relays.

3. Assignment of a pump / relay contact to a setpoint parameter is done by ratio of the logged service hours. When the service of a pump is required, the pump with the least amount of service hours (P\C-24 to 28) with respect to the set ratio (P\A - 24 to 28)is started. When a pump is to be taken out of service, the pump with the least amount of service hours is stopped.

e.g. relays 1, 2 and 3 control three pumps by service ratio. It is required that pump 1 operate 60% of the time, pump 2 operate 10% of the time and pump 3 operate 30%of the time.

- set the relay function : P-8, 11, 14 = dE : A9
- set the relay setpoints : P-9/10, 12/13, 15/16
- set the P-24, 25, 26 ratios : A-24 = 60
  A-25 = 10
  A-26 = 30

Relays assigned to pump control operation are software set that no two pumps can start up within 10 seconds of each other, a power failure or return to the run mode.

When in the program mode, pump relays will be held de-energized (OFF). In the event of a loss of echo condition, the pump relays can be individually programmed to be:

- de-energized (dE)
- energized (En)
- hold (Ho)

when the fail-safe timer P-75 expires. Refer to Applications/Relays.

In applications where flooding is possible, a submersible transducer should be used. The submersible transducer's air cavity insures that a high level reading will be maintained rather than a loss of echo condition when the liquid level reaches the transducer. ***When using a submersible transducer, set P-23.***

When relays are assigned a pump function, parameters P-24 through P-28 are used to log the respective service hours and number of pump starts for pump relays 1 - 5. These parameters may also be viewed while in the run mode by pressing the appropriate programmer keys. The initial pressing of the key causes the display to show the service hours. Holding the key in for at least five seconds causes the number of starts to be displayed. Each register may be reset to 0 by pressing "CLR" and then "ENTER" or preset by entering a particular value.

The preset value is immediately stored in memory, however subsequent values are only stored every 4 hours. Thus, after a power failure, the registers will display the last value stored. The registers will automatically reset to 0.000 after reaching a value of 9,999.

Pump Control Example

The application is to control the level in a wet well 3 meters deep. It is required that :

- the level is displayed in meters
- to start/stop two constant speed pumps: start pump 1 at 1 m level
  start pump 2 at 2 m level
  stop both pumps at 0.5 m level
- the two pumps operate on a cumulative sequential loop, de-energized under loss of echo
- low alarm is set at 0.4 m to protect the two pumps from cavitating
- the transducer is mounted 3.4 meters from the bottom of the wet well
- the span of level in the well is 3 m
- maximum fill rate is 1m / min, maximum draw rate is 0.2 m / min
- in the event of loss of echo, go into fail-safe low after 30 seconds to protect pumps
- the transducer is the submersible type as there is a possibility of flooding

select :

P-1	enter option "1",	units in meters

advance to:

P-2	enter option "1",	material level
P-3	enter "3.3",	empty distance to transducer
P-4	enter "3",	span
P-5	enter ".300",	blanking distance, (use factory setting)
P-7	enter "2",	display max 2 digits after decimal
P-8	enter option "dE 9" (press "9" and then "-" until "dE 9" is displayed)	relay 1 - pump function
P-9	enter "1",	relay 1 - pump ON
P-10	enter ".5",	relay 1 - pump OFF
P-11	enter option "dE 9" (press "9" and then "-" until "dE 9" is displayed)	relay 2 - pump function

P-12	enter "2",	relay 2 - pump ON
P-13	enter ".5",	relay 2 - pump OFF
P-14	enter option "1",	relay 3 - alarm function
P-15	enter ".4",	relay 3 - alarm ON
P-16	enter ".45",	relay 3 - alarm OFF deadband = 0.05 m, arbitrary setting
P-23	enter option "1",	using submersible transducer
P-37	enter "1",	convert display (x1)
P-68	enter "1",	fill damping 1 m / min
P-69	enter ".2",	empty damping 0.2 m / min
P-74	enter option "2",	fail-safe low to protect pumps
P-75	enter ".5",	fail-safe timer at a maximum draw rate of 0.2 m / min, this would protect pumps. If a loss of echo occurred at 0.5 m, after 30 sec the level would equal that of acceptable low level alarm and the pump would shut off.

 to re-enter run mode

Pump Run-On

Pump run-on is a special feature designed to allow the pump assigned, temporarily (sequential loop) or permanently (fixed roster), to the lowest OFF setpoint. The duration of run-on is set by P-30. Only one run-on duration is allowed per interval. The interval is the time period set by P-29 which begins upon return to the run mode or resumption of power. No run-on is allowed during the first interval.

Caution: extended pump run-on can lead to cavitation, causing air lock or pump damage

Conditions of use :

- Do not use run-on feature during pump-up operation as an overflow condition may occur. Set P-29 and 30 to 0.
- Select the loss of echo default "dE" to protect pumps from cavitating in the event of loss of echo
- The run-on interval must be greater that the run-on duration.

e.g. P-29 = 24 and P-30 = 15

After 24 hours from going into the run mode, the HydroRanger enters the second run-on interval allowing only one pump run-on cycle of 15 seconds, at the first time the lead pump turns off. If the lead pump turns off a second time during that 24 hour interval, no run-on will occur. After the 24 hour interval has elapsed, whether a pump run-on has occurred or not, the next run-on interval will begin, allowing one run-on cycle.

PUMP TOTALIZER
APPLICATION PARAMETERS

General		Relays		Pump Control		Vol. & Disp. Conversion		OCM		Totalizer		Custom		Filter	
P-1	**units**	**P-8**	**1 function**	P-23	submers.	P-34	tank	P-40	primary	P-51	OCM sim.	P-60	full	P-68	fill damp
P-2	**mode**	**P-9**	**1 on**	P-24	1 hrs.	P-35	dim. A	P-41	time	**P-52**	**factor**	**P-61**	**empty**	**P-69**	**empty damp**
P-3	**empty dist.**	**P-10**	**1 off**	P-25	2 hrs.	P-36	dim. L	P-42	expon.	**P-53**	**decimal**	**P-62**	**offset**	**P-70**	**rate disp.**
P-4	**span**	P-11	2 function	P-26	3 hrs.	P-37	convert	P-43	flume dim.	**P-54**	**low tot.**	**P-63**	**vel. 20 °C**	**P-71**	**rate avg.**
P-5	near blank	P-12	2 on	P-27	4 hrs.	P-38	disp. offset	P-44	spare	**P-55**	**high tot.**	**P-64**	**vel. P-65**	**P-72**	**fuzz filter**
P-6	mA out	P-13	2 off	P-28	5 hrs.	P-39	disp. opt'n	P-45	max. head	**P-56**	**remote tot.**	**P-65**	**temp.**	**P-73**	**agitator**
P-7	decimal	P-14	3 function	P-29	run-on			P-46	max. flow	**P-57**	**flow samp.**	**P-66**	**max. temp**	**P-74**	**f-s mode**
		P-15	3 on	P-30	run-on			P-47	auto zero	**P-58**	**flow samp.**	**P-67**	**min. temp**	**P-75**	**f-s timer**
		P-16	3 off	P-31	spare			P-48	cutoff	**P-59**	**time samp.**				
		P-17	4 function	P-32	DLD mA out			P-49	decimal						
		P-18	4 on	**P-33**	**totaling**			P-50	mA out						
		P-19	4 off												
		P-20	5 function												
		P-21	5 on												
		P-22	5 off												

P-# required parameters

P-# optional parameters

P-# parameters not required

PUMP TOTALIZER APPLICATION

This type of application is an extension of the pump control application, accessed by setting P- 2 = 4. Unlike a pump application in which the mode of the measurement (P-2) can be of material or space, the pump volume totalizer mode is a measurement of the liquid volume pumped with reference to the material level.

The material level must be converted to volume using volume conversion parameters P-34, 35 and 36 and / or convert display P-37. The HydroRanger in pump-down, will record the volume being pumped out. Alternately, the HydroRanger will record the volume pumped in if the pump setpoints are set for pump-up.

When the pump(s) is OFF, the HydroRanger estimates the volume of the inflow or discharge by recording the rate at which the liquid level changes. When the pump(s) is operating, the estimated inflow or discharge volume may be added (P-33 = 1) to the pumped volume total, as in batch processing.

When the pump(s) stops, the pumped volume of the previous pump cycle is added to the total volume pumped in the 8 digit totalizer.

The totalizer contents are stored in RAM and will be lost in the event of a power failure. However, after every 1 hour of continuous operation, the totalizer contents are stored in the EEPROM. Thus, after a power failure, the totalizer will be loaded with the last value stored.

In the event of a loss of echo, the totalizer will continue being incremented by the flowrate established from the last valid echo. The totalizer will stop being incremented and hold its last updated value when in the program mode or if the fail-safe timer expires ("LOE" is displayed"). Once the totalizer has been filled (99999999), it will automatically reset itself to zero and resume totalling.

The HydroRanger can be programmed (P-39) to normally display one of the following readings :

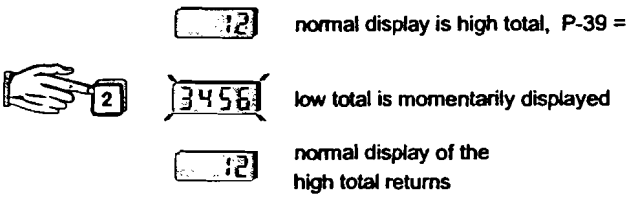
- enter option "0", hold last reading selected in run mode
- enter option "1", high total: 4 highest digits of the 8 digit totalizer
- enter option "2", low total: 4 lowest digits of the 8 digit totalizer
- enter option "5", level

It must be noted that only half of the totalizer digits can be accessed or viewed at one time.

e.g.	*high total*	*low total*
	P-54	P-55
8 digit total	1325	4679

If it is wished to momentarily view an alternate reading while in the run mode and P-39 ≠ 0, press the desired programmer key ('HEAD' and 'FLOW' are not applicable to the pumped volume totalling)

e.g.



normal display is high total, P-39 = 1

low total is momentarily displayed

normal display of the high total returns

If P-39 = 0, alternate reading cannot be momentarily displayed. Pressing the desired key will change the display and hold it there until the next alternate reading is selected.

In the program mode, the high and low totals can be viewed or preset to any value by P-54 and P-55 respectively.

The pumped volume readings (high and low total) may be scaled down by factors of 10 (P-52) to slow down the totalizer's rate of fill, and its decimal point (P-53) positioned for the resolution required. If it is desired to change the scaling factor or decimal point location after totalling has begun, record the high and low totals and reset the totalizer to zero.

Further to alarm and pump functions, relays may be programmed to act as a momentary contact closure for a remote totalizer, flow sampler or time sampler (refer to Applications \ Relays). The duration of a momentary contact closure is 200 msec for which the corresponding relay status LED will flash. As a remote totalizer relay, the contact is closed each time the displayed total is increased by the amount entered into P-56. As a flow sampler relay, the contact is closed each time the volume of liquid, as set by P-57 and P-58, is pumped. As a time sampler relay, the contact is closed at the rate of the time period entered into P-59.

The mA output responds to the liquid reading only (level, if P-34 = 0 or volume if P-34 ≠ 0). In the event of fail-safe due to loss of echo, the mA output will respond as programmed by P-6 and P-74, but the totalized volume will hold its last reading.

Pump Totalizer Example

Further to the Pump Control Example it is required that the volume pumped be totalized. A daily flow total of 1,200 cubic meters is expected and a contact closure is required every 10 cu. m. The full level of the well is equal to 42 cu.m. The following parameters should be set.

select:

P-2	enter option "4",	volume totalizer
P-17	enter option "11",	relay 4-remote totalizer contact
P-33	enter option "1",	estimated inflow volume is added to pumped volume
P-37	enter "14",	convert display, x14 (42 / 3 = 14)
P-39	enter option "2",	display low total
P-52	enter "1",	totalizer convert display, totalized volume will read as tens of cubic meters or 1 count per 10 cubic metres.
P-53	enter option "0",	totalizer decimal point no decimal digits or resolution equals 100% of a count
P-54	press "CLR" enter "0",	totalizer preset value, arbitrarily chosen
P-55	press "CLR" enter "0",	totalizer preset value, arbitrarily chosen
P-56	enter "1",	totalizer contact control-closure every 10 cu. m

to re-enter run mode.

VOLUME
APPLICATION PARAMETERS

General		Relays		Pump Control		Vol. & Disp. Conversion		OCM		Totalizer		Custom		Filter	
P-1	**units**	**P-8**	1 function	P-23	submers.	P-34	tank	P-40	primary	P-51	OCM sim.	P-60	full	P-68	fill damp
P-2	**mode**	P-9	1 on	P-24	1 hrs.	P-35	dim. A	P-41	time	P-52	factor	P-61	empty	P-69	empty damp
P-3	**empty dist.**	P-10	1 off	P-25	2 hrs.	P-36	dim. L	P-42	expon.	P-53	decimal	P-62	offset	P-70	rate disp.
P-4	**span**	P-11	2 function	P-26	3 hrs.	P-37	convert	P-43	flume dim.	P-54	low tot.	P-63	vel. 20 °C	P-71	rate avg.
P-5	near blank	P-12	2 on	P-27	4 hrs.	P-38	disp. offset	P-44	spare	P-55	high tot.	P-64	vel. P-65	P-72	fuzz filter
P-6	mA out	P-13	2 off	P-28	5 hrs.	P-39	disp. opt'n	P-45	max. head	P-56	remote tot.	P-65	temp.	P-73	agitator
P-7	decimal	P-14	3 function	P-29	run-on			P-46	max. flow	P-57	flow samp.	P-66	max. temp	P-74	f-s mode
		P-15	3 on	P-30	run-on			P-47	auto zero	P-58	flow samp.	P-67	min. temp	P-75	f-s timer
		P-16	3 off	P-31	spare			P-48	cutoff	P-59	time samp.				
		P-17	4 function	P-32	DLD mA out			P-49	decimal						
		P-18	4 on	P-33	totaling			P-50	mA out						
		P-19	4 off												
		P-20	5 function												
		P-21	5 on												
		P-22	5 off												

P-# required parameters

P-# optional parameters

P-# parameters not required

VOLUME APPLICATION

In addition to simple liquid level and pump applications, volume conversions can be included in the programming.

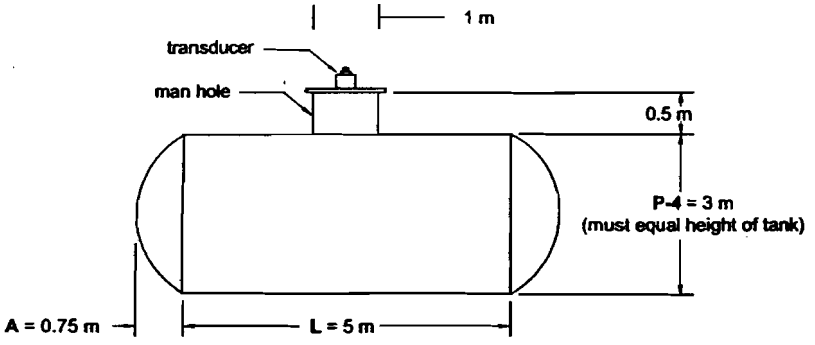
Common Tank Shapes

Volume conversion is provided for 8 common tank shapes, (P-34). Dimensions are entered using P-4 and 36. Volume is displayed as 0-100% and may be converted to volume units using P-37.

P-4, span, must be equal to the 100% (full) level of tank.

Volume Example

The application is to measure the volume of glue in a horizontal tank with parabolic ends. The tank manufacturer's specifications state that the volume is 40.6 cubic metres.



The maximum fill / draw rate is 0.35 cu. m / min. In the event of a loss of echo, the HydroRanger is to go into fail-safe high after 30 sec.

select:

P-1	enter option "1",	units in meters

advance to:

P-2	enter option "1",	material level
P-3	enter "3.5",	empty distance to transducer
P-4	enter "3",	span (inside diameter of tank)
P-5	enter ".300",	near blanking distance, (use factory setting)
P-7	enter "1",	display maximum 1 digit after decimal
P-34	enter option "7",	tank shape for volumetric conversion

P-35	enter ".75",	tank dimension A
P-36	enter "5",	tank dimension L
P-37	enter ".406",	convert display, x.406 (automatically shows the levels in %). As 100% full = 40.6 cubic metres, a conversion factor of .406 must be entered. $\frac{\text{actual volume}}{\text{percentage}}$ = conversion factor
P-68	enter "10",	fill damping 10 m/min $\frac{40.6 \text{ cu. m}}{0.35 \text{ cu. m / min}}$ = 116 min total fill time $\frac{3 \text{ m}}{116 \text{ min}}$ = 0.025 m / min average fill rate However, because of the tank's shape, the top and bottom levels will fill faster than the middle section. Therefore the actual P-68 value should be greater than the average value. Typically, the factory set damping of "10" can be used.
P-69	enter "10",	empty damping-same as fill damping rate
P-74	enter "1",	fail-safe high
P-75	enter ".5",	fail-safe timer, 30 sec.

to re-enter run mode

Custom Design Tanks

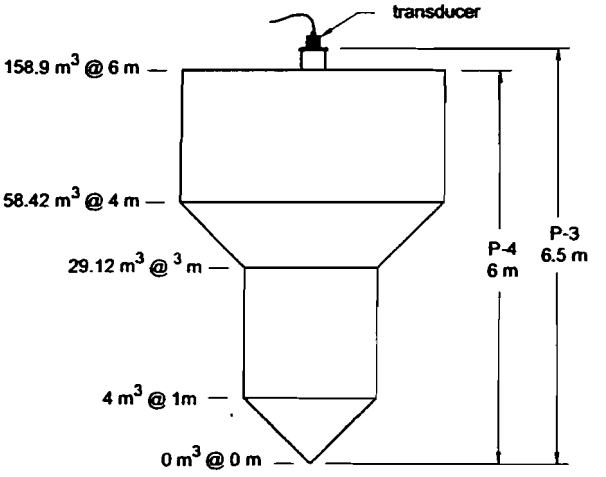
Where the tank design does not match one of the eight common tank shapes, P-34 may be programmed for level versus volume characterization.

Characterization is achieved by entering the level (H parameters) and corresponding volume (F parameters) for the elevations where there is a change in the tank profile. Where curves are involved, the more breakpoints that are defined, the more accurate will be the volume of measurement. A maximum of eleven breakpoints can be defined.

Level data is entered in the linear units selected (P-1) and volume data is entered in the tank desired volumetric units. Both of these are referenced to the bottom of the tank.

Custom Design Tanks Example 'A'

The application is to measure the level of liquid in a custom designed tank. The tank manufacturer specifies the following level versus volume data.



select :

P-1	enter option "1",	units in metres

advance to :

P-2	enter option "1",	material level
P-3	enter "6.5",	empty distance to transducer
P-4	enter "6",	span
P-5	enter ".5"	near blanking distance
P-34	enter option "9"	universal level vs volume

press	*display will show*
★	H - 1
▲	- - - -
0 ▬	0.0 0 0
▲	H - 2 *(then)* - - - -
1 ▬	1.0 0 0

press	*display will show*
▲	H-3 *(then)* ----
3 ENTER	3.000
▲	H-4 *(then)* ----
4 ENTER	4.000
▲	H-5 *(then)* ----
6 ENTER	6.000
★	F-5 *(then)* ----
ALT	F-5
1	F-1
ALT	----
0 ENTER	0.000
▲	F-2 *(then)* ----
4 ENTER	4.000
▲	F-3 *(then)* ----
2 9 . 1 2 ENTER	29.12
▲	F-4 *(then)* ----
5 8 . 4 2 ENTER	58.42
▲	F-5 *(then)* ----
1 5 8 . 9 ENTER	158.9
ALT	F-5
CLR	P-34

RUN CAL to re-enter run mode

Compensation

In many volume applications, the ambient atmosphere is other than air or at a temperature other than 20 °C. Refer to Functional \ Temperature or \ Sound Velocity, for details on compensating for such circumstances.

If it is noted that the HydroRanger reading is consistently off by a constant amount as compared to the physical reading, this may be compensated for by P-62. This tank measurement offset might occur when P-3 or P-4 does not exactly match the tank dimensions referenced for volume conversion. If the cause of the offset appears below the relay setpoints, the setpoint parameters may need to be reset as these will have shifted accordingly.

Custom Design Tanks Example 'B'

Further to the Volume Example or the Custom Design Tank Example 'A', the liquid is a glue giving off formaldehyde vapour. Velocity compensation will be required.

As the next two steps involve physical measurements, for convenience sake, P-60 can be done before P-61.

select:

P-62	(optional to P-60)	record present offset for reference
P-60	(optional)	with the tank as full as permissible, without going into the blanking zone, press "MEAS". The HydroRanger will take a measurement and display the level. Press "meas" at least 5 times and insure that a stable reading is being obtained. Enter the "physical measurement". The HydroRanger will now calculate the measurement offset to be used in future level measurements. The offset reading will be automatically entered into P-62 and can now be viewed.
P-63	record present sound velocity for reference	

P-61 with the tank as empty as permissible and filled with its normal vapour and at its normal temperature press "MEAS".
The HydroRanger will take a measurement and display the level in the units selected, regardless that percent, volume or convert display are used. Press "MEAS" at least 5 times and insure that a stable reading is being obtained.

Enter the "physical measurement". The HydroRanger will now calculate the correct sound velocity to be used in future level measurements.The new sound velocity will automatically be entered into P-63 and P-64, and can now be viewed.

to re-enter run mode.

DIFFERENTIAL LEVEL
APPLICATION PARAMETERS

General		Relays		Pump Control		Vol. & Disp. Conversion		OCM		Totalizer		Custom		Filter	
P-1	**units**	P-8	1 function	P-23	submers.	P-34	tank	P-40	primary	P-51	OCM sim.	P-60	full	**P-68**	**fill damp**
P-2	**mode**	P-9	1 on	P-24	1 hrs.	P-35	dim. A	P-41	time	P-52	factor	P-61	empty	**P-69**	**empty damp**
P-3	**empty dist.**	P-10	1 off	P-25	2 hrs.	P-36	dim. L	P-42	expon.	P-53	decimal	P-62	offset	**P-70**	**rate disp.**
P-4	**span**	P-11	2 function	P-26	3 hrs.	P-37	convert	P-43	flume dim.	P-54	low tot.	P-63	vel. 20 °C	**P-71**	**rate avg.**
P-5	near blank	P-12	2 on	P-27	4 hrs.	P-38	disp. offset	P-44	spare	P-55	high tot.	P-64	vel. P-65	**P-72**	**fuzz filter**
P-6	mA out	P-13	2 off	P-28	5 hrs.	**P-39**	**disp. opt'n**	P-45	max. head	P-56	remote tot.	P-65	temp.	**P-73**	**agitator**
P-7	decimal	P-14	3 function	P-29	run-on			P-46	max. flow	P-57	flow samp.	P-66	max. temp	**P-74**	**f-s mode**
		P-15	3 on	P-30	run-on			P-47	auto zero	P-58	flow samp.	P-67	min. temp	**P-75**	**f-s timer**
		P-16	3 off	P-31	spare			P-48	cutoff	P-59	time samp.				
		P-17	4 function	P-32	DLD mA out			P-49	decimal						
		P-18	4 on	P-33	totaling			P-50	mA out						
		P-19	4 off												
		P-20	**5 function**												
		P-21	5 on												
		P-22	5 off												

P-# required parameters

P-# optional parameters

P-# parameters not required

DIFFERENTIAL LEVEL APPLICATION

This type of application monitors the difference between two liquid levels, hence two transducers are required. The HydroRanger monitors the two levels, calculates the difference and displays the differential as the reading. The following parameters should be left at their factory setting:

- volume conversion (P-34)
- display conversion (p-37)
- offset (P-62)
- velocity compensation (P-63)
- temperature compensation (P-65)

In the run mode, the reading display will show the absolute difference between the levels, hence there are no negative readings. The level at transducer 1 or 2 may be viewed individually by pressing "PT1" or "PT2" respectively.

When programming as a differential level detector

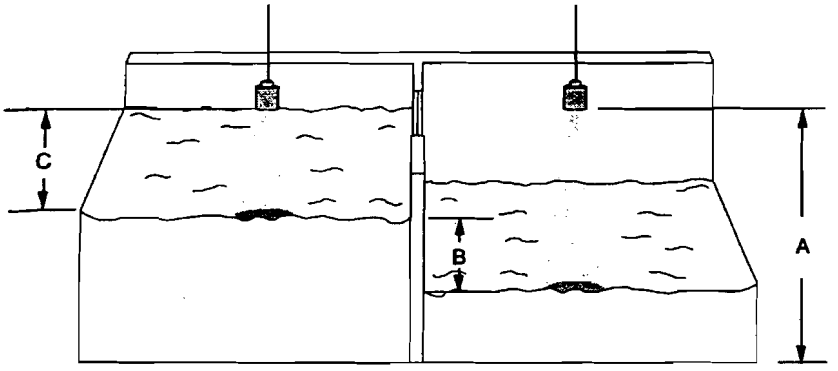
- P-2, mode: option 3 must be selected for DLD operation
- P-3, empty distance to transducer: represents the lowest or common level
- P-4, span: represents differential level corresponding to the 20 mA value
- P-6, ma output: select range
- P-20, function: option 14 must be selected for relay 5 to operate as scanner
- P-32, mA output: may be dedicated to correspond to differential or level under transducer #1

On alarm and pump relay functions with setpoints referenced to zero, the setpoints are common to both levels. The in bounds, out of bounds, rate of change and sequential relay functions are not allowed.

In the event that the echo on either transducer is lost:

- If set for fail-safe high: the differential reading will display the maximum differential level(P- 4)
- if set for fail-safe low: the differential reading will display zero
- If set for fail-safe hold: the display will hold its present reading after the fail-safe timer has expired

In order to use the HydroRanger as a differential level detector TB-1 must be wired as in Installation \ Installing the Transducer and both transducers must be installed at the same level.



A = transducers must be at the same elevation (P-3).

B = maximum differential (Span, P-4)

C = transducer should be mounted at least 0.3 m above the highest liquid level and 0.3 m away from the wall for every 3 m / ST-25 or 6 m / ST-50 of measurement.

Differential Level Example

The application is to monitor the differential level across a sewage bar screen. When a differential level of greater than 12" is obtained, it is required that a rake be started. If the water level on either side rises above 20", a high level alarm is required.

The height from the common (low) level to the transducer face is 4 ft . A 4 - 20 mA output corresponding to the differential is required, and the 20 mA has been arbitrarily set to correspond to a 24" differential (span). In the event of a loss of echo, the HydroRanger should go into a fail-safe high after 5 minutes.

select:

P-1	enter option "4",	units in inches
P-2	enter option "3",	differential level
P-3	enter "48",	empty distance to transducer
P-4	enter "24",	span
P-5	enter "11.81",	blanking distance, (use factory setting)
P-6	enter option "24",	4 - 20 mA output
P-7	enter "1",	display max 1 digit after decimal
P-8	enter option "4",	relay 1 - differential alarm
P-9	enter "12",	relay 1 - rake on This would be used only to initiate the rake control circuitry.

P-10	enter "6",	relay 1 - reset this value can be arbitrarily set
P-11	enter option "1",	relay 2 - alarm function
P-12	enter "20",	relay 2 - alarm ON
P-13	enter "19",	relay 2 - alarm OFF
P-20	enter option "14",	relay 5 - scanner
P-32	enter option "1",	mA output on differential
P-68	enter "393.7",	fill damping 393.7 in / min. Normally this level would rise over a period of days or weeks, therefore damping requirements would be fairly slow. Typically, the factory set damping of 32.81 can be used.
P-69	enter "393.7",	empty damping - same as fill damping
P-74	enter option "1,	fail-safe high
P-75	enter "5",	fail-safe timer

to re-enter run mode

OPEN CHANNEL MEASUREMENT
APPLICATION PARAMETERS

General		Relays		Pump Control		Vol. & Disp. Conversion		OCM		Totalizer		Custom		Filter	
P-1	**units**	P-8	1 function	P-23	submers.	P-34	tank	**P-40**	**primary**	P-51	OCM sim.	**P-60**	**full**	**P-68**	**fil damp**
P-2	**mode**	P-9	1 on	P-24	1 hrs.	P-35	dim. A	**P-41**	**time**	**P-52**	**factor**	**P-61**	**empty**	**P-69**	**empty damp**
P-3	**empty dist.**	P-10	1 off	P-25	2 hrs.	P-36	dim. L	***P-42**	**expon.**	**P-53**	**decimal**	P-62	offset	**P-70**	**rate disp.**
◊P-4	**span**	P-11	2 function	P-26	3 hrs.	P-37	convert	***P-43**	**flume dim.**	**P-54**	**low tot.**	P-63	vel. 20 °C	**P-71**	**rate avg.**
P-5	near blank	P-12	2 on	P-27	4 hrs.	**P-38**	**disp. offset**	P-44	spare	**P-55**	**high tot.**	P-64	vel. P-65	**P-72**	**fuzz filter**
P-6	mA out	P-13	2 off	P-28	5 hrs.	**P-39**	**disp. opt'n**	**◊P-45**	**max. head**	**P-56**	**remote tot.**	P-65	temp.	**P-73**	**agitator**
P-7	decimal	P-14	3 function	P-29	run-on			**P-46**	**max. flow**	**P-57**	**flow samp.**	P-66	max. temp	**P-74**	**f-s mode**
		P-15	3 on	P-30	run-on			**P-47**	**auto zero**	**P-58**	**flow samp.**	P-67	min. temp	**P-75**	**f-s timer**
		P-16	3 off	P-31	spare			**P-48**	**cutoff**	**P-59**	**time samp.**				
		P-17	4 function	P-32	DLD mA out			**P-49**	**decimal**						
		P-18	4 on	P-33	totaling			**P-50**	**mA out**						
		P-19	4 off												
		P-20	5 function												
		P-21	5 on												
		P-22	5 off												

P-# required parameters

P-# optional parameters

P-# parameters not required

* either parameter, depending on P-40

◊ same

OCM APPLICATION

This application is specific to monitoring the flowrate in one of the four following categories of primary measuring devices. Refer to the respective drawings at the end of this section for weir and flume outlines and transducer location.

Single Exponential, these are flumes and weirs that can be characterized by a single exponential term (P-40 = 1) i.e. $Q = K H^X$.

where : Q = flow
K = constant
H = head
x = exponent, characteristic to the primary measuring device (flume or weir)

Examples :

Primary measuring device	*exponent*
Suppressed rectangular, Cipolletti weir, or Venturi flume	1.50
Parshall Flume, or Leopold Lagco	1.55
V-notch weir	2.50
etc	

Refer to manufacturer's specifications for the exact exponent. The exponents listed above are for reference only.

Palmer-Bowlus flumes : **typically those manufactured by Plasti-Fab or Warminster Fiberglass (P-40 = 2)**

H-flumes : **excluding HS and HL sizes, as developed by the U.S. Department of Agriculture, Soil Conservation (P-40=3)**

Other : **these are primary measuring devices that do not fit the first three categories (P-40 = 4)**

As most OCM applications are outdoors, the use of a temperature sensor is strongly recommended for optimum accuracy. Refer to Functional \ Temperature.

Flow readings are calculated by the HydroRanger as a function of the head under the transducer, installed upstream from the primary measuring device (P-40). The flows are then accumulated in the arbitrary volume units chosen per the time units of P-41 in an 8 digit totalizer. In the event of a loss of echo, the totalizer will continue being incremented by the flowrate established from the last valid echo. The totalizer will stop being incremented and hold its last updated value when in the program mode or if the fail-safe timer expires ("LOE" is displayed).

The totalizer contents are stored in RAM and will be lost in the event of a power failure. However, after every 1 hour of continuous operation, the totalizer contents are stored in the EEPROM. Thus, after a power failure, the totalizer will be loaded with the last value stored. Once the totalizer has been filled (99999999) it will automatically reset itself to zero and resume totalling.

The MulitRanger Plus can be programmed (P-39) to normally display one of the following readings:

- enter option "0", hold last reading selected in run mode
- enter option "1", high total: 4 highest digits of the 8 digit totalizer
- enter option "2", low total: 4 lowest digits of the 8 digit totalizer
- enter option "3", head
- enter option "4", flow

It must be noted that only half of the totalizer digits can be accessed or viewed at one time.

e.g.		***high total***	***low total***
		P-54	P-55
	8 digit total	1325	4769

To momentarily view an alternate reading while in run mode and P-39 ≠ 0, press the desired programmer key ("READ" is not applicable to OCM).

e.g.

normal display is high total, P-39 = 1

low total is momentarily displayed

normal display of the high total returns

If P-39 = 0, alternate readings cannot be momentarily displayed. Pressing the desired key will change the display and hold it there until the next alternate reading is selected.

In the program mode, the high and low totals can be viewed or preset to any value by P-54 and P-55 respectively.

The flow readings (high and low total) may be scaled down by factors of 10 (P-52) to slow down the totalizer's rate of fill and its decimal point (P-53) positioned for the resolution required. To change the scaling factor or decimal point location after totaling has begun, record the high and low totals and reset the totalizer to zero.

The HydroRanger can be programmed to ignore low head, i.e. flows for heads less than that set in P-48 will not be accumulated in the totalizer. The low head cutoff is measured in % of maximum head (P-45).

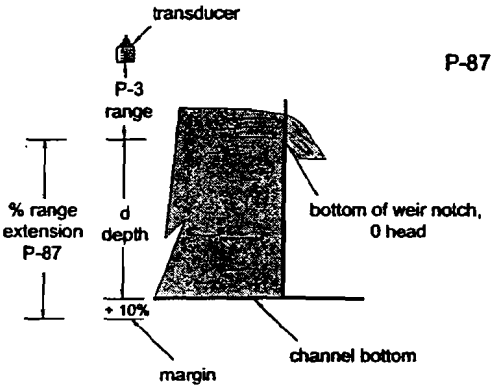
Further to alarm and pump functions, relays may be programmed to act as a momentary contact closure for a remote totalizer, flow sampler or time sampler (refer to Application \ Relays). The duration of a momentary contact closure is 200 msec for which the corresponding relay status LED will flash. As a remote totalizer relay, the contact is closed each time the displayed total is increased by the amount entered into P-56. As a flow sampler relay, the contact is closed each time the volume of liquid as set by P-57 and P-58 is pumped. As a time sampler relay, the contact is closed at the rate of the time period.

The mA output responds to the head or flow (P-50). In the event of fail-safe due to loss of echo, the mA output will respond as programmed by P-6 and P-74.

When programming the HydroRanger for the OCM function, the empty distance to transducer (P-3) may be considered and entered as the distance from the transducer face to the 0 head or no flow reference level. If this measurement is not easily obtained, P-3 can be estimated and corrected via P-47. This is referred to as the Auto Zero calibration and requires the HydroRanger to compare a physical measurement (from wall gauge, dipstick or stilling well) to the ultrasonic measurement via P-47. Refer to OCM Auto Zero Example.

It should also be noted that when operating in the OCM function: percent display, volume conversion (P-34) and convert display (P-37) are inoperative. Empty calibration (P-61) must be clear, i.e. 4 hyphens in the display.

An important consideration in OCM applications is that many primary measuring devices have the potential of running dry. In such cases, it must be insured that the range extension (P-87) is sufficient so that the floor of the channel or of the converging section of the flume can be read. Otherwise, false readings may be obtained indicating flow.



$$P\text{-}87 = \frac{d}{P\text{-}3} \times 110$$

OCM Example

9" Parshall Flume

$$Q = 1.98\ H^{1.53}$$

where Q = flow rate, MGD (million gallons per day),

H = head, feet

- max flow rate - Q max = 4.112 MGD
  = 4,112,000 gal. / day
- max head - H max = 1.61
- transducer is mounted 3 ft above the zero flow level
- max flow rate display = 4,112
  i.e. one count = 1000 gal.

select:

P-1	enter option "3",	units in feet
P-2	enter option "5",	OCM
P-3	enter "3",	zero level distance to transducer
P-4	enter "1.61",	max head
P-5	enter "1",	near blanking distance, minimum allowable
P-39	enter option "4",	display flowrate in units per day
P-40	enter option "1",	primary measuring device - exponential
P-41	enter option "4",	flowrate time units - per day
P-42	enter "1.53"	exponent from manufacturer's specs. for 9" Parshall Flume
P-46	enter "4112",	max flow in thousand gal / day
P-49	enter option "3",	flowrate decimal point display max 3 digits after decimal
P-52	enter option "0",	totalizer convert display total is divided by 1 before being displayed or 1 count per thousand gallons.
P-53	enter option "2",	totalizer decimal point display 2 digits after decimal or resolution equals 1/100th of a count.
P-68	enter "32.81",	fill damping 32.81 ft / min. As the head would fluctuate over a period of hours, damping requirements would be fairly low. Typically, the factory set damping of 32.81 can be used.
P-69	enter "32.81",	empty damping - same as fill damping

to re-enter run mode

OCM Auto Zero Example

Further to OCM Example, the following is required :

- alarm at 10% overflow (approx. = 1.8 ft) and 0 head
- in the event of loss of echo, the HydroRanger is to go into low alarm after 45 sec.
- head to read to 1 decimal place
- sampler contact every day
- head under "1" (40 thousand gal / day) not be totalized
- 4 - 20 mA output to respond to flow

select :

P-3	enter "3.33"	estimated empty distance to transducer
P-6	enter option "2",	4 to 20 mA
P-7	enter option "1",	decimal location for head display max 1 digit after decimal
P-8	enter option "1",	relay 1 - alarm function
P-9	enter option"1.8",	relay 1 - alarm ON
P-10	enter "1.5",	relay 1 - alarm OFF
P-11	enter option "1",	relay 2 - alarm function
P-12	enter "0",	relay 2 - alarm ON
P-13	enter ".3",	relay 2 - alarm OFF
P-14	enter option "13",	relay 3 - time sampler contact
P-47		Auto Zero

Press  and then  4 hyphens must appear in the display.

Press  at least 5 times to insure that the HydroRanger will obtain a stable ultrasonic measurement. The resultant reading will be the apparent head with respect to the estimated P- 3 = 3.33 ft . Enter "physical head measurement", over the displayed value previously obtained. This is the true head measurement from wall gauge, dipstick or stilling well, taken at the same time as the ultrasonic measurement and representing the same head measurement point as seen by the transducer. The physical head measurement must not be in the near blanking zone. An offset value, which is the apparent head minus the true head, is automatically calculated and entered into P-62. P-62 can only be cleared by P-47.

P-48	enter "5.2",	low head cutoff is 5.2% of P-45 flow for head below "1" (40 thousand gal. / day) will not be totalized

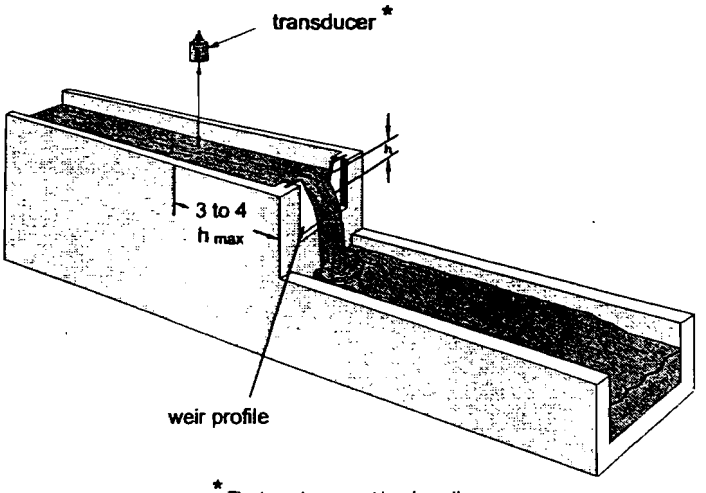
$$\frac{1"}{12" / ft \times 1.61\ ft} = 0.052 = 5.2\%$$

P-50	enter option "2",	mA output responds to flow
P-59	enter "1",	time sampler control closure once every hour
P-74	enter option "2",	fail-safe low
P-75	enter option ".75",	fail-safe timer, 45 sec.

 to re-enter run mode

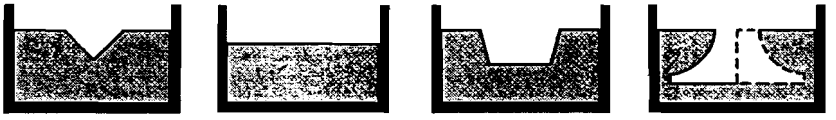
Single Exponential, P-40 = 1

Weirs



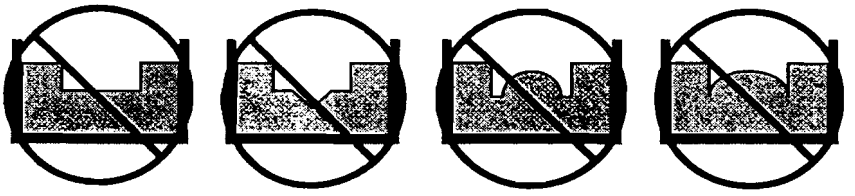
* The transducer must be above the maximum head by at least the blanking value, P-5.

Applicable Weir Profiles



V - notch or triangular | suppressed rectangular | cipolleti or trapezoidal | sutro or proportional

Non-Applicable Weir Profiles



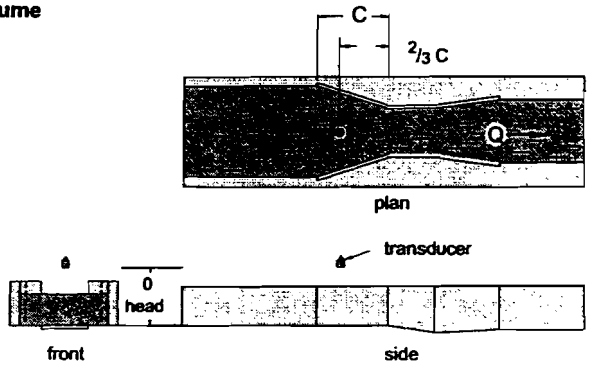
contracted rectangular | compound | Poebing | approximate exponential

Flows through these weirs may be measured using the universal head vs flow characterization, P-40 = 4.

Single Exponential P-40 = 1 (cont'd)

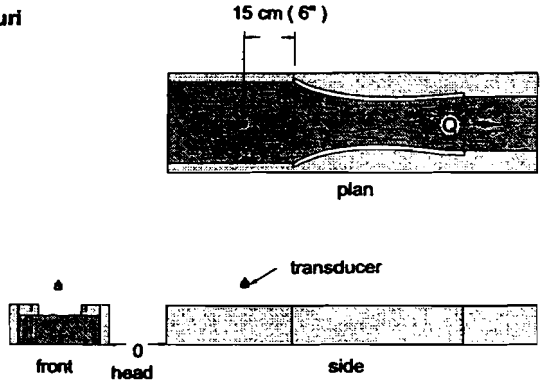
FLUMES

Parshall Flume



- sized by throat width
- set on solid foundation
- general free flow equation is $Q = K H^x$ where: Q = flow rate
  K = constant
  H = head
  x = exponent
- For rated flows under free flow conditions, the head is measured at 2 / 3 the length of the converging section from the beginning of the throat section.
- Position the transducer such that it is centered over the flow at a minimum head.

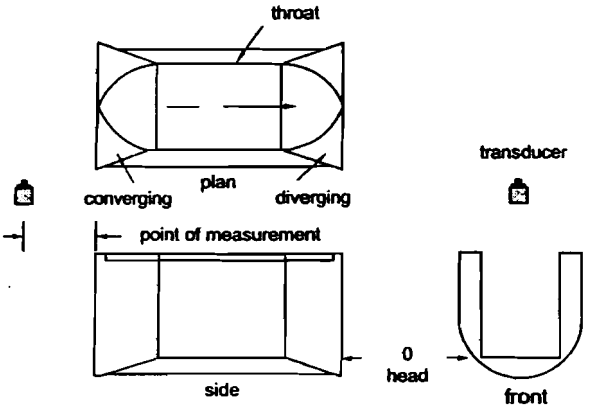
Khafagi Venturi



- for rated flows under free flow conditions, the head is measured 15 cm (6") upstream from the beginning of the converging section.
- position the transducer such that it is centered over the flow at a minimum height of 30 cm (12") above the maximum head.

Single Exponential, P- 40 = 1 (cont'd)
FLUMES (cont'd)

Leopold Lagco (as manufactured by Leopold Co., Inc.)



- designed to be installed directly into pipelines and manholes
- Leopold Lagco may be classed as a rectangle Palmer-Bowlus flume
- sized by pipe (sewer) diameter
- for rated flows under free flow conditions, the head is measured at a point upstream referenced to the beginning of the converging section. Refer to the following table:

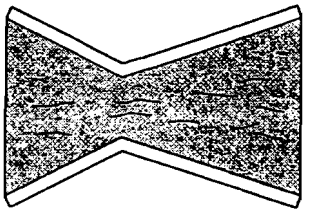
Flume Size (pipe dia. in inches)	Point of Measurement cm	inches
4 - 12	2.5	1
15	3.2	1 1/4
18	4.4	1 3/4
21	5.1	2
24	6.4	2 1/2
30	7.6	3
42	8.9	3 1/2
48	10.2	4
54	11.4	4 1/2
60	12.7	5
66	14.0	5 1/2
72	15.2	6

- general free flow equation is $Q = K H^x$, where: Q = flow rate
  K = constant
  H = head
  x = exponent
- position the transducer such that it is centered over the flow at a minimum height of 30 cm (12") above the maximum head.

Single Exponential, P-40 = 1 (cont'd)

FLUMES (cont'd)

Cutthroat Flume

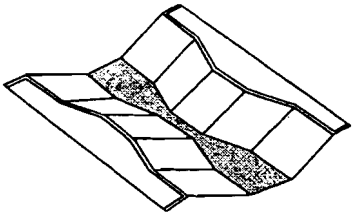


plan

- similar to Parshall flume except that the floor is flat bottomed and throat has no virtual length
- refer to manufacturer's specifications for flow equation and point of head measurement.

Flow through the following flumes may be measured using the universal head vs flow characterization, P-40 = 4.

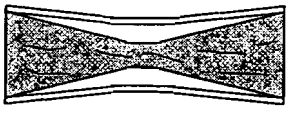
Trapezoidal Flume



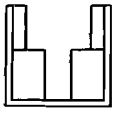
isometric

- similar to Parshall flume except that the floor is flat bottomed and walls are sloped.

Dual Range (nested) Parshall Flume



plan

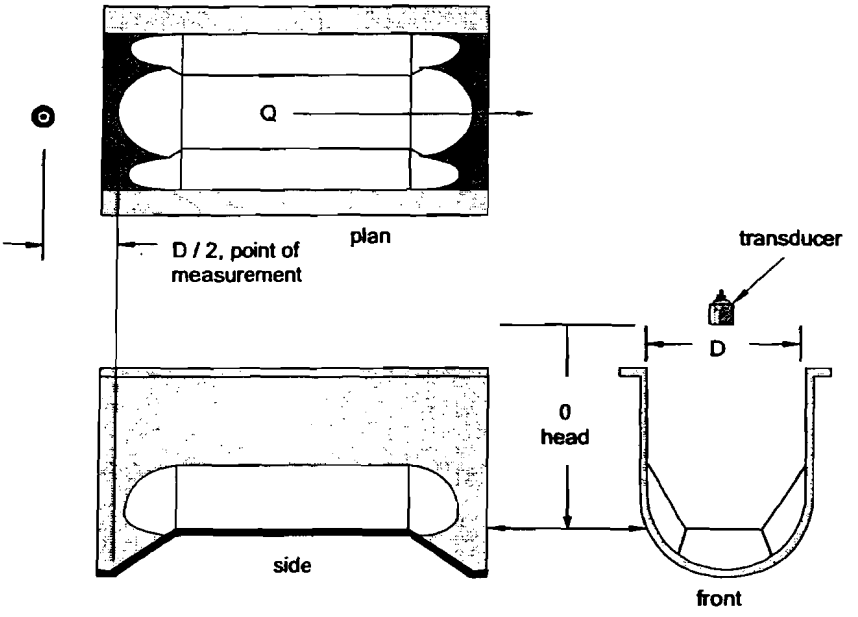


front

- two flumes, a larger on top of the smaller, in order to handle a larger range of flows.

Palmer-Bowlus Flume, P-40 = 2

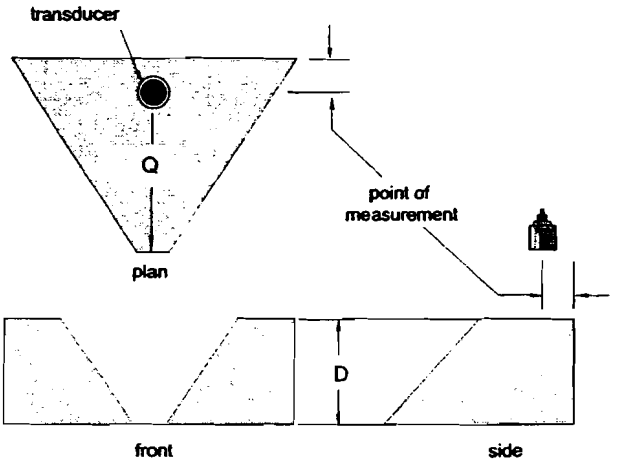
(typically those manufactured by Warminster Fiberglass or Plasti-Fab)



- sized by pipe diameter, D. Enter value (in units of P-1) into P-43.
- flume relief is trapezoidal
- designed to install directly into pipelines and manholes
- head is referenced to bottom of the throat not to bottom of pipes
- for rated flows under free flow conditions, the head is measured at a distance of D / 2 upstream from the beginning of the converging section
- position the transducer such that it is centered over the flow at a minimum height 30 cm (12") above the maximum head

H Flumes, P-40 = 3

(as developed by the U.S.Department of Agriculture, Soil Conservation Service)



- » sized by max depth of flume, D. Enter value (in units of P-1) into P-43.
- » approach is preferably rectangular, matching width and depth for distance 3 to 5 times the depth of the flume
- » flow range 100 : 1
- » may be installed in channels under partial submergence (ratio of downstream level to head).

  Typically: » 1% error @ 30% submergence
  » 3% error @ 50% submergence

- » for rated flows under free flow conditions, the head is measured at a point downstream for the flume entrance.

Flume Size (D ft)	Point of Measurement	
	cm	inches
0.5	5	1 3/4
0.75	7	2 3/4
1.0	9	3 3/4
1.5	14	5 1/2
2.0	18	7 1/4
2.5	23	9
3.0	28	10 3/4
4.5	41	16 1/4

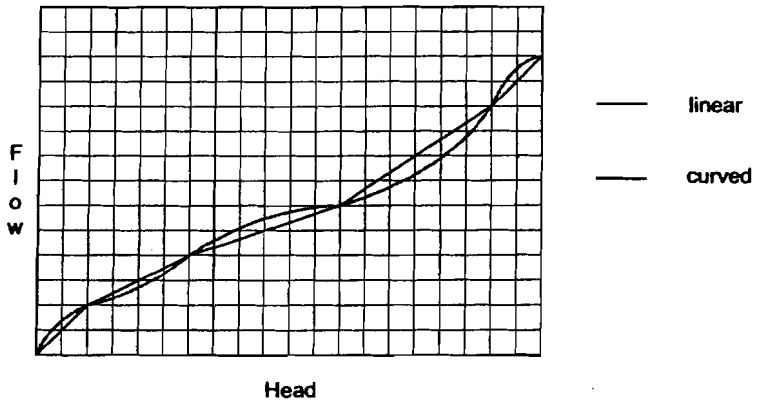
- » H flumes come with a flat or sloping floor. The same flow table can be used as error is less than 1%.
- » position the transducer such that it is centered over the flow at a minimum height of 30 cm (12") above the maximum head.

Other, P- 40 = 4

Where the primary measuring device does not fit one of the three other categories, P-40 may be programmed for one or two head versus flow characterizations:

- P-40 = 4 : curved
- P-40 = 5 : linear

Select the characterization which most closely fits the flow characteristics of the primary measuring element.



Characterization is achieved by entering the head (H parameter) and corresponding flow (F parameter) either from emperical measurement or from the manufacturer's specification. The more breakpoints that are defined, the more accurate will be the flow measurement. Breakpoints should be concentrated in areas exhibiting the higher degrees of non linear flow. A maximum of eleven breakpoints can be defined.

Head data is entered in the linear units selected (P-1) and flow data is entered in the desired units of flowrate.

Other Flumes Example

The application is to measure the flow across a 4 ft rectangular weir with end contractions. The flow is characterized by the following formula:

$$cfs = 3.33 (L-0.2H) H^{1.5}$$

where: cfs = flow in cu ft / sec
L = length of crest
H = head

select :

P-1	enter option "3",	units in feet

advance to:

P-2	enter option "5",	OCM
P-3	enter "4",	empty distance to transducer
P-4	enter "3",	span
P-5	enter "1",	near blanking distance
P-39	enter option "4",	display flowrate
P-40	enter option "4",	universal head vs flow

press	*display will show*
	H - 1
	- - - -
	0.0 0 0
	H - 2 *(then)* - - - -
	0.3 0 0
	H - 3 *(then)* - - - -
	0.6 0 0
« « «	
	H - 10 *(then)* - - - -
	2.7 0 0
	H - 11 *(then)* - - - -
	3.0 0 0
	F - 11 *(then)* - - - -
	F - 11
	F - 1
	- - - -

press	*display will show*
0 ENTER	0.0 0 0
▲	F - 2 *(then)* - - - -
2 . 1 5 6 ENTER	2.1 5 6
▲	F - 3 *(then)* - - - -
6 . 0 0 5 ENTER	6.0 0 5
⌄⌄⌄	
▲	F - 10 *(then)* - - - -
5 1 . 1 2 ENTER	5 1.1 2
▲	F - 11 *(then)* - - - -
5 8 . 8 3 ENTER	5 8.8 3
ALT	F - 11
CLR	P - 4 0

P-41	enter option "1",	flowrate time units per sec
P-46	enter "58.83",	maximum flowrate in cu ft / sec
P-49	enter option "3",	flowrate decimal point display max 3 digits after decimal
P-52	enter option "0",	totalizer convert display is divided by 1 before being displayed or 1 count per thousand cu ft
P-53	enter option "2",	totalizer decimal point display 2 digits after decimal or resolution equals 1/100th of a count

to re-enter run mode

APPLICATIONS WITH STANDPIPES

In many liquid applications, access to the vessel must be made via a standpipe. In such cases, Milltronics can provide flange mounted transducers that will readily mate to the standpipe.

The maximum standpipe length that can be used without additional near blanking (P-5 not greater than 0.3 m) is 200 mm (8"). For greater standpipe lengths, up to 30" long, near blanking must be extended to 150 mm (6") beyond the end of the pipe.

The preferred dimension when selecting a standpipe arrangement is a 100 mm (4") diameter pipe, 300 mm (12") long. Near blanking would be set at 460 mm (18").

Standpipe Example

Referring to Volume Application \ Volume Example, if the transducer were mounted to a 150 mm diameter flanged standpipe 0.5 m long, instead of a 1 m diameter manhole, the following will be required :

select :

P-5	enter ".65",	near blanking
		0.50 m (standpipe length)
		+0.15 m (blanking past pipe)
		0.65 total blanking distance

to re-enter run mode.

PARAMETER DESCRIPTION

**(F) indicates the parameter's factory setting, where applicable.
For reference only, factory set values
may change with software revisions.**

(V) indicates that parameter can be viewed only, not entered.

P-0 security

This parameter can be used to lock out the programmer such that the content of parameters P-1 through P-99 can not be changed. This however does not prevent the parameters from being selected and viewed. The programmer is locked out if the content of P-0 is of any value other than 1954. P-0 can only be direct accessed.

content = 1954, programmer functional (F)
≠ 1954, programmer locked out
= -1, pumps active during simulation

P-1 units of calibration and display

enter:		
	1 = meters (F)	1 • = calibrate in meters, display in %
	2 = centimeters	2 • = calibrate in centimeters, display in %
	3 = feet	3 • = calibrate in feet, display in %
	4 = inches	4 • = calibrate in inches, display in %

**For % display, entry must be made as # •
and will be displayed as " # P "**

e.g. Press [3] and then [★], the display will show " 3 P ".

P-2 mode of measurement

enter: 1 = material level
2 = space (F)
3 = differential level
4 = volume totalizer (pump totalizer)
5 = OCM (open channel measurement)

P-3 empty distance to transducer

enter desired amount (F = 10.00 m)

P-4 span

» distance between full (high) and empty (low) levels
» maximum level differential if DLD (P-2 = 3) is selected
» maximum head if OCM (P-2 = 5) is selected

enter desired amount (F = 10.00 m)

P-5 near blanking

normally leave at factory setting. However for blanking extension, entry must be slightly larger than distance to end of standpipe or far side of obstruction. Blanking should not extend all the way into span level. Some margin of material span should be allowed to avoid loss of echo.

enter distance required, in units as set in P-1 (F = 0.300 m)

P-6 milliamp output

enter: 0 = off
1 = 0 to 20 mA
2 = 4 to 20 mA
3 = 20 to 0 mA
4 = 20 to 4 mA

P-7 decimal point location

Sets the maximum number of digits after the decimal. The number of digits after the decimal will automatically reduce to avoid display overflow.

enter: 0 = no digits after decimal
1 = one digit after decimal
2 = two digits after decimal (F)
3 = three digits after decimal

P-8 relay 1 function

Refer to Functional \ Relays.

enter desired option (F = 0)

P-9 / 10 relay 1- ON / OFF setpoints

enter level in units as selected in P-1 or °C (F = - - - -)

P-11 relay 2 function

Refer to Functional \ Relays.

enter desired option (F = 0)

P-12 / 13 relay 2 - ON / OFF setpoints

enter level in units as selected in P-1 or °C (F = - - - -)

P-14 relay 3 function

Refer to Functional \ Relays.

enter desired option (F = 0)

P-15 / 16 relay 3 - ON / OFF setpoints

enter level in units as selected in P-1 or °C (F = - - - -)

P-17 relay 4 function

Refer to Function \ Relays.

enter desired option (F = 0)

P-18 / 19 relay 4 - ON / OFF setpoints

enter level in units as selected in P-1 or °C (F = - - - -)

P-20 relay 5 function

Refer to Functional \ Relays.

enter desired option (F = 0)

P-21 / 22 relay 5 - ON / OFF setpoints

enter level in units as selected in P-1 or °C (F = - - - -)

Parameters P-23 through P-33 are used specifically for pump applications.
Refer to Applications \ Pump Control Applications.

P-23 submersible transducer

enter: 0 = normal ST- series transducer (F)
1 = submersible transducer

P-24 relay 1 pump log *

P-25 relay 2 pump log *

P-26 relay 3 pump log *

P-27 relay 4 pump log *

P-28 relay 5 pump log *

* **These parameters are divided into three levels of subparameters:**

» **" service hours " log**
» **" pump starts " log**
» **" ratio " setpoint**

Access is made by scrolling through the levels.

press	*display will show*	
	P-24	initial access (service hours)
★	C-24	" pump starts "
★	A-24	" ratio " setpoints
★	P-24	" service hours "

press	*display will show*	
To view the service hours		
	P-24	at the 'P' parameter
ALT DISP	1234	e.g. 1,234 hours of service (F = 0.000)
To view the number of starts		
★	C-24	at the 'C' parameter
ALT DISP	321	e.g. 321 pump starts (F = 0)
To view the ratio setpoint		
★	A-24	at the 'A' parameter
ALT DISP	20.00	factory setting
To reset or preset the " service hours " or " pump starts" log		
	P-24	e.g. " service hours " selected
ALT DISP	1234	e.g. 1,234 hours
0	0	e.g. reset to zero
ENTER	0.000	e.g. 0 " service hours "
To set the service " ratio "		
	A-24	" ratio " setpoint
ALT DISP	20.00	e.g. 20
1 5	15	e.g. 15
ENTER	15.00	" ratio " setpoint is now 15

P-29 pump run-on interval

the cyclical period in hours, in which a pump run-on duration may occur. The initial interval begins upon return to the run mode or resumption of power to the HydroRanger. Subsequent intervals begin at the end of the previous interval. Intervals end after the time entered has expired or when the power or run mode is interrupted.

enter interval in hours (F = - - - -)

P-30 pump run-on duration

the amount of time which the lead pump will continue pumping after it has reached its OFF setpoint.

enter duration in seconds (F = 0)

P-31 spare

P-32 DLD milliamp output

when operating on the DLD mode, the milliamp output can be set to correspond either to the differential or to the level under transducer #1

enter: 1 = differential (F)
2 = level

P-33 inflow / discharge totaling

refer to Applications \ Pump Totalizer Application

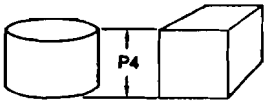
enter: 1 = estimated inflow or discharge volume as added to the pumped volume total (F)
2 = estimated inflow or discharge volume is omitted from the pumped volume total.

Parameters P-34 through P-39 are used for volume and display conversion.

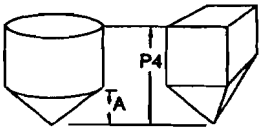
P-34 tank shape for volumetric conversion

enter: 0 = non volume - linear level measurement (F)

1 = flat bottom



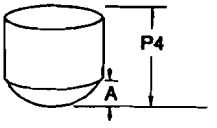
2 = conic or pyramidic bottom



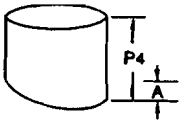
3 = parabolic bottom

or

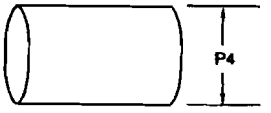
4 = half sphere bottom



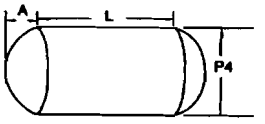
5 = flat slope bottom



6 = horizontal cylinder, flat ends



7 = horizontal cylinder, parabolic ends



8 = sphere

(cont'd)

9 = custom tank design *
(refer to Applications \ Volume Application)

* This option is divided into two levels of subparameters:

H - # where: H = level coordinate
F - # F = volume coordinate
= breakpoint 1 to 11

Access is made by scrolling through the levels.

press	*display will show*
	P-34
ALT	0
9	9
ENTER	9
★	H- 1
★	F- 1
★	H- 1

Setting of the subparameters is done in the same way as with the 'P' parameters.

To exit the " H " and " F " subparameters:

H- 1	select any 'H' or 'F' parameter
CLR	P-34 return to 'P' parameters

If P-34 ≠ 0, reading will be in percent of full volume. For volumetric reading, set conversion factoring by using P-37.

P-35 tank dimension 'A'

the height of the bottom section of tank shapes 2, 3, 4, 5 or
the length of one end section in tank shape 7.
(not required for other tank shapes)

enter " dimension A ", in units selected per P-1 (F = 0000)

P-36 tank dimension 'L'

horizontal length of tank shape excluding parabolic ends
(not required for other tank shapes).

enter " dimension L ", in units selected per P-1 (F = 0.0 0 0)

P-37 convert display

parameter value is the factor by which the measurement is to be multiplied by before being displayed. Range is 0.001 to 9999.
enter desired factor (F = 1)

P-38 display offset

this value is added to material space, volume or ullage measurement before being displayed (P-39, P-76 or " * " key). The mA output and alarms are not affected by the offset. The display offset is entered in the units programmed, subject to P-1, P-34 and P-37.
enter offset required (F = 0.000)

P-39 display reading options

enter : 0 = hold last alternate reading selected (F) 

1 = high total: 4 highest digits of the 8 digit totalizer (pumped volume and OCM only) 
= point 1: DLD level / transducer #1

2 = low total: 4 lowest digits of the 8 digit totalizer (pumped volume and OCM only) 
= point 2: DLD level / transducer #2

3 = head (OCM only) 

4 = flow rate (OCM only) 

5 = reading level, space, differential, volume or ullage 

In the run mode, the programmer keys illustrated can be pressed to view alternate readings. The display will return to the reading option selected (except option 0) after momentarily displaying alternate reading.

Parameters P-40 through P-50 used specifically for OCM applications. Refer to Applications.

P-40 primary measuring device

enter option:
1 = exponential (F)
2 = Palmer-Bowlus
3 = H-flume
4 = universal head vs flow - curve *
5 = universal head vs flow - linear *

* these options are divided into 2 levels of subparameters:

H - # where: H = level coordinate
F - # F = flow coordinate
= breakpoint 1 to 11

Access is made by scrolling through the levels.

press	*display will show*
	P - 40
4	
★	H - 1
★	F - 1
★	H - 11

Setting of the subparameters is done in the same way as with the ' P ' parameters.

To exit the ' H ' and ' F ' subparameters

H - 1	select any ' H ' or ' F ' parameter
	P - 40 return to ' P ' parameters

P-41 flow rate time units

enter option: 1 = per second
2 = per minute
3 = per hour
4 = per day (F)

P-42 OCM exponent

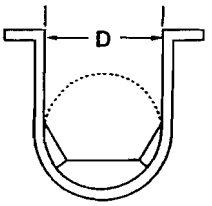
exponent for primary measuring devices, P-40 = 1 where $Q = K H^{x}$
Obtain from manufacturer's specifications.

enter " exponent " (F = 1.550)

P-43 flume dimension (P-40 = 2 or 3)

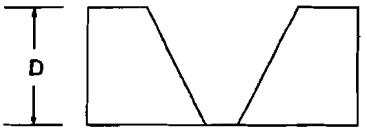
enter ' D ', flume size in units of P-1 (F = 1.000)

P-40 = 2



Palmer Bowlus
D = pipe or sewer dia.

P-40 = 3



H Flume

P-44 spare

P-45 maximum head

this is the head corresponding to the max flow rate. This parameter is identical to P-4, span. A change to either parameter will simultaneously change the other. (F = 10.00)

P-46 maximum flow rate

this is the flow rate which occurs at maximum head and determines the mA output span (refer to Functions \ Analog Output).
Obtain from manufacturer's specifications.

enter " maximum flow rate ", volume units are arbitrary (F = 1000)

P-47 Auto zero

this parameter allows automatic zero calibration for the empty distance to transducer parameter (P-3) when the physical measurement is not obtainable.

P-3 is the estimated empty distance to the transducer face with the transducer aimed at the proper portion of the crest in the open channel and at a height of at least 1 ft above maximum head.

Press  at least five times and until a stable reading is obtained on the display. The reading, regardless of the height of the transducer, will be the apparent head with respect to the estimated empty distance, P-3. Enter the actual physical measurement of head at a point beneath the transducer.

Press  , the HydroRanger will then calculate the correct zero reference level. The offset will be automatically entered into P-62.

P-48 OCM low head cutoff

flows for head below this level will not be totalled. Unit of cutoff is percent of maximum head (P-45)

enter "percentage required" (F=5.000)

P-49 OCM decimal point

sets the maximum number of digits after the decimal for display of flow rate (P-39 = 4). The number of digits after the decimal will automatically reduce to avoid display overflow.

enter: 0 = no digits after decimal
1 = one digit after decimal
2 = two digits after decimal (F)
3 = three digits after decimal

P-50 OCM mA output

refer to Functional \ Analog Output

enter: 1 = mA responds to head (F)
2 = mA responds to flow

P-51 OCM simulation

press  , display will show previous flow

enter head in units programmed, display will show head

press  , display will show corresponding flow

Parameters P-52 through P-59 are used specifically for OCM and pump totalizer applications. Refer to Applications.

P-52 totalizer display factor

totalizer display of flow or volume pumped is factored by a power of 10 to determine the count per flow. The factor is selected as follows:

enter: – 3 = multiply by 1000
– 2 = 100
– 1 = 10
0 = divide by 1 (F)
1 = 10
2 = 100
3 = 1,000
4 = 10,000
5 = 100,000
6 = 1,000,000
7 = 10,000,000

e.g. present flow rate is 450 gal / sec

if P-52 = 0, totalizer is incremented at a rate of 1 count per gallon
if P-52 = 3, totalizer is incremented at a rate of 1 count per thousand gallons

P-53 totalizer decimal point location

sets the number of digits after the decimal point for the low total only. The decimal point will not float.

enter: 0 = no digit after decimal
1 = one digit after decimal
2 = two digits after decimal (F)
3 = three digits after decimal

P-54 low total

this parameter will display the 4 lowest digits of the 8 digit totalizer used in pump totalizer or OCM application. The parameter will also allow the display to be reset to any value. (F = 00.00)

P-55 high total

the parameter will display the 4 highest digits of the 8 digit totalizer used in pump totalizer or OCM applications. The parameter will also allow the display to be reset to any value. (F = 0000)

P-56 remote totalizer contact control.

a momentary closure of the remote totalizer contact occurs once each time the entered flow or pumped volume has passed.

enter option:
- – 3 = 0.001
- – 2 = 0.01
- – 1 = 0.1
- 0 = 1(F)
- 1 = 10
- 2 = 100
- 3 = 1,000
- 4 = 10,000
- 5 = 100,000
- 6 = 1,000,000
- 7 = 10,000,000

P-57 & P-58 flow sampler control

a momentary closure of the flow sampler contact occurs once each time a volume of $y \times 10^x$, as defined by P-57 (x) and P-58 (y), flows or is pumped.

enter P-57 (x) = base 10 exponent, – 3 to 7 (F = 0)

enter P-58 (y) = mantissa, 0.001 to 9999 (F = 1.000)

e.g. if P-57 = 3 and P-58 = 5, then a sampler contact closure will occur each time $5 \times 10^3 = 5000$ units of volume has passed

P-59 time sampler control

a momentary closure of the time sampler contact occurs each time the entered amount of time in hours has elapsed (F = - - - -)

Parameters P-60 through P-67 are used to achieve specialized or custom calibration.

P-60 full calibration

this provides a measurement offset compensation on a full tank. A measurement offset might occur when parameters 3 and 4 do not exactly match the tank dimensions referenced for volume conversion. (F = - - - -)

Fill tank as much a permissible, but without going into the blanking zone.

Press  , the HydroRanger will take a measurement and display the space or level (P-2) in the linear units chosen (P-1) regardless if percent, volume or convert display is used. Press  at least 5 times and insure that a stable reading is being obtained.

Enter the actual space or level (P-2).

Press  , the HydroRanger will now calculate the correct measurement offset to be used in future measurements and automatically enter it into P-62.

P-61 empty calibration

this provides sound velocity compensation on an empty tank. This is required on a volume application where the atmosphere in the tank is other than air or the atmospheric temperature is constant but other than 20 °C and no temperature sensor is being used. (F = - - - -)

Empty tank is much as permissible. Leave filled with normal vapour and at normal operating temperature.

Press  , the HydroRanger will take a measurement and display the space or level (P-2) in the linear units chosen (P-1) regardless if percent, volume or convert display is used. Press  at least 5 times and insure that a stable reading is being obtained.

Enter the actual space or level (P-2).

Press  , the HydroRanger will now calculate in correct sound velocity to be used in future measurements and automatically enters it into P-63 and P-64.

P-62 measurement offset

this displays the measurement offset: used in conjunction with a full tank calibration, P-60, or an offset value may be entered directly. The offset is added to the ultrasonic measurement such that its effect will be carried through the reading (P-39, P-76 or ★), mA output and relay setpoints. (F = 0.000)

P-63 sound velocity at 20 °C

can be used to enter the known velocity, at 20 °C, of sound in a particular gas or vapour or to view the resultant velocity of an empty calibration (P-61), normalized to 20 °C. (F = 344.1)

the units of velocity are assumed to be:

meter / sec	if P-1 = 1 (meters), 2 (centimeters)
feet / sec	if P-1 = 3 (feet), 4 (inches)

P-64 velocity at P-65

can be used to enter the known velocity, at the temperature of P- 65, of sound in a particular gas or vapour or to view the resultant velocity of an empty calibration, at the temperature of P- 65. (F = 344.1)

the units of velocity are assumed to be:

meters / sec	if P-1 = 1 (meters), 2 (centimeters)
feet / sec	if P-1 = 3 (feet), 4 (inches)

P-65 air temperature in °C, as measured by temperature sensor or programmed transducer operating temperature, if sensor is not used, enter temperature required in °C (F = 20 °C)

P-66 maximum air temperature in °C

records maximum air temperature measured by temperature sensor.
Press CLR then ENTER to reset (F = – 99 °C)

P-67 minimum air temperature in °C

records the minimum air temperature measured by temperature sensor.
Press CLR then ENTER to reset (F = 150 °C)

Parameters in P-68 through P-75 are used to stabilize the reading. These are general purpose parameters, suitable for all applications.

P-68 fill damping

is the maximum rate at which the display reading and analog output will change under filling conditions. The damping rate is measured in P-1 units per minute and has a range of 0.001 to 9999. Thus the smaller the number entered, the greater the damping.

enter desired amount (F = 10.00 m / min).

In pump up applications, for safe operation it is suggested that the damping value allow for level changes at the pumps maximum operating capacity, rather than the process design value.

P-69 empty damping

is the maximum rate at which the display reading and analog output will change under emptying conditions. The damping rate is measured in P-1 units per minute and has a range of 0.001 to 9999. Thus the smaller the number entered, the greater the damping.

enter desired amount (F = 10.00 m / min).

In pump down applications, for safe operation it is suggested that the damping value allow for level changes at the pumps maximum operating capacity, rather than the process design value.

P-70 process rate display (V)

display the rate of filling (+) or emptying (–) in P-1 units / minute

P-71 process rate filter

controls the response of the rate display

enter option: 0 = continually averaged rate
1 = update rate every minute or 50 mm (F)
2 = update rate every 5 minutes or 100 mm
3 = update rate every 10 minutes or 300 mm
99 = programmable *

this option is divided into two levels of subparameters:

- S-71: time in seconds
- D-71: distance in linear units as set in P-1

Access is made by scrolling through the levels.

press	*display will show*
	P-71
9 9	99
	99
★	S-71
★	d-71
★	P-71

Setting the subparameters is done the same way as with the ' P ' parameters.

P-72 fuzz filter

the fuzz filter is designed to keep the display constant when minor changes on the surface of the liquid (ripples), electrical noise or air movements in the vessel occur.

enter: 0 = off
1 = on (F)

P-73 agitator discrimination

enter: 0 = off
1 = on (F)

P-74 fail-safe mode

in the event of a loss of echo, the HydroRanger will flash " LOE " and go into one of the following fail-safe modes after the timer (P-75) expires

enter: 1 = high
2 = low
3 = hold last entry (F)

P-75 fail-safe timer

the amount of time delay before going into fail-safe mode enter " desired amount of time ", in minutes (F = 15.00)

e.g. for 30 sec. time delay, enter " 0.5 "

Parameter P-76 through P-78 are used for measurement and simulation.

DISPLAY:

select desired parameter

P-76, 77 or 78 press  , the display will show the reading of the last ultrasonic measurement

press  to update ultrasonic measurement

SIMULATION:

select desired parameter

P-76, 77 or 78 press  , the display will show the simulated rise and fall of the material level

The simulation will raise and lower the material level through the calibrated span, P-4, at a rate of 1% of the span per second. On the DLD application, one side (relay / LED 5 ON) is kept at a constant level, while the other side (relay / LED 5 OFF) is varied. The DLD simulation will alternate every 6 seconds.

Pressing ▲ during simulation causes the apparent level to rise. Holding in ▲ , increases the rate of filling. Pressing ▼ causes the level to fall. Holding in ▼ , increases the rate of emptying. During simulation, relay LED's, alarm relays and mA output are all enabled to allow full response of the HydroRanger. Pump relays are maintained in a de-energized state throughout simulation (unless P-0 = – 1), however the corresponding relay LED's will respond. Relay LED's for pumps will not be illuminated within 1 second, simulating the 10 second start delay under actual operation. As damping, fuzz filtering and agitator discrimination are not required, they are turned off.

To end simulation program, press ESC twice.

P-76 reading

this is one of the optional displays selected in the display options parameter, P-39. It can also be obtained by pressing ★ .
This reading incorporates both the measurement and display offsets.

MODE (P-2)	READING (linear, %, volume)
material	material
space	space
DLD	differential
volume total	material
OCM	head

P-77 material level

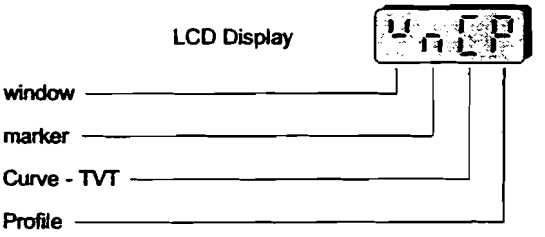
this is the actual material level referenced to zero or empty level in m, cm, ft or in.

P-78 space or distance

this is the actual distance from the transducer face to the material level in m, cm, ft. or in.

Parameters P-79 through P-88 are used for echo processing and analysis.

P-79 scope displays



select any combination of scope displays

0 = scope display off (display '_ ') (F = _ _ _ _)

1 = scope display on (display ' u , n, C or P')

press

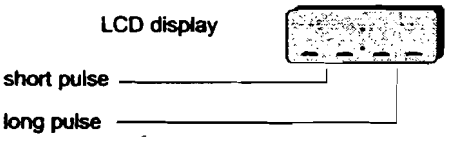
e.g. to display the curve and the profile on the oscilloscope:

press , enter " 0110 "

press , display will show

P-80 echo confidence (V)

a measure of echo reliability. Press to make an ultrasonic measurement and the updated echo confidence will be displayed. This feature is useful when aiming the transducer.



display:

e.g. short pulse confidence of '11' / long pulse confidence of '2' (dB)

e.g. short pulse confidence of '19' / no long pulses transmitted

pulses transmitted, but no echo (check for faulty transducer or wiring)

submersible transducer submerged (P-23 = 1)

P-81 confidence threshold for short measurement

minimum echo confidence for echoes within 1 meter of transducer. If echoes are beyond 1 meter or have a confidence under the threshold level, the short measurement will be ignored and the long measurements will become valid.

Enter threshold. (F = 10)

Typical usage; if transducer were picking up small unwanted echoes from close in, increase threshold to a value above that of the echo confidence (P-80) so that close in echoes are no longer detected.

P-82 confidence threshold for long measurement

minimum echo confidence for long measurements. If no echo confidences meet this threshold, a loss of echo condition will prevail.

Enter threshold. (F = 5)

Typical usage; during filling of vessel, material intersects beam path. Instead of displaying wrong level, increasing threshold to a value above that of the echo confidence (P-80) will force the HydroRanger into fail-safe.

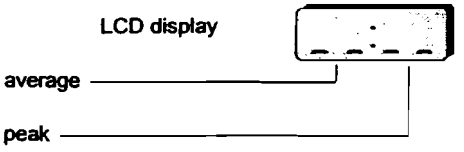
P-83 echo strength (v)

displays the absolute strength of the selected echo in dB above 1 uV rms

P-84 noise

average and peak ambient noise, in dB above 1 uV rms

Ambient noise includes acoustical and electrical noise being picked up by the transducer / receiver circuit when the transmit / receive cycles have been disabled during the program mode.



P-85 echo processing algorithms for long pulses
(for short pulses, a fixed algorithm is automatically selected)

enter: 1 = best echo of first and largest (F)
2 = first echo
3 = largest echo

P-86 TVT curve

enter: 1 = standard (F)
2 = flat

P-87 range extension

used to extend the measurement range into the far end blanking.

In applications where the zero level does not correspond to the bottom of the vessel and it is desired to monitor this zone, the far end blanking may need to be reduced. This is accomplished by entering a range extension value as the percentage of P-3 which equals the extra distance required. If it found that false echoes are appearing ahead of the far end blanking zone, the range extension should be decreased by reducing the factory set value of 20%.

enter, as percent of P-3, distance below 0 not blanked (F = 20)

P-88 number of transmit pulses

this parameter is used to select the number and duration of the pulses to be transmitted per measurement.

enter: 1 = one short pulse only *
2 = one long pulse only **
3 = two long pulses and one short pulse
4 = one short pulse if target is within 1 m, or
one short pulse and two long pulses if target is beyond 1 m (F)

* CAbL LOE message inactive
** submergence detection inactive

Parameters P-89 through P-98 are used for testing.

P-89 software revision number (V)

P-90 memory test (V)

press  the display will show

'PASS' » memory test passed
'1' » RAM failure
'2' » EPROM failure
'3' » EEPROM failure

P-91 LCD, LED and relay test (V)

This test will cause the relays to change state.
Be sure to lock out all applicable alarms,
pumps and machinery before pressing " Enter "

press  » LCD characters should flash sequentially
» all relays should turn on and off sequentially
» all LED's should flash sequentially
» press any key to stop

P-92 mA output test

used to display the last mA output (in the RUN mode, press 5)

A test value may be entered with the keypad or obtained by pressing  . The value displayed is transmitted via TB1. Upon returning to the RUN mode, the parameter value will assume the actual mA output level. (F = 0.000)

P-93 temperature sensor resistance in K ohms (V)

P-94 transmitter test (V)

press  , the transmitter will fire at a regular rate and the transmit neon LI will flash correspondingly.
Press any other key to stop. (F = - - - -)

P-95 programmer test (V)

press [ENTER], then press each key from left to right starting with the top row. The display will acknowledge each key pressed:

Key	*Display*	*Key*	*Display*
1	1	•	10
2	2	−	11
3	3	CAL	12
4	4	★	13
5	5	SEE CAL	14
6	6	ZERO	15
7	7	▲	16
8	8	▼	17
9	9	ALT CAL	18
0	0	ENTER	PASS

if any key is pushed out of sequence or malfunctions, the display will show ' FAIL '. Press [ALT CAL] to return to the parameter mode.

P-96 watchdog reset test (V)

press [ENTER], hyphens will flash for 5 seconds or less and then the HydroRanger goes into the run mode. Should the test fail, the HydroRanger will not go back into the run mode.

P-97 trim for 4 mA

when this parameter is selected, the mA output goes to 4 mA. This display however, will show a typical value of 200. The value can be increased or decreased by pressing [•] or [−] respectively, or by entering a value. This will proportionally change the mA output value so that remote equipment will read 4 mA. This parameter is not reset by P-99.

e.g. select P-97

press	*display will show*	*meter will show*
	P-97	
ENT	200	3.8 mA
●	201	3.9 mA
●	202	4.0 mA

P-98 trim for 20 mA

When this parameter is selected, the mA output goes to 20 mA. The display however, will show a typical value of 3490. The value can be increased or decreased by pressing ● or − respectively or by entering a value. This will proportionally change the mA output value so that remote equipment will read 20 mA. This parameter is not reset by P-99.

e.g. select P-98

press	*display will show*	*meter will show*
	P-98	
ENT	3490	20.1 mA
3 4 8 0	3480	20.0 mA

P-99 master reset

used to reset ALL parameters to their factory setting.

press	*display will show*
	P-99
ENT	----
▲	----
−	CALL

All parameters have now been returned to their factory settings. ■

TROUBLESHOOTING

GENERAL

There are a few adjustments for echo processing and they should be used judiciously. ***Transducer location and aiming are the most important factors affecting the reliability of the HydroRanger.*** Refer to the associated transducer manual.

OSCILLOSCOPE

An oscilloscope can be used to view the transmit, receive and processed echo signals.

Connect as follows:

oscilloscope	*location*	*description*
probe	J1,RCVR,board A	amplified receiver signal
	J2,SCOPE,board A	processed echo
	TB1-8,board B	raw transmit/receive signal
external trigger	J3,SYNC,board A	oscilloscope synchronization
ground	J4,COM,board A	ground

The transmit and receive signals are best viewed while in the run mode or with P-94, transmitter test, set to fire automatically in the program mode.

To view the processed echo, P-79 must be set for the desired display. If the PROGRAM mode is exited for more than 10 minutes, P-79 will have to be reset to view the displays on the oscilloscope.

The processed echo can be viewed and updated by pressing  . This must be done while in the program mode, but can be done while viewing any parameter. For example, echo analysis parameters 79 - 84 or echo processing parameters 85 - 87 can be viewed or changed while monitoring results on both the HydroRanger display and on the oscilloscope.

The processed echo display (P-79) can be made to show not only the processed echo profile, but also the:

- echo marker
- window
- TVT curve or auxiliary window

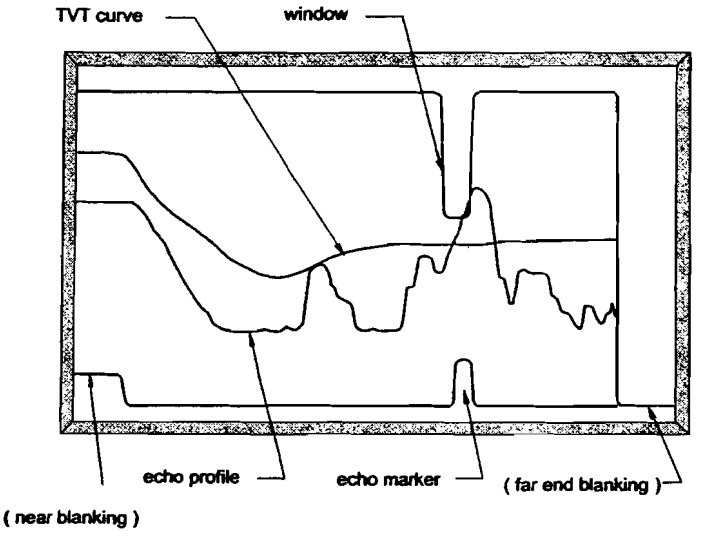
Typical scope settings for viewing the processed echo are:

- gain - 1 v / d
- sweep - 1 msec / div

The following are restricted to transmission in air at 20 °C.

- to obtain a time measurement of the processed echo, the sweep time must be multiplied by a factor of 10
- to obtain a time measurement of the transmit or receive signal, use the actual sweep setting
- to obtain a distance measurement of either of the above types of echoes, divide the respective time measurement by 1.8 msec / ft or 5.9 msec / m

Typical Scope Display



Scope Display	*LCD display (P-79)*
Window	u
Marker	n
Curve - TVT	c
Profile	P

TROUBLESHOOTING GUIDE

The following is a list of operating symptoms, their probable causes and the actions to resolve them.

SYMPTOM	CAUSE	ACTION
Loss of Echo (LOE)		
display will flash CAbL / LOE, neon L1 will flash but no pulsing is felt on the transducer face	open circuit	check transducer wiring *
	defective transducer	check maximum temperature P-66 against transducer rating * try a substitute
display will flash CAbL / LOE, neon L1 remains off and no pulsing is felt on the transducer face	short circuit	check transducer wiring *
	defective transducer or circuit board	check maximum temp. P-66 against transducer rating * try a substitute
display will flash LOE, neon L1 will flash, pulsing is felt on transducer face	level or target is out of range. Under optimum conditions maximum range is 15 m plus 20% of P-3	check transducer specifications * check calibration parameters
	application too steamy. Under these conditions range may be adversely affected	try using a longer range transducer
	if condition occurs only during filling, the transducer face may be covered. Shipping cardboard or material build-up on transducer face	increase fail-safe timer, P-75 clean move transducer to better location * mount in standpipe *

* refer to associated transducer manual

SYMPTOM	CAUSE	ACTION
. . . continued	transducer location or aiming : - poor installation - moved by material or vibration - flanging not level	re-locate or re-aim transducer for maximum echo confidence, P-80 *
	transducer malfunction - temperature too high or low - physical damage - excessive foam on liquid face	check P-65, 66 & 67 inspect use foam deflector or stilling well
Reading does not change, but the level does	HydroRanger processing wrong echo, i.e. vessel wall, structural member, stationary agitator	relocate transducer * check echoes with oscilloscope
	transducer ringing, reading high level	increase blanking, P-5 check echoes with oscilloscope raise short measurement confidence threshold, P-81
Measurement is consistently off by a constant amount	measurement offset	refer to P-60 & 62 and the volume application example
Reading error progressively worsens with distance	temperature compensation sound velocity compensation	insure that 'J2' is properly set, refer to Installation \ Selecting Temperature Sensor P-61 & 63, and the volume application example
Screen blank, neon L1 not flashing	loss of power	check power wiring, jumpers and fuse.

* refer to associated transducer manual

SYMPTOM	CAUSE	ACTION
HydroRanger will not respond to programmer	programmer improperly positioned	refer to installation
	infrared window obstructed	clean
	programmer battery low	test programmer P-95
Reading erratic	echo confidence weak	refer to P-85, 86 87 & 88
	liquid surface agitated	increase damping, P-68 & 69, turn on fuzz filter P-72
	material filling	relocate transducer *
		increase damping, P-68 & 69
	electrical noise	check P-84 under quiescent conditions, noise should be under 15 dB
		transducer cable must be in grounded metal conduit and cable grounded only at TB-1 *
		increase damping, P-68 & 69
	agitator blades	set P-73 to 1
Reading 'EEEE'	reading to large	re-calibrate, i.e. P-3, 4, 37, 52 & 53
Reading response slow	damping to high	increase P-68 & 69
	agitator on	turn off P-73
	fuzz filter on	turn off P-72
Reads correctly but occasionally reads high when vessel is not full	detecting close range echo or ringing	increase blanking
		increase short measurement threshold, P-81
		transducer mounting *
High level reading lower than material level	material is within near blanking zone (P-5).	decrease blanking limit material high
	Echo multiple being level processed	

* refer to associated transducer manual

MAINTENANCE

The HydroRanger requires no maintenance, however a program of periodic checks would be beneficial.

The enclosure and circuit boards should be cleaned if necessary, but only when the power is disconnected at the main breaker and using a vacuum cleaner and a clean, dry paint brush. Check all electrical contacts for corrosion and arcing.

If the HydroRanger is mounted in a dusty or oily environment, make sure that the programmer and front cover are kept clean, otherwise it may impede the infrared signal transmission required for programming.

It is also a good idea to periodically check the face of the transducer. It should be free of material build-up, corrosion or deformation.

SOUND VELOCITIES

GASES (0 °C)	*m/sec*	*ft/sec*
air, dry	331	1086
ammonia	415	1362
argon	308	1010
carbon dioxide	259	850
carbon monoxide	338	1109
chlorine	206	676
deuterium	890	2920
ethane (10 °C)	308	1010
ethylene	317	1040
helium	965	3166
hydrogen	1284	4213
hydrogen bromide	200	656
hydrogen chloride	206	676
hydrogen iodide	157	515
hydrogen sulfide	289	948
illuminating (coal gas)	453	1486
methane	430	1411
neon	435	1427
nitric oxide (10 °C)	324	1063
nitrogen	334	1096
nitrous oxide	263	863
oxygen	316	1037
sulfur dioxide	213	699
VAPOURS (97 °C)		
acetone	230	755
benzene	202	663
carbon tetrachloride	145	476
chloroform	171	561
ethanol	269	883
ethyl ether	206	676
methanol	335	1099
water vapour (134 °C)	494	1621

GLOSSARY

Aeration:	air gap between nappe and weir.
Beam angle:	angle between the opposing one-half power limits (–3 dB) of the sound beam
Blanking:	zone in which received echoes are ignored.
Crest:	the edge (sharp-crested weir) or surface (broad crested weir) over which the flow passes.
EEPROM:	electrically erasable programmable read only memory.
EPROM:	erasable programmable read only memory.
Flume:	a 3 part hydraulic structure, consisting of converging, throat and diverging sections, to constrict the flow through the throat, thereby increasing the head in the converging section. The change in head is proportional to the change in flow.
Free flow:	downstream liquid level is low enough or the discharge flow is fast enough, so as not to impede flow through the flume or weir.
Gauge well:	same as stilling well.
Head:	liquid level above zero (static) reference level.
LCD:	liquid crystal display.
Max head:	head at maximum flow rate.
Measurement:	each time a transmit pulse or set number of pulses is sent to the transducer.
Nappe:	the jet of liquid leaving the weir crest.
OCM:	open channel measurement
Primary measuring device:	hydraulic structure of an open channel for measuring liquid flow. e.g. weirs and flumes.
Ringing:	the inherent nature of the transducer to continue vibrating after the transmit pulse has ceased.
Secondary measuring device:	any instrument for measuring the head or flow related to the primary measuring device.

Stilling well:	a well separate from but adjacent to the primary measuring device and interconnected by a small duct to provide an ideal point of head measurement.
Subcritical flow:	same as submerged flow.
Submerged flow:	when the downstream level rises or the discharge flow is so slow that it impedes the free flow of liquid through the primary measuring device.
Ullage:	the remaining spatial volume of a vessel or the volume required to fill a vessel.
Weir:	a dam with or without flow notch across an open channel to produce a crest in the liquid upstream. The head of the crest is proportional to the flow.

ALPHABETICAL PARAMETER LISTING

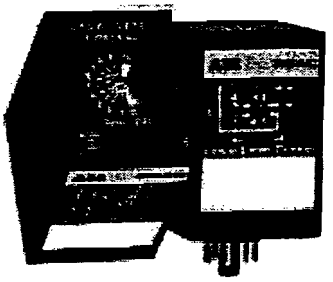
PARAMETER	#	PARAMETER	#
agitator discrimination	P-73	pump 5, hours	P-28
air temperature	P-65	pump, run-on, duration	P-30
air temperature, maximum	P-66	pump, run-on, interval	P-29
air temperature, minimum	P-67	range extension	P-87
algorithms	P-85	rate display	P-70
analog output	P-6	rate filter	P-71
analog output, DLD	P-32	relay 1, function	P-8
analog output, OCM	P-50	relay 2, function	P-11
analog output, trim, 4 mA	P-97	relay 3, function	P-14
analog output, trim, 20 mA	P-98	relay 4, function	P-17
auto zero (OCM)	P-47	relay 5, function	P-20
blanking	P-5	relay 1, setpoint, off	P-10
confidence	P-80	relay 2, setpoint, off	P-13
confidence threshold, short	P-81	relay 3, setpoint, off	P-16
confidence threshold, long	P-82	relay 4, setpoint, off	P-19
convert display	P-37	relay 5, setpoint, off	P-22
convert display, totalizer	P-52	relay 1, setpoint, on	P-9
damping, empty	P-69	relay 2, setpoint, on	P-12
damping, fill	P-68	relay 3, setpoint, on	P-15
decimal point	P-7	relay 4, setpoint, on	P-18
decimal point, OCM	P-49	relay 5, setpoint, on	P-21
decimal point, totalizer	P-53	relay, flow sampler, exponent	P-57
display reading options	P-39	relay, flow sampler, mantissa	P-58
echo strength	P-83	relay, time sampler	P-59
empty calibration	P-61	remote totalizer	P-56
empty distance	P-3	reset	P-99
exponent (OCM)	P-42	scope displays	P-79
fail-safe	P-74	security	P-0
fail-safe timer	P-75	simulation, distance	P-78
flume dimension	P-43	simulation, material level	P-77
full calibration	P-60	simulation, OCM	P-51
fuzz filter	P-72	simulation, reading	P-76
high total	P-55	software version	P-89
inflow/discharge totalling (pump)	P-33	sound velocity at 20 °C	P-63
low head cutoff (OCM)	P-48	sound velocity at air temperature	P-64
low total	P-54	span	P-4
maximum flow rate	P-46	tank dimension A	P-35
maximum head	P-45	tank dimension L	P-36
measurement, distance	P-78	tank shape	P-34
measurement, material level	P-77	test, analog output	P-92
measurement, reading	P-76	test, programmer	P-95
mode of measurement	P-2	test, memory	P-90
noise	P-84	test, temperature sensor	P-93
number of transmit pulses	P-88	test, transmitter	P-94
offset, display	P-38	test, watchdog reset	P-96
offset, measurement	P-62	test, LCD, LED and relay	P-91
primary measuring device	P-40	transducer, submersible	P-23
pump 1, hours	P-24	TVT curve	P-86
pump 2, hours	P-25	units	P-1
pump 3, hours	P-26	units, flow rate time	P-41
pump 4, hours	P-27		

Section 3-R

Clearwell Water Level Alarm Instruments (LSXL-211, LSXH-212, LSXL-221, LSXH-222)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Liquid Level Control
LLC4 Series
Single Probe

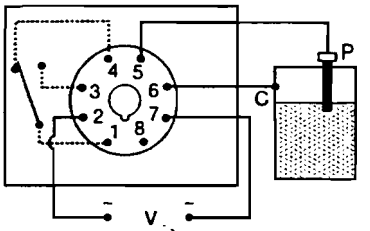


- Single Probe Level Control for Conductive Liquids
- Adjustable or Fixed Sensing up to 250KΩ
- Fill or Drain Operation Available
- 24, 120, or 230 V AC Models are Available
- Isolated AC Voltage on the Probes
- 4 A Resistive SPDT Isolated Contacts

Description
The LLC4 combines resistance sensing circuitry with solid state timing to provide single probe level maintenance. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. Transformer isolated 12 V AC is provided at the probe to prevent electrolysis. A trickle current of less than 1 mA determines the presence or absence of liquid between the probe and common. The LLC4 Series can be used with many types of low voltage (resistance changing) transducers to perform other control functions like temperature limit control, photo limit control, condensation sensing, and ice sensing.

Operation
Drain (Pump Down Mode): When the liquid level rises and touches the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level falls below the probe. The output relay then de-energizes and remains de-energized until the liquid again touches the probe.

■ Approvals:



Relay contacts are isolated. Dashed lines are internal connections.

Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

P = Probe C = Probe Common V = Voltage

Fill (Pump Up Mode): When the liquid level falls below the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level rises and touches the probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the probe.

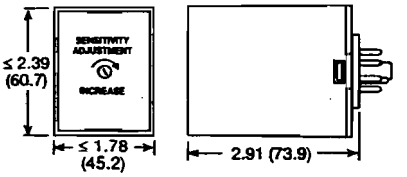
Ordering Table

LLC4 Series	X Input	X Operation	X Time Delay (Seconds)	X Sense Resistance
	2 - 24 V AC	A - Drain LL	Specify fixed delay (1 ... 60) secs. in 1 s increments 60	A - Adjustable
	4 - 120 V AC	B - Fill HH		F - Fixed Specify fixed resistance (1 ... 250) in 1K Ω increments
	6 - 230 V AC			

Example P/N: LLC44A1A Fixed - LLC46B5F50

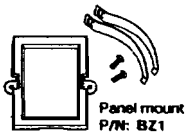
Technical Data

Control		
Type		ON/OFF (Single Level) Resistance sensor with built-in time delay to prevent rapid cycling
Sense Voltage		12 V AC at probe terminals
Sense Resistance		Factory fixed or adjustable to 250K Ω
Sense Resistance Tolerance		Adjustable - guaranteed range Factory fixed +/-10%
Input		
Voltage		24, 120, or 230 V AC
Tolerance	24 V AC	-15% ... +20%
	120 & 230 V AC	-20% ... +10%
Frequency		50 ... 60 Hz
Output		
Type		Electromechanical relay
Form		Isolated single pole double throw (SPDT) contacts
Rating		4 A resistive at 240 V AC; 1/10 hp at 240 V AC
Protection		
Surge		IEEE C62.41-1991 Level A
Isolation Voltage		≥ 1500 V RMS between input, output, & probe
Mechanical		
Mounting		Plug-in socket
Termination		8-Pin plug-in
Package		2.91 x 2.39 x 1.78 in. (73.9 x 60.7 x 45.2 mm)
Environmental		
Operating Temperature		-20°C ... +60°C
Storage Temperature		-40°C ... +80°C
Weight		≅ 6 oz (170 g)

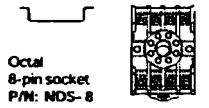


Inches (Millimeters)

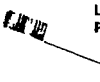
Accessories



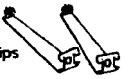
Panel mount kit
P/N: BZ1



Octal
8-pin socket
P/N: NDS- 8



Level probe
P/N: LLP-24



Hold down clips
P/N: PSC8

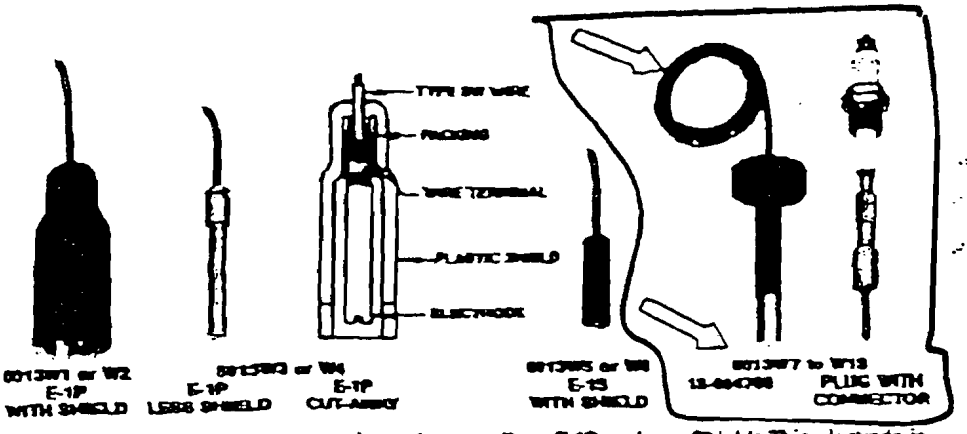
Electrode with common connection
P/N: WCC-1138-3

Electrode
P/N: WCC-1138

See accessory page at the end of this section.

DAVE. 800-377-7722 30EX.

WIRE SUSPENSION ELECTRODES



Wire suspension electrodes are designed for use in applications requiring long lengths, or where limited head room prevents installation of solid rod electrodes. They can be used with all holders except Type CE-2 & 3. Electrode Types E-1P and E-1S are for use in water and non-corrosive liquids. Type 13-064700 is designed for corrosive liquids and is available with a variety of rod materials. Types E-1P and E-1S electrodes with molded plastic shields can be used at temperatures up to 150°F and other electrodes up to 190°F.

Type E-1P-Shielded: This electrode is approximately 4" long and assembled in a molded plastic insulating shield 1 7/16" in diameter. Designed for general purpose use, it is ideal for elevated tanks, sewage pumping stations, and deep well installations.

Type E-1P — Less Shield: This electrode is intended for applications where space prevents the use of other electrodes and where vertical spacing between electrodes is 4" or more.

Type E-1S-Shielded: A 2" long electrode assembled in a molded plastic shield 9/16" in diameter. Ideal for use in submersible pump installations and other applications where little clearance is provided for installation.

Type 13-064700: This electrode is intended for corrosive liquids. It is 3" long made from a ½" diameter rod and available in any of the materials listed below. The type SW wire is attached at the factory and the connection is completely sealed with PVC and bonded to the insulation of the SW wire.

WIRE CONNECTOR: This adapter is necessary to attach the Type SW suspension wire to the ¼-20 female electrode holder connections. One is required for each wire suspension electrode used with electrode plugs, and Type E and Type AE-2 holders.

CATALOG NUMBER
6013 —— C —— BR

Material	
Brass Old No. 13-020400	BR
303 SS Old No. 13-040600	SS

Type SW Suspension Wire: Designed to provide maximum strength and insulation. Type SW wire should always be used with BW wire suspension electrodes to assure that a watertight seal is accomplished by the packing in the electrode. The wire is single conductor 18 gauge, 41 strand copper with 4/64" vinyl insulation.

CATALOG NUMBER
6013 —— SW —— 10

Specify Length In Feet Old No. 01-130500	

6013 —— W1

CATALOG SECTION

	ELECTRODE TYPE	ELECTRODE MATERIAL	OLD PART NO.
W1	E-1P With Shield	Brass	13-020600
W2	E-1P With Shield	303 Stainless	13-020700
W3	E-1P Less Shield	Brass	13-052700
W4	E-1P Less Shield	303 Stainless	13-052600
W5	E-1S With Shield	Brass	13-022000
W6	E-1S With Shield	303 Stainless	13-024300

These electrodes are field assembled and the required amount of Type SW wire must be ordered as a separate item. See above.

NOTE — When wire suspension electrodes are to be used with electrode plugs, or Type E or Type AE-2 electrode holders, wire connections must also be ordered for each electrode. See above.

6013 —— W7 —————— 10

CATALOG SECTION

	ELECTRODE TYPE	ELECTRODE MATERIAL	OLD PART NO.
W7	13-064700 With SW Wire	316 Stainless	13-064702
W8	13-064700 With SW Wire	Monel	13-064703
W9	13-064700 With SW Wire	Nickel	13-064704
W10	13-064700 With SW Wire	Carpenter 20	13-064705
W11	13-064700 With SW Wire	Hastelloy B	13-064707
W12	13-064700 With SW Wire	Hastelloy C	13-064706
W13	13-064700 With SW Wire	Titanium	13-064708

As Indicated/Quote.

	Type SW Wire Length In Feet

These electrodes come complete with the Type SW wire permanently attached to the electrode. Lengths must be specified when ordering.

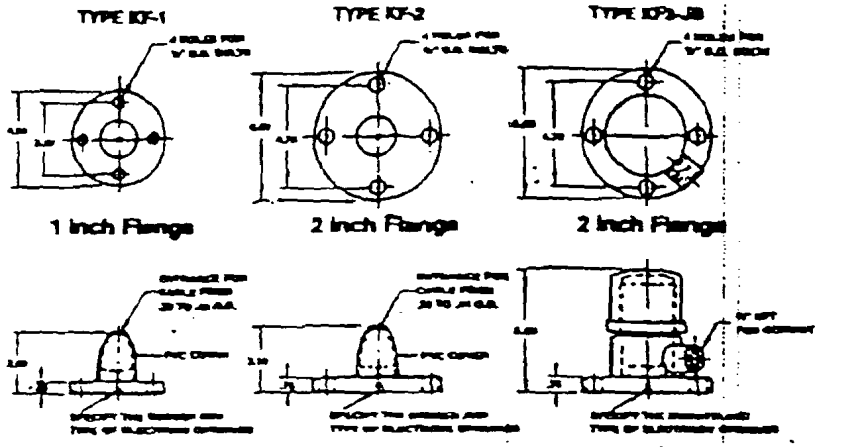
AMETEK®
PATRIOT SENSORS

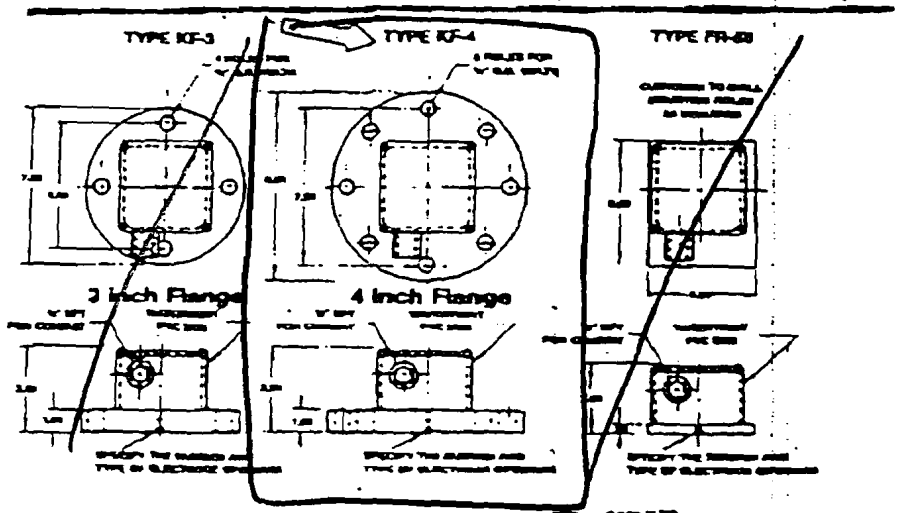
These versatile corrosion resistant electrode holders are made of unplasticized PVC for use on industrial and chemical applications such as acid storage tanks, plating tanks and liquid waste treatment systems. They are suitable for ambient temperatures up to 180°F (82°C). They include a watertight PVC cover or a junction box. Types are available for mounting on standard 1", 2", 3" or 4" flanges. The Type FR58 is intended for mounting on the corner of an open flanged rim tank, and only requires minimum space in the tank.

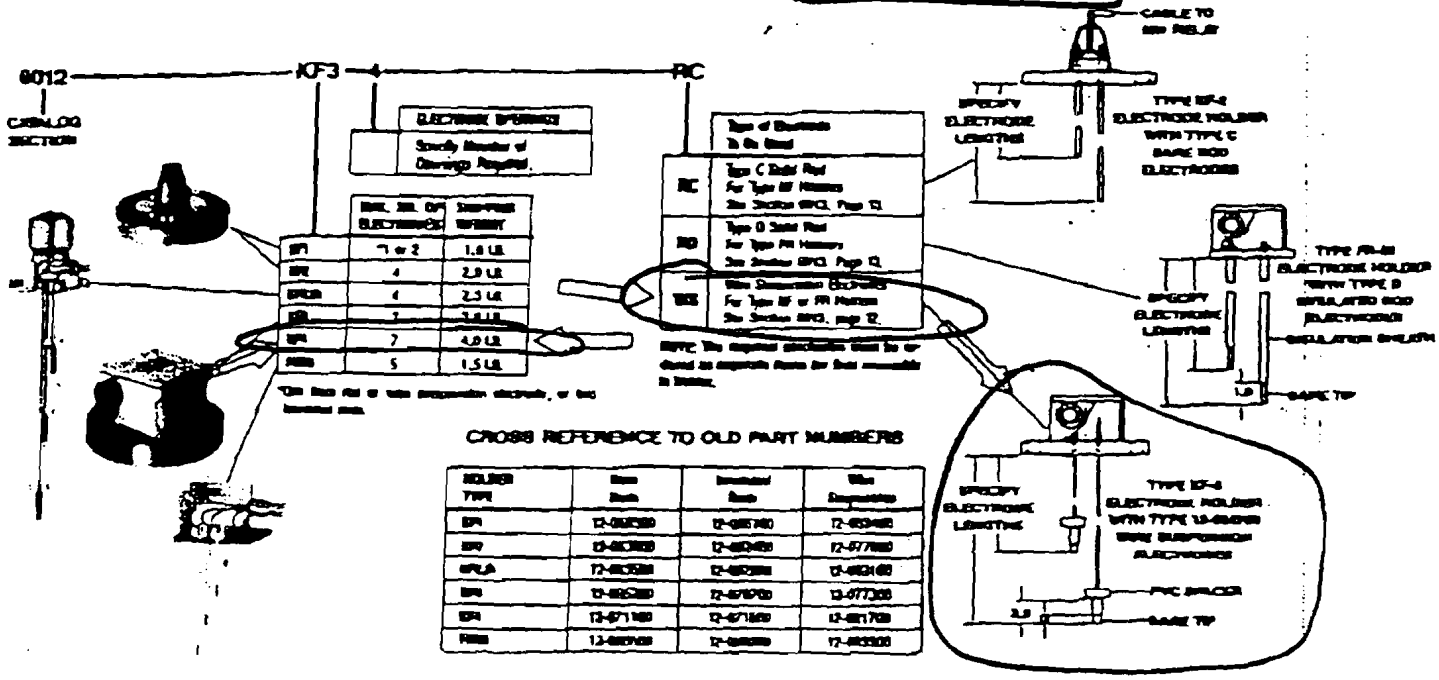
Models are available for use with either solid rod or wire suspension electrodes which must be ordered as separate items for field assembly at time of installation.

Solid rod electrodes extend thru the bottom of the holder and are tightened against a shoulder which provides a vapor tight seal for up to 10 psi. Rods should be insulated for lengths greater than 30 in.

Wire suspension electrodes are recommended for lengths over 6 feet. The BIW Type SW suspension wire is brought into the holder thru a clearance hole and is secured by a knot as illustrated below. The Type 13-064700 electrodes are available in the same selection of materials as the solid rods and must be used for corrosive liquids.

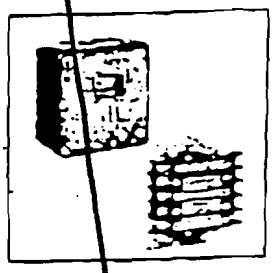




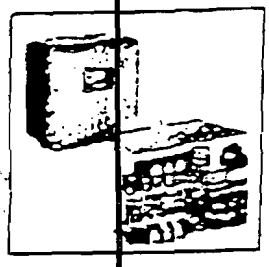


CROSS REFERENCE TO OLD PART NUMBERS

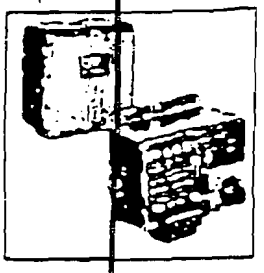
B|W Controls Brand Liquid Level Sensors and Controls from Patriot



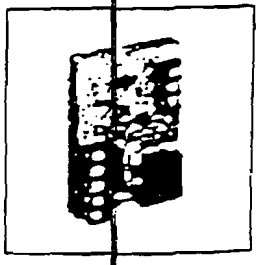
1500
CONTROL RELAYS
- Reliable, floatless liquid level control
- Available in open chassis or choice of NEMA enclosures
- Rectified relays to provide DC sensing circuits
- Contact arrangement can be added and/or changed in the field from N.O. to N.C. or from N.C. to N.O.
- Available with 1, 2, or 3 isolated double-break contacts
- All contacts rated 25 AMP at 120V, 240V or 480VAC
- U.L. Recognized
- CSA Listed



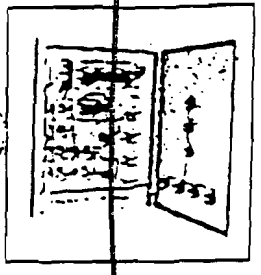
5200
SOLID-STATE RELAYS
- Very low-energy electrode potential with AC Low Sensitivity or DC High Sensitivity
- Available with fixed or variable sensitivity adjustment
- U.L. Recognized & CSA Listed



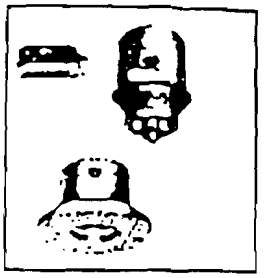
5300/5510
INTRINSICALLY SAFE CONTROL RELAYS
- Approved by FM and CSA for Classes I, II, & III hazardous areas
- Permits intrinsically safe operation from electrodes or from pilot switches in hazardous areas
- Available with fixed or variable sensitivity adjustment



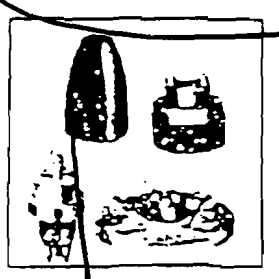
5600
SPECIAL PURPOSE SOLID-STATE CONTROL RELAYS
- Compact and low cost for OEM applications
- Low-voltage sensing circuit
- Direct or inverse operation
- U.L. Recognized & CSA Listed



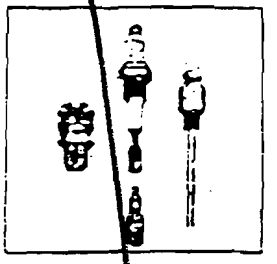
8040, 8041 & 8044
CONTROL PANELS STANDARD & CUSTOM
- Automatic alternators
- Multiple pump control systems
- Long distance remote control systems
- Signal and alarm panels
- Multiple relays in common enclosure



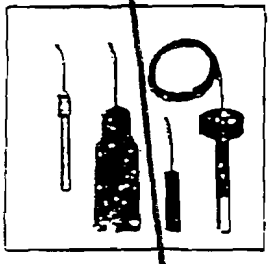
6012
CAST ELECTRODE HOLDERS
- Pressure-tight holders of brass, cast iron, or stainless steel can accommodate up to seven electrodes
- Flanged cast iron holders can accommodate up to 12 electrodes
- Conduit holder of cast iron or PVC can accommodate up to eight electrodes



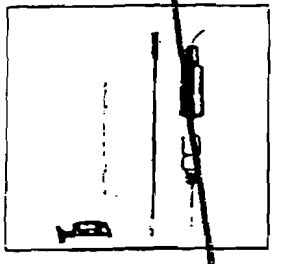
6012
PLASTIC ELECTRODE HOLDERS IDEAL FOR CORROSIVE LIQUIDS
- Flanged holders of PVC can accommodate up to seven electrodes
- Threaded holders of thermoplastic material can accommodate up to three electrodes



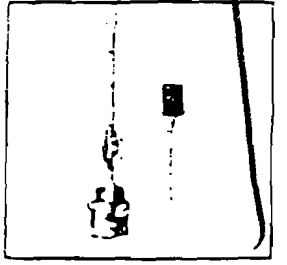
6012
ELECTRODE PLUGS
- A wide variety of plugs and connectors for solid rod and wire suspension electrodes are available, many designed for use under corrosive conditions



6013
WIRE SUSPENSION ELECTRODES
- Ideal in applications requiring long lengths or limited headroom
- Small diameter electrodes are available for use in submersible pump installations and other applications requiring little clearance
- Available as standard in brass or stainless steel and other materials for highly corrosive liquids



6013
SOLID ROD AND SPECIAL PURPOSE ELECTRODES
- Ideal for relatively short lengths of 8' or less
- Available as standard in brass, stainless steel, Monel, nickel, Carpenter 20, Hastelloy C, or titanium
- Rods are available bare or insulated and with or without carbon tips
- Special electrodes can be made to order to meet specific operating and/or installation conditions
- Moisture sensor



7010 & 7014
Uniflex® Switches
- Single float for up to 12 sensing levels
- Ideal in nonconductive liquids such as gasoline, fuel oil, and chemicals
- U.L. Recognized
- 2" or 3" Pressure-tight holder

Tilt Switches
- Mercury or Mechanical switch
- Chemically resistant Polypropylene casing and PVC cord
- N.O., N.C., or SPDT contacts available

Section 3-S

Clearwell No. 2 Discharge Butterfly Shut-Off Valve (V-225)

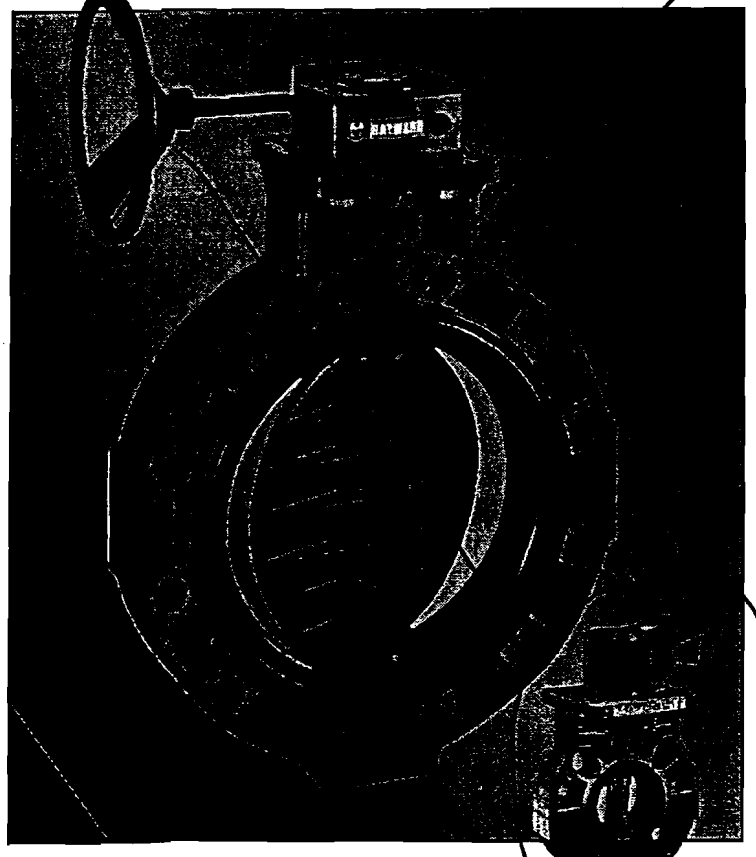
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

HAYWARD®

FlowControl

Butterfly Valves

1-1/2" to 12" • Bodies – PVC, Corzan® CPVC, PPL
Disks – PVC, Corzan® CPVC, PPL, PVDF



Features

- Rated at 150 PSI
- Stainless Steel Shaft
- Fully Supported Flange Bolt Holes
- Full Body, V-Notch Liner
- Blowout-Proof Shaft
- Viton, EPDM or Nitrile Liners

Options

- Stem Extensions
- Lug Body Design
- Gear Operators
- Electric Actuators
- Pneumatic Actuators
- Titanium Shaft
- 2" Square Operating Nut
- PVDF Discs

A Better Butterfly Valve

Hayward 1-1/2" through 12" all-Plastic Butterfly Valves are rated at a full 150 psi. Unlike other plastic butterfly valves, Hayward valves are constructed from a one piece body that incorporates fully supported flanged bolt holes to prevent stressing of the mating pipe flanges. Their heavy duty construction stands up to the most demanding applications. The rock solid integral mounting pad insures that the valve operator will function reliably – whichever operator is used, lever handle, gear box or actuator.

Extra Features, No Extra Cost

Hayward Butterfly Valves feature a blowout-proof stainless steel stem and a unique, full body liner that has a V-notch retention design. This assures positive sealing of the liner to the valve body. An integrally molded face seal provides positive sealing against the mating flange without the need for additional gaskets. And the lever handle has a built in lockout feature.

Better Sealing

Other plastic butterfly valves have only a thin o-ring on the disk to seal the valve, but Hayward valves feature a full body liner seal. This means that the process media never contacts the valve body. And you can count on the full liner seal to perform reliably, year after year.

Easy Retrofit

Hayward Butterfly Valves can be easily fitted into a metal piping system. All valve sizes meet industry face-to-face standards – allowing simple retrofit.

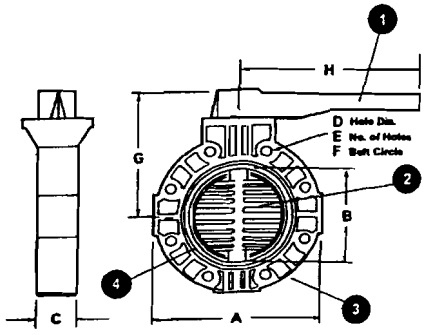
No Metal, No Corrosion

These valves have no metal in contact with the process media. They cannot corrode or rust – nor will they contaminate sensitive fluids flowing through them.

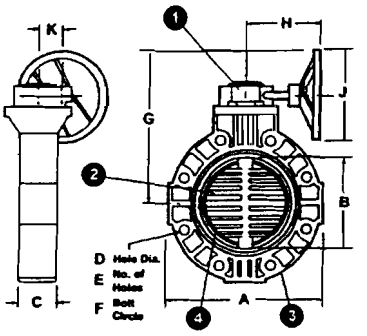
Corzan® CPVC is a trademark of Noveon, Inc.
Viton® is a trademark of DuPont Dow Elastomers

Technical Information

Lever Handle Operator



Gear Box Operator



Parts List
Butterfly Valves

1. Operator (Lever or Gear Box)
2. Disc
3. Body
4. Liner

Dimensions - Inches / Millimeters

Size	A	B	C	D	E	F	G		H		J	K	Wt. Lb / Kg
							Gear Box	Lever	Gear Box	Lever			
1-1/2 / 50	6.00 / 152	1.75 / 44	1.50 / 38	.63 / 16	4	3.88 / 99	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
2 / 63	6.00 / 152	1.75 / 44	1.50 / 38	.75 / 19	4	4.75 / 121	9.31 / 236	6.25 / 159	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	10.5 / 4.8
3 / 90	7.75 / 197	3.13 / 80	2.00 / 51	.75 / 19	4	6.00 / 152	9.75 / 248	6.69 / 170	7.13 / 181	10.50 / 267	8.00 / 203	1.88 / 48	11.6 / 5.3
4 / 110	9.25 / 235	3.94 / 100	2.19 / 56	.75 / 19	8	7.50 / 191	10.19 / 259	7.94 / 202	7.13 / 181	12.00 / 305	8.00 / 203	1.88 / 48	14.3 / 6.5
6 / 160	11.25 / 286	5.81 / 148	2.31 / 59	.88 / 22	8	9.50 / 241	12.38 / 314	9.50 / 241	7.13 / 181	14.00 / 356	8.00 / 203	1.88 / 48	15.4 / 7.0
8 / 225	13.75 / 349	7.75 / 197	2.50 / 64	.88 / 22	8	11.75 / 298	13.50 / 343	10.63 / 270	7.13 / 181	16.00 / 406	8.00 / 203	1.88 / 48	23.5 / 10.7
10 / 280	16.00 / 406	9.76 / 248	3.00 / 76	1.00 / 25	12	14.25 / 362	16.00 / 406	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	39.0 / 17.7
12 / 315	19.00 / 483	11.50 / 292	3.18 / 81	1.00 / 25	12	17.00 / 432	17.50 / 445	N/A	8.09 / 205	N/A	8.00 / 203	2.36 / 59	51.0 / 23.1

DIN metric flanges available

Cv Factors

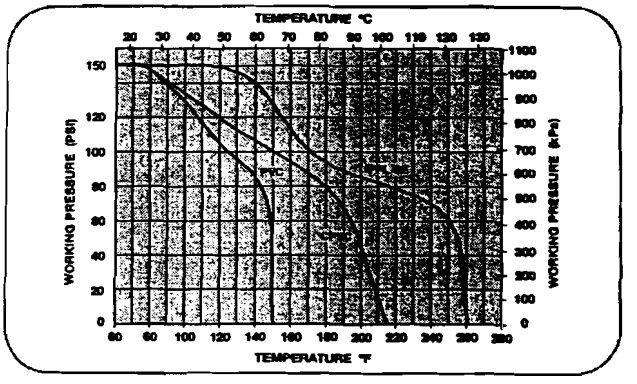
Size	Factor	Size	Factor
1-1/2"	90	6"	1100
2"	125	8"	2500
3"	280	10"	4700
4"	675	12"	7100

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

Operating Temperature/Pressure



Selection Chart

Size	Body Material	Disc Material	Shaft Material	Liner	Operator	Pressure Rating
*1-1/2" to 8"	CPVC	CPVC	316 SSTL	Viton®, EPDM or Nitrile	Lever or Gear Box	150 PSI @70F Non-Shock
1-1/2" to 8"	PVC	PVC, PPL, or PVDF				
1-1/2" to 12"	PPL	PPL				

* CPVC/CPVC 8" gear operated only

HAYWARD®

Hayward Industrial Products, Inc.
One Hayward Industrial Drive, Clemmons, NC 27012
Tel: 1-888-429-4635 (1-888-HAYINDL) • Fax: 1-888-778-8410
E-mail: industrial@haywardnet.com
Web Site: http://www.haywardindustrial.com

Hayward Industrial Products (UK) Ltd.
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Tel: +44 (0) 1206 854454 • Fax: +44 (0) 1206 851240

MC-1-BFY-12 Rev. 4 Printed in U.S.A.

Section 3-T

Air Stripper Butterfly Shut-Off Valves (V-1 through V-17)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

M&H Style 4500 & 1450

- AWWA Class 150B Butterfly Valves
- Suggested Specifications: 3" - 54"
- Consult Factory for valves 60" - 120"

A. GENERAL

All butterfly valves shall be of the rubber-seated tight-closing type. They shall meet or exceed AWWA standard C504, Latest edition. All valves shall be M&H 4500/1450 butterfly valves, or approved equal. Written approval must be given prior to bid.

Both ends shall be AWWA C111 mechanical joint or per flanged ANSI B16.1 (or as otherwise noted on plans and specs) per AWWA Standard C111.

B. VALVE SHAFT

Valve shafts shall be 18-8 Type 304 stainless steel. Each valve shaft shall be of a one piece design for valves 12" and smaller and a two piece design for valves 14" and larger. Valve shafts shall have a minimum diameter extending through the valve bearings and into the valve disc as specified in AWWA C504, Table 3. As well, all valve shafts must meet or exceed the minimum connection torque requirement set forth in AWWA C504, Section 4.5.3.2.

C. VALVE BODY AND DISC

For valve sizes 3" – 16", valve body and disc shall be high strength cast iron to ASTM A126. Class B or high strength ductile iron to ASTM A536 with ASTM A276 Type 304 stainless steel body seats.

Valves 18" and larger, Valve body shall be of high strength ductile iron to ASTM A536, Grade 65-45-12 with ASTM A276 Type 304 stainless steel body seat. Valve disc shall be high strength cast iron to ASTM A126. Class B.

D. VALVE SEAT

Rubber valve seats shall be a full-circle 360-degree seat not penetrated by the valve shaft. Valve seat may be Buna-N or Buna-S for cold water applications and EPDM for air and high temperature applications.

The valve seat will be attached to the valve disc by ASTM A276 Type 304 stainless steel self-locking fasteners. The valve seat must be easily field adjustable and replaceable without any special tools or lengthy curing time.

E. SHAFT SEALS

Valve shaft seals shall be of the O-ring type and utilize the same elastomer as specified for the valve seats and for the intended service. Valves using self-compensating split V-type packing will not be accepted. All valve shaft seals must be easily field replaceable.

F. VALVE OPERATOR

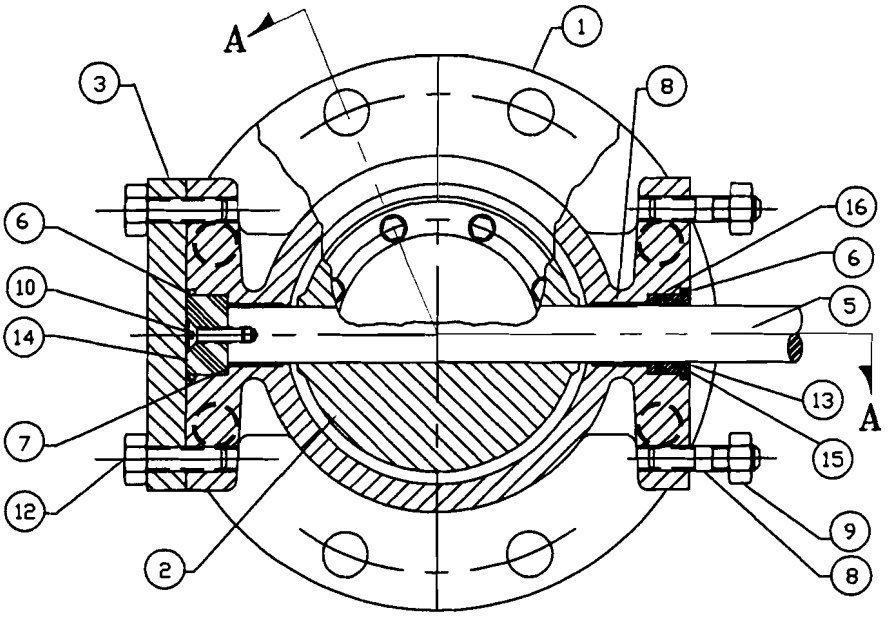
Valve operators shall be of the traveling nut type, sealed, gasketed and lubricated for underground or in-plant service. Operator shall be capable of withstanding an overload input torque of 450 ft-lbs. at full-open or full-closed position without damage to the valve operator. Operators for valves 14" and larger must have a 304 stainless steel external stop limiting device and travel adjustment. The travel adjustments must be able to be operated without removing the valve from the line or removing the actuator cover. No internal travel adjustment devices will be acceptable. All valve actuators must be sized per AWWA C504, Latest edition torque requirements. Certification of proof of design and torque requirements shall be submitted to the owner during shipment.

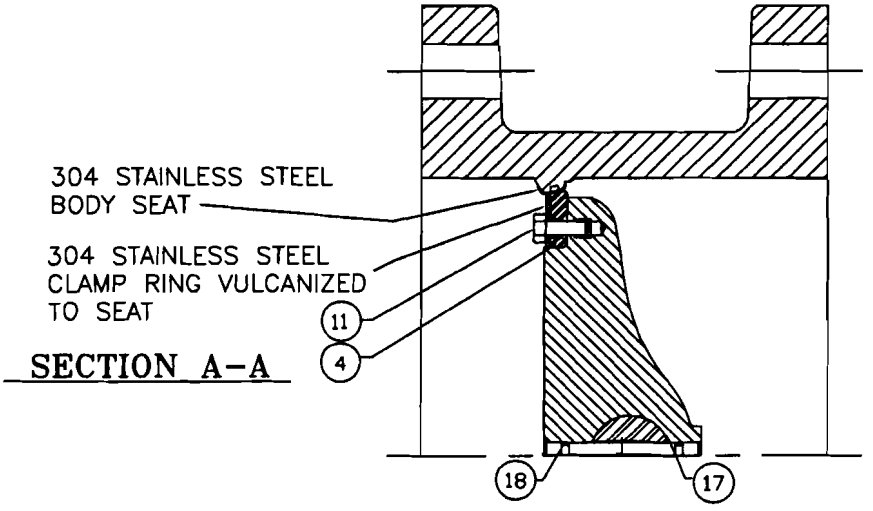
Handcrank, Handwheel or Chainwheel –All manual operators for service other than underground shall have a position indicator and shall be totally enclosed and permanently lubricated. In any event, a maximum pull of 80 lbs. on the crank or wheel shall produce full C50A Table 1 output torque throughout entire travel. Operators shall be of the "Traveling-Nut" type.

Cylinder – Cylinder operator shall be of the base mounted configuration. Cylinder barrel shall be of molybdenum-disulfide lined glass fiber reinforced epoxy tubing, to provide a corrosion-free, self-lubricated high strength barrel. Rod seal shall be of urethane, molybdenum-disulfide filled, to provide a self-lubricated, long life seal.

G. COATINGS

The valve interior and exterior surfaces shall be coated in accordance with the latest revisions of AWWA C504 and must be NSF 61 certified.





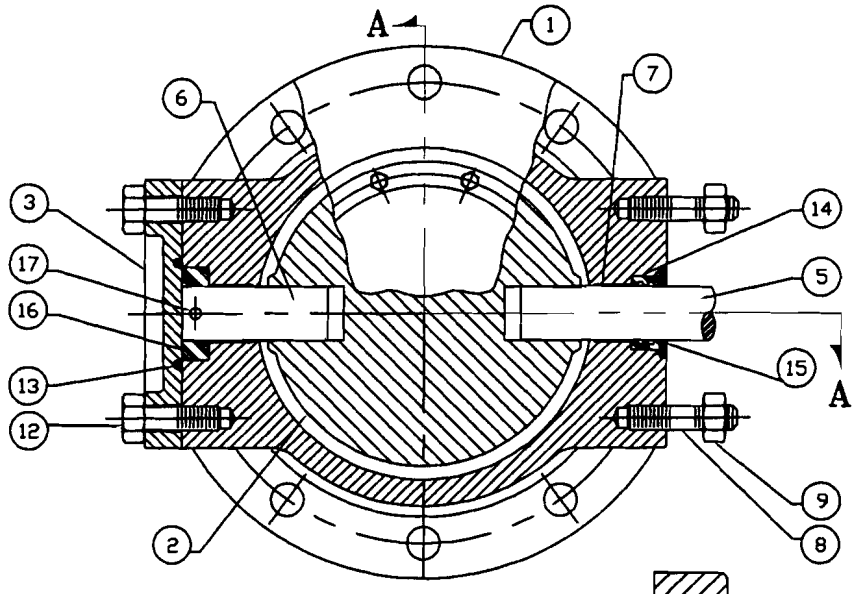
SECTION A-A

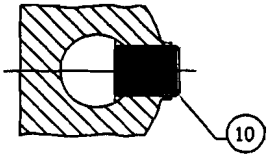
ITEM #	DESCRIPTION	MATERIAL
1	BODY, VALVE	CAST IRON ASTM A-126 CLASS B WITH STN STL SEAT
2	VANE	CAST IRON ASTM A-48 CLASS 40
3	COVER, END	CAST IRON, A-126, CLASS B
4	SEAT RING, VANE	BUNA "S' WITH 304 STAINLESS STEEL INSERT
5	SHAFT	TYPE 304 STN. STL. ASTM A-276
6	O-RING, BODY	BUNA "N"
7	BEARING, BODY	EPOXY FIBERGLASS WITH TEFLON LINER
8	STUD	STEEL, ASTM A-307, ELCTRO ZINC PLATED
9	NUT, HEAVY HEX	STEEL, ASTM A-563, GRADE A, ELCTRO ZINC PLATED
10	SOCKET SCREW, FLAT HEAD HEX	STAINLESS STEEL, 18-8
11	CAPSCREW, HEX	STAINLESS STEEL, 18-8 WITH NYLOK INSERT
12	CAPSCREW, HEX	STEEL, ASTM A-307, ELCTRO ZINC PLATED
13	CARTRIDGE SEAL	UHMW (POLYEHTYLENE)
14	THRUST DISK	ACETEL
15	"O" RING CARTRIDGE, INSIDE	BUNA "N"
16	"O" RING CARTRIDGE, OUTSIDE	BUNA "N"
17	GROOVED PIN	393 STAINLESS STEEL
18	O-RING, GROOVED PIN	BUNA-N

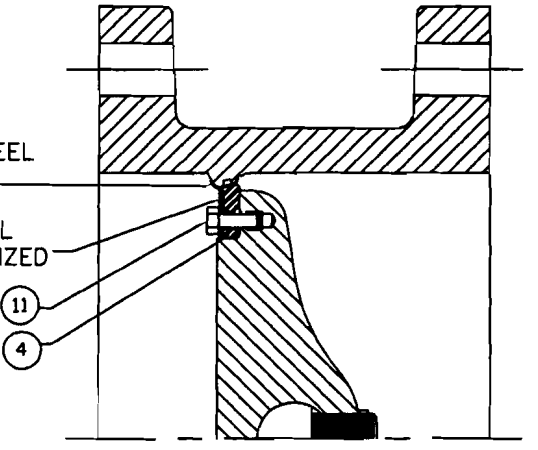
M&H VALVE COMPANY
ANNISTON,ALABAMA
A DIVISION OF MCWANE INC.

DWN: TRIJ
DATE: 7/1/05
DWG. NO. BFE-15-45A

3" THRU 12" STYLE 4500
CLASS 150 BUTTERFLY VALVE
SUB-ASSEMBLY / MATERIAL LIST
FLANGED ENDS







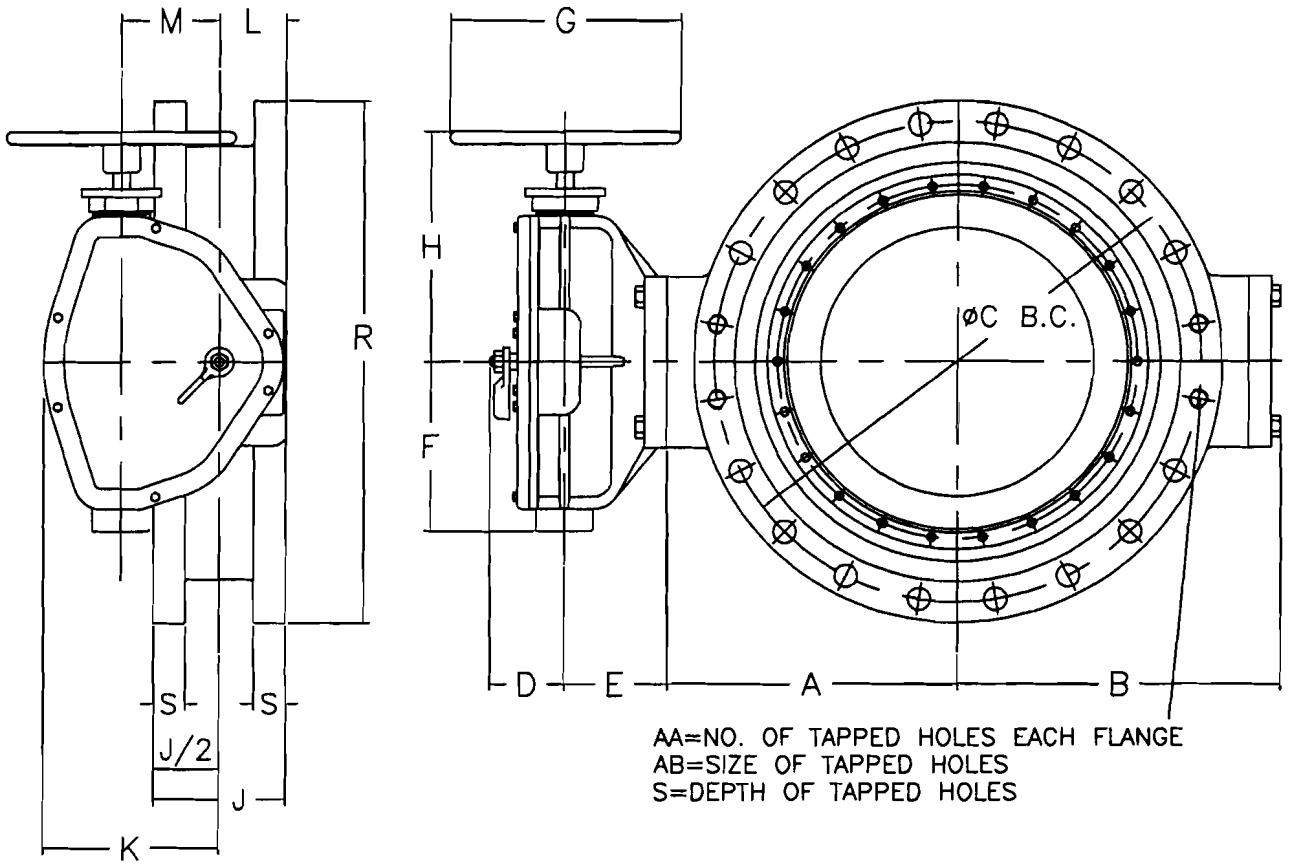
SECTION A-A

ITEM #	DESCRIPTION	MATERIAL
1	BODY, VALVE	CAST IRON, A-126, CLASS B WITH 304 STAINLESS STEEL SEAT
2	VANE	CAST IRON, A-48, CLASS 40
3	COVER, END	CAST IRON, A-126, CLASS B
4	SEAT RING, VANE	BUNA "N" WITH 304 STAINLESS STEEL INSERT
5	SHAFT, OPERATOR	304 STAINLESS STEEL, ASTM A-276
6	SHAFT, THRUST	304 STAINLESS STEEL, ASTM A-276
7	BUSHING	REINFORCED TEFLON
8	STUD	STEEL, ASTM A-307, ELCTRO ZINC PLATED
9	NUT, HEX	STEEL, ASTM A-307, GRADE A, ELCTRO ZINC PLATED
10	TORQUE PLUG, SHAFT	304 STAINLESS STEEL, ASTM A-276
11	CAPSCREW, HEX	STAINLESS STEEL, 18-8 WITH NYLOK INSERT
12	BOLT, HEX HEAD	STEEL, ASTM A-307, GRADE B, ELCTRO ZINC PLATED
13	O-RING, END COVER	BUNA "N"
14	SHAFT SEAL	BUNA "S"
15	SEAL RING	STEEL, C-1018
16	THRUST COLLAR	BEARING BRONZE, ASTM B-144, ALLOY 3B
17	ROLL PIN	STAINLESS STEEL, A.I.S.I. 420

M&H VALVE COMPANY
ANNISTON, ALABAMA
A DIVISION OF MCWANE INC.

DWN: TRIJ
DATE: 7/1/05
DWG. NO. BFE-15-45B

14" THRU 24" STYLE 4500
CLASS 150 BUTTERFLY VALVE
SUB-ASSEMBLY / MATERIAL LIST
FLANGED ENDS



AA=NO. OF TAPPED HOLES EACH FLANGE
AB=SIZE OF TAPPED HOLES
S=DEPTH OF TAPPED HOLES

VALVE SIZE	OPERATOR MODEL	D	E	F	G	H	K	L	M	N
3" & 4"	65	2 15/16	3 9/16	3 7/16	7 1/2	7 3/4	3 7/16	2 1/4	1 3/8	16 1/2
6"	150	2 15/16	3 9/16	3 7/16	7 1/2	7 3/4	3 7/16	2 1/4	1 3/8	16 1/2
8"	250	3	3 11/16	4 1/16	14	8 7/8	4 1/2	2 3/8	2	24
10" & 12'	510	3 3/16	4 1/2	5 7/16	14	10 3/16	6 1/8	2 3/4	3	36
14",16",18" & 20"	1250	4 1/16	5 3/4	8 3/8	18	12 1/2	7 7/8	3 1/4	4	48
24"	2200	4 1/16	6 1/4	10 3/8	18	14 1/2	10 3/4	3 7/8	6	72

VALVE SIZE	A	B	C	J	P	Q	R	S	AA	AB	WEIGHT
3"	4	5 7/16	6	5	4	5/8	9	15/16	4	5/8-11	75
4"	4	5 7/16	7 1/2	5	8	5/8	9	15/16	4	5/8-11	75
6"	5	6 1/2	9 1/2	5	8	3/4	11	1	4	3/4-10	95
8"	6	7 9/16	11 3/4	6	8	3/4	13 1/2	1 1/8	4	3/4-10	140
10"	7 3/4	9 5/8	14 1/4	8	12	7/8	16	1 3/16	–	–	237
12"	9 1/2	11 3/8	17	8	12	7/8	19	1 1/4	–	–	300
14"	10 7/16	12 15/16	18 3/4	8	12	1	21	1 3/8	4	1-8	485
16"	12 3/16	14 11/16	21 1/4	8	16	1	23 1/2	1 7/16	4	1-8	570
18"	13 5/16	15 13/16	22 3/4	8	16	1 1/8	25	1 9/16	4	1 1/8-7	735
20"	14 7/8	17 3/8	25	8	20	1 1/8	27 1/2	1 11/16	4	1 1/8-7	860
24"	17 19/32	20 1/8	29 1/2	8	20	1 1/4	32	1 7/8	4	1 1/4-7	1165

NOTE 1: FLOW MAY BE IN EITHER DIRECTION
NOTE 2: VALVE SHAFT WILL MEET OR EXCEED REQUIREMENTS OF SHAFT TABLE PER AWWA STANDARD C-504 FOR APPLICABLE CLASS.
NOTE 3: REFERENCE AWWA C-504 FLANGES & DRILLING (A.N.S.I. 125)
NOTE 4: "N" = NUMBER OF TURNS TO CLOSE
NOTE 5: "P" = NUMBER OF BOLTS ON EACH FLANGE
NOTE 6: "Q" = DIAMETER OF BOLTS
NOTE 7: OPERATED BY 2" AWWA OPERATING / WRENCH NUT

M&H VALVE COMPANY
ANNISTON,ALABAMA
A DIVISION OF MCWANE INC.

DWN: TRIJ
DATE: 7/1/05
DWG. NO. BFE-15-45E

3" THRU 24" STYLE 4500
CLASS 150 BUTTERFLY VALVE
POSITION INDICATOR
HANDWHEEL OPERATOR
FLANGED ENDS

Section 3-U

Building Flood Switches (LS-210A, LS-201B)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Electrical Data

Standard reed switches in GEMS level switch units are hermetically-sealed, magnetically actuated, make-and-break type. Switches are SPST or SPDT and are rated in Volt-Amps (VA).

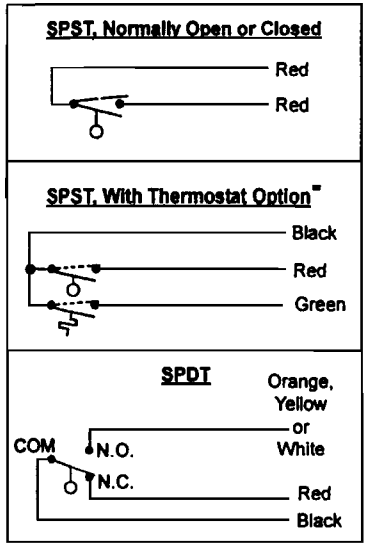
See the chart below for maximum load characteristics of GEMS level switches. CAUTION: Contact protection is required for transient or high in-rush current. Refer to GEMS Bulletin #133702 or call your GEMS representative.

VA	Volts	Amps AC	Amps DC
10 General Use	0-50	.2	.13
	120	.08	N.A.
	100	N.A.	.10
20 Pilot Duty	0-30	.4	.3
	120	.17	.13
	240	.08	.06
50 General Use	0-50	0.5	0.5
	120	.4	.4
	240	.2	.2
100*	120	.8**	N.A.
	240	.4	N.A.

* Not U.L. Recognized ** Limited to 50,000 operations

Typical Wiring Diagrams

(Circuit Condition Dry)



"Thermostat switches open or close when ambient temperature reaches specified setpoint. Thermostat units not CE approved.

CE This product is suitable for Class I and Class II applications only, per the requirements of standard EN60730 and any additional specific requirements for a particular application or medium being sensed. Class I compliance of metal bodied units requires a ground connection between the metal body and the earthing system of the installation. Class I compliance of plastic bodied units in contact with a conductive medium requires that the medium be effectively earthed so as to provide an earthed barrier between the unit and accessible areas. For Class III compliance, a supply at safety extra-low voltage (SELV) must be provided. Please consult the Factory for compliance information on specific part numbers.

Important Points!

Product must be maintained and installed in strict accordance with the National Electrical Code and GEMS product catalog and instruction bulletin. Failure to observe this warning could result in serious injuries or damages.

An appropriate explosion-proof enclosure or intrinsically safe interface device must be used for hazardous area applications involving such things as (but not limited to) ignitable mixtures, combustible dust and flammable materials.

Pressure and temperature limitations shown on individual catalog pages and drawings for the specified level switches must not be exceeded. These pressures and temperatures take into consideration possible system surge pressures/temperatures and their frequencies.

Selection of materials for compatibility with the media is critical to the life and operation of GEMS level switches. Take care in the proper selection of materials of construction; particularly wetted materials.

Life expectancy of switch contacts varies with applications. Contact GEMS if life cycle testing is required.

Ambient temperature changes do affect switch set points, since the specific gravity of a liquid can vary with temperature.

Level switches have been designed to resist shock and vibration; however, shock and vibration should be minimized.

Liquid media containing particulate and/or debris should be filtered to ensure proper operation of GEMS products.

Electrical entries and mounting points may require liquid/vapor sealing if located in an enclosed tank.

Level switches must not be field repaired.

Physical damaged sustained by the product may render it unserviceable.

P/N 72947
Rev. V

Gems Sensors Inc.
One Cowles Road
Plainville, CT
06062.1198
tel 860.747.3000

Single-Station Level Switches

Instruction Bulletin No. 72947

Series	Mounting	HEX Size	Float Diameter
LS-1700**	1/8" NPT	1/2"	1" (Slosh Shield Version 1-13/32")
LS-1700TFE*	1/8" NPT	1/2"	1-1/8"
LS-1750**	1/8" NPT	1/2"	1-1/2" (Slosh Shield Version 1-13/16")
LS-1755**	1/8" NPT	1/2"	1-1/32"
LS-1800**	1/8" NPT	1/2"	1-1/4"
LS-1850**	1/2" NPT	3/4" Wrench Flat	3-1/2"
LS-1900**	1/4" NPT	5/8"	1-7/8"
LS-1900TFE*	1/4" NPT	21/32"	2-1/8"
LS-1950**	1/4" NPT	5/8"	2-1/16"
LS-19735*	1/4" NPT	5/8"	1-1/2"
LS-3*	1/8" NPT	1/2"	1"
	3/8" - 16 Str. Thd.	1/2"	1"
	1/8" NPT	1/2"	1-1/4" (Slosh Shield Version)
	1/8" NPT	1/2"	1-7/8" (P/N 76707)
	1/8" NPT	1/2"	3/4" (P/N 201540)
LS-30*	1/4" NPT	5/8"	1-7/8"
LS-38760**	1/4" NPT	9/16" Wrench Flat	1-7/8"
LS-74780*	1/4" NPT	5/8"	1-1/2"
LS-77700**	1/8" NPT	1/2"	1"
	3/8" - 24 Str. Thd.	3/4"	1-1/2"
TH 800-A*** Level Temp	1/4" NPT	5/8"	1-1/4"

*** Plastics** **** Alloys**

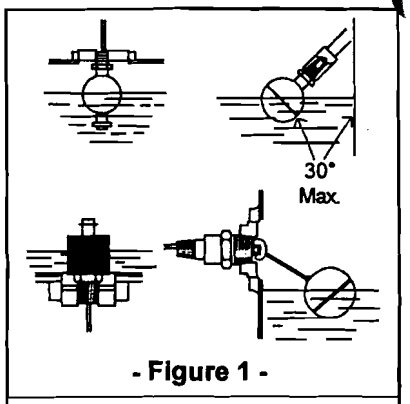
*** **Specialty Switches: Please use caution when handling these units, as shock may damage the thermostat temperature setting.**
Thermostat units not CE approved.

Installation

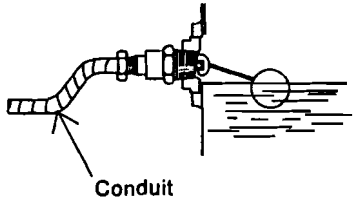
A standard NPT female boss in tank top, bottom or side is all that is required. Units operate in any attitude - from the vertical to a 30° inclination - with lead wires up or down. Standard IPS pipe extends units to any intermediate level in the tank. ***(Figure 1)***

Moisture Protection: When moisture exists in conduit and extension pipes, the potential for this moisture to "wick" down the wire leads and into the switch assembly exists. Should this happen, the switch will appear to be closed due to a high resistance path through the moisture. The following suggestions may help to prevent this from happening:

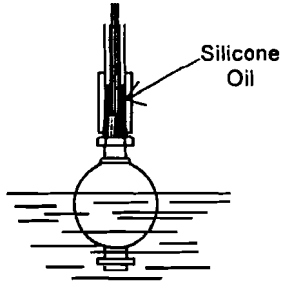
1. Pitch conduit away from the level switch when possible, so that condensation will drip away from the level switch assembly. ***(Figure 2)***
2. When a vertical run of extension pipe is used to extend a level switch down from the top of the tank, a non-conductive silicone oil should be used to fill the vertical run. Alternatively, an appropriate potting may be used to fill the vertical run to occupy the space in which condensation will normally form. ***(Figure 3)***



- Figure 1 -



- Figure 2 -



- Figure 3 -

CAUTION

Most of GEMS level products incorporate a potting cap or are fully potted. Due to the bonding characteristics of the potting to the wire leads, there is no way of assuring a water-tight seal at the potting joint. Our potting cap will resist moisture to some degree, but the precautions mentioned above should be used to assure moisture doesn't enter the switch and cause a short.

Consult your GEMS representative for more suggestions on how to lessen the effects of moisture.

Thread Treatment

1. Sealing: When threading metal threads into a metal coupling, pipe sealant or Teflon® tape is recommended. Due to potential compatibility problems, when sealing plastic threaded units, a compatible pipe sealant such as **No More Leaks™** from Permatex® is recommended.
2. Tightening: When threading a plastic level switch into a metal coupling, the installer should use a suitable wrench and tighten the threads one to one and one-half additional turns past hand-tight. Over-torquing of the threads will result in damage to the plastic mounting plug.

No More Leaks is a trademark of Permatex® Industrial Corp., a subsidiary

3. The Effect of Thread Engagement on Actuation Points

The length of mounting threads engaged at installation is important in calculating switch actuation points and the actual length of stem extending into the tank. Use **the chart below** to find the thread engagement length (T) for a given NPT size. Factor the dimension into any calculation of switch actuation levels (L) and overall length (L_0).

NPT	1/8"	1/4"	1/2"	3/4"	1"	1-1/4"	2"	3"
T Dim.	.27"	.39"	.53"	.55"	.68"	.71"	.76"	1.20"

- See Examples Below -

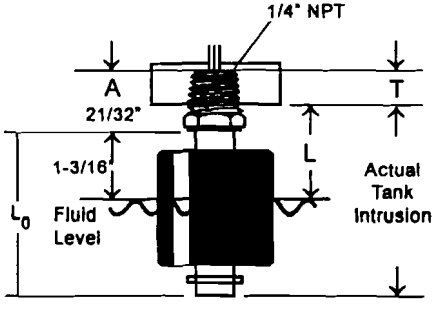
Definition of Variables Used in Examples Below

A = Mounting Length
T = Thread Engagement
P = Distance from coupling (bung) top to inside surface of tank or bracket
L_0 = Overall length from bottom of mounting
L = Switch actuation level as measured from inside surface of tank or bracket to fluid surface
L_1 = Switch actuation level, nominal, as measured from bottom of mounting (based on a liquid specific gravity of 1.0)

Internally Mounted LS-1900
(Standard Length)

LS-1900 Series internally mounted through a 1/4" NPT hole. To calculate "L" dimension:

$L = L_1 + (A-T)$
$L = 1\text{-}3/16" + (21/32" - .39")$
$L = 1.46"$



Internally Mounted LS-1700/1750
(Standard Length)

LS-1700/1750 internally mounted through a 1/8" NPT hole. To calculate "L" dimension:

$L = L_1 + (A-T)$
$L = .63" + (.56" - .27")$
$L = .92"$