

2. To: (Receiving Organization) Project W-011H	3. From: (Originating Organization) Effluent Treatment and Laboratory Projects	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: W-011H/Laboratory Programs	6. Cog. Engr.: <i>JE WITHERSPOON</i> LL Curfman	7. Purchase Order No.: N/A
8. Originator Remarks: Release		9. Equip./Component No.: Septic system
11. Receiver Remarks: Release		10. System/Bldg./Facility: WSCF Complex
		12. Major Assm. Dwg. No.: H-6-1676, Sh 1 & 2
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: July 15, 1993



15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Impact Level	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-W011H-OMM-001	N/A	0	Operation and Maintenance Manual for Septic Tank System 6607-9	4	2	1	1

16. KEY		
Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)											
(G)	(H)	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G)	(H)
2	1	Cog. Eng. JE Witherspoon (1)	<i>[Signature]</i>		R3-35	RG Talley (1)			T3-01	3	6
2	1	Cog. Mgr. DP Hughes (0)	<i>[Signature]</i>	7/12/93	R3-35	JM Frank (1)			E6-25	3	6
6	6	QA CE Norton (1)			S1-54	MS Collins (1)			A5-18	3	6
3	6	Safety GE McPherson (1)			T4-10						
3	6	Env. KA Giese (9+original)			H6-25						
3	6	JA Thornock (1)			S1-64						
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18. JE Witherspoon <i>[Signature]</i> Signature of EDT Originator Date: 7/12/93	19. DP Hughes <i>[Signature]</i> Authorized Representative for Receiving Organization Date: 7/12/93	20. DP Hughes <i>[Signature]</i> Cognizant/Project Engineer's Manager Date: 7/12/93	21. DOE APPROVAL (if required) Ltr. No. <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/comments <input type="checkbox"/> Disapproved w/comments
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Date Received: <b>July 12, 1993</b>	<b>INFORMATION RELEASE REQUEST</b>	Reference: WHC-CM-3-4
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Purpose <input type="checkbox"/> Speech or Presentation <input type="checkbox"/> Full Paper (Check only one suffix) <input type="checkbox"/> Summary <input type="checkbox"/> Abstract <input type="checkbox"/> Visual Aid <input type="checkbox"/> Speakers Bureau <input type="checkbox"/> Poster Session <input type="checkbox"/> Videotape	<input type="checkbox"/> Reference <input type="checkbox"/> Technical Report <input type="checkbox"/> Thesis or Dissertation <input type="checkbox"/> Manual <input type="checkbox"/> Brochure/Flier <input type="checkbox"/> Software/Database <input type="checkbox"/> Controlled Document <input checked="" type="checkbox"/> Other	ID Number (include revision, volume, etc.) WHC-SD-W-11H-OMM-001, Rev. 0 List attachments. N/A Date Release Required July 15, 1993

Title <b>Operation and Maintenance Manual for Septic Tank System 6607-9</b>	Unclassified Category <b>UC-620</b>	Impact Level <b>4</b>
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New or novel (patentable) subject matter? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", has disclosure been submitted by WHC or other company? <input type="checkbox"/> No <input type="checkbox"/> Yes Disclosure No(s).	Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (Identify)
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Title of Conference or Meeting N/A	Group or Society Sponsoring N/A		
Date(s) of Conference or Meeting N/A	City/State N/A	Will proceedings be published? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Will material be handed out? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Title of Journal N/A
-------------------------

CHECKLIST FOR SIGNATORIES			
Review Required per WHC-CM-3-4	Yes	No	Reviewer - Signature Indicates Approval
			Name (printed)                      Signature                      Date
Classification/Uncontrolled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Nuclear Information	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Patent - General Counsel	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	} <u>SILBERMAN</u> <i>(Signature)</i> 7/20/93
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Publication Services	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<u>K.C. Freeman</u> <i>(Signature)</i> 7-30-93
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INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP	
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Date Cancelled	Date Disapproved

SUPPORTING DOCUMENT

1. Total Pages 90

2. Title

Operation and Maintenance Manual for Septic Tank System 6607-9

3. Number

WHC-SD-W011H-OMM-001

4. Rev No.

0

5. Key Words

Project W-011H, Operation, Maintenance, Septic System

6. Author

Name: J. E. Witherspoon

Signature

Organization/Charge Code 24380/AM11A

7. Abstract

Describes operation and maintenance of septic system for the Waste Sampling and Characterization Facility

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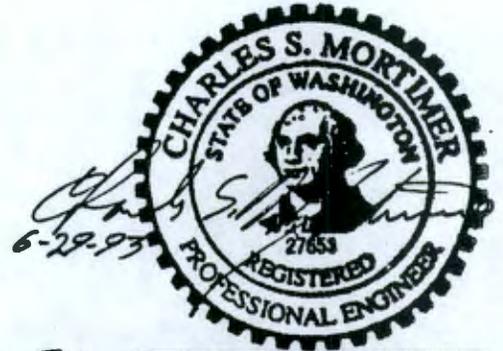
CW 7-30-93

OFFICIAL RELEASE BY WHC DATE AUG - 2 1993 Sta # 10

9. Impact Level 4

APPROVAL:

Kaiser Engineers Hanford Company



*Charles S. Mortimer*  
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6-29-93  
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EXPIRES 6/27/94

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Date

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Environmental

7/14/93  
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*J. S. Stain*  
Sanitary Systems Maintenance

7/8/93  
Date

Compliance with this document is required to meet Washington Administrative Code (WAC) 246-272 criteria. Any changes to this document must have the concurrence of the Washington State Department of Health and the Kaiser Engineers Hanford Company Project Engineer.

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## INTRODUCTION

This manual was prepared to provide detailed information for the operation and maintenance of septic tank soil absorption system 6607-9. The manual sets forth the standard operating procedures which include type and frequency of required maintenance. Procedures to follow for a system failure are also included.

## SYSTEM DESCRIPTION

The wastewater treatment facility consists of a septic tank, a dosing/pumping chamber, and three pressure distribution soil absorption fields. Each soil absorption field is designed to accept 50% of the maximum daily flow. Two of the three constructed fields are in operation at any one time. Provision is made to construct a fourth field in the event of a failure of one of the constructed fields. The maximum daily design flow is 6,700 gal. The system location is shown on drawing H-6-1676, sh 1 (all drawings are in Appendix G).

## SYSTEM OPERATION

### Normal Operating Conditions

Raw sewage enters the septic tank and departs through installed effluent filters to the dosing/pumping chamber. Duplex alternating pumps each pressurize a soil absorption field. Flow is directed to the soil absorption fields through the valve vault. Each pump supplies one 50% soil absorption field. Pump control is through float switches.

### Operation Sequence

- Effluent enters the dosing chamber.
- A dose volume of 1,600 gal trips the dose float switch which starts the primary pump.
- Upon completion of the pumping cycle, the pump is shut off by the low-level float switch and the pump alternator selects the other pump as the primary pump.
- The cycle is repeated.
- The dosing chamber is sized to accept a total effluent volume of 1,760 gal prior to an alarm signal. This chamber provides a total storage of 4,658 gal if a power or pump failure occurs.

**Off-Normal Operating Conditions**

An accumulation of more than 1,760 gal of effluent in the dosing/ pumping chamber will produce an alarm signal. The signal is a local audible alarm and magenta strobe light. Continued filling of the dosing/pumping chamber will activate the second pump, which will then pump the contents of the dosing chamber into the soil absorption field. This off-normal event is the result of the primary pump failure.

Corrective action: attempt to manually operate the primary pump. Successful pump operation in the manual mode would indicate a malfunction in the float switches. Failure of the pump to operate in the manual mode would indicate either an absence of power to the pump or a mechanical problem possibly necessitating the removal of the pump for repair.

In the unlikely event of the mechanical failure of both pumps, emergency pumping of the dosing chamber by pumper truck(s) must be initiated immediately. The Manager of Sanitary Systems Maintenance and the Manager of Maintenance Integration and Material Support shall be notified to reduce or stop all discharge to minimize pumping costs during repairs (buildings served are listed in Appendix A). Pumper truck disposal of the effluent must then be continued until at least one pump is restored to normal service. It is important to restore both pumps to normal service at the earliest possible time to minimize the overloading of one of the soil absorption fields.

Any off-normal event shall be reported immediately to the Washington State Department of Health, 924 West Sinto, Spokane, WA 99201-2595, telephone (509) 456-2490.

**PERIODIC INSPECTION**

Regular inspection of key system components is necessary to ensure the system integrity for the system design life. These periodic inspections are recorded on an INSPECTION RECORD FORM (see Figure 1). The inspection points are described as follows.

**Pumps**

**Visual Inspection:** Observe the red light above the pump control panel for a seal failure warning. If illuminated, pump service is required. Remove pump and service per manufacturers direction.

### **Pump Controls and Electrical Panel**

**Float Switch Operation:** Manually rotate all four float switches to determine that the contacts are in accordance with the design function. Recover each float switch by reaching into the dosing chamber with a hooked stick and raise each float line to the ground surface.

- The lowest float switch shuts off the pump(s).
- The second lowest float switch turns the lead pump on.
- The third lowest float switch activates the alarms (both audible and the strobe light).
- The highest float switch activates the "Emergency Pump On."

**Manually Operate Controls:** Operate the "Off-On-Auto" switch for each pump. Determine that the switch functions as designed, i.e., the connection is broken in the "Off" position; the pump actually starts in the "On" position; and the pump circuits are active and waiting for the other controls to start the pump in the "Auto" position.

**Check for Moisture and Corrosion:** Visually inspect the control panel cabinet for moisture intrusion. Visually observe all wire connection points within the control cabinet for visible corrosion. Report any evidence of moisture intrusion, electrolysis, and/or corrosion, noting specific wire connection points via wire numbers.

### **Distribution System and Drainfields**

**Soil Absorption Monitor Ports:** Two monitor ports are located in each 50% soil absorption field. Follow Preventive Maintenance Procedure, "Septic Tank Inspection and Drainfield Integrity," (paragraph 3.2, Appendix B).

**Inspect Valves for Corrosion:** The valve vault contains nine valves. These valves are normally operated semiannually. Visually observe each valve for evidence of rust, electrolysis, and/or corrosion. Report all evidence of rust and/or corrosion by the valve number attached to each valve.

**Note:** The valve vault is defined as a confined space. Follow the requirements of WHC-CM-4-3, Standard W-13, Rev. 1, and Guide W-13, "Confined Space Entry," for entry into the vault.

**INSPECTION RECORD FORM**

Component/Task	Frequency	Date	Date	Date
<b>Pumps</b>				
Visual Inspection	Monthly			
<b>Pump Controls and Electrical Panel</b>				
Check Float Switch Operation	Annually			
Manually Operate Controls	Annually			
Check for Moisture and Corrosion	Annually			
<b>Distribution System and Drainfields</b>				
Inspect Monitor Ports	Monthly			
Inspect Valves for Corrosion	Annually			
Exercise all Valves	Annually			
Switch Fields in Operation	Semi-annually			
<b>Septic Tank</b>				
Check Sludge Level	Annually			
Check Floating Solids Level	Annually			
Clean Effluent Filters	Annually			
Check Inlets and Outlets	Annually			
<b>Elapsed Time Meters</b>				
<b>Record Pump Net Run Time</b>				
Pump 1	Weekly			
Pump 2	Weekly			
Average Daily Flow	Weekly			

**FIGURE 1**

**Exercise all Valves:** The valves are lever-lock quarter-turn butterfly valves. Prior to exercising all valves, lock and tag both pumps to prevent undue pressure accumulation during the valve exercising. Remove the lock and tag when the valve exercise is complete.

**Switch Fields in Operation:** Observe valve position at the outset of this operation. From the operations schedule (shown in Appendix D) and/or the operations schedule posted in the valve vault, determine the field cycle in service. Reset valves to the succeeding field cycle.

### **Septic Tank**

See Appendix B.

**Effluent Filters:** Check and clean filters in accordance with manufacturer's recommendation. (See Appendix C.)

**Inlets and Outlets:** Visually inspect the inlet and outlet device(s) within the septic tank. Ensure that the devices are in place and functioning with no visible clogging or physical damage. (See Attachment 3 in Appendix B.)

### **Elapsed Time Meters**

**Pump Net Run Time:** Record the hour-meter readings for each pump on the attached Inspection Record Form. (Figure 1)

**Average Daily Flow:** Compute the total volume of wastewater processed during the interval to ensure that the daily design capacity has not been exceeded. The following is an example:

T = Total pump run time in hours

P = Pump capacity, 325 gpm

Q = Average daily flow in gallons

V = 1,609 gal discharged per cycle

D = 6,700 gpd (design capacity)

$Q = T \cdot 60 \cdot P / \text{number of days between readings}$

**Example Problem:**

Assume: Pump 1 hour-meter reads 125.4 and Pump 2 hour-meter reads 127.1 on a Monday morning.

The following Monday morning, Pump 1 hour-meter reads 126.4 and Pump 2 hour-meter reads 128.0.

Therefore, the total hours for the 7-day period is 1.9.

$$Q = 1.9 \cdot 60 \cdot 325 / 7$$

$$Q = 5,293 \text{ gpd}$$

Conclusion: The system is operating within the daily design flow of 6,700 gpd.

Submit the completed Inspection Record Form annually to the Washington State Department of Health, 924 West Sinto, Spokane, WA 99201-2595.

**REFERENCES**

1. Preventive Maintenance Procedure, "Septic Tank Pumping," prepared by Westinghouse Hanford Company Maintenance Engineering Services, Document No. 1231, Rev 0, Change A.
2. Preventive Maintenance Procedure, "Septic Tank Inspection," prepared by Westinghouse Hanford Company Maintenance Engineering Services, Document No. 1233, Rev 0, Change A.

## Appendix A

### Building List

6266  
6269  
6270  
MO-280

## **Appendix B**

### **Procedure**

**MAINTENANCE ENGINEERING SERVICES  
PREVENTIVE MAINTENANCE PROCEDURES  
SEPTIC TANK INSPECTION AND DRAINFIELD INTEGRITY**

**1.0 PURPOSE**

Establish uniform criteria for septic tank inspection in order to determine tank integrity and need for pump out. Drainfield inspection shall reveal its level of performance.

**2.0 GENERAL REQUIREMENTS**

**2.1 GENERAL SAFETY**

- 2.1.1 A septic tank is a confined space. Follow the requirements of WHC-CM-4-3, Standard W-13, Rev 1 and Guide W-13, Confined Space Entry (KEH Procedure IS 10C) for entry into the vault.

**2.2 EQUIPMENT REQUIREMENTS**

- 2.2.1 Scum measurement device (see Attachment 1).
- 2.2.2 Sludge measurement device (see Attachment 2).
- 2.2.3 Measuring device (tape measure).
- 2.2.4 Illuminating device (flashlight).

**2.3 REFERENCES**

- 2.3.1 Onsite Wastewater Treatment and Disposal Systems, EPA 625/1-80-012.
- 2.3.2 Manual of Septic Tank Practice, U. S. Dept. of Health Education & Welfare.

## 3.0 PROCESS

### 3.1 SEPTIC TANK INSPECTION

- 3.1.1 Remove riser cover adjacent to the compartment divider shown in Attachment 3 as the center riser. Depending on the septic tank configuration, there may be more than three risers. Perform visual inspection to determine if PVC effluent outlet exists and is in good condition (see Attachment 3).
- 3.1.2 Insert scum measurement device with hinge closed, cord pulled taut and the flap facing toward the drainfield into the septic tank approximately 8 ft from the top of the riser.
- 3.1.3 Release the cord to open the flap and raise the device until resistance is felt from the bottom of the effluent outlet (see Attachment 3). Obtain measurement to the top of the riser and record the value in number 1 on the Septic Tank/Drainfield Evaluation Form (Attachment 4).
- 3.1.4 Turn scum measurement device 180 degrees and raise gently until resistance is felt by the bottom of the scum layer (see Attachment 3). Obtain a measurement to the opening of the septic tank riser and record this value in number 2 of the Septic Tank/Drainfield Evaluation Form.
- 3.1.5 Insert sludge measurement device to the bottom of the septic tank. Hold in place for a few minutes to allow sludge to absorb into the towel.
- 3.1.6 Remove device and measure the depth to which sludge absorbed into the towel. Record this value in number 4 of the Septic Tank/Drainfield Evaluation Form.

3.1.7 If the value for number 3 on the Septic Tank/Drainfield Evaluation Form is 3 in. or less or the value for number 4 is 8 in. or more then pump septic tank.

3.1.8 Restore site.

### **3.2 DRAINFIELD INSPECTION**

3.2.1 Conduct walkdown to visually inspect field to ensure no saturated areas and locate monitor tubes (see drawing H-6-1676, sh 1 of 3).

3.2.2 Remove cap and using a strong light source (sun directed via a mirror works best) observe the presence or absence of moisture at the bottom of the monitor tube. Through the monitor tubes, visually inspect liquid levels in the bed and record condition on the Septic Tank/Drainfield Evaluation Form.

3.2.3 If standing liquid exists, remedial action may be required. Notify Maintenance Engineering for further evaluation and an action plan.

### **3.3 DISPOSITION**

3.3.1 Return Septic Tank/Drainfield Evaluation Form to the Maintenance Manager.

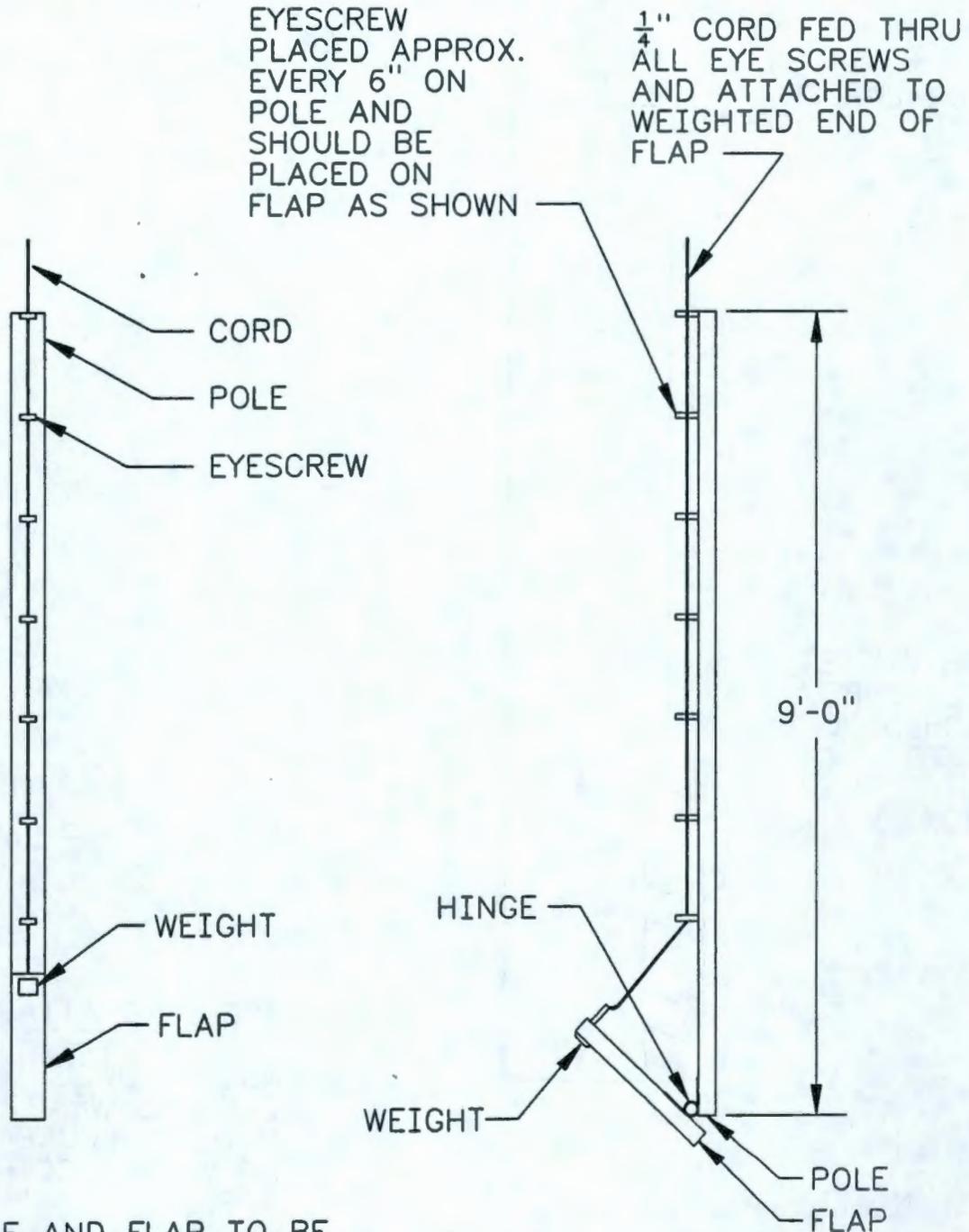
3.3.2 If septic tank pumping is required, maintenance must ensure that backflushing of the septic tank also occurs to remove all sludge and scum.

## 4.0 RECORDS

Document	QAR/ NOAR	Record Submittal Responsibility	Record Retention Responsibility
Septic Tank/Drainfield Evaluation Form	NOAR	Performing Organization	Environmental Engineering

## 5.0 ATTACHMENTS

- Scum Measurement Device
- Sludge Measurement Device
- Septic Tank Profile
- Septic Tank/Drainfield Evaluation Form



NOTES:

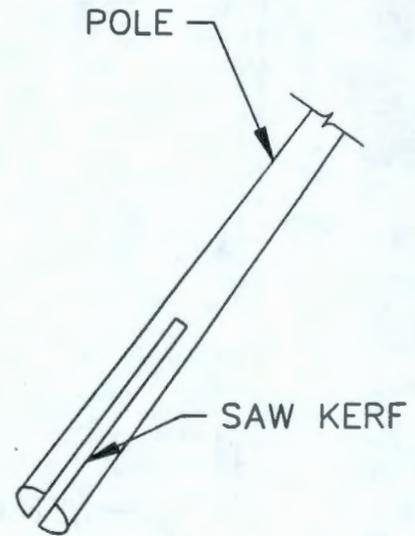
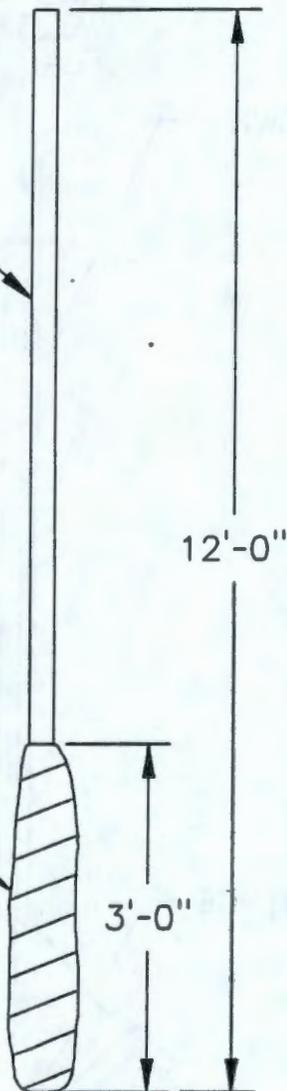
1. POLE AND FLAP TO BE 1" x 2" WOOD CONSTRUCTION.
2. MEASURING TAPE SHALL BE ATTACHED TO POLE WITH THE ORIGIN AT THE HINGED END.

SCUM MEASUREMENT DEVICE  
NTS

Attachment 1

1"Ø OR LARGER  
POLE (I.E. CLOSET  
ROD)

ROUGH WHITE  
TOWEL TO BE  
ATTACHED TO  
POLE TO A  
HEIGHT OF  
APPROX. 3'



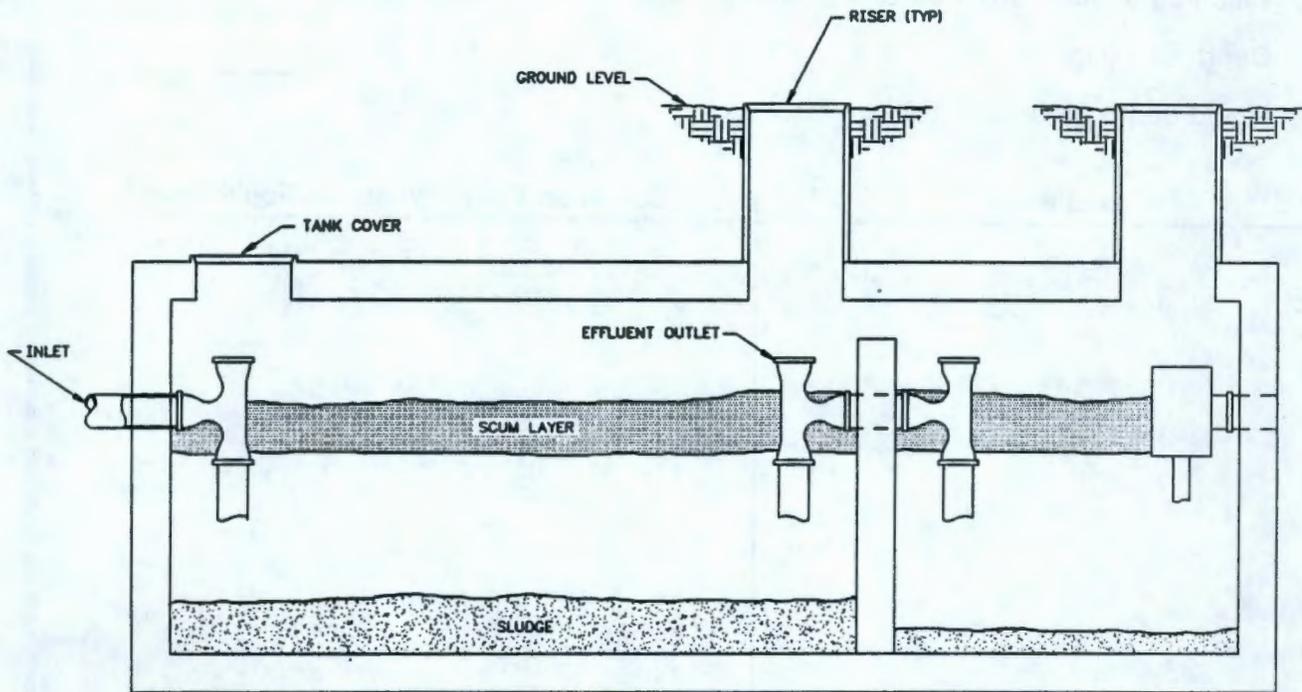
SUGGESTED ATTACHMENT

INSERT TOWEL THROUGH  
KERF AND WRAP TIGHTLY  
AROUND. SECURE LOOSE  
END WITH ELECTRICAL  
TAPE.

NOTES:

1. TOWEL TO BE REPLACED  
AFTER EACH USE.

SLUDGE MEASUREMENT DEVICE  
NTS



SEPTIC TANK PROFILE  
NTS

Attachment 3

**SEPTIC TANK/DRAINFIELD EVALUATION FORM**

**Date**

**Location**

**Personnel Performing Inspection**

- 1. Depth to bottom of effluent \_\_\_\_\_
- 2. Depth to bottom of scum \_\_\_\_\_
- 3. Distance of scum from bottom of baffle (subtract No. 2 from No. 1) \_\_\_\_\_
- 4. Depth of sludge \_\_\_\_\_
- 5. Liquid depth in monitor tubes \_\_\_\_\_

**Location**

**Condition (i.e., dry, moist, liquid depth)**

**Appendix C**  
**Septic Tank Effluent Filters**

© OSI, December 1988

ORENCO SYSTEMS™

# Effluent Filter

## the Concept & the Application

*The OSI Effluent Filter is a device for improving the quality of the effluent produced by a septic tank by (a) modulating the flow and (b) preventing gross solids from leaving the tank.* Constructed entirely of corrosion-proof components, the OSI Effluent Filter is simple to install and is easily removable for seldom-required maintenance. It consists of an intake pipe within a screened vault, connected to the tank's discharge by a flexible hose.

**The concept is simple.** Effluent from the relatively clear zone of the septic tank, between the sludge and scum layers, enters the Effluent Filter through its influent holes. As effluent surrounds the 1/8-inch mesh screen, particles larger than 1/8 of an inch are trapped in the annular space between the vault and screen. Once it has been filtered through the screen, effluent passes through the flow-modulating orifice at the base of the intake pipe and exits the tank through the discharge hose.

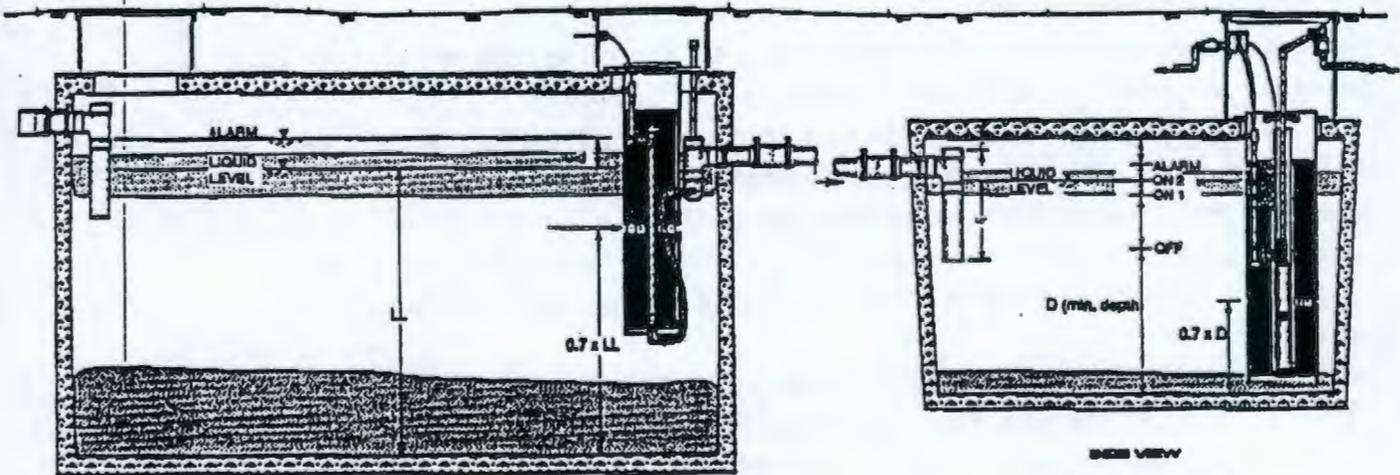
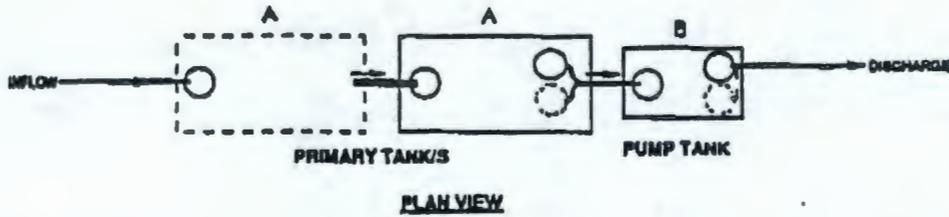
If inflow should become temporarily excessive (e.g. from a broken flush valve in the home or as a result of leaks), the fluid level in the tank and Effluent Filter will rise and effluent may enter the screened top of the intake pipe then flow out the discharge hose. The Effluent Filter continues to operate, maintaining filtration, as the problem is being corrected. An alarm with a sensor float to attach at the top of the intake pipe is available from OSI to serve as a warning that either the inflow is excessive or the screen is plugged.

While an OSI Effluent Filter seldom needs cleaning any more frequently than a septic tank requires pumping (usually at ten-year intervals in properly designed and operated systems), accidental overloading may occasionally cause premature plugging of the screen. But that should be considered a success, not a failure, since the screen serves to protect the integrity of the collection and treatment facilities. Cleaning a screen is quick and easy and infinitely preferable to dealing with the damage that solids carryover can cause downstream in a system. Furthermore, the screen permits identification of a problem at its source where abuse can be nipped in the bud.

To clean the screen, lift the entire Effluent Filter from the tank. A flap check valve in the bottom of the Filter allows it to drain. Remove the support pipes and slide the screen out of the vault by pulling on the two plastic straps attached to the top of the screen. Hose down the screen and vault so that the debris falls back into the septic tank and does not wash into the unscreened vault. Replace the screen in the Effluent Filter vault, insert the support pipes and slip it back in the tank. That's all there is to it!

\*OSI Effluent Filter is covered by U.S. Method of Use Patent No. 4,439,323.

**ORENCO SYSTEMS, INC.**  
 2826 Colonial Road Roseburg, OR 97470  
 503 673-0165



**PRIMARY TANK "A"**  
 with Effluent Filter  
 (See Detail: Drawing 10)

**PUMP TANK "B"**  
 with High-Head Pumping Assembly  
 (See Detail: Drawing 11)

**SIZING CHART**

FLOW GPD	EDU'S	TANK SIZE in gallons		EFFLUENT FILTERS	DISCHARGE SIZE	d'	MODULATION ORIFICE	PUMPING ASSEMBLY**
		A	B					
1000	3 - 6	1 1500	1000	1 F-1548	1.25"	2"	3/8"	8 OSI DUPLEX
2000	7 - 12	1 3000	1000	1 F-1560	1.25"	2"	5/8"	20 OSI DUPLEX
3500	13 - 18	1 3000	1000	2 F-1560	2"	4"	5/8"	20 OSI DUPLEX
5000	19 - 28	1 4000	1500	2 F-1560	2"	6"	5/8"	20 OSI TRIPLEX
10000	29 - 36	2 3000*	3000	2 F-1560	2"	6"	3/4"	20 OSI QUADRUPLEX

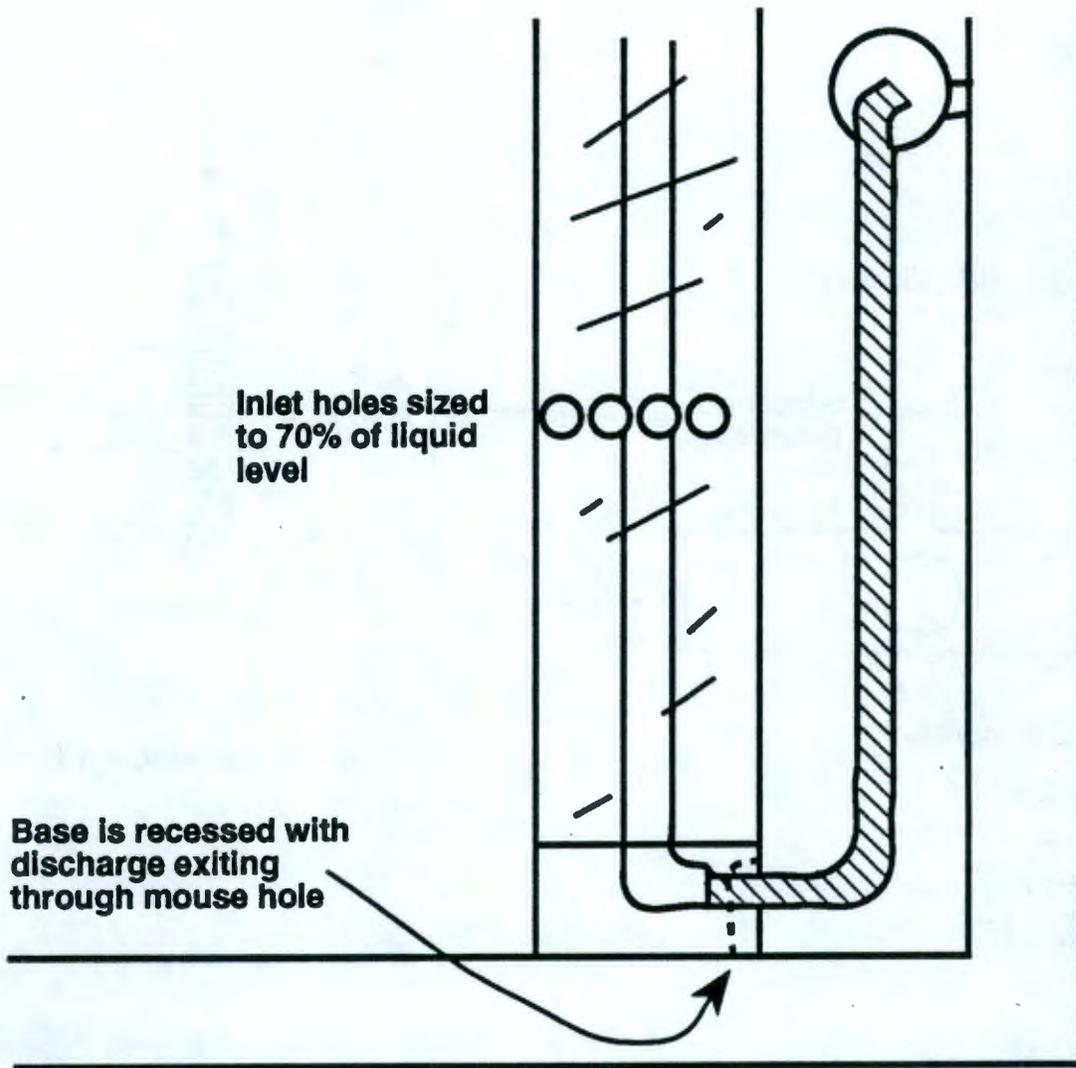
\* Or one 6000 gallon tank

\*\* Two (2) pumps will fit in one screened vault.

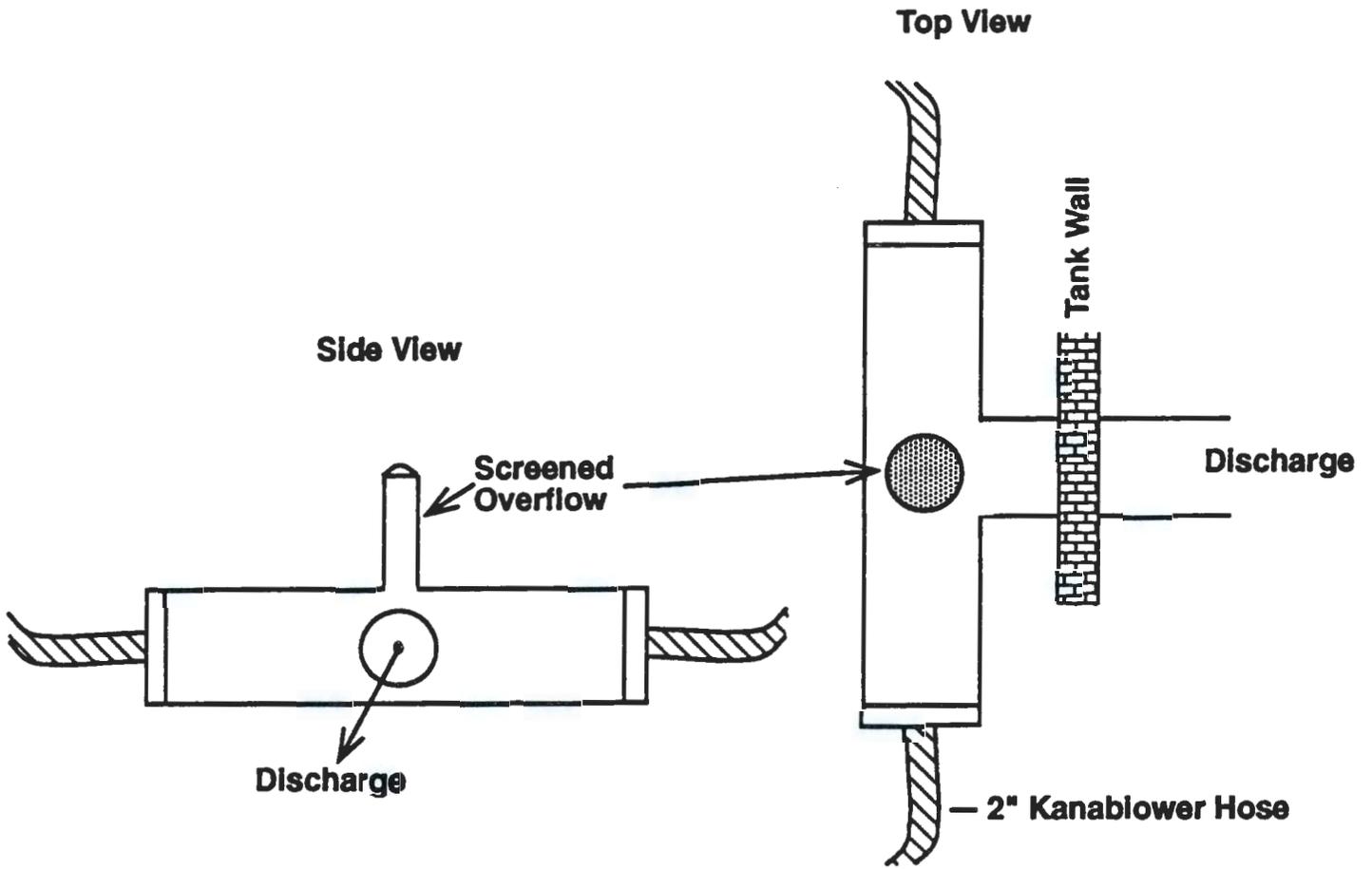
**COMMERCIAL AND MULTIPLE USER SYSTEMS**

drawing **9**

# Recessed base with mouse hole to allow the filter to set on the bottom of the tank.



MAC/FH/DM/059380



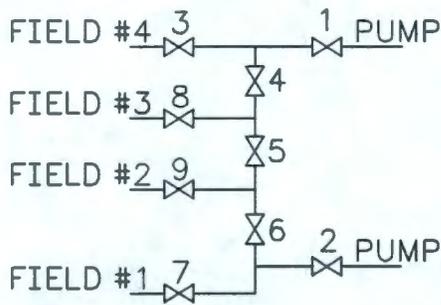
MAC/FH/DM/059381

## Appendix D

### Valve Vault

# OPERATIONS SCHEDULE

## VALVE DIAGRAM



## FIELD ROTATION SCHEDULE

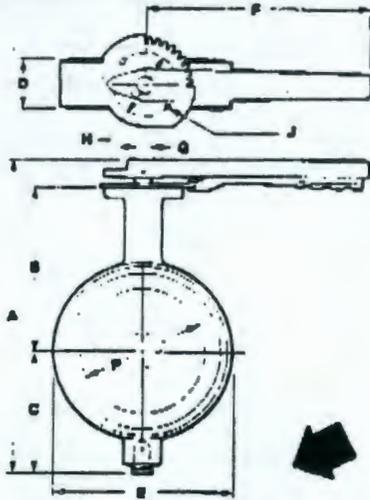
3 FIELD CYCLE	FIELDS IN SERVICE
1	1 & 2
2	1 & 3
3	2 & 3
REPEAT CYCLE	

4 FIELD CYCLE	FIELDS IN SERVICE
1	1 & 2
2	3 & 4
REPEAT CYCLE	

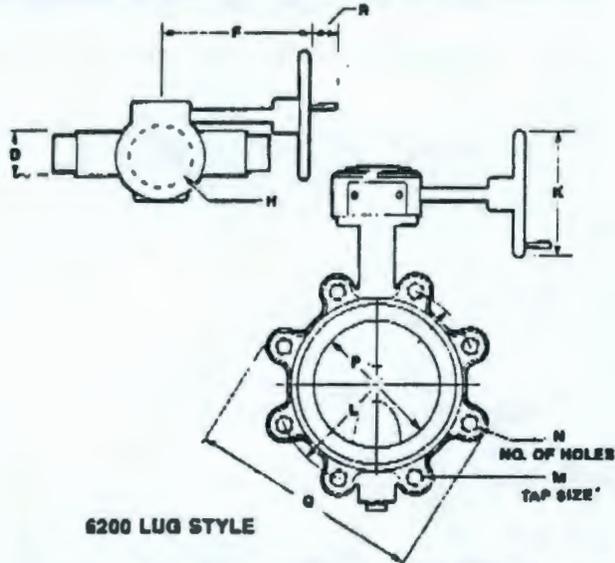
## VALVE SCHEDULE

VALVE NO	FIELDS IN SERVICE			
	1 & 2	1 & 3	2 & 3	3 & 4
1	OPEN	OPEN	OPEN	OPEN
2	OPEN	OPEN	OPEN	OPEN
3	CLOSED	CLOSED	CLOSED	OPEN
4	OPEN	OPEN	OPEN	CLOSED
5	OPEN	CLOSED	CLOSED	OPEN
6	CLOSED	CLOSED	OPEN	OPEN
7	OPEN	OPEN	CLOSED	CLOSED
8	CLOSED	OPEN	OPEN	OPEN
9	OPEN	CLOSED	OPEN	CLOSED

# 6000 SERIES BUTTERFLY 200 PSI



6100 WAFER STYLE



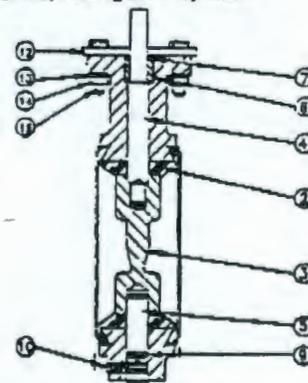
6200 LUG STYLE

2" - 12" DIMENSIONS		MEETS OR EXCEEDS API 609 / MSS-SP-67							
Size	2	2½	3	4	5	6	8	10	12
A	9¾	10¾	10⅞	13	14	15¾	17¾	20½	23½
B	5¾	5⅞	6	7	7⅞	7⅞	9⅞	10½	12⅞
C	3	3¼	3⅞	4⅞	5¼	5½	6⅞	8¾	9⅞
D	1¾	1¾	1¾	2¼	2¼	2¼	2½	2⅞	3¼
E	4	4¼	5¼	6¼	7½	8½	10¼	12½	14¼
F	8	8	8	11	11	11	16	16	16
G	.561	.561	.561	.688	.688	.811	.938	1.123	1.247
H	3¼	3¼	3¼	3¼	3¼	3¼	4¼	4¼	4¼
J	.268	.268	.268	.268	.268	.268	.563	.563	.563
K	6	6	6	6	6	6	10	10	12
L	4¼	5½	6	7½	8½	9½	11¼	14¼	17
M*	⅝-11 UNC	⅝-11 UNC	⅝-11 UNC	⅝-11 UNC	¾-10 UNC	¾-10 UNC	¾-10 UNC	⅞-9 UNC	⅞-9 UNC
N	4	4	4	8	8	8	8	12	12
P	2	2½	3	4	5	6	6	10	12
Q	6	7	7½	9	10	11	13½	16	19
R	3	3	3	3	3	3	3	3	3

\*For drilled lugs, add ¼".

All dimensions for reference only. For certified dimensions contact factory. For other valve materials, see figure # system.

NO.	ITEM DESCRIPTION	MATERIAL	QTY.
1	BODY	CAST IRON/ASTM A-126-B	1
2	LINER	EPDM	1
3	DISC	BRONZE ASTM-562	1
4	UPPER STEM	416 S.S.	1
5	LOWER STEM	416 S.S.	1
6	BEARING	OIL IMPREGNATED BRONZE	1
7	UPPER "O" RING	EPDM	1
8	LOWER "O" RING	EPDM	1
10	SET SCREW	CARBON STEEL	1
11	NAME TAG	ALUMINUM	1
12	POSITION PLATE	CARBON STEEL	1
13	LOCK WASHER	CARBON STEEL	2
14	HEX NUT	CARBON STEEL (CAD. PLTD.)	2
15	HEX HEAD BOLT	CARBON STEEL (CAD. PLTD.)	2



**175 WWP  
IRON BODY  
SWING  
CHECK  
VALVES**

**BRONZE MOUNTED  
COMPOSITION DISC**

# FIRE PROTECTION VALVES

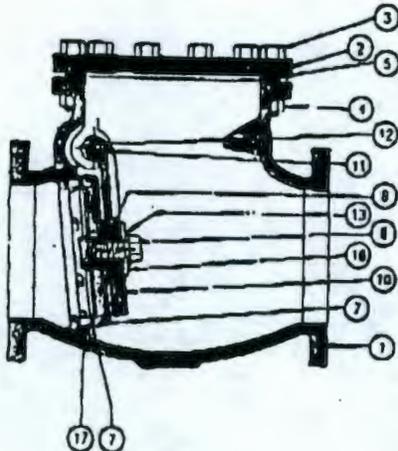
**175 PSI NONSHOCK WATER WORKING PRESSURE\***

**SERVICE FEATURES**

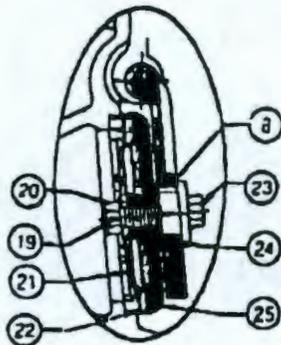
Check valves with synthetic rubber discs recommended for quiet nonreturn control with tight closure at low line pressures. \* Bodies and caps are coated with a durable black finish to resist corrosive underground elements.



Approved by the New York City Board of Standards and Appeals



**G-840**  
**2 1/2" - 10" SIZES**

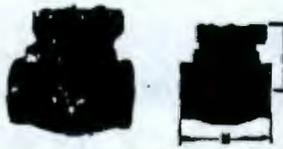


**12" SIZE**

NO.	DESCRIPTION	MATERIAL	ASTM SPEC.	UNS NO.
1	BODY	CAST IRON	A-126 Class B	F12102
2	CAP	CAST IRON	A-126 Class B	F12102
3	CAP BOLT, HEX. HD.	STEEL	A-307 Grade A	
4	CAP BOLT NUT, HEX. HD.	STEEL	A-563 Grade A	
5	CAP BASKET	COMPRESSED NONASBESTOS		
6	CAP SCREW	STAINLESS STEEL		
7	DISC	CAST IRON W/VULCANIZED IN PL. SYN. RUB. FACE	A-126 Class B	F12102
8	DISC BUSHING (4-10)	BRONZE	B-62	C83600
10	HINGE	BRONZE (2 1/2-3) MALL. IRON (4-6) DUCTILE IRON (8-12)	B-62 A-197 A-395	C83600 F22000 F32800
11	HINGE PIN	BRASS	B-16	C86000
12	HINGE PIN BUSHING (6-12)	BRASS	B-16	C86000
13	LOCKWASHER	STEEL E2P		
115	PIPE PLUG (2 1/2-8)	CAST IRON	A-126 Class B	F12102
16	PLAIN WASHER	STEEL E2P		
17	SEAT RING	BRONZE	B-584	C84400
118	SIDE PLUG	BRONZE	B-62	C83600
19	COTTER PIN (12)	BRASS		
20	DISC BOLT NUT (12)	BRASS	B-16	C86000
21	SPIDER (12)	BRONZE	B-584	C84400
22	DISC (12)	SYNTHETIC RUBBER		
23	DISC BOLT (12)	BRONZE	B-584	C87500
24	DISC BASKET (12)	COMPRESSED NONASBESTOS		
25	DISC HOLDER (12)	CAST IRON	A-126 Class B	F12102

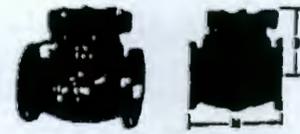
\* Not Shown—1/4" Standard Ball Drip Tap at Position C

\* Internal pressures great enough to burst castings can be developed during the formation of ice. Valves should be protected so that contained media does not freeze.



**G-836, THREADED ENDS**

SIZE	WGT.	D	H
2 1/2	40	7.00	9.30
3	51	7.25	10.25
4	60	8.75	12.50
5	120	9.80	14.30
6	156	10.50	15.30



**G-840, FLANGED ENDS**

SIZE	WGT.	D	H
2 1/2	51	7.00	10.00
3	63	7.25	11.00
4	105	8.75	13.12
5	151	9.80	15.00
6	193	10.50	16.00
8	330	12.50	20.00
10	482	14.50	24.00
12	730	17.25	27.50

IRON  
VALVES

# Stockham Iron Body Valves

Stockham iron body valves are proven performers in mechanical systems of commercial buildings throughout America. Chemical plants, steel mills, shipyards, refineries, pulp and paper mills, and utilities have also found that Stockham iron body valves do the job better and longer for their many general services.

## MATERIALS

The cast iron used as the basic valve material conforms to the chemical and physical requirements of the American Society for Testing and Materials Specification A-126, Class B.

All valve materials are listed and described in the "Materials Specifications" section.

## RATED WORKING PRESSURES

The pressure-temperature ratings of Stockham iron body valves\* in this catalog section are as follows:

### PRESSURE-TEMPERATURE RATINGS NONSHOCK

TEMPERATURE (°F)	PRESSURE (PSIG)				
	CLASS 125			CLASS 250	
	200 PSI			500 PSI	
	SIZES 2-12	SIZES 14-24	SIZES 30-36	SIZES 2-12	SIZES 14-24
-20 to 150	200	150	150	500	300
200	190	135	115	460	280
225	180	130	100	440	270
250	175	125	85	415	260
275	170	120	65	395	250
300	165	110	50	375	240
325	155	105		355	230
350	150	100		335	220
375	145			315	210
400	140			290	200
425	130			270	
450	125			250	

\*U-Bolt gate valves, hub end valves, and quick-opening valves are excluded from these ratings.

## DESIGN

### GATE VALVES—SOLID WEDGE DISC

Nonrising Stem—125 and 250 Pound

Outside Screw and Yoke—125 and 250 Pound

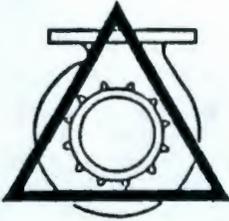
Quick-Opening—125 Pound

**Stem**—All stems are designed for ample strength and are machined to function easily. Repacking seats are provided on all stems.

**Packing Gland Assembly**—Glands and gland flanges have a ball and socket joint which assures alignment. It provides for proper packing compression without binding against the stem.

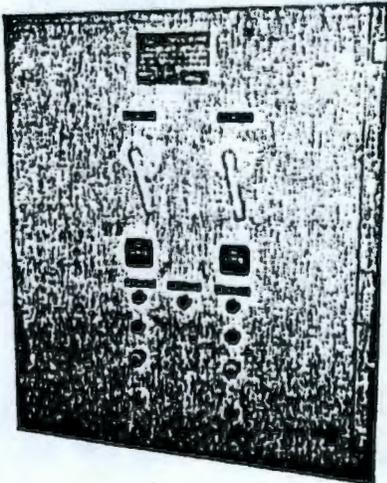
**Packing**—Teflon® Impregnated asbestos packing provides superior sealing and durability.

**Appendix E**  
**Pump Controls**



TRIANGLE PUMP  
AND EQUIPMENT, INC.

# CUSTOM BUILT MOTOR CONTROLS



Triangle Pump offers custom control panels for ~~simplex, duplex and multiple unit operation.~~ Standard panels are available in ~~NEMA 1, 3R, 4 & 12~~ enclosures. Control provides short circuit, overload and undervoltage protection. Each control normally includes circuit breaker with door mounted operating handle, ~~magnetic contactor for single phase~~ and magnetic motor starter with ambient compensated overloads for 3 phase, H-O-A selector switches, reset buttons, electric cycle alternator where applicable, 120 VAC control circuit transformer and terminal strips. **INNER DOOR**

A variety of accessories are available; some of which are run indicating lights, elapsed time meters, probe relays, ~~cycle counters, strip heater and thermostat,~~ intrinsically safe control circuits, ~~special control voltages and a variety of~~ both audible and visual alarms.

File No. E70758

Bulletin C1-979

(503) 656-1473

This Product is Listed by  
UNDERWRITERS LABORATORIES INC.  
and Bears the Mark:





## TRIANGLE PUMP AND EQUIPMENT INC.

### Operation & Maintenance Instructions

**System Operation:** The Acutec model 3001 accunator provides an intrinsically safe input barrier for the wetwell mounted float switches.

**Automatic Mode:** With both selector switches in the Auto position, the pumps start and stop in conjunction with the sequencing of the float switches.

The Acutec model 3001 provides the start, stop and alternation of the pumps, as well as the 'high level alarm' output.

As the liquid level rises, the 'off' float switch closes, providing a hold circuit for pump stop. When the level reaches the 'lead' float level, the accunator outputs whichever pump has been selected by the alternator, starting the chosen pump.

As the liquid level falls, the pump remains operated until the level reaches the 'off' float.

Should the liquid level rise to the 'lag' float position, both pumps will operate.

If the liquid level reaches the 'high' float level, an audible/visual alarm is activated. To silence the alarm, push the silence pushbutton.

**Manual Mode:** With each respective selector switch in the Hand position, the chosen pump will run regardless of the level in the wetwell.

**Motor Overload:** Ambient compensated thermal overloads are provided on each pump start. Should there be an overload trip, push the 'OL reset' button associated with the failed pump.

**Pump Seal Leak:** Each pump seal chamber is equipped with a moisture sensor (probe). Should moisture enter the seal chamber, a panel mounted 'seal leak' light will illuminate. No audio/visual alarm will be annunciated. See Pump O & M for repair procedures.

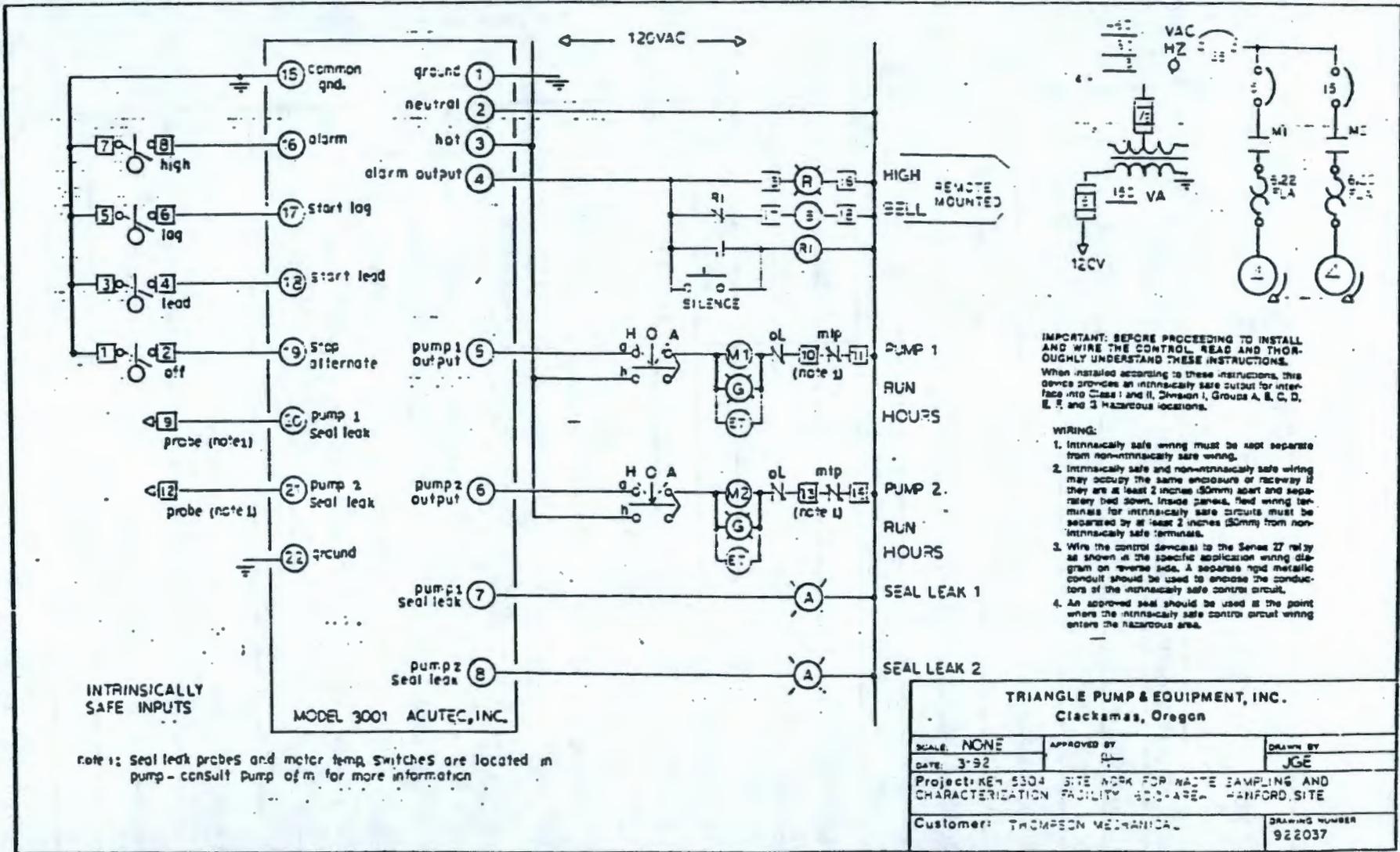
**System Maintenance:** The control panel requires only periodic inspection to observe that the system is functioning properly.

See Pump O & M for additional requirements.

**Spares:** No spare control panel parts are required.

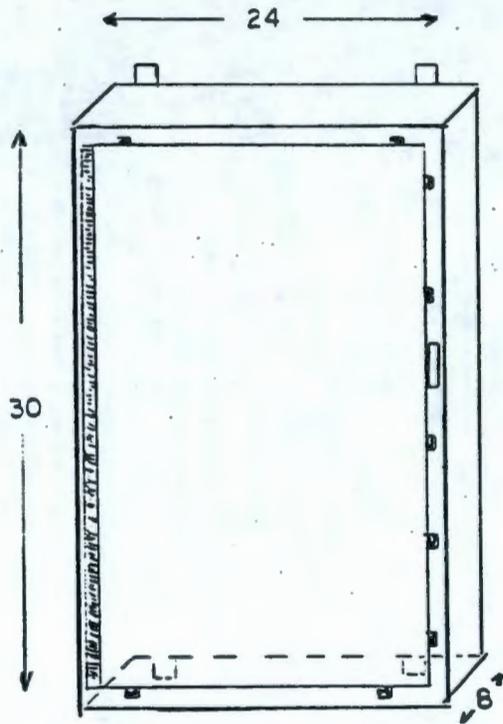
□ 18189 S.E. 108th St./PO Box 950  
Clackamas, Oregon 97015  
(503) 658-1473  
FAX (503) 658-2037

□ 225 S.W. 41st St.  
Renton, Washington 98058  
(206) 251-9888  
FAX (206) 251-9887





E-6



DIMENSIONAL DRAWING

112 LBS.

**TRIANGLE PUMP & EQUIPMENT, INC.**  
 Clackamas, Oregon

SCALE: NONE

APPROVED BY

DRAWN BY

DATE: 3-92

*AC*

JGE

Project: KEH 5304 SITE WORK FOR WASTE SAMPLING AND CHARACTERIZATION FACILITY 600-AREA HANFORD SITE

Customer: THOMPSON MECHANICAL

DRAWING NUMBER

922037

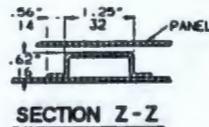
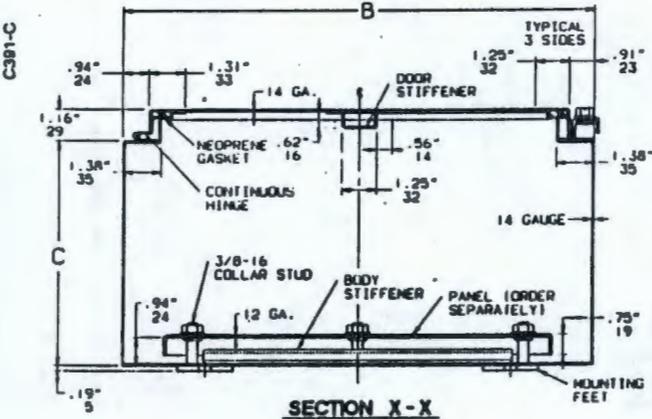
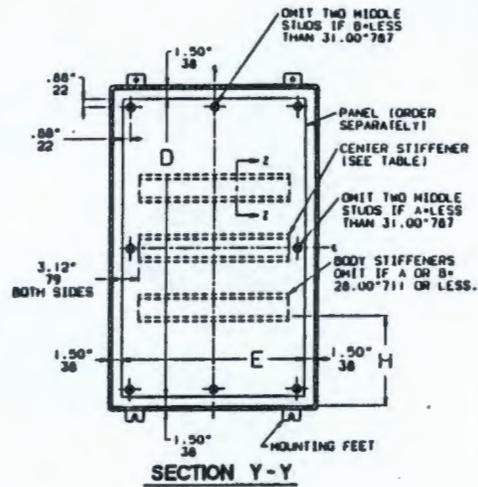
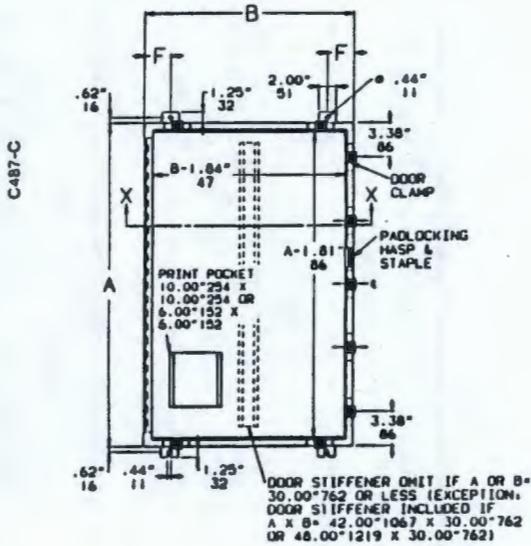
E+

WHC-SD-W011H-OMM-001, Rev. 0

# Single Door NEMA 4 Enclosures

Bulletin A-4

**B**



- NOTE:
1.  $F=3.00$  (76) when  $B$  is 16.00 (406) or more.  $F=1.25$  (32) when  $B$  is less than 16.00 (406).
  2. Large print pocket furnished if  $A=30.00$  (762) or more and  $B=20.00$  (508) or more.
  3. The number of door clamps is dependent on size of enclosure. Clamps are furnished along three sides of the door. Maximum spacing between door clamps is 15.00 inches (382 millimeters).
  4. Panels have flanges along sides which are more than 21.00 inches (533 millimeters) long, except A-24P20 has flanges on two sides.



Inch  
Millimeter

**CUTLER-HAMMER MOLDED CASE CIRCUIT BREAKERS**

47

4/15/88

**Separate Circuit Breakers and Enclosures**

**WHEN ORDERING SPECIFY**

- Circuit breaker and enclosure catalog numbers

**TYPE FS — Thermal Magnetic — Fixed Trip**

System	Ampere Rating	Circuit Breaker Only						Enclosure Only With Groundable Neutral									
		FS (EC) 240V Ac		FS (EHC) ● 480V Ac		FS (FC) 600V Ac		General Purpose NEMA 1			Rainproof NEMA 3R Use C-H Hub ●						
		Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	Surface M't'd.	Flush M't'd.	Price	Cat. No.	Price					
1-POLE 	15	---	---	●●● FS130015A	---	---	---	● SFH	● FFH	\$85.	RFH	\$180.					
	20	---	---	130020A	\$59.	---	---										
	30	---	---	130030A													
2-POLE 	15	FS220015A		FS240015A				SFH	FFH	85.	RFH	180.					
	20	220020A		240020A													
	30	220030A	\$117.	240030A	212.	---	---										
	40	220040A		240040A													
	50	220050A		240050A													
	60	220060A		240060A													
3-POLE 	70	FS220070A	191.	FS240070A				SFH	FFH	85.	RFH	180.					
	90	220090A		240090A													
	100	220100A		240100A													
	15	FS320015A		FS340015A		FS360015A							\$318.				
	20	320020A		340020A		360020A											
	30	320030A		340030A		360030A											
	40	320040A	173.	340040A	271.	360040A											
	50	320050A	187.	340050A	296.	360050A											
	60	320060A		340060A		360060A											
	3-POLE	70	FS320070A		FS340070A		FS360070A										
80		320080A	246.	340080A	224.	360080A	391.										
90		320090A		340090A		360090A											
100		320100A	266.	340100A	350.	360100A											
3-POLE	125	---	---	FS340125A		---		Not Available									
	150	---	---	340150A		---											

- Single pole breaker rated 65,000 AIC at 120V and 22,000 AIC at 277V.
- Single pole breakers are supplied without line lugs for panelboard mounting. If line lugs are required, order part number 99-2008 at no extra charge. Base mounting hardware is also required for mounting in these enclosures, or any other individual breaker mounting. Order parts kit FS6MH1 with the breaker, no extra charge.
- For group mounting of single pole breakers, order parts kit FS6MH2, no extra charge.
- Padlocking device will not lock single pole breaker in the OFF position.
- Single pole 15A and 20 Amp breakers are suitable for switching duty.
- Enclosure provided with blank plate. See page 40 for Hub selection.

DISCOUNT SCHEDULE 22CD-3

4/15/88

**CUTLER-HAMMER MOLDED CASE CIRCUIT BREAKERS**

53

**Thru-The-Door Operating Mechanisms**

CB

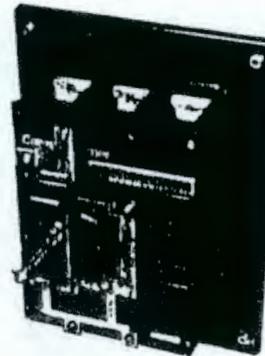
**WHEN ORDERING SPECIFY**

- Catalog Number of Kit.
- Catalog Number of Long Shaft if required.

**DESCRIPTION**

The rotary, door mounted handle is gasketed to be suitable for NEMA 1, 3R & 12 fabricated enclosures. Standard Kit consists of a door mounted handle, a short threaded shaft for cutting to proper panel depth, and a breaker mounted operating mechanism. The optional long shaft is ordered separately to provide for greater panel depths. Panel depth is the distance from the inside of the enclosure door to the mounting surface of the circuit breaker.

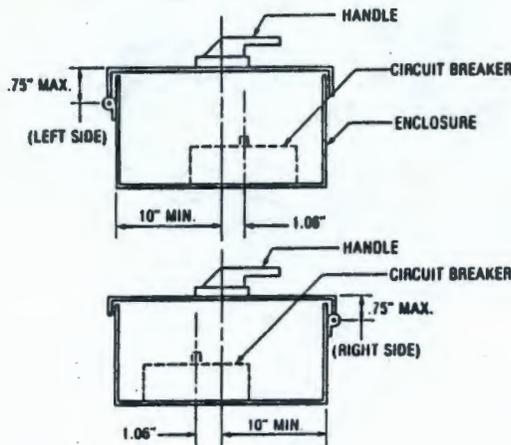
The handle may be padlocked in the OFF position. It is interlocked to the operating mechanism so that the door cannot be opened in the ON position without using a hidden defeator. The handle, when locked in the OFF position, also locks the enclosure door closed so that the defeator cannot be utilized.



CBL06 Mechanism

**ROTARY OPERATOR — NEMA 1, 3R, 12**

Circuit Breaker		Standard Shaft Kit			Separate Long Shaft		
Type	Maximum Amperes	Panel Depth in Inches	Catalog Number	Price	Panel Depth in Inches	Catalog Number	Price
3 Pole FS, FH	150A	5.00 — 10.25	CBF01	270.76	10.25 — 14.00	CBSL1	\$13.10
JS, JH, JL	250A	5.88 — 11.12	CBJ02	87.	11.12 — 14.88		
KS, KH	400A	5.88 — 11.12	CBK04B	87.	11.12 — 14.88		
LS, LH	600A	6.12 — 11.25	CBL06	118.	11.25 — 15.00		
MS, MH	800A	6.68 — 11.81	CBM08	118.	11.81 — 15.56		
NS, NH	1200A	7.94 — 13.25	CBN12	118.	12.94 — 16.94		



Typical Hinge Position Constraints  
CBF01 Operator, Bottom Views

DISCOUNT SCHEDULE 22CD-3

Printed in U.S.A.  
GG

E-9

**EATON**

53

7/1/90

**CUTLER-HAMMER FREEDOM SERIES**

45

**I.E.C. Style 3 Phase Starters — Magnetic Full Voltage Non-Reversing — 600 Volt Max.**

**AE16**

— TYPE AE16 I.E.C. STARTERS — MANUAL OR AUTOMATIC RESET OVERLOAD RELAY **PG 63**

SIZE	Motor Voltage	MAXIMUM HORSEPOWER ①			Magnet Coil Voltage (60 Hz)	OPEN TYPE — 3 POLE			
		1 Phase	3 Phase	With Side Mounted Holding Circuit Contact ②		Without Holding Circuit Contact			
				Cat. No.		Price	Cat. No.	Price	
 <p>45 mm Frame Width 3 Power Poles</p>	115 200 230 460 575	1/4	---	120 ②	AE16ANSOA	\$ 142.	AE16ANOA	\$129.	
		1/2	1-1/2	208	ANSOE		ANOE		
		---	1-1/2	240	ANSOB		ANOB		
	10 18	115 200 230 460 575	---	---	120 ②	AE16BNSOA	156.	AE16BNOA	138.
			1/2	2	208	BNSOE		BNOE	
			---	2	240	BNSOB		BNOB	
	12	115 200 230 460 575	---	---	120 ②	AE16CNSOA	186.	AE16CNOA	168.
			1/2	3	208	CNSOE		CNOE	
			---	3	240	CNSOB		CNOB	
	 <p>45 mm Frame Width</p>	115 200 230 460 575	1	---	120 ②	AE16DNSOA	207.	AE16DNOA	189.
			---	5	208	DNSOE		DNOE	
			---	5	240	DNSOB		DNOB	
25		115 200 230 460 575	2	---	120 ②	AE16ENSOA	219.	AE16ENOA	201.
			---	5	208	ENSOE		ENOE	
			---	7-1/2	240	ENSOB		ENOB	
32		115 200 230 460 575	2	---	120 ②	AE16FNSOA	270.	AE16FNOA	252.
			---	5	208	FNSOE		FNOE	
			---	10	240	FNSOB		FNOB	
 <p>65 mm Frame Width</p>		115 200 230 460 575	3	---	120 ②	AE16GNSOA	348.	AE16GNOA	330.
			---	7-1/2	208	GNSOE		GNOE	
			---	10	240	GNSOB		GNOB	
	44	115 200 230 460 575	3	---	120 ②	AE16HNSOA	366.	AE16HNOA	348.
			---	10	208	HNSOE		HNOE	
			---	15	240	HNSOB		HNOB	
	60	115 200 230 460 575	5	---	120 ②	AE16JNSOA	420.	AE16JNOA	402.
			---	15	208	JNSOE		JNOE	
			---	20	240	JNSOB		JNOB	
	69 90	115 200 230 460 575	5	---	120 ②	AE16KNSOA	453.	AE16KNOA	435.
			---	20	208	KNSOE		KNOE	
			---	25	240	KNSOB		KNOB	
 <p>90 mm Frame Width</p>	115 200 230 460 575	7-1/2	---	120 ②	AE16LNOA	585.	---	---	
		---	25	208	LNOE		---		
		---	30	240	LNOB		---		
	105	115 200 230 460 575	10	---	120 ②	AE16MNOA	753.	---	---
			---	30	208	MNOE		---	
			---	40	240	MNOB		---	
	140 135	115 200 230 460 575	10	---	120 ②	AE16NNOA	1110.	---	---
			---	40	208	NNOE		---	
			---	50	240	NNOB		---	

Prices of starters do not include heater packs. Select 1 carton of 3 heater packs at \$27. total. Heater pack selection, Page 63.

① On I.E.C. Sizes A through C, the 4th power pole position is used as the side mounted auxiliary contact and adds no additional width to the standard device. Size A-K starters may be supplied with a top mounted holding circuit contact instead of a side mounted contact. To order, change the 7th digit of the listed catalog number from "S" to "T". Example: AE16ANTOA.

② For separate 120 V control circuit. For maximum hp at listed motor voltages, use the rating of other starters of same size.

③ Maximum horsepower rating of starters for 380 V 50 Hz applications:

I.E.C. Size	A	B	C	D	E	F	G	H	J	K	L	M	N
Horsepower	3	5	7½	10	15	20	25	30	40	50	60	75	100

**CUTLER-HAMMER FREEDOM SERIES**

63

7/1/90

**Thermal Overload Relays  
Manual or Automatic Reset**

**C306**

**DESCRIPTION**

Type C306 Manual or Automatic Reset overload relays are designed for use with Type CE or CN non-reversing and reversing contactors. Four sizes are available for overload protection up to 144 amperes. The 32 and 75 A overload relays can be directly attached to contactors. Alternately, these relays can be DIN rail mounted — see adapter listed below. The 100 and 144 A overload relays are panel mounted only. Features include:

- Selectable Manual or Automatic Reset operation.
- Interchangeable Heater Packs adjustable  $\pm 24\%$  to match motor FLA and calibrated for 1.0 and 1.15 service factor motors.  
Heater packs for 32 A overload relay will mount in 75 A overload relay — useful in derating applications such as jogging.
- Bimetallic, ambient compensated operation. Trip free mechanism.
- Electrically isolated NO — NC contacts (pull RESET button to test).
- Shrouded or "finger proof" terminals to reduce possibility of electrical shock.
- Single phase protection.

**TYPE C306 THERMAL OVERLOAD RELAYS**

MAXIMUM AMPERE RATING	Number of Poles	OPEN TYPE		NEMA 1 ENCLOSED	
		Catalog Number	Price	Catalog Number	Price
32	3	C306DN3	\$ 63.	C306D63	\$ 87.
75	3	GN3	100.	GG3	156.
105	3	KN3	156.	---	---
144	3	NN3	216.	---	---

**DIN RAIL AND PANEL MOUNTING ADAPTER**

These adapters are required when component overload relays are to be separately mounted. The terminal base adapter includes line terminals and connects with the overload relays listed above.



Cat. No. C306TB1

Description	Catalog Number	Price
For 32 Ampere Overload Relay	C306TB1	\$ 9.
For 75 Ampere Overload Relay	C306TB2	18.

**CONTACT RATINGS (Amperes)**

Current	Ac Volts			
	120 V	240 V	480 V	600 V
<b>NC CONTACT (B600)</b>				
Make & Interrupting	30	15	7.5	6
Break	3	1.5	0.75	0.6
Continuous	5	5	5	5
<b>NO CONTACT (C600)</b>				
Make & Interrupting	15	7.5	3.75	3
Break	1.5	0.75	0.375	0.3
Continuous	2.5	2.5	2.5	2.5

**DISCOUNT SCHEDULE ICD-1**

Printed in U.S.A.  
GG



32 Ampere Overload  
Cat. No. C306DN3



75 Ampere Overload Cat.  
No. C306GN3

**HEATER PACKS**

**MANUAL OR AUTOMATIC RESET**

NOTE: Heater packs are shipped 3 to a carton. Catalog Numbers and prices listed below are for 3 heater packs.

Motor Full Load Ampere Rating ①				Catalog Number (Includes 3 Heater Packs)		Price (Includes 3 Heater Packs)
Dial Position				Fast Trip Class 10	Sid. Trip Class 20	
A	B	C	D			
<b>FOR USE WITH NEMA SIZES 00-2, I.E.C. SIZES A-K ONLY</b>						
283	328	374	420	H2101-3	H2001-3	\$27.
421	488	556	623	H2102-3	H2002-3	
624	724	824	924	H2103-3	H2003-3	
925	1.07	1.22	1.37	H2104-3	H2004-3	
1.38	1.60	1.82	2.04	H2105-3	H2005-3	
2.05	2.38	2.71	3.03	H2106-3	H2006-3	
2.53	2.93	3.34	3.74	H2107-3	H2007-3	
3.70	4.29	4.88	5.48	H2108-3	H2008-3	
5.39	6.25	7.11	7.98	H2109-3	H2009-3	
7.83	9.08	10.3	11.6	H2110-3	H2010-3	
10.8	12.4	14.1	16.0	H2111-3	H2011-3	
16.1	18.7	21.3	23.8	H2112-3	H2012-3	
21.6	25.1	28.5	32.0	H2113-3	H2013-3	

<b>FOR USE WITH NEMA SIZE 2, I.E.C. SIZES G-K ONLY</b>						
27.0	31.3	35.6	40.0	---	H2014-3	27.
27.4	30.7	34.0	37.3	H2114-3	---	
32.5	37.7	42.9	48.2	---	H2015-3	
35.5	39.0	42.5	46.0	H2115-3	---	
42.1	48.8	55.6	62.3	---	H2016-3	
44.5	49.6	54.8	60.0	H2116-3	---	
50.6	58.7	66.8	74.9	---	H2017-3	
58.0	63.6	69.3	74.9	H2117-3	---	

<b>FOR USE WITH NEMA SIZES 3-4, I.E.C. SIZES L-N ONLY</b>						
18.0	20.2	22.3	24.5	---	H2018-3	27.
24.6	27.6	30.5	33.4	---	H2019-3	
33.5	37.5	41.5	45.6	---	H2020-3	
45.7	51.2	56.7	62.1	---	H2021-3	
62.2	69.7	77.1	84.6	---	H2022-3	
84.7	95.0	105.0	115.0	---	H2023-3	
106.0	118.0	131.0	144.0	---	H2024-3	

<b>FOR USE WITH SIZE 5 STARTERS ONLY</b>						
55.5	64.2	73.2	82.2	---	H2004-3	27.
82.8	96.0	109.	122.	---	H2005-3	
123.	143.	163.	182.	---	H2006-3	
152.	176.	200.	224.	---	H2007-3	
222.	257.	293.	---	---	H2008-3	

<b>FOR USE WITH SIZE 6 STARTERS ONLY</b>						
165.	192.	218.	245.	---	H2005-3	27.
246.	286.	325.	364.	---	H2006-3	
304.	352.	401.	449.	---	H2007-3	
444.	515.	585.	---	---	H2008-3	

① For motor full load amperes between listed values, adjust dial clockwise for higher or counterclockwise for lower motor currents. The currents listed are for 1.0 and 1.15 service factor motors. A position adjustment is provided for 1.0 service factor motors.

# Power and Performance

1. Constructed with high quality silicon steel lamination to minimize core losses and increase efficiency.
2. Designs incorporate precision wound coils for improved regulation.
3. Primary fuse blocks and secondary fuse kits available and easily adaptable.
4. Series-parallel connecting links save wiring and labor costs.
5. Sturdy glastic terminal panel protects the coil from foreign objects and mechanical damage.
6. Copper windings on all groups.
7. 130°C Insulation class.
8. Wire retention on both primary and secondary terminals.
9. Welded construction eliminates core bolt shorts and provides rugged one piece construction.
10. Mounting plate adapts to various mounting dimensions.
11. Voltage regulation exceeds NEMA requirements.
12. UL Listed CSA Certified.
13. Attractive finish, nameplate, and design features enhance the end product.



50 to 2000 VA  
(Jumper Link Connections Available on 50-150 VA Units)

# Specifications and Dimensions

All Transformers Listed are Carried in Stock

UL Listed and SF Certified

## GROUP A

Primary Volts — 120 x 240			Secondary Volts — 24							50/60 Hz	Primary Fuse Block	Secondary Fuse Kit	Secondary Fuse Size
Catalog No.	VA Rating	Output Amps	Dimensions (Inches)						Weight (Lbs.)	Part No.	Part No.	24 Volts	
			A	B	C	D	E	F					
TA-2-81141	50	2.08	4.35	3.00	2.59	2.50	2.13	.22 x .50	4	PL-112700	PL-112602	3 3/16 amps	
TA-2-81142	75	3.13	4.84	3.00	2.59	2.50	2.61	.22 x .50	4	PL-112700	PL-112602	5 amps	
TA-2-81143	100	4.17	5.00	3.00	2.59	2.50	2.81	.22 x .50	4	PL-112700	PL-112602	6 1/4 amps	
TA-2-81144	150	6.25	4.90	3.75	3.21	3.125	2.625	.22 x .50	6	PL-112701	PL-112602	10 amps	
TA-2-81146	250	10.42	5.08	4.50	3.84	3.75	3.05	.22 x .50	9	PL-112702	PL-112601	15 amps	
TA-2-81148	350	14.58	6.12	4.50	3.84	3.75	4.06	.22 x .50	13	PL-112702	PL-112601	20 amps	
TA-2-81149	500	20.83	5.90	5.25	4.47	4.38	4.19	.31 x .50	16	PL-112704	PL-112601	30 amps	
TA-2-81150	750	31.25	7.49	5.25	4.47	4.38	5.25	.31 x .50	24	PL-112704	—	—	
TA-2-81151	1000	41.67	6.66	6.75	5.72	5.75	3.81	.31 x .50	26	PL-112705	—	—	

## GROUP B

Primary Volts — 240 x 480, 230 x 460, 220 x 440			Secondary Volts — 120, 115, 110							50/60 Hz	Primary Fuse Block	Secondary Fuse Kit	Secondary Fuse Size
Catalog No.	VA Rating	Output Amps	Dimensions (Inches)						Weight (Lbs.)	Part No.	Part No.	120 Volts	
			A	B	C	D	E	F					
TA-2-81210	50	0.42	4.35	3.00	2.59	2.50	2.13	.22 x .50	4	PL-112700	PL-112602	9/16 amp	
TA-2-81201	75	0.63	4.84	3.00	2.59	2.50	2.61	.22 x .50	4	PL-112700	PL-112602	1 amp	
TA-2-81211	100	0.83	5.00	3.00	2.59	2.50	2.81	.22 x .50	4	PL-112700	PL-112602	1 1/4 amps	
TA-2-81212	150	1.25	5.09	3.75	3.21	3.125	2.810	.22 x .50	6	PL-112701	PL-112602	2 amps	
TA-2-81213	250	2.08	5.57	4.50	3.84	3.75	3.05	.22 x .50	9	PL-112702	PL-112601	3 3/16 amps	
TA-2-81200	300	2.50	5.57	4.50	3.84	3.75	3.13	.22 x .50	10	PL-112702	PL-112601	4 amps	
TA-2-81214	350	2.92	6.32	4.50	3.84	3.75	3.83	.22 x .50	12	PL-112702	PL-112601	4 1/2 amps	
TA-2-81215	500	4.17	6.30	4.88	4.15	4.06	3.81	.22 x .50	15	PL-112703	PL-112601	6 1/4 amps	
TA-2-81216	750	6.25	6.59	5.25	4.47	4.38	5.13	.31 x .50	23	PL-112704	PL-112601	10 amps	
TA-2-81217	1000	8.33	6.83	6.75	5.72	5.75	3.69	.31 x .50	25	PL-112705	PL-112601	12 amps	
TA-2-81218	1500	12.50	7.99	6.75	5.72	5.75	5.75	.31 x .50	43	PL-112705	PL-112601	15 amps	
TA-2-81219	2000	16.67	8.44	6.75	5.72	5.75	6.38	.31 x .50	49	PL-112705	PL-112601	20 amps	
TA-2-81220	3000	25.00	8.85	7.50	8.25	6.50	7.52	.406 x .813	70	PL-112706	—	—	
TA-2-81221	5000	41.67	9.24	11.92	9.34	6.75	6.25	.406 x .813	125	PL-112707	—	—	

22.5 mm INDUSTRIAL PUSHBUTTONS AND INDICATING LIGHTS

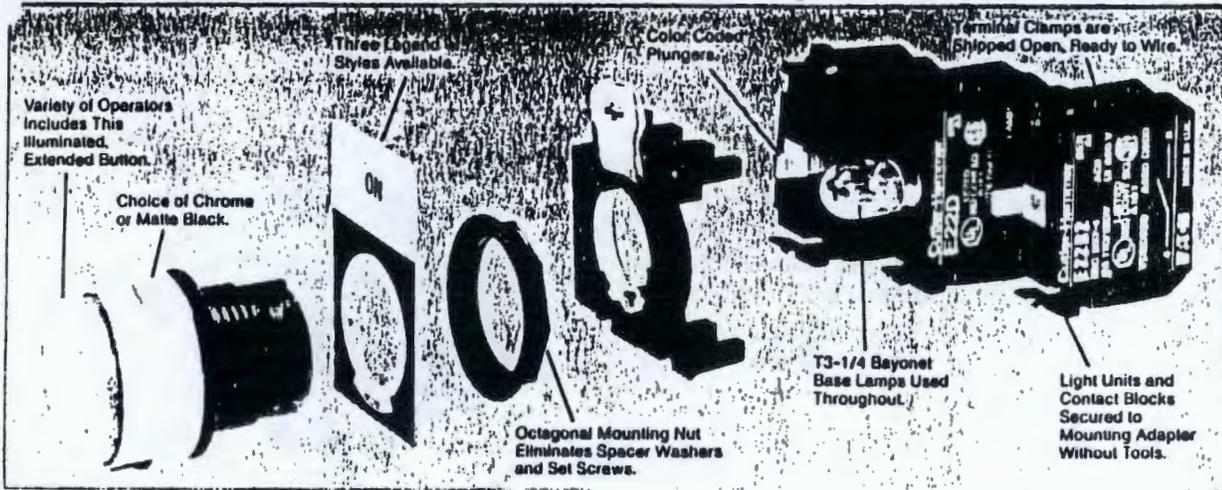
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7/1/90

FILE

E22

Part by part no other Industrial Pushbutton comes together with as much class!



SPECIFICATIONS

International Standards and Approval

- UL listed — File #E131568, Guide #NKCR.
- CSA Certified — Class #3211 03, 352C, 54094.
- UL508, I.E.C. 337 (BS4794), VDE0660, MTTA, NEMA.

Environmental and Operating Conditions

- UL listed (NEMA) Type 1, 2, 3, 3R, 4, 4X, 12, 13 when mounted in enclosure rated for those same applications.
- I.E.C. 529 — All operators IP65.
- Ambient Temperature Range:  
 Operating: -20°C to 60°C (-4°F to 140°F)  
 Storage: -40°C to 80°C (-40°F to 176°F)

Contact Block Specifications

- I.E.C. 337-1 — AC11/DC11.
- UL486E — Terminal secureness test.
- IP20 — Fingerproof protected (shrouded) terminals.
- Positive drive operation on NC contacts.
- 1 NO, 1 NC, 1 NO Early Make, 1 NC Late Break, 2 NO, 1 NO-1 NC
- Solid or stranded wires, single or in pairs, between AWG 12-22.



CONTACT BLOCK RATINGS

	Ac — UL Type A600				Dc — UL Type Q600			
	120	240	480	600	125	250	440	600
Make and emergency interrupting capacity	60	30	15	12	0.55	0.27	0.1	0.1
Normal Load Break	6	3	1.5	1.2	0.55	0.27	0.1	0.1
Continuous Current	10	10	10	10	2.5	2.5	2.5	2.5

GENERAL DESCRIPTION

Cutler-Hammer's 22.5 mm Industrial Heavy Duty Pushbutton line offers functional, smartly styled illuminated and non-illuminated pushbuttons, selector switches, indicating lights, mushrooms, twist-to-release operators, enclosures and wobble sticks. Complete line also includes transformer, full voltage and LED light units, a wide selection of contact blocks, aluminum and plastic legend plates and accessories. The operators are available with either a traditional chrome or new matte black front-of-panel appearance. The space saving design and modular construction of the E22 line makes on-the-job assembly fast, and simplifies the stocking of both components or complete devices.

These devices are 600 V heavy duty industrially rated — watertight, oiltight and corrosion resistant, and meet international standards and approvals for easy exporting.

The operators mount from the front-of-panel in an unnotched 22.5 mm (7/8") diameter hole, and are secured from the rear by an octagonal mounting nut.

PAGE GUIDE

Catalog Number	Page Number	Catalog Number	Page Number
E22A	244, 259-260	E22LL	243, 252
B	243, 245, 258-259	M	242, 252, 259
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HD	246	X	247, 253
J	242-243, 252	Y	250
K	248, 260		
L	242, 252, 258		

22.5 mm INDUSTRIAL PUSHBUTTONS AND INDICATING LIGHTS

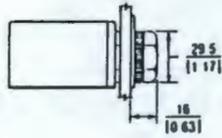
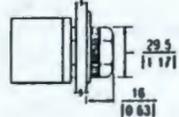
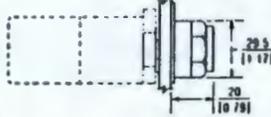
7/1/90

Indicating Lights and Selector Switches  
Complete Devices

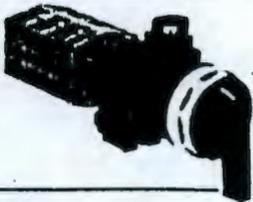
FILE



INDICATING LIGHT OPERATORS WITH STANDARD LENS — UL LISTED (NEMA) TYPE 4-4X-13  
Including Light Unit with Lamp. Components overpacked in a single carton.

	Supply Voltage	Lens Color	Catalog Number	Price	Approximate Dimensions mm (in) For Rear of Panel Extension, See Page 257	
WITH TRANSFORMER TYPE LIGHT UNIT						
	120 120 120	Red Green Amber	E22H2X11 H3X11 H9X11	\$52.10		
WITH FULL VOLTAGE LIGHT UNIT						
	24 24 24 120 120 120	Red Green Amber Red Green Amber	E22H2X4 H3X4 H9X4 H2X8 H3X8 H9X8	32.60		
WITH RESISTOR UNIT						
	120 120 120	Red Green Amber	E22H2X10 H3X10 H9X10	36.10		
PRES-TEST — EXTENDED ILLUMINATED PUSHBUTTON WITH 120 V TRANSFORMER LIGHT UNIT AND PREWIRED 1 NO — 1 NC CONTACT BLOCKS						
	120 120 120	Red Green Amber	Chrome Bezel E22T2X27 T3X27 T9X27	Black Bezel E22TB2X27 T83X27 T89X27	76.10	

SELECTOR SWITCHES — NON-ILLUMINATED — UL LISTED (NEMA) TYPE 4-4X-13  
Black Lever — Including Contact Blocks. Components overpacked in a single carton.

	Contact Sequence O = Circuit Open X = Circuit Closed			Contact Block(s)	Button Color	Operator Type	Catalog Number		Price		
	Left	Center	Right				Chrome Bezel	Black Bezel			
TWO POSITION MAINTAINED											
	---	O	X	1 NO	Black	Knob Lever	E22XF1A VE1A	E22XB1A VB1A	\$23.80 23.80		
	---	X O	O X	1 NO — 1 NC	Black	Knob Lever Knob Lever	E22XF1C VE1C X51C	E22XB1C VB1C X851C	34.30 34.30 34.30		
	X O	O O	O X	2 NO	Black	Knob Lever	E22XG1D VG1D	E22XBG1D VBG1D	34.30 20.00		
	X O O	O X O	O O X	2 NO — 2 NC Prewired	Black	Knob Lever	E22XG1R VG1R	E22XBG1R VBG1R	43.80 43.80		
THREE POSITION MAINTAINED											
FOUR POSITION MAINTAINED											
	Circuit					4 Pole Rotary Cam	Black	Knob Lever	E22LDN1 JDN1	E22LDN1 JDN1	55.00 55.00

DISCOUNT SCHEDULE IC0-1

DIMENSIONS, See Component Listings

LEGEND PLATES, Pages 254-256

Printed in U.S.A.  
GO



## AC VOLTAGE HOUR METERS

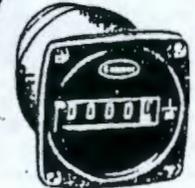
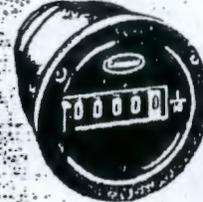
- Input voltage 115V, 60 Hz
- Permanent magnet motor for accuracy;  $\pm 50$ msec per start stop, 100% when running at normal frequency
- Large, easy-to-read numbers—whole numbers are white on black, decimal numbers black on white
- Housing material high impact black styrene
- Continuous duty cycle
- No. 6X144 3½" model has NEMA standard round and square detachable bezels
- Includes 22 gauge wire leads 6" long
- Mounts in 2¼" diameter hole; mounting hardware included

**R**  
E18084

**Cramer**

**SP**  
16385

635 and 636 Series—Flange Mount  
Hour and Minute Types  
Power Dissipation—3 Watts



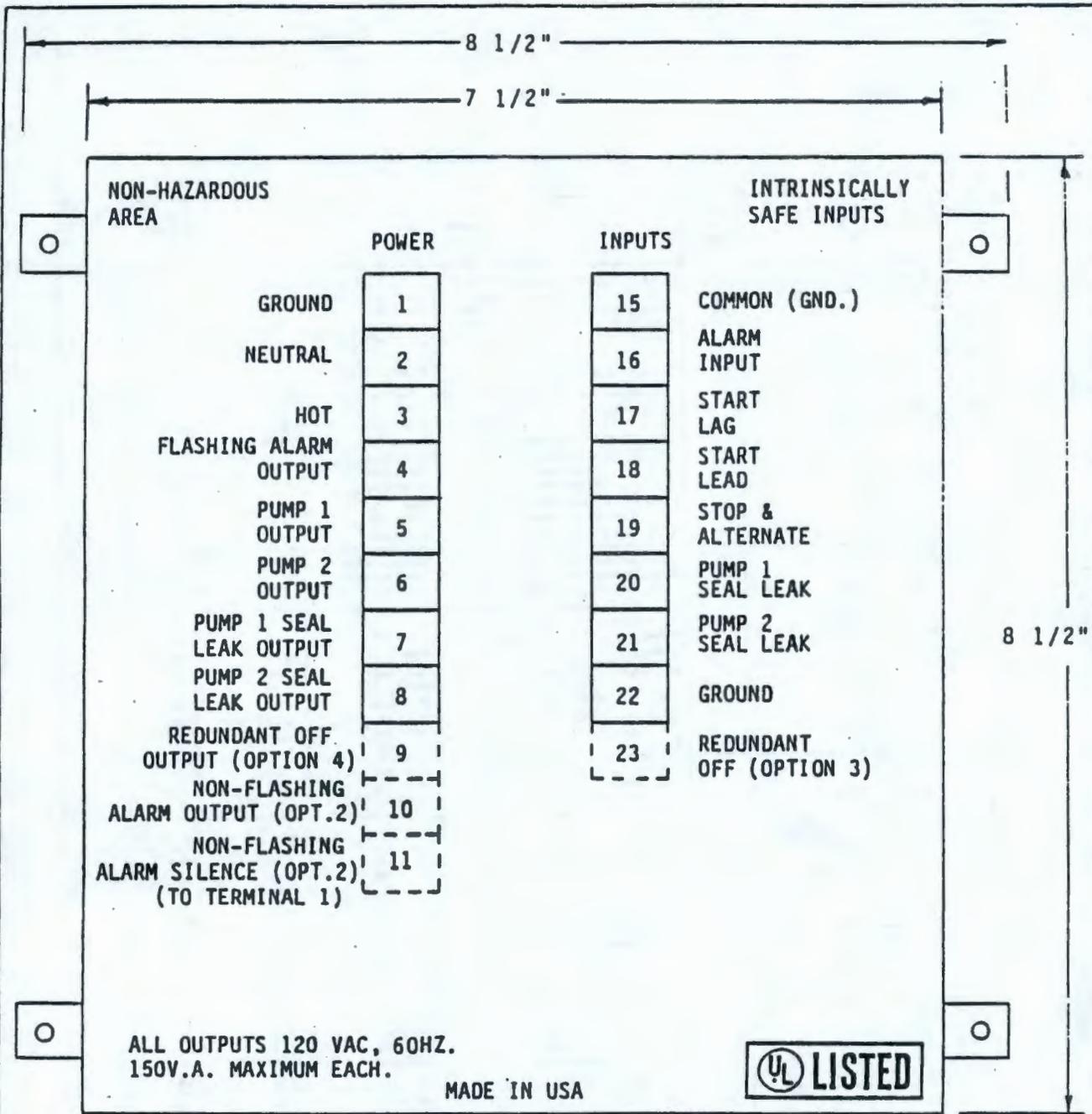
### HOUR METER SPECIFICATIONS AND ORDERING DATA

Registers Elapsed Time Up To:	Bezel (Face)	Length from Back of Bezel	Cramer Model	Stock No.	List	Each	Shpg. Wt.
<b>PUSHBUTTON RESETTABLE ELAPSED TIME INDICATORS</b>							
9999.9 Hrs	2½" Round	3¾"	636X	6X141	\$70.15	\$56.12	0.8
9999.9 Hrs	2½" Square	3¾"	636Y	6X143	70.15	56.12	0.8
<b>NONRESETTABLE ELAPSED TIME INDICATORS</b>							
99999.9 Min	2½" Round	2¾"	635G	6X136	30.25	29.00	0.7
99999.9 Hrs	2½" Round	2¾"	635G	6X137	30.25	29.00	0.5
99999.9 Min	2½" Square	2¾"	635K	6X138	30.25	29.00	0.7
99999.9 Hrs	2½" Square	2¾"	635K	6X139	30.25	29.00	0.7
99 1.9 Hrs	3½" Rd. & Sq.	2¾"	635E & S	6X144	43.22	34.58	0.9

# Through-Type Terminals

## Selection and ordering data

Dimensions (mm)	Terminal size Conductor size	Voltage rating	Contin- uous current A	As- sembly width mm	Catalog No.	List Price Each \$	Standard pack Qty
<b>Through-type terminals with insulating body of molded thermoplastic, narrow version, with screw terminals on both sides</b>							
	Terminal size 2.5 22-12 AWG 18-12 AWG solid 0.6 to 4 mm <sup>2</sup> Insly stranded 0.5 mm <sup>2</sup> to 2.5 mm <sup>2</sup>	600 V  AC 750 V, DC 900 V	26	Single terminal 5.5 Block of three 16.6 Block of ten 55.4 (marked 1... 10) Single terminal, blue 5.5	SWA1 201 0.78 SWA1 301 2.20 SWA1 401 7.10 SWA1 011-1BF11 0.95	100 50 25 100	
			26	Accessories: Barrier 1 Separator for single terminal Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow white, for inscription Test socket 2.3 dia	SWA1 820 0.40 SWA1 825 0.26 SWA1 840 0.85 SWA1 843 1.12 SWA1 800 2.45 SWA1 810 0.28 SWA1 880 0.32 SWA1 854 0.15	100 100 100 100 100 100 100	
			10	Single terminal 6.5 Single terminal, blue 6.5 Single terminal, green yellow 6.5	SWA1 011-1DG11 0.90 SWA1 011-1BQ11 1.10 SWA1 011-1PQ11 2.70	100 100 100	
			35	Accessories: Barrier 1 Separator Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow white, for inscription Test socket 2.3 dia	SWA1 820 0.40 SWA1 825 0.26 SWA1 850 1.00 SWA1 851 1.20 SWA1 853 3.05 SWA1 811 0.30 SWA1 882 0.35 SWA1 854 0.15	100 100 100 100 100 100 100	
	Terminal size 4 18-10 AWG 18-10 AWG solid 0.5 to 6 mm <sup>2</sup> Insly stranded 0.5 mm <sup>2</sup> to 4 mm <sup>2</sup>	600 V  AC 750 V, DC 900 V	35	Single terminal 6.5 Single terminal, blue 6.5 Single terminal, green yellow 6.5	SWA1 011-1DG11 0.90 SWA1 011-1BQ11 1.10 SWA1 011-1PQ11 2.70	100 100 100	
			35	Accessories: Barrier 1 Separator Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow white, for inscription Test socket 2.3 dia	SWA1 820 0.40 SWA1 825 0.26 SWA1 850 1.00 SWA1 851 1.20 SWA1 853 3.05 SWA1 811 0.30 SWA1 882 0.35 SWA1 854 0.15	100 100 100 100 100 100 100	
			10	Single terminal 7.2 Block of three 21.8 Single terminal, blue 7.2	SWA1 202 1.20 SWA1 302 3.30 SWA1 011-1BH11 1.46	100 50 100	
			44	Accessories: Barrier 1 Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow white, for inscription	SWA1 821 0.46 SWA1 841 1.07 SWA1 844 1.45 SWA1 801 3.36 SWA1 811 0.35 SWA1 882 0.30	100 100 100 50 100 100	
	Terminal size 6 14-8 AWG 14-8 AWG solid 0.75 mm <sup>2</sup> to 10 mm <sup>2</sup> Insly stranded 1.5 mm <sup>2</sup> to 6 mm <sup>2</sup>	600 V  AC 750 V, DC 900 V	47	Single terminal 7.2 Block of three 21.8 Single terminal, blue 7.2	SWA1 202 1.20 SWA1 302 3.30 SWA1 011-1BH11 1.46	100 50 100	
			44	Accessories: Barrier 1 Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow white, for inscription	SWA1 821 0.46 SWA1 841 1.07 SWA1 844 1.45 SWA1 801 3.36 SWA1 811 0.35 SWA1 882 0.30	100 100 100 50 100 100	
			79	Single terminal 10 Block of three 30 Single terminal, blue 10	SWA1 204 2.00 SWA1 304 5.70 SWA1 011-1BK11 2.37	50 50 50	
			82	Accessories: Barrier 1 Link rails for 2 terminals 3 terminals 10 terminals Cover with warning arrow	SWA1 821 0.46 SWA1 842 2.00 SWA1 845 2.70 SWA1 802 6.80 SWA1 812 0.48	100 50 50 50 100	
	Terminal size 16 12-4 AWG 14-6 AWG solid and stranded 1 mm <sup>2</sup> to 25 mm <sup>2</sup> Insly stranded 2.5 mm <sup>2</sup> to 16 mm <sup>2</sup>	600 V  AC 750 V, DC 900 V	120	Single terminal 16 Block of three 48 Single terminal, blue 16	SWA1 205 3.40 SWA1 305 9.65 SWA1 011-1BM11 3.68	50 20 50	
			135	Accessories: Barrier 1.5 Link rails for 3 terminals 10 terminals Cover with warning arrow	SWA1 823 2.76 SWA1 803 4.54 SWA1 804 13.35 SWA1 813 0.57	25 20 20 100	



ALL OUTPUTS 120 VAC, 60HZ.  
150V.A. MAXIMUM EACH.

MADE IN USA



3 1/8" DEEP (EXCLUDING TERMINALS)  
4 " DEEP (INCLUDING TERMINALS)

ACUNATOR MODEL 3001 - ELECTRONIC INTRINSICALLY SAFE RELAY SYSTEM

DUPLEX

PUBL. NO. 300132

**Acutec, inc.**  
5485 N.W. 22nd Avenue  
Ft. Lauderdale, Florida 33309-2781  
(305) 486-1588

NOT TO SCALE



5485 N.W. 22nd Avenue • Ft. Lauderdale, Florida 33309-2781 • (305) 486-1588

### ACUNATOR PERFORMANCE TESTS

- 1) Alarm Output Load Test (Lamp Load)  
 The alarm output is rated at 150 VA, but was tested using a 400 watt lamp for one million cycles at a rate of approximately one cycle per second.
- 2) Alarm Output Load Test (Using Size 4 Starter)  
 The alarm output was tested using an Allen-Bradley size 4 starter for 500,000 cycles at a rate of approximately one cycle per second.
- 3) Full Function Cycle Test  
 For the full function cycle test, the loads used were 400 watts on Alarm Output and an Allen-Bradley size 5 starter on each pump output. With these output loads, a full function test of 500,000 cycles have been performed at a rate of 4 cycles per minute.
- 4) Minimum Current Test  
 The outputs of the Acunator will not switch on or off properly with an output load of less than 15 MA. A 10K OHM resistor additional load would ensure that the output load turned on and off reliably.
- 5) Minimum and Maximum Operating Voltage  
 The minimum supply voltage is 95 VAC and the maximum supply voltage is 140 VAC.
- 6) Temperature Tests  
 The Acunator and Acunex (all models) will operate properly over the temperature range of -20°C to 60°C (-4°F to 140°F). A high Temperature Test of the controller output loads at 150 watts and cycling on a full function cycle test has been performed satisfactorily at a controlled ambient temperature of 60°C (140°F).
- 7) Miscellaneous Tests
  - (a) Maximum Inrush current per output is 100 Amps for one cycle of 60 Hz.
  - (b) Noise immunity: For non-intrinsically safe applications, input wiring may be run with motor power wiring from 8,000 to 11,000 feet using 120 VAC single phase motors and from 4,000 to 6,000 feet using 230 VAC single phase motors. For three phase motors up to 600 volts, runs of up to 10,000 feet are acceptable. See publication No. 254 for details.



# OMRON GENERAL-PURPOSE RELAY

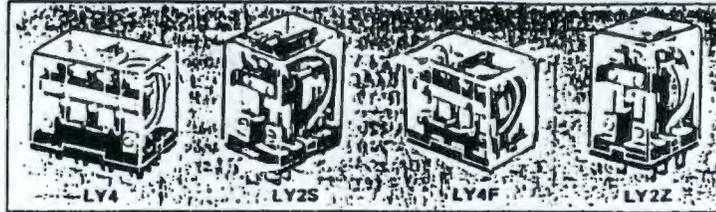
Cat. No. J02-E3-3

Model **LY**

Small, General-purpose 10A Relay for Various Applications

### FEATURES

- High shock and vibration resistance
- Arc barrier equipped
- High dielectric strength (2,000 VAC)



### AVAILABLE TYPES

Type	Mounting style	Terminal form	Single contact			Dual contact		
			Standard mounting	Upper mounting	Lower mounting	Standard mounting	Upper mounting	Lower mounting
Standard	Plug-in socket	SPDT	LY1-US	LY1F-US	LY1S-US	LY2-US	LY2F-US	LY2S-US
		DPDT	LY7-US	LY7F-US	LY7S-US	LY8-US	LY8F-US	LY8S-US
		3PDT	LY3-US	LY3F-US	LY3S-US	-	-	-
	PCB	SPDT	LY4-US	LY4F-US	LY4S-US	LY4Z-US	LY4ZF-US	LY4ZS-US
		DPDT	LY7-0-US	-	-	LY7Z-0-US	-	-
		3PDT	LY3-0-US	-	-	LY3Z-0-US	-	-
Clearance indicator and lock	Plug-in socket	SPDT	LY10-US	-	-	LY22H-US	-	-
		DPDT	LY70-US	-	-	LY22H-0-US	-	-
		3PDT	LY30-US	-	-	LY22H-0-0-US	-	-
	PCB	SPDT	LY10-0-US	-	-	LY22H-0-US	-	-
		DPDT	LY70-0-US	-	-	LY22H-0-0-US	-	-
		3PDT	LY30-0-US	-	-	LY22H-0-0-0-US	-	-
Clearance indicator and lock	Plug-in socket	SPDT	LY10-02-US	-	-	LY22H-02-US	-	-
		DPDT	LY70-02-US	-	-	LY22H-02-0-US	-	-
		3PDT	LY30-02-US	-	-	LY22H-02-0-0-US	-	-
	PCB	SPDT	LY10-02-0-US	-	-	LY22H-02-0-US	-	-
		DPDT	LY70-02-0-US	-	-	LY22H-02-0-0-US	-	-
		3PDT	LY30-02-0-US	-	-	LY22H-02-0-0-0-US	-	-
Trip lever and lock	Plug-in socket	SPDT	LY12-US	-	-	LY22I-US	-	-
		DPDT	LY72-US	-	-	LY22I-0-US	-	-
		3PDT	LY32-US	-	-	LY22I-0-0-US	-	-
	PCB	SPDT	LY12-0-US	-	-	LY22I-0-US	-	-
		DPDT	LY72-0-US	-	-	LY22I-0-0-US	-	-
		3PDT	LY32-0-US	-	-	LY22I-0-0-0-US	-	-
Clearance indicator and lock	Plug-in socket	SPDT	LY20-US	-	-	LY22M-US	-	-
		DPDT	LY70M-US	-	-	LY22M-0-US	-	-
		3PDT	LY30M-US	-	-	LY22M-0-0-US	-	-
	PCB	SPDT	LY20-0-US	-	-	LY22M-0-US	-	-
		DPDT	LY70M-0-US	-	-	LY22M-0-0-US	-	-
		3PDT	LY30M-0-US	-	-	LY22M-0-0-0-US	-	-

When placing your order, add the desired coil voltage rating listed in "SPECIFICATIONS" to the part number as shown below.

LY1-US-DC6  
→ Coil rating

OMRON

## STANDARD TYPE

### SPECIFICATIONS

#### COIL RATINGS

Rated voltage (V)	Rated current (mA)						Coil resistance (Ω)			Coil inductance (ref. value) (mH)								Must-operate voltage (% of rated voltage)	Must-dropout voltage (% of rated voltage)	Min. inrush current (mA)	Power consumption (VA, W)		
	SPDT, DPDT		3PDT		4PDT		SPDT, DPDT	3PDT	4PDT	SPDT, DPDT		3PDT		4PDT		SPDT, DPDT	3PDT				4PDT		
	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz				Arms. OFF	Arms. ON	Arms. OFF	Arms. ON	Arms. OFF	Arms. ON							Arms. OFF	Arms. ON
AC	6	214	183	310	270	388	330	12.2	6.7	5	0.04	0.08	0.03	0.05	0.02	0.04	85 max.	30 min.	110	Approx. 1.0 to 1.2	Approx. 1.6 to 2.0	Approx. 1.95 to 2.5	
	12	106	91	159	134	199	170	46	24	20	0.17	0.33	0.12	0.21	0.10	0.17							
	24	53	46	80	67	93	80	180	100	78	0.69	1.30	0.44	0.79	0.38	0.67							
	50	25.7	22	38	33	46	40	788	410	350	3.22	6.66	2.24	3.87	1.74	2.88							
	120	10.8	9.2	17.3	14.8	19.0	16.4	4,430	2,200	2,200	19.00	32.40	11	20.1	9.3	19							
240	5.4	4.6	9.4	8	11.0	9.5	18,790	10,400	9,000	75.70	128.7	38.6	74.6	33.2	63.4								
DC	6	150	124	214	183	270	234	40	25.7	25	0.16	0.33	0.11	0.21	0.09	0.21	85 max.	10 min.	110	Approx. 0.9	Approx. 1.4	Approx. 1.5	
	12	75	62	112	91	134	117	160	107	100	0.73	1.37	0.45	0.98	0.39	0.84							
	24	36.9	31	58.6	46	67	58	650	410	350	3.20	5.72	1.89	3.87	1.41	2.91							
	50	18.5	15.5	28.2	22	33	28	2,600	1,700	1,600	10.6	21.0	6.93	13.9	6.39	13.6							
	110	10	8	13	11	15.8	13.5	11,000	8,500	6,900	45.6	86.2	29.6	54.3	32	63.7							

NOTE: The rated current, coil resistance and inductance are measured at coil temperature of 73°F with tolerances of +15%, -20% for AC rated current, ±15% for DC rated current, and ±15% for rated coil resistance.

#### CONTACT RATINGS

Item	Type	SPDT, DPDT, 3PDT, 4PDT	
		Resistive load (p.f.=1) (VA, W)	Inductive load (p.f.=0.4, L/R=7ms.) (VA, W)
Rated load		110 VAC 15A 24 VDC 15A	110 VAC 10A 24 VDC 7A
Carry current		15A	10A
Max. operating voltage		250 VAC 125 VDC	
Max. operating current		15A	10A
Max. switching capacity		1,700VA 360W	1,100VA 170W
Minimum permissible load (ref. value)		5 VDC 100mA	

**LIGHTING**

**SPECIAL APPLICATION INCANDESCENT AND FLUORESCENT FIXTURES**

**INCANDESCENT VAPOR-TIGHT FIXTURES**

Designed for heavy-duty, nonexplosive environments, Dayton vapor resistant incandescent fixtures are also used in weather-exposed, high traffic areas. These include processing plants, cold storage, foundries, factories, loading docks, railways, tunnels, bridges and walkways. Recommended for use whenever vibration, dust, or moisture are involved. UL Listed for wet locations if installation has a weatherproof outlet box. If not, use No. 2V567 outlet box (not included) to qualify fixture for wet location. Dayton brand.

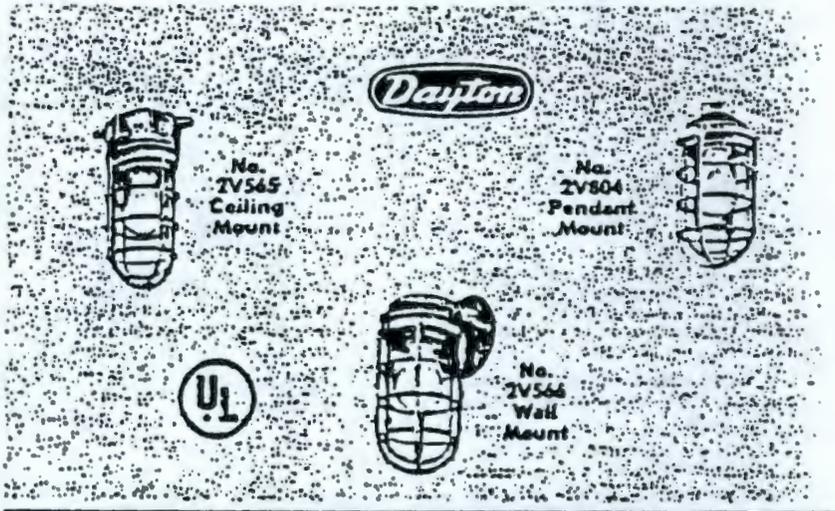
Die cast aluminum housing is heavy-duty. Contains prewired porcelain socket and 11" long wire leads.

Fully enclosed and gasketed with heat resistant glass globe and screw on cast aluminum guard. Uses maximum 100 watt incandescent bulb, not included.

Ceiling Mount No. 2V565 Fixture fits on standard 3 1/2" round and octagon and 4" round boxes.

Wall Mount No. 2V566 Fixture fits on standard 4" round and octagon boxes.

Pendant Mount No. 2V804 Fixture fits on standard 1/2" conduit. Fixture has tapped 1/2" NPT hub.

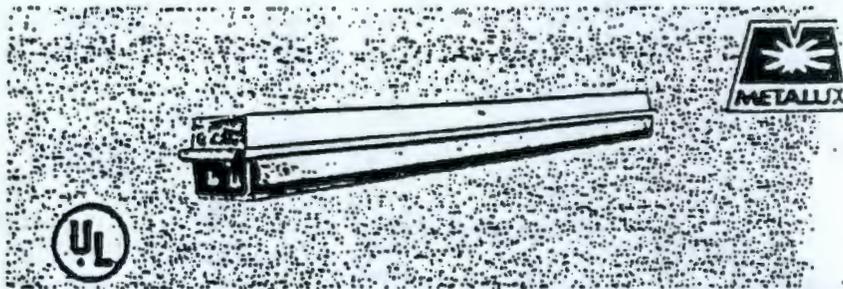


**INCANDESCENT FIXTURES ORDERING DATA**

Fixture Type	Height	Width	Stock No.	List	Lamp Not Included Each	Lot 12
Ceiling Mount	9 1/4"	5 1/4"	2V565	\$45.70	\$24.42	\$19.75
Wall Mount	7 1/4"	4 3/4"	2V566	58.54	30.55	24.71
Pendant Mount	8 1/2"	4 3/4"	2V804	48.68	25.51	20.63

**DUST/VAPOR RESISTANT FLUORESCENT FIXTURES**

- Noncorrosive fiberglass body for indoor use only. Use in kitchens, food processing plants or where sanitation is important
- Completely sealed, fully gasketed to resist dust and moisture
- "P" rated Ballast; clear acrylic diffuser
- 120V, 60 Hz. UL Listed as suitable for damp locations; IBEW Label
- No. 4V378 for suspension mounting only

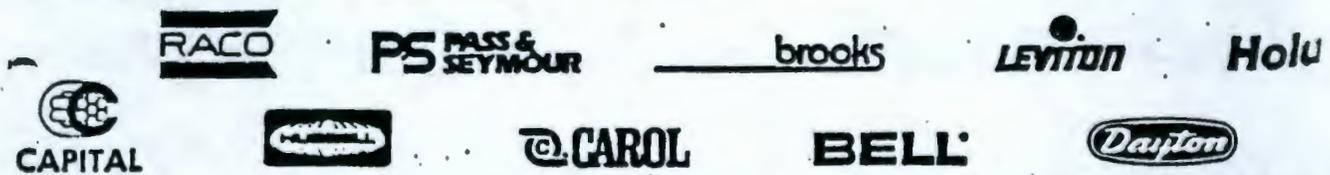


**FLUORESCENT FIXTURES SPECIFICATIONS AND ORDERING DATA**

Qty.	Lamps Required (Not Included)		Ambient Temp °F Min Max	Line Amps	Dimen., in. L W H	Metalux Model	Stock No.	List	
	Watts	Type						Each	Lot 12
2	40	F40	50 122	0.73	52 8 4 1/4	VT240DRDL120V	3V391	\$89.53	\$67.89
2	75	F96T12	50 122	1.46	100 8 4 1/4	VT296DRDL120V	3V392	188.53	128.27
2	40	F40	50 122	0.73	52 8 4 1/4	VT240DRDL120VLE3	3V441	108.70	76.21
2	75	F96T12	50 122	1.35	100 8 4 1/4	VT296DRLE3	4V379	188.83	134.88
2	110	F96T12HO	-20 122	2.05	100 8 4 1/4	VT296HOLE3-20	4V378	274.18	195.84

(\*) Energy efficient model. (†) Not available for sale in some states. See Ballast section for state listings. (‡) Exempted non-energy saving fixture designed for use weather applications.

**electri-flex** MANY BRANDS OF ELECTRICAL PRODUCTS AVAILABLE **LUTRO**

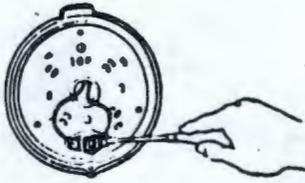


498 NET WHOLESALE PRICES—W.W.GRAINGER, INC.

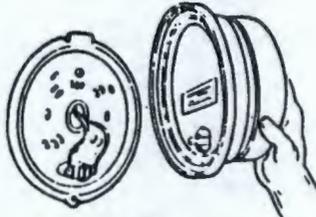
# Edwards® AC Adaptabels

## SIMPLE 3-STEP INSTALLATION

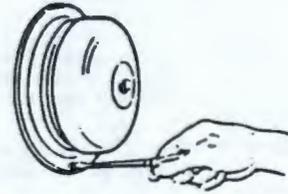
Universal Adaptaplate mounting plate mounts directly on surface or fits any single-gang opening or any 3¼", 3½" or 4" octagon box or any plaster cover with mounting holes on 2¾" centers. 6" & 10" bells also mount on 4" square box. Permits quick, easy installation in three simple steps.



1. Pull wires through spacious center hole and connect to large binding posts.

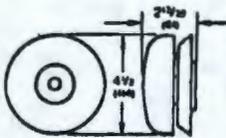


2. Slip Adaptabel onto sturdy hanger and push home.

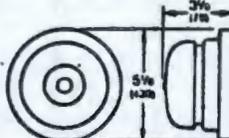


3. Tighten one screw and installation is complete. (On 4 inch bell tighten 2 screws).

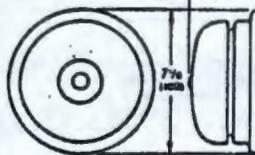
4" SINGLE-STROKE SIZE



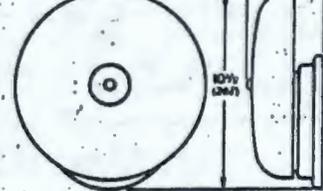
4" VIBRATING SIZE



6" SIZE



10" SIZE



## AC VIBRATING TYPE

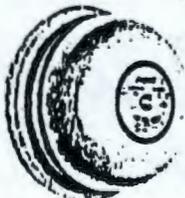
For timing, scheduling or general alarm applications. UL listed, FM approved and NEMA standard. Supplied complete with Adaptaplate.



Cat. No.	Size	Volts	Amps	VA	DC Coll Res. (Ohms)	dB at 10 FL
340-4E5	4 (102)	12	.62	7.4	13	88
340-4FM		16V 60Hz	.46	7.4	22	
340-4FX		18V 60Hz	.41	7.4	37	
340-4G5		24	.31	7.4	50	
340-4H5		120	.062	7.4	1300	
340-4R5		240	.031	7.4	5000	
340-6E5	6 (152)	12	.72	8.4	8	92
340-6FM		16V 60Hz	.53	8.4	13	
340-6FX		18V 60Hz	.47	8.4	22	
340-6G5		24	.35	8.4	30	
340-6H5		120	.07	8.4	700	
340-6R5		240	.035	8.4	2650	
340-10G5	10 (254)	24	.35	8.4	30	98
340-10H5		120	.07	8.4	700	
340-10R5		240	.035	8.4	2650	

## AC SINGLE-STROKE TYPE

For indoor paging, timing, coding, end-of-cycle indicator applications. UL listed, and NEMA standard. Supplied complete with Adaptaplate.



332-4G5	4 (102)	24	.5	12	10	84
332-4H5		120	.1	12	250	
332-6G5	6 (152)	24	.5	12	10	86
332-6H5		120	.1	12	250	
332-10G5	10 (254)	24	.7	17	5	92
332-10H5		120	.14	17	130	

# Appendix F

## Pumps

# Installation Operating & Maintenance Manual

SUBMERSIBLE SOLIDS & INDUSTRIAL WASTES PUMPS

**ABS PUMP MODELS:**

AF 13 to 90

AF 30-4-EX-4"

S/N 1323054  
1323057

FOR REPLACEMENT PARTS CONTACT ABS PUMPS OR  
TRIANGLE PUMP & EQUIP.

ABS Pumps Inc.  
140 Pond View Drive  
Meriden, Connecticut 06450  
(203) 238-2700



The AFP & AF Series Five Year Warranty is contingent on proper start-up. Please read this manual carefully. The Product Start-up Report form must be completed and returned to ABS Pumps Inc. In the event the Product Start-up form has not been received with the pump, please contact your supplier or the factory.

# Warranty

## FIVE YEAR WARRANTY - STANDARD & EXPLOSION PROOF AFP & AF SERIES PUMPS PERMANENT TYPE INSTALLATION

ABS Pumps Inc. warrants its AFP & AF Series of Submersible Pumps to be free from defects in workmanship and materials for a period of five (5) years after date of shipment to end customer, with approval of installation and start-up of the equipment by the Company's authorized on-site representative and, upon payment of the applicable percentage of the list price of the following parts in effect at time of replacement.

Part Description	Months After Shipment			
	0-18	19-31	32-45	46-60
Rotor & Stator*	0%	25%	50%	75%
Mechanical Seal	0%	25%	50%	75%
Impeller	0%	25%	50%	75%
Cutter Disc	0%	25%	50%	75%
Pump Housing	0%	25%	50%	75%
Ball Bearings	0%	40%	80%	90%

\*Stator guarantee effective only if Company's authorized control panels are used.

All other ABS manufactured equipment or other uses of AFP or AF series pumps will carry a one (1) year warranty from date of shipment to end customer, but in no event, longer than eighteen (18) months from date of shipment from the Company.

Start-up reports and electrical system schematics may be required to support Warranty claims and will be required for claims on pumps of 30 horsepower and greater.

The Company's sole obligation under this warranty shall be to make repairs and replace parts when necessary on products that have been returned to it or to an authorized service facility and found to be defective by the Company. Explosion Proof pumps (EX) must be serviced at a facility approved by ABS Pumps Inc. The Company shall not be liable for any special, indirect, or consequential damages of any kind. Major components not manufactured by the Company are covered by the original manufacturer's warranty in lieu of this warranty. The Company will not be held responsible for travel expenses, rented equipment, outside contractors fees, or unauthorized repair shop expenses. The Company neither assumes nor authorizes any person or other company to assume for it, any other obligation in connection with the sale of its equipment. Any enlargement or modification of this Warranty by a Representative or other Sales Agent is their exclusive responsibility. Transportation charges shall be borne by the Buyer. Labor charges for warranty repairs shall not be assumed by the Company for repairs made after one (1) year from date of shipment to end customer. Returns must have prior written authorization from the Company.

This warranty shall extend only to the original Owner, and shall not apply to any products that have been repaired or altered without the Company's consent or have been subject to misuse, accident or neglect, or have been used for pumping other than raw sewage or similar non-corrosive liquids.

NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WILL APPLY.

## SECTION I

### 1-1 INTRODUCTION

This manual was prepared to assist you in the correct installation, operation, maintenance and repair of your ABS pump.

Please read it through carefully and make certain that you are familiar with the contents, and that the recommendations in the chapter on installation and operation are fully understood before running the pump.

ABS pumps have been designed to minimize maintenance. However, regular checks will ensure longer life and greater operating reliability.

**WARRANTY:** No repair work should be carried out during the guarantee period without prior factory approval. To do so may render the guarantee void.

**PUMP SERIAL NO.:** In all correspondence and reports, make certain that the pump serial number is given.

### 1-2 DESIGN OF PUMP

The ABS AF type submersible pumps are designed to operate in installations handling raw sewage, industrial waste or other liquids and sludge where suspended solids are found within the medium being pumped.

The motor and pump form a close coupled, fully submersible, watertight unit.

The squirrel cage induction motor is insulated against heat and moisture in accordance with Class "F" (155°C) regulations.

Thermal overload protectors (one per phase) are imbedded in the stator windings. These are connected in series and wired to the control panel so they shut down the pump if overheating occurs.

The motor is protected against damage from water entry by an oil chamber and mechanical seal located between the volute and the motor chamber. A di-electrode seal probe located in the oil chamber which, when coupled to the ABS Seal-minder control, senses the water content in the oil chamber and provides a signal which gives a visual or audible warning that water is in the oil chamber and that an inspection is necessary.

On explosion proof models, the di-electrode is located at a low point in the motor chamber to give early warning of water entry into the motor chamber.

The bearings are prelubricated and maintenance free.

The impellers are of the single channel type with the well-proven CB (contra-bloc) system. The system consists of a spiral bottom plate with wave shaped ridges. Rags, fibers, etc., are torn or cut by the shearing edge of the suction inlet and clogging is prevented. The AF pump can also be supplied with vortex impellers which are especially suitable for 4% and 5% sludge applications.

## SECTION II

### 2-1 INSPECTION ON RECEIPT OF PUMP

The shipping container shall be immediately inspected for damage that may have occurred in shipment. Exercise care in opening the shipping container to avoid damage to the pump. Remove any blocking and cushioning from within the container. Check all cushioning for spare parts before discarding. Visually check the pump and any spare parts for damage. Check for damaged inlet and outlet port threads and flanges, and electrical wires--especially where they exit the pump housing. Report any damage or shortage of parts to your supervisor or directly to the carrier.

### 2-2 STORAGE BEFORE USE

ABS pumps are shipped from the factory ready for installation and use. They should be held in storage if the pump station is not complete. If storage is necessary, the pump should remain in its shipping container. It should be stored in a warehouse or storage shed that has a clean, dry, temperature-stable area where the pump and its container should be covered to protect it from water, dirt, dust, etc. The ends of the cables must be protected against moisture.

#### CAUTION!

AT NO TIME SHALL THE PUMP BE STORED WITHIN AN INCOMPLETE WET PIT. THE PUMP SHALL NOT BE PLACED INTO THE PIT UNTIL IT CAN BE FULLY INSTALLED AND OPERATED.

### LONG TERM STORAGE

1. If it is necessary to store a pump for a long period of time, it should be stored indoors in a clean, dry temperature-stable environment. The pump should be covered to protect it from dust, dirt and water. The ends of the cable must be protected against moisture.
2. Do not allow the pump to freeze. Water trapped during quality testing may expand and cause damage. If the pump must be stored in a sub-freezing environment, consult the factory for specific recommendations and precautions.
3. During storage, the motor should be rotated a few turns once a month. This can be accomplished by turning the impeller by hand. Spinning the motor will lubricate the mechanical seals and prevent their seizing.
4. Prior to installation, the pump motor should be rotated by hand to ensure the mechanical seals are free-spinning.
5. Installed pumps which are idle for long periods of time should be jogged once a month to lubricate the mechanical seals.

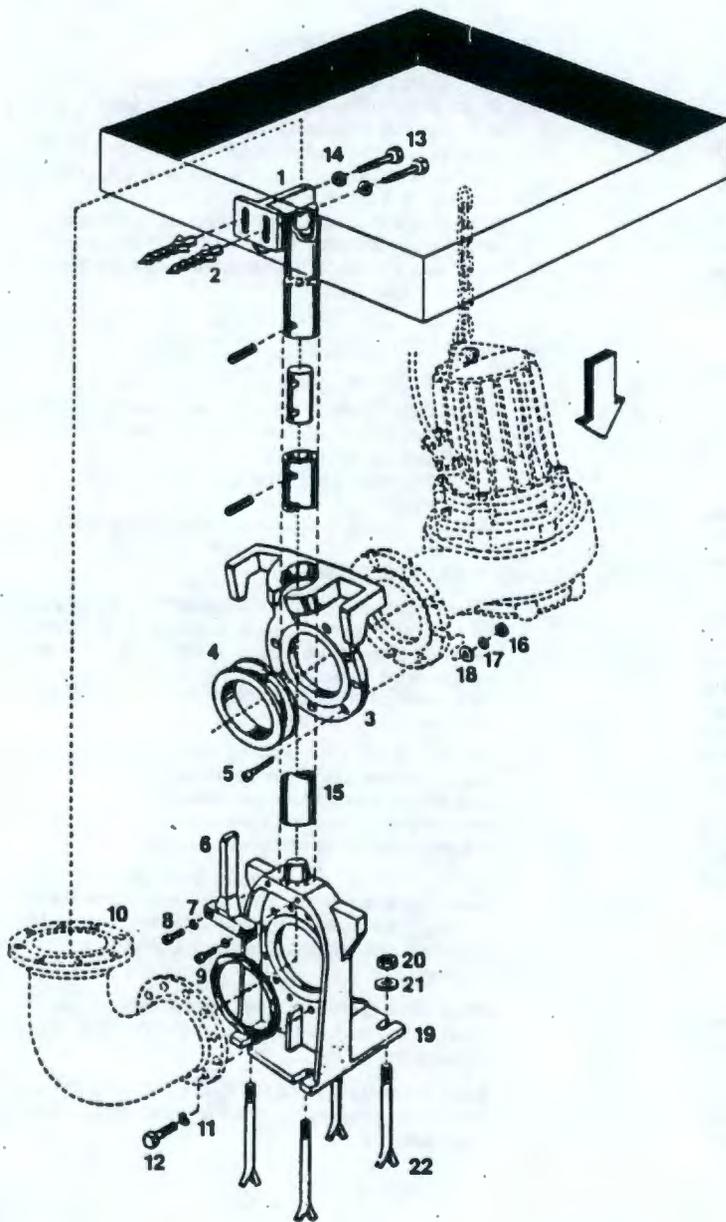
**AUTOMATIC COUPLING  
WITH  
SINGLE GUIDE RAIL**

The ABS guide rail with the automatic coupling system ensures rapid and economical installation and allows connection of the pump to the discharge pipe by gravity.

The guide rail base is securely mounted together with the discharge line on the bottom of the wet well.

The submersible pump is lowered by chain down the guide rail; when it reaches the proper operating position, it seals off the discharge outlet automatically by means of its own weight.

The automatic coupling can be repeated as often as necessary. For routine inspection, the pump can be easily lifted by the chain, checked or repaired, and lowered again.



1. Upper guide bracket
2. Anchor bolts
3. Pump bracket
4. Specially shaped gasket
5. Socket head screw
6. Straightening vane
7. Spring washer
8. Socket head screw
9. Flat gasket
10. Flanged discharge elbow
11. Spring washer
12. Hexagon head screw
13. Screw with hex head
14. Washer
15. Guide rail
16. Hex nut
17. Spring washer
18. Washer
19. Guide rail base
20. Hexagon nut
21. Washer
22. Anchor bolts

Automatic Coupling  
FIGURE 2-1

Starts Per Hour	SIMPLEX		DUPLEX	
	Maximum Use Diagram	Multiplier to Switch Differential	Maximum Use Diagram	Multiplier to Switch Differential
4	B	2	B	1
6	A	2	A	1
8	B	1	B	1/2
12	A	1	A	1/2

**Example 1**

1. Diameter of your wet well is 6 feet and you have determined that you want 6 starts per hour.
2. Design capacity of your pump is 300 GPM.
3. You have a Duplex station, therefore from the table you use Diagram "A" and your switch height differential multiplier is 1.
4. Enter Diagram "A" at 300 GPM and draw a vertical line to intersect the 6 foot diameter wet well curve (the dotted line for this example).
5. Draw a horizontal line to the left of the curve to determine the ON/OFF differential of 1.75 feet. Your switch differential is 1, therefore your differential remains at 1.75 feet for 6 starts per hour. Note in the table that if this were a Simplex station, the pump would start 12 times per hour (the maximum).

**Example 2**

1. Diameter of your wet well is 6 feet and you have determined that you want 8 starts per hour.
2. Design capacity of your pump is still 300 GPM.
3. You have the Duplex station, and from the table you use Diagram "B" and multiply the switch ON/OFF height differential by one half.
4. Enter Diagram "B" at your 300 GPM design capacity, move vertically up to the 6 foot diameter wet well curve.
5. Proceed horizontally to the left and determine that the new ON/OFF switch differential is 2.5 feet. Multiply 2.5 feet differential by the one half multiplier, (reference step 3), and the product is 1.25 feet. Note again in the table that this is half of the 2.5 feet required for 8 starts per hour Simplex.

Using both charts with a multiplier to the switch differential, it is possible to use all the starts per hour shown for either Simplex or Duplex installations.

**CAUTION!**

NO PUMP STATION SHOULD BE DESIGNED TO EXCEED 12 STARTS PER HOUR PER PUMP!

**SECTION III**

**3-1 CONTROL PANELS, GENERAL**

Electrical control panels are usually supplied with the pumps, although pumps may be connected to customer supplied panels. If a control panel other than that supplied by ABS is used, the panel must be wired so that the built-in SAFETY FEATURES of the AF pumps are utilized. These safety features are the Sealminder probe in the oil chamber and thermal overload connections.

There are many variations of control panels and it is impractical to include instructions for each and every variation. The standard panel supplied by ABS is equivalent to a NEMA 3R enclosure. All connections to this panel are made at the terminal strips. When control panels other than ABS' are used, refer to that manufacturer's wiring diagrams and instruction manuals for proper wiring connections.

Mounted on the inside of the ABS control panel door is a complete wiring diagram and terminal strip diagram. The terminal strip diagram indicates where to connect the float switches, water warning electrode lead and pump leads.

**3-2 ELECTRICAL CONNECTIONS, PUMP TO CONTROL PANEL**

The pumps are supplied with free cable ends. The connection of the pump cable should be carried out by a licensed electrician in accordance with the identification on the individual leads and the corresponding connections in the control panel. On dual voltage pumps, be certain that the motor is properly wired for your supply voltage. See the wiring diagrams Figure 3-1 through 3-9 and terminal strip diagram inside the control panel.

The electrical controls and plugs should be protected from dampness and never laid directly on moist or muddy ground. If there is danger of flooding, they should be mounted above possible flood level. The Sealminder control and thermal overload switches (Klixons) are installed to protect the motor--make sure they are correctly connected.

**CAUTION!**

UNDER NO CIRCUMSTANCES SHALL ANY MOTOR LEAD BE SPLICED AT A SUBMERGED POINT OR IN ANY WET LOCATION THAT WILL ALLOW WICKING ALONG THE CABLE.

### 3-3 ABS CONTROL PANELS

The successful and safe operation of the control panel is dependent upon proper handling, installation, operation and maintenance, as well as proper design and manufacture. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury and the failure and loss of the control panel as well as damage to other property.

#### HANDLING OF THE CONTROL PANEL

1. Handle the control panel with care to avoid damage to components and to the enclosure.
2. Move and store the control panel on its back or base.
3. When the control panel is received, unpack it sufficiently to inspect it for concealed damage and to determine that the shipment is complete and correct.
4. If the panel is to be stored for any length of time prior to installation, restore the packing for protection during that period. Where conditions permit, leave the packing intact until the panel is at its final installation position.

#### STORAGE OF THE CONTROL PANEL

A non-energized outdoor type panel (NEMA 3R or NEMA 4) should, if at all possible, be stored in a clean, dry space having a constant temperature to prevent condensation. Preferably, it should be stored in a heated building having adequate air circulation and protected from dirt and water. If the panel must be stored outdoors, temporary electrical heating should be installed to prevent condensation. Approximately 5 watts (from a light bulb or equivalent) per cubic foot of enclosure volume is adequate for the average environment.

#### CAUTION!

ELECTRICAL CONTROL PANELS SHOULD BE SERVICED ONLY BY A LICENSED ELECTRICIAN.

#### CARE AND MAINTENANCE OF THE CONTROL PANEL

#### CAUTION!

TURN "OFF" POWER AHEAD OF CONTROL PANEL BEFORE PERFORMING ANY MAINTENANCE ON THE PANEL. CHECK INCOMING LINE TERMINALS WITH A VOLTMETER TO BE SURE THAT THE EQUIPMENT IS TOTALLY DE-ENERGIZED. MAIN SWITCHES SHOULD BE TAGGED AND LOCKED "OFF". THIS ALSO APPLIES WHENEVER WORK IS BEING DONE ON THE MOTORS AND/OR FLOAT SWITCHES.

Power should be turned off by switching "OFF" the main disconnect switch ahead of the control panel.

On single phase panels the main disconnect switch is interlocked with the panel inner door. The inner door cannot be opened unless the main switch is in the "OFF" position.

1. Inspect the control panel at least once a year or after any electrical fault to ensure correct operation.
2. Do not use any flammable cleaning agents within the control panel.
3. Look for moisture or signs of previous wetness or dripping inside the control panel. Condensation in conduits or dripping from outside sources is a common cause of control panel failure.
  - a. Seal off any conduits which have dripped condensate and provide an alternate means for the conduit to drain.
  - b. Seal off any cracks or openings which have allowed water to enter the enclosure. Eliminate the source of any dripping.
  - c. Replace or thoroughly dry any insulating material which is damp or wet or shows evidence of previous wetting.
  - d. If the control panel is subject to large temperature variations, causing condensation within the panel, it is recommended that space heaters be installed (approx. 5 watts per cubic foot of space).
4. If there is a significant amount of dust or dirt within the panel, it should be cleaned using a brush, vacuum cleaner or lint-free rags. Make sure the main power is turned "OFF" ahead of the panel. Do not use a blower or compressed air for cleaning.
5. Before energizing the control panel, tighten all connections on all components within the panel.
6. Check the operation of all switches. Look for missing or broken parts, free movement, rusting or corrosion, dirt and excessive heat. DO NOT LUBRICATE SWITCHES OR CONTACTORS. Door hinges and interlocks may be lubricated with a light, clean grease. Wipe off excessive lubrication to avoid attracting dirt.

#### CAUTION!

IF THE ABS SEALMINDER RELAY AND THERMAL OVERLOAD MOTOR PROTECTION FEATURES ARE NOT CONNECTED, THE WARRANTY WILL BE VOID.

~~2-3 MOUNTING BASE CONSTRUCTION~~

~~ABS AF pumps may be either guide rail mounted or pedestal base mounted. The foundation for both must be rigid enough to absorb any induced vibrations and stress normally generated during pump operation. A pedestal pump will simply sit on this, therefore the foundation must be absolutely level. The guide rail mounted pump will have the guide rail base bolted to the foundation. The mounting bolts will be imbedded in the foundation with size and location defined by the particular job specification and engineering drawings.~~

**CAUTION!**

PRIOR TO INSTALLING THE PUMP IN THE WET WELL, REFER TO PARAGRAPH 3-4 ENTITLED "INITIAL START-UP". BE SURE THE PUMP IS RUNNING WITH THE CORRECT IMPELLER ROTATION.

**2-4 GUIDE RAIL INSTALLATION AND ASSEMBLY OF AUTOMATIC COUPLING SYSTEM**

Normally, ABS will be supplying the access cover for the pump installation wet well. This access cover should be cast either into the concrete roof of the wet well or be mounted on top of an ABS or contractor supplied steel or fiberglass basin in the position shown on the particular job specification engineering drawings and ABS installation drawings. At the same time, the guide rail base anchor bolts should be cast in the bottom of the wet well, again per the job specification engineering drawings and ABS installation drawings.

**NOTE**

The foundation bolts must be suitably grouted with a good commercial grade grout. The grout should be properly installed to prevent air bubble inclusion and completely encase and seal the area around the bolt.

To assemble the Automatic Coupling System and to install the Guide Rail Assembly, follow these instructions (See Figure 2-1):

1. Mount the straightening vane (8) to the guide rail base (19) with screws (8) and spring washer (7).
2. Install the guide rail base in the bottom of the wet well by means of cast-in anchor bolts (22). Check that the base is level. Add grout beneath base to level. Recheck base after grout dries. Finally, secure in place with hex nuts and washers (20 and 21).
3. Position the upper guide bracket to the access cover or to the wall of the opening to determine length of guide rail. The guide rail, which shall be customer supplied, will be 2" schedule 40 galvanized pipe. After positioning, cut pipe to the required length.
4. Install the guide rail pipe over the tapered plug of the guide rail base.

5. Insert the upper guide bracket tapered plug into the upper end of the guide rail and locate so the guide rail is plumb. Secure upper guide bracket to the access cover or opening wall and recheck for plumbness. Check that the guide rail base (19), the guide rail (15), and the upper guide bracket (1) are on the same center line with the discharge connection and vertically aligned. This is necessary to assure that the pump will seal itself correctly. Press upper guide bracket (1) into the guide rail pipe (15) so that no play remains and finally secure the upper guide rail bracket by tightening the screws (13).
6. The molded gasket (4) is placed in the pump bracket (3) so that the tapered face points towards the guide rail base and the sealing lips make proper contact all around on both sides. The pump bracket is fastened to the discharge of the pump with socket head screws (5), washer (18), hex nuts (16), and spring washers (17). The hex nuts (16) should be equally tightened in a cross-wise manner to prevent leakage of the seal.
7. The discharge elbow (10), with the flat gasket in place, is attached to the guide rail base with hex head screws (12) and spring washers (11).
8. No welding or building of the guide rail is required.

**CAUTION!**

NEVER RAISE, LOWER, OR MOVE THE PUMP BY LIFTING WITH, OR PULLING ON, THE POWER CABLES. THE PUMP IS PROVIDED WITH A LIFTING EYE AND CHAIN. THE CHAIN SHALL BE USED AT ALL TIMES WHEN MOVING THE PUMP.

Referring to Figure 4-1 and using the pump support chain, follow the procedural steps, (a through d) when lowering the pump down the guide rail until it seats against the guide rail base. The pump should be lowered at an angle to ensure that the top of the discharge connection makes contact first with the base. Continue lowering until pump is completely seated. Slack off the chain, as noted in Step "d" of Figure 4-1, and fasten the upper end of the chain to the hook of the upper guide bracket. Check to make sure that the electrical cables are supporting no weight.

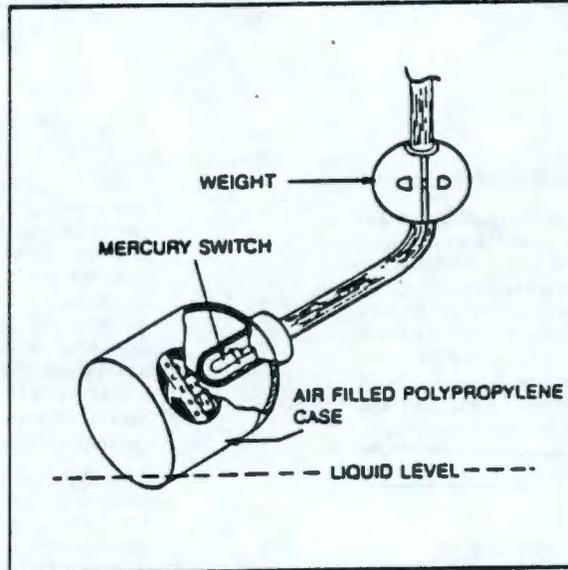


FIGURE 2-2 Float Switches

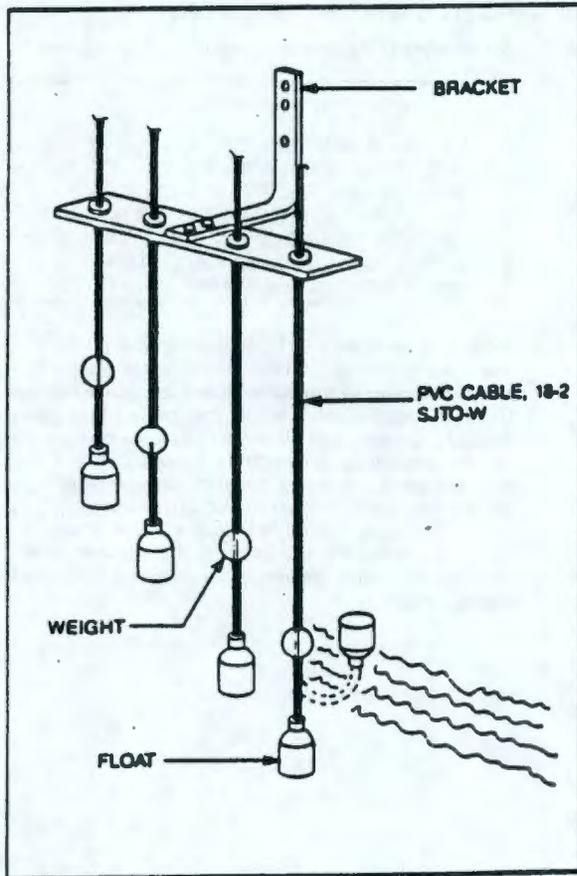
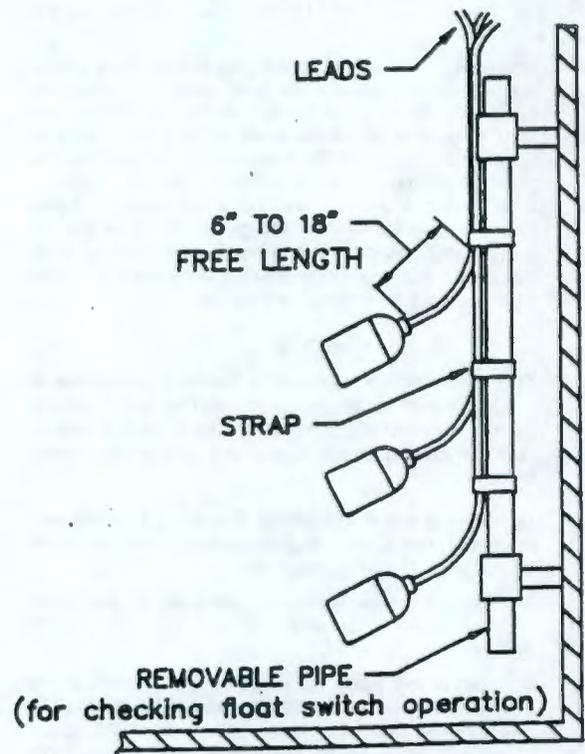


FIGURE 2-3A



(ALL HARDWARE CUSTOMER SUPPLIED)

FIGURE 2-3B

Float Mounting Methods  
FIGURES 2-2, 2-3A & 2-3B

**CAUTION!**

ALL DISCHARGE PIPING AND VALVES SHOULD BE SUPPORTED IN SUCH A MANNER THAT NO LOAD IS CARRIED BY THE PUMP DISCHARGE ELBOW.

~~2-6-1 PEDESTAL MOUNTING~~

~~The pedestal mounted pump is used for portable service. The pump, as supplied by ABS, contains a fully assembled pedestal base and discharge elbow. Either rigidly mounted permanent piping or hoses with quick disconnect couplings may be installed. Refer to the preceding CAUTION note.~~

**2-6 FLOAT SWITCHES & FLOAT SEQUENCES**

The fluid levels at which the pumps start or stop are normally controlled by mercury float switches. The float switches are free hanging into the wet well. The cables are held by special brackets mounted to the access cover frame. The clamps are designed to hold the cables without pinching or damaging them.

**NOTE**

The float switches shall never be mounted in direct line of the influent flow.

The float switch consists of a mercury switch within an air filled housing. The cable is permanently sealed to form a watertight unit (Figure 2-2). A mounting bracket is available with three or four float positions (Figure 2-3A). An alternate mounting method is shown in Figure 2-3B.

Make sure that the float switches do not tangle with each other, catch on pipes, ladders, or brackets, which may cause erroneous ON and OFF signals.

~~2-6-1 FLOAT SEQUENCE, SIMPLEX STATION~~

~~As the level of influent rises, "PUMP OFF" float is tilted - nothing is activated. As influent continues to rise inside the basin, "PUMP ON" float is activated. This starts the pump. It will pump until "PUMP OFF" float deactivates the pump. Should the liquid level continue to rise above the "PUMP ON" float, the "ALARM" float is activated and energizes the high level alarm light at the control panel.~~

**2-6-2 FLOAT SEQUENCE, DUPLEX STATION**

As level of influent rises, "PUMP OFF" float is tilted - nothing is activated. As influent continues to rise inside the basin, the "LEAD PUMP ON" float is activated and starts the lead pump. It will pump until "PUMP OFF" float deactivates the pump.

On the next start, the opposite pump will be activated by the "LEAD PUMP ON" float. The pumps will then continue to alternate on each start. Should the fluid level continue to rise above the "LEAD PUMP ON" float, the "LAG PUMP ON" float will activate the lag (non-operating) pump and run both pumps until the "PUMP OFF" float deactivates both pumps.

Should the liquid level continue to rise above the "LAG PUMP ON" float, the "ALARM" float is activated and energizes the high level alarm light on the bottom of the control panel.

The engineering drawings will normally specify the levels at which the pump, or pumps, shall turn ON, turn OFF and the point of high level alarm if required. If the various levels are not specified, the following guidelines should be adhered to in determining float switch locations.

~~SIMPLEX STATION~~

~~Pump OFF - minimum level at top of pump motor housing.~~

~~Pump ON - minimum level of 1 1/2' above pump OFF level.~~

~~Pump High Level Alarm - minimum level of 1' above pump ON, but below influent pipe.~~

**DUPLEX STATION**

Pump OFF - minimum level at top of pump motor housing.

Pump ON - minimum level of 1 1/2' above pump OFF level.

Lag Pump ON - minimum level of 1' above lead pump ON.

High Level Alarm - minimum level of 1' above lag pump ON, but below influent pipe.

**NOTE**

No pump ON/OFF float switch differential should be set that will exceed 12 starts per hour per pump.

**2-6-3 FLOAT SEQUENCE, CALCULATED METHOD**

This is a more precise method of determining the distance between the PUMP ON and PUMP OFF float switches. It takes into consideration the number of pump starts per hour.

1. Determine the diameter of the wet well.
2. Determine the design capacity of the pump in GPM.
3. Using the table on page 6, determine which graph to use, Figure 2-4A, or Figure 2-4B. Determine the Switch Differential Multiplier according to the desired number of starts per hour.
4. Using the appropriate graph, follow the vertical line from the design capacity of the pump to the well diameter line. A horizontal line from this point will indicate the float switch differential distance. Multiply this distance by the Switch Differential Multiplier from the table on page 6.

"A" DIAGRAM FOR: 12 Starts per Hour, Simplex  
6 Starts per Hour, Duplex

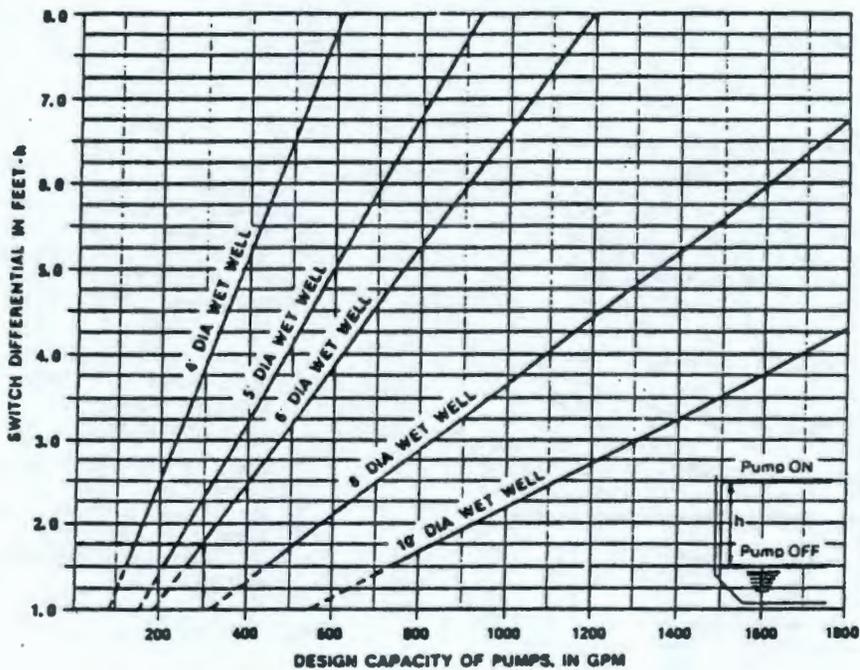


FIGURE 2-4A

"B" DIAGRAM FOR: 8 Starts per Hour, Simplex  
4 Starts per Hour, Duplex

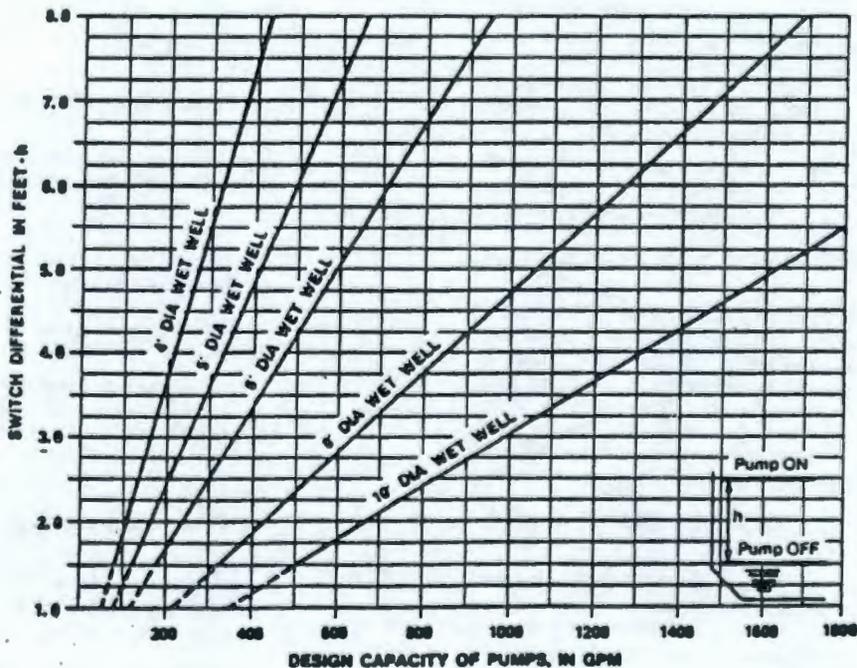


FIGURE 2-4B

"ON-OFF" Float Switch Differentials

FIGURES 2-4

Starts Per Hour	SIMPLEX		DUPLEX	
	Maximum Use Diagram	Multiplier to Switch Differential	Maximum Use Diagram	Multiplier to Switch Differential
4	B	2	B	1
6	A	2	A	1
8	B	1	B	1/2
12	A	1	A	1/2

**Example 1**

1. Diameter of your wet well is 6 feet and you have determined that you want 6 starts per hour.
2. Design capacity of your pump is 300 GPM.
3. You have a Duplex station, therefore from the table you use Diagram "A" and your switch height differential multiplier is 1.
4. Enter Diagram "A" at 300 GPM and draw a vertical line to intersect the 6 foot diameter wet well curve (the dotted line for this example).
5. Draw a horizontal line to the left of the curve to determine the ON/OFF differential of 1.75 feet. Your switch differential is 1, therefore your differential remains at 1.75 feet for 6 starts per hour. Note in the table that if this were a Simplex station, the pump would start 12 times per hour (the maximum).

**Example 2**

1. Diameter of your wet well is 6 feet and you have determined that you want 8 starts per hour.
2. Design capacity of your pump is still 300 GPM.
3. You have the Duplex station, and from the table you use Diagram "B" and multiply the switch ON/OFF height differential by one half.
4. Enter Diagram "B" at your 300 GPM design capacity, move vertically up to the 6 foot diameter wet well curve.
5. Proceed horizontally to the left and determine that the new ON/OFF switch differential is 2.5 feet. Multiply 2.5 feet differential by the one half multiplier, (reference step 3), and the product is 1.25 feet. Note again in the table that this is half of the 2.5 feet required for 8 starts per hour Simplex.

Using both charts with a multiplier to the switch differential, it is possible to use all the starts per hour shown for either Simplex or Duplex installations.

**CAUTION!**

NO PUMP STATION SHOULD BE DESIGNED TO EXCEED 12 STARTS PER HOUR PER PUMP!

**SECTION III**

**3-1 CONTROL PANELS, GENERAL**

Electrical control panels are usually supplied with the pumps, although pumps may be connected to customer supplied panels. If a control panel other than that supplied by ABS is used, the panel must be wired so that the built-in SAFETY FEATURES of the AF pumps are utilized. These safety features are the Sealminder probe in the oil chamber and thermal overload connections.

There are many variations of control panels and it is impractical to include instructions for each and every variation. The standard panel supplied by ABS is equivalent to a NEMA 3R enclosure. All connections to this panel are made at the terminal strips. When control panels other than ABS are used, refer to that manufacturer's wiring diagrams and instruction manuals for proper wiring connections.

Mounted on the inside of the ABS control panel door is a complete wiring diagram and terminal strip diagram. The terminal strip diagram indicates where to connect the float switches, water warning electrode lead and pump leads.

**3-2 ELECTRICAL CONNECTIONS, PUMP TO CONTROL PANEL**

The pumps are supplied with free cable ends. The connection of the pump cable should be carried out by a licensed electrician in accordance with the identification on the individual leads and the corresponding connections in the control panel. On dual voltage pumps, be certain that the motor is properly wired for your supply voltage. See the wiring diagrams Figure 3-1 through 3-9 and terminal strip diagram inside the control panel.

The electrical controls and plugs should be protected from dampness and never laid directly on moist or muddy ground. If there is danger of flooding, they should be mounted above possible flood level. The Sealminder control and thermal overload switches (Klixons) are installed to protect the motor--make sure they are correctly connected.

**CAUTION!**

UNDER NO CIRCUMSTANCES SHALL ANY MOTOR LEAD BE SPLICED AT A SUBMERGED POINT OR IN ANY WET LOCATION THAT WILL ALLOW WICKING ALONG THE CABLE.

### 3-3 ABS CONTROL PANELS

The successful and safe operation of the control panel is dependent upon proper handling, installation, operation and maintenance, as well as proper design and manufacture. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury and the failure and loss of the control panel as well as damage to other property.

#### HANDLING OF THE CONTROL PANEL

1. Handle the control panel with care to avoid damage to components and to the enclosure.
2. Move and store the control panel on its back or base.
3. When the control panel is received, unpack it sufficiently to inspect it for concealed damage and to determine that the shipment is complete and correct.
4. If the panel is to be stored for any length of time prior to installation, restore the packing for protection during that period. Where conditions permit, leave the packing intact until the panel is at its final installation position.

#### STORAGE OF THE CONTROL PANEL

A non-energized outdoor type panel (NEMA 3R or NEMA 4) should, if at all possible, be stored in a clean, dry space having a constant temperature to prevent condensation. Preferably, it should be stored in a heated building having adequate air circulation and protected from dirt and water. If the panel must be stored outdoors, temporary electrical heating should be installed to prevent condensation. Approximately 5 watts (from a light bulb or equivalent) per cubic foot of enclosure volume is adequate for the average environment.

#### CAUTION!

ELECTRICAL CONTROL PANELS SHOULD BE SERVICED ONLY BY A LICENSED ELECTRICIAN.

#### CARE AND MAINTENANCE OF THE CONTROL PANEL

#### CAUTION!

TURN "OFF" POWER AHEAD OF CONTROL PANEL BEFORE PERFORMING ANY MAINTENANCE ON THE PANEL. CHECK INCOMING LINE TERMINALS WITH A VOLTMETER TO BE SURE THAT THE EQUIPMENT IS TOTALLY DE-ENERGIZED. MAIN SWITCHES SHOULD BE TAGGED AND LOCKED "OFF". THIS ALSO APPLIES WHENEVER WORK IS BEING DONE ON THE MOTORS AND/OR FLOAT SWITCHES.

Power should be turned off by switching "OFF" the main disconnect switch ahead of the control panel.

#### NOTE

On single phase panels the main disconnect switch is interlocked with the panel inner door. The inner door cannot be opened unless the main switch is in the "OFF" position.

1. Inspect the control panel at least once a year or after any electrical fault to ensure correct operation.
2. Do not use any flammable cleaning agents within the control panel.
3. Look for moisture or signs of previous wetness or dripping inside the control panel. Condensation in conduits or dripping from outside sources is a common cause of control panel failure.
  - a. Seal off any conduits which have dripped condensate and provide an alternate means for the conduit to drain.
  - b. Seal off any cracks or openings which have allowed water to enter the enclosure. Eliminate the source of any dripping.
  - c. Replace or thoroughly dry any insulating material which is damp or wet or shows evidence of previous wetting.
  - d. If the control panel is subject to large temperature variations, causing condensation within the panel, it is recommended that space heaters be installed (approx. 5 watts per cubic foot of space).
4. If there is a significant amount of dust or dirt within the panel, it should be cleaned using a brush, vacuum cleaner or lint-free rags. Make sure the main power is turned "OFF" ahead of the panel. Do not use a blower or compressed air for cleaning.
5. Before energizing the control panel, tighten all connections on all components within the panel.
6. Check the operation of all switches. Look for missing or broken parts, free movement, rusting or corrosion dirt and excessive heat. DO NOT LUBRICATE SWITCHES OR CONTACTORS. Door hinges and interlocks may be lubricated with a light, clean grease. Wipe off excessive lubrication to avoid attracting dirt.

#### CAUTION!

IF THE ABS SEALMINDER RELAY AND THERMAL OVERLOAD MOTOR PROTECTION FEATURES ARE NOT CONNECTED, THE WARRANTY WILL BE VOID.

**INSTALLATION OF THE CONTROL PANEL**

Refer to the wiring diagrams supplied with the control panel for connection and location of actual components.

1. Follow the current edition of the National Electrical Code, as well as local electrical codes and ordinances.
2. When wall-mounting the enclosure, do not depend on wooden plugs driven into masonry, concrete, plaster or similar materials.
3. Power and control terminals are located at the bottom of the panel. Locate conduit stubs and position control panel accordingly.
4. Conduits should be installed to prevent moisture or water from entering and accumulating within the enclosure. All conduits should be located in areas which will avoid cable interference with structured members and live components.
5. The control panel terminals are suitable for copper wire only. **DO NOT USE ALUMINUM WIRE!**
6. Care should be exercised in stripping insulation from the conductors so as not to nick or ring the conductors. All lugs should be tightened to approximately 15 inch-pounds of torque for wire sizes #14AWG thru #10AWG.
7. Provision should be made to locate conductors in the enclosure so that they will be free from physical damage and to avoid overheating. The conductors should be supported and braced properly.
8. All incoming and outgoing control and power connections should be made in accordance with the wiring diagram supplied with the panel.

**STEPS TO BE TAKEN BEFORE ENERGIZING**

1. Retighten all field-made connections, as well as factory-made connections (which may have loosened due to shipping and handling vibrations).
2. Check the security of all mounting hardware.
3. Check the enclosure to see that it has not been damaged in such a manner as to reduce electrical spacings.
4. Manually turn on and off all switches, motor protectors and contactors to make certain that they are properly aligned and operate freely.
5. Conduct an electrical insulation resistance test to make sure that the control panel is free from short circuits and ground faults. This should be done both phase-to-phase and phase-to-ground.

**NOTE**

Disconnect control circuit during this testing by removing the control circuit protection fuse. Failure to do so may cause damage to control circuit components.

6. **MOTOR OVERLOAD PROTECTION:** The pump motor is protected from locked-rotor and running overloads by a circuit breaker. This device may contain adjustable thermal tripping elements. To adjust the thermal tripping function (for motor overload/locked rotor) use a small screwdriver and rotate the dial (located just under "AMP" and just above the "STOP" button) until the full load current of the pump motor is next to the "AMP" marking. The full load current rating is found on the pump nameplate.
7. Check to determine that all grounding connections are made properly.
8. Remove all debris, scrap wire etc., from the control panel interior.
9. Install covers, close doors and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.
10. Energizing a control panel for the first time is potentially dangerous. Licensed electrical personnel should be present when the panel is energized for the first time. If faults caused by damage or poor installation practices have not been detected, serious damage can result when power is applied.

**ENERGIZING SIMPLEX CONTROL PANELS**

1. Temporarily disconnect, mark and secure motor leads before applying power. Temporarily jump or close the contacts of the pump circuit breaker.
2. With the panel H-O-A switch in the "OFF" position, turn "ON" the main disconnect switch ahead of the panel.
3. Turn the H-O-A switch to "HAND" position. The motor contactor should energize and the run lamp should light. Turn the H-O-A switch to "OFF".
4. With all float switches in the open position, turn the H-O-A switch to "AUTO". No contactors or lights should energize. Simulate closure of the ON and OFF float switches. The motor contactor should energize and the run lamp should light. Open the contacts of the ON float switch. The motor contactor should remain energized and the run lamp on. Open the contacts of the OFF float switch. The motor contactor should de-energize and the run lamp should go out.
5. Simulate closure of the HIGH LEVEL ALARM float switch. The alarm lamp should flash on and off.
6. Turn "OFF" the main disconnect switch ahead of the panel. Remove jumper from the contacts of the motor overload protection breaker, 1MCP. Reconnect motor leads. Check for proper rotation. Re-test panel, making sure that actual motor and float switches operate properly.
7. If control panel components do not perform properly, refer to the troubleshooting chart.

### 3-3-2 ENERGIZING DUPLEX CONTROL PANELS

1. Temporarily disconnect, mark and secure motor leads before applying power. Temporarily jump or close the contacts of the pump circuit breakers.
2. With the two panel H-O-A switches in the "OFF" position, turn "ON" the main disconnect switch ahead of the panel.
3. Turn the PUMP NO. 1 H-O-A switch to "HAND" position. The PUMP NO. 1 motor contactor should energize and the PUMP NO. 1 run lamp should light. Turn the H-O-A switch to "OFF".
4. Turn the PUMP NO. 2 H-O-A switch to "HAND" position. The PUMP NO. 2 motor contactor should energize and the PUMP NO. 2 run lamp should light. Turn the H-O-A switch to "OFF".
5. With all float switches in the open position, turn the PUMP NO. 1 H-O-A switch to "AUTO". No contactors or lights should energize. Simulate closure of OFF and LEAD float switches. The PUMP NO. 1 motor contactor should energize and the PUMP NO. 1 run lamp should light. Open the contacts of the LEAD PUMP float switch. The motor contactor should remain energized and the run lamp on. Open the contacts of both float switches. The motor contactor should de-energize and the run lamp should go out. Turn the H-O-A switch to "OFF".
6. With all float switches in the open position, turn the PUMP NO. 2 H-O-A switch to "AUTO". No contactors or lights should energize. Simulate closure of OFF and LEAD PUMP float switches. The PUMP NO. 2 motor contactor should energize and the PUMP NO. 2 run lamp should light. Open the contacts of the LEAD PUMP float switch. The motor contactor should remain energized and the run lamp on. Turn the PUMP NO. 1 H-O-A switch to "AUTO". Close the contacts of the LAG PUMP float switch. PUMP NO. 1 motor contactor should energize and the PUMP NO. 1 run lamp should light. Open the contacts of all float switches. Both motor contactors should de-energize and both run lamps should go out.
7. With both H-O-A switches in the "AUTO" position, close the contacts of the OFF and LEAD PUMP float switches. PUMP NO. 1 motor contactor should energize and the PUMP NO. 1 run lamp should light. Open the contacts of both float switches. The motor contactor should de-energize and the run lamp should go out. Close the contacts of the OFF and LEAD PUMP float switches. PUMP NO. 2 motor contactor should energize and the PUMP NO. 2 run lamp should light. This confirms the operation of the pump alternator relay.
8. Simulate closure of the HIGH LEVEL ALARM float switch. The alarm lamp should flash on and off.
9. Turn "OFF" the main disconnect switch ahead of the panel. Remove jumper from the contacts of the pump circuit breakers. Reconnect motor leads. Check for proper rotation. Re-test panel, making sure that actual motor and float switches operate properly.
10. If control panel components do not perform properly, refer to the troubleshooting chart.

### 3-3-3 MAJOR REPAIRS OF THE CONTROL PANEL

Should major repairs to the control panel become necessary, consult the ABS Product Service Department.

### 3-4 INITIAL START-UP

#### 3-4-1 CHECKING THE IMPELLER ROTATION



After completion of the electrical service power connections to the pump, the direction of rotation should be checked when the pump is first used (also if moved to a new location). Incorrect direction of rotation will result in reduced discharge and can damage the pump.

The top portion of the pump motor housing contains a cast-in arrow and the words "START REACTION" which indicates the direction in which the pump should kick when it is started. This is the starting reaction. The impeller rotates in the opposite direction, indicated by a second arrow "ROTOR ROTATION".

To carry out this test, suspend the pump by the lifting chain and jog the motor. In the case of a fixed installation, this should be done before the pump is fixed in position. The electrical connection of the pump and the rotor rotation (direction of the rotation of the impeller) are correct if the pump (when starting and looking from above) makes an anti-clockwise start reaction (in the direction of the arrow "START REACTION").

If the pump should twist in the opposite direction of the arrow, the pump is now running backwards. Remove the main power to the control panel. Interchange two pump power leads at the terminal strip. In a duplex station, be sure to check both pumps.

#### CAUTION!

DO NOT SWITCH INCOMING POWER SUPPLY LINE LEADS AS THIS WILL AFFECT ALL PUMPS IN A MULTIPLE INSTALLATION.

#### NOTE

If a single phase pump should run backwards, consult the ABS Product Service Department immediately. Do not operate the pump.

**3-4-2 CURRENT UNBALANCE, (THREE PHASE PUMPS ONLY)**

Upon ascertaining that the pump is rotating in the correct direction, the amount of current unbalance between phases must be calculated. Run the pump under water, checking that all the valves are open in the discharge lines to simulate normal operating load conditions.

**CAUTION!**

CURRENT UNBALANCE BETWEEN PHASES SHALL NOT EXCEED 4%. CONSULT THE FACTORY WHEN CURRENT UNBALANCE EXCEEDS 4%. THE PERCENT OF CURRENT UNBALANCE IS DEFINED AND CALCULATED PER THE FOLLOWING EXAMPLE:

$$\% \text{ of current unbalance} = \frac{\text{max. current difference from average} \times 100}{\text{average current}}$$

**Example**

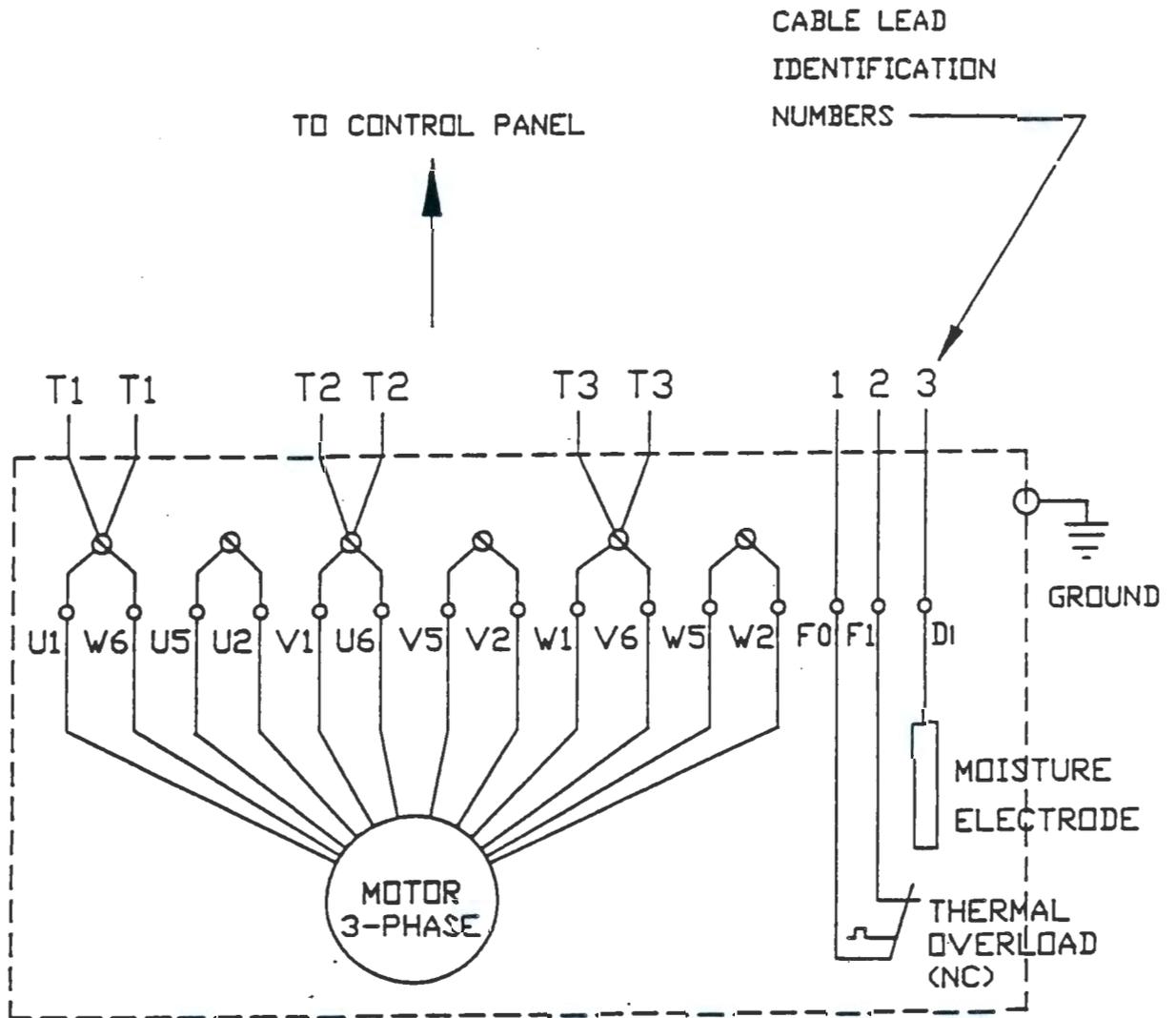
1. Current readings in amps shall be taken on each phase at the control panel terminal strip:  
 $T_1 = 10 \text{ amps}, T_2 = 10.5 \text{ amps}, T_3 = 10.5 \text{ amps}$
2. The average current =  

$$\frac{10 + 10.5 + 10.5}{3} = 10.33 \text{ amps}$$
3. The maximum current difference from average = .33 amps
4. The current unbalance for this particular three-phase hookup is 3.2%. If your unbalance between phases should exceed 4%, consult ABS Product Service Department immediately. Do not operate the pump. The results of this current unbalance calculation shall be entered on the "Product Start-Up Report".

**3-4-3 INITIAL CURRENT CHECK, (SINGLE PHASE PUMPS)**

Run the pump under water, checking that all valves are open in the discharge lines to simulate normal operating load conditions. Take current readings on the control panel terminal strip on the motor leads. The current drawn should never exceed the value given on the nameplate of the pump as "F.L. Amps". If the measured value is higher than the rated "F.L. Amps" value, consult factory immediately.

SECTION 3 PUMP WIRING DIAGRAM



PUMP WIRING DIAGRAM

AF30-6, AF40-4, AF60-4, AF90-4

WITHOUT TERMINAL CHAMBER

460V 60HZ 3 PHASE

FIGURE 3-9

## SECTION IV

**CAUTION!**

PRIOR TO PLACING THE PUMP INTO OPERATION, A PRODUCT START-UP PROCEDURE SHALL BE ACCOMPLISHED BY AUTHORIZED PERSONNEL. FAILURE TO COMPLETE AND RETURN THE "PRODUCT START-UP REPORT" TO THE FACTORY WILL VOID THE WARRANTY. A COPY OF THIS REPORT IS FURNISHED WITH EACH PUMP.

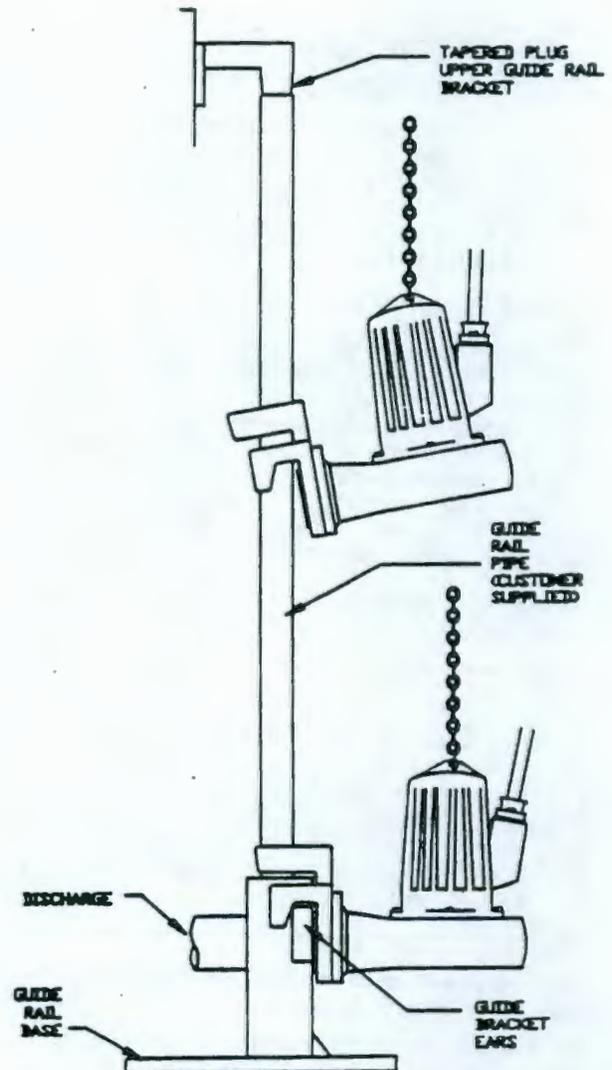
**4-1 GUIDE RAIL INSTALLATION**

When the electrical service has been properly connected, the initial Start-Up Procedure completed, all control switches checked, and the pump mechanically mounted in position, the operation of the pump is completely automatic. No operational procedures are required except to apply rated power to the pump. There are also no specific shut-down procedures beyond disconnecting the electrical power supply.

- a. ABS submersible pumps are fitted with a bracket which forms an integral part of the pump. A molded gasket is locked into position between the back of the bracket and the discharge face of the pump.
- b. The pump bracket slips over the upper guide rail bracket and the unit is lowered down the two inch guide rail into the wet well.
- c. As the pump is lowered into position an angled slot in the pump bracket hits a straightening vane which squares the pump with the mating flange of the guide rail base. Pump should be lowered at an angle until bracket ears engage as shown.
- d. When the pump is in position, the chain is slacked off. The weight of the pump is suspended by the two pump bracket ears which seat on the pedestal base. The ears also distribute the pump weight for compression of gasket against the mating flange of the guide rail base.

**4-2 PORTABLE USAGE**

When using the ABS AF pump for portable service, care must be taken to prevent undue wear or damage. When using the pump on a soft muddy bottom, place a flat plate beneath the pedestal base to prevent the pump from burrowing itself into the mud or sand.



Guide Rail Installation  
FIGURE 4-1

**CAUTION!**

NEVER RAISE, LOWER, OR MOVE THE PUMP BY LIFTING WITH, OR PULLING ON, THE POWER CABLES. THE PUMP IS PROVIDED WITH A LIFTING EYE AND A CHAIN. THE LIFTING EYE SHALL BE USED AT ALL TIMES WHEN MOVING THE PUMP.

## SECTION V MAINTENANCE

ABS pumps are designed for long lasting, efficient and reliable service with a minimum number of preventative maintenance checks. These checks are few but will add years of satisfactory service to the life of the pump. Maintenance checks should be performed at approximately the intervals stated (the actual time interval will depend on the operating environment).

### 5-1 MAINTENANCE NOT REQUIRING REMOVAL OF THE PUMP

#### 5-1-1 PUMP WASH-DOWN

The build-up of sludge on the pump body and cooling fins prevent the efficient dissipation of heat from the motor. This internal heat rise can lead to a shortening of the motor life. It is recommended, therefore, that at six month intervals the pump be washed down with a pressure hose.

#### 5-1-2 FLOAT SWITCH CLEANING

The build-up of the same fats, grease, and sludge on the float switches may cause them to function improperly. The float switches should be checked for sludge build-up at three month intervals. They may be lifted from the pit and cleaned, or cleaned in place if they are anchored to structural parts of the station. After cleaning, they should be visually inspected and worked in sequence to check pump operation. See Paragraph 2-6.

### 5-2 MAINTENANCE REQUIRING REMOVAL OF THE PUMP

#### CAUTION!

NO REPAIRS SHALL BE MADE TO PUMP DURING WARRANTY PERIOD WITHOUT PRIOR FACTORY APPROVAL. TO DO SO MAY VOID THE WARRANTY. ANY REPAIRS SHALL BE MADE BY AN AUTHORIZED SERVICE REPRESENTATIVE.

To accomplish pump removal for periodic maintenance, the following procedures are recommended:

To remove the pump assembly from the sump basin, first close the discharge gate valve. Then, using the lifting chain, raise the pump along the guide rail out of the well. If the pump is checked right outside the tank, it is not necessary to disconnect the cable. If the pump is to be moved away from the wet well, the cable must be disconnected.

#### CAUTION!

IT IS EXTREMELY IMPORTANT THAT UNDER NO CIRCUMSTANCES THE PUMP BE LIFTED USING THE CABLE.

UNDER NO CIRCUMSTANCES SHOULD TOOLS BE APPLIED TO THE PUMP AND MOTOR WITHOUT THE POWER TO THE CONTROL BOX BEING DISCONNECTED AND LOCKED OUT.

### 5-2-1 SEAL OIL CHECK

WHC-SD-W011H-OMM-001, Rev. 0

The seal oil in the oil chamber should be checked at yearly intervals or when the seal alarm signal is given.

1. Lay the pump in a horizontal position with the oil fill plug upwards. Clean around the pump (2010).
2. Remove the plug and fiber washer (2010 and 4600). The oil level should be approximately 20mm (3/4 inch) below the counterbore.
3. Drain off a small quantity of oil (7400). If the oil is in a clean condition, no further checks are necessary. Replenish the oil and replace the plug using a new fiber washer (4600).
4. If the oil has become discolored or emulsified, i.e., milky looking, drain off all the oil and refill with the correct quantity of new 10W High Detergent oil (7400). Multi-viscosity oil is not suitable.
5. A further check must be made after an interval of three weeks. If the oil has again become discolored, the lower mechanical seal and possibly the upper mechanical seal should be replaced. The motor housing should be removed to inspect for water entry (see Paragraph 5-2-2).

**5-2-2 MOTOR HOUSING REMOVAL AND MOTOR INSPECTION**

If contaminated oil is found in the oil chamber, check for possible water in the motor housing as follows:

1. With the pump upright, remove 4 Allen screws (1040) holding the motor housing to the oil chamber (0040).
2. Lift the pump vertically about 2 inches above the bench.
3. Tap gently to free the O-Ring (4410) compressed between oil chamber and motor housing until the pump drops down from the motor housing (0010).
4. Disconnect the seal probe (di-electrode) (0510) wire from the bearing lid (0760) using longnosed pliers and remove the motor housing.
5. Visually inspect for water or oil.
6. If the stator (0020) is wet, take action as required or call factory.

**5-2-3 LOWER MECHANICAL SEAL REMOVAL**

1. Drain off the oil (see Paragraph 5-2-1).
2. Remove the volute (0200) by taking out the 4 Allen screws (1040) securing it to the oil chamber. If the volute does not release easily, lift the pump a short distance off the bench and tap the volute all around until it releases. Lay the pump on its side. The impeller (0160) is now removed by withdrawing the Allen screw (right hand thread) (1000 or 1002) and washer (0480) from the center.
3. Remove the impeller key (4800).
4. The mechanical seal (3800) can now be dismantled; refer to Figure 5-1.

**5-2-4 OIL CHAMBER REMOVAL**

1. Remove the motor housing per Paragraph 5-2-2 and the lower mechanical seal per Paragraph 5-2-3.
2. Tap off the oil chamber (0040).

**NOTE**

See Paragraph 5-2-14 for proper oil quantities and assembly procedure.

**5-2-5 REMOVAL OF UPPER MECHANICAL SEAL AND TRANSITION PIECE**

1. Remove circlip (5410).
2. Remove the rotating metal seal ring, together with its O-Ring, discard O-Ring (3900). Never reuse a removed or exposed O-Ring; replace with new.
3. Remove the transition piece (0050) by taking the 4 Allen screws (1020) out. Discard the transition piece O-Ring (4420).
4. Pry out the stationary seal (rubber boot and ceramic/carbon seal) with a screwdriver, and discard (see Figure 5-1).

**5-2-6 INSTALLATION OF UPPER MECHANICAL SEAL AND TRANSITION PIECE**

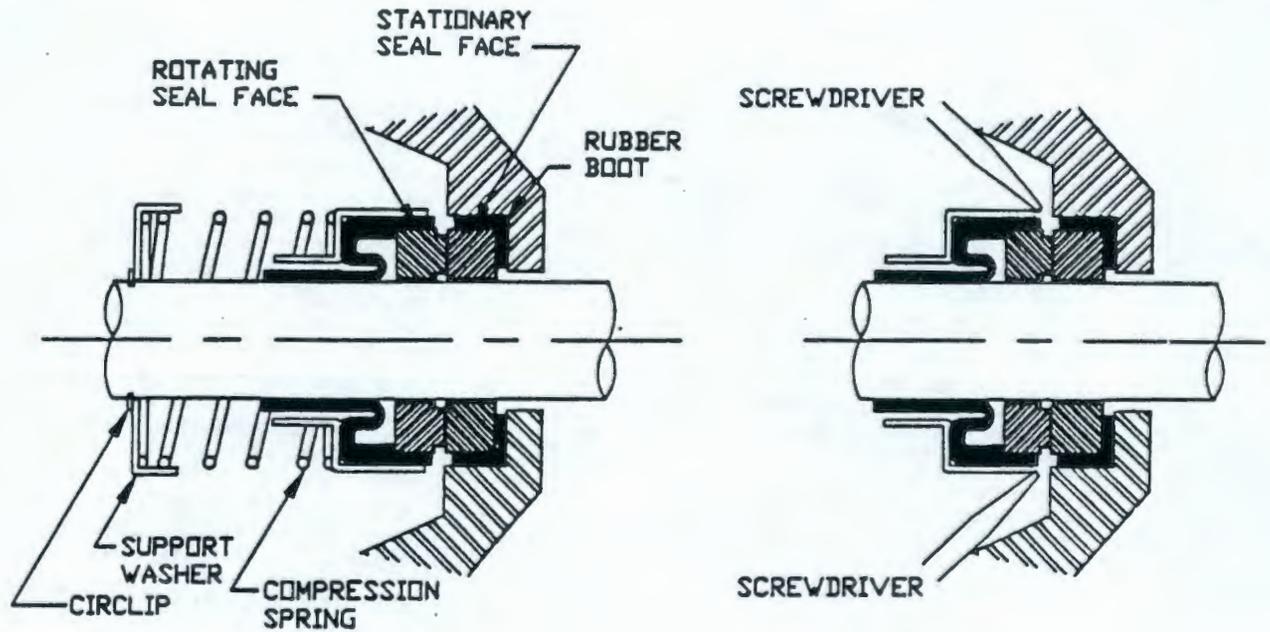
1. Using soapy water, lubricate the outside of the rubber boot of the stationary seal assembly (3900). Do not touch the ceramic/carbon seal face. Insert seal into the transition piece (0050).
2. Install new transition piece O-Ring (4420), and place the transition piece into the bearing lid (0760). Secure with the 4 Allen screws (1020) and spring washer (3300); apply pressure evenly.
3. Apply water/soap solution on the seal rubber skirt and install the new rotating seal ring on the shaft so that the polished face mates with the ceramic/carbon face of the stationary seal. Take care not to cut the rubber skirt on the circlip groove.
4. Install the compression spring and support washer. Insert circlip, compress the mechanical seal assembly in order to properly seat the circlip (5410).

**5-2-7 BEARING LID AND LOWER BEARING REMOVAL**

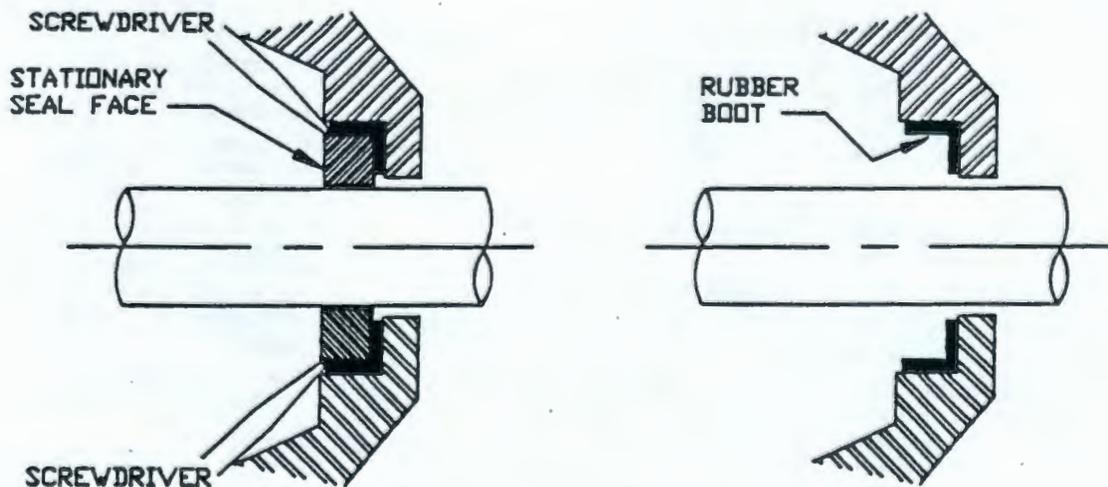
1. Remove the motor housing per Paragraph 5-2-2, the lower mechanical seal per Paragraph 5-2-3, the oil chamber per Paragraph 5-2-4, the upper mechanical seal per Paragraph 5-2-5, and the transition piece per Paragraph 5-2-5.
2. Remove the shaft circlip (5400).
3. Support the bearing lid (0760) and press out the motor shaft.
4. Press the double row ball bearing (5100) out of the transition piece (0050) opening.
5. Remove the safety ring (5200) from behind the bearing (5100). It can be cleaned and re-used after inspection.

**5-2-8 CABLE REPLACEMENT (STANDARD)**

1. If a connection chamber (0350) is fitted, remove four Allen screws (1004) and spring washers (3300). Remove chamber lid (0410).
2. Disconnect ground wire from body. Disconnect cable wires from terminal board (9030) by removing nuts (2500).
3. If a connection chamber is not fitted, remove motor housing per 5-2-2. Disconnect ground wire from housing. Clip other wires close to crimp connectors.
4. Remove two Allen screws (1010 or 1020) and spring washers (3300 or 3310) from cable clamp (0150) on the side of the cable cap (0320). Take out the clamp. Remove two Allen screws (1030) and spring washers (3310, 3320 or 3301) securing the cable cap (0320) to the housing.
5. Pull out the cable cap (0320), cable seal (0400), washer (0340) if present, and cable (9120).



1. Remove the circlip (5410) underneath the support washer.
2. Remove the support washer and compression spring. Clean the shaft thoroughly and coat with seal oil.
3. Using two screwdrivers 180° apart, pry the rotating seal face away from the stationary seal face.
4. With a continuous twisting motion, pull the seal face along the shaft.
5. Using two screwdrivers 180° apart, pry the stationary seal face out from the rubber boot.
6. Remove the rubber boot from the housing.



Mechanical Seal Dismantling Sequence  
FIGURE 5-1

**5-2-9 CABLE REPLACEMENT (EXPLOSION PROOF)**

Cables for explosion proof pumps are of a special type using a potted cable entry (0320).

If the cable has been damaged, a factory replacement assembly (9120-EX) must be obtained. Do NOT attempt to make repairs to the assembly as safety regulations could be violated and the installation become hazardous. Replacement MUST be performed by a factory authorized service representative.

1. Remove motor housing per 5-2-2.
2. Disconnect ground wire from housing body. Clip stator leads close to crimp connectors.
3. Remove four Allen screws (1010) and spring washers (3301). Pull out cable assembly (9120-EX).
4. To replace cable, thoroughly clean cable cap. Install a new O-Ring (4430). Brush O-Ring with oil, push cable cap into housing. Secure with four Allen screws (1010) and spring washers (3301). Connect wires per wiring diagram.

**5-2-10 STATOR REPLACEMENT**

1. Clip stator leads close to crimp connections. Remove connector chamber (if required) per Paragraph 5-2-12.
2. Remove the securing screws (1000 or 1002) and washers (4610) from the side of the housing (0010). Measure the depth of the tapped holes.
3. Stand the housing upright and heat the housing externally to a temperature of approximately 100° C all around. Wearing asbestos gloves, tap the housing bottom on a piece of wood until the stator (0020) drops out.

**NOTE**

The securing screws on EX Models are covered in a special compound and with a steel cap.

4. To refit a new stator, locate the housing securely on the press. The stator leads should be 90° to the cable entry hole and the V-slots in the stator body should not line up with the securing holes in the housing.
5. Press the stator home using a suitable tool on the outside flange of the stator body. Never put pressure on the stator windings or use hand tools on them.
6. This may also be accomplished by heating the motor housing to 100°C to slide stator in freely.
7. Tuck/tie all leads in neatly. Tap new screw holes into the stator to the depth previously measured. Apply a non-hardening thread sealer. Insert securing screw(s) (1000 or 1002) and washer(s) (4610).

**5-2-11 CABLE INSTALLATION**

1. Cable installation is a direct reversal of the removal sequence. There should be about 15mm of the outer jacket projecting inside the housing after tightening the cap securing screws (1030). Always use a new cable seal (0400).
2. If a connection chamber is not fitted, the leads are crimped in the correct order with insulated connectors, checking each crimp for security.
3. The ground is attached to the tapped hole provided on the housing side, using special washers and a slotted screw (1800).
4. The di-electrode wire is left loose for the present.
5. If a connection chamber is fitted, connect wires to terminal board (4030) according to wiring diagram.

**5-2-12 CONNECTION CHAMBER REPLACEMENT**

1. Remove four Allen screws (1004) and spring washers (3300). Remove chamber lid (0410).
2. Disconnect wires from terminal board (9030) by removing hex nuts (2500).
3. Remove four Allen screws (1000) and washers (3020). Remove terminal board (9030).
4. Remove two Allen screws (1035) and sealing washers (4605).
5. Remove connection chamber (0350).
6. Slice around silicone seal (if present) with a sharp knife and remove grommet (0401).
7. Thoroughly clean surfaces of connection chamber (0350), inspect and replace O-Ring (4425) if damaged.
8. Feed wires through grommet (0401). Position grommet on chamber (0350).
9. Install two new sealing washers (0402). Brush O-Ring (4425) with oil and insert chamber (0350) into motor housing (0010).
10. Place two new sealing washers (4605) onto Allen screws (1035) and secure chamber to motor housing.
11. Install terminal board (9030) using four Allen screws (1000) and washers (3020).
12. Fill cavity around wires between terminal board and grommet with silicone seal to assure a water-tight seal.
13. Connect wires to hex terminal board according to wiring diagram with nuts (2500) and jumpers (0950). Connect ground wire to housing with round head screw (1800) and lock washer (3200).
14. Inspect O-Ring (4415), replace if damaged. Brush O-Ring with oil and install chamber lid (0410) with four Allen screws (1004) and spring washers (3300).

**5-2-13 BEARING LID INSTALLATION**

1. Thoroughly clean the bearing lid (0760) having first removed the old O-Ring (4400).
2. Ensure that the dowel pin (6100) is in position.
3. Oil and loop a new O-Ring (4400) into the bearing lid groove.
4. Place the lid on the press table. Insert the safety ring (5200), position the bearing (5100) and press home.
5. Turn the lid over, place the support washer (5600) in position on the bearing, note that the lid must be mounted on a special tool supporting the bearing (5100) so that it is not pushed out as the shaft is pushed in.
6. Oil the rotor shaft (0030) and place it in the bearing (5100) and support washer (5600). Press the shaft home.
7. Remove the assembly from the press, turn it upside down and rest it on the bench. Insert the shaft circlip (5400).
8. Clean the transition piece (0050) thoroughly, oil and insert a new O-Ring (4420).
9. Push the transition piece into the bore, lining up the holes.
10. Insert and tighten evenly 4 Allen screws (102) and spring washers (3300).

**5-2-14 OIL CHAMBER INSTALLATION**

1. Thoroughly clean the oil chamber (0040) shaft and transition piece (0050) bores and rotor shaft.

**NOTE**

A new O-Ring (4400) must be used.

2. Place the oil chamber (0040) on the press table. Brush oil around the inside diameter to facilitate fitting the lid.
3. Position the lid/rotor assembly and press home.
4. Oil Chamber Capacity

Use Only 10W High Detergent Oil

AF 15,22,30-4	1.5 Litres
AF 13, 18,28-4W	(1.8 Quarts)
AF 13-8	
AF40,60-4	1.7 Litres
AF70-2, 90-4	(1.8 Quarts)

**5-2-15 MOTOR HOUSING INSTALLATION**

1. Loop a new O-Ring (4410) over the bearing lid diameter. Brush oil around same.
2. Suspend the motor housing/stator assembly over the oil chamber/shaft assembly.
3. Line up the location marks on the housing and oil chamber.
4. Line up the dowel pin in the bearing lid with the for slot in the housing. The bearing lid may have to be turned to do this.
5. Lower the housing to within about 2 inches of the oil chamber.
6. Insert the seal probe (di-electrode) wire using long nosed pliers.
7. Lower the housing the rest of the way, ensuring that:
  - a. The dowel locates in the motor housing for slot.
  - b. the location marks line up.
  - c. the O-Ring is not pinched and,
  - d. no wires are pinched.
8. Insert and tighten the 4 securing Allen screws (1040) and spring washers (3320).

**5-2-16 LOWER MECHANICAL SEAL INSTALLATION**

1. Dip the stationary part of the mechanical seal (3800) in soapy water.
2. Press into position using a clean, lint-free rag with both thumbs. Do not use hard or sharp tools on the mechanical seal.
3. Slide the rotating part of the seal into position after dipping in soapy water.
4. When the complete seal assembly is in place, insert the securing circlip (5410).

**5-2-17 REPLACING THE IMPELLER**

1. Place the impeller key (4800) in slot on shaft (0030).
2. Tap the impeller (0160) into position.
3. Insert the impeller securing washer (0480) and the Allen screw (1000), tighten.

**5-2-18 REPLACING THE VOLUTE**

For Vortex models, oil and loop a new O-Ring (4470) over the oil chamber end. Push the volute (0200) onto the oil chamber with the discharge in the proper position. Install the hammer screws (1100) and hex nuts (2540).

For CB models, push the volute onto the oil chamber with the discharge in the proper position. Install the Allen screws (1000) and lock washers (3320). Install the bottom plate (0230) into the volute per Paragraph 5-2-19.

**5-2-19 BOTTOM PLATE ADJUSTMENT**

1. Push the bottom plate (0230) into position on the volute (0200).
2. Hold it in position with one hand, check the gap between the impeller blade and bottom plate shearing with a feeler gauge. The correct gap is 0.4--1.0mm (.010" --.025").
3. The gap is adjusted by turning the brass adjusting screws (0290) one half turn at a time until the gap is even all around.
4. Insert and tighten the four Allen screws (1001) through the brass screws (0290). Re-check the gap and adjust if necessary.

**5-3 HELPFUL HINTS FOR ON-SITE INSPECTION AND SERVICING OF PUMPS**

There are many checks which can be carried out on site without the necessity of transporting the pump to a workshop. They are listed below to aid the service technician.

1. Check direction of rotation - see Paragraph 3-4-1.
2. When pump is fully submerged and running under normal conditions, check the current draw. Compare with nameplate or technical data and check setting of overload in control panel.
3. Check the function of the seal probe (di-electrode). Is the warning signal on? Is the probe functioning? This can be checked by placing a jumper lead between the #3 control lead from the pump and ground. This simulates water in the oil chamber.
4. Check float switches and cable for accumulations of dirt, grease, etc. Carefully wash off floats. Check operation as indicated in Paragraph 2-6 of maintenance manual.
5. Check cables for damage.
6. Sump/Well cleaning: When cleaning the pump, the opportunity to remove any build-up of sediment/sludge in the sump bottom should be taken. Loosen the sediment with a spade and shovel it towards the pump. Add water and pump loose sediments away, repeating until well is clean.
7. Check control panel for functioning. Note any faults and check also for moisture or corrosion.
8. Check function of check valves - especially in duplex stations.

9. Stator Check: The stator windings can be checked for continuity via the cable ends.
10. Meg-Ohm resistance test: This is done between pump body or ground connection and power leads. The resistance should be in the meg-ohm range.
11. After raising and cleaning the pump, it is recommended that the impeller be inspected and the gap measured - see Paragraph 5-2-19 for adjustment method.
12. Seal Oil Check - see Paragraph 5-2-1. If the oil is good, simply replenish the amount taken out (within 20mm or 3/4 inch of the plug screw). Use a new fiber washer when replacing plug. (Do not overfill with oil as an air pocket is needed to compensate for heat expansion).
13. Head and Flow Check: In certain cases, pressure gauges are installed which measure pressure in the pump discharge line. These are mainly used to indicate fall-off in head pressure. Direct comparison to the pump performance curve is difficult as:
  - a. The head will vary as water level falls,
  - b. the discharge may vary depending on valve settings. However, regular recording of the head will indicate that impeller/bottom plate adjustment may be needed or that a check valve is allowing back flow in a duplex station.

Regular recording of the pressure readings will help in determining the condition of the pump unit and piping system.

\* For dry pit models, loop a new O-Ring (4450) onto the bottom plate.

# 5-4 TROUBLESHOOTING CHART

AF 13-90

WHC-SD-W011H-OMM-001, Rev. 0

SYMPTOM	POSSIBLE CAUSE	REMEDY
1. PUMP WILL NOT START	<ul style="list-style-type: none"> <li>A. Power supply failure</li>   <li>B. Burned-out fuse or tripped circuit breaker.</li> <li>C. Damaged power cable.</li> <li>D. Level switch failure</li> <li>E. Jammed impeller.</li> <li>F. Water inside motor.</li> <li>G. Foreign matter build-up.</li> </ul>	<ul style="list-style-type: none"> <li>A. Check power supply Check out electrical system for loose connections. Check operating voltage between a two power lines, three phase. Check operating voltage between terminals L1 and L2, single phase.</li> <li>B. Check circuit protectors, reset circuit breakers.</li> <li>C. Check external cable for damage-repair.</li> <li>D. Check level switches.</li> <li>E. Inspect and remove jamming object</li> <li>F. Refer to Symptom 8 and 9.</li> <li>G. Clean floats carefully.</li> </ul>
2. REPEATED TRIPPING	<ul style="list-style-type: none"> <li>A. Circuit protection underrated.</li> <li>B. Phase current unbalance.</li> <li>C. Pump connected to incorrect voltage.</li> <li>D. Wet or damaged wiring.</li>   <li>E. Obstruction in pump.</li> <li>F. Incorrect rotation.</li> </ul>	<ul style="list-style-type: none"> <li>A. Check rating and replace with proper size.</li> <li>B. Check amp draw.</li> <li>C. Verify connections. See wiring diagram.</li> <li>D. Inspect external cable and replace if worn or damaged.</li> <li>E. Remove obstruction.</li> <li>F. Check rotation per Paragraph 3-4-</li> </ul>
<b>IF SYMPTOMS CONTINUE, CONSULT ABS PRODUCT SERVICE DEPARTMENT.</b>		
3. PUMP RUNS IN "HAND" BUT NOT IN AUTOMATIC MODE	<ul style="list-style-type: none"> <li>A. Bad "OFF" float</li>   <li>B. Bad "ON" float switch.</li> </ul>	<ul style="list-style-type: none"> <li>A. Install wire jumper between OFF sw terminals. If pump starts to run, replace the "OFF" float switch.</li> <li>B. Install wire jumper between ON float terminals. If pump starts to run replace the ON float switch.</li> </ul>
4. PUMPS RUN SEPARATELY BUT NOT TOGETHER (DUPLEX OPERATION)	<ul style="list-style-type: none"> <li>A. Faulty lead pump float switch.</li>   <li>B. Faulty lag pump float switch.</li> <li>C. Foreign matter build-up on floats.</li> </ul>	<ul style="list-style-type: none"> <li>A. With power off, invert each float switch. Check leads for continuity. Replace failed switch.</li> <li>B. Same as Remedy A.</li> <li>C. Clean floats.</li> </ul>

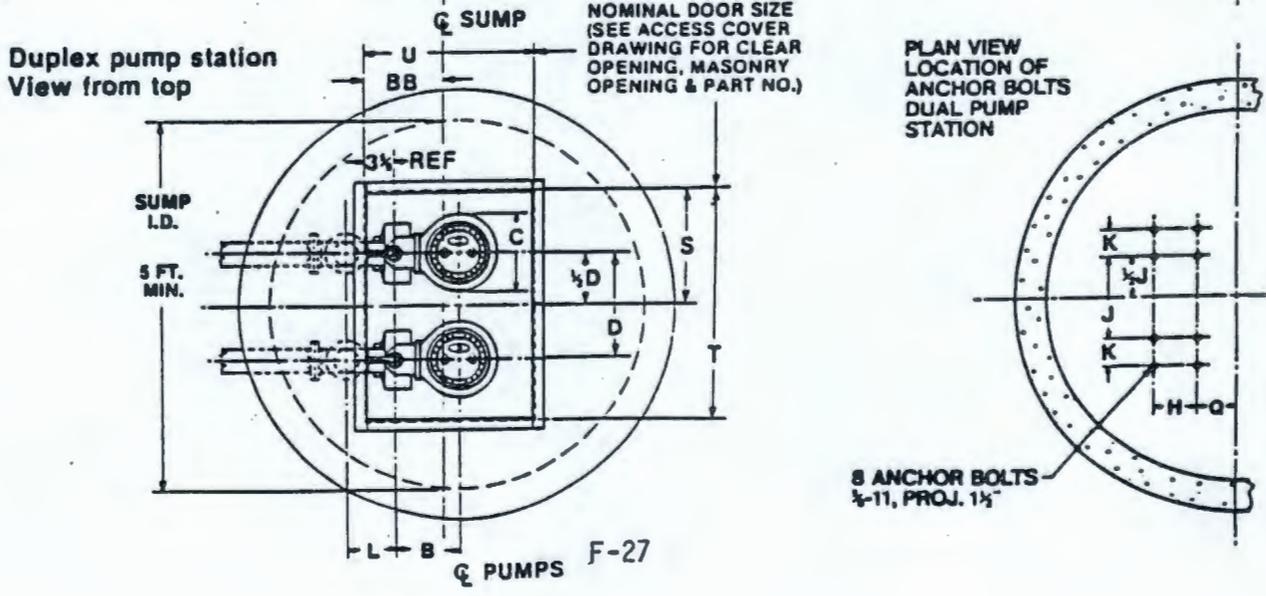
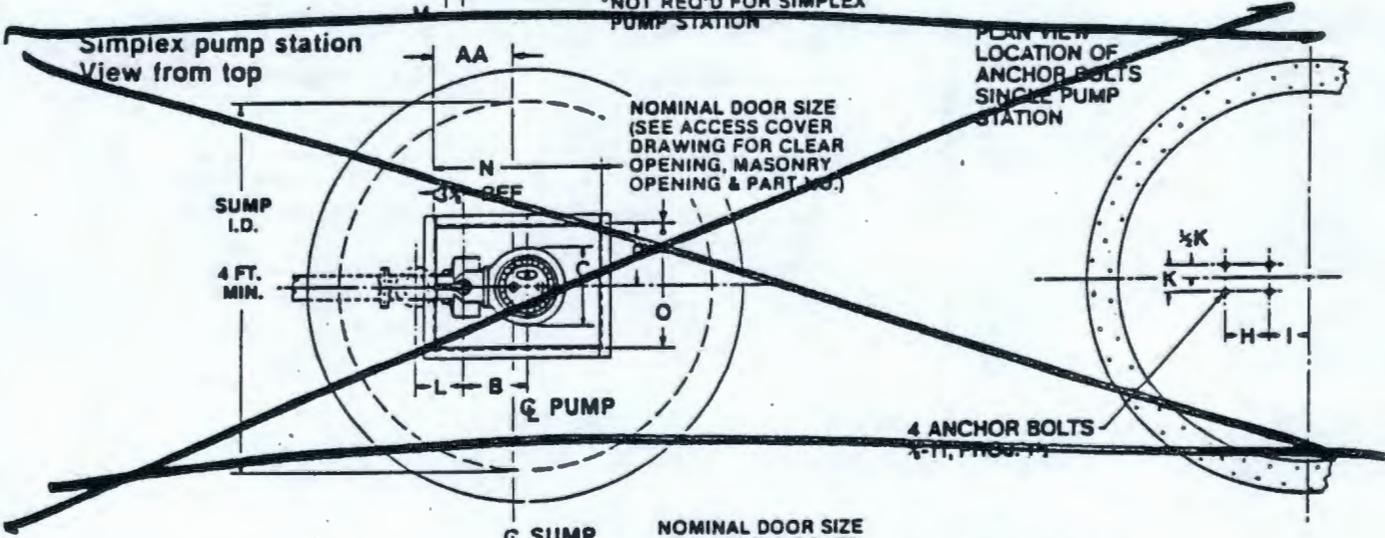
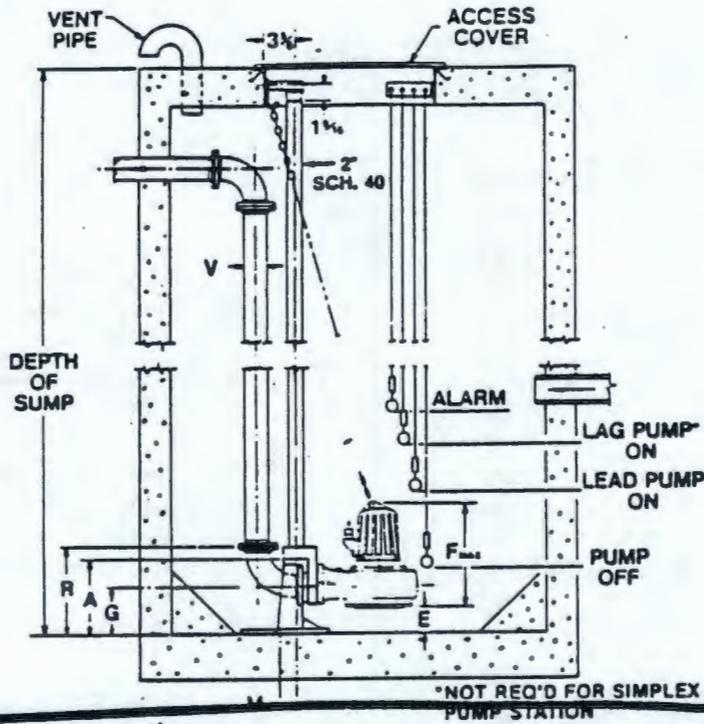
5-4 TROUBLESHOOTING CHART  
AF 13-90

SYMPTOM	POSSIBLE CAUSE	REMEDY
5. PUMP WILL NOT SHUT OFF.	<ul style="list-style-type: none"> <li>A. Float switch failure.</li> <li>B. Control panel failure.</li> </ul>	<ul style="list-style-type: none"> <li>A. With power off, check float switches for continuity.</li> <li>B. Check control panel schematic drawing.</li> </ul>
6. HIGH LEVEL ALARM DOES NOT COME ON.	<ul style="list-style-type: none"> <li>A. Faulty high level alarm switch.</li> </ul>	<ul style="list-style-type: none"> <li>A. Install wire jumper between alarm terminals. Replace high level alarm float switch.</li> </ul>
7. LOW FLOW.	<ul style="list-style-type: none"> <li>A. Incorrect rotation.</li> <li>B. Liquid level in pit too low, air bound.</li> <li>C. Obstruction in pump or piping.</li> <li>D. Partially closed valve(s).</li> </ul>	<ul style="list-style-type: none"> <li>A. Check rotation per Paragraph 3-4-1.</li> <li>B. Check liquid level and location of level switches.</li> <li>C. Remove obstruction.</li> <li>D. Check and adjust valve.</li> </ul>
8. WATER IN OIL CHAMBER	<ul style="list-style-type: none"> <li>A. Loose or damaged oil plug.</li> <li>B. Mechanical seal failure.</li> </ul>	<ul style="list-style-type: none"> <li>A. Check plug - replace.</li> <li>B. Replace mechanical seal per Paragraph 5-2-3.</li> </ul>
9. WATER INSIDE MOTOR CASING.	<ul style="list-style-type: none"> <li>A. Damaged upper lip seal or mechanical seal.</li> <li>B. Damaged O-Ring between oil chamber and motor casing.</li> </ul>	<ul style="list-style-type: none"> <li>A. Replace seal per Paragraph 5-2-5. and Paragraph 5-2-6.</li> <li>B. Replace O-Ring.</li> </ul>

# PUMP STATION DIMENSIONS

WHC-SD-W011H-OMM-001, Rev. 0

TYPICAL DRAWING ONLY, NOT FOR CONSTRUCTION PURPOSES.  
CONTACT FACTORY FOR CERTIFIED DRAWINGS.



**INSTALLATION DIMENSIONS**  
**~~STANDARD AND EXPLOSION PROOF MODELS~~**

(Refer to Illustrations on Preceding Page)

~~MODELS: AF 13-4, AF 18-4W, AF 15-4, AF 22-4, AF 13-6 CB 2 4"  
AF 28-4W, AF 30-4, AF 13-6 CB 3 4"~~

A	B	C	D	E	F	G	H	I	J	K	L
13.19	12.50	•	26.00	**	•	8.00	6.50	1.00	21.25	4.75	7.69

M	N	O	P	Q	R	S	T	U	V	AA	BB
1.63	30.00	24.00	12.00	3.00	14.50	24.00	48.00	30.00	4.00	9.50	11.50

~~CB 2 • 12.81 \*\* 2.75 \*\*\* 20.19  
CB 3 • 14.32 \*\* 4.00 \*\*\* 19.50~~

MODELS: AF 40-4, AF 60-4, AF 30-6 CB 6 4"

A	B	C	D	E	F	G	H	I	J	K	L
13.19	12.50	14.76	26.00	6.25	24.50	8.00	6.50	1.00	21.25	4.75	7.69

M	N	O	P	Q	R	S	T	U	V	AA	BB
1.63	30.00	24.00	12.00	3.00	14.50	24.00	48.00	30.00	4.00	9.50	11.50

~~MODELS: AF 13-4, AF 15-4, AF 18-4W, AF 22-4, AF 28-4W, AF 30-4 CB 1 3"~~

A	B	C	D	E	F	G	H	I	J	K	L
11.25	11.50	12.20	26.00	2.75	20.62	6.00	6.50	1.25	21.62	4.38	6.63

M	N	O	P	Q	R	S	T	U	V	AA	BB
1.50	30.00	24.00	12.00	4.25	11.50	24.00	48.00	30.00	3.00	9.88	12.88

~~MODELS: AF 22-4, AF 28-4W, AF 30-4 CB 4 6"  
AF 40-4, AF 30-4 CB 5 6"~~

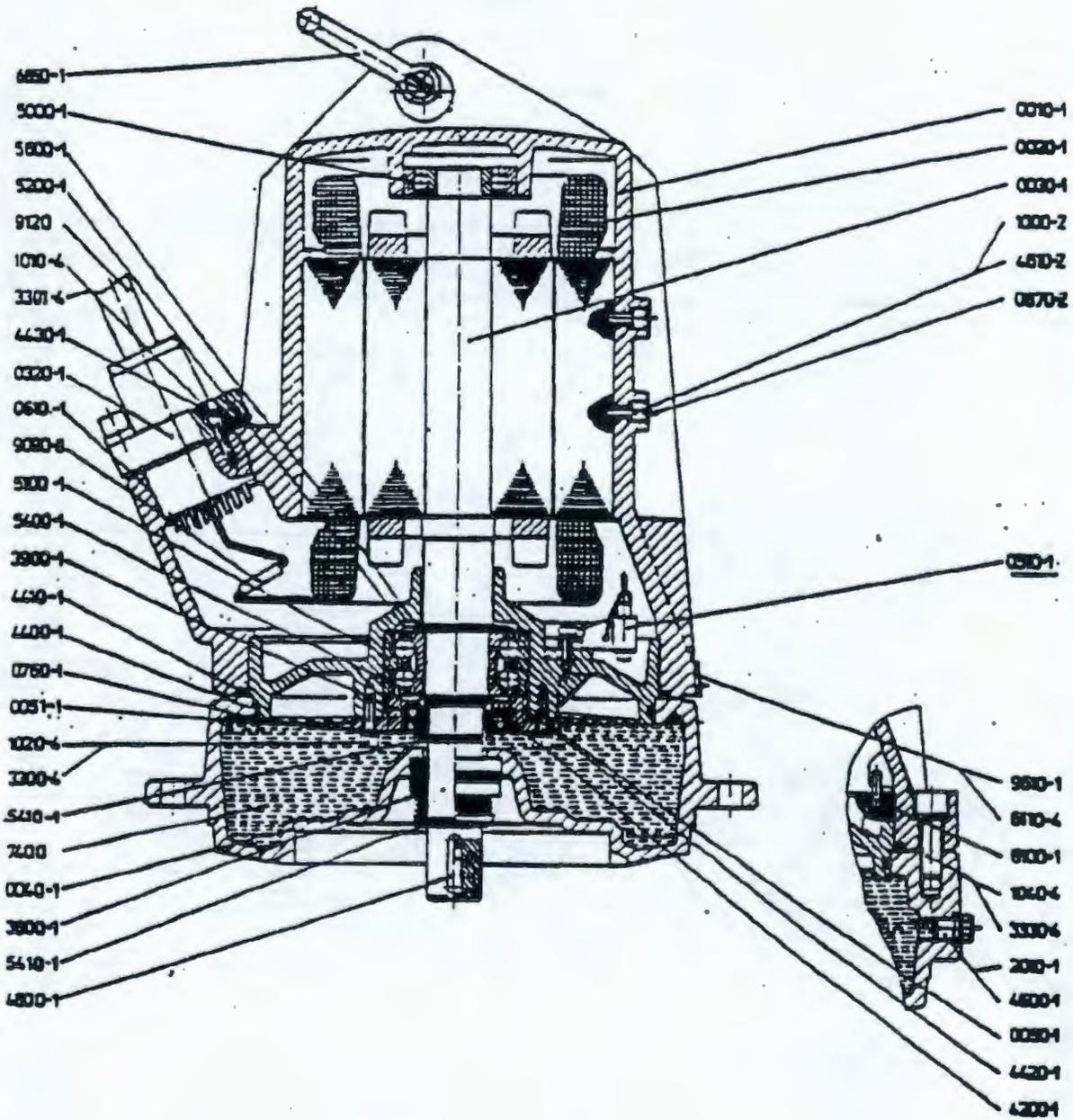
A	B	C	D	E	F	G	H	I	J	K	L
16.56	•	**	26.00	6.00	***	7.00	8.50	1.00	19.25	6.69	11.00

M	N	O	P	Q	R	S	T	U	V	AA	BB
2.69	30.00	24.00	12.00	3.00	22.50	24.00	48.00	30.00	6.00	10.38	12.38

~~CB 4 • 13.68 \*\* 15.19 \*\*\* 20.56  
CB 5 • 14.69 \*\* 17.50 \*\*\* 24.50~~

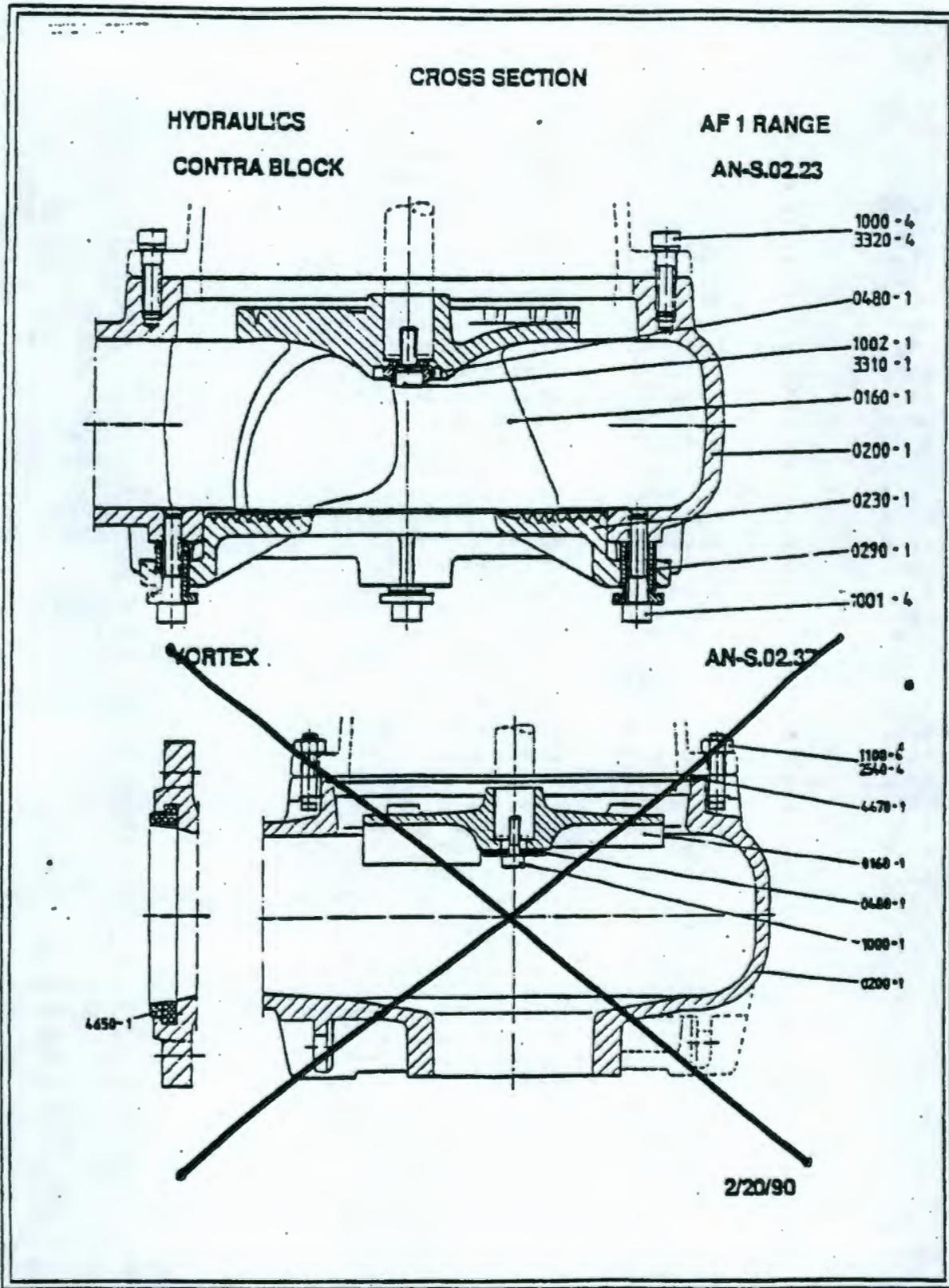
ALL DIMENSIONS ARE IN INCHES

### AF30-6, AF40-4, AF60-4 EXPLOSION PROOF CROSS SECTION



AN-S.02.54

2/20/90



28-Feb-90

PARTS LIST AF30-6, 40-4, 60-4, 90-4  
STANDARD AND EXPLOSION PROOF

REF. NO.	QTY	PART NO.	DESCRIPTION	
0010	1	3100543	Motor Housing	EX
0010	1	3100172	Motor Housing	ST
0020	1	6000240	Stator Assembly	208V AF60-4
0020	1	6000268	Stator Assembly	208V AF30-6
0020	1	6100159	Stator Assembly	208V AF40-4
0020	1	6100297	Stator Assembly	230/460V AF40-4
0020	1	6100362	Stator Assembly	230/460V AF60-4
0020	1	6100408	Stator Assembly	230/460V AF30-6
0020	1	6100302	Stator Assembly	230/460V AF90-4
0020	1	6100961	Stator Assembly	600V AF40-4
0020	1	6100962	Stator Assembly	600V AF60-4
0020	1	6100967	Stator Assembly	600V AF90-4
0020	1	6000322	Stator Assembly	600V AF30-6
0030	1	6101750	Rotor Assembly	AF40-4 EX
0030	1	6101751	Rotor Assembly	AF60-4 EX
0030	1	6101755	Rotor Assembly	AF30-6 EX
0030	1	6101795	Rotor Assembly	AF30-6 ST
0030	1	6101796	Rotor Assembly	AF40-4 ST
0030	1	6101797	Rotor Assembly	AF60-90 ST
0040	1	3104544	Oil Chamber	
0050	1	3104557	Transition Piece	
0135	2	1121113	Socket Hd. Screw	M10X25 ST
0150	1	3425522	Cable Clamp	ST
0320			Included in cable assy. (9120)	EX
0320	1	3108512	Cable Cap	ST
0340	1	1149009	Washer	20X28X3MM ST
0350	1	3130556	Connection Chamber	ST
0400	1	4307122	Cable Seal	ST
0401	1	4307334	Seal	ST
0402	2	4304002	Seal Ring	ST
0410	1	3139511	Terminal Chamber Lid	ST
0510	1	6103130	Seal Probe Assembly	EX
0510	1	6102118	Seal Probe Assembly	ST
0610			Included in cable assy. (9120)	EX
0760	1	5115229	Bearing Lid	EX
0760	1	3115228	Bearing Lid	ST
0870	2	1149020	Sealing Washer	EX
0950	6	1220048	Jumper	AF30-90ST & AF60
1000	2	1121123	Socket Head Screw	M6X16mm EX
1000	4	1121107	Socket Head Screw	M6x12mm ST
1002	2	1121014	Socket Head Screw	M5x16mm ST
1004	4	1121123	Socket Head Screw	M6x16mm ST
1010	4	1121097	Socket Head Screw	M6x25mm EX
1010	6	1121100	Socket Head Screw	M6x20mm ST
1020	4	1121027	Socket Head Screw	M6x20mm EX
1030	2	1121128	Socket Head Screw	M10x35mm
1040	4	1121114	Socket Head Screw	M12x35mm EX
1040	9	1121114	Socket Head Screw	M12x35mm ST
1800	2	1126104	Round Head Screw	M5x10mm
2010	1	1156024	Oil Plug Screw	R 1/4 EX
2010	2	1156024	Oil Plug Screw	R 1/4 ST

28-Feb-90

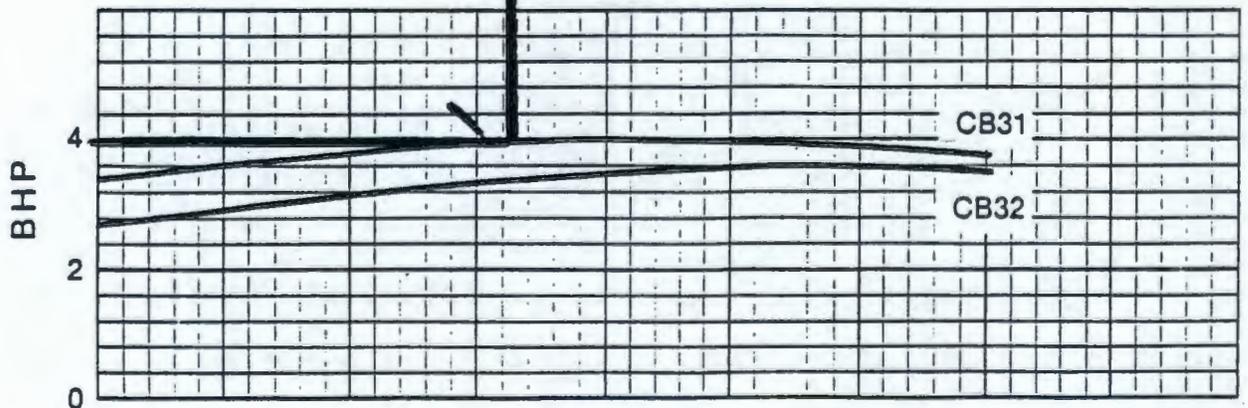
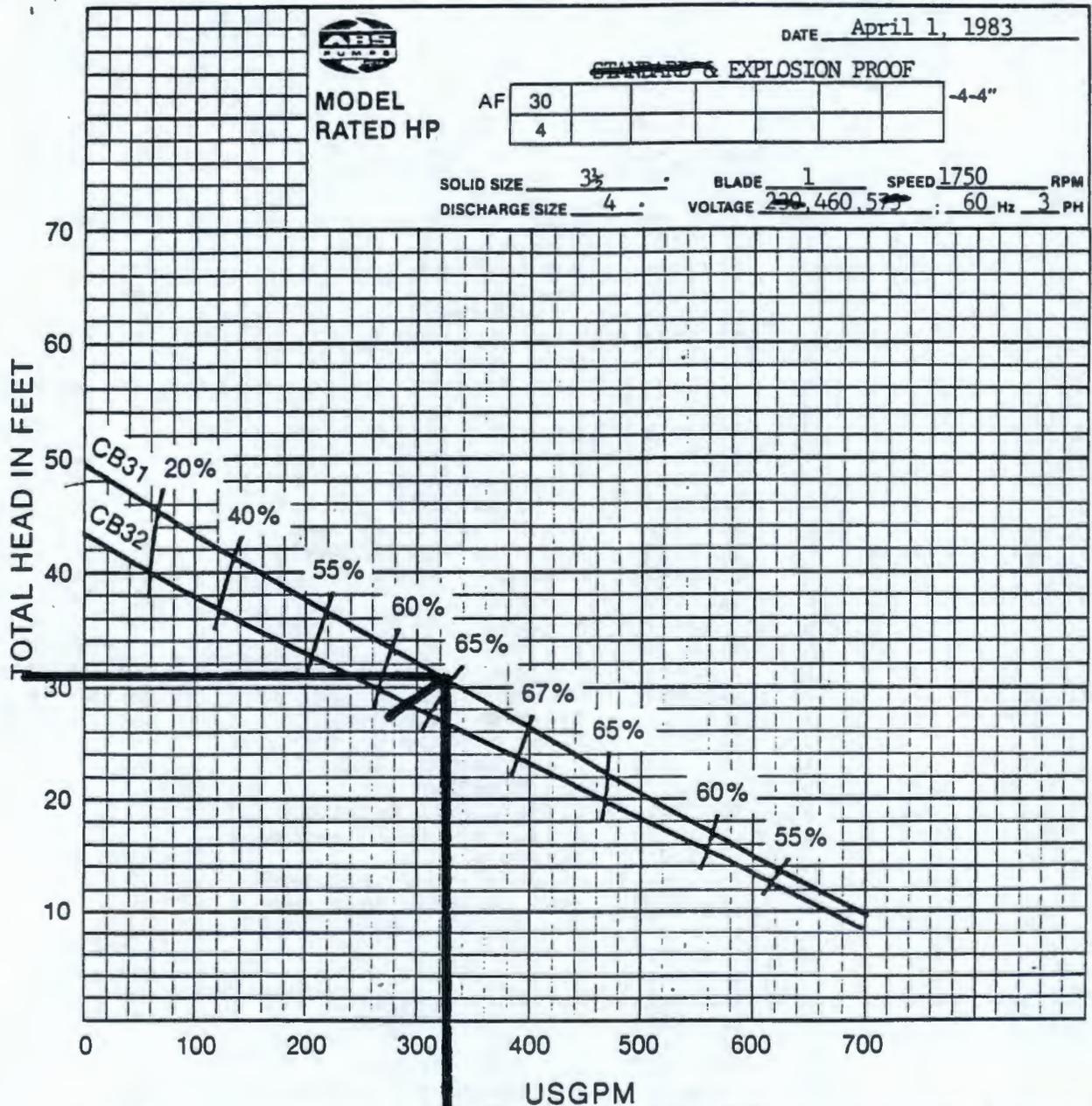
PARTS LIST AF30-6, 40-4, 60-4, 90-4  
STANDARD AND EXPLOSION PROOF

REF. NO.	QTY	PART NO.	DESCRIPTION	
2500	33	1140051	Hex Lock Nut	M5
3020	4	1147030	Washer	M5
3200	1	1153016	Lock Washer	M6
3300	4	1153004	Lock Washer	M6 EX
3300	4	1153004	Lock Washer	M6 AF30, 60, 90 ST
3300	6	1153004	Lock Washer	M6 AF40-4 ST
3301	4	1153015	Lock Washer	M6
3320	2	1153018	Lock Washer	M10
3330	4	1153019	Lock Washer	M12 EX
3330	6	1153019	Lock Washer	M12 AF30, 60, 90 ST
3330	4	1153019	Lock Washer	M12 AF40-4 ST
3800	1	1111096	Lower Mechanical Seal	
3900	1	1110029	Upper Mechanical Seal	
4400	1	1112063	O-Ring	205x5mm
4410	1	1112063	O-Ring	220x5mm
4415	1	1112038	O-Ring	101x3mm ST
4420	1	1112027	O-Ring	70x3.5mm
4425	1	1112015	O-Ring	42x3mm ST
4430	1	1112021	O-Ring	52x5mm EX
4600	1	1113014	Fiber Sealing Washer	13x18x2mm
4605	2	1113016	Fiber Sealing Washer	10.7x16x1.5mm ST
4610	1	1113003	Fiber Sealing Washer	6x10x1.5mm
4800	1	1153011	Impeller Key	
5000	1	1101049	Grooved Ball Bearing	
5100	1	1102017	Double Row Ball Bearing	
5200	1	1114017	Safety Ring	
5400	1	1108056	Circlip (Ext) 35x1.5mm	
5410	2	1107003	Circlip (Ext) 30x1.5mm	
5600	1	4201044	Support Washer	
6100	4	1155024	Rivet	AF30-90 ST
6100	1	1155054	Dowel Pin 5x20mm	AF30-60 EX
6110	4	1155024	Rivet	AF30-60 EX
6110	1	1155054	Dowel Pin 5x20mm	AF30-90 ST
6850	1	1499061	Shackle	
7400	3	1103021	10W High Detergent Oil	
9030	1	6113147	Terminal Board Assembly	ST
9060	1	1217023	Clamping Strap	ST
9090	8	1213044	Crimp Connectors	EX
9100	23	1218014	Cable Shoe	ST
9120	1	6102701	Cable Assembly 30ft	EX
9120	1	1210044	Cable 101.5 Ozoflex	42x3mm ST
9210	1	1217024	Lock Washer	ST
9610	1	4224015	Nameplate	EX
9610	1	4224014	Nameplate	ST
9680	1	1342213	Adhesive Label	ST

For replacement parts contact ABS Pumps or  
Triangle Pump & Equip.

325 GPM @ 31' TDH

SECT. 200 TAB 4" 1750 RPM 3Ø PG. 111



ABS Pumps Inc. 140 Pond View Drive Meriden, CT 06450

The AFP & AF Series Five Year Warranty is contingent on proper start-up. Please read this manual carefully. The Product Start-up Report form must be completed and returned to ABS Pumps Inc. In the event the Product Start-up form has not been received with the pump, please contact your supplier or the factory.

# Warranty

## FIVE YEAR WARRANTY - STANDARD & EXPLOSION PROOF AFP & AF SERIES PUMPS PERMANENT TYPE INSTALLATION

ABS Pumps Inc. warrants its AFP & AF Series of Submersible Pumps to be free from defects in workmanship and materials for a period of five (5) years after date of shipment to end customer, with approval of installation and start-up of the equipment by the Company's authorized on-site representative and, upon payment of the applicable percentage of the list price of the following parts in effect at time of replacement.

Part Description	Months After Shipment			
	0-18	19-31	32-45	46-60
Rotor & Stator*	0%	25%	50%	75%
Mechanical Seal	0%	25%	50%	75%
Impeller	0%	25%	50%	75%
Cutter Disc	0%	25%	50%	75%
Pump Housing	0%	25%	50%	75%
Ball Bearings	0%	40%	80%	90%

\*Stator guarantee effective only if Company's authorized control panels are used.

All other ABS manufactured equipment or other uses of AFP or AF series pumps will carry a one (1) year warranty from date of shipment to end customer, but in no event, longer than eighteen (18) months from date of shipment from the Company.

Start-up reports and electrical system schematics may be required to support Warranty claims and will be required for claims on pumps of 30 horsepower and greater.

The Company's sole obligation under this warranty shall be to make repairs and replace parts when necessary on products that have been returned to it or to an authorized service facility and found to be defective by the Company. Explosion Proof pumps (EX) must be serviced at a facility approved by ABS Pumps Inc. The Company shall not be liable for any special, indirect, or consequential damages of any kind. Major components not manufactured by the Company are covered by the original manufacturer's warranty in lieu of this warranty. The Company will not be held responsible for travel expenses, rented equipment, outside contractors fees, or unauthorized repair shop expenses. The Company neither assumes nor authorizes any person or other company to assume for it, any other obligation in connection with the sale of its equipment. Any enlargement or modification of this Warranty by a Representative or other Sales Agent is their exclusive responsibility. Transportation charges shall be borne by the Buyer. Labor charges for warranty repairs shall not be assumed by the Company for repairs made after one (1) year from date of shipment to end customer. Returns must have prior written authorization from the Company.

This warranty shall extend only to the original Owner, and shall not apply to any products that have been repaired or altered without the Company's consent or have been subject to misuse, accident or neglect, or have been used for pumping other than raw sewage or similar non-corrosive liquids.

NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WILL APPLY.



The AFP & AF Series Five Year Warranty is contingent on proper start-up. Please read this manual carefully. The Product Start-up Report form must be completed and returned to ABS Pumps Inc. In the event the Product Start-up form has not been received with the pump, please contact your supplier or the factory.

# Warranty

## FIVE YEAR WARRANTY - STANDARD & EXPLOSION PROOF AFP & AF SERIES PUMPS PERMANENT TYPE INSTALLATION

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Part Description	Months After Shipment			
	0-18	19-31	32-45	46-60
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Mechanical Seal	0%	25%	50%	75%
Impeller	0%	25%	50%	75%
Cutter Disc	0%	25%	50%	75%
Pump Housing	0%	25%	50%	75%
Ball Bearings	0%	40%	80%	90%

\*Stator guarantee effective only if Company's authorized control panels are used.

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Start-up reports and electrical system schematics may be required to support Warranty claims and will be required for claims on pumps of 30 horsepower and greater.

The Company's sole obligation under this warranty shall be to make repairs and replace parts when necessary on products that have been returned to it or to an authorized service facility and found to be defective by the Company. Explosion Proof pumps (EX) must be serviced at a facility approved by ABS Pumps Inc. The Company shall not be liable for any special, indirect, or consequential damages of any kind. Major components not manufactured by the Company are covered by the original manufacturer's warranty in lieu of this warranty. The Company will not be held responsible for travel expenses, rented equipment, outside contractors fees, or unauthorized repair shop expenses. The Company neither assumes nor authorizes any person or other company to assume for it, any other obligation in connection with the sale of its equipment. Any enlargement or modification of this Warranty by a Representative or other Sales Agent is their exclusive responsibility. Transportation charges shall be borne by the Buyer. Labor charges for warranty repairs shall not be assumed by the Company for repairs made after one (1) year from date of shipment to end customer. Returns must have prior written authorization from the Company.

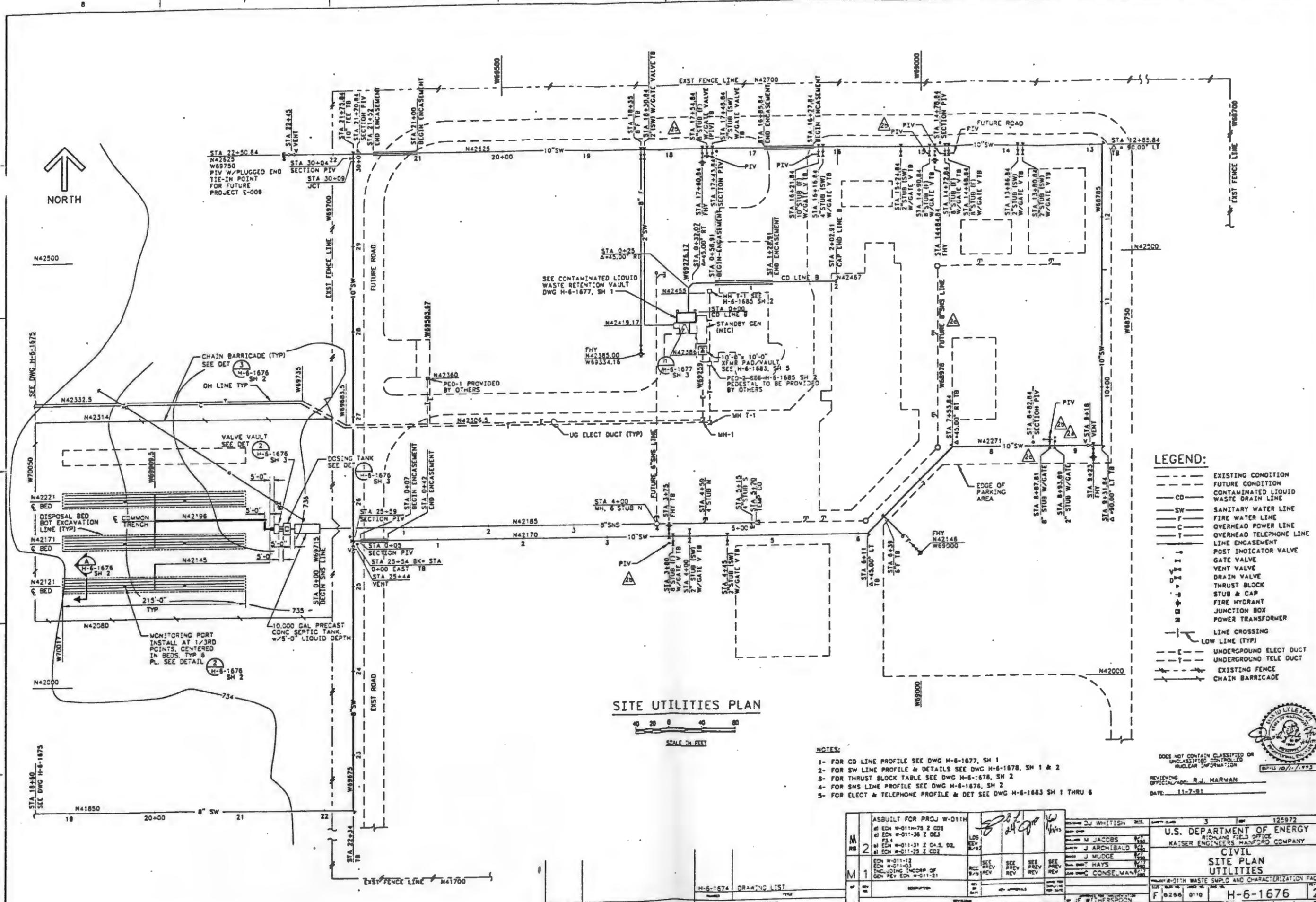
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NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WILL APPLY.

## Appendix G

### Drawings

H-6-1676, sh 1 of 3	Civil Site Plan Utilities
H-6-1676, sh 2 of 3	Civil Site Plan SNS Profile and Details
H-6-1676, sh 3 of 3	Civil Site Plan SNS Details



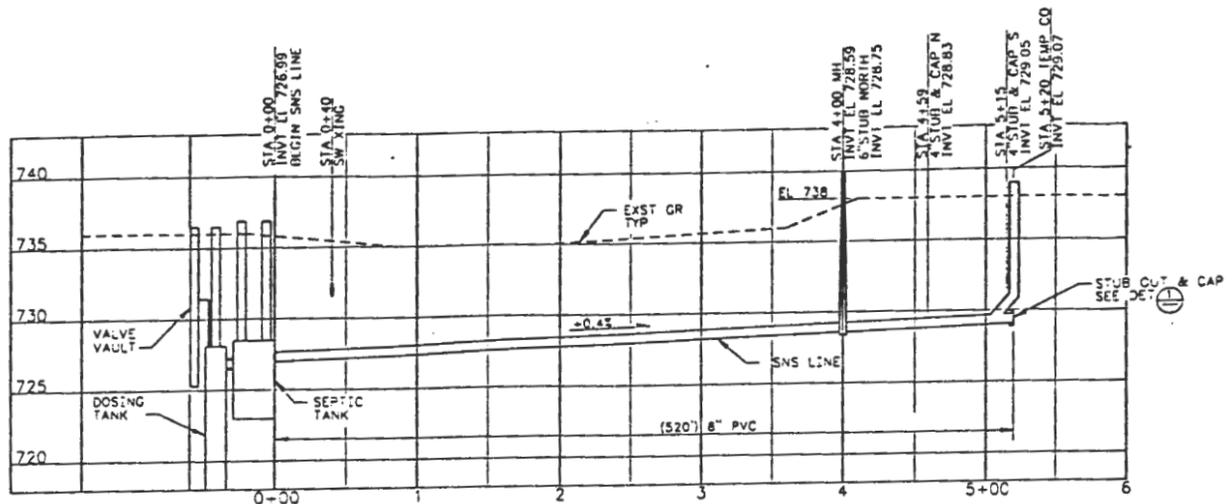
**SITE UTILITIES PLAN**



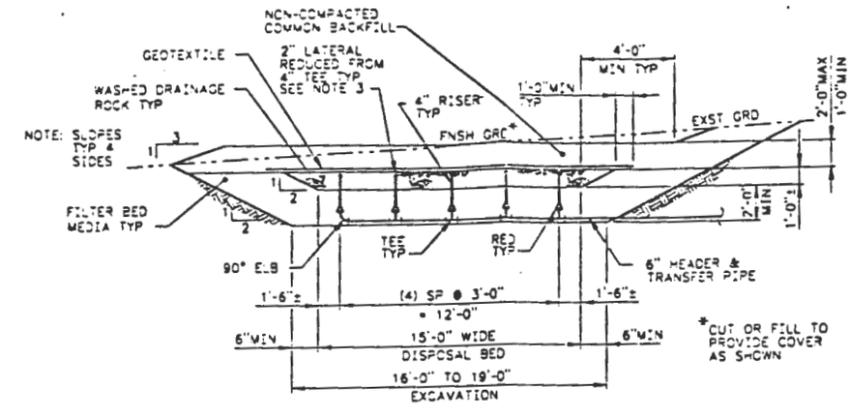
DOES NOT CONTAIN CLASSIFIED OR UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION  
 DATE: 11-7-91

ASBUILT FOR PROJ W-011H		DATE: 12/5/92		125972	
M	2	REV	BY	DATE	DESCRIPTION
	1	1	JAC	12/5/92	ISSUED FOR CONSTRUCTION
U.S. DEPARTMENT OF ENERGY RICHLAND FIELD OFFICE KATSER ENGINEERS HANFORD COMPANY <b>CIVIL SITE PLAN UTILITIES</b>					
PROJECT: W-011H WASTE SWRLC AND CHARACTERIZATION FACIL					
F 0256 010		H-6-1676		2	
DATE: 5/24/90 SCALE: 1"=40' SHEET: 1 OF 3 PLOT SCALE: 1:1 KE: A					

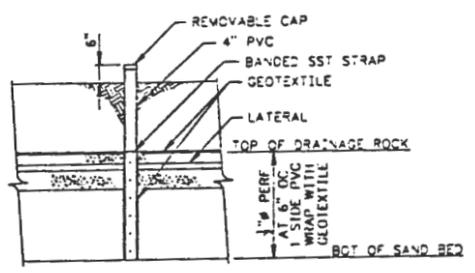
H-6-1674 DRAWING LIST



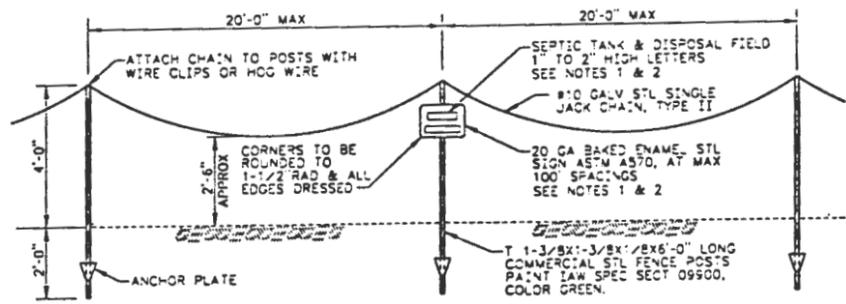
**SANITARY SEWER LINE PROFILE**  
SCALE: HORIZ: 1"=50'  
VERT: 1"=5'



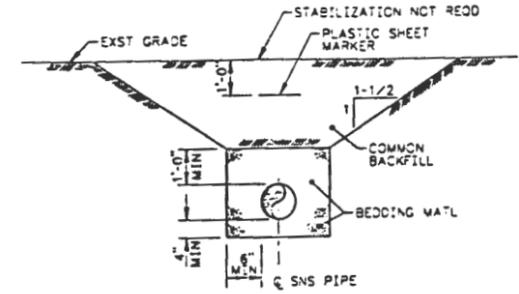
**SECTION A**  
SCALE: NONE  
TYPICAL 3 BEDS



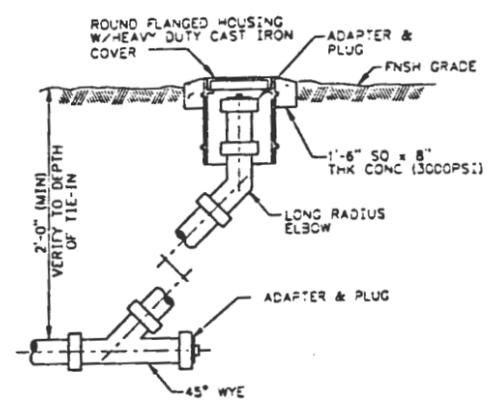
**MONITORING PORT**  
SCALE: NONE



**CHAIN BARRICADE**  
SCALE: NONE



**TYP PIPE TRENCH SECT**  
SCALE: NONE



**CLEAN OUT DET**  
SCALE: 1/4"=1'-0"

- NOTES:
- 1- SIGN CHARACTERS SHALL BE CAPITAL, VERTICAL BLOCK TYPE (GOthic).
  - 2- MOUNT SIGN USING GALV BOLTS, NUTS & WASHERS, 1/2" MIN.
  - 3- 2" LATERALS SHALL EXTEND 105.25 FEET EACH DIRECTION FROM 4" RISER TEE. DRILL 3/16" HOLES IN 2" LATERALS AT 3'-0" SPACING. THE FIRST HOLE SHALL BE 3 FEET FROM THE PIPE RISER TEE. THE LAST HOLE APPROXIMATELY 3 INCHES FROM THE CAPPED END OF THE LATERAL. THE HOLES SHALL BE PLACED IN THE TOP OF THE PIPE WITH EXCEPTION OF THE FIRST, TWELFTH, TWENTY FOURTH AND THIRTY FIFTH HOLES TO BE DRILLED IN THE BOTTOM OF THE PIPE.

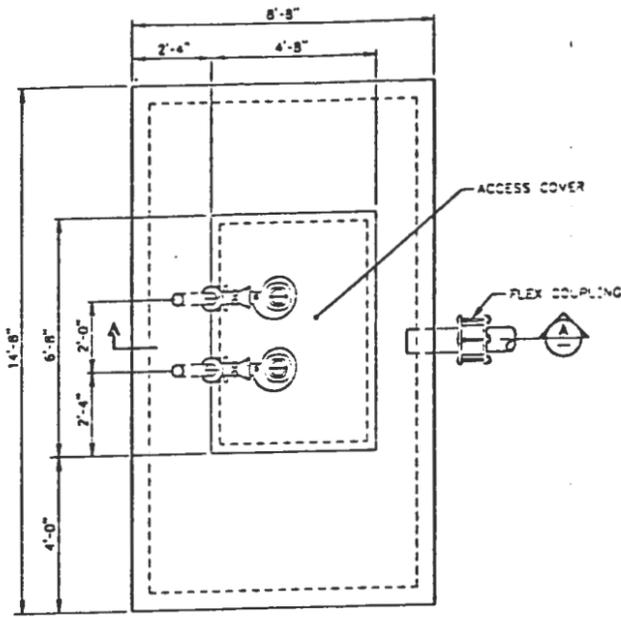
NOTE: THIS DRAWING ISSUED BY ECN W-011-21

DOES NOT CONTAIN CLASSIFIED OR UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

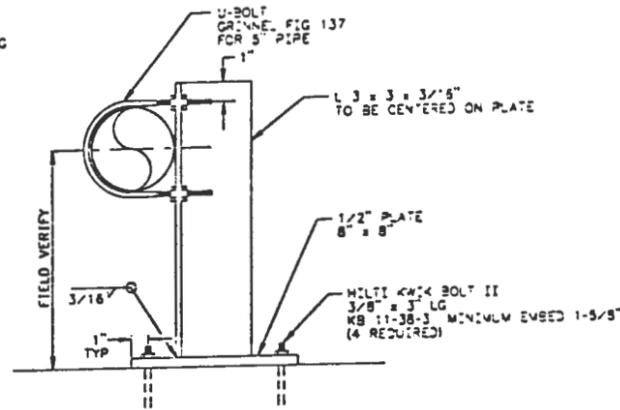
R.J. HARMAN  
Senior Equipment Support Company  
11-7-91  
Date

DAVID LYLE FORT  
Kaiser Engineers Hanford Company  
11-7-91

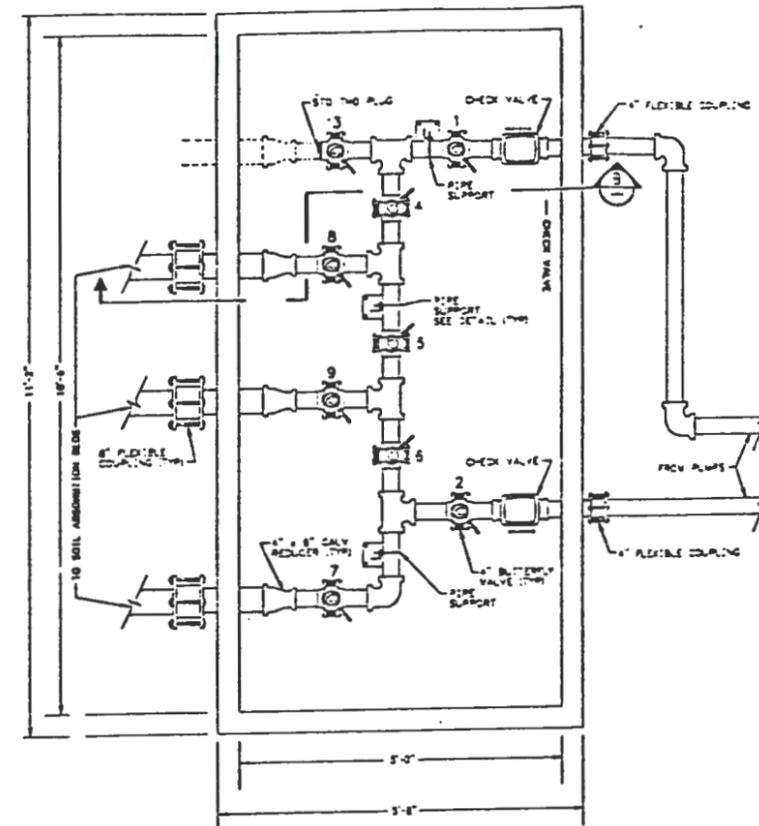
RC CROSKREY		3	ECN-W-011-21
U.S. DEPARTMENT OF ENERGY		RICHLAND FIELD OFFICE	
Kaiser Engineers Hanford Company		CIVIL	
SITE PLAN		SNS PROFILE & DETAILS	
PROJECT: W-011H WASTE SAMPLE AND CHARACTERIZATION FACILITY		H-6-1676	
DATE: 11-7-91		SHEET 2 OF 3	
DRAWING LIST		PLOT SCALE: 1:1	
H-6-1674		KE-040	



**DOSING TANK ①**  
SCALE: 1/4" = 1'-0" (4-6-1676 SH 1)



**PIPE SUPPORT**  
SCALE: NONE



**VALVE VAULT ②**  
SCALE: NONE (4-6-1676 SH 1)

**OPERATIONS SCHEDULE**

VALVE DIAGRAM

FIELD NO.	1	2	3	4
FIELD #1	1	2	3	4
FIELD #2	1	2	3	4
FIELD #3	1	2	3	4
FIELD #4	1	2	3	4

FIELD ROTATION SCHEDULE

FIELD NO.	1	2	3	4
FIELD #1	1	2	3	4
FIELD #2	1	2	3	4
FIELD #3	1	2	3	4
FIELD #4	1	2	3	4

VALVE SCHEDULE

VALVE NO.	1	2	3	4	5	6	7	8	9
1	OPEN								
2	OPEN								
3	CLOSED								
4	OPEN								
5	OPEN								
6	CLOSED								
7	OPEN								
8	CLOSED								
9	OPEN								

30" WIDE x 22" HIGH x 12 TO 18 GAGE SS SHEET  
EPDM GASKET, PAINT - LIGHT GREEN BACKGROUND  
W/ BLACK LETTERS EXCEPT THE WORDS "CLOSED"  
AND "VALVE" SHALL BE RED

**SIGN DETAIL ②**  
SCALE: NONE

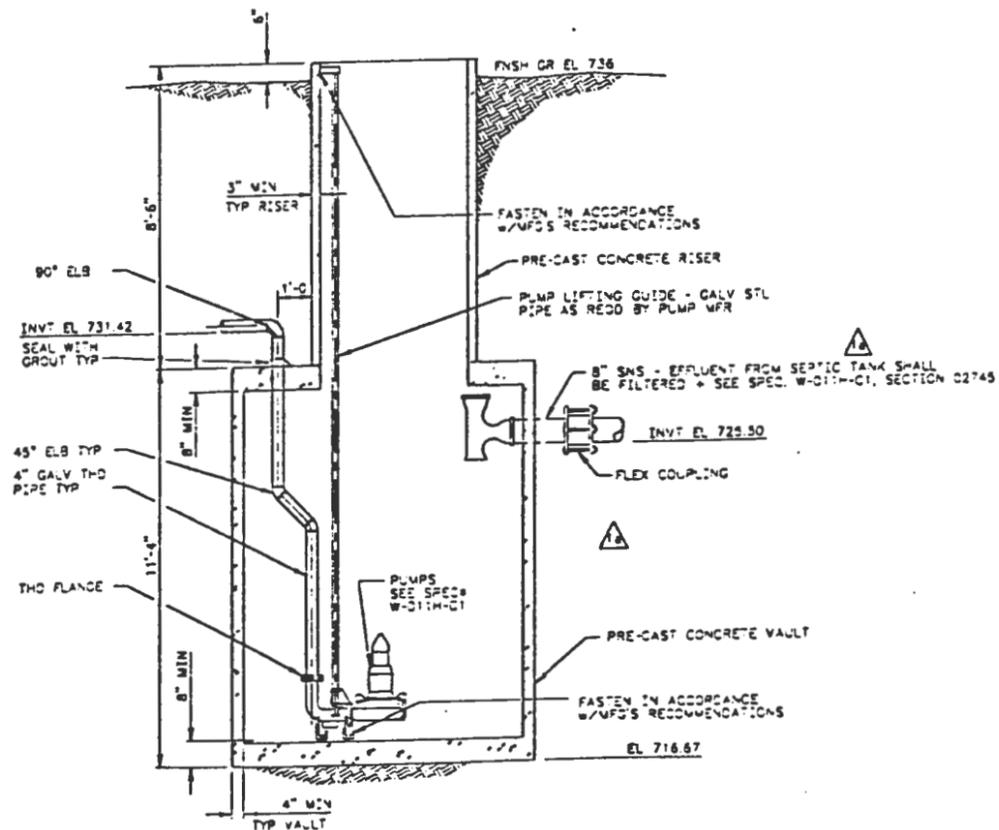
**NOTES:**

- ALL PIPE & FITTINGS BETWEEN FLEXIBLE COUPLINGS SHALL BE GALVANIZED STEEL.
- PHYSICAL ARRANGEMENT WITHIN THE VAULT MAY BE MODIFIED TO ACHIEVE IMPROVED CONSTRUCTION, SAFETY AND/OR ACCESS, INCLUDING THE SIZE OF THE VAULT.
- FLEXIBLE COUPLINGS SHALL BE INSTALLED AS SHOWN WITHIN 1'-6" OF THE VAULT WALL.
- FASTEN METAL TAGS (SSST) TO EACH VALVE WITH THE VALVE NUMBER ENGRAVED ON THE TAG.
- FLOAT BULB SWITCHES IN THE DOSING TANK SHALL BE SET TO SIGNAL PUMP CONTROLS AT THE FOLLOWING ELEVATIONS OR HEIGHTS ABOVE TANK FLOOR:  
LEAD PUMP OFF ELEV. 719.3 (1.8 FEET)  
LEAD PUMP ON ELEV. 721.2 (3.7 FEET)  
LAG PUMP ON ELEV. 721.5 (4.0 FEET)  
LAG PUMP OFF ELEV. 719.3 (1.8 FEET)  
ALARM ON ELEV. 721.4 (3.9 FEET)  
ELEVATION ABOVE DOSING TANK FLOOR MAY VARY UP TO +0.2 FEET AS LONG AS THE DIFFERENCE BETWEEN ANY TWO BULB ELEVATIONS REMAINS WITHIN ±0.05 FEET OF THAT INDICATED ABOVE.

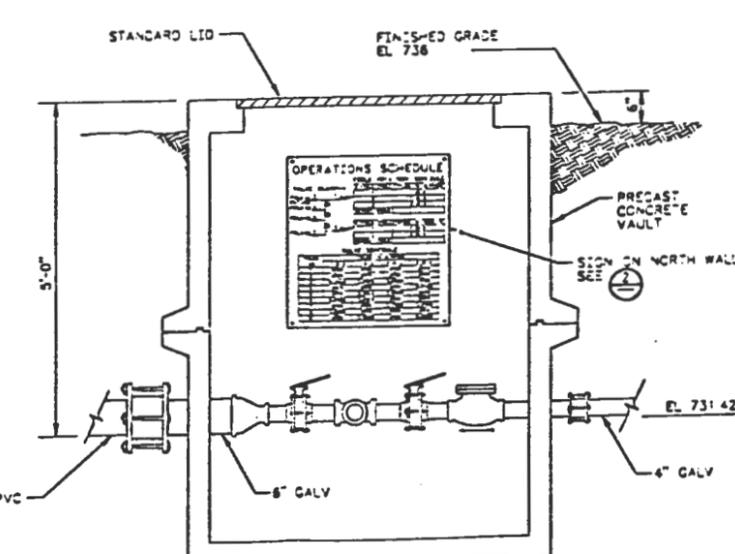
NOTE: THIS DRAWING ISSUED BY EON W-011-21

DO NOT CHANGE UNLESS BY  
ENGINEER'S CONTROLLED  
REVISIONS

R. J. HARMAN  
Senior Engineer, Kaiser Company  
11/7/91  
Date



**SECTION A**  
SCALE: 1/4" = 1'-0"



**SECTION B**  
SCALE: NONE

U.S. DEPARTMENT OF ENERGY  
RICHMOND FIELD OFFICE  
KAISER ENGINEERS HANFORD COMPANY

**CIVIL SITE PLAN SNS DETAILS**

PROJECT: ASBUILT FOR PROJ. W-011-21  
SHEET: H-6-1676 1

DATE: 11/7/91

SCALE: 1/4" = 1'-0"

2 PLOT SCALE: 1:1 KE-CAO G-4