

OPERA
MAN

**A
E
A
M
U
7
7
7**

ZUR

PERMUTIT[®]
A **ZURN** COMPANY

OPERATING AND MAINTENANCE MANUAL

THE PERMUTIT COMPANY, INC.
E. 49 MIDLAND AVENUE
PARAMUS, N.J. 07652

MARINE BASE

CAMP LEJEUNE, NORTH CAROLINA

VOLUME 1

PERMUTIT JOB NO. A141E39857

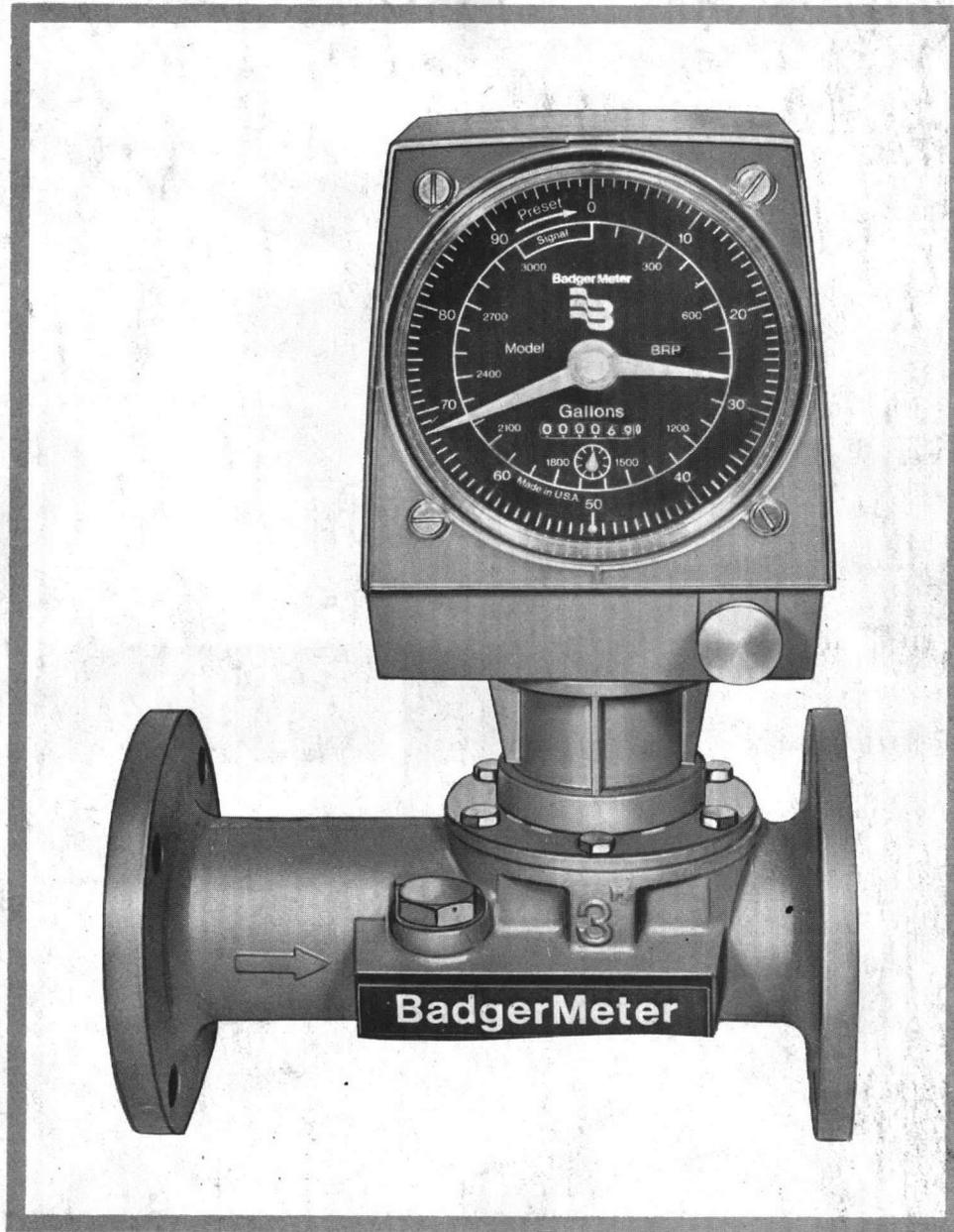
OFFICE COPY

RON BAILEY C.Q.C.

Sizes 2" through 6"
Industrial Turbo Meters

Badger Meter Instruction Manual

Model
AR
P/J 56681-99906



Badger Meter, Inc. Industrial Products Division
4545 W. Brown Deer Road, P.O. Box 23099, Milwaukee, WI 53223



(414) 355-0400

Telex: 2-6757

APPROVED:
L. E. WOOTEN and COMPANY
Consulting Engineers

By DKA

Date: 8/27/80

PREFACE

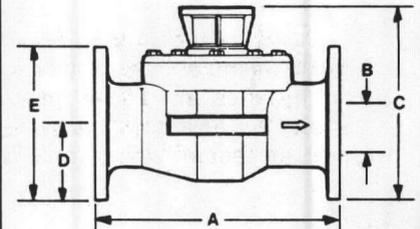
SCOPE OF THE MANUAL

This manual contains information concerning the installation, operation and maintenance of Badger magnetic drive turbo meters. To ensure efficient operation of the meters, the instructions given in this manual should be thoroughly read and understood. Retain the manual in a location where it is readily available for reference.

CHANGES IN THE MANUAL

Changes or additions to the original edition of this manual will be covered by a "CHANGE NOTICE" supplied with the manual. The change notice will explain any differences between the turbo meter received and the meters described in this manual.

METER SIZE	DIMENSIONS (Approximate Values)					NORMAL FLOW RANGE	MAX. HEAD LOSS
	A	B	C	D	E		
(50mm) 2"	10" 254mm	2" 51mm	8" 203mm	2 3/4" 70mm	6" 152mm	8-160 GPM 30-605 LPM	4.5 PSI .3 Bar
(80mm) 3"	12" 303mm	3" 76mm	9" 228mm	3 1/2" 89mm	7 1/2" 190mm	10-350 GPM 37-1320 LPM	6 PSI .4 Bar
(100mm) 4"	14" 355mm	4" 101mm	10" 254mm	4 1/4" 114mm	9" 228mm	25-1000 GPM 95-3785 LPM	5.5 PSI .37 Bar
(150mm) 6"	18" 457mm	6" 152mm	12" 304mm	5 1/4" 133mm	11" 279mm	40-2000 GPM 151-7570 LPM	5.5 PSI .37 Bar



Maximum Operating Temperature.....	250 °F (120 °C)
Maximum Operating Pressure	150 PSI (10 Bar) 300 PSI (20 Bar) Optional
Accuracy Over Entire Range*	0 to ± 1.5%
Repeatability	0.5% or Better
Connections.....	Round Flange ASA or DIN
Body Materials	SS 316, Bronze, Cast Iron, Carbon Steel
Rotor and Nose Cone Materials	Kynar or Ryton
Head Assembly Materials	SS 316 or Bronze
Straightening Vanes Material	SS 316
Head Gasket Materials	Asbestos, Nitrile or Chloroprene
"O" Ring Materials.....	EPR, Buna, Viton A
Bearing and Magnet Material	Ceramic
Spindle.....	SS 316

*Stated accuracies are calibration requirements before shipment. Tests are conducted with potable water at ambient temp. (70 °F). Accuracy may be better if electronic registration is used. All specifications may change without notice.

Tables 1-1. Configuration and Specification Data for 2" through 6" Turbo Meters

Section I

GENERAL INFORMATION

1-1. GENERAL DESCRIPTION

Badger's industrial turbo meters, available in sizes from 2" through 6", utilize a straight-through flow design to provide high accuracy over a broad flow range. Meter housings are offered in four different materials for measuring chemical solutions, water and other liquids at temperatures up to 250°F. The meters are designed for use with a variety of meter-mounted accessories such as registers or pulse transmitters.

Basic components of the turbo meter consist of the housing, meter operating head, rotor assembly, straightening vanes and register base. In addition, the 2" and 3" sizes have an adjustable bypass valve for on-site calibration (on cast iron and bronze bodies only).

In the operation of a turbo meter, liquid flows through the straightening vanes and nose cone at the inlet side of the meter so that the swirling effect of upstream piping is minimized. The liquid then strikes the blades of a rotor, causing the rotor to turn.

By means of a magnetic coupling, the rotor's motion is transferred to a vertical spindle and then to gears in the meter's register or pulse transmitter. The magnetic drive eliminates the need for packing glands and minimizes the number of parts that come in contact with the liquid being metered.

Each complete revolution of the rotor is directly proportional to a specific volume of liquid. The volume measured with each revolution increases with the size of the meter.

1-2. CONFIGURATION AND SPECIFICATION DATA

Tables 1-1 provide a summary of configuration and specification data pertaining to Badger's turbo meters for industrial applications. As indicated in the tables, there are four standard meter sizes — 2", 3", 4" and 6". In addition, each meter size is available with four different housing materials — 316 stainless steel, cast iron, carbon steel and cast bronze.

The differences between the meter sizes are characterized by the flow range, head loss, laying length and weight. The differences between configurations are characterized by the flange connections, accessories and the type of housing material that is compatible with the liquid to be metered. When reviewing the specifications, it is important to note that all flow data is based on water or liquid with the same specific gravity and viscosity as water at ambient temperature.

1-3. APPLICATIONS

The size and configuration of the turbo meter selected for use in a liquid metering application is determined, primarily, by the flow and physical characteristics of the liquid to be metered, i.e., rate of flow, operating pressure, temperature, viscosity and chemical composition of the liquid. These meters can, for example, handle a variety of chemical solutions, paper coating materials, oils, water and food ingredients.

NOTE: When ordering a turbo meter, it is important that the type of housing and "O" ring material be compatible with the liquid or chemical solution to be metered. In addition, the rotor magnet must be compatible with the type of transmitter selected.

For applications relative to a specific liquid, contact your local Badger Meter representative or the Industrial Products Division, Badger Meter, Inc. (address on title page).

1-4. ACCESSORIES

A meter-mounted and driven accessory device such as a register or pulse transmitter must be used with Badger turbo meters to obtain a visual and/or signal output that is directly proportional to the volume of liquid flowing through the meter. When using the electronic processor, the meter is furnished with an electronic transmitter and the Kynar or Ryton rotor has a four-pole magnet. For detailed information (such as function, dial capacities, unit of measure, pulse rates, etc.) regarding any of the accessories shown, contact your local Badger Meter representative or the Industrial Products Division of Badger Meter, Inc.

Section II INSTALLATION

2-1. UNPACKING AND INSPECTION

To avoid damage in transit, Badger turbo meters are shipped to the customer in special shipping containers. Upon receipt of the order, perform the following unpacking and inspection procedures:

NOTE: If damage to a shipping container is evident upon receipt of a meter, request the carrier to be present when the meter is unpacked.

a. Carefully open the shipping container following instructions that may be marked on the container. Remove all cushioning material surrounding the meter and carefully lift the meter from the container.

Retain the container and all packing material for possible use in reshipment or storage.

b. Visually inspect the meter and applicable accessory device for any physical damage such as scratches, loose or broken parts or other signs of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A claim for equipment damaged in transit is the responsibility of the customer.

2-2. INSTALLATION

The procedures for installing Badger turbo meters are essentially the same for all meter sizes. Any special instructions required for the installation and/or electrical connection of meter-mounted or free-standing accessory devices such as registers, pulse transmitters, valves and remote batch controllers will be provided as a supplement to this manual.

a. **PRELIMINARY CONSIDERATIONS.** Before proceeding with the installation, read the instructions given in the following paragraphs to become familiar with the requirements and procedures involved.

NOTE: Badger's 2" through 6" industrial turbo meters are designed for operation in HORIZONTAL piping arrangements.

1. Verify that the operating temperature range of the meter is compatible with the temperature range of the liquid to be metered. These meters can be used to meter both cold and hot liquids up to 250 degrees fahrenheit.

2. Ensure that the flow range of the meter coincides with the flow rate of the liquid to be metered. Refer to Tables 1-1 in Section I of this manual for the applicable meter flow range specification data.

CAUTION: The life of the turbo meter will be impaired if operated at flow rates higher than specified.

3. If solid material is present in the liquid to be metered, a strainer must be installed in the facility piping upstream of the meter. The 2", 3" and 4" meters require a strainer with 1/16" diameter holes and the 6" meter requires a strainer with 1/8" diameter holes.

4. Avoid locating the meter in close quarters. Allow sufficient space to permit access for cleaning and maintenance.

5. To permit periodic cleanout of the meter and to provide a convenient means of stopping fluid flow during maintenance, it is recommended that a flushing system be incorporated into the facility piping arrangement.

b. **INSTALLING THE METER.** Badger turbo meters are designed for horizontal, in-line installation. The overall dimensions (including laying lengths) of each of the meter sizes are given in Tables 1-1 in Section I of this manual. After reviewing the applicable dimensional requirements, proceed as follows:

1. Measure the overall length of the meter with the gaskets attached to the inlet and outlet flange connections of the turbo meter.

2. Provide proper gap length in the facility piping.

3. Install the meter in the pipeline making sure that the flow arrow on the meter housing is in proper relation to the direction of liquid flow.

4. Install and tighten the flange connection bolts.

5. To relieve possible strain on the piping due to the weight of 4" and 6" turbo meters, it is recommended that a meter support be installed under the meter housing.

2-3. PERFORMANCE

Complete the following checks to ensure that the meter is properly installed and operational.

a. Slowly open the upstream valve to apply liquid pressure to the meter and check the flange connections for possible leaks. Retighten the flange bolts as required.

b. Perform a functional test of the turbo meter using the adjustment and calibration procedure given in Section IV, Paragraph 4-4 of this manual.

Section III OPERATION

3-1. GENERAL OPERATING INSTRUCTIONS

The instructions for operating Badger turbo meters depend on the meter-accessory combination employed and the type of flow control devices used in the facility piping. In general, operation of the meter can be either manually controlled or accessory controlled. Manual operation applies to metering applications employing hand-operated valves or other manually-activated, flow-regulating devices that are not functionally controlled by a meter accessory device. Accessory controlled operation is used in metering applications involving meter accessories that provide an electronic, electrical or pneumatic signal to activate and/or deactivate a valve or other type of flow control device.

CAUTION: Regardless of the operating procedure used, the valves or devices controlling the flow of liquid through the turbo meter must always be opened and closed slowly or in stages to prevent shock loads that may damage the meter's rotor assembly.

a. **MANUAL OPERATION.** Instructions for the manual operation of a turbo meter are limited to the following start and stop procedures. The procedures are intended for use in simple metering applications where the flow of liquid through the meter is controlled by hand-operated valves located in the facility piping upstream and downstream of the meter.

1. Slowly open the upstream valve and apply liquid to the meter.
2. Slowly open the downstream valve to initiate metering.

3. Adjust the downstream valve so that the rate of flow does not exceed the maximum continuous flow rate specification of the meter (Refer to Tables 1-1 in Section I of this manual for the applicable flow rate specification data).

NOTE: On meters equipped with an accessory device providing a totalizing indicator, the rate of flow can be quickly checked by timing the number of gallons registered through the meter in one minute.

4. To stop metering, slowly close the downstream valve, then close the upstream valve.

b. **ACCESSORY CONTROLLED OPERATION.** The step-by-step operating procedures used in accessory controlled metering applications are dependent on the specific function of the meter-accessory employed and its electrical or pneumatic interconnection with the flow control device or devices. Refer to the IOM manuals covering the applicable accessories for specific operating instructions (included as a supplement to this manual when required.)

3-2. SHUTDOWN INSTRUCTIONS

If the turbo meter is to be shut down for an extended period of time, it is recommended that the measuring chamber be thoroughly flushed to prevent the settling out of undissolved solids or the accumulation of corrosive deposits.

Section IV MAINTENANCE

4-1. GENERAL

This section contains information for servicing and maintaining Badger turbo meters. The information consists of preventive maintenance, calibration and service instructions. Exploded views, a parts list and other illustrations are provided as a supplement to the text.

4-2. MAINTENANCE EQUIPMENT

The tools and equipment recommended for use in servicing and maintaining turbo meters are listed in Table 4-1. With the exception of a special change gear mesh gage and a calibration test tank, the tools required are the usual compliment of standard hand tools used by plumbers and mechanics.

DESCRIPTION	SPECIFICATION
Tool Kit.....	Std. Mechanics Tools
Truarc Right-Angle Pliers	P/N 1549
Change Gear Mesh Gage	Badger P/N 21747
Test Tank.....	Calibrated Volume

Table 4-1. Recommended Maintenance Equipment

4-3. PREVENTIVE MAINTENANCE

The purpose of preventive maintenance for turbo meters is to ensure efficient operation and long life by detecting and correcting any defects before damage or failure occurs to the meter. Preventive maintenance consists of periodic inspection and cleaning procedures. The procedures should be performed at regular intervals and any defects discovered should be corrected before attempting further operation of the meter.

a. PERIODIC INSPECTION

1. Visually inspect the turbo meter and meter-mounted accessory for missing hardware, loose connections, broken or scratched register lens, damaged wiring or any other signs of wear or deterioration. Repair or replace components as required.

2. Verify that the meter operates at the proper flow rate and pressure. A loss in pressure, coupled with the resulting decrease in flow rate, may indicate the screen in the upstream pipeline is clogged with material and requires cleaning.

b. CLEANING

1. Clean all dust, dirt, grease, moisture or other foreign material from the exterior of the meter and meter-mounted accessory. Use a dry cleaning solvent or volatile mineral spirits to remove grease or oil. After cleaning, rinse with water and dry thoroughly.

2. If the facility piping arrangement includes a flushing system, shut off liquid flow to the meter and flush the interior of the meter with clean water or other appropriate cleaning fluid to remove any buildup of internal deposits or corrosion.

4-4. CALIBRATION CHECK AND ADJUSTMENT

Accuracy of Badger turbo meters is tested at the factory with water. However, since these meters will be used to measure a wide variety of liquids that could vary in viscosity, it may be necessary to recalibrate a meter under operating conditions using the actual liquid. The following instructions are provided to assist the customer in performing an on-site calibration check and adjustment.

a. ACCURACY TEST

1. Place a test tank of known volume at the output of the meter.

2. Operate the meter until the test tank is filled to a calibrated level. Since the accuracy of the meter may vary slightly with the flow rate, make a test run at the actual flow rate used in the operation.

3. Record the quantity indicated on the meter-mounted accessory.

4. Repeat the test three times and take the average of the readings.

5. Perform the following calculations to determine percent of accuracy of the meter-accessory combination:

$$\frac{\text{Qty. Indicated on Accessory}}{\text{Actual Quantity in Test Tank}} \times 100 = \text{Meter Accuracy}$$

EXAMPLE 1.

$$\frac{95 \text{ Gallons}}{100 \text{ Gallons}} \times 100 = 95\% \text{ accuracy}$$

In this example the meter-mounted accessory is slow and must be speeded up by a change gear correction.

EXAMPLE 2.

$$\frac{104 \text{ Gallons}}{100 \text{ Gallons}} \times 100 = 104\% \text{ accuracy}$$

In this example the meter-mounted accessory is fast and must be slowed down by a change gear correction.

b. CHANGE GEAR CORRECTIONS. If the accuracy test of a turbo meter-accessory combination indicates that an adjustment is required, proceed as follows:

1. Remove the accessory from the register base on the turbo meter. To remove the change gears from the spindles on the register and the register base, loosen the setscrew on the hub of the change gears.

NOTE: Both the O.D. dimension (in decimal inches) and the number of teeth are stamped on each gear.

2. Calculate the ratio of existing change gears as follows:

$$\text{Ratio} = \frac{\text{No. of Teeth on Register Change Gear}}{\text{No. of Teeth on Meter Register Base}}$$

3. Calculate the new change gear ratio required by multiplying the ratio of existing change gears by percent-of-meter accuracy determined in section 4-4a.

EXAMPLE:

$$\text{Existing Change Gear Ratio} = \frac{42 \text{ Teeth}}{43 \text{ Teeth}} = .976$$

$$\text{Meter Accuracy} = 95\%$$

$$\text{Corrected Change Gear Ratio} = .976 \times \frac{95}{100} = .927$$

4. Select a combination of new change gears that match the corrected change gear ratio. If stocked change gears are not available, submit order for change gears to your nearest Badger Meter representative or the Industrial Products Division of Badger Meter, Inc.

NOTE: When ordering, give the serial number of the turbo meter which is stamped on the outlet flange of the meter. Specify the meter size and accessory device employed along with the number of teeth and diameter on existing change gears. Specify the corrected change gear ratio.

5. Install the corrected change gears on the register base and register spindles taking care that the correct change gears are assembled to the appropriate spindles (See Figure 4-1). Assemble the register to the register base on the meter. Refer to section 4-7a for instructions covering the proper method of installing and meshing change gears. On meters with 76 Series registers, provision for change gear adjustment is built into the registers. See the applicable register IOM manual for recalibrating instructions.

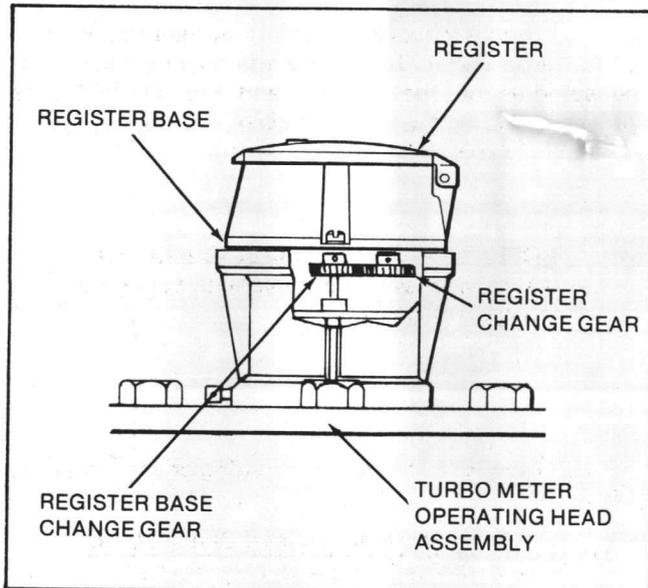


Figure 4-1. Change Gear Location Register Base and Register Assembly

NOTE: For instructions on removing and installing the gear train assembly in the new and old-style register bases, refer to par. 4-8 which explains and illustrates the difference between these two register bases.

4-5. CALIBRATING 2" AND 3" METERS

Badger's 2" and 3" turbo meters with bronze and cast iron housings are equipped with a bypass valve for "minor" calibration adjustment in the field. Test the meter's accuracy to determine if recalibration is required. If the meter is out of calibration, proceed as follows:

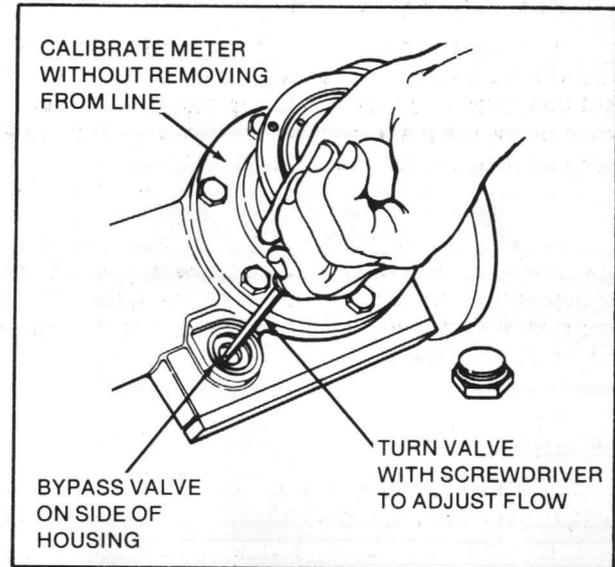


Figure 4-2. Calibrating 2" and 3" Turbo Meters

1. Remove the bypass cover nut with a wrench.
2. Using a wide-bladed screwdriver, loosen the bypass valve lock ring.
3. Adjust the bypass valve with a screwdriver in the following manner (See Figure 4-2):
 - a. To INCREASE registration, turn the slot in the valve perpendicular to the axis of the meter (line of flow). This will restrict the amount of volume flowing through the bypass and increase flow through the metering chamber.
 - b. To DECREASE registration, turn the slot in the valve parallel to the axis of the meter. This will increase liquid volume through the bypass and decrease flow through the metering chamber.

NOTE: The total range of the bypass adjustment occurs within a 90 degree or quarter turn of the valve from the parallel, inline position to the perpendicular position, or vice versa. The total range of adjustment is about four percent. Tested and calibrated at the factory, the bypass valve will be set at about 45° from the full "open" or "closed" position. This setting will allow for a $\pm 2\%$ adjustment to recalibrate the meter in the field.

4. With the valve turned to the desired bypass setting, tighten the valve lock ring.
5. Install and tighten the bypass valve cover nut.
6. Retest the meter to confirm the accuracy of the bypass adjustment. If the meter is still out of calibration, repeat the procedure outlined above.

4-6. REGISTER BASE REPLACEMENT

Badger turbo meters can be serviced without removing the meters from the system. A typical service is equipped with drain and piping valves. To inspect or replace component parts of the head assembly, close the upstream and downstream valves. If the installation is equipped with an inlet and drain valve for flushing the meter, open the drain valve to relieve pressure from within the meter. However, if the meter piping is not equipped with a drain valve, proceed as follows to relieve pressure within the meter:

1. Do not remove the register base from the operating head assembly. The entire head assembly must be removed as a complete unit (See Figure 4-3).
2. Loosen each of the head bolts about one and one-half turns. Do not remove the bolts completely.
3. If the gasket-seal between the meter head and the housing is not leaking at this time, pry the head assembly loose with a screwdriver. To accomplish this, insert the screwdriver from the outlet side of the head assembly where the head and housing join together.

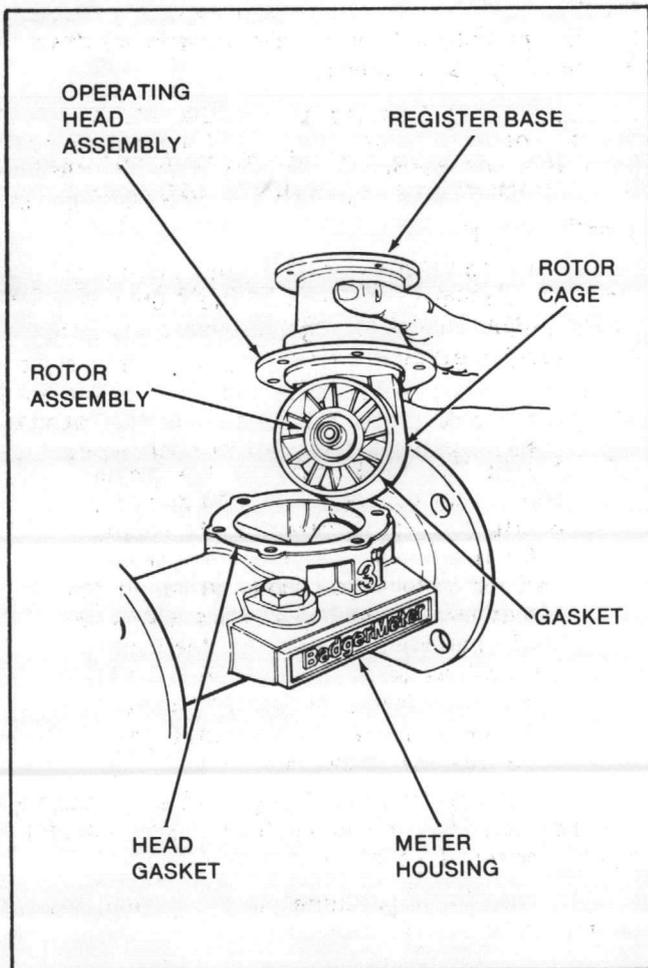


Figure 4-3. Turbo Meters Serviced Without Removal from the Line

CAUTION: Exercise precaution to make certain that fluid does not spray from the meter. The liquid spray could contact electrical equipment and create an electrical hazard.

4. Allow the meter to drain and relieve internal pressure.
5. When pressure is relieved, remove the head bolts and shift the head assembly toward the outlet-end of the meter to release the head-to-housing seal. Then lift the entire head assembly from the housing and, at the same time, tilt the operating head up to prevent the rotor from falling off the rotor spindle.

NOTE: Rotors made of Kynar or Ryton are furnished with two-pole or four-pole magnets depending on the type of application. Rotors with four-pole magnets are used with Badger electronic transmitters.

6. When the operating head has been removed, lift the rotor out of the rotor cage and set it aside. Remove the head gasket.

NOTE: A dummy cover plate is available to close the meter in the line and continue service while the operating head assembly is being inspected or parts are being replaced.

7. To remove the register base from the head assembly, loosen the seal screw on the base with a screwdriver. Rotate the base 45 degrees in either direction to release it from the bayonet lock detents on the head assembly.
8. The register base retaining ring is accessible through the rotor cage in the head assembly. With a Truarc right-angle pliers #1549, expand and remove the register retaining ring on the extension tube. When this is accomplished, the register base can be removed from the head assembly.

9. To reinstall or replace the register base, repeat the procedure above in reverse making sure that the retaining ring has been reinstalled on the extension tube.

NOTE: The head unit has a gasket bonded to the periphery of the rotor cage. Depending on the chemical solution to be metered, the gasket will be made of EPR, Buna N or Viton A material. Reinserting the head assembly into the meter housing correctly will require compressing the gasket slightly. This is done by tilting the top of the register base on the head toward the inlet side of the meter. The meter head has a pilot diameter machined into the cage at the gasket face. This pilot diameter must extend through the housing gasket inner diameter and into the housing bore. After lowering the head assembly into the housing, move the entire head assembly straight toward the inlet side of the meter. The pilot diameter must snap into the bore of the housing to provide a tight seal.

10. With the head gasket aligned and the head assembly properly positioned in the housing, reinstall and tighten the head bolts (between 90-180 in.-lbs. of torque).

11. Close the flushing system drain valve. Open the upstream valve partially, then open the downstream valve slightly which will purge any air from the service line. Then open both valves completely.

4-7. SERVICING

For periodic inspection or when operation of the turbo meter indicates a need for servicing, refer to the following paragraphs for instructions covering the removal, inspection and installation of service parts and assemblies. Refer to the illustrated parts list, Figure 5-1, for part numbers of replaceable components and the correct ordering information. Any service or repair procedures that apply to a meter-mounted or free-standing accessory are provided in the IOM instruction manual pertaining to that device (also provided as a supplement to this manual.) If satisfactory repair cannot be made, contact the Industrial Products Division of Badger Meter, Inc.

a. CHANGE GEAR REPLACEMENT

1. Replacing the change gear on the register base spindle requires no gage to properly mesh this gear with the register change gear. A shoulder-stop is built into the spindle at the proper gear height thus eliminating gear adjustment.

2. The change gear in the register should be installed with the aid of a Badger change gear mesh gage (P/N 21747) to ensure proper gear mesh. The procedure is as follows:

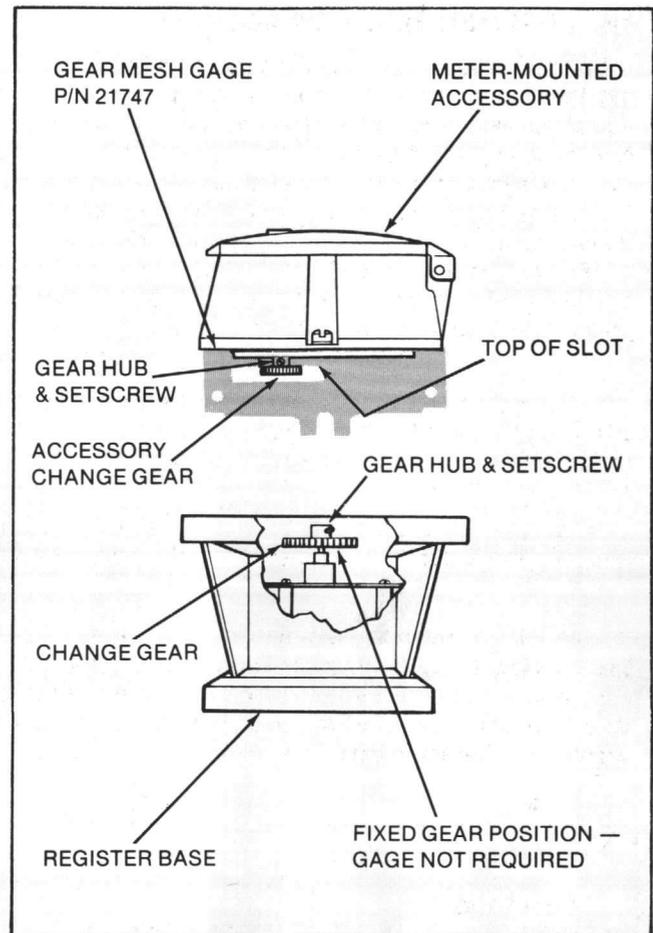


Figure 4-4. Replacing Turbo Meter Change Gears Register Base and Register (or Accessory)

(a) Place the bottom of the register on the top edge of the gage (See Figure 4-4).

(b) Adjust the change gear on the register spindle so that it rests against the "top" of the slot in the gage. Holding the change gear in this position, tighten the setscrew in the hub of the change gear.

NOTE: Install the change gears on the spindles with the hub of the gears in the "UP" position.

(c) Carefully install the register on the base making sure that the gears fully mesh. Install and tighten the register seal screws.

CAUTION: Take care not to bend the spindles when installing the gears or reassembling the register to the register base.

4-8. INSTRUCTIONS FOR REMOVING THE GEAR TRAIN ASSEMBLY WITH MAGNET

The gear train assembly can be removed and replaced without removing the turbo meter from the line and the register base from the operating head assembly.

Two gear train assemblies are used with industrial turbo meters. To find out what the gear train ratio is, count the number of spindles (gear and pinions) that protrude through the five mounting holes provided in the top plate of the gear train assembly. If there are only three spindles, the gear ratio is 366:1 and if there are five spindles, the gear ratio is 1200:1.

1. Remove the register, transmitter or adapter mounted on the register base. A screwdriver, pliers or small box wrench can be used to remove the mounting bolts (or screws) securing the accessory to the base.

2. To remove the gear train from the register base of molded plastic, use a small screwdriver and loosen three screws and special washers located on the top plate of the gear train assembly.

3. Turn each washer until the flat edge frees the washer from the groove on the inside wall.

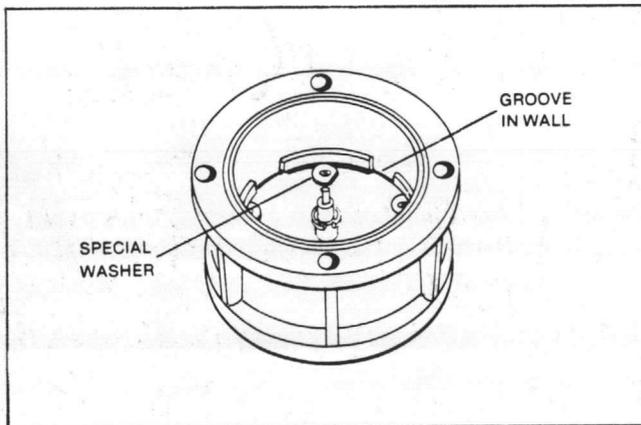


Figure 4-5. Turn each washer to free it from the groove on the inside wall.

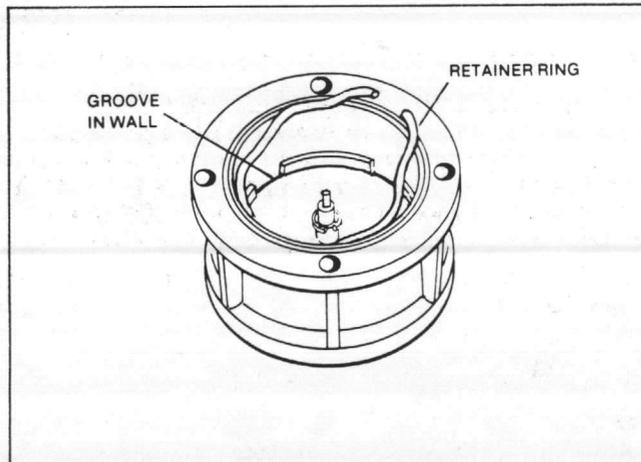


Figure 4-6. Release the retainer ring from the groove to free the gear train assembly from the base.

Turbo meters with an aluminum register base have a clip-type retainer ring to secure (or lock) the gear train assembly in the base. Use a small screwdriver to release the retainer ring from the groove in the wall adjacent to the top plate of the gear train assembly.

4. Grip the change gear spindle and lift to remove the gear train assembly with magnet from the register base.

5. Remove the accessory change gear or coupling from the gear train spindle. Before removing, note the location of the change gear (or coupling) on the spindle so that it can be reinstalled in the same location.

NOTE: A flat surface is provided at the top of the spindle of the change gear assembly so that the setscrew in the change gear or coupling can be properly seated and tightened to the spindle.

6. Gear train assemblies are packaged with the magnet and spindle assembly disassembled from the gear train assembly. Before assembling, carefully check the spindle for minute burrs on the threaded end of the spindle. If there are burrs, use a crocus cloth and carefully remove them from the spindle. This will prevent damage to the surface of the jewel bearing when inserting the magnet spindle through the jewel-bushing in the bottom plate of the gear train assembly. An "E" ring should be mounted on the spindle. If missing, remove the "E" ring from the replacement spindle and snap it into the grooved collar near the threaded end of the spindle.

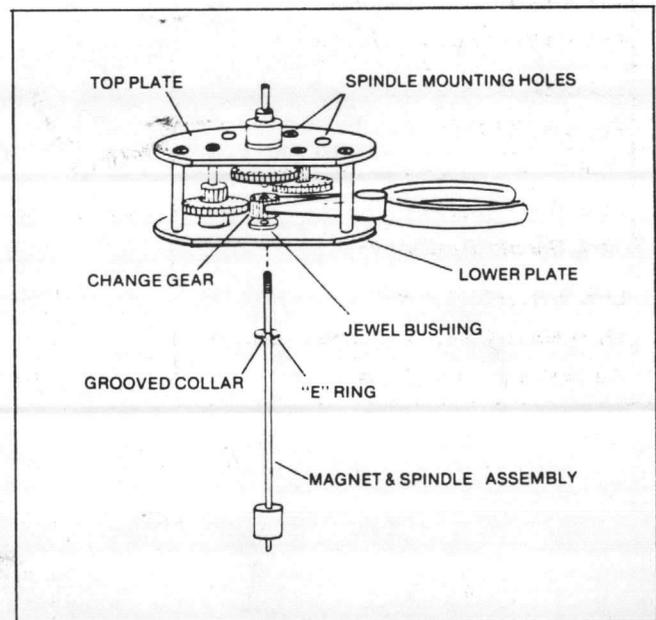
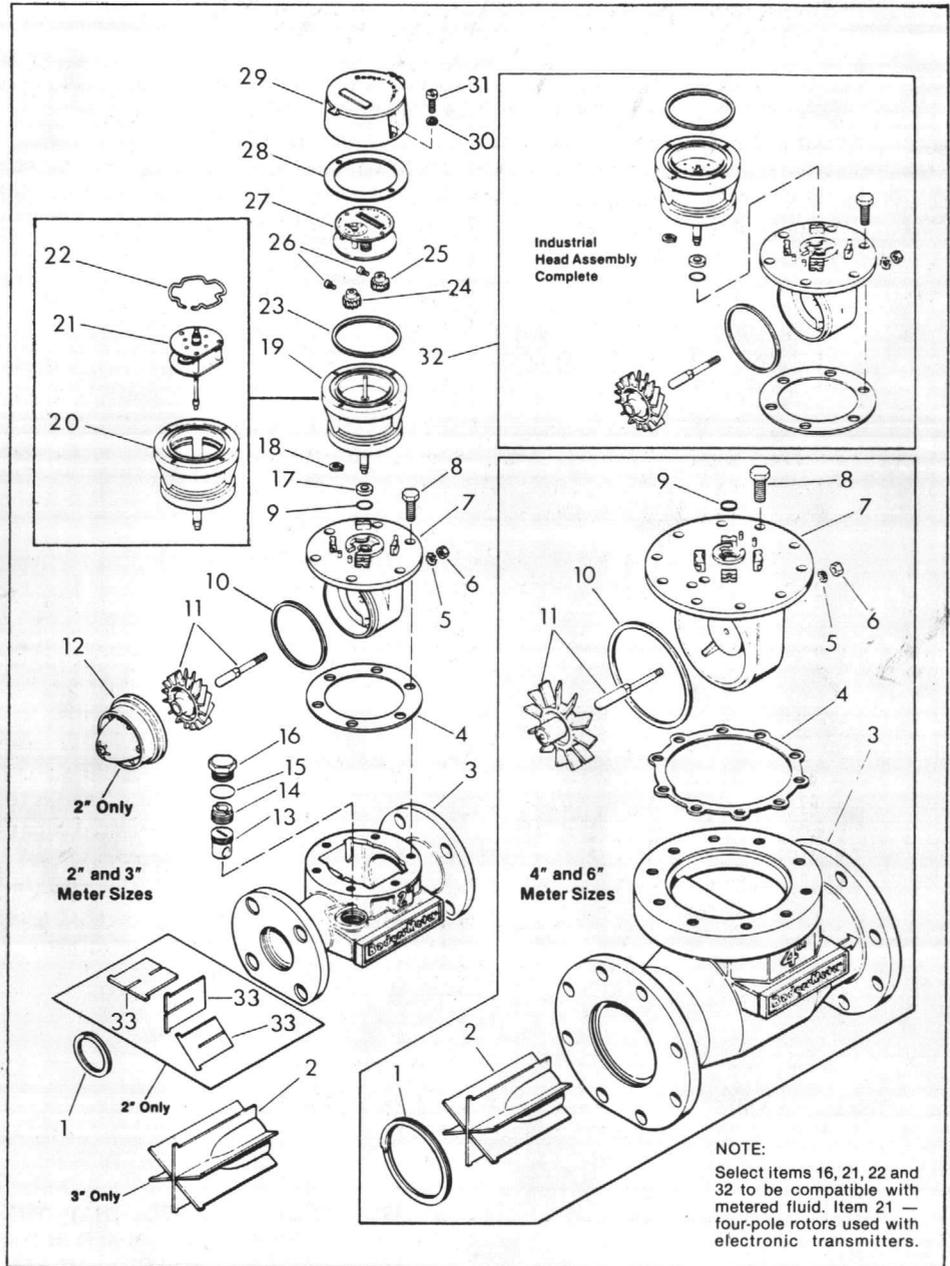


Figure 4-7. Installing the magnet spindle assembly to the gear train assembly.

Section V ILLUSTRATED PARTS LIST

ITEM NO.	PART DESCRIPTION
1	Retaining Ring, Straightening Vane
2	Straightening Vane Assy., Complete
3	Housing, (Note 1)
4	Gasket, Head Assy., (Note 2)
5	Lock Washer, Rotor Spindle
6	Nut, Hex., Rotor Spindle
7	Meter Head, Machined (Note 2)
8	Bolt, Hex., Meter Head
9	Tetraseal, Meter Head Adapter
10	Tetraseal, Meter Head (Note 1)
11	Rotor & Spindle Assy. (Note 3)
12	Nose Cone (Note 2)
13	Bypass
14	Lock Ring, Bypass
15	"O" Ring, Bypass (Note 2)
16	Nut, Bypass Cover
17	Spacer, Register Base
18	Retaining Ring, Register Base
19	Register Base Assy. (Note 4)
20	Register Base Only
21	Gear Train, Base Assy. (Note 4)
22	Retaining Ring, Base Assy.
23	Tetraseal, Base Assembly
24	Change Gear, Adapter (Note 5)
25	Change Gear, Accessory (Note 5)
26	Setscrew, Change Gear
27	Register, 258 (Note 6)
28	Gasket, Register Hood
29	Hood, Register, 258
30	Lock Washer, Register, 258
31	Screw, Register Cover, 258
32	Meter Head Assy., Complete (Notes 2 & 6)
33	Straightening Vane (2" Only)



NOTE:
Select items 16, 21, 22 and 32 to be compatible with metered fluid. Item 21 — four-pole rotors used with electronic transmitters.

- NOTE 1 Advise body material, flange rating (150 psi or 300 psi).
- NOTE 2 Material will depend on corrosiveness of fluid being metered.
- NOTE 3 Number of poles in magnet will depend on type of meter accessory.
- NOTE 4 Gear train ratio is marked on plate of adapter (i.e. 1200:1 or 366:1).
- NOTE 5 Number of teeth and gear diameter is stamped on each gear.
- NOTE 6 Advise size of meter and units of measure (i.e., gallons, m³, etc.).

Figure 5-1. 2", 3", 4" and 6" Turbo Meters

WARRANTY

Badger warrants meters and parts manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of 18 months from date of shipment or 12 months from date of installation, whichever period shall be shorter. If within such period any meters or parts shall be proved to Seller's satisfaction to be defective, such meters or parts shall be repaired or replaced at Seller's option. Seller's obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such meters or parts to Seller f.o.b. its factory. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES WHATSOEVER INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES (EXCEPT OF TITLE) OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Badger shall not be liable for any defects attributable to acts or omissions of others after shipment, nor any consequential, incidental or contingent damage whatsoever.

NUCLEAR DISCLAIMER

Equipment sold by Badger Meter, Inc. is not intended for use in connection with any nuclear facility or activity unless covered by a specific quotation where the conditions of such usage will be detailed. If equipment is used in a nuclear facility or activity without a supporting quotation, Badger Meter disclaims all liability for any damage, injury or contamination, and the buyer shall indemnify and hold Badger Meter, its officers, agents, employees, successors, assigns and customers, whether direct or indirect, harmless from and against any and all losses, damages or expenses of whatever form or nature (including attorneys' fees and other costs of defending any action) which they, or any of them, may sustain or incur, whether as a result of breach of contract, warranty, tort (including negligence), strict liability or other theories of law, by reason of such use.

IT IS HEREBY CERTIFIED THAT THE (MATERIAL)
(EQUIPMENT) SHOWN AND MARKED IN THIS SUBMITTAL,
SHOP DRAWINGS, CATALOG CUT (S), ETC., AND
APPROVED/PROPOSED TO BE INCORPORATED INTO

CONTRACT NUMBER 1478 IS IN COMPLIANCE
WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS
AND CAN BE INSTALLED IN THE ALLOCATED SPACE,

AND IS _____ APPROVED FOR USE/

SUBMITTED FOR GOVERNMENT APPROVAL _____
APPROVED FOR USE SUBJECT TO GOVERNMENT
APPROVAL OF SPECIFIC DEVIATION.

AUTHORIZED REVIEWER _____

DATE _____

SIGNATURE COC REP _____

DATE 5/14/84 _____

All rights reserved. All data subject to change without notice.

INSTALLATION OPERATION AND MAINTENANCE MANUAL

IT IS HEREBY CERTIFIED THAT THE (MATERIAL)
(EQUIPMENT) SHOWN AND MARKED IN THIS SUBMITTAL,
SHOP DRAWINGS, CATALOG CUT (S), ETC., AND
APPROVED/PROPOSED TO BE INCORPORATED INTO
CONTRACT NUMBER 1478 IS IN COMPLIANCE
WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS
AND CAN BE INSTALLED IN THE ALLOCATED SPACE,
AND IS APPROVED FOR USE/
SUBMITTED FOR GOVERNMENT APPROVAL
APPROVED FOR USE SUBJECT TO GOVERNMENT
APPROVAL OF SPECIFIC DEVIATION.

AUTHORIZED REVIEWER [Signature]
DATE 5/14/84
SIGNATURE CQC REF [Signature]
DATE 5/14/84

MODELS AR AND SR METER REGISTERS

Badger Meter, Inc. Industrial Products Division
4545 W. Brown Deer Road, P.O. Box 23099, Milwaukee, WI 53223



SCOPE OF THE MANUAL

This manual provides information pertaining to the installation, operation and maintenance of Badger Series 76, Models AR and SR Meter Registers. Before attempting installation, operation or maintenance, read the instructions presented to become familiar with the procedures involved. Retain the manual in a readily accessible location for future reference.

CHANGES IN THE MANUAL

Changes or additions to the manual are covered by a "CHANGE NOTICE" form that is supplied with the manual when applicable. The "CHANGE NOTICE" will explain any differences between the register received and the registers covered in this manual.

Table 1-1. Technical Specifications

DRIVE	Mechanical 2-pin direct coupling (Adapter must be used for magnetic drive meters)
MOUNTING	4 holes equidistant on 3.665 in. diameter circle
DIMENSIONS	
Height	8-7/8 in.
Width	7-1/2 in.
Depth	7-1/2 in. SR 6-3/4 in. AR
WEIGHT	8 lbs.
OPERATING TEMPERATURE	250°F, with proper adapter
DIAL	
Diameter	5-3/4 in.
Display	White on black
TOTALIZER COUNTER	
Type	Non-resettable
Display	Six-digit (to 999,999)
Numerals	5/32 in. high — white on black
TEST CIRCLE	10 increments each equal to 1/10 of last totalizer digit
ENCLOSURE	
Type	Moistureproof and dustproof
Housing and base	NEMA-4, foam molded polycarbonate, glass filled
Bezel	Clear polycarbonate
MODEL AR — AUTOMATIC REGISTER	
Accuracy and repeatability	Signal within $\pm 2\%$ of dial capacity
Pointers	Two, nickel-plated outer reset and red inner reading
Switch and relay contact rating	7 amps, 125-250 vac
Motor and relay (one of the ratings listed)	24 vac, 60 Hz, 20 rph 110 vac, 60 Hz, 20 rph 110 vac, 60 Hz, 4 rph 220 vac, 50 Hz, 20 rph
MODEL SR — SIGNAL REGISTER	
Accuracy and repeatability	Signal within $\pm 1\%$ of outer circle
Pointers	Two, nickel-plated inner and red outer
Contact rating	7 amps, 110 or 220 vac, 1/8 hp at 110 vac, 1/4 hp at 220 vac, 1/2 amp at 125 vdc, 1/4 amp at 250 vdc

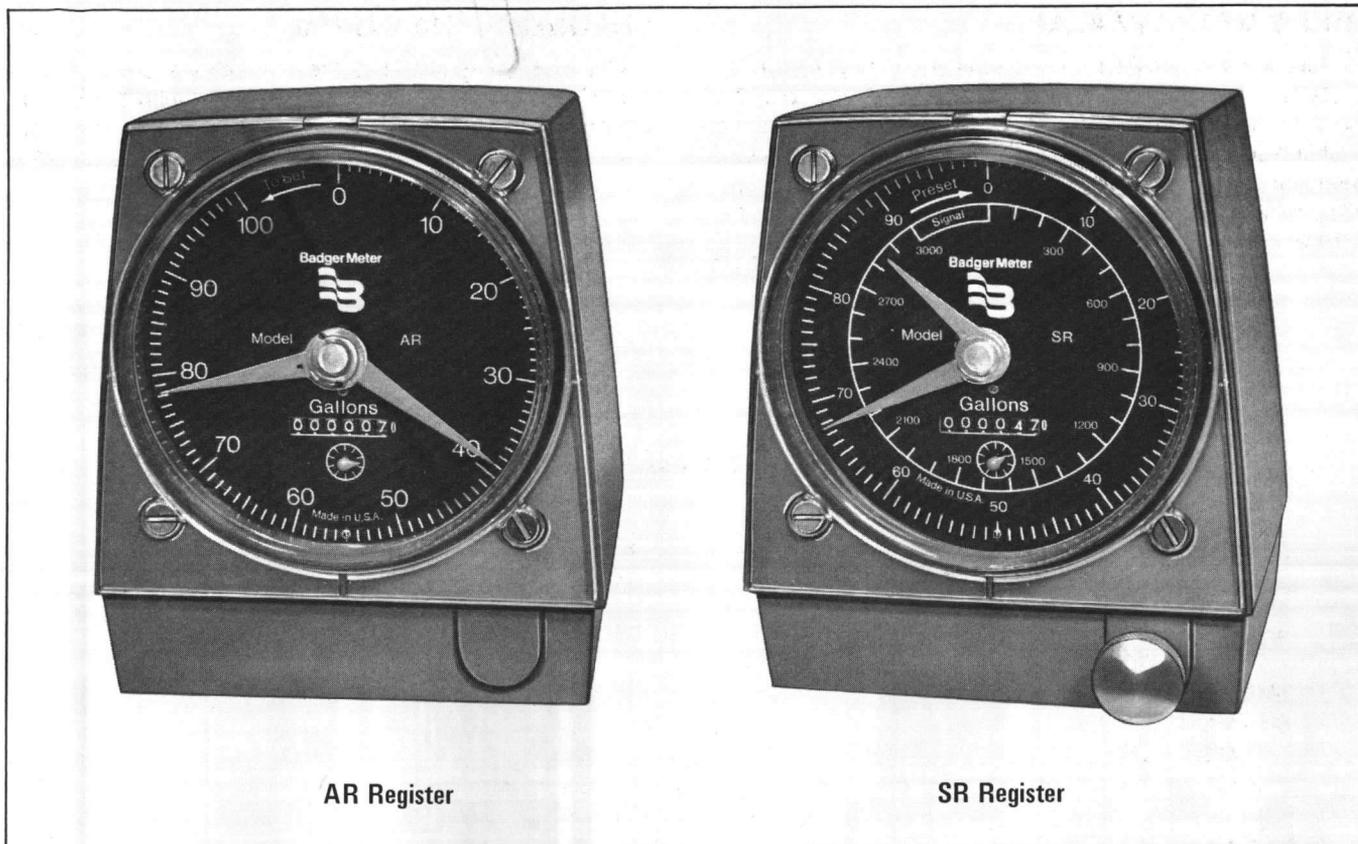


Figure 1-1.

Section I GENERAL INFORMATION

1-1. GENERAL DESCRIPTION

The Badger Model AR Automatic Reset Register and Model SR Signal Register are designed primarily to control the regeneration cycle of water softeners. (See Figure 1-1.) Models AR and SR employ electrical switching to provide the signal for external control, and both are equipped with a 6-digit non-reset totalizer. The basic configuration and mounting of the instruments is the same. The registers are available in a wide range of dial capacities and units of measurement.

The Model AR is an automatic reset unit for repetition of the same preset metered cycle. The instrument may be preset to any quantity within the dial capacity by positioning the nickel-plated outer reset pointer. The housing must be removed to preset. The red pointer indicates the amount of liquid remaining to be delivered. At the end of a cycle when the red delivery pointer reaches zero, the motor-driven reset pointer is turned one complete revolution to return the red pointer to the preset point in readiness for the next cycle. End of cycle and reset switching are cam actuated. The AR can be automatically reset any time prior to the completion of the cycle by an external momentary contact.

The Model SR is a manual preset register with two pointers. The pointers are preset with the control knob on

the front of the unit. When both pointers reach zero, the internal cam-actuated microswitch closes to provide the control signal.

External electrical connections are made to the rear of the instrument. The housings are easily removed for internal access required for wiring, gear changes, settings and adjustments.

1-2. INSTRUMENT CONFIGURATIONS

The Model AR is available with an internal relay for use in multiple register systems. The relay may be connected into the control circuit to lock out one register reset motor until a second register regeneration cycle is completed.

1-3. APPLICATIONS

The Model AR and SR Registers are well suited for control of industrial water softener installations, whether single manual regeneration or multiple automatic regeneration. All Series 76 registers can be used interchangeably on Badger disc, oscillating piston, turbine, turbo and propeller meters, both mechanical and magnetic drive. These registers are ideal replacements for older similar registers.

Section II

INSTALLATION

2-1. UNPACKING AND INSPECTION

The Model Series 76 Registers are shipped to the customer in a special shipping container to avoid damage during transit. Upon receipt of the instrument, perform the following unpacking and inspection procedures:

NOTE

If damage to the shipping container is evident upon receipt of the instrument, request a representative of the carrier to be present when the instrument is unpacked.

a. Carefully open the shipping container, following any instructions that may be marked on the container. Remove all cushioning material surrounding the instrument and carefully lift the instrument from the container. Retain the container and all cushioning material for possible use in storage or reshipment.

b. Check the contents of the shipping container against the packing list to verify that all equipment has been received.

c. Visually inspect the instrument for physical damage such as dents, scratches, loose or broken parts or any other signs of physical damage that may have occurred during shipment.

NOTE

If damage is found, request an inspection by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A claim for equipment damaged in transit is the responsibility of the customer.

2-2. INSTALLING THE REGISTER

NOTE

Installation of the register in areas of high temperature or severe vibration should be avoided. When used on oscillating piston meters, turbine meters and SOT meters with flow temperatures over 140°F, use finned mounting adapter to dissipate heat. Use P/N 31278-1 for oscillating piston meters and P/N 31728 for SOT and turbine meters.

a. **MOUNTING THE REGISTER.** (See Figure 2-1.) The register mount will fit a 3/4 inch hood base. The instrument is mounted with four or two 1/4-20 screws. The mounting holes on existing meters may have to be drilled to 17/64 inch dia. to accept the 1/4 inch screws.

1. Remove the existing register if meter is so equipped.

2. Check the mounting holes on meter. Re-drill to 17/64 inch to accept 1/4 inch screws if necessary.

3. Check the position and alignment of pin drive coupling. Surface A must be 3/32" to 1/8" below Surface B (See Figure 2-1). Be sure to tighten the set screw after adjustment.

4. Place the square section gasket in the mounting set.

5. Align the drive holes in the base of register with the drive coupling pins as closely as possible. Carefully position the register on the meter mount or magnetic drive adapter so the drive pins engage. Rotate the register to align the mounting holes and position the register as desired.

6. Install 1/4-20 mounting screws to secure the register.

b. **ELECTRICAL CONNECTIONS.** All electrical (power and signal) connections to a register are made to a terminal strip located inside the instrument enclosure. Remove the four housing cover screws in the base and lift off the cover to gain access. Caution must be exercised in cover removal to avoid bending the pointers. When the screws are removed, lift the cover in a slightly forward motion. It is recommended that flexible conduit be used for a distance of at least 2 feet from the register to allow access to the meter.

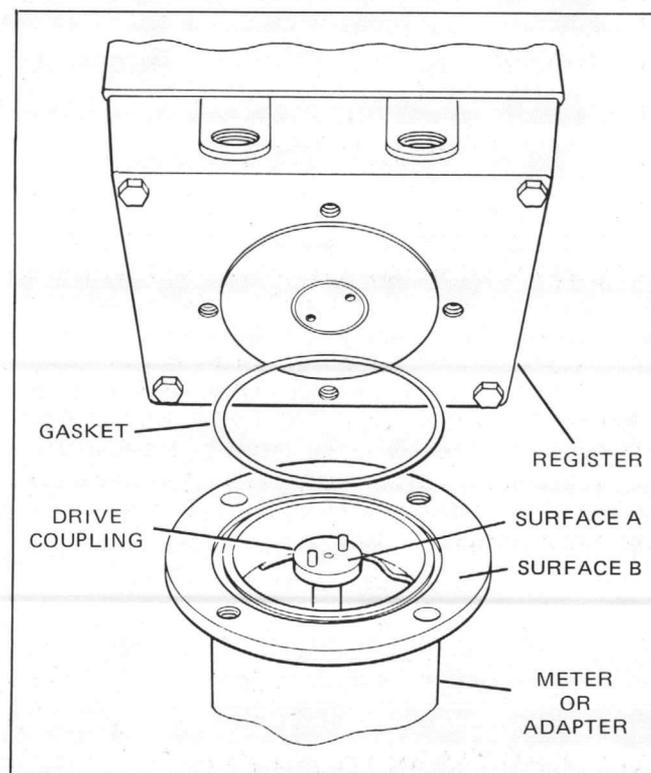


Figure 2-1. Register Mounting

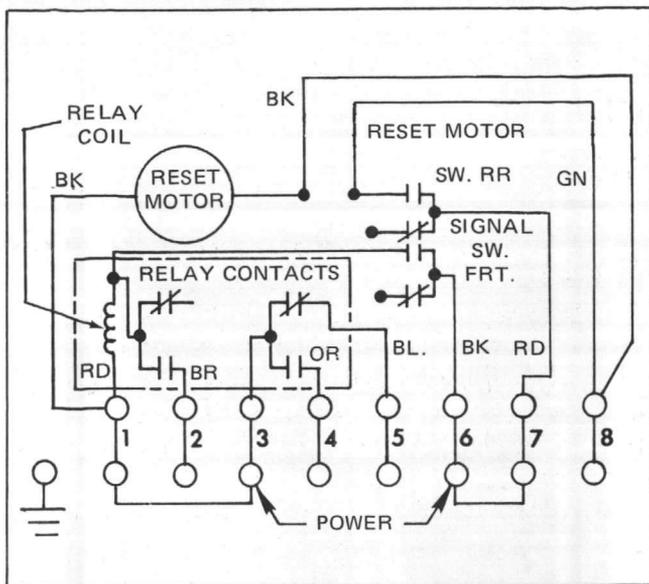


Figure 2-2. Internal Wiring Diagram — Model AR with Relay

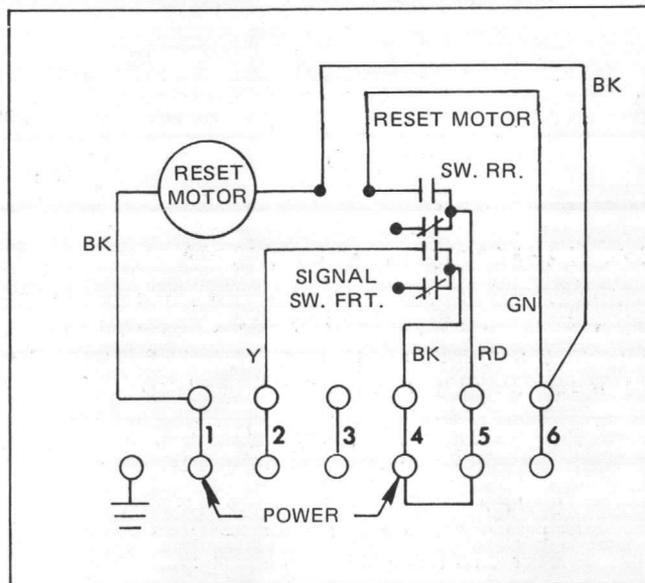


Figure 2-3. Internal Wiring Diagram — Model AR less Relay

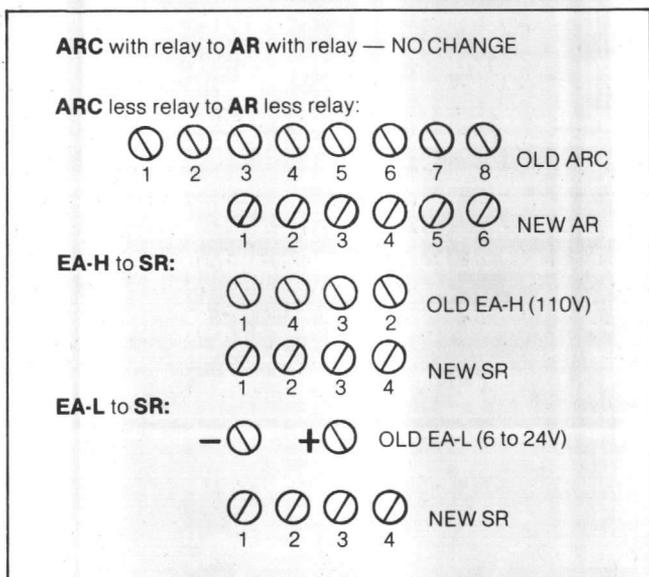


Figure 2-5. Wiring Changes for Register Replacement

The basic internal wiring diagrams are shown in Figures 2-2 thru 2-4. If additional information or assistance is required to make a specific installation, contact Badger Meter, Inc., Flow Products Division, Industrial Sales Department, or the local representative. Make sure that all wiring to the instrument (both power and signal) conforms with the local electrical code.

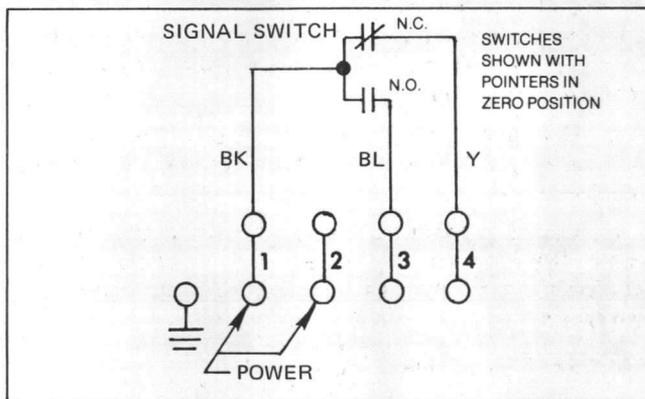


Figure 2-4. Internal Wiring Diagram — Model SR

2-3. PERFORMANCE CHECK

Although the registers are factory adjusted for switch actuation and pointer alignment, it is advisable to check the operation of a register before actual use. For AR registers the reset pointer is set at 50 per cent of the scale. The user may require a different operating point. Complete adjustment and test information is given in Section V.

2-4. REGISTER REPLACEMENT

Model AR and SR registers can be used to replace Model ARC, EA-H and EA-L registers. The necessary wiring changes are shown in Figure 2-5.

Section III OPERATION

3-1. CONTROLS AND INDICATORS

a. **CONTROL KNOB.** The single control knob for Register SR is used to preset the desired flow quantity as indicated by the pointers. Pushing the knob in and turning counterclockwise moves the pointers to the desired batch quantity. The inner pointer moves one graduation for each

complete revolution of the outer pointer.

b. **DIALS.** The 5-3/4 inch dial is calibrated in units of measure marked on the dial face. The small test circle is marked with 10 divisions. One revolution of the test circle pointer is equivalent to one digit change on the lowest (right side) position of the totalizer.

3-2. OPERATING PROCEDURE — SR REGISTER

At the end of a flow cycle the pointers will both be at zero. To preset the unit, proceed as follows:

- a. Push in the control knob which will engage the coupling on the preset shaft with the register gear train.
- b. Turn the knob counterclockwise to the desired quantity as indicated by the pointers. Release the knob. Spring tension will return the knob to the out position.
- c. The register will start when flow starts and continue to indicate the remaining quantity until the pointers reach zero at the end of the cycle. At this time the signal switch opens or closes to operate external alarms or functions. The pointers move counterclockwise during operation.
- d. After regeneration preset the register as described above.

3-3. OPERATING PROCEDURE — AR REGISTER

To preset the register, remove housing cover and proceed as follows:

- a. Rotate the reset pointer until it picks up the red pointer and continue until the switch arm drops into the notch in the motor cam.
- b. Loosen two screws in the reset pointer hub and position both pointers to the desired preset quantity. Be sure the motor cam remains stationary during pointer positioning.
- c. Tighten the reset pointer hub screws.
- d. Run the register through one cycle to check preset. The instrument must stop with both pointers at the preset position.

3-4. OPERATOR EMERGENCY MAINTENANCE

If the register does not start or stops prematurely, check the power source. If the power source checks out, the register may require adjustment. Refer to troubleshooting data and adjustment procedures in Section V.

If a register fails to stop at zero, turn off the power to the instrument. Investigate the cause of malfunction (Section V).

Section IV

PRINCIPLES OF OPERATION

4-1. GENERAL

Whenever there is liquid flow, the movement of the meter's measuring element is coupled to the register and transferred to the indicating pointers and totalizer through a gear train. The exact makeup of the gear train is determined by the dial capacity, unit of measure and meter application. Each instrument incorporates a set of change gears which allows some variation in overall gear train ratio to compensate for differences in liquids and conditions.

In an automatic system the end of cycle or zero point signal is used to start the regeneration cycle. The switch is cam actuated off the pointer shaft(s). The actuation of the switch(es) and position of the pointer(s) are adjustable to permit exact correlation between the pointers and switch action.

4-2. MODEL SR

A coupling is mounted on the control knob shaft. With the knob in, the coupling engages the gear train and allows the pointers to be moved when the knob is rotated.

Initially with the register at zero, the signal switch is on the low part of the pointer cams. In this position the signal switch (normally open contacts) is open. When the pointers are moved off zero to preset, the cams rotate so that the signal switch is on the high part of the cams and the signal switch (normally open contacts) is closed. When flow starts, the register continues to run toward zero until both pointer cams reach the initial position to reverse the switch mode.

4-3. MODEL AR (See Figure 4-1)

The Model AR employs two tandem cams to actuate the signal switch and reset motor switch. The front signal cam is

mounted on the delivery (red) pointer shaft; the rear motor switch on the reset motor-pointer shaft. Both cams contact the common pivoting switch arm which actuates the switches. Each switch is mounted independently on adjustable brackets to allow separate adjustment. The switch arm is latched or unlatched by a spring-loaded pawl as controlled by the cams.

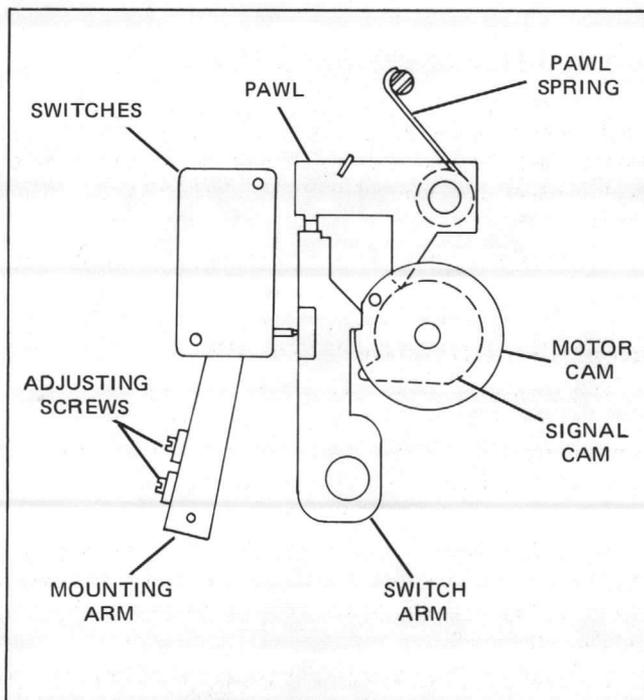


Figure 4-1. Model AR Switch Mechanism

At the end of the preset cycle, the switch arm is at rest in the notch or low point of the motor cam. Both the reset motor switch and signal switch are open. The pawl is contacting the outer edge of the switch arm as shown in Figure 4-1.

When flow starts, the red pointer and signal cam are driven around until the high point of the signal cam moves the switch arm to close the switches at zero. This allows the pawl to engage the notch in the switch arm to lock the switches in close position. The reset motor is energized through the motor switch and drives the reset pointer and reset motor cam. The signal switch closure is used to start the regeneration cycle either directly or through a relay and

external circuitry provided by the water conditioning equipment manufacturer.

The motor cam continues to rotate and the reset pointer picks up the red delivery pointer to return to the preset position. As the cam nears the end of its full revolution, the pin on the motor cam pushes the pawl out to unlatch the switch arm but the switch arm is on the high part of the motor cam so the switches remain closed.

When the notch in the motor cam reaches the switch arm, the arm drops into the notch and opens the switches. This stops the reset motor and interrupts the regeneration signal. The register is now ready for another cycle.

Section V

MAINTENANCE

5-1. GENERAL

This section of the manual provides information pertaining to maintenance of the registers. The information consists of preventive maintenance, troubleshooting and corrective maintenance procedures.

NOTE

Maintenance of the registers requires adequate test equipment as well as personnel experienced in the checkout and repair of electro-mechanical equipment.

5-2. MAINTENANCE EQUIPMENT

The test equipment and tools required for checkout and maintenance of the registers are listed below. Besides those items listed, the only other maintenance equipment required is the usual complement of hand tools used by service technicians.

- a. Voltmeter or test lamp for continuity checks and tests.

5-3. PREVENTIVE MAINTENANCE

The purpose of preventive maintenance for the registers is to ensure efficient, trouble-free operation and to discover and correct conditions that can result in damage or instrument failure. Perform the following preventive maintenance procedures on a routine basis.

- a. **CLEANING.** Clean all dust, dirt, moisture or grease from the front panel and housing of the instrument. Use a clean cloth dampened with detergent and water. Wipe dry with a clean cloth.

- b. **INSPECTION.** Visually inspect the instrument for breaks, cuts, wear or deterioration in the power interconnecting wiring and signal wiring. Replace any defective wiring.

NOTE

The operator should always note any erratic indications and unusual noises. These are cause for instrument checkout.

- c. **LUBRICATION.** Apply a soft grease such as Lubriplate sparingly to the following points every 6 months.

1. Drive bevel gears.
2. Reset shaft (SR only).

5-4. TROUBLESHOOTING

Should a register fail to operate properly, the first step in troubleshooting the instrument is to try to localize the malfunction to a component. The trouble symptoms listed in the troubleshooting chart, Tables 5-1 and 5-2, will aid in determining and locating the difficulty. The chart lists possible troubles, probable causes and remedies. Use the wiring diagrams in Section II as a further aid in isolating the fault.

5-5. ADJUSTMENTS — MODEL SR

a. SIGNAL SWITCH, SECOND STAGE

Use a test light or an ohmmeter with the power off. Connect to the common and normally-open signal switch terminals. See Figure 5-1.

1. Loosen the switch bracket locking screw slightly with an offset screwdriver.
2. With an Allen wrench, loosen the setscrew in the high-speed cam.
3. By hand, rotate the high-speed cam to position the switch roller in the drop-off zone of the cam.
4. Rotate the low-speed cam (by hand) to position the switch roller in the center of the drop-off zone of this cam.
5. Rotate the high-speed cam until the switch roller is on the drop-off point of the cam. Tighten the setscrew in the high-speed cam.

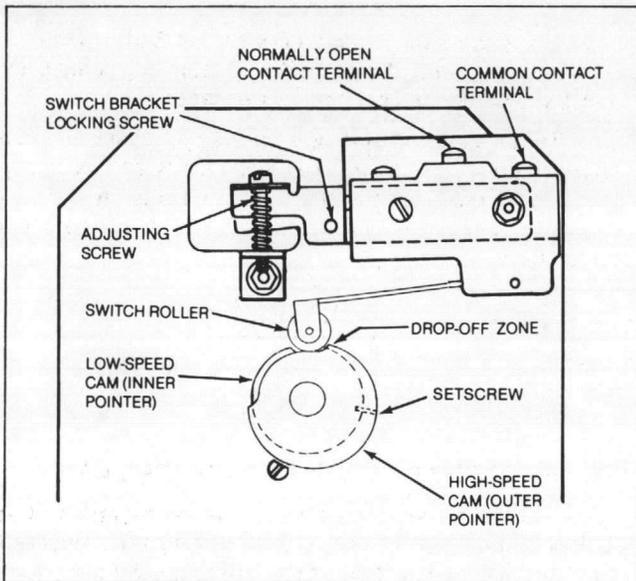


Figure 5-1. Signal Switch Adjustment (Positioning Roller on Cams)

6. Slowly advance the adjusting screw while slowly turning the register's reset knob to rotate the high-speed cam until only one signal is received during two revolutions of the high-speed cam past the trip point.

NOTE

To obtain proper cam adjustment, carefully observe the movement of the switch roller. When the high-speed cam completes one revolution before shut-off, the switch roller must lower into the drop-off zone of the low-speed cam to activate an electrical signal.

7. Tighten the switch bracket locking screw.

8. Recheck cam adjustments by rotating the cams (turn the reset knob) until drop-off points are aligned. The switch roller must be positioned in the center of the low-speed drop-off zone.

9. Recheck operation.

b. **POINTER POSITION.** At the end of a metering cycle with the signal switch closed, the red pointer must be on zero. If necessary, loosen the screw on the hub and reposition pointer. Tighten screw after adjustment.

5-6. ADJUSTMENTS — MODEL AR

a. **SWITCH ARM PAWL.** The pawl may require adjustment if the switch arm does not latch.

1. Set the pawl spring tension as shown in Figure 5-2, View A.

2. Bend the pawl tab to obtain latch clearance as shown in Figure 5-2, Views B and C.

3. Rotate the reset pointer so it picks up the red pointer and continues until the switch arm drops into the notch in the motor (rear) cam.

4. Rotate the red pointer (and cam) and observe latching of the switch arm by the pawl. As the high point of the signal cam passes the switch arm, the pawl must engage the notch of the switch arm and latch the arm. (See Figure 5-2, View B.) The switch arm must remain latched when the high point of signal cam is past the switch arm.

b. **SIGNAL AND MOTOR SWITCHES.** (See Figure 5-3.)

1. Slightly loosen three switch mounting arm locking screws.

2. Rotate the register drive if necessary to set the high part of the motor cam (rear) on the switch arm.

3. Back off both adjusting screws so that the signal and motor switches are open (normally-open contacts).

4. Advance the motor switch (rear) adjusting screw until the motor switch closes. Then advance the adjusting screw 1-1/3 turns for proper overtravel.

5. Advance the signal switch (front) adjusting screw until the signal switch closes. Then advance the adjusting screw 1 turn for proper overtravel.

6. Tighten the switch mounting bracket locking screws.

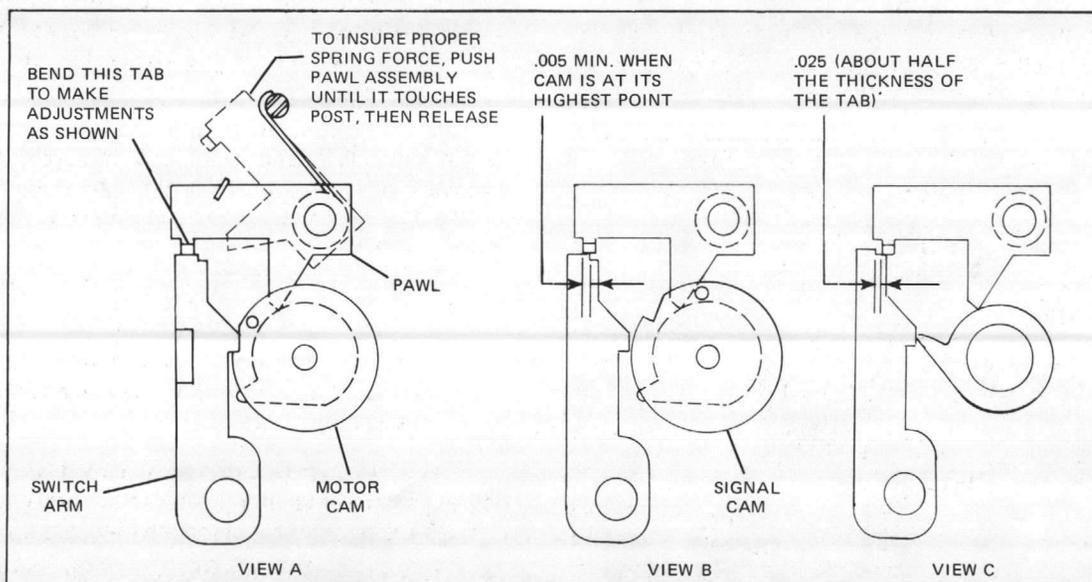


Figure 5-2. AR Pawl Adjustment

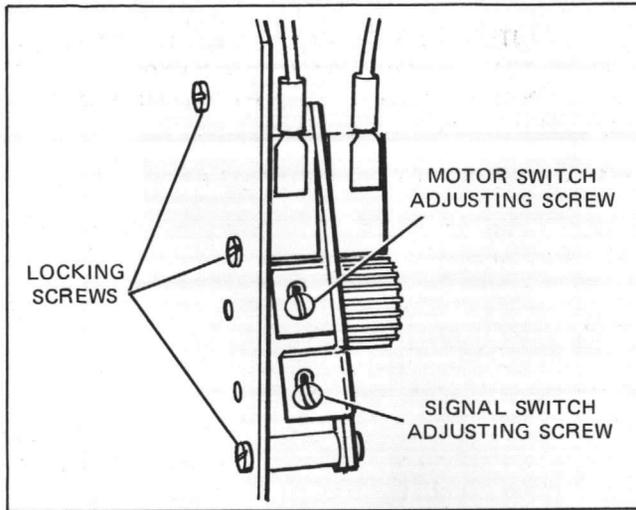


Figure 5-3. AR Switch Adjustment

c. DELIVERY POINTER (RED).

1. Rotate the reset pointer counterclockwise until the switch arm drops into the notch in the motor cam.

2. Rotate the red delivery pointer counterclockwise until the motor (rear) switch closes. With this cam position the red pointer should be at zero on the dial. If it is not, remove reset pointer and hub. Loosen the pointer lock screw, set the pointer on zero and tighten the lock screw. Do not move the signal cam during pointer position adjustment. Replace reset pointer and adjust to preset position.

d. PRESETTING. Refer to paragraph 3-3.

5-7. CHANGE GEARS

Due to differences in fluid viscosity, specific gravity, temperature, et cetera, the register may not be indicating the correct flow quantity. If this occurs, proceed as follows:

a. Determine the exact register reading for the corresponding quantity of product delivered. Measure quantity exactly.

b. Check the number of teeth on the driven and driver change gears on the rear of the gear plate (See Figure 5-4). The gears are stamped with the number of teeth.

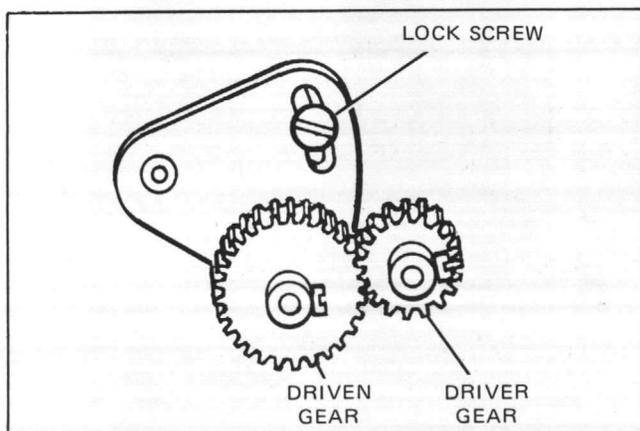


Figure 5-4. Change Gears

c. Notify the Flow Products Division of Badger Meter of the data in a and b above. Badger Meter engineering will advise you of required changes to be made.

d. To adjust or interchange the gears, loosen the lock screw and pivot the driven gear away. Replace the change gears if required. Align the gear teeth and setscrews. Swing the driven gear until it meshes with the driver gear and tighten the lock screw.

NOTE

Be sure gear teeth mesh fully without any tightness.

5-8. PERFORMANCE CHECK — MODEL AR

To test for proper actuation and relay operation (if so equipped), perform an operational performance check. A set of test lights should be used. Different color lamps with corresponding color test leads are suggested for simplicity.

Connect the power source per unit rating with an external switch to the terminals as shown on the applicable wiring diagram in Section II. The external power switch must be open.

a. MODEL AR WITH RELAY (Normally-Open)

1. Connect test lights to the terminal strip as follows:

Test Light No. 1 — to terminals 2 and 3

Test Light No. 2 — to terminals 4 and 6

Test Light No. 3 — to terminals 5 and 6

Test Light No. 4 — to terminal 3 and the normally-closed terminal of the reset motor switch (rear switch — unconnected terminal).

2. Rotate the pointers to the preset position where the switch arm drops into the notch of motor cam.

3. Turn on the power. As the power is turned on the test lights No. 3 and No. 4 must light up.

4. Turn the red pointer counterclockwise to a position close to zero on the dial.

5. Slowly advance the red pointer further by rotating the register drive shaft. As the red pointer reaches zero the test light No. 4 will go out and the reset motor will start. Do not rotate any further.

6. The motor will turn the motor cam and raise the switch arm until it rides on the O.D. of the motor cam. This will close the front or signal switch and energize the relay. Test light No. 3 will go out and test lights No. 1 and No. 2 will light simultaneously.

NOTE

Test light No. 4 must go out when the red pointer indicates zero on the dial and before test light No. 3 goes out.

7. The reset pointer (nickel-plated) will pick up the delivery pointer (red) and reset it to the preset position and turn the motor off. This completes the cycle and the test.

b. MODEL AR LESS RELAY (Normally-Open Signal Switch).

1. Connect test lights to the terminal strip as follows:
 Test Light No. 1 — to terminals 1 and 2
 Test Light No. 2 — to terminal 1 and the normally-closed terminal of the reset motor switch (rear switch — unconnected terminal).
2. Rotate the pointers to the preset position where the switch arm drops into the notch of motor cam.
3. Turn on the power. As the power is turned on the test light No. 2 must light up.
4. Turn the red pointer counterclockwise to a position close to zero on the dial.
5. Slowly advance the red pointer further by rotating the register drive shaft. As the red pointer reaches zero the test light No. 2 will go out and the reset motor will start. Do not rotate any further.
6. The motor will turn the motor cam and raise the switch arm until it rides on the O.D. of the switch cam. This

will close the front or signal switch and test light No. 1 will light up.

NOTE

Test light No. 2 must go out when the red pointer indicates zero on the dial and before the test light No. 1 lights up.

7. The reset pointer (nickel-plated) will pick up the delivery pointer (red) and reset it to the preset position and turn the motor off. This completes the cycle and the test.

5-9. PARTS REPLACEMENT

Normal parts replacement includes the microswitches, relay, and possibly gears or cams which are worn. Mounting of these parts is shown in the exploded views in Section VI. Refer to Section VI for parts replacement listings and ordering information.

Table 5-1. Model AR Troubleshooting Chart

NOTE

Since the AR register is usually a part of a larger control system not supplied by Badger Meter, Inc., it is necessary that the system is checked to be sure it is installed properly and wired in accordance with the manufacturer's recommendations before changing any adjustments or troubleshooting is done on the AR register.

POSSIBLE TROUBLE	PROBABLE CAUSE	REMEDY
Pointers do not return to proper preset.	<ol style="list-style-type: none"> 1. Loose reset pointer screws. 2. Malfunctioning or faulty motor switch. 	<ol style="list-style-type: none"> 1. Re-adjust preset and tighten screws. 2. Check switch actuation and mounting. Adjust if required. Replace if defective.
Register does not stop at zero.	<ol style="list-style-type: none"> 1. Loose delivery pointer screw. 	<ol style="list-style-type: none"> 1. Re-adjust position of pointer.
Register does not stop.	<ol style="list-style-type: none"> 1. Malfunctioning or faulty signal switch. 	<ol style="list-style-type: none"> 1. Check switch actuation and mounting. Adjust if required. Refer to para. 5-6 a.
Register does not reset.	<ol style="list-style-type: none"> 1. Malfunctioning motor switch. 2. Faulty motor switch. 3. Loose motor cam. 4. Broken pawl spring. 5. Faulty reset motor. 	<ol style="list-style-type: none"> 1. Check switch actuation. Re-adjust if required. Refer to para. 5-6 a. 2. Check operation of switch. Replace if defective. 3. Secure motor cam. Re-adjust. 4. Replace spring and adjust pawl. 5. Replace motor.
Delivery pointer does not move.	<ol style="list-style-type: none"> 1. Loose gear. 	<ol style="list-style-type: none"> 1. Check setscrews in gears for looseness. Tighten.

Table 5-2. Model SR Troubleshooting Chart

POSSIBLE TROUBLE	PROBABLE CAUSE	REMEDY
Switch does not close or open.	1. Malfunctioning or faulty signal switch.	1. Check switch actuation and mounting. Adjust if required. Replace if defective.
Register pointer(s) do not move.	1. Loose gear.	1. Check setscrews on gears for looseness. Tighten.

For other malfunctions of the system check external equipment as recommended by the manufacturer.

Section VI

ILLUSTRATED PARTS LIST

6-1. PART LOCATION ILLUSTRATIONS

The location and identification of the assemblies and parts comprising Models AR and SR are shown on the exploded view illustrations. Each assembly or part shown on the illustrations is identified by an index number that is cross-referenced to an associated parts list.

6-2. PARTS LISTS

The parts lists consist of columnar lists of the assemblies and parts that are shown in the part location illustrations and provide the following information for each item listed.

- a. FIGURE AND INDEX NUMBER.
- b. PART NUMBER.
- c. DESCRIPTION.

6-3. ORDERING INFORMATION

Order replaceable parts for applicable register through the local Badger Meter Sales Representative or directly from the Industrial Sales Department, Flow Products Division of Badger Meter, Inc. (address on title page). When placing an order, provide the following information:

- a. Complete name plate data.
- b. Dial capacity and number of fixed digits behind the totalizer.
- c. Complete description of the assembly or parts required.
- d. Part number of the item as indicated in the parts list.
- e. Quantity of parts required.
- f. A purchase order number and exact return and billing address.

	Spec. data
Model	Model
Part No.	Part No.
Manufactured by Badger Meter, Inc. Milwaukee, Wisconsin 53223	

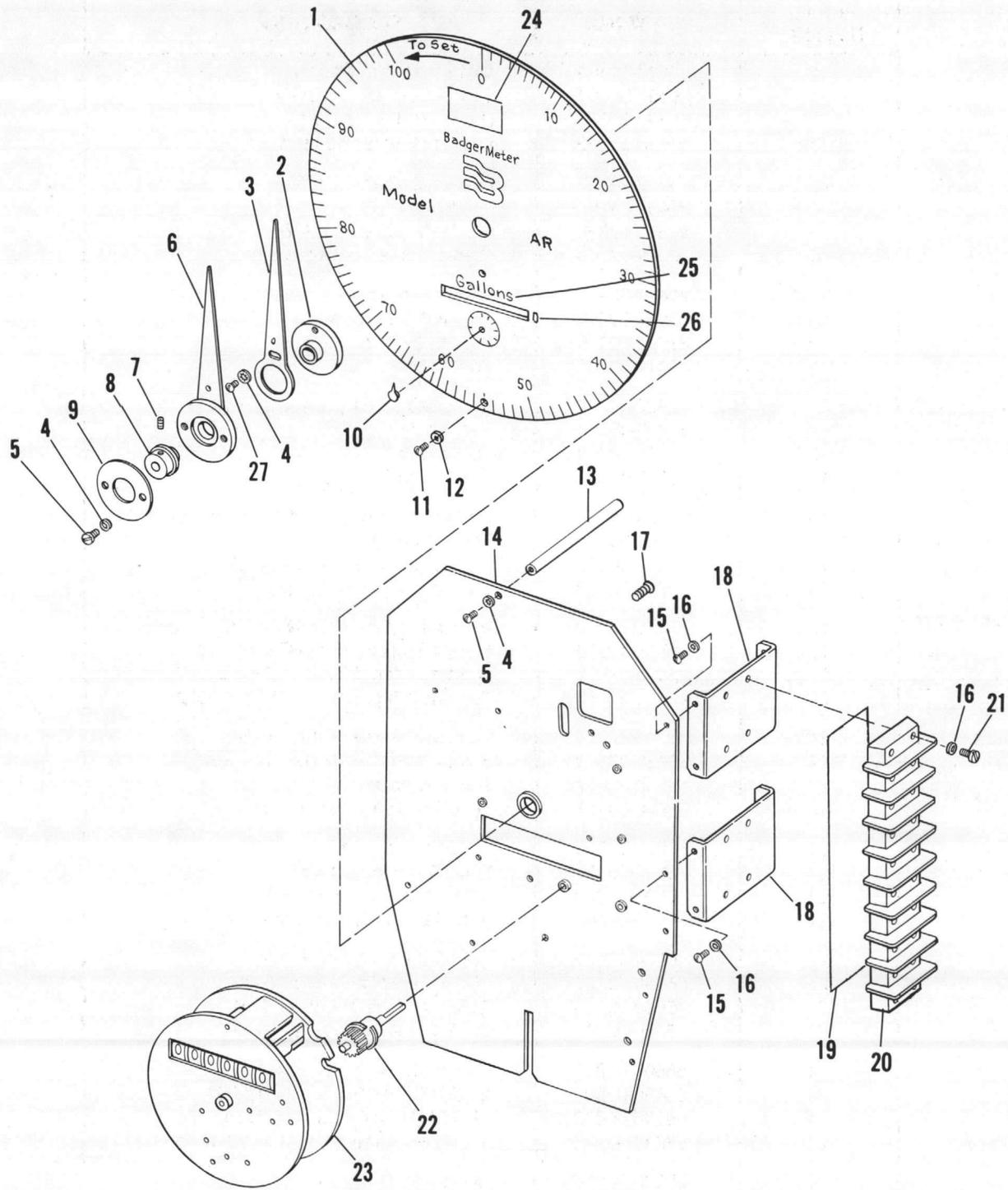


Figure 6-1. Model AR Front Plate

FIG. 6-1 ITEM NO.	PART NO.	DESCRIPTION
1	56599-00300	Dial — 100 Gal. Capacity
1	56599-00400	Dial — 200 Gal. Capacity
1	56599-00500	Dial — 500 Gal. Capacity
2	56948-00100	Delivery Pointer Hub Assy.
3	24349-00000	Delivery Pointer
4	20454-00000	Lockwasher #3
5	55090-08600	Pan Head Screw — 3-48 x 3/16
6	56949-00100	Preset Pointer Assembly
7	21451-00000	Set Screw — 4-48 x 1/8
8	30089-00000	Preset Pointer Hub
9	30090-00000	Pointer Retainer Plate
10	33319-00000	Pointer
11	31820-00000	Pan Head Screw — 2-32 x 5/16
12	55293-00300	Lockwasher
13	21700-00000	Spacer Post
14	56678-00300	Front Plate Assembly
15	55109-16700	Round Head Screw — 6-32 x 3
16	55294-00700	Lockwasher #6
17	31820-00400	Flat Head Screw — 2-32 x 3/8
18	56664-00100	Terminal Mounting Bracket
19	31898-00800	Marker Strip, 8-Term. AR w/Relay
19	31898-00900	Marker Strip, 6-Term. AR less/Relay
20	22800-01800	Terminal Strip, 8-Term. AR w/Relay
20	22800-01700	Terminal Strip, 6-Term. AR less/Relay
21	55090-17200	Pan Head Screw — 6-32 x 1/2
22	56630-00100	Spindle and Cam Assembly
23	56950-00100	Totalizer Assembly
24	56600-00500	1000 Capacity Label x 10
24	56600-00500	2000 Capacity Label x 10
24	56600-00500	5000 Capacity Label x 10
24	56600-00600	10M Capacity Label x 100
24	56600-00600	20M Capacity Label x 100
24	56600-00600	50M Capacity Label x 100
24	56600-00700	100M Capacity Label x 1000
24	56600-00700	200M Capacity Label x 1000
24	56600-00700	300M Capacity Label x 1000
24	56600-00800	1000M Capacity Label x 10,000
24	56600-00800	2000M Capacity Label x 10,000
24	56600-00800	5000M Capacity Label x 10,000
24	56600-00900	10,000M Capacity Label x 100M
25	56600-00200	Label — Liters
25	56600-00300	Label — M ³
25	56600-01400	Label — Imp. Gallons
25	56600-01000	100 Test Circle Label — 00
25	56600-01100	1000 Test Circle Label — 000
26	56600-01500	.1 Test Circle Label — x .1
26	56600-01600	Blank Label
27	55109-08600	Round Head Screw — 3-48 x 3/16

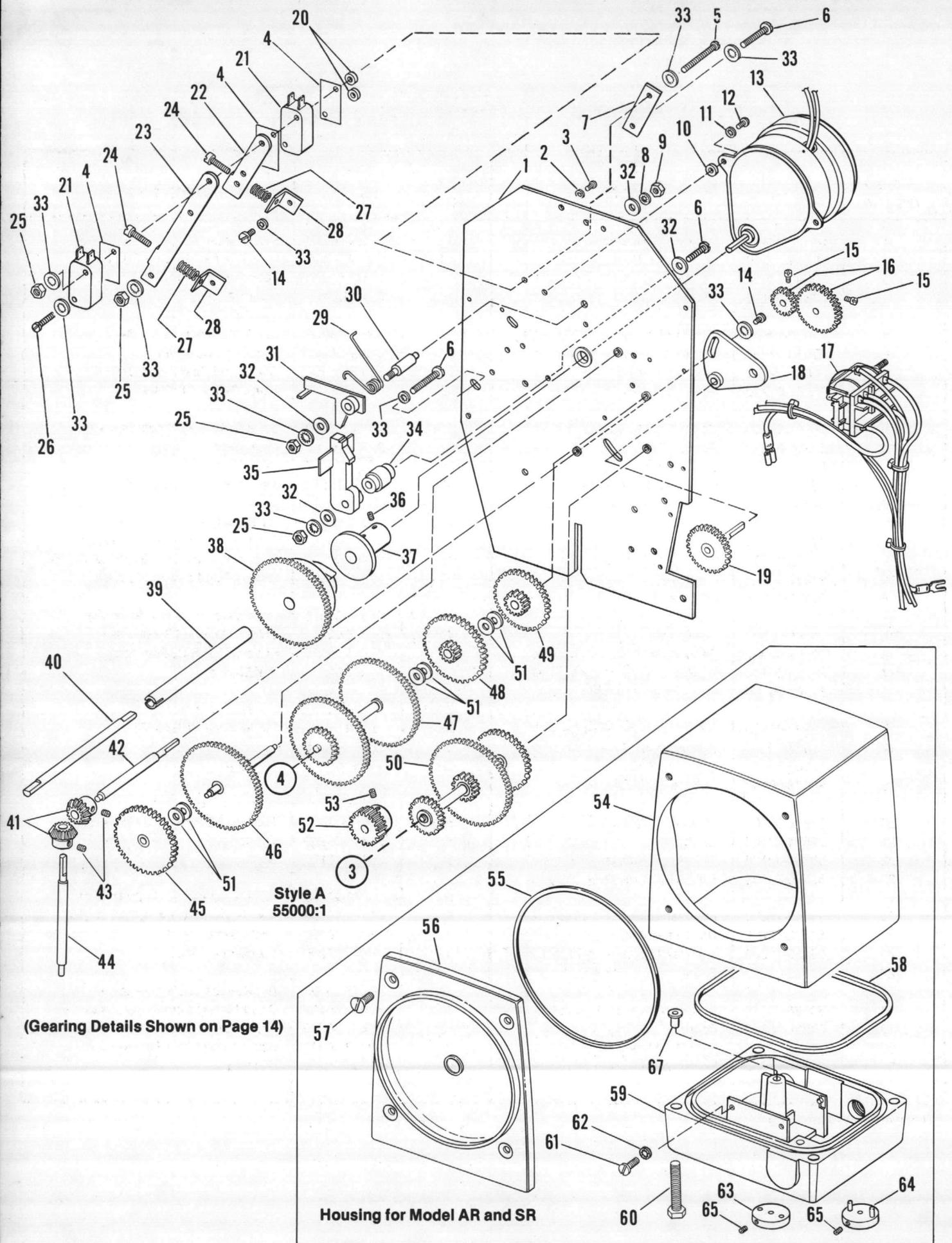


Figure 6-2. Model AR Back Plate

FIG. 6-2 ITEM NO.	PART NO.	DESCRIPTION	FIG. 6-2 ITEM NO.	PART NO.	DESCRIPTION
1	56679-00300	Back Plate Assembly	32	22562-01300	Flat Washer
2	20454-00000	Lockwasher No. 3	33	55292-00500	Lock Washer No. 4 Int. Teeth
3	55090-08600	Rd. Head Screw — 3-48 x 3/16	34	56656-00100	Post, Pivot Switch Arm
4	24579-00100	Insulation	35	24580-00100	Switch Arm
5	55089-12600	Pan Head Screw — 4-40 x 1-3/8	36	55230-16500	Set Screw No. 6-32 x 1/8
6	55089-12200	Pan Head Screw — 4-40 x 7/8	37	24336-00000	Motor Cam Assembly
7	56639-00100	Switch Retaining Plate	38	56660-00100	Clutch and Gear Assembly
8	55283-00700	Lockwasher No. 6	39	56648-00100	Shaft, Delivery Pointer
9	55002-03400	Hex Nut No. 6	40	56652-00100	Spindle No. 7 — Preset Pointer
10	23983-02800	Spacer	41	20398-00000	Miter Gear
11	55270-00500	Lockwasher	42	56634-00100	Drive Spindle
12	55046-11400	Pan Head Screw — 4-40 x 1/4	43	55230-16500	Set Screw No. 6-32 x 1/8
13	24335-00000	Motor — 110 V, 60 Hz., 20 rph	44	56649-00100	Input Spindle
13	24335-00100	Motor — 24 V, 60 Hz., 20 rph	45	56670-00100	Gear and Pinion Assy. Style A & B
13	24335-00200	Motor — 220 V, 50 Hz., 20 rph	46	56960-00400	Gear & Spindle Assy. Style A,B,C, & D
13	24335-00300	Motor — 110 V, 60 Hz., 4 rph	47	56959-00500	Gear & Spindle Assy. Style A
14	55109-11300	Rd. Head Screw — 4-40 x 3/16	48	56670-00500	Style A Gear and Hub Assembly
*15	1065-00000	Set Screw	49	56676-00100	Style A Gear and Pinion Assy.
*16	32652-00000	Change Gear — Spec. No. Teeth	50	56955-00100	Style A Gear & Spindle Assy.
*17	56966-00100	AR Relay w/Wire Harness, 110 V	51	22562-01200	Flat Washer
17	56966-00200	AR Relay w/Wire Harness, 220 V	52	34780-00100	Gear — 20 Teeth
17	56966-00300	AR Relay w/Wire Harness, 24 V	53	55230-11300	Set Screw — 4-40 x 3/16
17	53841-00100	Wire Harness, AR less Relay	54	56564-00100	Housing
18	56867-00100	Adjusting Plate	55	22559-01600	Tetraseal
19	56673-00100	Change Gear Spindle Assy.	56	56563-00100	Lens and Bezel
20	31239-00100	Spacer — .109 Long	57	55068-27400	Flat Head Screw — 1/4-20 x 3/8
*21	24574-00100	Switch	58	22559-04200	Tetraseal
22	56654-00100	Switch Adj. Bracket — Short	59	56750-00100	Base
23	56655-00100	Switch Adj. Bracket — Long	60	55030-11800	Hex Capscrew — 1/4-20 x 1-3/4
24	55046-12300	Fil. Head Screw — 4-40 x 5/8	61	55109-19700	Round Head Screw — 8-32 x 3/8
25	55002-03200	Hex Nut — 4-40	62	55294-00800	Lockwasher No. 8
26	55089-11800	Pan Head Screw — 4-40 x 1/2	63	56646-00200	Coupling — Upper
27	22602-00900	Spring	64	56646-00300	OP Meters Coupling — Lower
28	56736-00100	Switch Adjustment Bracket	64	56646-00100	Other Meters Coupling — Lower
29	24334-00000	Spring	65	21451-00000	Set Screw — 4-48 x 1/8
30	24333-00000	Pawl Pivot Post	66	22562-00900	Flat Washer (Gear Spacer)
31	24330-00000	Pawl and Hub Assembly	67	56691-00100	Bushing

*Recommended Spare Parts

For gear reductions, see table 6-1

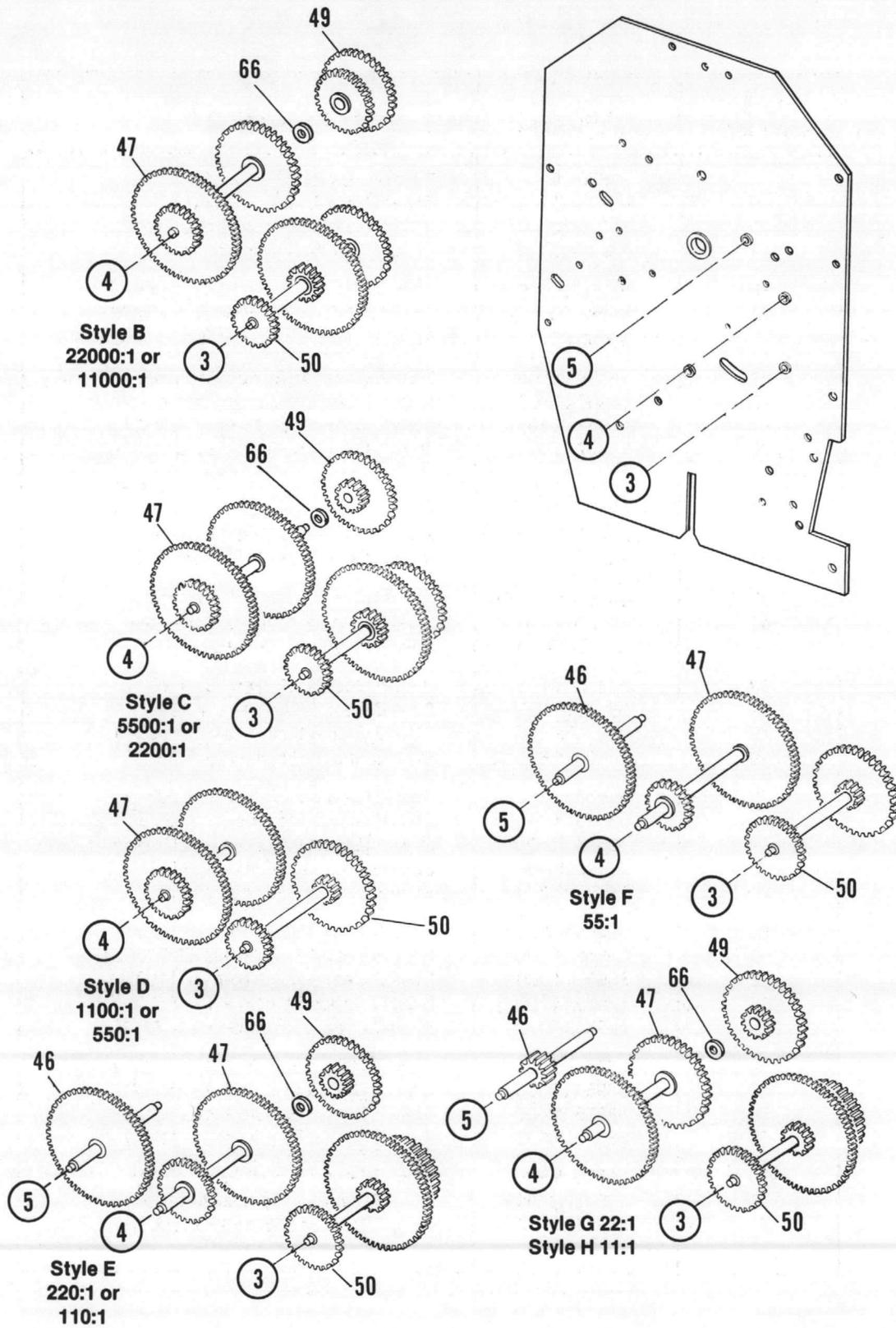


Figure 6-2. (Continued) Model AR Gearing

FIG. 6-2 ITEM NO.	PART NO.	DESCRIPTION
45	56670-00100	Style A & B Gear & Pinion Assy.
45	56670-00100	Style C Gear & Pinion Assy. (5500:1)
45	56670-00700	Style C Gear & Pinion Assy. (2200:1)
45	56670-00700	Style D Gear & Pinion Assembly
46	56960-00400	Style A,B,C, & D Gear & Spindle Assy.
46	56960-00600	Style E & F Gear and Spindle Assembly
46	56960-00300	Style G & H Gear and Spindle Assembly
47	56959-00500	Style A Gear and Spindle Assembly
47	56960-00100	Style B Gear and Spindle Assembly
47	56957-00400	Style C Gear & Spindle Assy. (5500:1)
47	56957-00500	Style C Gear & Spindle Assy. (2200:1)
47	56958-00100	Style D Gear & Spindle Assy. (1100:1)
47	56958-00200	Style D Gear & Spindle Assy. (550:1)
47	56957-00100	Style E Gear and Spindle Assembly
47	56958-00600	Style F Gear and Spindle Assembly
47	56960-00200	Style G Gear and Spindle Assembly
47	56957-00200	Style H Gear and Spindle Assembly
48	56670-00500	Style A Gear and Hub Assembly
49	56676-00100	Style A Gear and Pinion Assembly
49	56670-00100	Style B Gear Pinion Assy. (22000:1)
49	56670-00400	Style B Gear & Pinion Assy. (11000:1)
49	56670-00600	Style C Gear & Pinion Assy. (5500:1)
49	56676-00100	Style C Gear & Pinion Assy. (2200:1)
49	56670-00600	Style E Gear & Pinion Assy. (220:1)
49	56676-00100	Style E Gear & Pinion Assy. (110:1)
49	56670-00400	Style G Gear and Pinion Assembly
49	56670-00600	Style H Gear and Pinion Assembly
50	56955-00100	Style A Gear & Spindle Assembly
50	56956-00200	Style B Gear & Spindle Assy. (22000:1)
50	56956-00300	Style B Gear & Spindle Assy. (11000:1)
50	56955-00200	Style C Gear & Spindle Assy. (5500:1)
50	56955-00300	Style C Gear & Spindle Assy. (2200:1)
50	56956-00400	Style D Gear & Spindle Assy. (1100:1)
50	56956-00500	Style D Gear & Spindle Assy. (550:1)
50	56955-00400	Style E Gear & Spindle Assy. (220:1)
50	56955-00500	Style E Gear & Spindle Assy. (110:1)
50	56956-00400	Style F Gear and Spindle Assembly
50	56956-00100	Style G Gear and Spindle Assembly
50	56955-00600	Style H Gear and Spindle Assembly

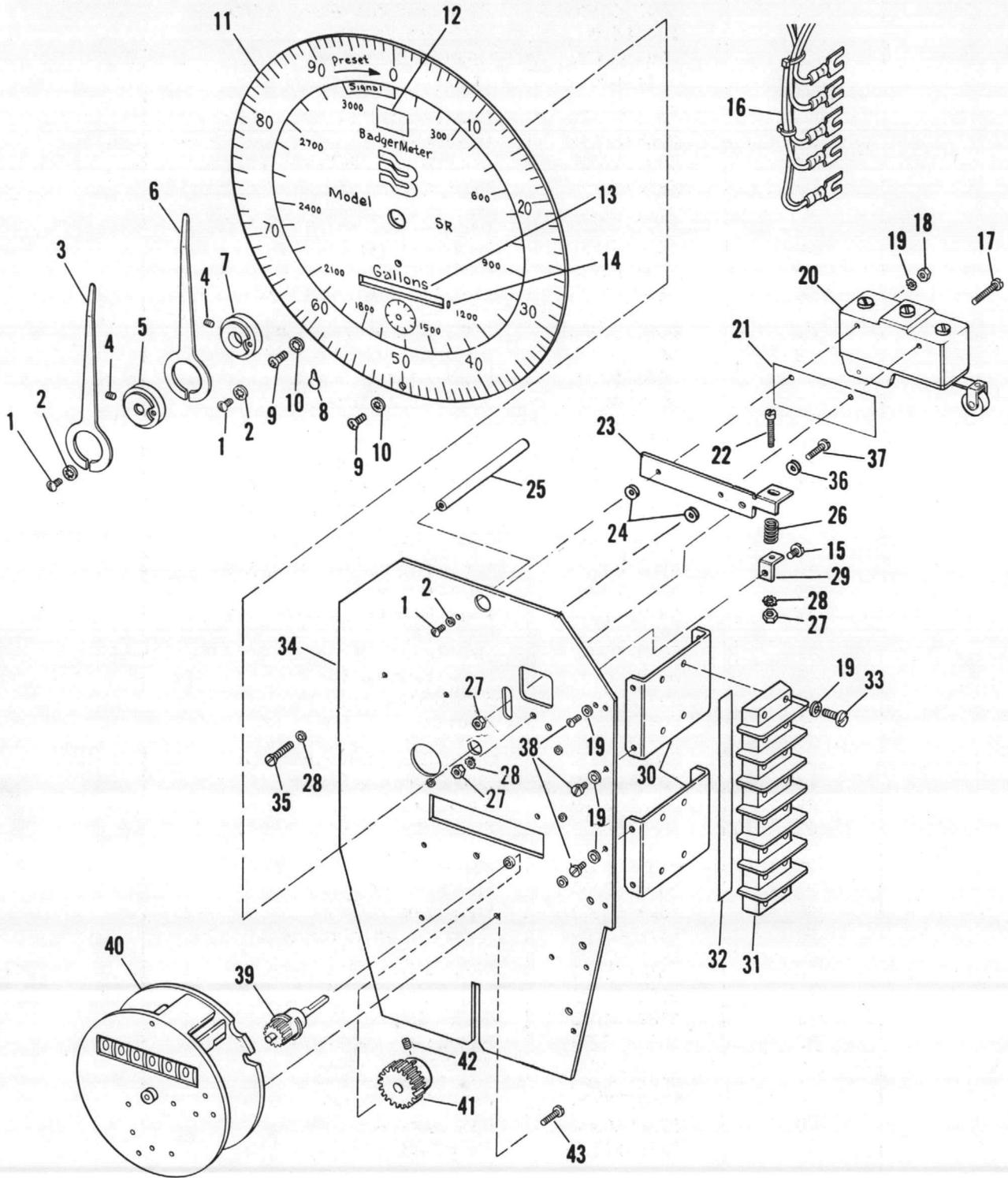
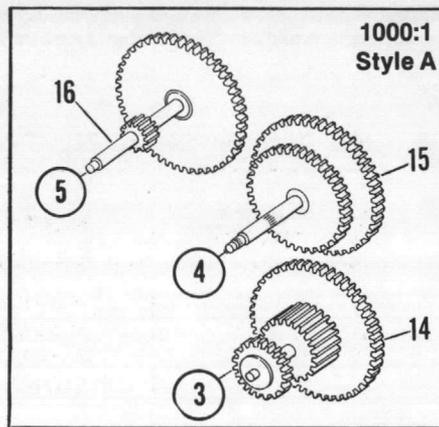
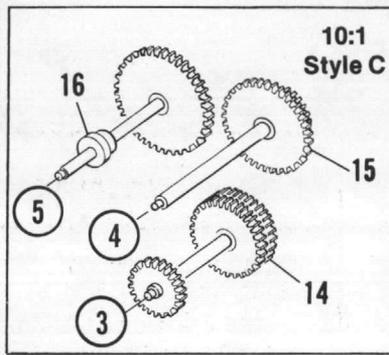
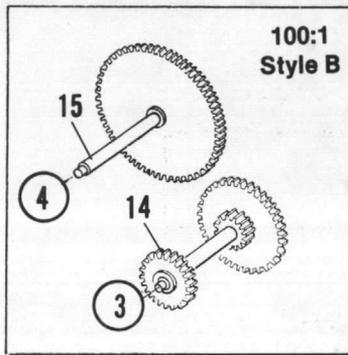


Figure 6-3. Model SR Front Plate

FIG. 6-3 ITEM NO.	PART NO.	DESCRIPTION
1	55090-08600	Pan Head Screw — 3-48 x 3/16
2	20454-00000	Lockwasher No. 3
3	22859-00000	Outer Pointer
4	21451-00000	Set Screw — 4-48 x 1/8
5	22860-00000	Outer Pointer Hub
6	22859-00100	Inner Pointer
7	56962-00100	Inner Pointer Hub Assembly
8	33319-00000	Test Circle Pointer
9	31820-00000	Pan Head Screw — 2-32 x 5/16
10	55293-00300	Lockwasher No. 2
11	56599-00100	Dial
12	56600-00500	30,000 Capacity Label x 10
12	56600-00600	300,000 Capacity Label x 100
12	56600-00700	3,000,000 Cap. Label x 1000
13	56600-00200	Label — Liters
13	56600-01400	Label — Imp. Gallons
13	56600-00300	Label — M ³
14	56600-01000	100 Test Circle Label — 00
14	56600-01100	1000 Test Circle Label — 000
14	56600-01500	.1 Test Circle Label — x .1
14	56600-01600	Blank Label
15	55090-11500	Pan Head Screw — 4-40 x 5/16
16	56844-00100	Wiring Harness
17	55109-17500	Round Head Screw — 6-32 x 3/4
18	55002-03400	Hex Nut — 6-32
19	55294-00700	Lockwasher No. 6
*20	24574-00500	Signal Switch
21	56872-00100	Insulation
22	55046-12300	Fil. Head Screw — 4-40 x 5/8
23	56734-00100	Switch Adjusting Bracket
24	22562-00100	Flat Washer
25	21700-00000	Spacer Por t
26	22602-02500	Spring
27	55002-03200	Hex Nut — 4-40
28	55291-00500	Lockwasher No. 4
29	56736-00100	Switch Adjusting Bracket
30	56664-00100	Terminal Mounting Bracket
31	22800-01400	Terminal Strip — 4 Term.
32	31898-01000	Marker Strip — 4 Term.
33	55090-17200	Pan Head Screw — 6-32 x 1/2
34	56678-00100	Front Plate Assembly
35	55109-17700	Round Head Screw — 6-32 x 1
36	55291-00500	Lockwasher No. 4
37	55089-11400	Pan Head Screw — 4-40 x 1/4
38	55109-16700	Round Head Screw — 6-32 x 3/16
39	56630-00100	Cam Spindle Assembly
40	56950-00100	Totalizer Assembly
41	34780-00100	Gear — 20 Teeth
42	55230-11300	Set Screw — 4-40 x 3/16
43	31820-00400	Flat Head Screw — 2-32 x 3/8

*Recommended Spare Parts



Alternate Gearing

For gear reductions,
see table 6-1

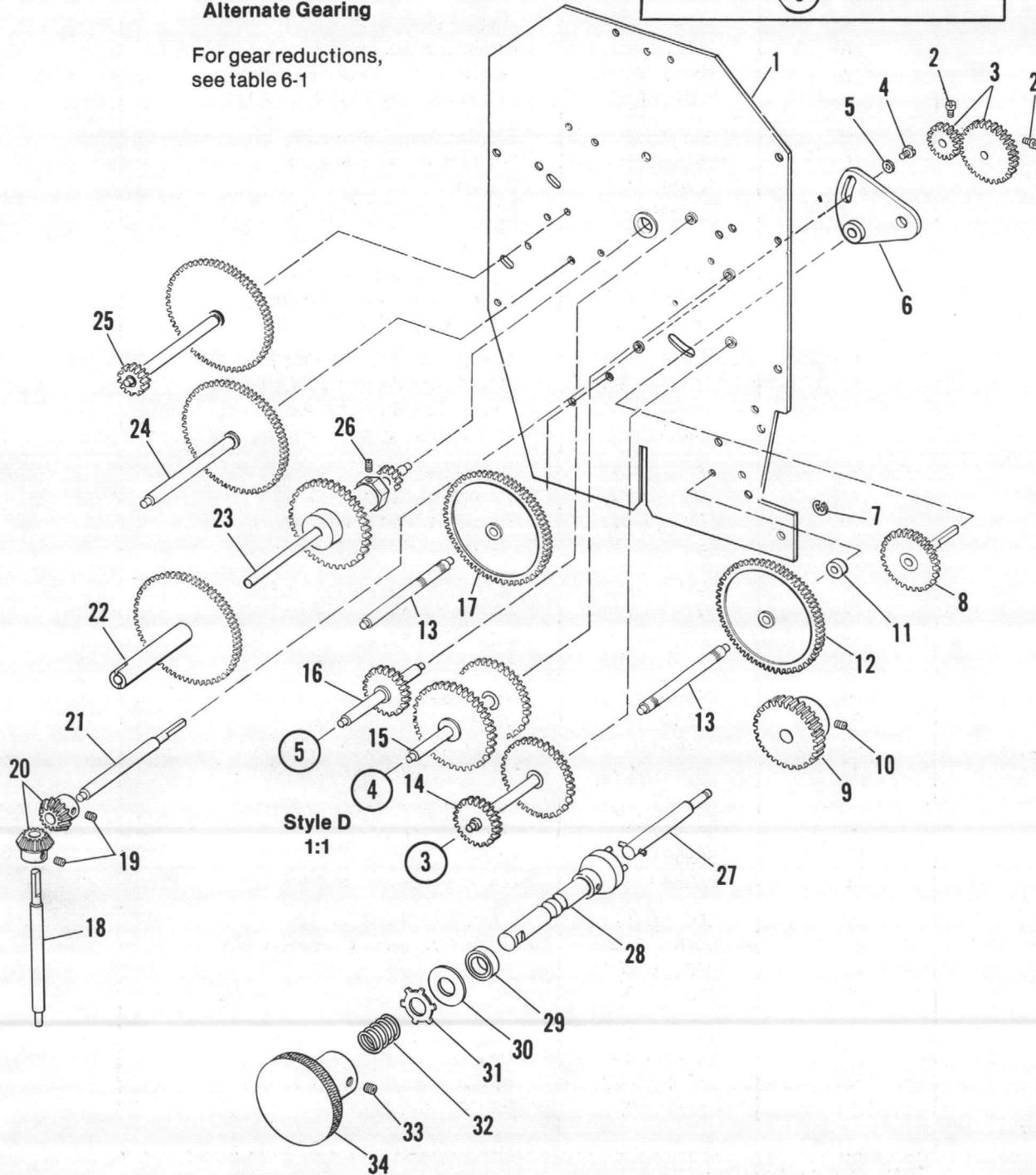


Figure 6-4. Model SR Back Plate and Gearing

FIG. 6-4 ITEM NO.	PART NO.	DESCRIPTION
1	56679-00100	Back Plate Assembly
*2	1065-00000	Set Screw — 4-48
*3	32652-00000	Change Gear — Spec. No. Teeth
4	55109-11300	Round Head Screw — 4-40 x 3/16
5	55283-00500	Lockwasher No. 4
6	56867-00100	Adjusting Plate Assembly
7	22570-00300	"E" Ring
8	56673-00100	Change Gear Spindle Assembly
9	26459-03000	Drive Pinion — 30 Teeth
10	55230-11300	Set Screw — 4-40 x 3/16
11	56708-00100	Spacer
12	56720-00100	Gear Cluster — 50 Teeth
13	56711-00100	Spindle
14	56955-00700	Style A Gear & Spindle Assy.
14	56956-00400	Style B Gear & Spindle Assy.
14	56956-00600	Style C Gear & Spindle Assy.
14	56955-00800	Style D Gear & Spindle Assy.
15	56960-00500	Style A Gear & Spindle Assy.
15	56958-00400	Style B Gear & Spindle Assy.
15	56958-00500	Style C Gear & Spindle Assy.
15	56959-00100	Style D Gear & Spindle Assy.
16	56959-00300	Style A Gear & Spindle Assy.
16	56959-00300	Style B Gear & Spindle Assy.
16	56959-00400	Style C Gear & Spindle Assy.
16	56959-00200	Style D Gear & Spindle Assy.
17	56710-00100	Gear & Hub Assy. — 60 Teeth
18	56649-00100	Input Spindle
19	55230-16500	Set Screw — 6-32 x 1/8
20	20398-00000	Miter Gear
21	56634-00100	Drive Spindle
22	56706-00200	Gear & Cam Assy. — 77 Teeth
23	56705-00600	Clutch Spindle Assy., Style A, B & C
23	56705-00700	Clutch Spindle Assy., Style D
24	56957-00300	Spindle Assembly
25	56958-00300	Spindle Assembly
26	55234-11100	Set Screw — 4-48 x 1/8
27	56961-00100	Reset Spindle
28	56787-00100	Reset Knob Spindle Assembly
29	22877-00400	"V" Ring
*30	22562-02300	Flat Washer
31	56751-00100	Retaining Ring
32	22602-02400	Spring
*33	55230-19400	Set Screw — 8-32 x 3/16
*34	24399-00000	Control (Preset) Knob

*Recommended Spare Parts

Table 6-1. Gear Reduction Versus Dial Capacities

MODEL AR AUTOMATIC RESET REGISTER

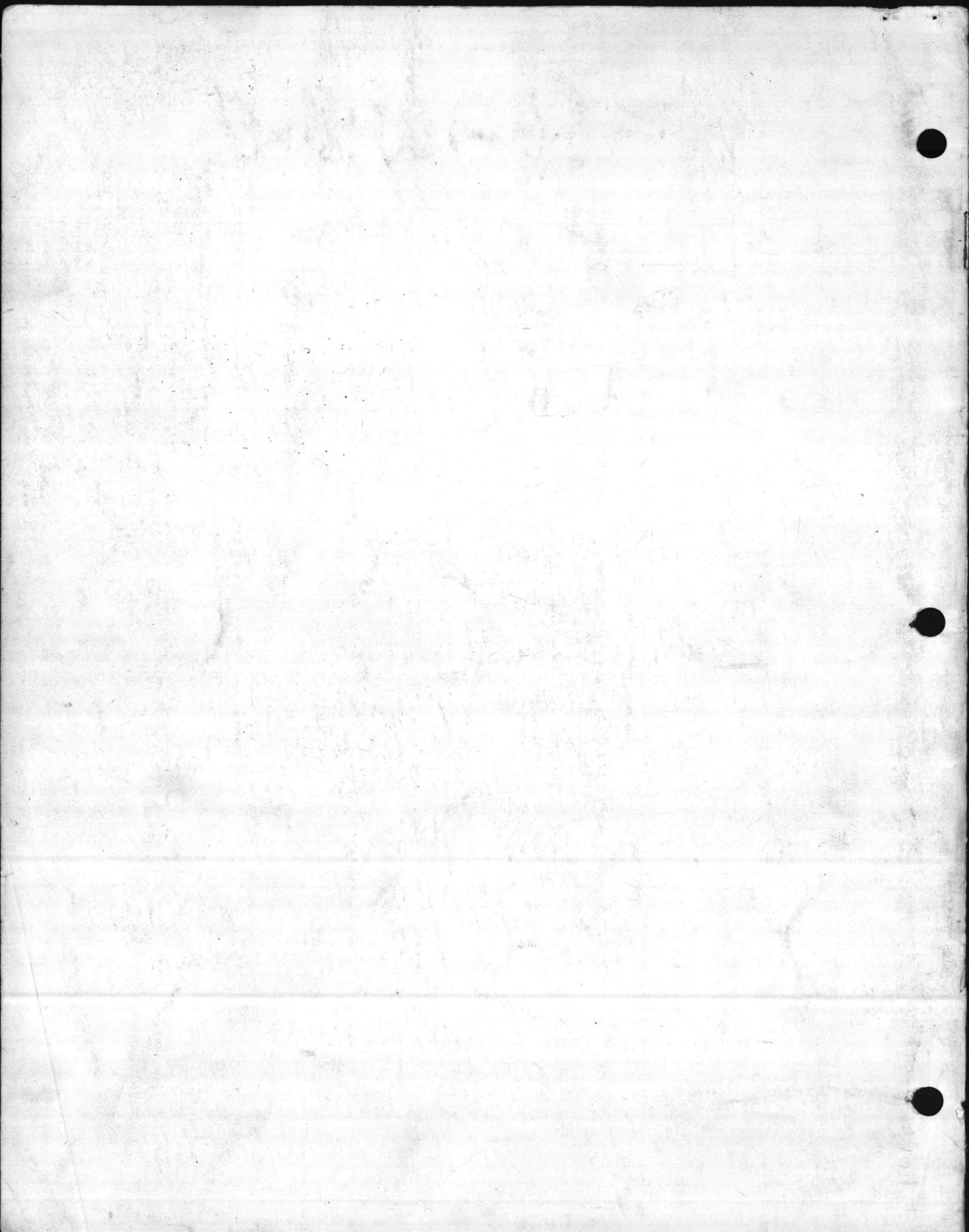
METER SIZE	REGISTER TEST CIRCLE	DIAL CAPACITY	REDUCTION RATIO
5/8" Through 1"	10	100	11:1
	10	200	22:1
	10	500	55:1
	10	1,000	110:1
	10	2,000	220:1
	10	5,000	550:1
	10	10,000	1,100:1
	10	20,000	2,200:1
	10	50,000	5,500:1
	10	100,000	11,000:1
1-1/2" Through 3"	100	1,000	11:1
	100	2,000	22:1
	100	5,000	55:1
	100	10,000	110:1
	100	20,000	220:1
	100	50,000	550:1
	100	100,000	1,100:1
	100	200,000	2,200:1
	100	500,000	5,500:1
	100	1,000,000	11,000:1
4" and Over	1,000	50,000	55:1
	1,000	100,000	110:1
	1,000	200,000	220:1
	1,000	500,000	550:1
	1,000	1,000,000	1,100:1
	1,000	2,000,000	2,200:1
	1,000	5,000,000	5,500:1
1,000	10,000,000	11,000:1	

MODEL SR SIGNAL REGISTERS

METER SIZE	REGISTER TEST CIRCLE	OUTER CIRCLE	INNER CIRCLE	REDUCTION RATIO
5/8" Through 1"	10	100	3,000	10:1
	10	1,000	30,000	100:1
	10	10,000	300,000	1,000:1
1-1/2" Through 3"	100	100	3,000	1:1
	100	1,000	30,000	10:1
	100	10,000	300,000	100:1
	100	100,000	3,000,000	1,000:1
4" and Above	1,000	1,000	30,000	1:1
	1,000	10,000	300,000	10:1
	1,000	100,000	3,000,000	100:1

WARRANTY

Badger warrants meters and parts manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of 18 months from date of shipment or 12 months from date of installation, whichever period shall be shorter. If within such period any meters or parts shall be proved to Seller's satisfaction to be defective, such meters or parts shall be repaired or replaced at Seller's option. Seller's obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such meters or parts to Seller f.o.b. its factory. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES WHATSOEVER INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES (EXCEPT OF TITLE) OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Badger shall not be liable for any defects attributable to acts or omissions of others after shipment, nor any consequential, incidental or contingent damage whatsoever.



NAT'L. B.D. MFG. AND ASME 34887

CERTIFIED BY

DIV. 1 STOVSTOWN TANK

& STEEL COMPANY

STOVSTOWN P.A.

W. MAX. W.P. 200 PSI

SW. - 154 H.D. - 132

650 F

YEARS 4 REHL. 221

AIR COMPRESSOR

CHANGED OIL

SAE 30

BB - 190

BA 138

~~NEW TRANSFORMER FOR BB 221A~~

2 LOADS

SALT

BB 190

ORDERED

10-1-87

1 LOAD

SALT

BA 138

94 ft Head
Filter Pumps @
40 PST

OPERATING INSTRUCTIONS

DUAL MEDIA FILTER

DATA:

NUMBER OF UNITS.....
 SIZE - DIAMETER (INCHES).....
 STRAIGHT HEIGHT (FT-IN).....
 MAXIMUM OPERATING PRESSURE (PSI).....
 MAXIMUM OPERATING TEMPERATURE (°F.).....
 UNDERDRAIN (TYPE).....
 VALVE (TYPE).....
 OPERATING (MANUAL OR AUTOMATIC)....
 OPERATING WEIGHT (EACH UNIT--LBS)..
 FILTER BED (TYPE).....
 FILTER BED (CU. FT.).....
 BED DEPTH (INCHES IN STRAIGHT)..
 SUPPORTING BED (TYPE).....
 TANK LINING (IF USED).....
 OPERATING RATES (EACH UNIT)

2.31
 90
 6
 540
 9
 24
 41
 231

BW - 10 min.
 Rises - 5 min.

A. FILTER, NORMAL (GPM).....	90.6
B. BACKWASH (GPM).....	440
DURATION.....	10 MINUTES ⁽²⁾
C. REWASH (GPM) (RINSE).....	90.6
DURATION.....	5 MINUTES

* Interior surfaces including double dish strainer plate painted with 2 coats to 10 mils dry film thickness IAW AWWA D102-78 inside paint system No. 1.



94 ft Head
Filter Pumps @
40 PSI

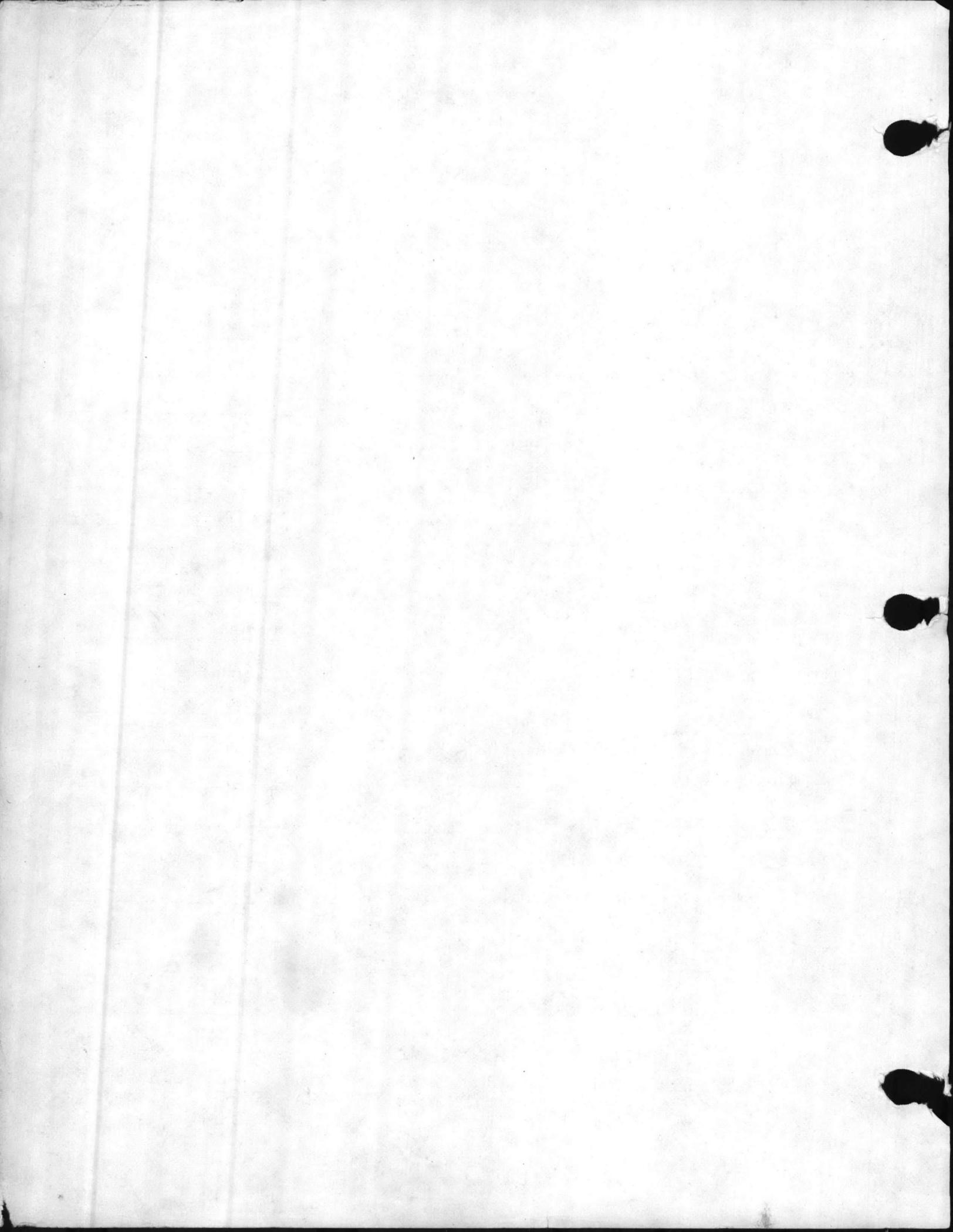
OPERATING INSTRUCTIONS

DUAL MEDIA FILTER

DATA:

NUMBER OF UNITS.....	<u>SIX (6)</u>
SIZE - DIAMETER (INCHES).....	<u>90</u>
STRAIGHT HEIGHT (FT-IN).....	<u>4-0</u>
MAXIMUM OPERATING PRESSURE (PSI).....	<u>100 ASME CODE</u>
MAXIMUM OPERATING TEMPERATURE (°F.).....	<u>100</u>
UNDERDRAIN (TYPE).....	<u>DOUBLE DISH WITH STRAINERS</u>
VALVE (TYPE).....	<u>MULTI-PORT VALVE</u>
OPERATING (MANUAL OR AUTOMATIC).....	<u>MANUAL AND SEMI-AUTOMATIC</u>
OPERATING WEIGHT (EACH UNIT--LBS).....	<u>20,500</u>
FILTER BED (TYPE).....	<u>ANTHRACITE/SAND</u>
FILTER BED (CU. FT.).....	<u>49</u>
BED DEPTH (INCHES IN STRAIGHT).....	<u>12" - ANTHRACITE</u> <u>18" - SAND</u>
SUPPORTING BED (TYPE).....	<u>NONE</u>
TANK LINING (IF USED).....	<u>*</u>
OPERATING RATES (EACH UNIT)	
A. FILTER, NORMAL (GPM).....	<u>90.6</u>
B. BACKWASH (GPM).....	<u>440</u>
DURATION.....	<u>10 MINUTES</u> ⁽²⁾
C. REWASH (GPM) (RINSE).....	<u>90.6</u>
DURATION.....	<u>5 MINUTES</u>

* Interior surfaces including double dish strainer plate painted with 2 coats to 10 mils dry film thickness IAW AWWA D102-78 inside paint system No. 1.





HANKISON CORPORATION

7610.478.8
7/83

SERIES-80 AIR DRYERS
MODELS 8010, 8015, 8025, 8035

Instruction Manual

WARRANTY

The manufacturer warrants the equipment manufactured by it to be free from defects in material or workmanship for a period of one (1) year from date of shipment to buyer by manufacturer or manufacturer's authorized distributor. If the equipment or any part thereof becomes defective within one (1) year from such date, the defective equipment or part will be replaced or credit allowed therefore at the sole option of manufacturer, but without any credit or payment for any labor or expense.

The foregoing is the exclusive remedy of any buyer of manufacturer's equipment. The maximum damages liability of manufacturer is the cost of replacement of the equipment or part.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR STATUTORY, AND IS EXPRESSLY IN LIEU OF THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. THE MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OR DAMAGE BY REASON OF STRICT LIABILITY IN TORT OF ITS NEGLIGENCE IN WHATEVER MANNER INCLUDING DESIGN, MANUFACTURE OR INSPECTION OF THE EQUIPMENT OR ITS FAILURE TO DISCOVER, REPORT, REPAIR, OR MODIFY LATENT DEFECTS INHERENT THEREIN.

THE MANUFACTURER, HIS REPRESENTATIVE OR DISTRIBUTOR SHALL NOT BE LIABLE FOR LOSS OR USE OF THE EQUIPMENT OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES OR DAMAGES INCURRED BY THE BUYER, WHETHER ARISING FROM BREACH OF WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

The manufacturer does not warrant any equipment, part material component, or accessory manufactured by others and sold or supplied in connection with the sale of manufacturer's products.

1-80

AUTHORIZATION FROM THE SERVICE DEPARTMENT IS NECESSARY BEFORE MATERIAL IS RETURNED TO THE FACTORY OR IN-WARRANTY REPAIRS ARE MADE.

General Safety Information

CAUTION

1. Pressurized devices —

This equipment is a pressure containing device.

- Do not exceed maximum operating pressure as shown on equipment serial number tag.
- Make sure equipment is depressurized before working on or disassembling it for servicing.

2. Electrical —

This equipment requires electricity to operate.

- Install equipment in compliance with national and local electrical codes.

- Standard equipment is supplied with NEMA 1 electrical enclosures and is not intended for installation in hazardous environments.
- Disconnect power supply to equipment when performing any electrical service work.

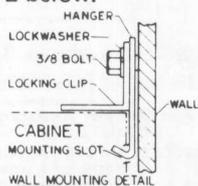
3. Breathing air —

- Air treated by this equipment may not be suitable for breathing without further purification. Refer to OSHA standard 1910.134 for the requirements for breathing quality air.

INSTALLATION

1. Care should be taken in placement of compressor intake so as to avoid introduction of contaminants into the air system that are harmful to dryer wetted material (e.g., ammonia). Optional dryer heat exchanger materials of construction are available.
2. Install the air dryer in an area that will allow the air to pass freely through the refrigeration section. Do not place obstructions near either side of the cabinet.
3. Wall Mounting

- A. Models 8010 and 8015 can be mounted by either Method 1 or 2 below.



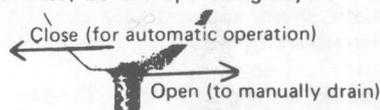
Method 1 — Models 8010 and 8015 are supplied with a horizontal mounting slot in the back of the cabinet and a wall mounting bracket assembly consisting of a "J" shaped hanger and a "L" shaped locking clip. Place a 3/8" bolt first through the "L" shaped locking clip then through the "J" shaped hanger and insert assembly into the wall. Tighten bolt sufficiently to support unit. With the bottom of the "L" shaped locking clip swung to the side, hang the unit on the wall by placing the horizontal slot on the "J" shaped hanger. Seat the "L" shaped locking clip firmly on the top of dryer cabinet. Finish tightening bolt. Anchor unit by means of anchor bolt hole located 2" from the base of the cabinet.

Method 2 — These units are also supplied with two (2) keyhole slots with 5/16" holes in the back of the cabinet. Place mounting screws in wall (1/4" cap screw recommended) leaving 1/8" to 3/16" from wall surface to underside of mounting screw head. Seat dryer on mounting screws. Tighten screws. Anchor unit at anchor bolt hole.

- B. Models 8025 and 8035.

Although wall mounting is not normally recommended, keyhole slots are provided in the back of the cabinet and may be used to wall mount the unit as in Method 2 above.

4. Connect compressed air lines to "Air Inlet" and "Air Outlet" located and identified on the side of the cabinet. Piping arrangements should include inlet and outlet valves and also a suitable air by-pass to facilitate maintenance without shutting off air supply.
5. The moisture separator is furnished with an internal automatic drain as standard. This drain will automatically discharge any condensed water and/or oil collected in the separator. At the bottom of the separator is a knurled fitting with flexible drain tubing attached to transfer the condensate away from the unit. Be sure the knurled fitting is tightened by turning it to your left (counterclockwise) before operating dryer.



6. Check serial tag on unit for voltage requirement. Standard unit is wired for 115 volt, single phase, 60 hertz (240/220 volt, single phase, 50 hertz units also available). A six (6) foot power cord with plug is standard on the 115/1/60 Hz. units. Units supplied with plugs include separate locking clip to be used to prevent accidental removal of plug from receptacle. Wiring is 3-wire ground. The 240/220 unit should be "hard wired" by going directly through the knock outs into the conduit box. Refrigeration compressor and fan motor have built-in overload protection with automatic reset. See Electrical Data, page 4 for recommended electrical circuit protection.

NOTE: Refrigeration condensing unit is designed to run continuously and should *NOT* be wired to cycle on/off with air compressor.

SERVICE DEPARTMENT: (412) 746-1100

OPERATION

1. Red and green indicator lights are provided. The green light will be on when the unit has electrical power. The red light is a high outlet air temperature warning light and is activated by a thermostatic switch. When the red light is on, the temperature of the air leaving the cooling coil is higher than normal. Both the red and green light will come on when the unit is first connected to power. When the air is cooled down satisfactorily, the red light will go off, usually in less than 15 minutes. If the red light fails to go off in 30 minutes, or if it comes back on after being off for several hours of normal continuous operation, one of the following conditions could be the cause:

- A. The unit is overloaded, i.e., it is operating at a flow rate and/or inlet temperature greater than the rated capacity. (See Operating Conditions, page 3)
- B. The refrigeration section of the unit may have lost some refrigerant or the refrigeration compressor has cut out.
- C. The unit is functioning normally but the thermostatic switch is malfunctioning.

If you think the problem is either (B) or (C), call your sales or service representative immediately.

- 2. Under normal conditions, removal of moisture from the compressed air begins immediately. After several hours of operation, some sign of condensate discharge should be visible.
- 3. After initial startup periodically check:
 - That condensate is being discharged to drain.
 - That hi-temperature switch is out.

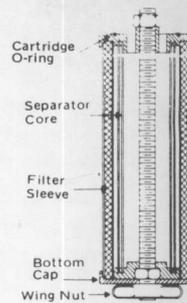
MAINTENANCE

- 1. Do *NOT* tamper with refrigeration section. Settings made at the factory are for normal conditions. Note: High Altitude Adjustment: The hot gas by-pass valve is normally adjusted to maintain the design evaporator pressure in altitudes up to 4500 feet above sea level. Installation in altitudes above this require an adjustment to the valve. If the factory had been notified of a high altitude condition at the time the order was placed, the valve has been adjusted at the factory and a tag has been affixed to the dryer indicating this. If valve has not been adjusted for altitudes above 4500 feet and dryer is to be installed in higher altitude, contact the service department at (412) 746-1100 for adjustment instructions.
- 2. The refrigeration condenser should be kept clean and clear of dirt to allow free passage of air. In particularly dirty areas, a furnace type filter installed in front of the refrigeration condenser is recommended.
- 3. The separator assembly includes a separator filter sleeve and automatic drain. It normally requires no maintenance. The separator assembly can be "blown down" manually.
 - A. To manually "blow down" the separator:
 - Step 1** Remove metal clamp and tubing from knurled drain fitting.
 - Step 2** Turn knurled fitting to your right (clockwise) to open (blow down), then to your left (counterclockwise) to close.
 - Step 3** Reassemble.
 - B. To replace automatic drain mechanism:
 - Step 1** Isolate dryer from air system.
 - Step 2** Depressurize dryer by manually blowing down separator (see Steps 1 and 2 in 3A above).
 - Step 3** Unscrew the metal collar holding the separator bowl to the head and remove bowl and collar.
 - Step 4** Remove old drain mechanism by turning the knurled fitting and removing it from the bottom. Install new drain mechanism.
 - Step 5** Reassemble.

4. The filter sleeve in the moisture separator may require replacement after extended service. (This will be determined by excessive pressure drop across air dryer.)

To replace the filter sleeve:

- Step 1** Follow steps 1 through 3 in 3B above.
- Step 2** Remove wing nut and bottom cap.
- Step 3** Slide disposable filter sleeve down over separator core.
- Step 4** If necessary, unscrew separator core from filter head and clean with soap and water.
- Step 5** Reassemble separator core to head. (Check to make sure new O-ring is in place.)
- Step 6** Slide new filter sleeve over separator core.
- Step 7** Replace bottom cap and wing nut.
- Step 8** Reassemble separator bowl to separator assembly head.



CAUTION: Polycarbonate Bowls

In standard units the separator bowl is constructed of polycarbonate. Be aware that the following circumstances could adversely affect the polycarbonate material. Care should be taken to:

AVOID

Installation areas where high temperatures (120°F/49°C or higher) exist or solvent fumes or chemical vapors (see Chemical Resistance table) with an adverse affect on polycarbonate are present in the atmosphere.

AVOID

Cleaning the polycarbonate bowl with solvents such as acetone, alcohols, ketones, esters or aromatic hydrocarbons such as benzene, toluene, xylene, etc. Clean with a mild household detergent only.

AVOID

Adverse solvent fumes & chemical vapors (see Chemical Resistance table) being drawn into the compressed air system via the compressor intake.

AVOID

The use of polycarbonate bowls on air systems where synthetic compressor lubricants are transmitted downstream.

AVOID

Compressed air temperatures above 120°F/49°C or pressures above 150 psig/10 bar at inlet to dryer.

Chemical and Solvent Resistance Table
(Partial List)

LIMITED RESISTANCE:	
Cyclohexanol	Milk of Lime (CaOH)
Gasoline (High Aromatic)	Nitric Acid (Conc.)
Hydrochloric Acid (Conc.)	Sulfuric Acid (Conc.)
NOT RESISTANT:	
Acetaldehyde	Ethane Tetrachloride
Acetic Acid (Conc.)	Ethylamine
Acetone	Ethyl Ether
Acrylonitrile	Ethylene Chlorohydrin
Ammonium Fluoride	Formic Acid (Conc.)
Ammonium Sulfide	Freon (Refrigerant & Propellant)*
Benzene	Nitrobenzene
Benzoic Acid	Nitrocellulose Lacquer
Benzyl Alcohol	Phenol
Bromobenzene	Phosphorous Hydroxy Chloride
Butyric Acid	Phosphorous Trichloride
Carbon Tetrachloride	Propionic Acid
Carbon Disulfide	Sodium Sulfide
Carbolic Acid	Styrene
Caustic Potash Solution (5%)	Sulfuryl Chloride
Caustic Soda Solution (5%)	Tetra Hydronaphthalene
Chlorobenzene	Thiophene
Cyclo Hexanone	Toluene
Cyclohexene	Xylene
Dimethyl Formamide	Synthetic Compressor Lubricants**
DISSOLVED BY:	
Chloroform	Ethylene Dichloride
Cresol	Methylene Chloride
Dioxane	Pyridine

*DuPont Trademark.

**Phosphate Ester Lubricants; where compressor lubricants other than normal mineral base lubricants are used, contact lubricant manufacturer.

NOTE: Metal Bowls are Available.

ENGINEERING DATA

I. Compressed Air Flow Capacities

A) CAPACITY AT RATED CONDITIONS

Rated flow capacities are established in accordance with Compressed Air and Gas Institute Standard for Rating and Testing Compressed Air Dryers and National Fluid Power Association Recommended Standard NFPA/T3.27.2-1975. These standards state that the rated dryer capacity be established at 100°F and 100 psig inlet compressed air conditions with 100°F ambient air or 85°F cooling water supplied to the refrigeration condenser and with a pressure drop of 5 psi or less.

B) CAPACITY AT OTHER THAN RATED CONDITIONS

When operating at conditions other than rated, adjustments to the rated flow capacity must be made. Conditions which affect the amount of flow that can be handled by a dryer are:

1) Dew point

Dew point is the temperature at which the air can no longer hold all the water vapor present and some of the vapor is condensed into a liquid. As long as the temperature of the compressed air, as it flows downstream, is kept safely above the dew-point temperature, no troublesome liquid will form in the air lines.

At dew points higher than 35°F (up to 50°F) additional flow capacity can be put through the dryer.

2) Compressed air conditions at inlet to dryer

The temperature and pressure of the inlet air determine how much work has to be done to wring out moisture (lower the dew point).

- Compressed air temperature

As the temperature of the compressed air at the inlet to the dryer decreases, the capacity of the dryer increases. It is a good practice to install the dryer where the compressed air has been adequately cooled by an aftercooler or while in the receiver tank.

MODEL	8010	8015	8025	8035
Rated Capacity (scfm)	10	15	25	35

TABLE 1 RATED CAPACITY **RC**

INLET AIR PRESSURE (psig)	PRESSURE DEW POINT											
	35°F		50°F		35°F		50°F		35°F		50°F	
	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F
20	1.10	2.00	.83	1.35	.65	1.00	.52	.76	.41	.60		
40	1.30	2.00	1.00	1.65	.80	1.24	.65	.96	.53	.76		
60	1.41	2.00	1.10	1.85	.89	1.40	.73	1.10	.60	.88		
80	1.50	2.00	1.17	1.98	.95	1.51	.79	1.20	.66	.98		
100	1.55	2.00	1.23	2.00	1.00	1.60	.83	1.27	.70	1.04		
120	1.59	2.00	1.26	2.00	1.03	1.66	.86	1.33	.73	1.09		
140	1.63	2.00	1.30	2.00	1.06	1.71	.89	1.38	.76	1.14		
160	1.65	2.00	1.32	2.00	1.09	1.76	.91	1.42	.78	1.17		
180	1.68	2.00	1.34	2.00	1.10	1.79	.93	1.45	.80	1.20		
200	1.69	2.00	1.36	2.00	1.12	1.82	.95	1.48	.81	1.23		
220	1.70	2.00	1.37	2.00	1.13	1.85	.96	1.50	.83	1.25		
240	1.72	2.00	1.38	2.00	1.15	1.87	.97	1.52	.84	1.27		
260	1.74	2.00	1.39	2.00	1.16	1.89	.98	1.54	.85	1.29		
280	1.74	2.00	1.40	2.00	1.17	1.91	.99	1.56	.86	1.30		
300	1.75	2.00	1.41	2.00	1.18	1.92	1.00	1.57	.86	1.31		
	80°		90°		100°		110°		120°			
	INLET AIR TEMPERATURE (°F)											

TABLE 2a CAPACITY ADJUSTMENT FACTOR **CFpt**
For Compressed Air Inlet Temperature and Pressure
For Models: 8010, 8015, 8025

- Compressed air pressure

As operating pressure increases so does the capacity of the dryer.

3) Refrigeration system

In air-cooled units ambient air carries heat away from the refrigeration condenser. Lower ambient air temperatures result in greater refrigeration capacity allowing the dryer to handle a greater flow capacity.

C) DETERMINING DRYER CAPACITY AT ACTUAL OPERATING CONDITIONS

Step 1 From Table 1, below find the flow capacity at rated conditions **RC** of the dryer model in question.

Step 2 Using Tables 2 and 3, determine the following Capacity Adjustment Factors:

CFpt = Capacity Adjustment Factor for the actual inlet pressure and temperature — Refer to Table 2a or 2b (for the dryer model under consideration). Using the column under the dew point desired (35°F or 50°F), find the Capacity Adjustment Factor at the intersection of the inlet temperature and pressure corresponding to your operating conditions.

CFac = Capacity Adjustment Factor for ambient air temperature (air-cooled models only) — Using Table 3, obtain the Capacity Adjustment Factor corresponding to the maximum ambient temperature of the area in which the dryer will be installed.

Step 3 Adjust the Rated Capacity (found in Step 1) for the actual operating conditions by calculating an Adjusted Capacity as follows:

$$\text{Adjusted Capacity} = \frac{\text{RC}}{\text{From Table 1}} \times \frac{\text{CFpt}}{\text{From Table 2}} \times \frac{\text{CFac}}{\text{From Table 3}}$$

If the flow through the dryer is below the Adjusted Capacity, the dryer is big enough for the application.

Overloading — Operating dryer at excessive capacity can overload it resulting in high exit air dew points (moisture downstream) or in extreme cases, compressor cycling due to thermal/current overloading with possible compressor failure.

Ambient Temperature (°F)	80	90	100	110
Capacity Adjustment Factor	1.12	1.06	1.0	.94

TABLE 3 CAPACITY ADJUSTMENT FACTOR **CFac**
for Ambient Air Temperature

INLET AIR PRESSURE (psig)	PRESSURE DEW POINT											
	35°F		50°F		35°F		50°F		35°F		50°F	
	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F	35°F	50°F
20	.86	2.00	.64	.96	.47	.68	.36	.50	.28	.37		
40	1.15	2.00	.87	1.34	.67	.98	.52	.73	.41	.55		
60	1.32	2.00	1.02	1.60	.81	1.19	.64	.92	.52	.71		
80	1.45	2.00	1.14	1.80	.91	1.36	.74	1.06	.60	.84		
100	1.55	2.00	1.23	1.94	1.00	1.49	.82	1.18	.67	.95		
120	1.62	2.00	1.30	2.00	1.06	1.60	.88	1.28	.73	1.03		
140	1.68	2.00	1.35	2.00	1.11	1.69	.93	1.36	.78	1.10		
160	1.73	2.00	1.40	2.00	1.16	1.76	.97	1.42	.82	1.17		
180	1.76	2.00	1.44	2.00	1.19	1.82	1.00	1.48	.86	1.22		
200	1.80	2.00	1.47	2.00	1.22	1.87	1.03	1.53	.89	1.27		
220	1.82	2.00	1.49	2.00	1.25	1.92	1.06	1.57	.91	1.31		
240	1.85	2.00	1.52	2.00	1.27	1.96	1.09	1.61	.93	1.35		
260	1.87	2.00	1.53	2.00	1.29	1.99	1.11	1.64	.95	1.38		
280	1.88	2.00	1.55	2.00	1.31	2.00	1.12	1.67	.97	1.41		
300	1.90	2.00	1.57	2.00	1.32	2.00	1.13	1.70	.99	1.43		
	80°		90°		100°		110°		120°			
	INLET AIR TEMPERATURE (°F)											

TABLE 2b CAPACITY ADJUSTMENT FACTOR **CFpt**
For Compressed Air Inlet Temperature and Pressure
For Model: 8035

II. Minimum-Maximum Operating Conditions

	8010	8015	8025	8035
1) Min.-Max. Inlet Air Pressure (compressed air at inlet to dryer)				
a) Standard dryer w/polycarbonate bowl		20 psig (1.4 bar) — 150 psig (10 bar)		
b) Units with optional metal bowl & standard trap		20 psig (1.4 bar) — 175 psig (12 bar)		
c) Units with optional metal bowl & optional high pressure trap		20 psig (1.4 bar) — 300 psig (21 bar)		
2) Max. Inlet Air Temp. (compressed air at inlet to dryer)		120°F (49°C)		
3) Min.-Max. Ambient Temperature		30°F (1.7°C) — 110°F (43°C)		
4) Nominal Pressure Drop at rated flow	2.5 psid	3.0 psid	2.0 psid	4.5 psid

III. Refrigeration System Data

	Tecumseh			
	Hermetic — Resistance Start, Induction Run — Non-Cycling			
Condensing Unit Mfg.	Tecumseh			
Compressor Type	Hermetic — Resistance Start, Induction Run — Non-Cycling			
Refrigeration Compressor Horsepower	1/6	1/5	1/3	1/3
BTU/HR — Refrigeration Only @ 35°F Evaporator & 100°F Ambient	1260	1960	3030	3030
Outlet Air Temp. (nominal at rated conditions)	40°F (4.4°C)	40°F (4.4°C)	40°F (4.4°C)	70°F (21°C)
Refrigerant Type	R12	R12	R12	R12
Refrigerant Charge	See dryer serial number tag			
Suction Pressure Setting (Controlled by hot gas by-pass valve)	34 psig	33 psig	33 psig	33 psig
Condenser Fan Switch Setting (In-out)	N/A		101 psig — 76 psig	
Air Flow Across Condenser (cfm)	200	300	350	350

IV. Electrical

A) Installation

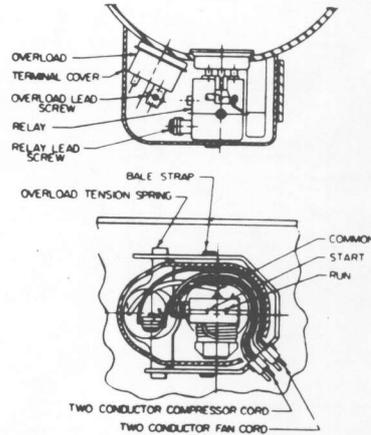
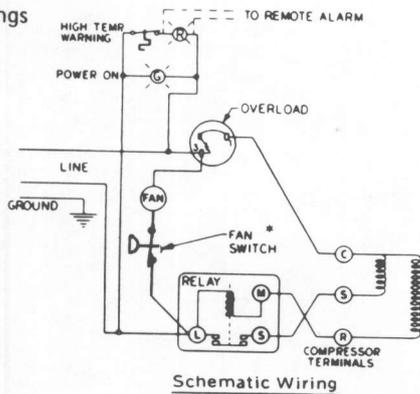
Electrical cord set, type SJ stationary, AWG 18/3 with plug is standard for 115V models. Internal pigtailed and 1/2" knockouts are supplied with 240/220V models.

B) Remote Alarm

Remote alarm can be wired at dryer installation site
Connect alarm in parallel to high temp. light terminals in electrical box

Amperage rating of alarm circuit	@ 115 VAC	@ 240/220 VAC
Resistive load amps	10.0	5.0
Inductive full load amps	5.8	2.9
Inductive locked rotor amps	34.8	17.9

C) Electrical Drawings

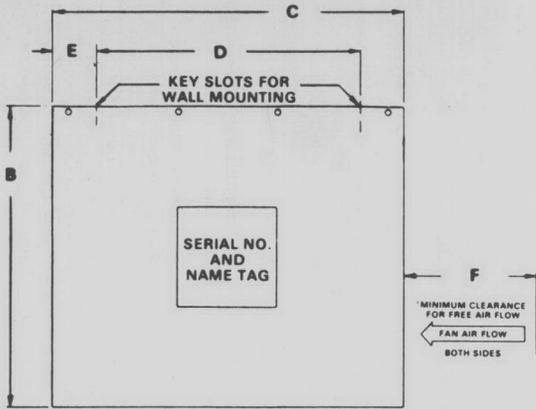


*Omit fan switch for Model 8010

D) Electrical Data

1) 115-160 UNITS	8010	8015	8025	8035
Max. — Min. Voltage	127-104	127-104	127-104	127-104
Total Full Load Amps	3.4	4.8	7.4	7.4
Total Locked Rotor Amps	18.5	24.5	35.7	35.7
Compressor Full Load Amps	2.9	4.4	6.8	6.8
Compressor Locked Rotor Amps	18	24	35	35
Unit Protection Fuse Size (amps)*	5	6	10	10
Branch Circuit Fuse Size (amps)	15	15	15	15
Watts @ 35°F Evaporator & 100°F Ambient	250	415	478	478
Resistance (ohms) — Start	12.4	12.3	12.1	12.1
Resistance (ohms) — Run	3.5	1.9	1.3	1.3
Overload	Thermal & Current (Auto reset)			
2) 240/220-1-50				
Max. — Min. Voltage	264-198	264-198	264-198	264-198
Total Full Load Amps	1.5	2.2	3.5	3.5
Total Locked Rotor Amps	9.1	11.6	16.4	16.4
Compressor Full Load Amps	1.3	2	3.2	3.2
Compressor Locked Rotor Amps	8.7	11.2	16	16
Unit Protection Fuse Size (amps)*	2	3	5	5
Branch Circuit Fuse Size (amps)	15	15	15	15
Watts @ 35°F Evaporator & 100°F Ambient	250	415	478	478
Resistance (ohms) — Start	53.0	48.0	60.9	60.9
Resistance (ohms) — Run	17.8	11.2	5.85	5.85
Overload	Thermal & Current (Auto reset)			

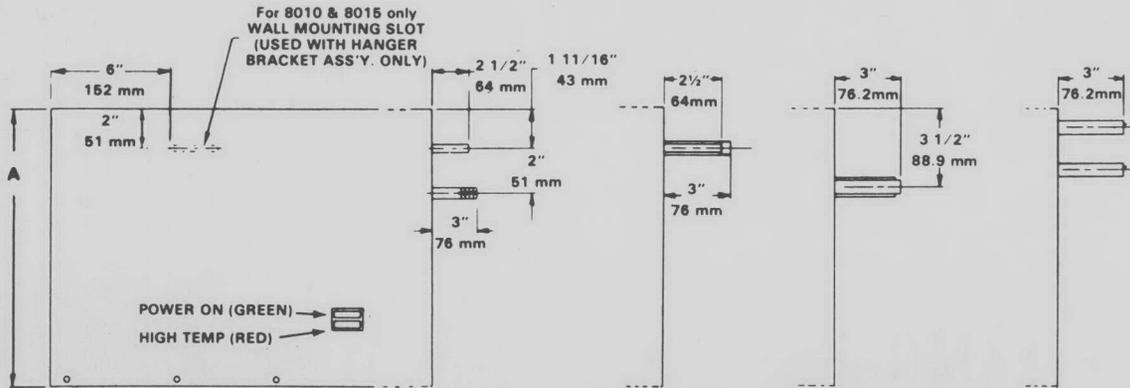
*Amp rating is for dual element fuse



TOP VIEW (ALL MODELS—CABINET DIMENSIONS)

Dimensions & Weight

	8010	8015	8025	8035
A	14" (356 mm)		16" (406.4 mm)	
B	15" (381 mm)		16" (406.4 mm)	
C	16-1/8" (410 mm)	22-1/16" (560.4mm)		
D	12" (305 mm)		16" (406.4 mm)	
E	2-1/16" (52 mm)		3-1/32" (76.9 mm)	
F	6" (152 mm)		12" (304.8 mm)	
Wt.	57 lb 26 kg	65 lb 29 kg	97 lb 44 kg	100 lb 45 kg



FRONT VIEW MODEL 8010

MODEL 8015

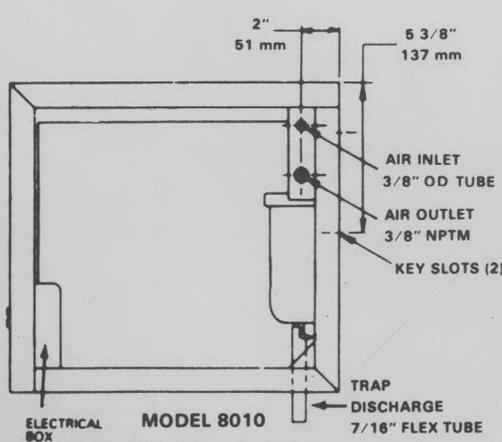
MODEL 8025

MODEL 8035

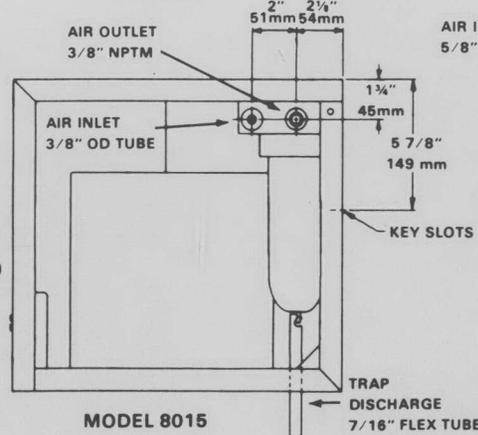
Drawing No. 100182

General Tolerance
± 1/8"

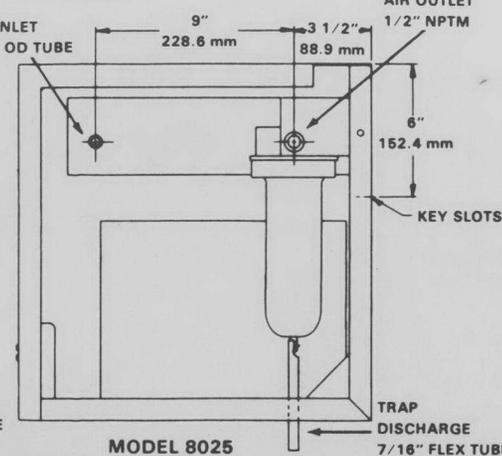
8010, 8025, 8035, 8045
Dimensional Drawing



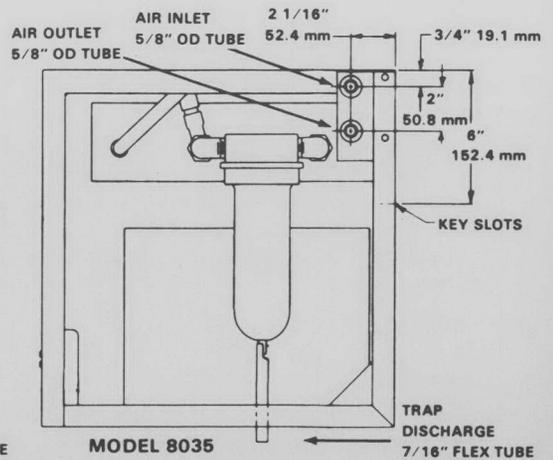
MODEL 8010



MODEL 8015



MODEL 8025



MODEL 8035

RIGHT SIDE VIEW

REPLACEMENT PART NUMBERS

REFRIGERATION CONDENSING UNITS 1/6 H.P. THRU 1/3 H.P.

* Important: When ordering replacement parts, specify your dryer model, serial number, and part number listed below.

Part Description	Model 8010 1/6 H.P.		Model 8015 1/5 H.P.		Model 8025 & 8035 1/3 H.P.	
	115/1/60	240/220/1/50	115/1/60	240/220/1/50	115/1/60	240/220/1/50
Condensing Unit C/W Refrigerant by-pass line	02.1437-51	02.1437-52	02.1438-51	02.1438-52	02.1440-51	02.1440-52
Compressor Only	4130.105.2	4130.105.3	4130.103.2	4130.103.3	4130.102.7	4130.102.8
Overload	5925.570.2	5925.570.3	5925.572.4	5925.574.4	5925.574.7	5925.574.8
Starting Relay	5945.659.5	5945.655.6	5945.659.5	5945.658.7	5945.659.5	5945.659.2
Fan Motor	6105.237.5	6105.237.6	6105.237.5	6105.237.6	6105.239.1	6105.239.2
Fan Blade	4140.228.2	4140.228.2	4140.228.2	4140.228.2	4140.229.5	4140.229.5
Fan Cut-out Switch	N/A	N/A	4130.143.10	4130.143.10	4130.143.10	4130.143.10
Hot Gas By-pass Valve	9801-1	9801-1	9801-1	9801-1	9801-1	9801-1
Dryer Strainer, Refrigerant	4130.165.3	4130.165.3	4130.165.2	4130.165.2	4130.165.2	4130.165.2
Condenser, Refrigerant	4130.112.5	4130.112.5	4130.110.3	4130.110.3	4130.112.9	4130.112.9
Chiller Section Capsule Assy.	03.1014-01	03.1014-01	03.1015-01	03.1015.01	03.1016.01	03.1016-01
High Temp. Light Sensor	5930.189.1	5930.189.1	5930.189.1	5930.189.1	5930.189.1	5930.189.1
Light Assembly, Dual	6350.454.8	6350.454.9	6350.454.8	6350.454.9	6350.454.8	6350.454.9
Cabinet	8835.108.4	8835.108.4	8835.108.4	8835.108.4	8835.108.8	8835.108.8
Complete Separator/Filter/ Drain Assy. (c/w poly bowl) MWP 150 psig	03.7082-07	03.7082-07	03.7080-03	03.7080-03	*	*
(c/w metal bowl) MWP 175 psig	03.7083-08	03.7083-08	03.7080-07	03.7080-07	*	*
(c/w metal bowl) MWP 300 psig	03.7080-10	03.7080-10	03.7080-10	03.7080.10	*	*
Separator/Filter Cartridge (includes separator core and filter sleeve) 150 & 175 psig MWP models	07.4441-01	07.4441-01	07.4442-01	07.4442-01	07.4442-01	07.4442-01
Separator/Filter Cartridge (includes separator core and filter sleeve) 300 psig MWP models	07.4441-01	07.4441-01	07.4441-01	07.4441.01	**	**
Separator/Filter replacement filter sleeve only 150 & 175 psig MWP models	0734-1	0734-1	0734-2	0734-2	0734-2	0734-2
Separator/Filter replacement filter sleeve only 300 psig MWP models	0734-1	0734-1	0734-1	0734-1	**	**
Auto Drain mechanism 150 & 175 psig MWP models	05.4170-01	05.4170-01	05.4170-01	05.4170-01	05.4170-01	05.4170-01
Auto Drain mechanism 300 psig MWP models	4330.185.1	4330.185.1	4330.185.1	4330.185.1	4330.185.1	4330.185.1
Polycarbonate Bowl (16 oz.) complete w/guard	03.0810.03	03.0810.03	03.0810.03	03.0810.03	03.0810.03	03.0810.03
Metal Bowl (16 oz.)	4460.079.3	4460.079.3	4460.079.3	4460.079.3	4460.079.3	4460.079.3
Drain Tube Plastic	4720.604.1-1	4720.604.1-1	4720.604.1-1	4720.604.1-1	4720.604.1-1	4720.604.1-1

N/A — not applicable to this model.

* Complete Separator/Filter — Drain Assy.

8025 c/w polycarbonate bowl (MWP 150 psig) 03.7084-04
8025 c/w metal bowl (MWP 175 psig) 03.7085-05
8025 c/w metal bowl (MWP 300 psig) 03.7085-03

8035 c/w polycarbonate bowl (MWP 150 psig) 03.7086-04
8035 c/w metal bowl (MWP 175 psig) 03.7087-05
8035 c/w metal bowl (MWP 300 psig) 03.7087-03

**8025 & 8035 300 psig MWP models use 40 micron bronze element #4460.436.3



HANKISON CORPORATION

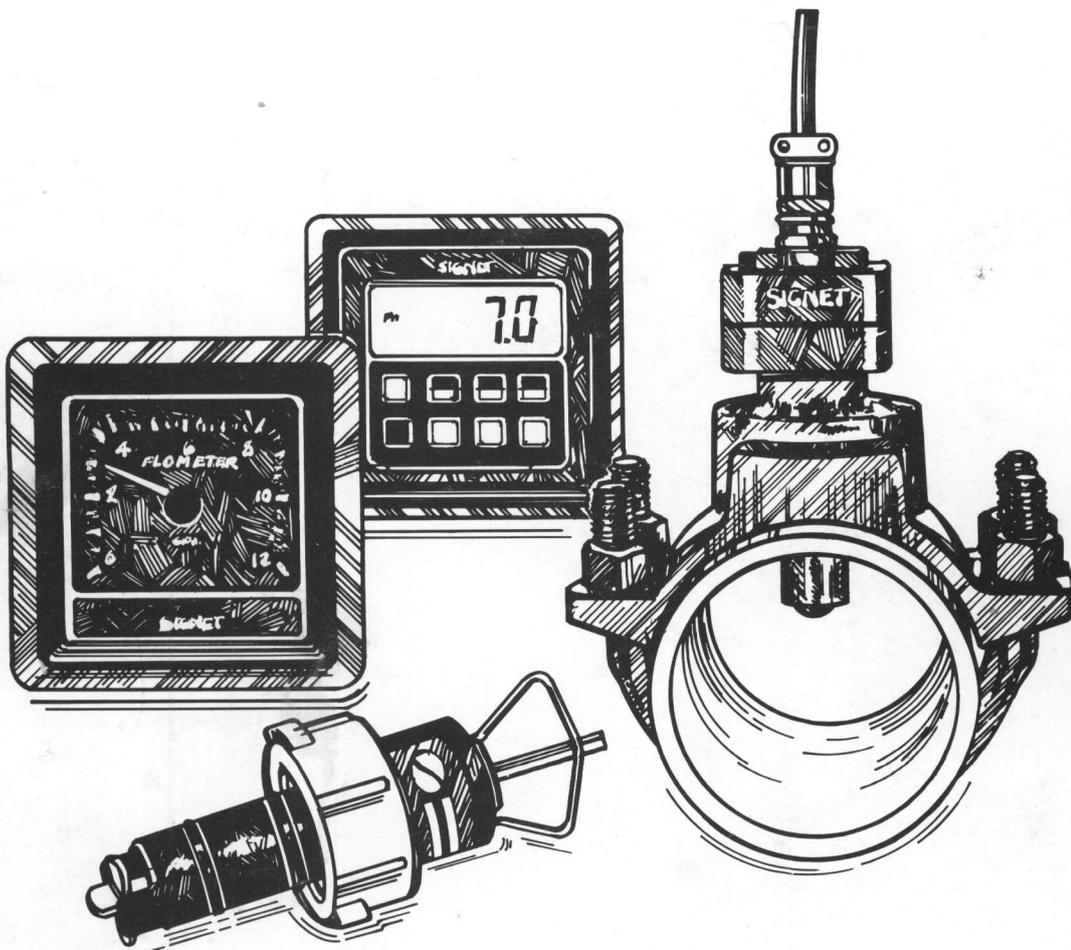
CANONSBURG, PA 15317 U.S.A.
CABLE: HANKORP

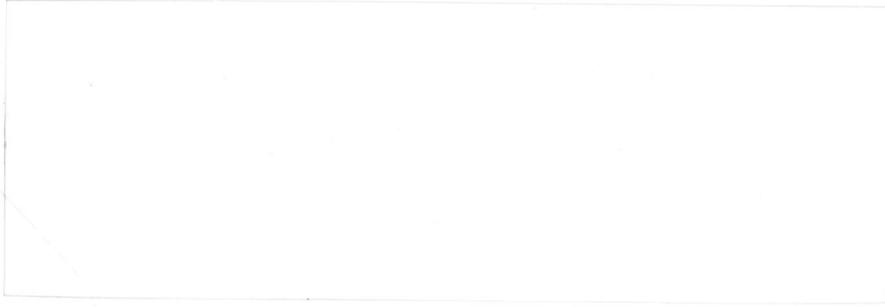
PHONE: (412) 745-1555
TELEX: 81-2452

Printed in U.S.A.

**MK 515/415
PADDLEWHEEL
FLOSENSORS**

**INSTRUCTION
MANUAL**





6000

SIGNET WARRANTY CARD

MODEL _____

SERIAL NO. _____

NAME _____

STREET _____

CITY _____ STATE _____ ZIP _____

DATE OF PURCHASE _____ 19 _____

DISTRIBUTOR PURCHASED FROM _____

TYPE OF INSTALLATION _____

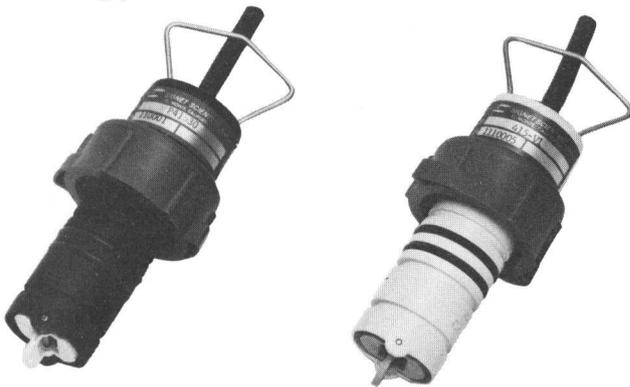
WARRANTY IS VALID ONLY IF THIS CARD IS RETURNED TO
THE MANUFACTURER WITHIN 30 DAYS FROM PURCHASE DATE.

SIGNET SCIENTIFIC COMPANY

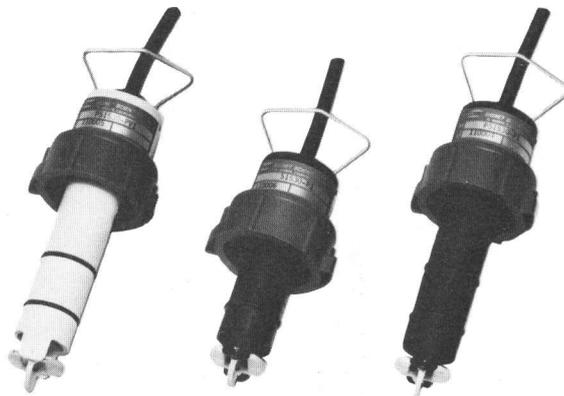
3401 AEROJET AVENUE

EL MONTE, CALIFORNIA 91731

MK 515/415 PADDLEWHEEL FLOSENSORS



515 Paddlewheel Flosensor, PVDF (light) and Polypro (dark) shown here in regular and extended housings.



The 415 Hi-Clearance Paddlewheel Flosensor; Polypro (dark) and PVDF (light).

TABLE OF CONTENTS

SECTION	PAGE
1.0 INTRODUCTION	1
1.1 Description	1
1.2 Specifications	3
2.0 INSTALLATION	4
2.1 Unpacking and Inspection	4
2.2 Installation Fittings	4
2.3 Installation of Specific Pipe Fittings	5
2.3.1 PVC and CPVC	5
2.3.2 Stainless Galvanized, and Brass	7
2.3.3 Brazolet and Weldolet	7
2.4 Flosensor Installation	7
2.5 Sensor Conduit Kit	7
3.0 THEORY OF OPERATION	9
4.0 TROUBLESHOOTING	9
5.0 CARE AND MAINTENANCE	9
6.0 APPENDICES	9
6.1 Parts List	9
6.2 Optional Accessories/Replacement Parts	10
6.3 Warranty	10
7.0 MANUAL CHANGE INFORMATION	10

1.0 INTRODUCTION

This manual contains description, specifications, and instructions for the installation and operation of your Signet MK 515 and 415 Flosensor transducers. PLEASE READ ALL OF THIS INSTRUCTION MANUAL; it will answer most of your questions about these transducers. If you require further assistance, please contact your Signet dealer.

1.1 DESCRIPTION

Your Signet Paddlewheel Flosensor and appropriate Signet indicator measure rate of flow of a liquid in a pipe. The flosensor has a rugged design with no measurable head loss. It is readily removable for inspection and cleaning.

The MK 415 and 515 must be installed in a Signet Installation Fitting for proper operation. The MK 515 is designed for installation in MK 316 fittings or the MK 319 Wet-Tap Assembly. The MK 415 sensor is designed for installation in MK 416 series fittings.

A plug is supplied with each ordered Signet Pipe Fitting to seal the fitting when the flosensor is removed. Both the MK 515 and MK 415 are available with a glass-filled polypropylene or PVDF (polyvinylidene fluoride) housing. The fluid-tight flosensor seal is made with two standard Viton O-rings (see Figure 1) which may be easily replaced. Highly stable corrosion-resistant Kalrez

O-rings are available as a separate item. See section 6.1 (Parts List) for specific information. The paddlewheel contains 4 permanent magnets sonically welded into a PVDF paddle.

The MK 515 and MK 415 Flosensors are similar in most respects, with the exception that the MK 415 provides more clearance between the paddlewheel and its surrounding components, to accommodate liquids containing suspended particles comprising up to 10% of the liquid volume. Because of its increased clearance, the MK 415 has a larger body diameter, and must be installed in specially designed Signet MK 416 fittings.

The MK 515 is available in nine versions and the MK 415 in two versions to accommodate various pipe sizes and applications (see Table 1). The -P0, -P1, -P2 polypropylene versions of the MK 515 are for standard applications. The -V0, -V1, -V2 PVDF versions are for severe-environment applications. Housing extensions for all MK 515 flosensors are made from CPVC (Chlorinated Polyvinyl Chloride). The -P3, -P4, -P5 polypropylene specially extended versions are for use with the MK 319 Wet Tap (See Table 2). The Wet Tap is an interface between the sensor and Signet installation fittings. It provides a safe and fast method of removing the flosensor from the pipe fitting, while the pipe is under normal operating pressures up to 100 psig maximum.

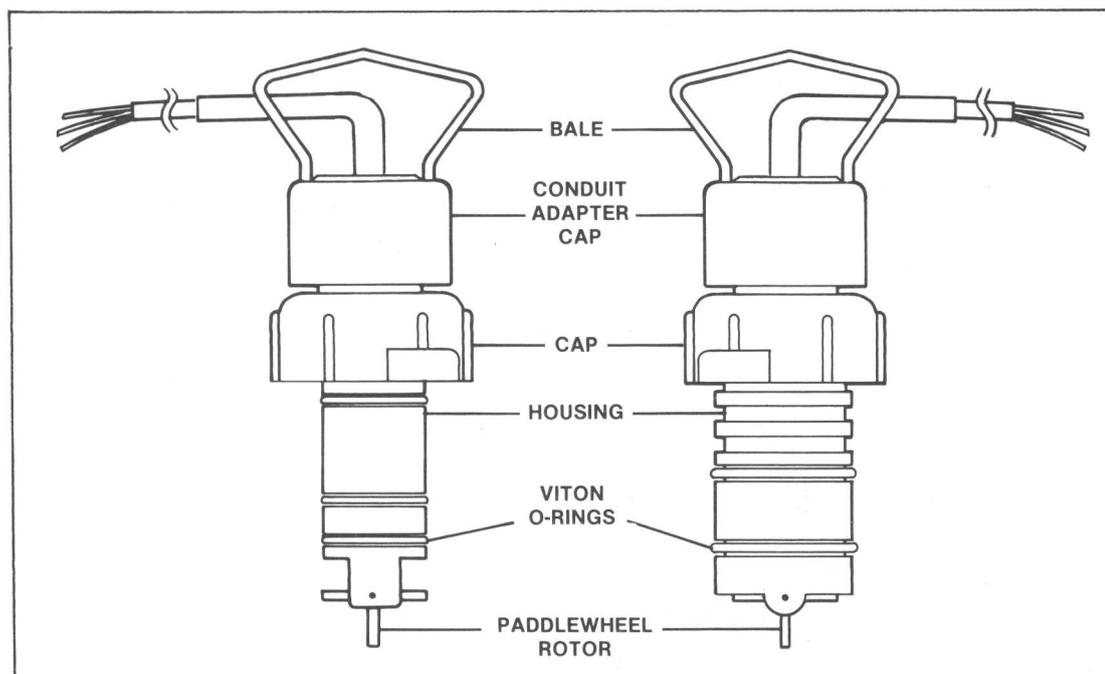


Figure 1. Detailed drawing of the MK 515 (left) and MK 415 (right).

TABLE 1

FLOSENSOR	PART NO.	PIPE SIZE
Standard Polypropylene	MK 515-P0	½" to 4"
Extended Polypropylene	MK 515-P1	5" to 8"
Double Extended Polypropylene	MK 515-P2	10" & up
Standard Polypropylene (for MK 319)	MK 515-P3	½" to 4"
Extended Polypropylene (for MK 319)	MK 515-P4	5" to 8"
Double Extended Polypropylene (for MK 319)	MK 515-P5	10" & up
Standard PVDF	MK 515-V0	½" to 4"
Extended PVDF	MK 515-V1	5" to 8"
Double Extended PVDF	MK 515-V2	10" & up
High-Clearance Polypropylene	MK 415-P0	2" to 12"
High-Clearance PVDF	MK 415-V0	2" to 12"

TABLE 2

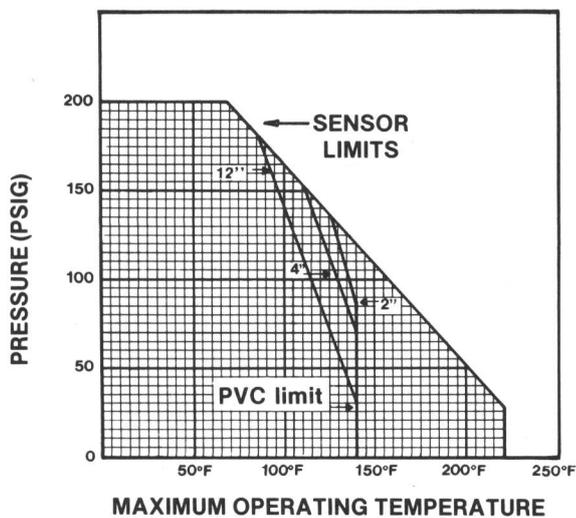
MK 515/415 FLOSENSOR MATERIALS AVAILABLE						
Model No.	MK 515-0, -1, -2		MK 515-3, -4, -5		MK 415	
Sensor Designation	P	V	P	V	P	V
Part						
Paddlewheel Material	V	V	V	V	V	V
Shaft Material	Ti	H	Ti	H	Ti	H
Main Housing Material	P	V	P	V	P	V
Extension Housing Material (see Note 3)	CP	CP	CP	N/A	N/A	N/A
O-Ring Material	----- Viton -----					
<p>Note:</p> <p>1) P = Polypropylene V = PVDF (Polyvinylidene Fluoride) CP = CPVC (Chlorinated Polyvinyl Chloride) Ti = Titanium H = Hastelloy</p> <p>2) Model number and sensor designation must be specified when ordering.</p> <p>3) -0 version includes main housing material only</p>						

1.2 SPECIFICATIONS

MK 515

MK 415

Output Signal	1 V peak-to-peak per ft/sec.	0.44 V peak-to-peak per ft/sec.
Output Frequency	5-6 Hz per ft/sec.	4-5 Hz per ft/sec.
Source Impedance	8 kilohms	8 kilohms
Flow Rate Range	1 fps to 50 fps	1.5 fps to 50 fps
Linearity	± 1% over full range	± 1% over full range
Output Accuracy	± 1% over full range	± 1% of full range
Repeatability	± 0.5% of full range	± 0.5% of full range
Pressure Rating	200 psig max. @ 20°C (68°F) (see Figure 2); -P3, -P4, and -P5 versions rated @ 100 psig max.	200 psig max. @ 20°C (68°F) (see Figure 2)
Temperature Rating	105°C (220°F) max. @ 25 psig (see Figure 2)	105°C (220°F) max. @ 25 psig (see Figure 2)
Maximum % Solids	1% of fluid volume	10% of fluid volume
Bottom Diameter	1.05	1.36
Standard Cable Length	25 ft.	25 ft.



NOTES: (1) Do not use flosensors in applications where pressure/temperature points are greater than values within the area of the curve. Special fittings may restrict these limits.

(2) To calculate pressure (P) or temperature (T) for any point within the area of the curve,

$$P = 281.7 - 1.167 T, \text{ therefore, } T = \frac{281.7 - P}{1.167}$$

Figure 2. Pressure/temperature limitations for Signet flosensor transducers. Note reduced curve for PVC fittings with 2-inch, 4-inch and 12-inch pipes.

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

When unpacking your MK 515 or 415 package, be sure you have received everything (see Figure 3). Carefully check each item for any damage incurred during shipment. If damage has occurred, promptly notify your dealer and the shipping carrier.

However, if no suspended particles are present in the liquid, a bottom mounting is best (see Figure 4B). The flosensor may still function adequately in a top or vertically mounted position (see Figure 4B), but there must not be any suspended particles in the liquid and the pipe must be absolutely full.

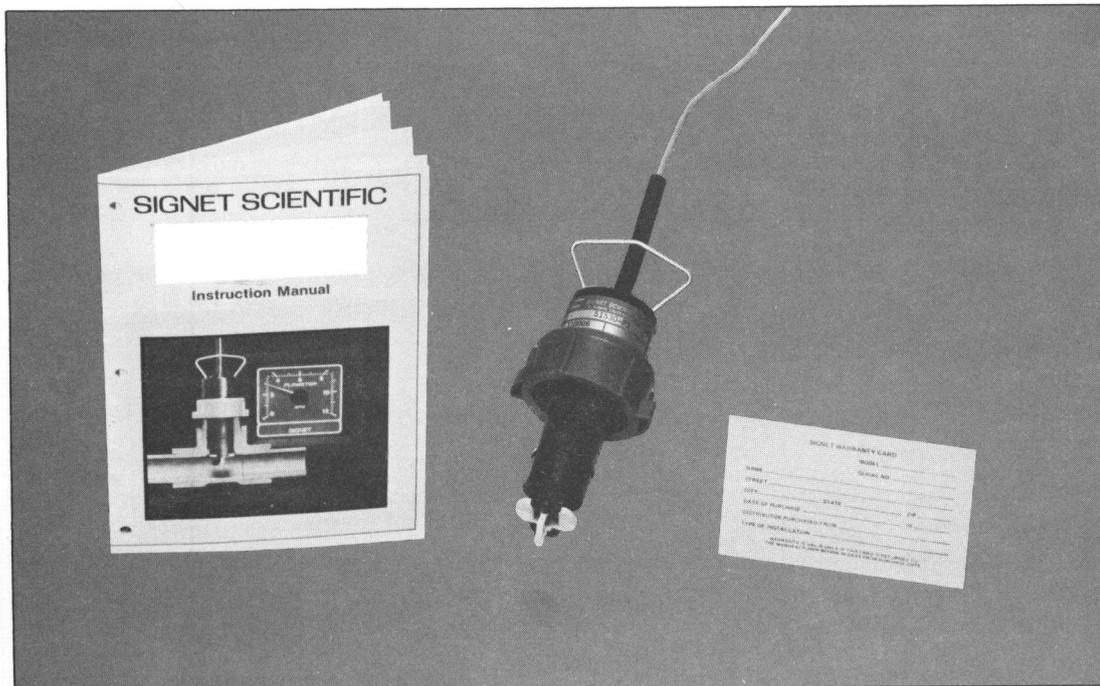


Figure 3.

The following items are included in your flosensor package:

1. MK 515 or MK 415 Flosensor
2. Instruction manual and warranty card

Please fill out and return the warranty card as soon as possible.

2.2 INSTALLATION FITTINGS

Signet Flosensors are designed to measure flow rate in full pipes. To accomplish this, a Signet Pipe Fitting must be installed in the pipe to receive the Flosensor. A wide variety of fittings are available from your dealer for virtually any type and size of pipe.

Side mounting of the fitting and flosensor is most desirable for horizontal pipe runs (see Figure 4A).

Vertical mounting of the flosensor runs the risk of having either air bubbles or sediment interfere with the continuous action of the paddlewheel. For vertical pipe runs, the location of any flow disturbance will dictate the best flosensor installation location.

The installation location of the Signet Pipe Fitting and Flosensor must be in a free-flowing straight-run section of the pipe. This section must be at least 10 diameters down-stream of any minor flow changes. There must be at least 5 diameters of free-flowing straight-runs beyond the fitting (see Figure 5). Major up or down-stream obstructions will require longer straight runs. A partially open butterfly valve, for example, may require 50 diameters of free flow for adequate liquid stability at the flosensor.

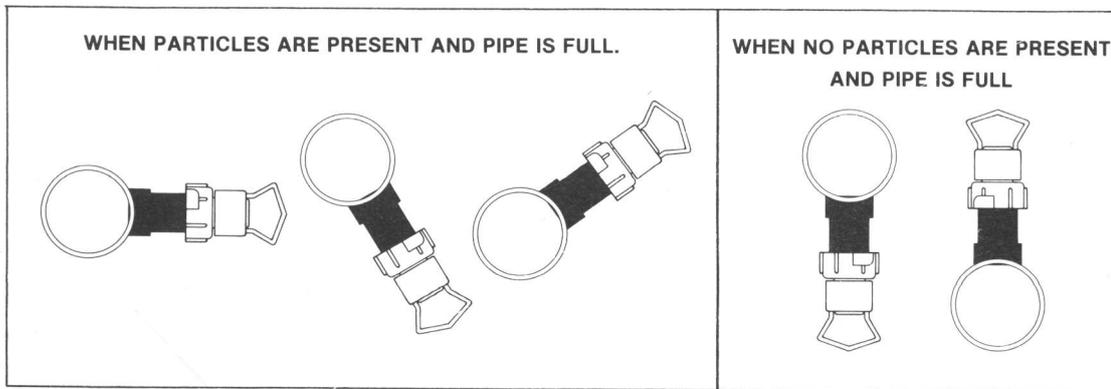


Figure 4A. Some suggested side-mounting positions.

Figure 4B. Bottom and top-mounting positions.

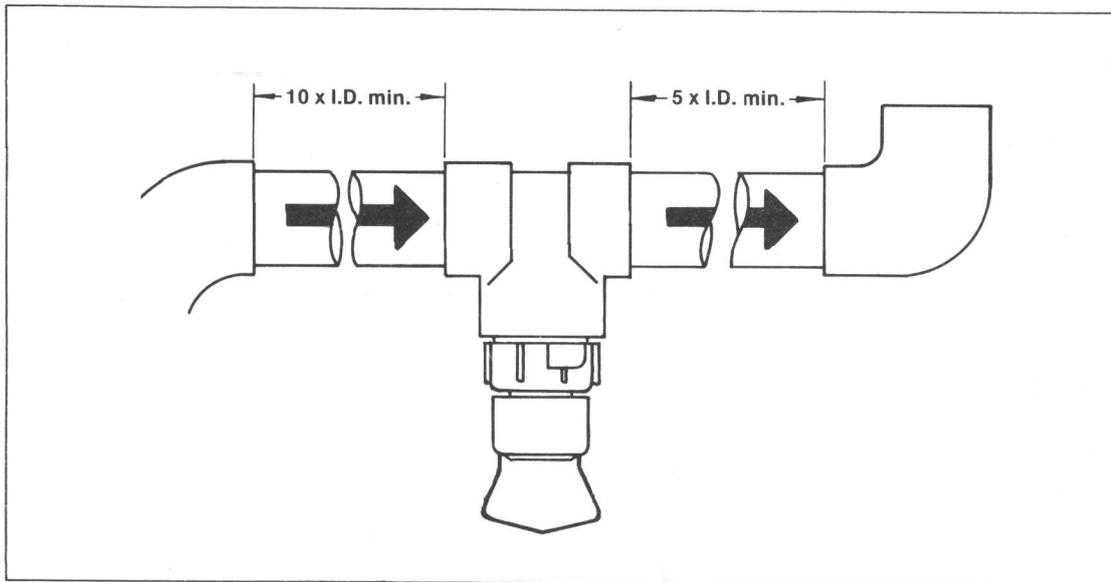


Figure 5. Installation location of the Signet Pipe Fitting & Flosensor.

2.3 INSTALLATION OF SPECIFIC PIPE FITTINGS

The installation of PVC, CPVC, stainless, galvanized, brass, brazolet, and weldolet fittings are covered in this section. Typical pipe-fitting installations are shown in Figure 6.

2.3.1 PVC and CPVC

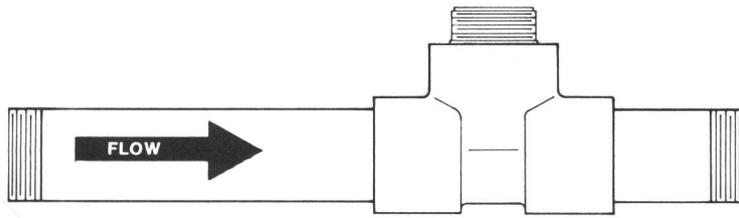
1. Twist-on PVC and CPVC fittings:
Wrap threaded pipe ends with Teflon tape and secure fasteners.

2. Tapping saddle for PVC schedule 40 and 80, CPVC; 2 inches to 8 inches:

- A. Select area for fitting installation (see 2.2 Installation Fittings).
- B. Drill a 1-7/16 inch hole in the pipe. For extended flosensors, a 2-1/4 inch hole will be needed. This applies to pipes over 4 inches.
- C. Prime the area to be glued with either P-70 PVC primer or P-72 CPVC primer with respect to the fitting material.

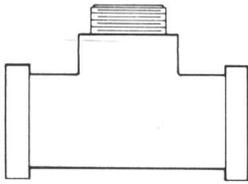
(continued)

TOP VIEW



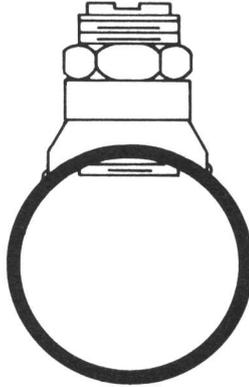
PLASTIC PIPE 1/2''-4''

TOP VIEW



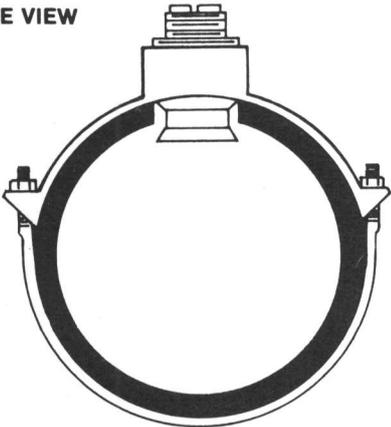
MODIFIED T FITTING
METAL PIPE 1/2''-2''

SIDE VIEW



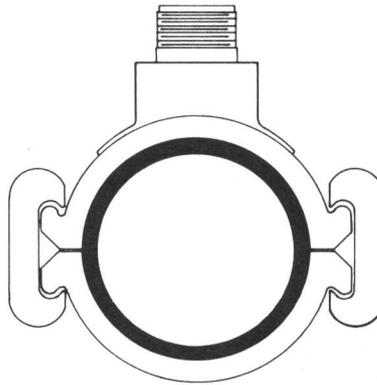
WELDOLET (THREADED)
METAL PIPE 2''-12''

SIDE VIEW



STRAP ON SADDLE
METAL PIPE 2''-12''

SIDE VIEW



TAPPING SADDLE
PLASTIC PIPE 2''-8''

Figure 6. Typical pipe fitting installations.

- D. Apply glue (#711 for PVC or #714 for CPVC) to all areas to be glued.
- E. Install all fitting pieces so that the insert fits in the hole in the pipe. Put the two saddle pieces around the pipe and alternately tap the wedges over the exposed ears.

Note: The arrows on the wedges must match the direction of the arrows on the pipe fitting.

- 3. PVC and CPVC pipe larger than 8 inches must use a strap-on saddle. See 2.3.2 stainless, galvanized, or brass, installation instruction 2, for strap-on saddles.

2.3.2 Stainless, Galvanized, and Brass

- 1. T fittings:

Apply Teflon tape to the pipe ends, and install the fitting snugly.

- 2. Strap-on saddles:

- A. Drill a 1-7/16 inch hole in the pipe. For Extended Flosensors, a 2-1/4 inch hole will be necessary. This applies to pipes over 4 inches.
- B. Install the fitting piece so that the insert fits in the hole in the pipe.
- C. Tighten clamping nuts alternately to eliminate any chance of leaks.

2.3.3 Brazolet and Weldolet

- 1. A certified welder, using the proper techniques, should install these fittings.

- A. Remove the insert (see Figure 7) before installing the fitting.
- B. Drill a 1-7/16 inch hole in the pipe. For Extended Flosensors, a 2-1/4 inch hole will be necessary. This applies to pipes over 4 inches.
- C. Deburr the hole. This hole must be completely free of all burrs and projections.
- D. Install the fitting so that the insert will fit into the hole in the pipe.
- E. Teflon-tape the insert.
- F. Reinstall the insert, referring to the "A" dimension in Figure 7.

NOTE: In all cases, the slots in the plastic insert must be parallel to the liquid flow. DO NOT USE ANY TOOL ON THE PLASTIC INSERT. YOU MAY MAR THE THREADS. HAND-TIGHTEN ONLY. RE-TAPE THE INSERT WITH TEFLON WHEN REMOVED.

REMOVE INSERT BEFORE WELDING.

AFTER INSTALLATION OF WELDOLET USE TEFLON TAPE ON INSERT. "A" DIMENSION SHOULD BE APPROXIMATELY

INSURE THAT SLOTS ARE IN LINE WITH PIPE.

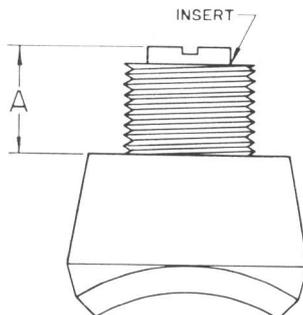


Figure 7. The above Installation Dimension Tag is attached to each fitting.

2.4 FLOSENSOR INSTALLATION

1. Check the paddlewheel. It should rotate freely when flicked with a finger, or by directing a stream of water or air across it to stimulate liquid flow.
2. Insert the flosensor in the Signet Pipe Fitting.
3. Align the bail parallel to the pipe.
4. Make sure that the flosensor is fully seated in the fitting slots. The flosensor will not turn once it is properly installed.
5. Tighten the plastic cap finger-tight to retain the flosensor. DO NOT USE ANY TOOL ON THE CAP. HAND TIGHTEN ONLY TO AVOID DAMAGE.

NOTE: For cable runs longer than 25 feet, splice additional cable length to the existing flosensor cable, and waterproof the splice with high-quality silicone sealant or the equivalent. Up to 200 feet of total cable length will not affect flosensor operation.

2.5 SENSOR CONDUIT KIT

(See Section 6.2 Optional Accessories)

Signet MK 515/415 Flosensors have a specially designed cap that allows installation of flexible conduiting (Liquitite®). A Signet Sensor Conduit Adapter Kit (MK 515.89) is required for this particular type of installation.

The MK 515.89 Kit consists of two separate adapters. The right angle adapter is designed for insertion in the flosensor, while a straight adapter is included for use with Signet controllers and/or the MK 500.78 waterproof housing. Both adapters are designed for use with 1/2 inch conduit knockouts. The conduit end accepts 3/8 inch flex conduit.

Once the right angle adapter is screwed into the cap, attach the section of flexible conduit by threading it into the adapter. Complete the installation by connecting the straight adapter to the conduit. This adapter can then be attached to the appropriate Signet junction box.

NOTE: Special conducting material can be obtained from your local electrical supplier.

For correct flexible conduiting installation, first remove the cap-plug as shown in Figure 8. Thread the sensor cable through the right angle adapter, and carefully screw it into the adapter cap. (The rubber boot can be discarded when the conduit adapter kit is used).

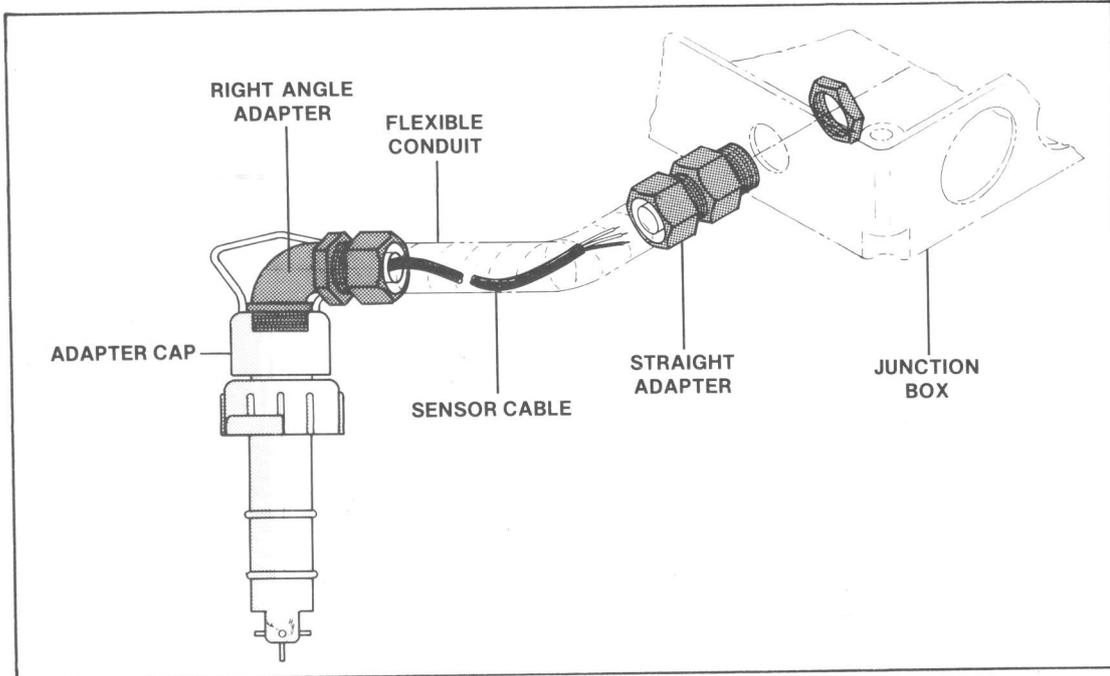


Figure 8. Detailed drawing of the MK 515.89 Sensor Conduit Kit.

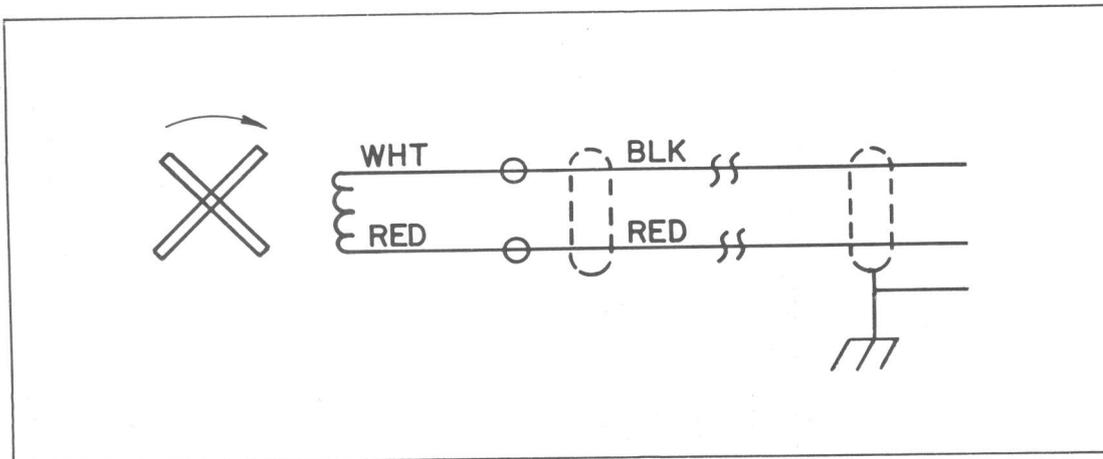


Figure 9. Simplified schematic of the MK 515/415.

3.0 THEORY OF OPERATION

A simplified schematic of the MK 515/415 is shown in Figure 9. The flosensor is installed in a pipe line to measure flow rate. The flow passing by the flosensor paddlewheel rotates the paddlewheel, moving the magnets past a coil in the transducer body. An ac voltage is induced in the coil by the rotating magnets of the paddlewheel.

Both the frequency and the amplitude of the output of the coil are then directly proportional to the velocity of the fluid flow in the pipe. A complete cycle occurs every time two of the paddlewheel blades go by the coil; therefore, two entire cycles are generated for each paddlewheel rotation.

4.0 TROUBLESHOOTING

Major problems with the MK 515/415 can occur when either flosensor is being used for something it was not designed to do, or when it has been improperly installed. The paddlewheel is designed to rotate on the shaft; the shaft should not rotate with respect to the housing. The paddlewheel must turn freely. If it does not, clean the paddlewheel assembly as follows:

1. Remove the flosensor from the pipe and insert the plug into the pipe fitting. Clean any external debris from the paddlewheel.
2. For the MK 515, using a small flat-bladed screwdriver, gently pry one of the paddlewheel mounting ears away from the pin (see Figure 10A). The MK 415 pin does not have a shoulder and may be pressed straight out (see Figure 10B).

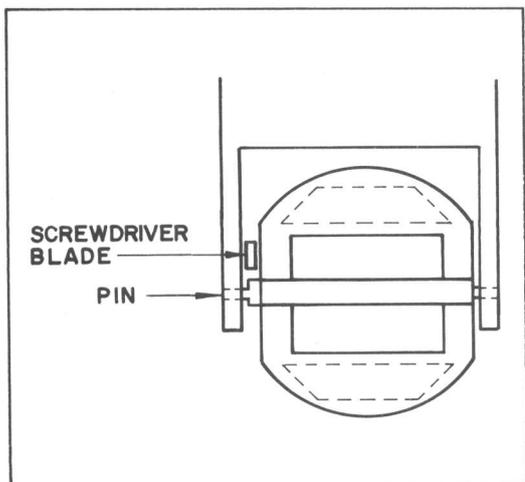


Figure 10A. Removal of MK 515 paddlewheel pin.

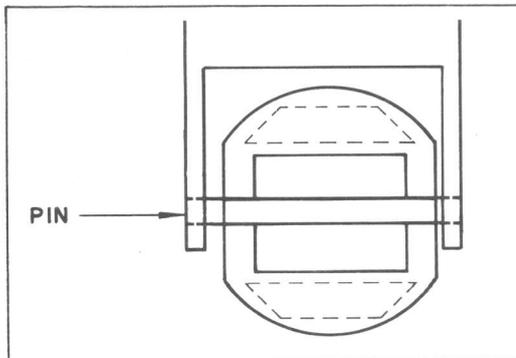


Figure 10B. Removal of MK 415 paddlewheel pin.

3. When one end of the pin is free, gently work the paddlewheel and pin out of the remaining mounting ear.
4. Thoroughly clean the pin, paddle, and pin holes with a wire brush and/or toothpick along with alcohol and/or soap and water.
5. To reinstall the paddlewheel and pin, reverse steps 1, 2, and 3.
6. After cleaning, the paddlewheel should spin freely without binding or sticking.

5.0 CARE AND MAINTENANCE

The MK 515/415 should require minimal care during the life of the flosensor. Periodically, check the O-rings and replace them when necessary. The paddlewheel must always turn freely. Be sure that connections to the Signet indicator and additional cable length, if any, are still intact. Lubricate the barrel and O-rings with G.E. Silicone Compound #G660 every three months. Keep the paddlewheel and pin free of any lubrication. A Spare Rotor Kit consisting of a spare paddlewheel, O-rings, and a pin is available (see 6.2 Optional Accessories). Actual maintenance intervals will have to be determined in operation. It is suggested that you check your flosensor periodically until some history of your specific application can be created.

6.0 APPENDICES

6.1 PARTS LIST

MK 515

Spare Paddlewheel	MK 15.38-1
Titanium Rotor Pin	MK 15.46-1
Hastelloy Rotor Pin	MK 15.46-2
Spare Viton O-rings	PP-1220-0021
Polypropylene Flosensor Cap ...	MK 515.42

MK 415

Spare Rotor Kit: PVDF
paddlewheel, titanium shaft,
Viton O-rings (2) MK 415.31

6.2 OPTIONAL ACCESSORIES/ REPLACEMENT PARTS

Tantalum Rotor Pin MK 15.46-3
Stainless Steel Rotor Pin MK 15.46-4
EPR O-Ring PP-1224-0021
Polypropylene Plug MK 315.36-1
PVDF Plug MK 315.36-2
Kalrez O-rings PP-1228-0021

MK 415

Polypropylene Plug MK 415.36
PVDF Plug MK 415.36V

Miscellaneous

Conduit Sensor Kit: one straight
and one right-angle ½" NPT
adapter for 3/8" conduit MK 515.89
Wet Tap: interface between
515-3, -4, and -5 only and pipe
fitting to allow flosensor removal
while under operating pressure MK 319
Flow Test Indicator MK 561
Cable Adapter Kit: Flosensor-to-
Tester and Tester-to-Flometer
adapter cables for the MK 561 MK 561.60
Cable Adapter Kit: MK 515/415
Flosensor to Series 300 Indica-
tor/Controller, adapter cables . . MK 500.61-2

6.3 WARRANTY

SIGNET SCIENTIFIC COMPANY LIMITED TWO-YEAR WARRANTY

Signet Scientific Company warrants its instruments to be free from defects in material and workmanship under normal use for a period of two years from date of purchase by the initial owner, or three years from date of manufacture, whichever comes first, as described in the following paragraphs.

This warranty does not cover defects caused by abuse or electrical damage. Signet will not cover under warranty any instruments damaged during shipment to the factory, less case, or improperly packed. Repair attempts by anyone other than authorized service personnel will void the warranty. Proof of date of purchase will be required before warranty repairs can begin.

Parts which prove to be defective in the first year will be repaired or replaced free of charge including labor, shipped F.O.B. our factory or a designated service center (address furnished upon request).

Only non-moving parts, such as electrical components, which prove defective during the second year are warranted. Meter movements will not be covered. All units qualifying for warranty service after one year are subject to a maximum service charge of \$15.00 for replacement of non-moving parts.

Items returned for warranty repair must be shipped prepaid and insured. Warranty claims are processed on the condition that prompt notification of a defect is given to Signet within the warranty period. Signet shall have the sole right to determine whether in fact a warranty situation exists.

The Signet warranty does not cover travel time, mileage expenses, removal, reinstallation, or calibration.

Signet is continually making design changes and improvements that adapt to the original circuit configuration. These will be incorporated as required in older units on a minimal-charge basis while under warranty.

CONSEQUENTIAL DAMAGES

Signet Scientific Company shall not be liable for special consequential damages of any nature with respect to any merchandise or service sold, rendered, or delivered.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

7.0 MANUAL CHANGE INFORMATION

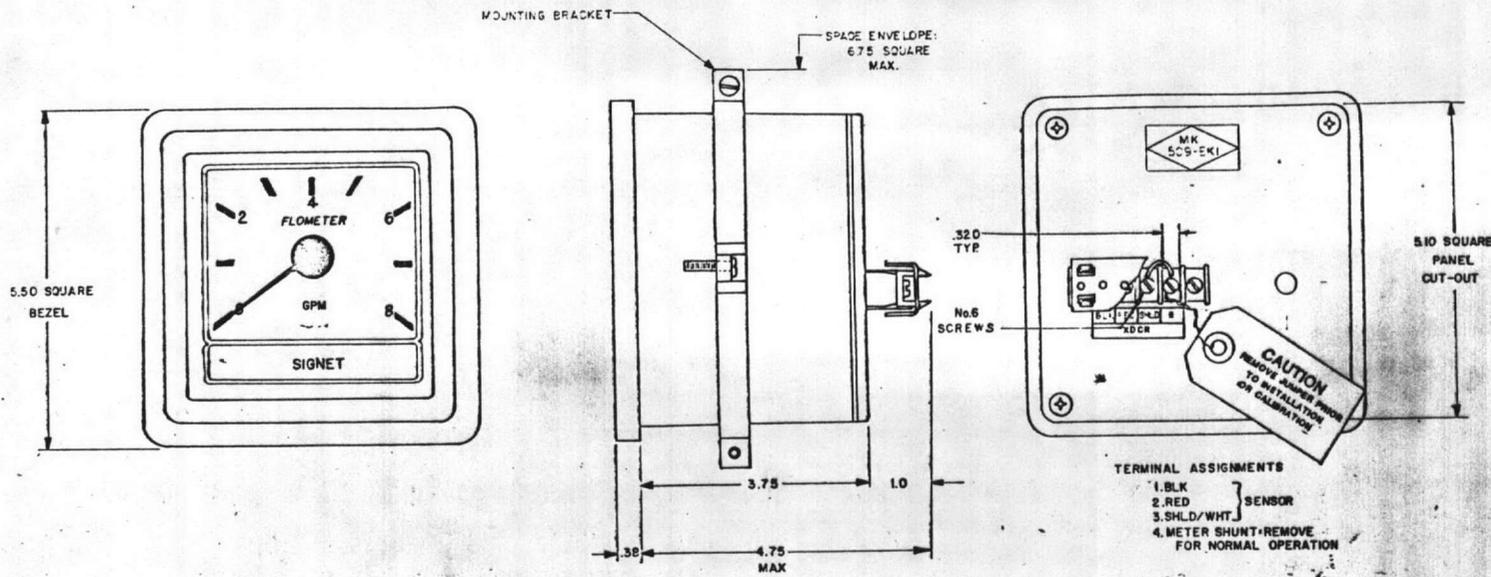
Signet continually strives to keep up with the latest electronic and design developments by adding circuit, component, and design improvements to its instruments as soon as they are developed and tested. Sometimes, due to printing and shipping requirements, we cannot immediately get these changes into printed manuals. Therefore, your manual may contain new change information on the following pages. A single change may affect several sections. Be sure to make all changes within the appropriate sections of this manual.



P.O. BOX 5770 • EL MONTE, CA 91734-1770 • (213) 571-2770
TWX 9105893376 TDI ELM • TLX 6831174SIGNET UW

REVISIONS		DATE	APPROVED
1/1	DESCRIPTION		

MAR 2 5 1985



- TERMINAL ASSIGNMENTS**
- 1. BLK } SENSOR
 - 2. RED } SENSOR
 - 3. SHLD/WHT }
 - 4. METER SHUNT-REMOVE FOR NORMAL OPERATION

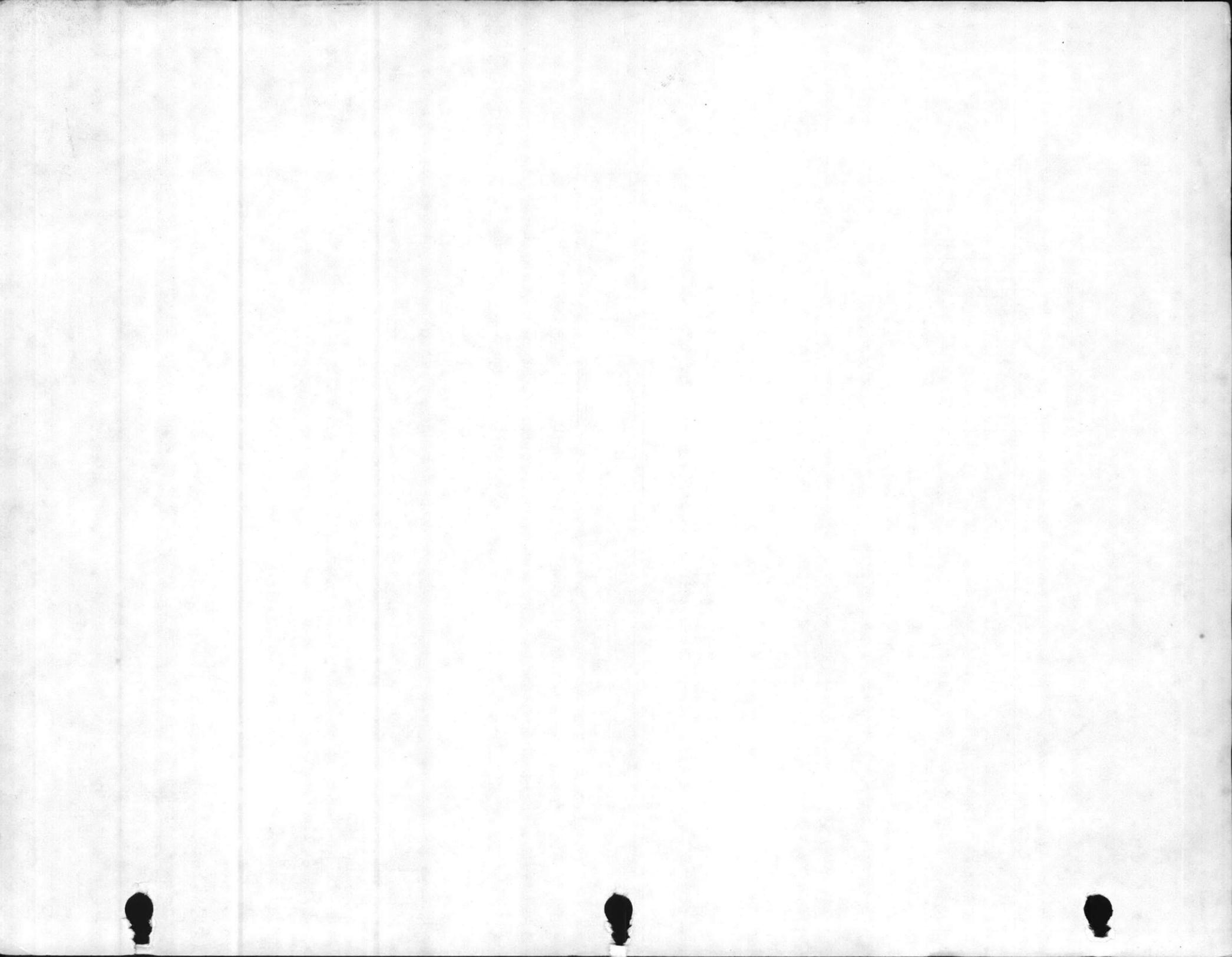
SPECIFICATIONS

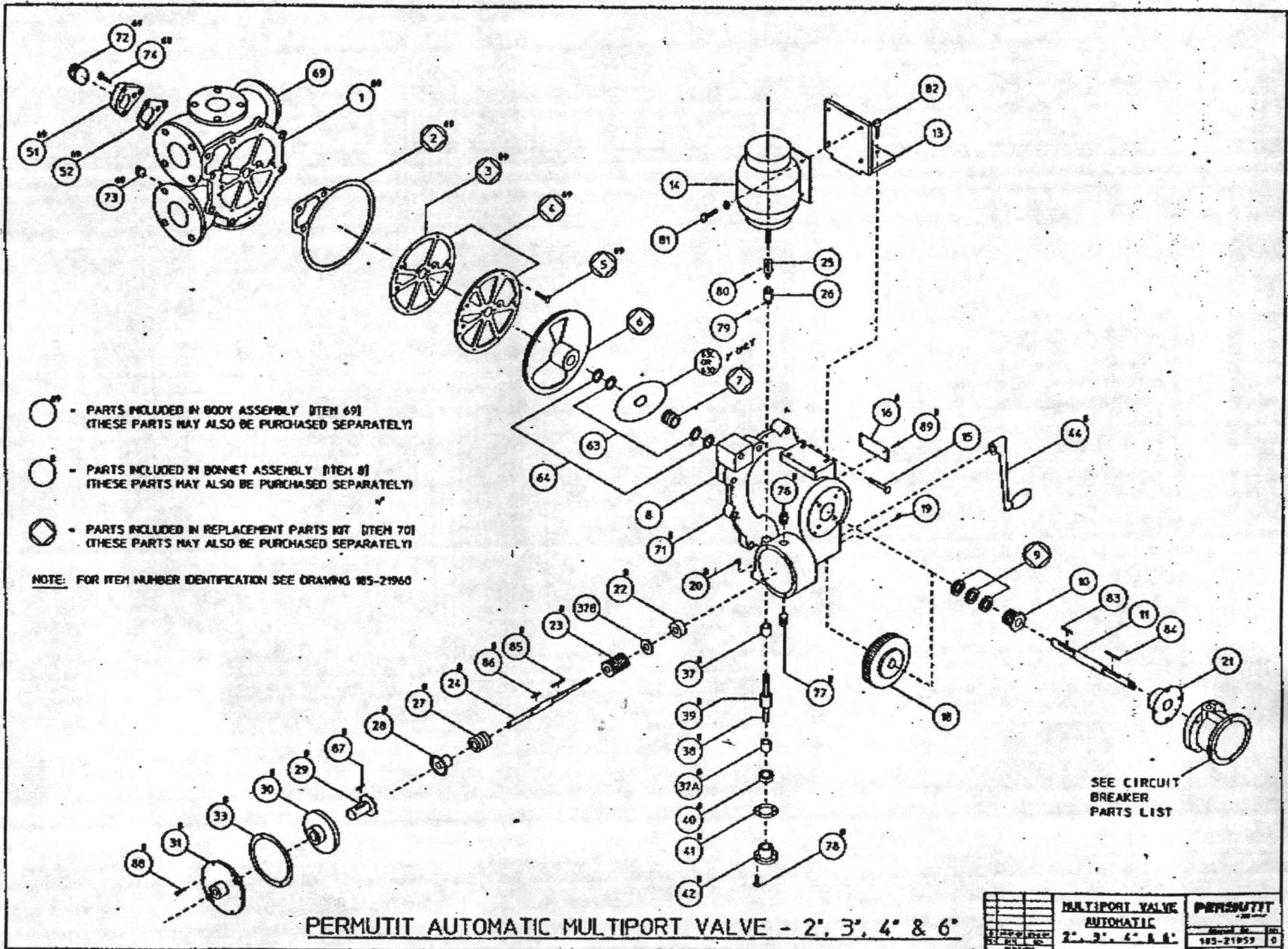
USE WITH SENSOR: 515 ONLY
 SIGNAL IN: AC WAVEFORM 4V PK-PK MIN.
 MAX. FREQUENCY 200 HZ

OUTLINE DRAWING

NOTES:

REQD. ITEM	PART NUMBER	DESCRIPTION	MATERIAL	MTL. SPECIFICATION	VENDOR
LIST OF MATERIAL					
SEE ENGINEERING RECORDS	DRAWN DATE	CHECKED DATE	 SIGNET SCIENTIFIC COMPANY <small>2000 W. 10th St. - Lincoln, NE 68502</small>		
NEXT ASSY. USED ON	RL PRICE	4/17/81			
APPLICATION	STRESS DATE	SYSTEM DATE	SELF-POWERED FLOMETER		
DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.	PROJECT DATE	CONTRACT NO.	MK509		
TOLERANCES	DATE		DWG. SIZE	CODE	DRAWING NUMBER
.XX ± .05	XXX ± .005	APPROVED: <i>[Signature]</i>	D	162	P50900
.XX ± .010	ANGLES 1/4°	DATE	SCALE	FULL	TOTAL OF 1
MATERIAL:	APPROVED SPECIAL OFFICER				





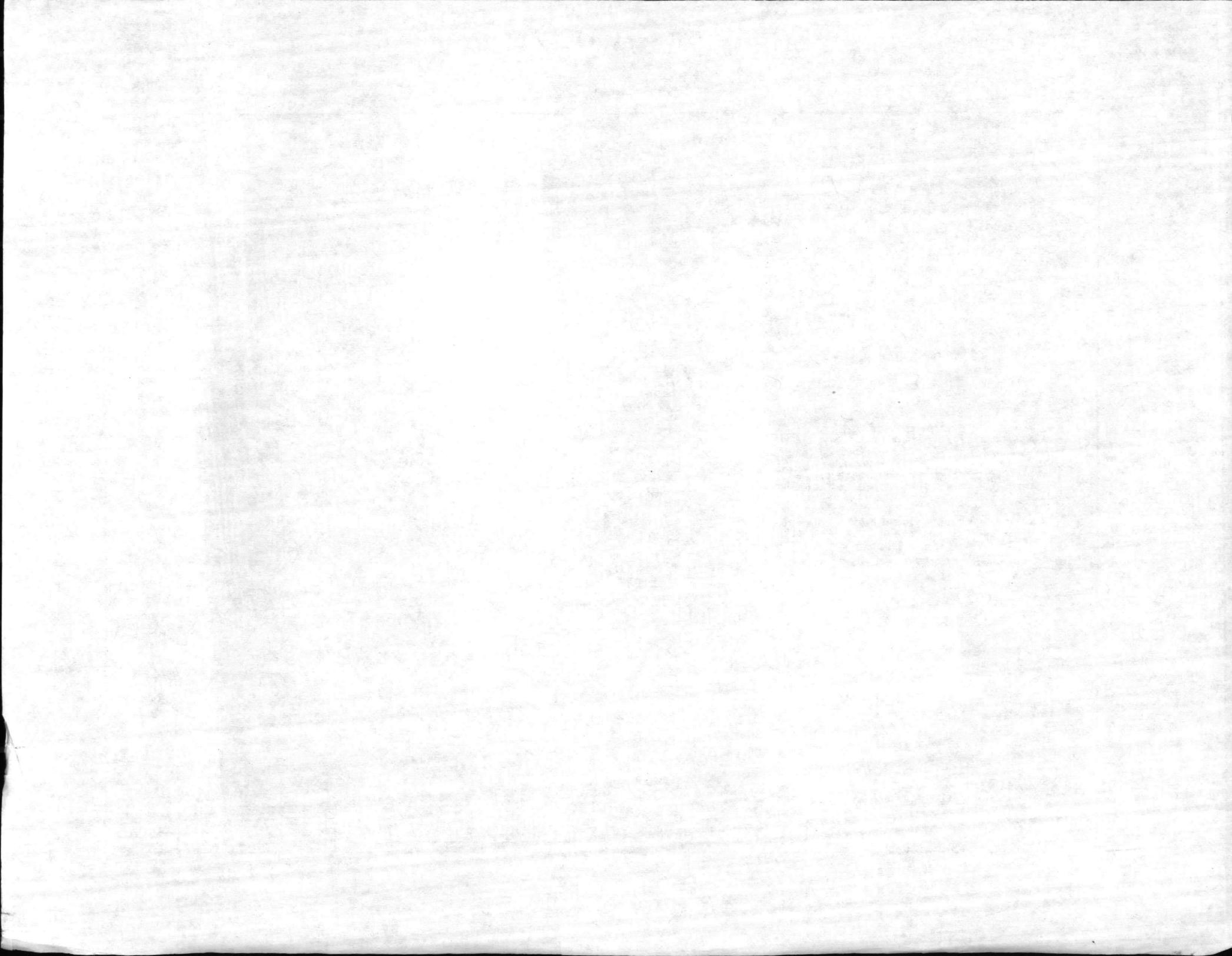
- - PARTS INCLUDED IN BODY ASSEMBLY (ITEM 69)
(THESE PARTS MAY ALSO BE PURCHASED SEPARATELY)
- - PARTS INCLUDED IN BONNET ASSEMBLY (ITEM 81)
(THESE PARTS MAY ALSO BE PURCHASED SEPARATELY)
- ◊ - PARTS INCLUDED IN REPLACEMENT PARTS KIT (ITEM 70)
(THESE PARTS MAY ALSO BE PURCHASED SEPARATELY)

NOTE: FOR ITEM NUMBER IDENTIFICATION SEE DRAWING 185-21960

SEE CIRCUIT
BREAKER
PARTS LIST

PERMUTIT AUTOMATIC MULTI-PORT VALVE - 2", 3", 4" & 6"

MULTI-PORT VALVE AUTOMATIC		PERMUTIT
2" 3" 4" & 6"		185-21959 0



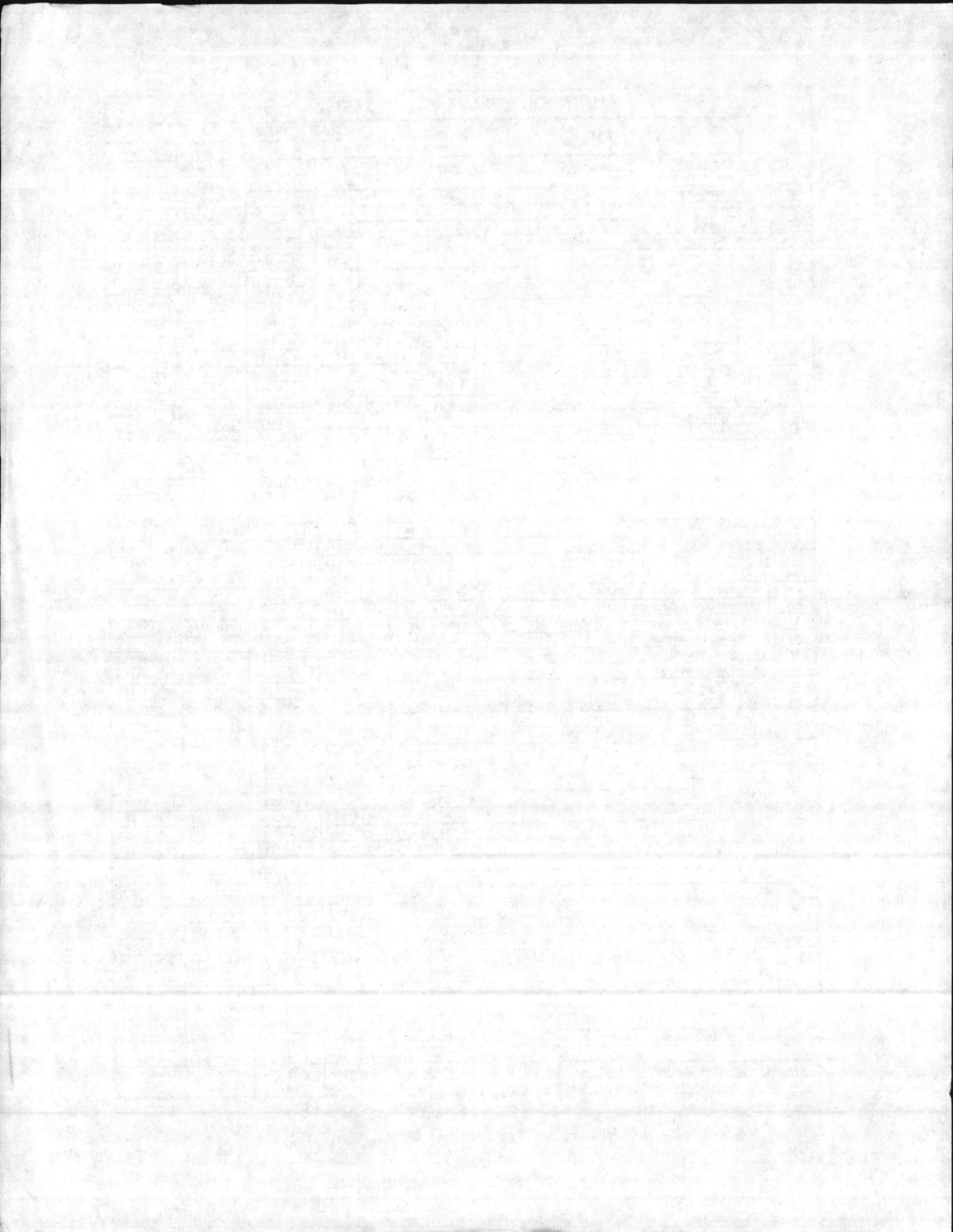
MULTI-PORT VALVE PARTS LIST

ITEM NO	DESCRIPTION	PART NUMBER				
		MATERIAL	2" MPV	3" MPV	4" MPV	6" MPV
1A	BODY FLANGED	CAST IRON	156-03843	156-03718	156-02501	156-04390
1B	BODY FLANGED	CL. VINYL COATED	156-09649	156-10052	156-09651	156-09654
1C	BODY (SCREWED)	CAST IRON	156-03799	-	-	-
2	BONNET AND GEAR (AGE GASKET)	GARLOCK 91	157-10293	129-05484	129-06422	129-06505
3	PORT PLATE GASKET	GARLOCK 91	102-28308	157-09348	129-06419	157-10998
4A	PORT PLATE	BRONZE	102-28307	157-09347	129-06418	129-06506
4B	PORT PLATE	316 SS	102-39144	157-34107	129-27536	129-27537
4C	PORT PLATE	MONEL	102-30842	157-14792	129-08996	129-08997
5A	PORT PLATE SCREWS *** 3, 9, 10 OR 15 REQUIRED ***	316 SS	188-01710	188-07649	188-01766	188-01860
5B	PORT PLATE SCREWS *** 3, 9, 10 OR 15 REQUIRED ***	MONEL	188-03642	188-03644	188-03644	188-03607
6A	SLIDE ASS'Y (UNLINED VLV) (2"-4" H/RUB/6" PVC FACING)	CAST IRON	157-10909	157-11800	129-06420	129-17507
6B	SLIDE ASSEMBLY (LINED VALVE) VINYL COATED, PVC FACING	CAST IRON	157-19173	157-19619	129-13560	129-13487
6C	SLIDE ASSEMBLY HIGH TEMP. 250°	BRONZE	157-18723	157-18724	129-11775	156-09321
7A	SLIDE SPRING (UNLINED VLV) (2"-B2) (3", 4", 6"-S.S.)	BRONZE/304SS	102-28749	102-29420	102-28883	102-28980
7B	SLIDE SPRING (LINED VALVE)	316 SS	104-30830	105-29641	103-29091	103-29092
7C	SLIDE SPRING (LINED VALVE)	MONEL	103-30830	104-29641	104-29091	104-29092
8A	BONNET & GEAR CAGE ASSEMBLY (AUTO VALVE)	-	100-09452	100-09457	100-09461	100-09465
8B	BONNET & GEAR CAGE ASSEMBLY (LINED VALVE)	-	100-09454	100-09458	100-09462	100-09466
9	RING PACKING FOR SLIDE SHAFT *** 2" REQ'D ***	GARLOCK 393	102-29670	102-29671	102-29672	102-29673
10	PACKING NUT FOR SLIDE SHAFT	BRONZE	102-28748	102-29422	102-28845	102-28941
11A	SLIDE SHAFT FOR HIGH & LOW PRESS. VALVE (MAN)	17-4 PH SS	102-30375	159-11798	159-10992	104-28935
11B	SLIDE SHAFT FOR HIGH & LOW PRESS. VALVE (AUTO)	17-4 PH SS	157-10639	159-11799	159-10880	104-28942
12	GREASE FITTING	-	187-01485	187-01485	187-01485	187-01485
13	MOTOR SUPPORT (SEND MOTOR DATA)	-	-	-	-	-
14	MOTOR-SEND NAMEPLATE INFORMATION	-	-	-	-	-
15	CAP SCREWS *** 6, 9, 9 OR 11 REQUIRED ***	STEEL	188-01708	188-01497	188-01818	188-01834
16	INSTRUCTION PLATE	-	102-29771	102-29771	102-29771	102-29771
17	HAND WHEEL	CAST IRON	102-10727	-	-	-
18A	SLIDE SHAFT WORM GEAR (AUTO & MANUAL) (AUTO ONLY ON 2')	DUCTILE IRON	102-28750	103-29625	103-28959	103-28961
18B	SLIDE SHAFT WORM GEAR (2" MANUAL ONLY)	DUCTILE IRON	102-28312	-	-	-
19	OIL HOLE COVER (FOR CROSS SHAFT)	-	187-01607	187-01607	187-01607	187-01607
20	OIL HOLE COVER (FOR DRIVE SHAFT) 2"-6"	-	188-02482	188-01563	188-01563	188-01503
21	SLIDE SHAFT BEARING ASSEMBLY	BRONZE	102-28884	102-28830	102-28958	102-28943
22	BALL THRUST BEARING	-	187-01701	187-01484	188-01814	187-01829
23A	CROSS SHAFT WORM (AUTO & MANUAL) (MANUAL ONLY ON 2')	STEEL	102-28313	102-12568	102-12572	102-12576
23B	CROSS SHAFT WORM (2" AUTO ONLY)	STEEL	102-12570	-	-	-
24	CROSS SHAFT (AUTO)	STEEL	102-28603	102-28578	102-28842	157-11000
25	MOTOR COUPLING, DRIVING HALF	STEEL	102-29479	102-24562	102-24562	102-24560
25A	MOTOR COUPLING, DRIVING HALF (6" H.P.) (SEND MOTOR DATA)	STEEL	-	-	-	102-31342
26	MOTOR COUPLING, DRIVEN HALF	STEEL	102-24562	102-24562	102-24562	102-24563
26A	MOTOR COUPLING, DRIVEN HALF (6" H.P.) (SEND MOTOR DATA)	STEEL	-	-	-	102-31343
27	CLUTCH SPRING	STEEL	102-28604	102-28579	102-13273	102-28938
28	CLUTCH, SLIDE HALF	STEEL	102-29665	102-13276	102-13272	102-13263
29	CLUTCH, DRIVE HALF	STEEL	102-29664	102-13275	102-13271	102-13262
30	CROSS SHAFT WORM WHEEL	BRONZE	102-28600	102-28586	157-10879	102-28940
31	END BEARING ASSEMBLY	CAST IRON	157-10965	157-10864	157-10999	129-06500
32	HAND WHEEL GRIP (ONLY ON 2" MANUAL)	RUBBER	102-10751	-	-	-
33	END BEARING GASKET	GARLOCK 660	102-28832	102-28832	157-10881	102-28944
34	SHOULDER SCREW (ONLY ON 2" MANUAL)	STL. CD PLATED	102-17048	-	-	-
35	SET COLLAR	STEEL	102-10734	-	102-28927	102-28927
36	CRANK SHAFT (MANUAL ONLY)	STEEL	-	102-11269	102-28928	102-28928
37	SPACER	STEEL	-	-	102-28849	102-28945
37A	SPACER	STEEL	-	-	102-28848	102-28945
37B	SPACER	STEEL	102-12618	-	-	-
38	WORM AND DRIVE SHAFT (2' & 3' - WORM ONLY (4' & 6'))	STEEL	102-28599	102-28585	102-12570	102-12568
39	DRIVE SHAFT	STEEL	-	-	102-28847	102-28900
40	BALL THRUST BEARING	-	187-01702	187-01501	187-01701	187-01484

188-0105

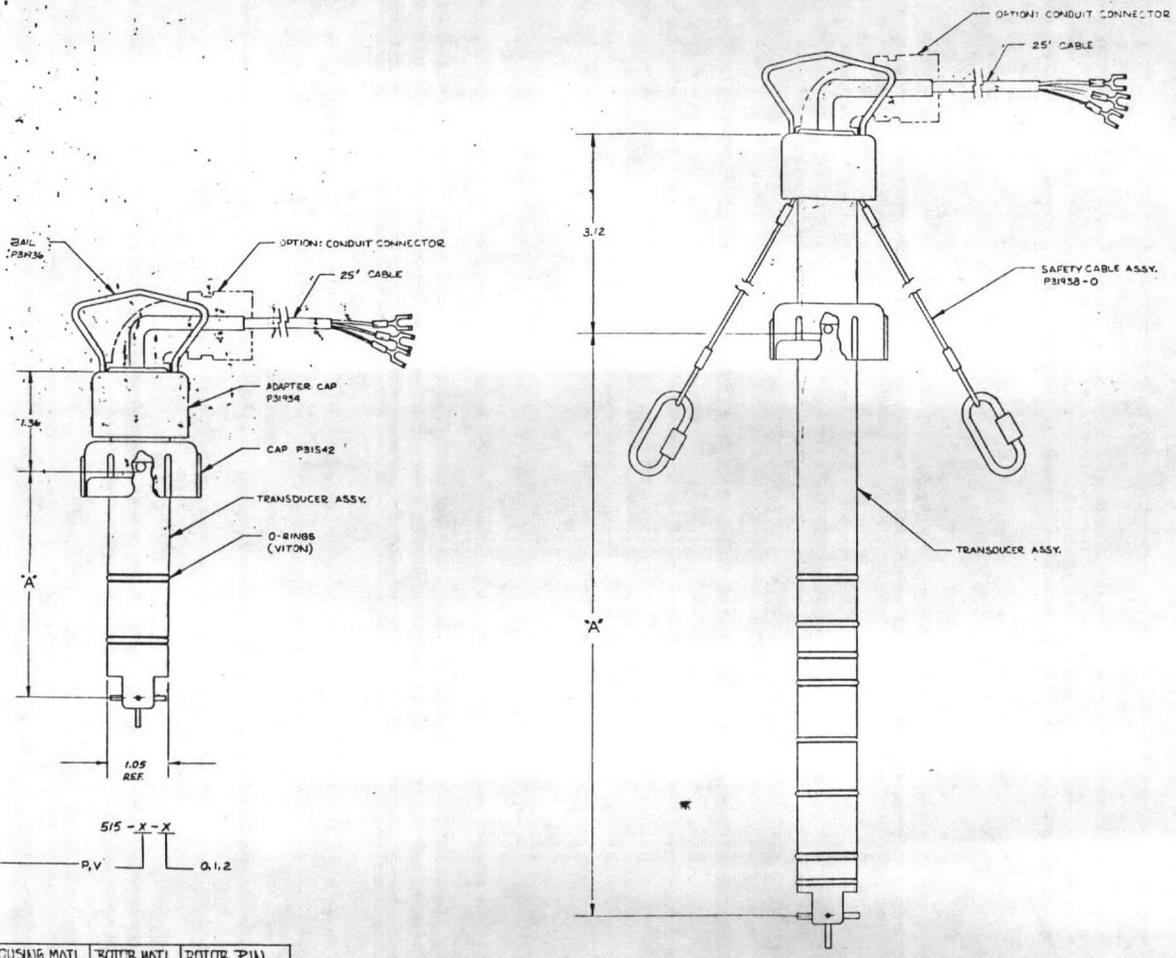
MULTI-PORT VALVE PARTS LIST, CONTINUED

ITEM NO	DESCRIPTION	PART NUMBER				
		MATERIAL	2" NPV	3" NPV	4" NPV	6" NPV
41	DRIVE SHAFT BEARING GASKET	GARLOCK 660	102-28797	102-28796	102-28946	102-28946
42	DRIVE SHAFT BEARING ASSEMBLY	BRONZE	102-28798	102-28833	102-28937	102-28948
43	GEAR COVER GASKET	GARLOCK 91	-	-	102-28924	102-28937
44A	CRANK HANDLE	STEEL	187-01703	187-04102	187-01763	187-01763
44B	CRANK HANDLE (3" & 6" AUTO) (3" & 6" STEEL)	C. I. / STEEL	-	187-01608	-	188-01836
45	PACKING RINGS FOR GREASE TUBES *** 2 REQUIRED ***	GARLOCK 219	188-01486	188-01486	188-01486	188-01486
46	PACKING NUT FOR GREASE TUBES	BRASS	102-13851	102-13851	102-13851	102-13851
47	GREASE TUBES (ALLENITE LONG) 2, 3, 4, 6	BRASS	102-19159	102-19160	102-29675	102-27578
48	KEY (MANUAL VALVE)	STEEL	-	108-31770	118-31770	119-31770
49	GROOVE PIN (2" MANUAL ONLY)	STL. CD PLATED	188-04423	-	-	-
50	GROOVE PIN (2" MANUAL ONLY)	STL. CD PLATED	188-04428	-	-	-
51	EJECTOR FLANGE (FOR LINED VALVE)	AMPCO	102-28314	102-28976	-	-
52	EJECTOR FLANGE GASKET (FOR LINED VALVE)	GARLOCK 122	102-28315	102-28977	-	-
53	CROSS SHAFT SPUR GEAR	DUCTILE IRON	-	102-13393	102-28923	102-28930
54A	BONNET & GEAR CASE ASSEMBLY (MANUAL VALVE)	CAST IRON	100-09451	100-09455	100-09459	100-09463
54B	BONNET & GEAR CASE ASSEMBLY (FOR LINED VALVE)	CLYNYL COATED	100-09453	100-09456	100-09460	100-09464
55	KEY (MANUAL VALVE)	STEEL	-	124-31771	106-31770	125-31771
56	GEAR COVER ASSEMBLY	CAST IRON	-	102-28840	157-10993	129-06502
57	SCREW (MANUAL VALVE)	STEEL	-	188-01508	188-01819	188-01833
58	PINION (3" BRASS, 4" & 6" STEEL)	BRASS/STEEL	-	102-13392	102-28929	102-28929
59A	DIAL PLATE (FOR SOFTENER) (2" BZ, 3", 4" & 6" BR)	BRONZE/BRASS	102-29426	102-10937	102-10937	102-10937
59B	DIAL PLATE (FOR FILTER)	BRONZE/BRASS	102-29427	102-11039	102-11039	102-11039
60	CROSS SHAFT (MANUAL)	STEEL	102-10735	102-11268	102-28925	102-28931
61	SPACER (3" BRASS, 4" & 6" STEEL)	BRASS/STEEL	-	102-13391	102-28926	102-28934
62	PONTER (2" BRONZE, 3", 4" & 6" BRASS)	BRONZE/BRASS	102-30376	102-10726	102-10726	102-10726
63A	VALVE PACKING RETAINER (FOR LINED VALVE)	303 SS	104-30828	104-29080	103-29081	103-29082
63B	VALVE PACKING RETAINER (FOR LINED VALVE)	MONEL	103-30828	103-29080	104-29081	104-29082
63C	SLIDE SPRING FLANGE (FOR 2" LINED VALVE)	316 SS	104-30829	-	-	-
63D	SLIDE SPRING FLANGE (FOR 2" LINED VALVE)	MONEL	103-30829	-	-	-
64	VALVE PACKING RING (FOR LINED VALVE)	SBR RUBBER	102-28318	102-29084	102-29085	102-29086
65	MOTOR SHAFT BEARING	BRONZE	102-10969	-	-	-
66	PN (MANUAL VALVE)	STL. CD PLATED	-	188-04433	188-04442	188-04442
67	SILICONE LUBRICANT	SILICONE LUB	187-02738	187-02738	187-02738	187-02738
68	SILICONE SEALANT	732 RTV	187-17234	187-17234	187-17234	187-17234
69	BODY ASSEMBLY (CALL PARTS DEPT. FOR INFO)	-	-	-	-	-
70	REPLACEMENT PARTS KIT (CALL PARTS DEPT. FOR INFO)	-	-	-	-	-
71	BONNET ONLY (CALL PARTS DEPT. FOR INFO)	-	-	-	-	-
72	PLUS (2" PVC, 3" CI)	PVC/C.I.	188-07165	188-01490	-	-
73	PLUS (UNLINED ONLY)	CAST IRON	188-00583	188-00583	188-00583	188-00583
74	BOLT *** 3 REQUIRED ***	STEEL	188-01191	188-01191	-	-
75	PN (MANUAL VALVE)	STL. CD PLATED	-	188-04439	188-02509	188-02509
76	PLUG	CAST IRON	188-00583	188-00583	188-00583	188-00583
77	PLUG	CAST IRON	188-00583	188-00583	188-00583	188-00583
78	BOLT (2" STEEL, CD PLATED, 3", 4" & 6" STEEL)	STL. CD PLATED/STL	188-08825	188-06186	188-01823	188-05600
79	SCREW	STEEL	188-02475	188-02475	188-02475	188-02475
80	SCREW	STEEL	188-02475	188-02475	188-02475	188-02475
81	BOLT	STL. CD PLATED	188-04516	188-04516	188-04516	188-04516
82	BOLT	STEEL	188-00977	188-01191	188-01191	188-00977
83	KEY, SLIDE SHAFT, SLIDE END	416 SS	113-31771	103-31538	104-31538	105-31538
84	KEY, SLIDE SHAFT, WORM END *** 2 REQUIRED ***	416 SS	109-31770	103-31537	104-31537	105-31537
85	KEY	STEEL	106-31770	117-31770	118-31770	119-31770
86	KEY	STEEL	120-31771	128-31771	122-31771	123-31771
87	KEY	STEEL	-	126-31771	127-31771	123-31771
88	SCREW (2" STEEL, CD PLATED, 3", 4" & 6" STEEL)	STL. CD PLATED/STL	188-08825	188-06186	188-01508	188-01508
89	SCREW	STL. CD PLATED	188-01500	188-01500	188-01500	188-01500
90	NUT (2" MANUAL ONLY)	STL. CD PLATED	188-00611	-	-	-
91	THRUST WASHER (2" MANUAL ONLY)	BRASS	102-30377	-	-	-
92	RETAINING RING (2" MANUAL ONLY)	STEEL	187-03434	-	-	-
93	CIRCUIT BREAKER (ENCODER) (CALL PARTS DEPT. FOR INFO)	-	-	-	-	-



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	*A DIM - 3 WPS: 2262; - 4 WPS: 0.734 - 5 WPS: 1.0.34	7/81	K
B	CAP (P31542) WAS MISSED; PVDF WAS PEREEL; UPDATED P-FE SIZES, ADDED LOSS TO CABLE.	10/81	K

MAR 25 1985



ORDERING INFORMATION

BASIC PN	PIPE SIZE	"A" DIMENSION
S15-X-X	0 = 1/2" - 4"	2.555
	1 = 5" - 8"	3.850
	2 = 10" FUP	4.850
	3 = 1/2" - 4"	8.640
	4 = 5" - 8"	10.012
	5 = 10" FUP	13.012

MATERIAL
P = POLYPRO
V = PVDF

* NOTE: 3-5 AVAILABLE IN POLYPRO ONLY.

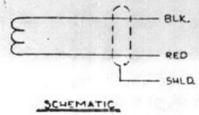
ACCESSORIES

CONDUIT SENSOR KIT (P31534):
STRAIGHT ADAPTER FOR 3/8 CONDUIT,
RIGHT ANGLE ADAPTER FOR 3/8 CONDUIT.

SPECIFICATIONS

VOLTAGE: APPROX. 1V PK-PE/PPS
FREQUENCY: APPROX. 5 Hz / PPS
SOURCE IMPEDANCE: APPROX. 8000 OHM / 2 H
PRESSURE RATINGS: 100 PSI @ 20°C; 25 PSI @ 105°C
3, -4, -5 TRANSDUCER: 100 PSI MAX

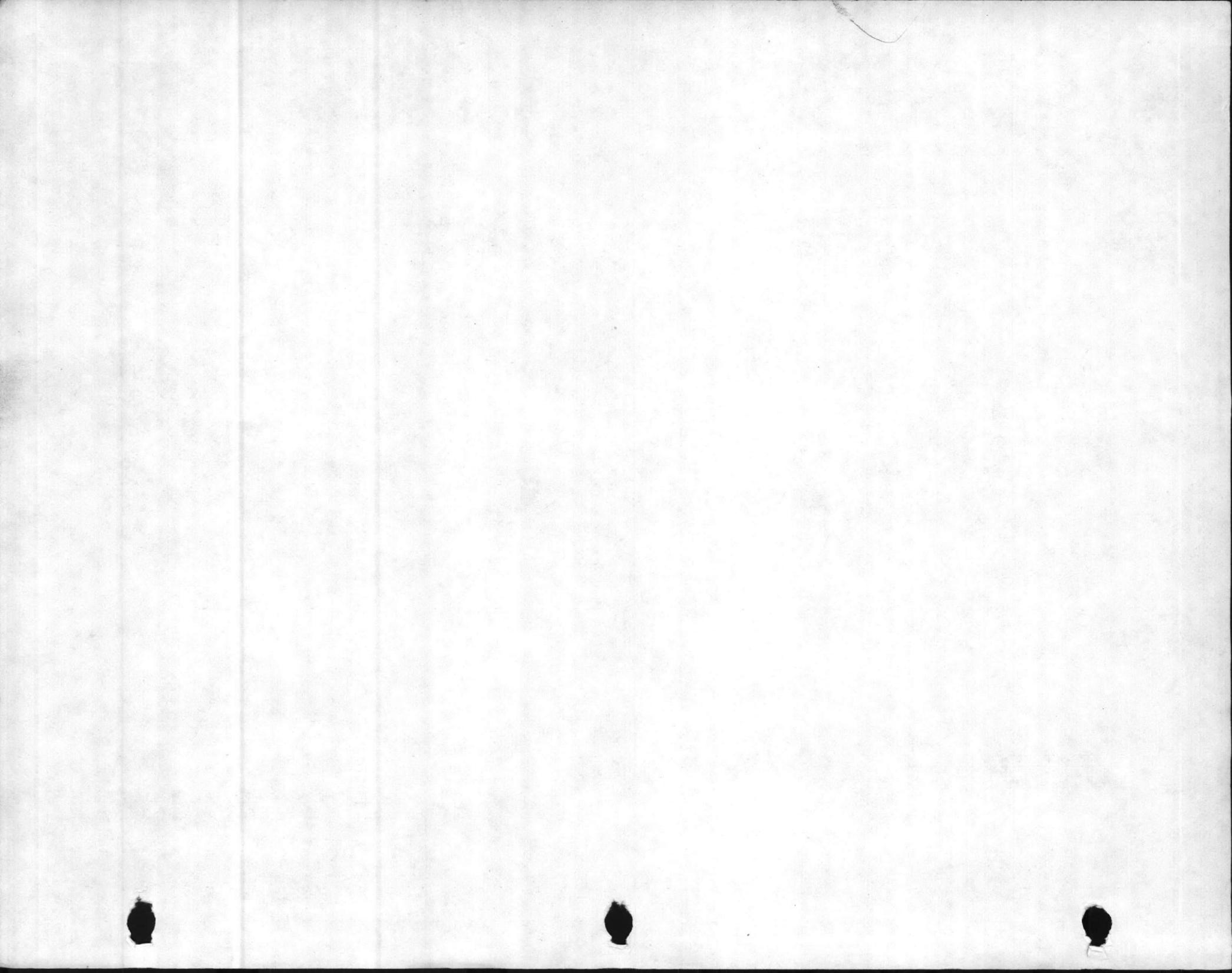
HOUSING MATL.	ROTOR MATL.	ROTOR PIN
D	POLYPROPYLENE	PVDF
V	PVDF	PVDF



NOTES:

REQD ITEM	PART NUMBER	DESCRIPTION	MATERIAL	MTL SPECIFICATION	VENDOR
LIST OF MATERIAL					
SEE ENGINEERING RECORDS	MKS 5	DRAWN DATE	CHECKED DATE	 SIGNET SCIENTIFIC COMPANY 3801 MARKET AVE., # 2, SUITE 7, CALIFORNIA, CA 91108	
NEXT ASSY.	USED ON	11/11 8			
APPLICATION		STRESS DATE	SYSTEM DATE	TRANSUCER OUTLINE DRAWING MK515	
DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.		PROJECT DATE	CONTRACT NO.		
TOLERANCES XX ± .05 XXXX ± .005 XXX ± .010 ANGLES 4°		DATE			
MATERIAL:		DATE	DATE	DWG SIZE	CODE IDENT
		19	19	D	16290
		APPROVED SPECIAL OFFICER	SCALE	PS500	

2/11/81 6-7-84





OPERATING INSTRUCTIONS

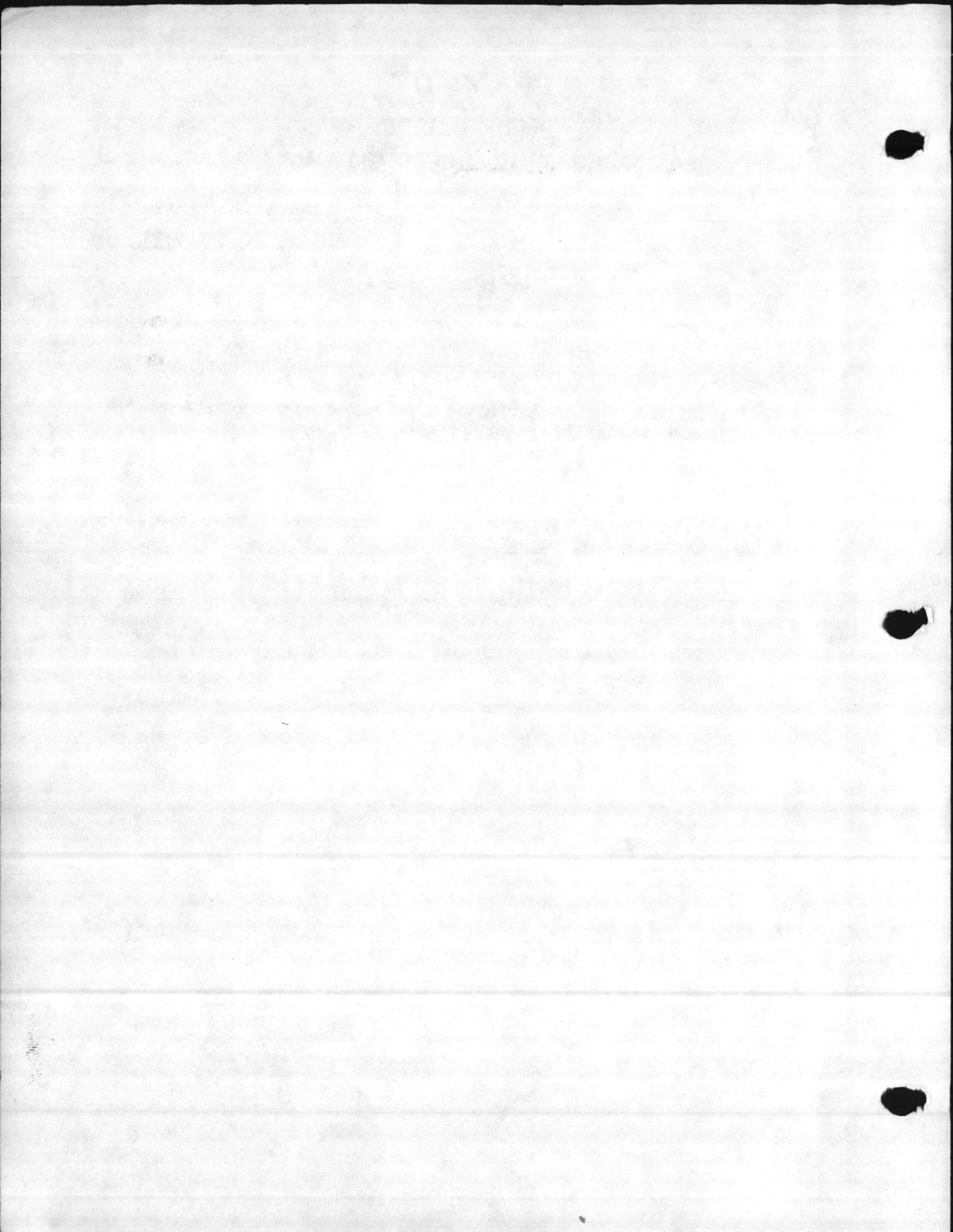
FIELD SERVICE

Permutit Field Service provides equipment assembly supervision and equipment services.

These services are available on a per diem basis at the time of equipment installation or start-up.

The services of a field serviceman at the time of equipment installation and equipment start-up are recommended to check that the installation is in accordance with the drawings and instructions and to instruct owner's operators in the operation of the equipment.

A complete description of responsibility, availability, rates and expenses will be furnished upon request or by contacting our Field Service Department at (201)-967-6000.



OPERATING INSTRUCTIONS

for **WATER CONDITIONING EQUIPMENT**

Date FEBRUARY, 1985

Job No. A141E39857

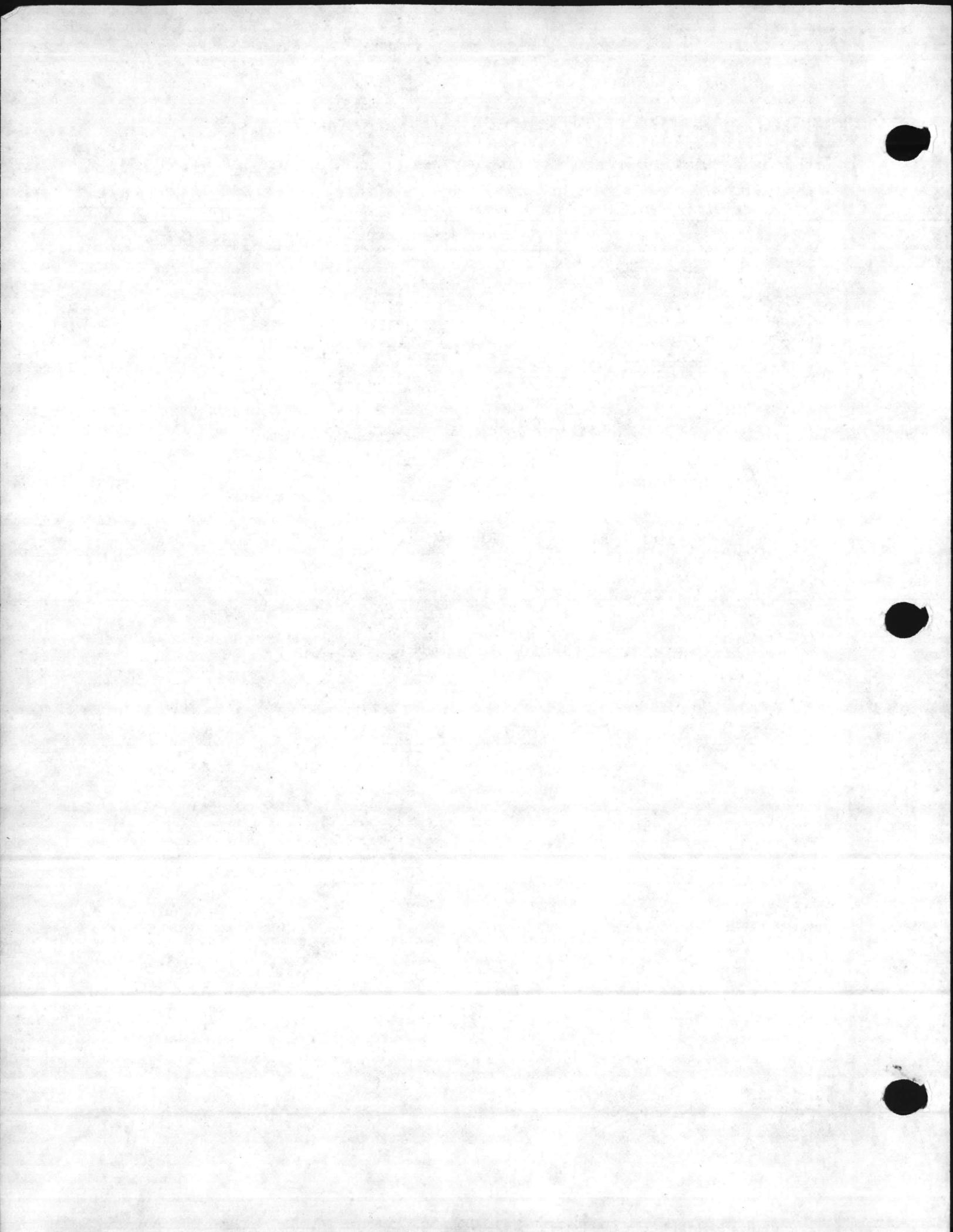
Prepared for MARINE BASE

CAMP LEJEUNE, NORTH CAROLINA

PART I - DUAL MEDIA FILTERS

PART II - WATER SOFTENERS

PART III - MANUFACTURERS' LITERATURE



OPERATING INSTRUCTIONS

for WATER CONDITIONING EQUIPMENT

Date FEBRUARY, 1985

Job No. A141E39857

Prepared for MARINE BASE

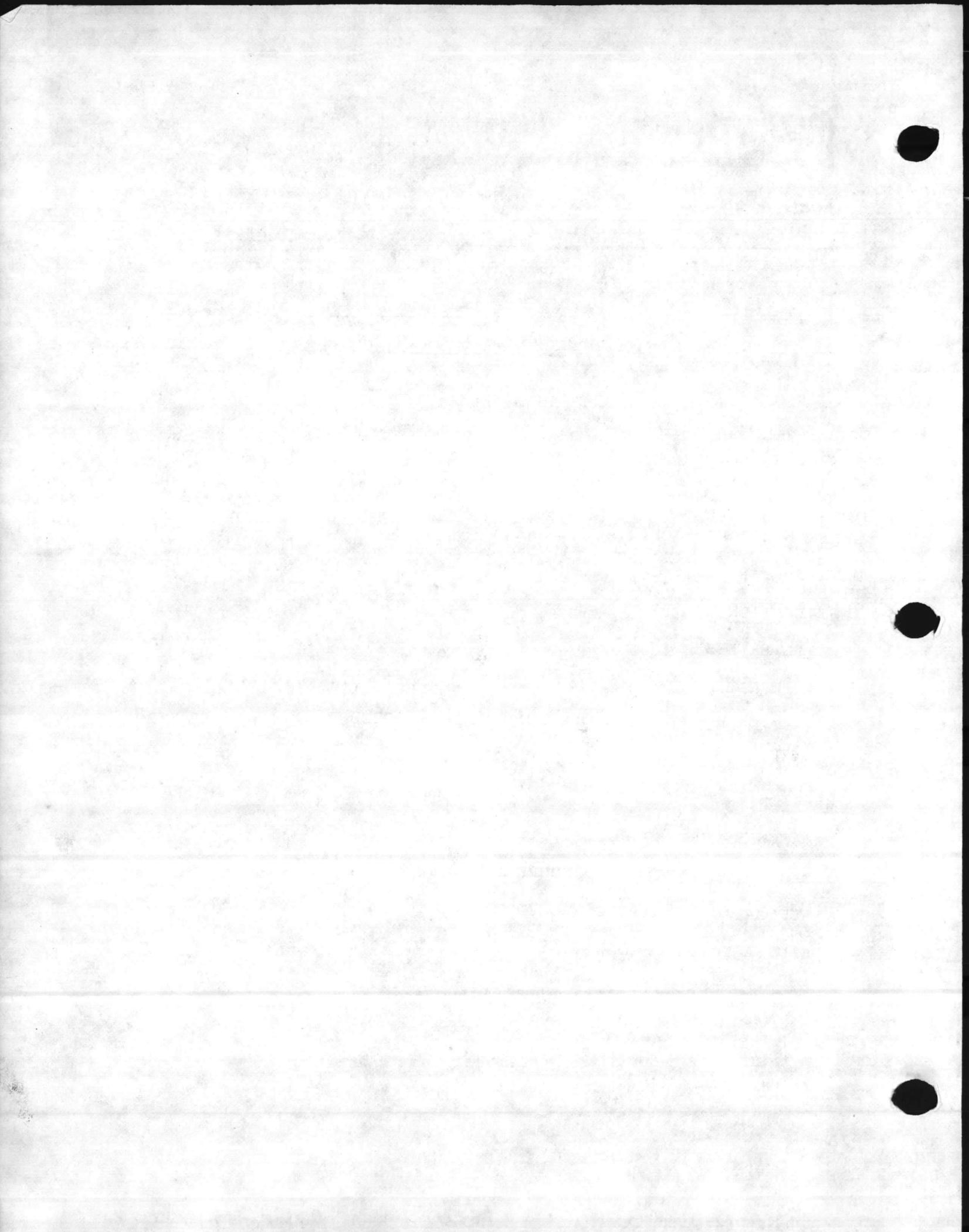
CAMP LEJEUNE, NORTH CAROLINA

DUAL MEDIA FILTERS

PART I

TABLE OF CONTENTS

	<u>PAGE</u>
GENERAL DESCRIPTION.....	1
DATA.....	2-3
<u>INSTALLATION</u>	
FILTER ASSEMBLY.....	4-5
INTERNAL ASSEMBLY.....	6
TESTING STRAINERS & LOADING MEDIA PROCEDURE.....	7-8
STRAINER ASSEMBLY.....	9
<u>OPERATION</u>	
BACKWASH PROCEDURE.....	10
MANUAL OPERATION PROCEDURE.....	11-12
AUTOMATIC OPERATING PROCEUDRE.....	13
SEMI-AUTOMATIC MODE.....	14
MANUAL MODE.....	15-16



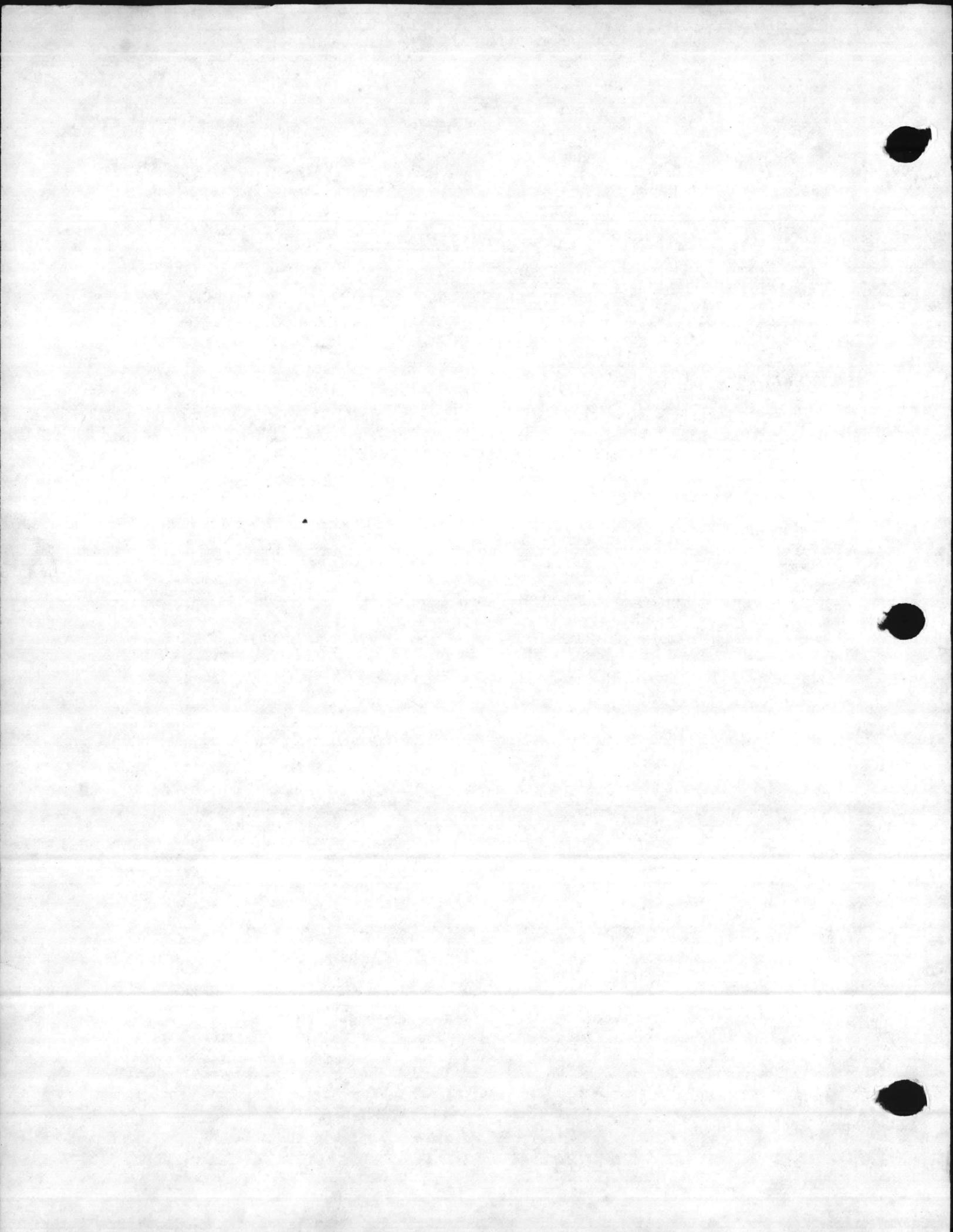


OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

TABLE OF CONTENTS

	<u>PAGE</u>
<u>MAINTENANCE</u>	
INSPECTION.....	17
EFFLUENT QUALITY.....	17
SHUTDOWN.....	17
TEMPERATURE.....	17
BED REPLACEMENT.....	17
REMOVAL OF MEDIA PROCEDURE.....	18
MULTIPOINT VALVE LUBRICATION.....	19



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

GENERAL DESCRIPTION

The filters are supplied with a 6" automatic multiport valve and loaded with sand and anthracite selected for the removal of suspended solids and turbidity.

The underdrain assembly is a double dish with strainers of 316 SS construction. The water to be filtered enters at the top of the vessel via the multiport valve and percolates downward through the filter bed and departs the strainers at the bottom. The effluent stream passes through the multiport valve and is directed to the softener vessels.

The filter bed must be backwashed periodically to remove the excessive build-up of particles on the filter bed. A high differential pressure observed on the pressure gauges on the inlet and outlet lines shall signal a unit is to be backwashed.

Backwash and inlet rates can be observed on the rate of flow indicators mounted on each line respectively.

The manual and semi-automatic operation of the backwash procedure is discussed in a latter section.

$$\begin{array}{r} 90 \\ \underline{6} \\ 540 \end{array}$$

$$\begin{array}{r} 41 \\ \hline 2.31 \overline{) 95.00} \\ \underline{724} \\ 260 \end{array}$$

100032



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

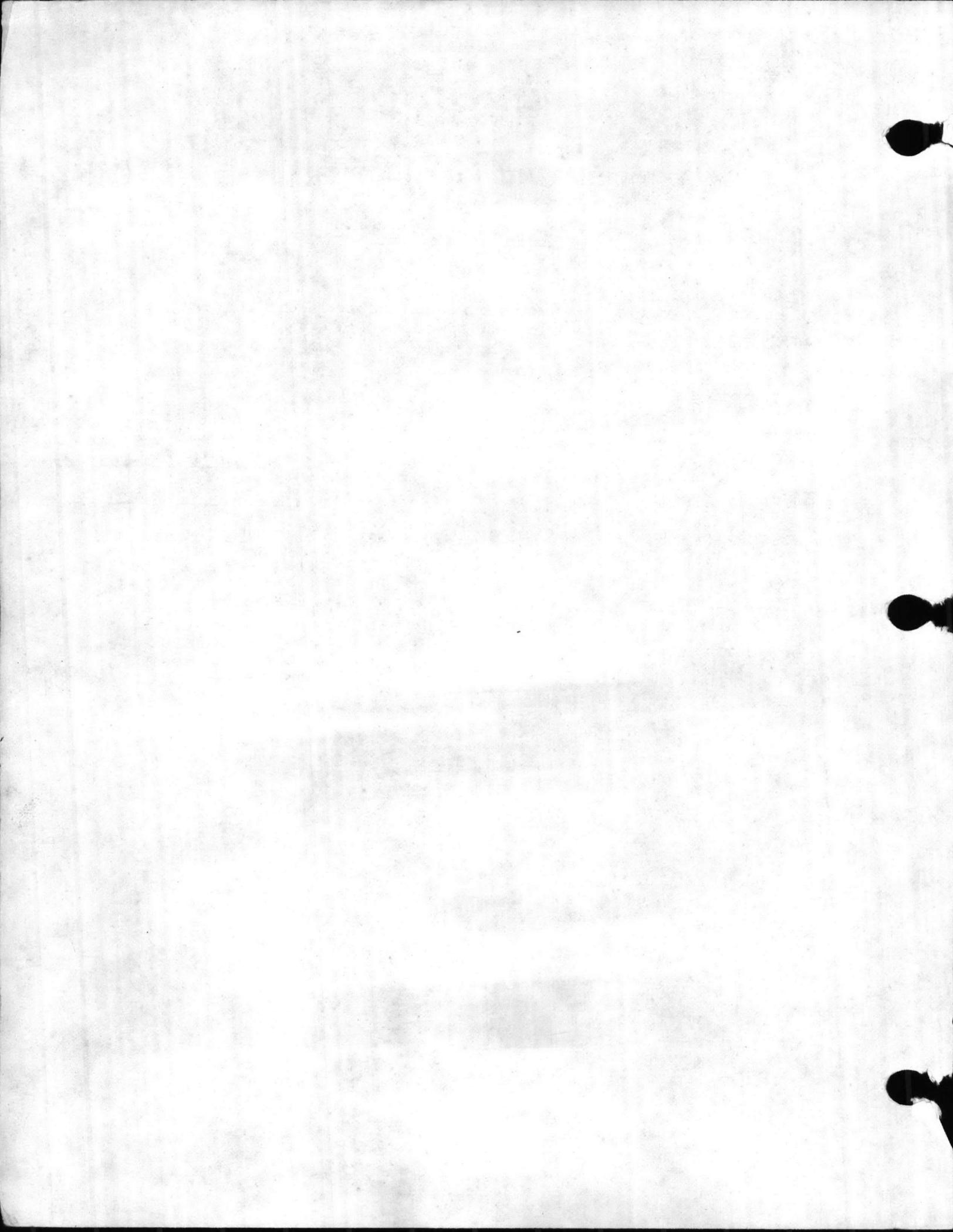
Adjust butterfly valves in wash or rewash outlet line to provide specified rates. Check rate by flow indicator.

REFERENCE DRAWINGS:

LAYOUT.....	<u>184-18784</u>
FLOW DIAGRAM.....	<u>N/A</u>
INTERNAL ASSEMBLY.....	<u>101-40120</u>
UNDERDRAIN ASSEMBLY (STRAINER).....	<u>102-33600</u>

REMARKS:

For your reference the Manual Operating Procedure is included, refer to Part V for Automatic Operation of this filter assembly.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

INSTALLATION

FILTER ASSEMBLY

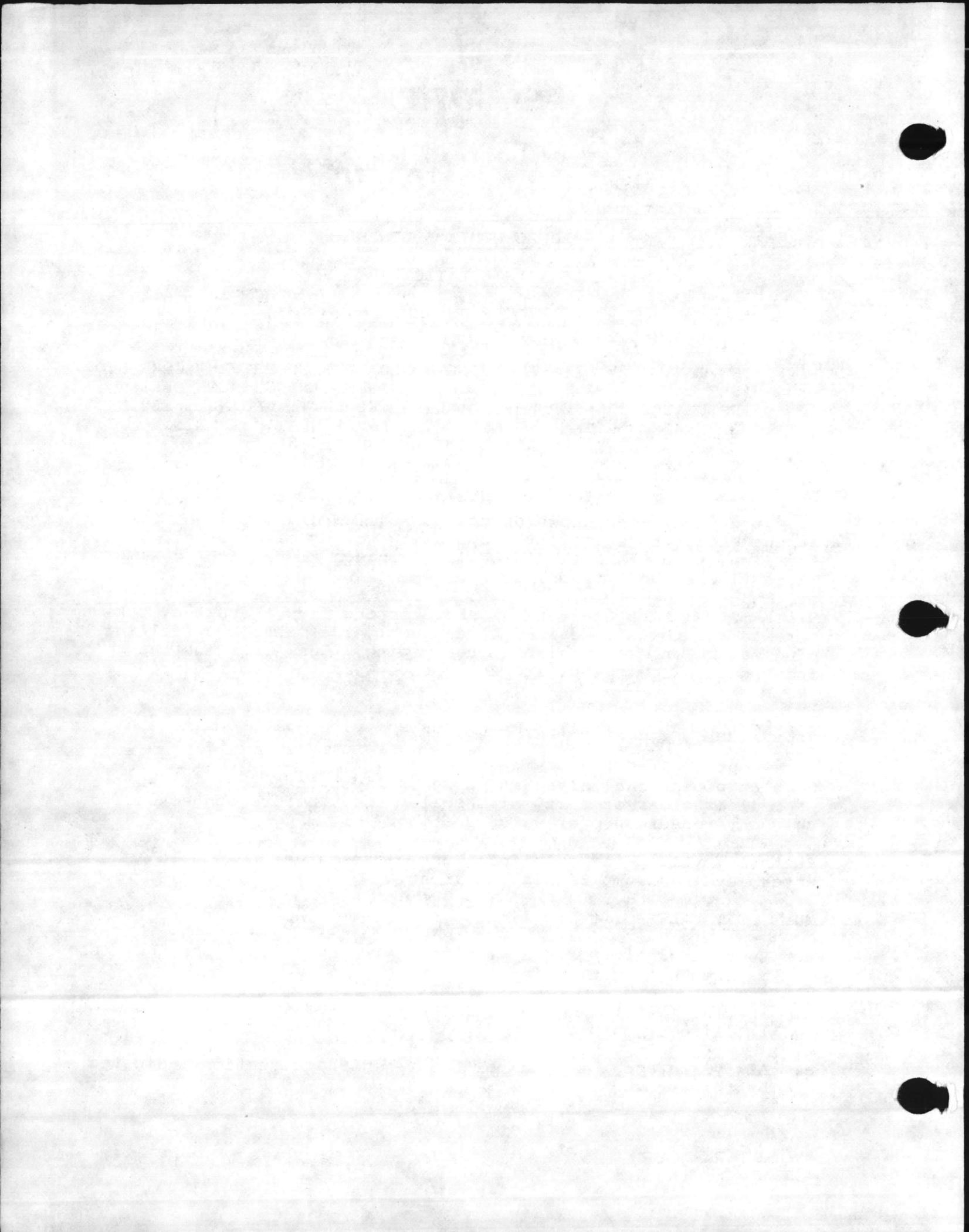
CAUTION: THE TANKS MAY HAVE A LINING OR COATING TO PREVENT CORROSION, (SEE DATA PAGE). DO NOT INJURE THIS LINING WHEN WORKING INSIDE THE TANK OR WHEN LOADING THE UNIT. DO NOT WELDING OR BURNING ON TANK OR OTHERWISE APPLY HEAT. IF LINING IS INJURED, SEVERE CORROSION WILL RESULT.

1. FOUNDATION: The foundation should be constructed in accordance with the dimensions shown on the FOUNDATION drawing, and must be strong enough to sustain the operating weight of each unit without settling. The DRAIN should be large enough to pass the maximum waste flow without flooding.
2. FILTER TANK: Set the tank as shown on the layout drawing, taking care to see that it is installed plumb. The manhole or filling plug may be on either side of the piping. Tank legs must be located to allow the piping to pass between them to the front of the tank.
3. PIPING AND VALVES: All pump glands and pipe joints must be air tight.

Connect piping and valves as shown on layout drawing. Flush all pipe lines clear of dirt, mill scale, etc., before connecting to valves to ensure proper valve seating.

Butterfly valves (if supplied) must close rather than open as water level in sump raises the float.

4. MULTIPOINT VALVES (If Supplied):
 - a. Lubricate multiport valve before placing it into service, (see maintenance instructions).
 - b. Shutoff (gate) valves should be installed in the inlet and outlet line of each unit.
 - c. Always rotate the multiport valve in the direction indicated by the arrow.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

INSTALLATION

FILTER ASSEMBLY

5. UNDERDRAIN SYSTEM: Normally, either a double dish or a deflector distributor underdrain system is provided. Instructions covering these types are given below. If any other type system is supplied, special instructions will be provided if necessary.
 - A. DOUBLE DISH: Refer to Form 4938, included with these instructions, for installation details. In some cases, tanks will be shipped with strainer assemblies already installed. It is still important to carefully inspect each assembly before loading the unit. Tighten any strainers which may have worked loose in shipment.
 - B. DEFLECTOR-DISTRIBUTOR: Examine the deflector plate to certain there is a uniform clearance between it and the bottom head of the tank.

$$\begin{array}{r} 33\frac{1}{2} \\ \underline{30} \\ 63\frac{1}{2} \end{array}$$

(FLANGE OR SCREWED
SEE LAYOUT)

FFLE PLATE

MANHOLE

STR.

TOP OF BED

CAUTION

BEFORE ADDING FILL MATERIAL IN TANK, INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS, STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE UP GAP.

CLEANOUT
CONN.

STR.

HOLE

STRAINER ASSY
(DWG. 102-33600)
(SEE B/M FOR QUANTITY)

OUTLET

STRAINER PLATE

(FLANGED OR SCREWED, SEE LAYOUT)

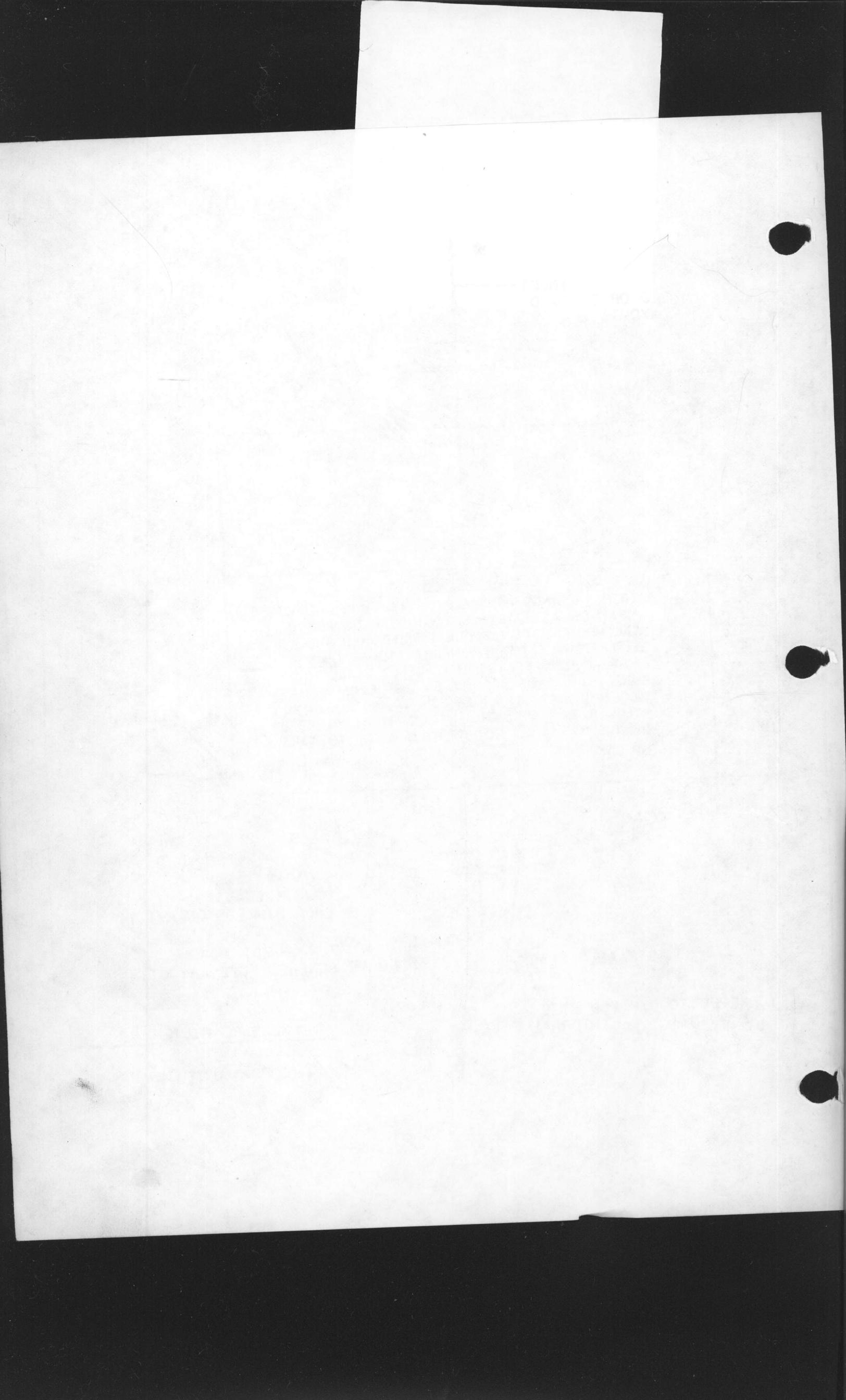
INTERNAL ASSEMBLY

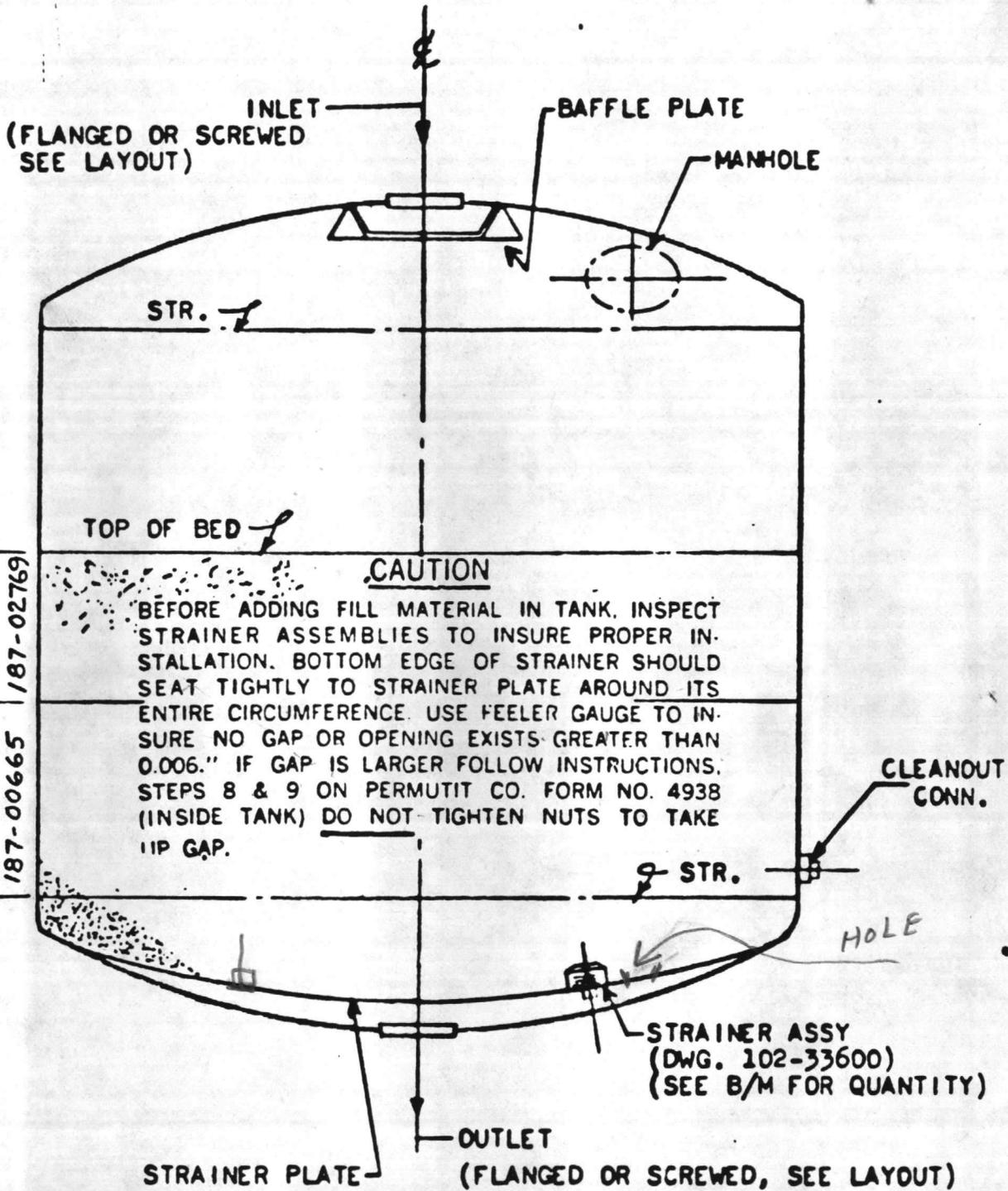
90" DIA.

PRESSURE FILTER

NOTE: REFER TO B/M FOR SIZE & QUANTITY OF INTERNAL FILL.

THE PERMUTIT COMPANY

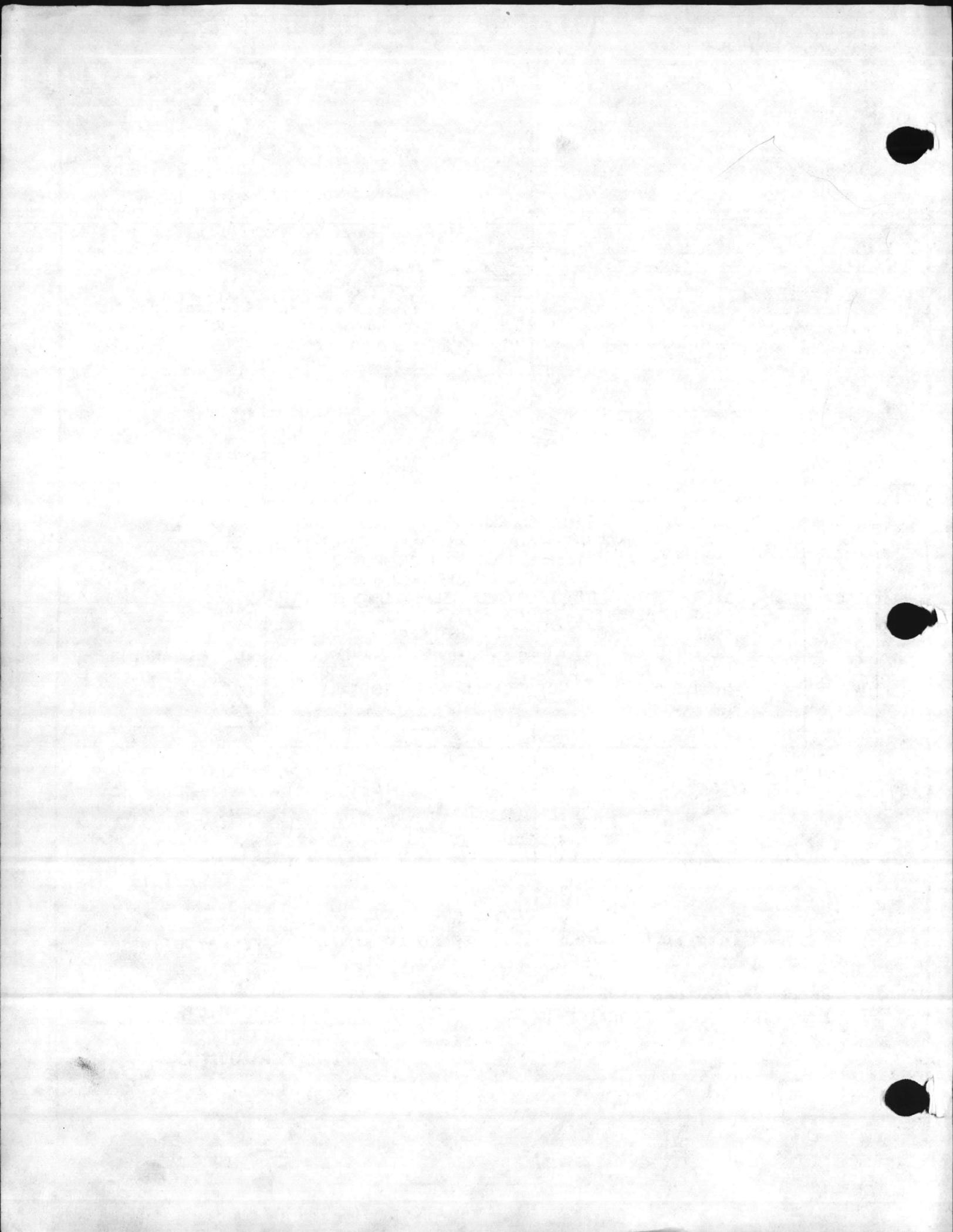




NOTE: REFER TO B/M FOR SIZE & QUANTITY OF INTERNAL FILL.

INTERNAL ASSEMBLY
90" DIA.
PRESSURE FILTER

THE PERMUTIT COMPANY



PERMUTT

OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

INSTALLATION

TESTING STRAINERS & LOADING MEDIA

TESTING STRAINERS: After piping and valve installation has been completed and all valves are closed.

NOTE: The empty filter is to be tested and loaded with media first. Remove the manhole from the empty filter and with a man at the manhole to observe the underdrain system, partially open the inlet backwash valve (F2) on the empty filter to admit water to the bottom of the filter.

MULTIPOINT VALVE (If Supplied): Place in backwash position and slowly open backwash shutoff valve.

NOTE: Whether water comes freely from every strainer. Several trials will be necessary, and after each trial, drain the water from the filter being tested. Any clogged strainers should be thoroughly flushed out.

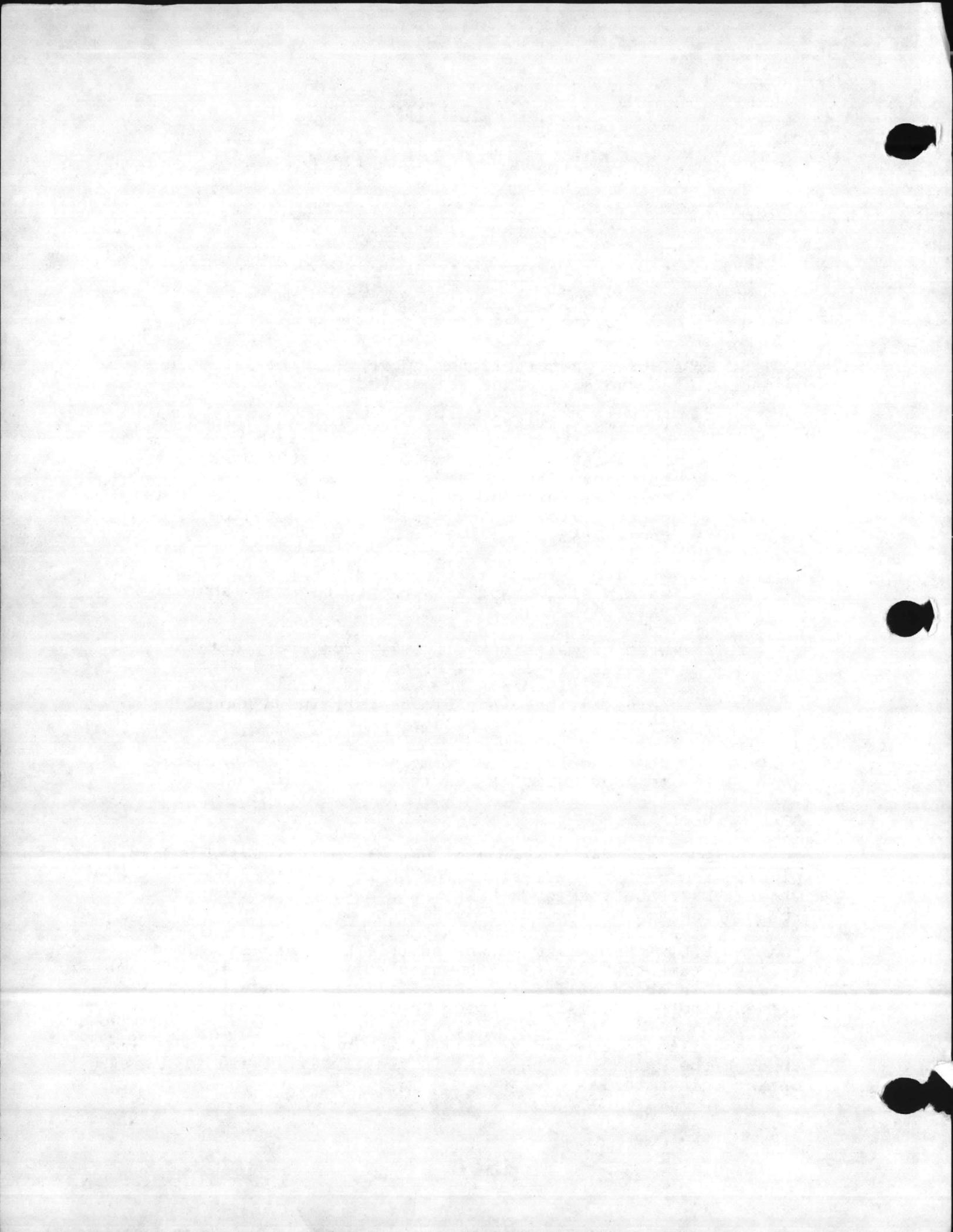
When underdrain system is acceptable, proceed to loading media instructions.

LOADING MEDIA:

LOADING SUBFILL: Each layer must be carefully leveled before placing the next smaller size. As an aid to leveling add water, VERY SLOWLY through bottom of tank, until it just reaches the top of the layer just placed.

LOADING FILTER MEDIA: Once the subfill has been installed, fill the tank VERY SLOWLY with water added through the bottom, until it is about half-full. Slow filling is necessary to prevent the possibility of upsetting the subfill layers.

Add the filter media and subfill to the unit by pouring it in through the manhole. The water in the tank will aid in distributing this material



PERMUTT

OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

INSTALLATION

TESTING STRAINERS & LOADING MEDIA

LOADING FILTER MEDIA: (CONTINUED)

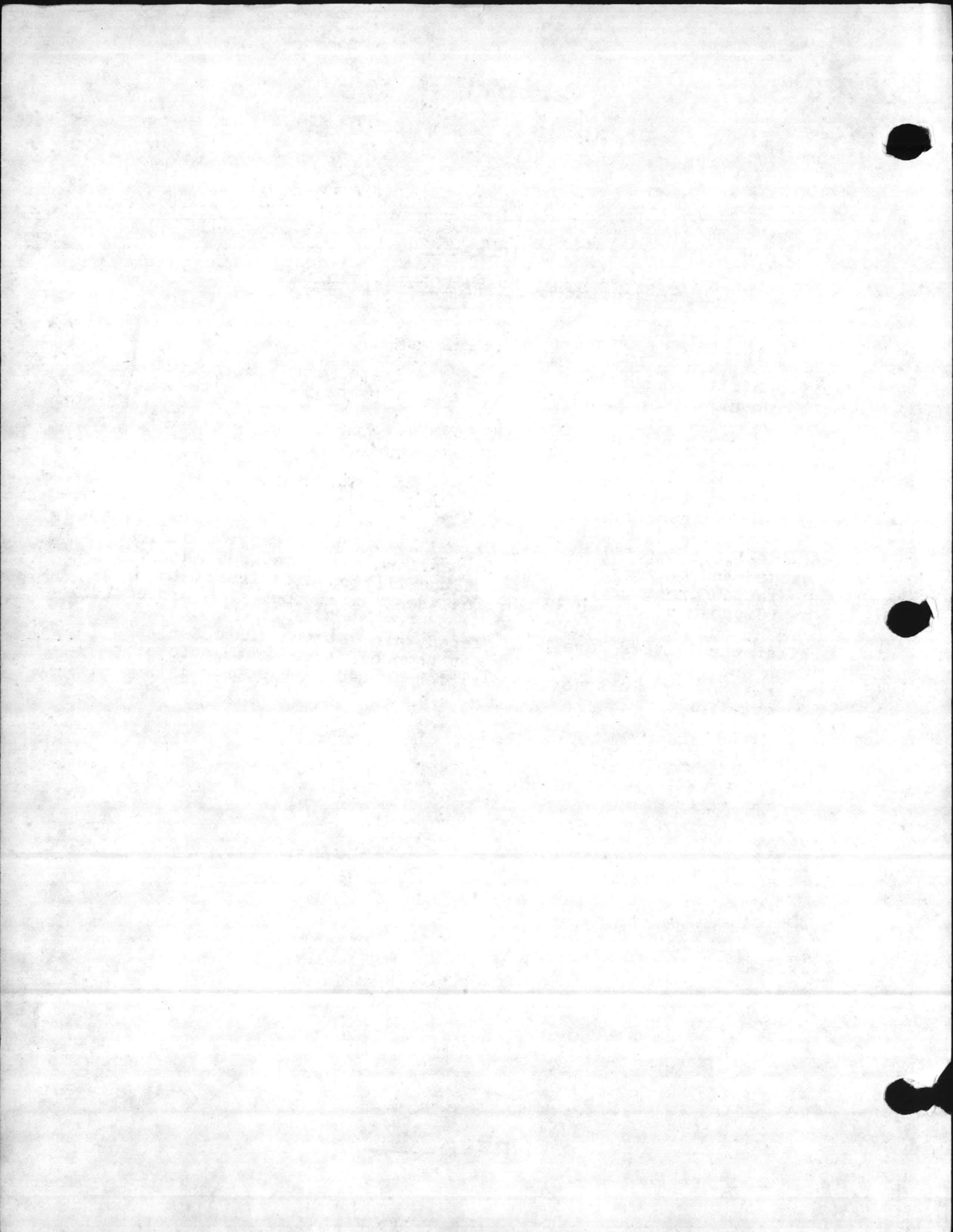
If subfill is not required, load the filter media directly on the double dish, after filling tank about half-full with water.

After this has been done, replace the manhole, and proceed with a backwash, (see manual operation procedure).

After the first filter has been tested, loaded with media and backwashed; repeat the above procedure, for the next filter.

When all of the filters are tested, loaded with media and backwashed the battery is ready for a rinse sequence, (see manual operation procedure). Once all the filters are rinsed, the battery can be placed in service, (see manual operation procedure).

After the filters have been placed into service (Rate Set) has been set, the filter battery can then be placed into automatic operation, (see automatic operation procedure electrical description).



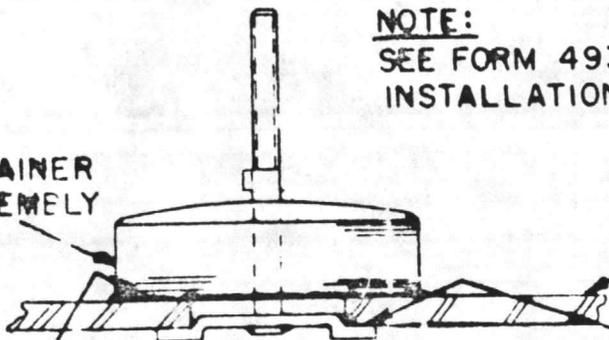
NOTE:
SEE FORM 4938 FOR
INSTALLATION INSTRUCTIONS

**TOLERANCE ON DIMENSIONS
NOT OTHERWISE SPECIFIED**

DECIMAL	±.005
FRACTIONAL	±1/64
ANGULAR	±1°

STRAINER
ASSEMBLY

STRAINER R.

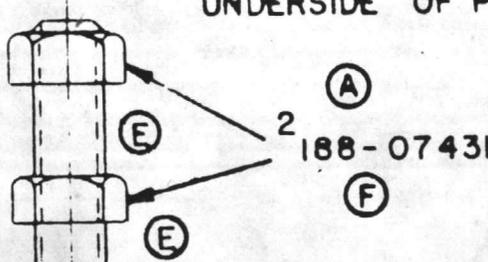


TYPICAL INSTALLATION
IN STRAINER PLATE

INSTALL TEE-BAR AT ASSEMBLY
AS REQUIRED TO CLEAR ANY
WELD PROTRUDING FROM
UNDERSIDE OF PLATE

TOP OF PLATE UNDER STRAINER
ASS'Y. MUST BE FLAT AND
FREE OF WELD SPLATTER

(A)



(A)

(E)

2

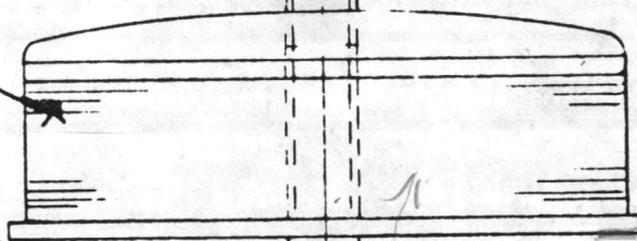
188-07431

(F)

(E)

(C)

103-33908



102-34592

(F)

PAGE 9

MATERIAL REQD

- 1. 103-33908 SCREEN STACK ASSEMBLY #310
- (F) 1. 102-34592 S.S. SCREEN STUD
- (F) 2. 188-07431 3/8-16^{FF} 316 S.S. NUT

F	12-4-62	3197F
E	10-3-62	3307A
D	7-10-61	3141B
C	12-1-60	3141
B	8-30-60	3071
A	6-29-60	3040
-	3-31-60	2960
NO.	DATE	REASON

REVISIONS

**STRAINER ASSEMBLY
12 DIETS**

THE PERMITT COMPANY

SCALE FULL DATE 1-12-60
102-33600

STANDARDS

CHECKED
M.H.M.
MADE

22 10/10

22

11 11 11 11 11

OPERATING INSTRUCTIONS

DUAL MEDIA FILTER

OPERATION

GENERAL DESCRIPTION - BACKWASH PROCEDURE

PURPOSE: The filter unit is backwashed periodically to loosen the bed and prevent excessive packing, which would increase pressure losses and might result in channeling and inferior effluent quality. In addition, the backwash will remove suspended matter which may accumulate in the bed and on the surface.

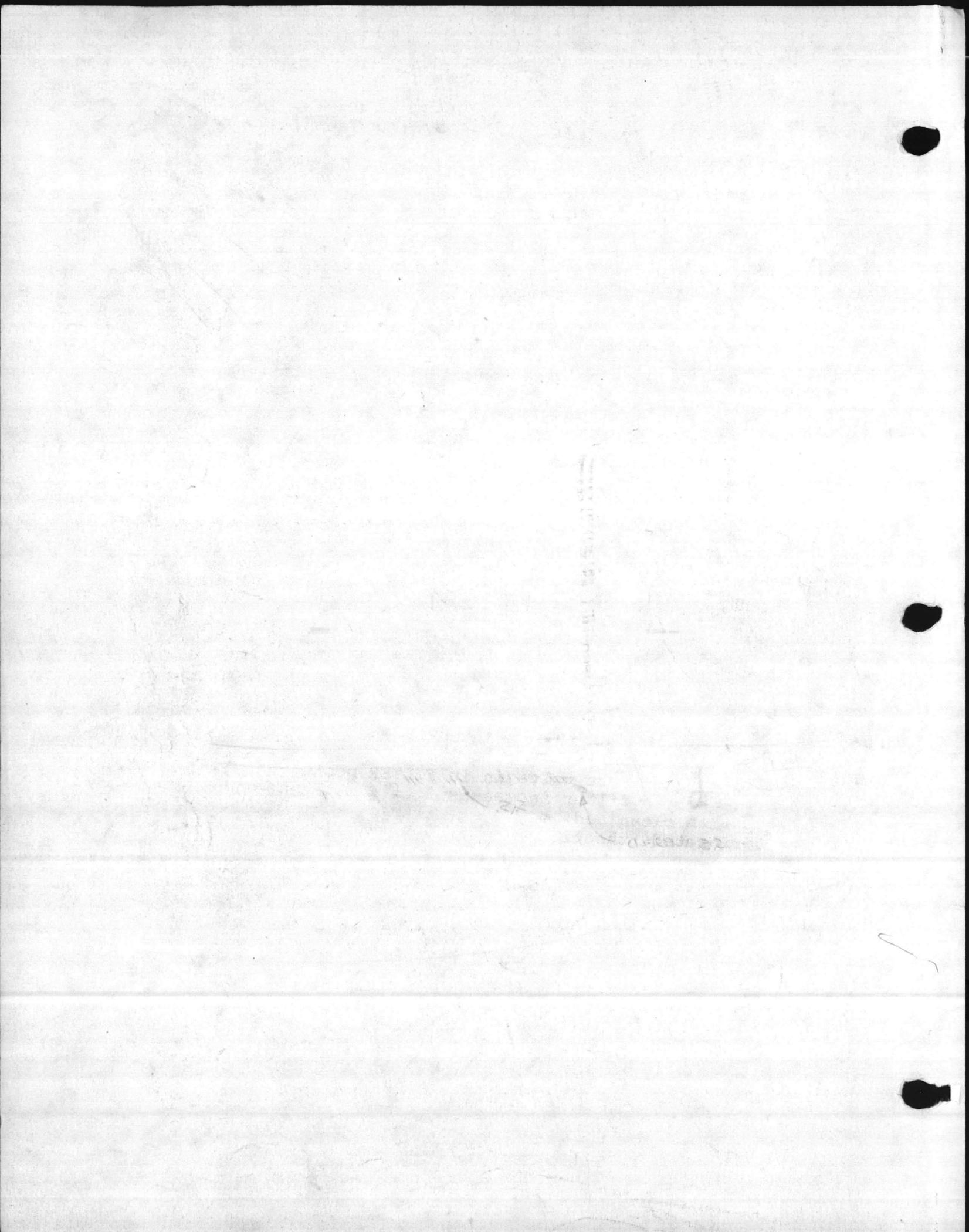
A small amount of "fines" and dust is normally present when a new fill of material is installed. These "fines" will be washed from the unit during the initial backwash, and for perhaps two or three subsequent backwashings. This is both expected and desired; since the continued presence of these "fines" in the unit would increase the possibility of operational problems due to packing or channeling.

It is suggested that a small sample of the normal sized material be set aside when first installed. This sample can then be used to compare with material which may be washing out of the unit.

PROCEDURE: Backwash is accomplished by an upward flow of water to expand the bed and wash out any suspended matter present. Details of the valve operating procedure for backwashing a unit are given elsewhere in the instructions.

MULTIPLE UNIT INSTALLATION: Where two or more units are installed in a "battery" and operate in parallel, they should each be backwashed in succession at approximately the same time (one after another over a period of several hours will usually be satisfactory, if it is inconvenient to wash them in succession). This will ensure that each unit contains approximately the same accumulation of impurities - and that the flow rate will be distributed equally to all units.

FLOW RATES: The flow rate employed during backwash is very important for continued satisfactory operation of the filter units. Too low a wash rate will not produce the desired effect. Too high a wash rate may result in the loss of normal sized particles.



PERMUTT

OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

MULTIPOINT VALVE

OPERATION

MANUAL OPERATING PROCEDURE

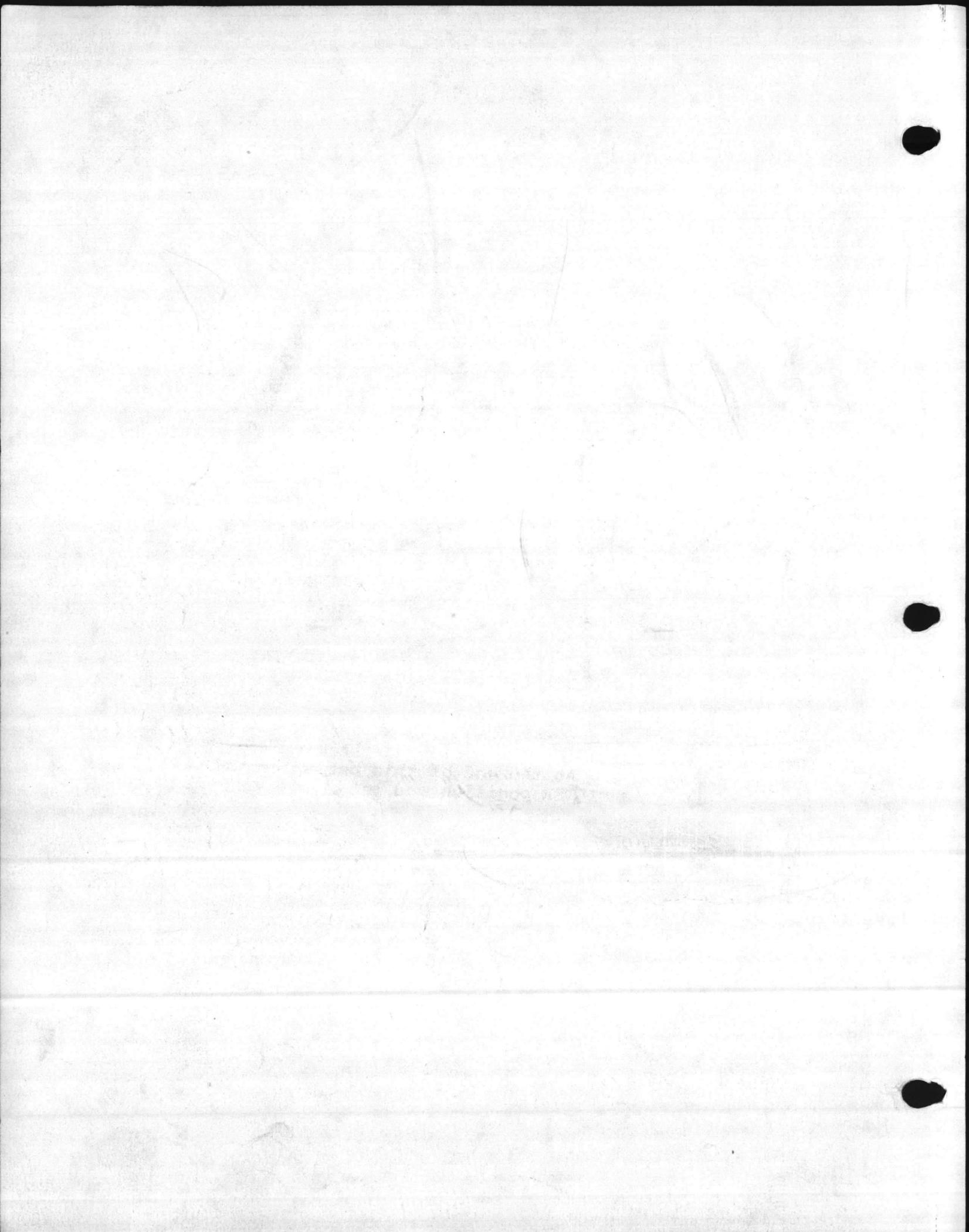
ALWAYS ROTATE THE MULTIPOINT VALVE IN THE DIRECTION INDICATED BY THE ARROW

STARTUP:

1. Fill the tank very slowly through the bottom. Multiport valve is in WASH position and wash inlet shutoff valve is slightly opened. When water discharges from the wash outlet pipe, throttle back on the rate-set valve in this line. Then open wash inlet valve fully, next adjust rate-set valve until the specified WASH RATE is obtained. (See Operating Rates in DATA Section).
2. At completion of wash period, rotate multiport valve to REWASH position. Set the rewash rate by means of the rate controller in the rewash outlet line, using the same procedure as described above for backwash. After 2 or 3 minutes of REWASH at the correct rate, the unit is ready to be placed in service.

SERVICE: Multiport valve is in FILTER position. When pressure drop across a filter increases 5 to 6 psi over normal pressure drop with clean bed, or the quality of the effluent has deteriorated, the filter should be backwashed to clean it.

A carbon purifier should be backwashed at regular intervals (perhaps every 24 to 48 hours) since the pressure loss across this unit normally will not increase as much as it does for a filter. If free chlorine is detected in the effluent of the carbon purifier, the unit should be backwashed.



PERMUTT

OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

MULTIPOINT VALVE

OPERATION

MANUAL OPERATING PROCEDURE

BACKWASH: Rotate multiport valve to the WASH position. Backwash at the specified rate. Continue washing for 8 to 10 minutes, or until backwash outlet water is nearly clear.

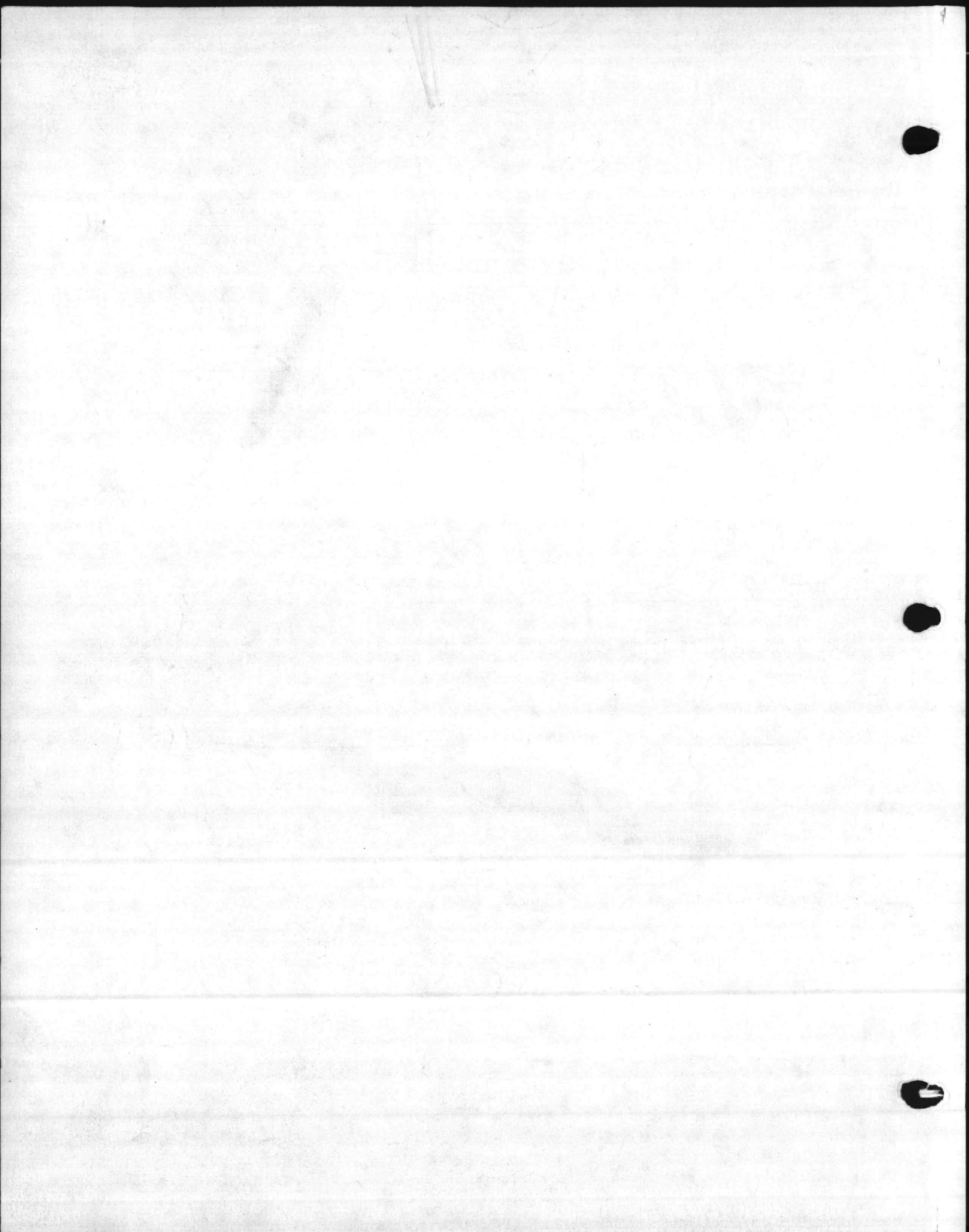
CAUTION:

NOTE: Backwash rate should not be increased beyond 20 percent unless tank is full of water. The strainer system may be damaged or the subfill may be upset.

NOTE: Double dish type underdrain systems usually have no subfill, therefore, bed is not subject to upset. However, backwash flow should always be increased gradually.

REWASH: (Rinse): Rotate multiport valve to the REWASH position, and rewash at the specified rate for approximately 3 minutes. At the end of this period, rotate the valve to the FILTER position and return the unit to service.

NOTE: If the water supply to the filter should fail during the WASH operation, close the inlet shutoff valve to the filter or purifier before restarting the pump. Backwash flow should be increased gradually and sudden surges must be avoided to prevent upsetting the bed.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

OPERATION

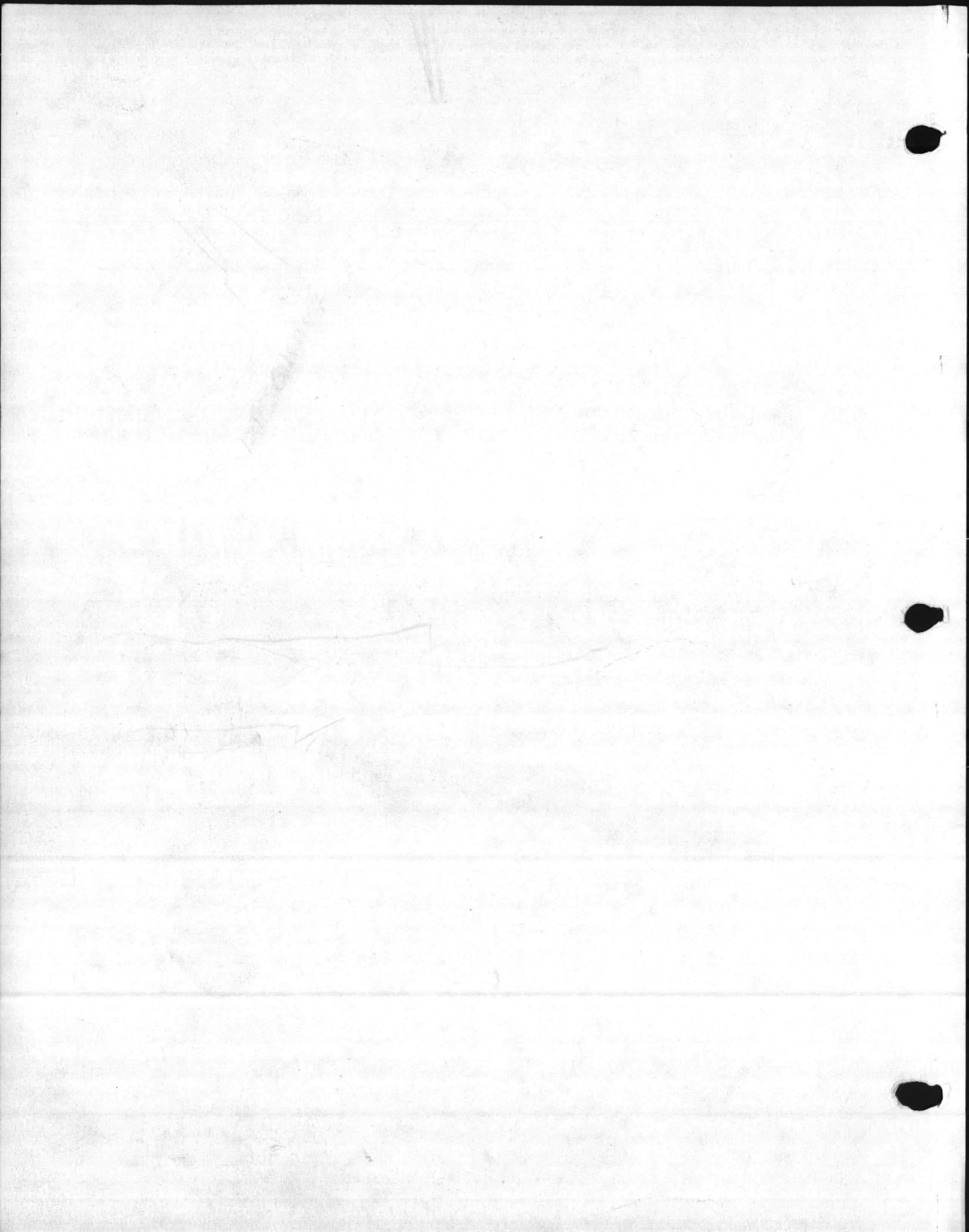
AUTOMATIC OPERATING PROCEDURE

The operation of the filters may be accomplished two ways "manually or semi-automatically" by selecting either mode on panel "Filter Mode Selector" switch. In the "semi-automatic" mode "Start Backwash and Return Filter to Service" pushbuttons control the filter operation. The "manual" position enables use of the following selector switches:

1. Raw Water Inlet Valve
2. Backwash Water Inlet Valve
3. MPV Advance to Wash Position
4. MPV Advance to Rinse Position
5. MPV Advance to Service Position

Before backwashing a vessel the vessel shall be selected on the transfer switch SS-1.

When the selector switch is placed in the "OFF" position all power is off to all timers and controls associated with the filters and softeners.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

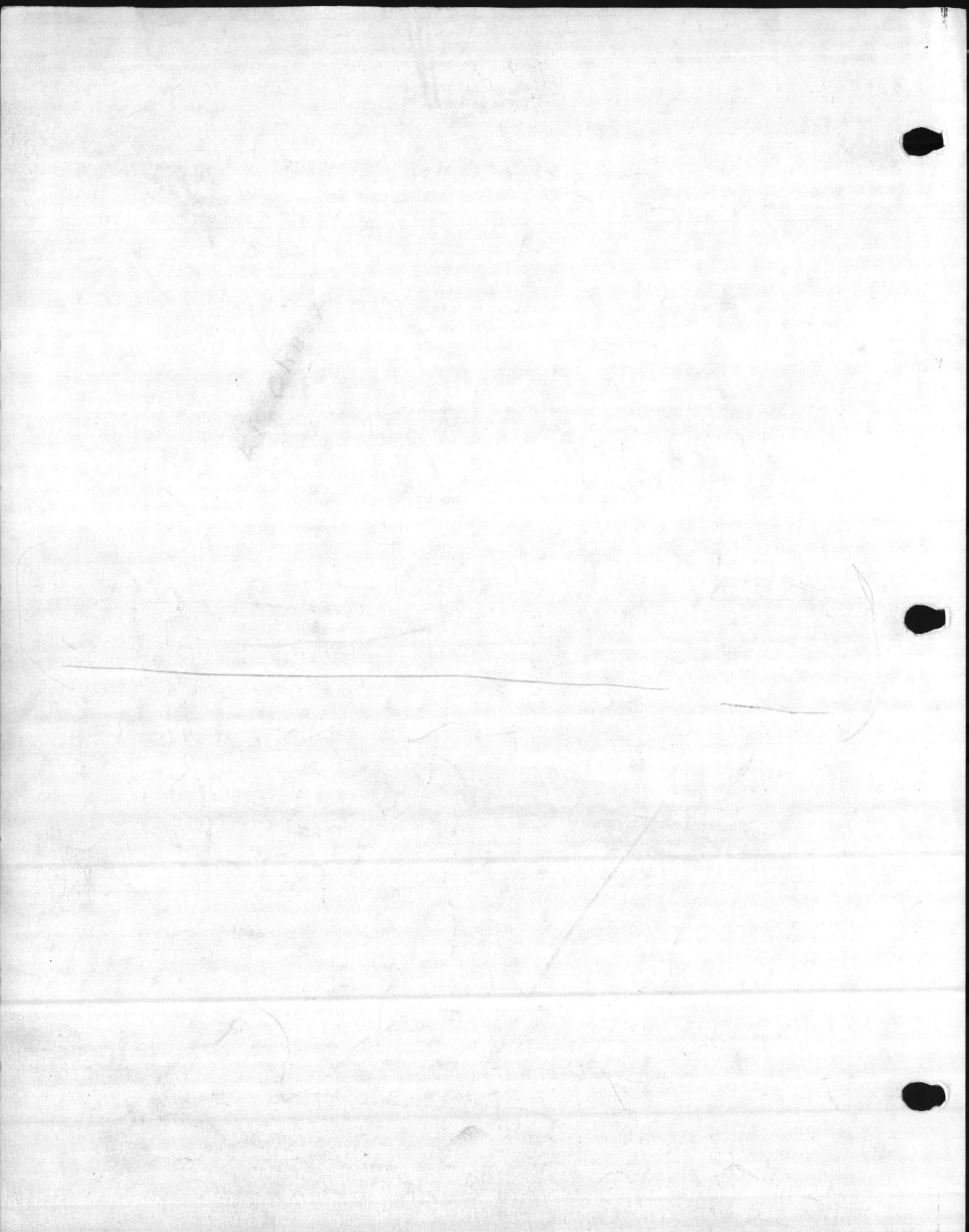
OPERATION

SEMI-AUTOMATIC MODE

Before placing the selector switch in the "semi-automatic" position; ensure that the MPV is in the service position and the raw water pump control switch is in the "auto" position. The service timer starts when in "semi-auto" and the raw water inlet valve opens. The timer will sound an alarm and illuminate a visible light "END OF RUN" when the end of a preset time is reached. The alarm is silenced by depressing pushbutton "Alarm Silence". Select the filter to be backwashed by placing transfer switch SS-1 to the appropriate filter position. Begin backwash by depressing "Start Backwash" pushbutton.

The backwash cycle timer is energized; however a time delay of 90 seconds prevents the operation to begin so that the MPV has rotated fully to the B.W. position and the timer motor seal period has ended. The backwash water inlet valve opens to backwash the media bed for the prescribed time whereupon the timer cam switches S-3 and S-4 moves the MPV into the wash position. Raw water inlet valve opens to provide rinse water to the vessel.

When the filter has completed the B.W. cycle and the MPV has moved to the service position; the unit enters a hold state until placed back into service by depressing the "Return to Service" pushbutton. The raw water inlet valve opens and the filter is in service.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

OPERATION

MANUAL MODE

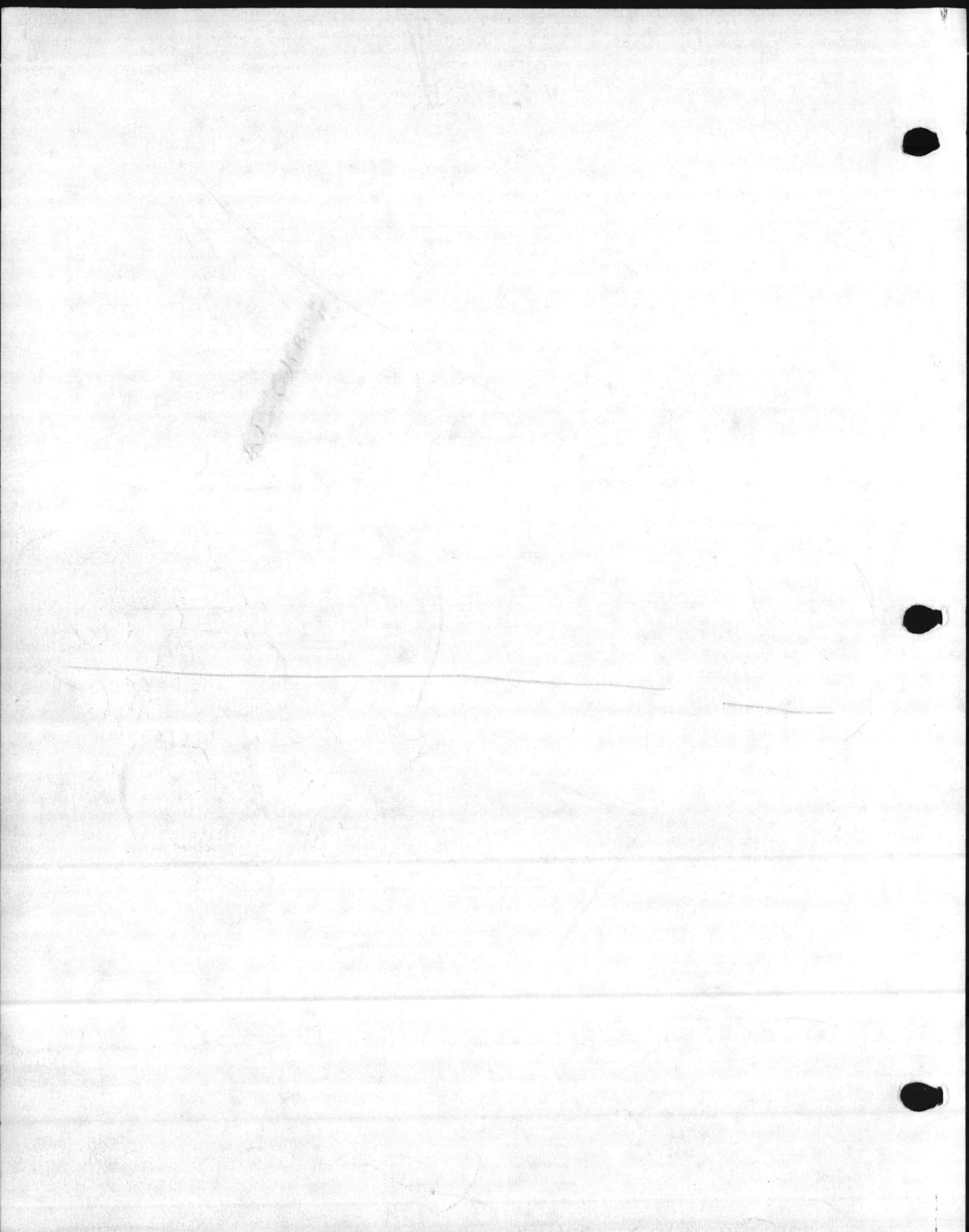
The service timer operates as described in the "Semi-Auto" mode; however the backwash timer is not energized in this mode. The manual mode allows the operator to place the filter through a complete backwash cycle by manipulating the valves and monitoring step times.

The filter is placed on-line by the following actions:

1. Place Filter Mode 2 Selector in "Manual" position.
2. Place transfer switch into Filter No. desired to be backwashed.
3. Place Raw Water Inlet Valve in open position.
4. Place local raw water pump control switch in manual position.
5. Following selector switches must be in "OFF" position:
 - a. MPV Wash Position
 - b. MPV Rinse Position
 - c. MPV Service Position
 - d. Backwash Inlet Valve Switch in "Closed" Position

During the backwash cycle the operator must maintain a watch on the step time to ensure that the time does not radically deviate from the suggested intervals defined in this section.

The cycle shall commence by placing selector switch Raw Water Inlet Valve in the "closed" position. Next, place "MPV Wash Position" selector switch in the "jog" position and release. A relay is energized to rotate the MPV to the B.W. position. After approximately 60 seconds, the MPV will be in position so that placing the backwash water inlet valve selector switch in the "open" position starts the backwashing. The backwash period ends after 10 minutes; thus the valve selector switch is placed in close position. The vessel is in hold until the next step begins by placing the "MPV Rinse Position" switch in the "jog" position and release. The MPV rotates to the rinse position; whereupon the raw water inlet valve selector switch is placed in the "open" position to begin the rinse operation.



OPERATING INSTRUCTIONS

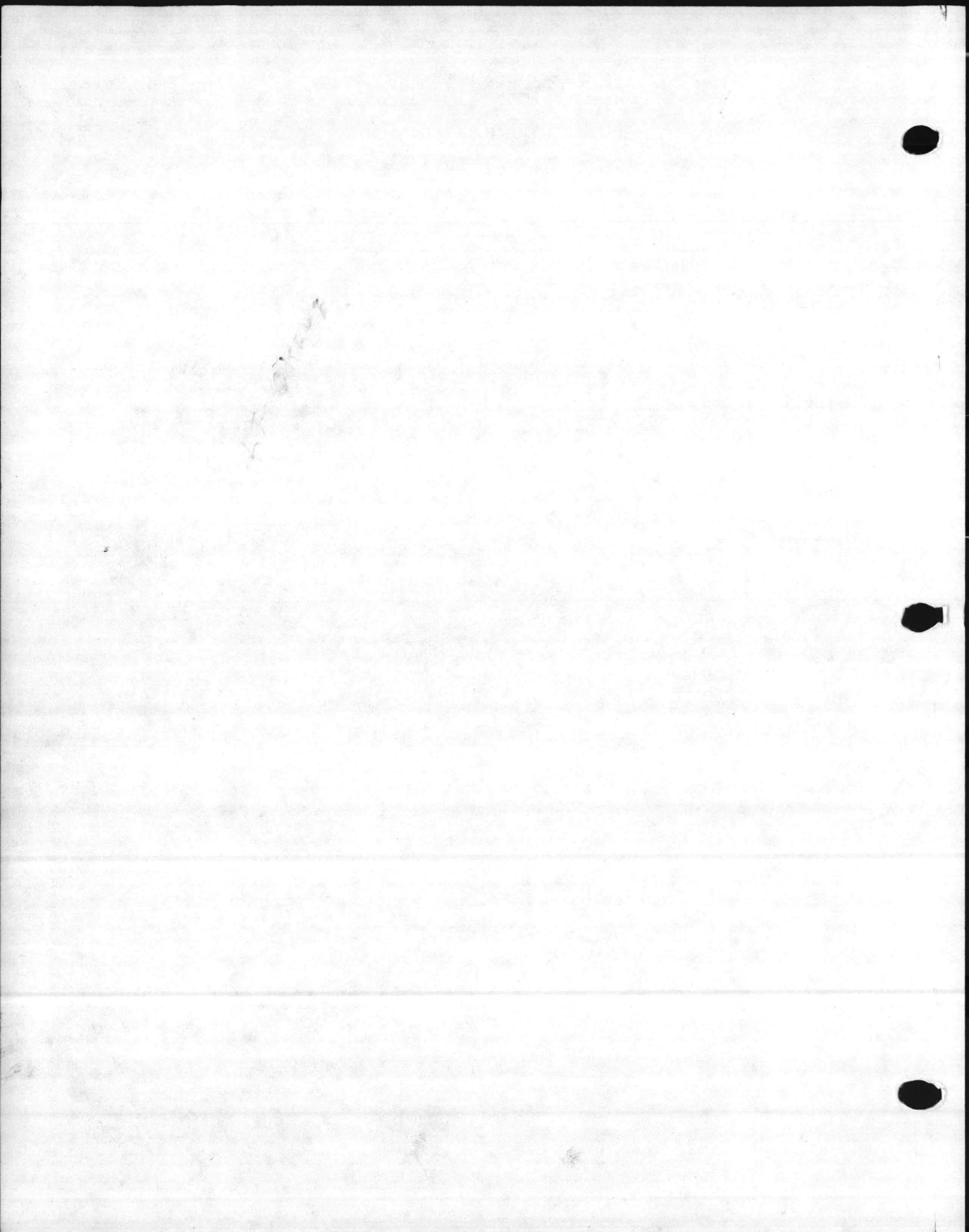
DUAL MEDIA FILTERS

OPERATION

MANUAL MODE (CONT'D.)

After 5 minutes the switch is placed in the "closed" position. The vessel is ready to be returned to service so that the "MPV Service Position" switch shall be placed in the "jog" position to rotate the MPV to service. After 60 seconds, the "Filter Return to Service" is depressed to open the raw water inlet valve. Panel service light is "ON".

Another filter may be backwashed at this time by following the procedure described.



PERMUTTI

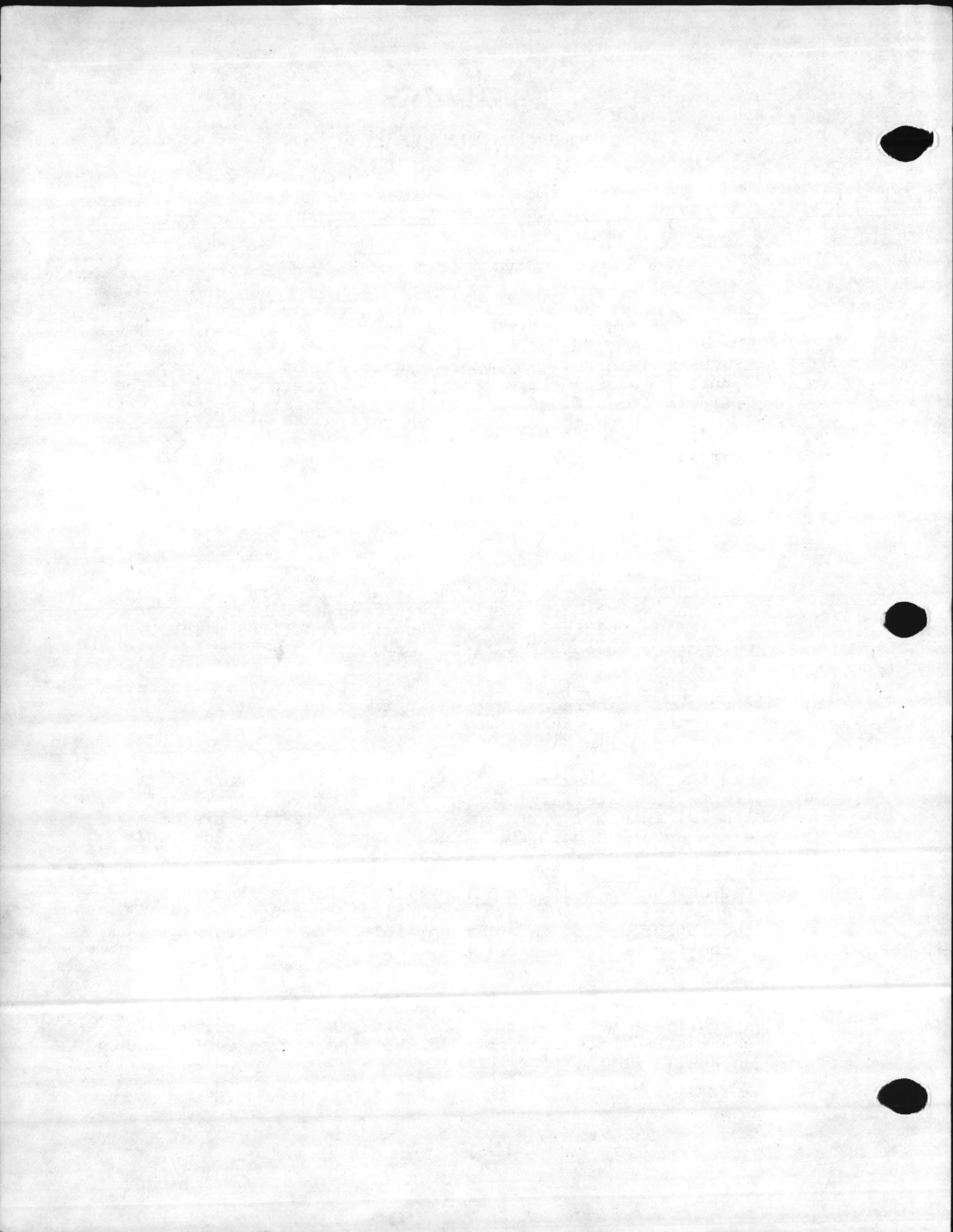
OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

MAINTENANCE

1. Inspect filter internals at least once a year to be sure that no unusual conditions exist.
2. EFFLUENT QUALITY: Improper or careless operation may result in poor quality water in the effluent. Any of the following conditions may result in impurities being forced through the unit, and therefore, should be avoided:
 - (a) Flow Rate greater than maximum rate specified.
 - (b) Sudden changes in flow rate (surges).
 - (c) Backwash not at proper frequency - Unit builds up excessive head loss.
 - (d) Under some circumstances it is necessary that the water be properly coagulated with alum or other chemicals before entering the filters in order to obtain satisfactory results.
3. IDLE PERIODS: If the filter is to stand idle and there is danger of it being subjected to freezing temperature, drain the unit, then remove drain plugs from tank and lowest point in piping.
4. TEMPERATURE: Maximum allowable water temperature is limited by materials of construction of valves, vessel lining, internal parts and/or piping. Temperature of water entering unit should not exceed 100°F unless otherwise specified in DATA Section.
5. CARBON PURIFIER (IF PROVIDED): Chlorine is removed by a chemical reaction with the activated carbon. This chemical reaction is not reversible and, therefore, the Carbo-Dur bed will eventually lose its ability to remove chlorine.

Based on past experience, a fill of Carbo-Dur will last approximately two years. To avoid passing chlorine to the system, it is recommended that the bed be replaced on an annual basis.



OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

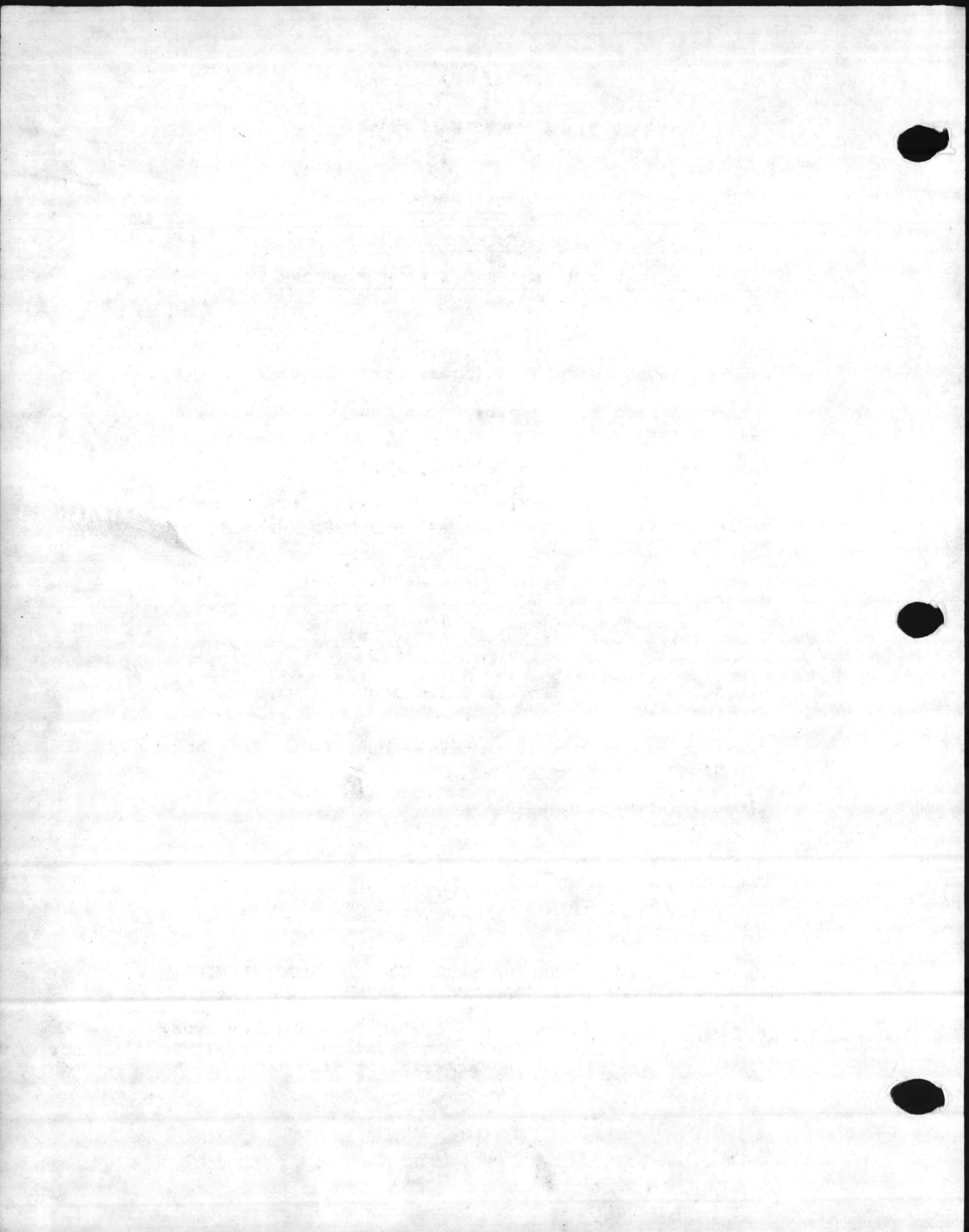
MAINTENANCE

PROCEDURE FOR REMOVING MEDIA FROM PRESSURE VESSEL

1. Depressurize and drain unit.
2. Remove sluice out plug on lower straight side of unit.
3. Connect a hose to the sluice out connection, using an adapter.
4. Position multi-port valve in backwash.
5. Open inlet shut-off valve very slowly, until media begins to flow. Maintain inlet shut-off valve at that setting.
6. Continue sluicing media until water flowing from hose discharge is clear.
7. Close inlet shut-off valve for (2) minutes.
8. Open inlet shut-off valve very slowly, until media begins to flow. Maintain inlet shut-off valve at that setting.
9. Continue sluicing media until water flowing from hose discharge is clear.
10. Close inlet shut-off valve.
11. Drain unit.
12. Open manhole.
13. Using soft bristle brush, remove remaining media from around strainers.

CAUTION: CARE SHOULD BE TAKEN NOT TO DAMAGE LINING WITH HARD SOLED SHOES OR SHARP OBJECTS.

NOTE: For equipment piped with individual valves: use same procedure as above except valves are placed in backwash position.



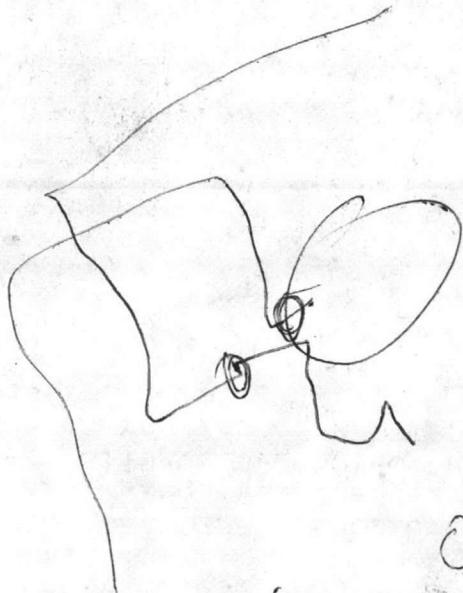
OPERATING INSTRUCTIONS

DUAL MEDIA FILTERS

MAINTENANCE

MULTIPOINT VALVE

1. GENERAL: Water pressure on valve must not exceed maximum operating pressure listed on DATA pages. Keep stuffing gland around valve stem leak tight, but do not tighten gland nut too much. Take valve apart at least once a year to inspect slide and port plate. Coat contact surfaces lightly with silicone lubricant before reassembling.
2. GENERAL LUBRICATION: Check oil in valve case occasionally to keep at level of 1/4" plug on left side of valve. Change oil in gear case every 6 months. Use S.A.E. 90 oil (purchase at service station). In manually operated 2" and 3" valves, use grease (such as Gargoyle AA-3) instead of oil. Do not allow dirt or water to get into gear case.
3. LUBRICATION OF SLIDE: Lubricate slide before valve turns or hard or clatters. Required frequency will depend on operating water pressure. Slide LUBRICATING PROCEDURE and recommended lubricant are given on reverse of MULTIPOINT VALVE PARTS LIST, included with these instructions.



O
R

O
B-W

O
BWP

O
RP

O
S

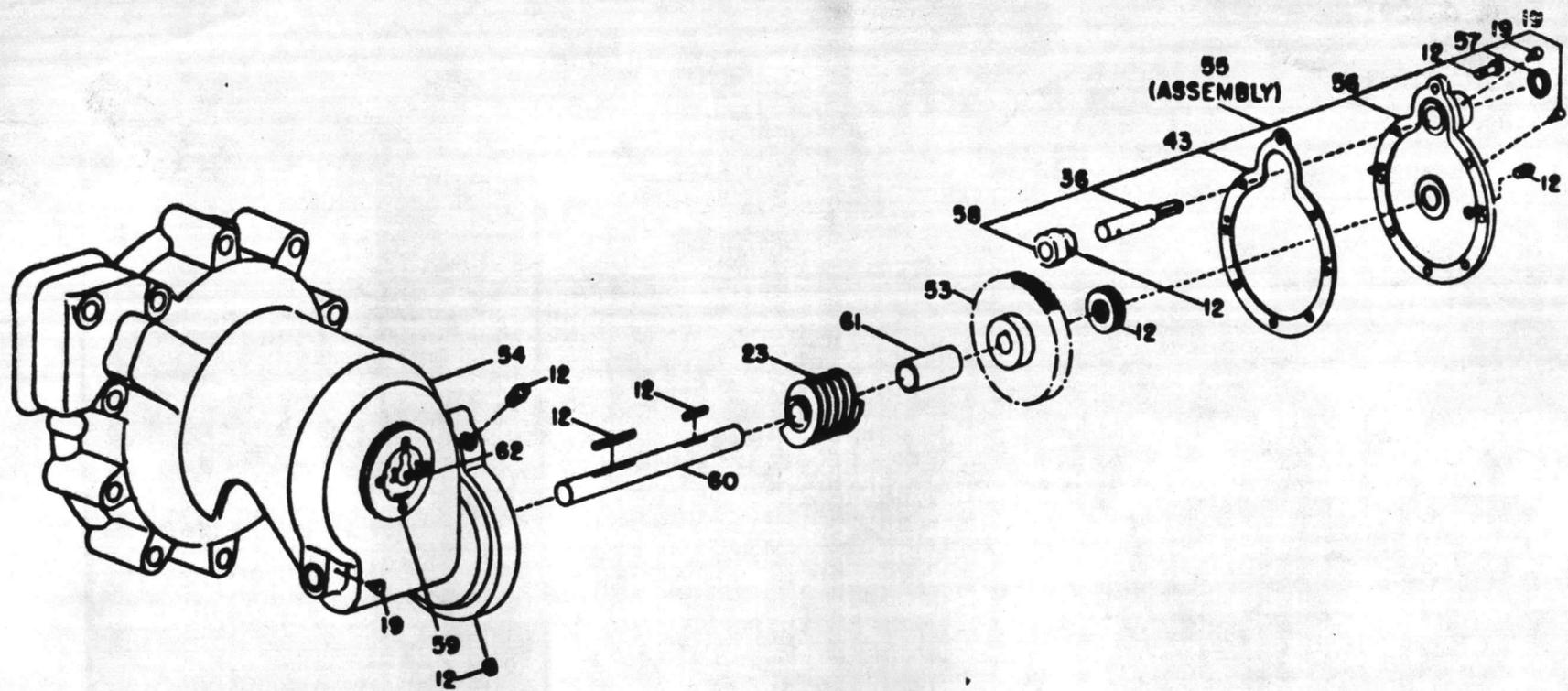


Fig. 2 - PERMUTIT MANUAL MULTIPORT VALVE - 3", 4" and 6"

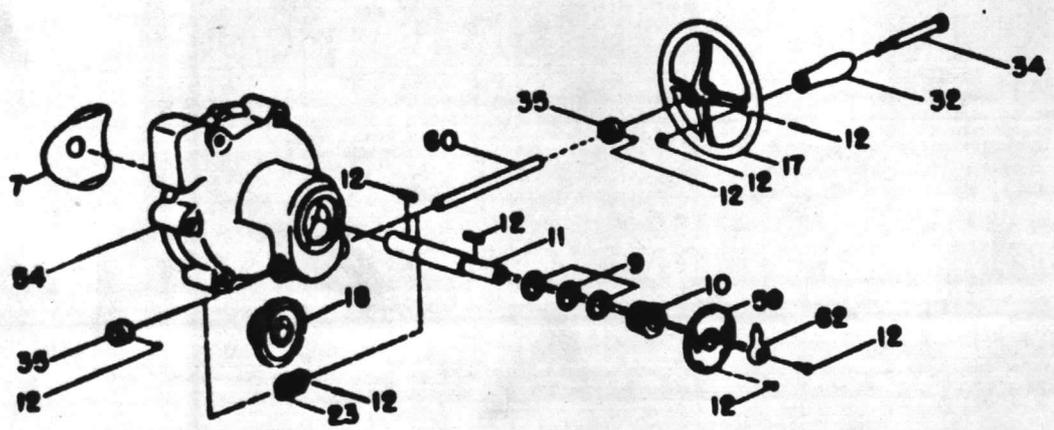


Fig. 3 - PERMUTIT MANUAL MULTIPORT VALVE - 2"

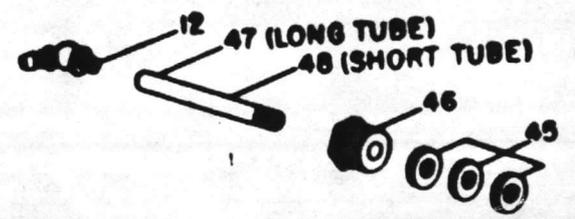


Fig. 4 - Grease Tube Assembly

INDUSTRIAL MULTI-PORT VALVE PARTS LIST DESIGN 5

PART NO.	SHOWN IN FIG.	PART NAME
1A	1	BODY
1B	1	BODY (PLASTISOL LINED)
* 2	1	BONNET AND GEAR CAGE GASKET
3	1	PORT PLATE GASKET
* 4A	1	PORT PLATE AND GASKET ASSEMBLY (BRONZE)***
* 4B	1	PORT PLATE AND GASKET ASSEMBLY (STAINLESS STEEL)
* 4C	1	PORT PLATE AND GASKET ASSEMBLY (MONEL)***
* 5	1	PORT PLATE SCREWS (SFT)
* 6A	1	SLIDE ASSEMBLY (HARD RUBBER FACED)
* 6B	1	SLIDE ASSEMBLY (PLASTISOL) P.V.C. FACED
* 6C	1	SLIDE ASSEMBLY (PLASTISOL COVERED)
* 6D	1	SLIDE ASSEMBLY HIGH TEMP. 160° (FORMICA)
* 6E	1	SLIDE ASSEMBLY HIGH TEMP. 250° (BRONZE)
7A	1 & 3	SLIDE SPRING (BRONZE)
7B	1 & 3	SLIDE SPRING (STAINLESS STEEL)
7C	1 & 3	SLIDE SPRING (MONEL)
8A	1	BONNET AND GEAR CAGE ASSEMBLY (AUTOMATIC VALVE)
8B	1	BONNET AND GEAR CAGE ASSEMBLY (PLASTISOL LINED)
* 9	1 & 3	RING PACKING FOR SLIDE SHAFT (SET OF 3)
10	1 & 3	PACKING NUT FOR SLIDE SHAFT
11A	1 & 3	SLIDE SHAFT (STAINLESS STEEL)
11B	1 & 3	SLIDE SHAFT FOR HIGH PRESSURE VALVE (S.S.)
12	ALL	STANDARD PART, CAN BE PROCURED LOCALLY
13	1	MOTOR SUPPORT
14	1	MOTOR-SEND NAMEPLATE INFORMATION
15	1	CAP SCREWS (SET)
16	1	INSTRUCTION PLATE
17	3	HAND WHEEL
18A	1 & 3	SLIDE SHAFT WORM GEAR
18B	1 & 3	SLIDE SHAFT WORM GEAR (FOR HIGH PRESSURE)
19	1 & 2	OIL HOLE COVER (FOR CROSS SHAFT)
20	1	OIL HOLE COVER (FOR DRIVE SHAFT)
21	1	SLIDE SHAFT BEARING ASSEMBLY
22	1	BALL THRUST BEARING
23	1, 2 & 3	CROSS SHAFT WORM
24	1	CROSS SHAFT (AUTOMATIC VALVE)
25	1	MOTOR COUPLING, DRIVING HALF
26	1	MOTOR COUPLING, DRIVEN HALF
27	1	CLUTCH SPRING
28	1	CLUTCH, SLIDE HALF
29	1	CLUTCH, DRIVE HALF
30	1	CROSS SHAFT WORM WHEEL
31	1	END BEARING ASSEMBLY
32	3	HAND WHEEL GRIP (ONLY ON 2" UNIT)
33	1	END BEARING GASKET
34	3	SHOULDER SCREW
35	3	SET COLLAR
36	2	CRANK SHAFT
37	1	SPACER
38	1	DRIVE SHAFT WITH WORM
39	1	DRIVE SHAFT
40	1	BALL THRUST BEARING
41	1	DRIVE SHAFT BEARING GASKET
42	1	DRIVE SHAFT BEARING ASSEMBLY
43	2	GEAR COVER GASKET
44	1	CRANK
45	4	PACKING RINGS FOR GREASE TUBES (SET OF 3)
46	4	PACKING NUT FOR GREASE TUBES
47	4	GREASE TUBES (ALEMITE) (LONG)
48	4	GREASE TUBES (ALEMITE) (SHORT)
49	-	PRESSURE GAUGE PIPING FLANGE (FOR LINED VALVE)**
50	-	PRESSURE GAUGE PIPING FLANGE GASKET (FOR LINED VALVE)**
51	-	EJECTOR FLANGE (FOR LINED VALVE)**
52	-	EJECTOR FLANGE GASKET (FOR LINED VALVE)**
53	2	CROSS SHAFT SPUR GEAR
54A	2 & 3	BONNET AND GEAR CAGE ASSEMBLY (MANUAL VALVE)
54B	2 & 3	BONNET AND GEAR CAGE ASSEMBLY (FOR LINED VALVE)
55	2	CRANK SHAFT AND GEAR COVER ASSEMBLY
56	2	GEAR COVER ASSEMBLY
57	2	COLLAR
58	2	PINION
59	2 & 3	DIAL PLATE
60	2 & 3	CROSS SHAFT
61	2	SPACER
62	2 & 3	POINTER
63	-	VALVE PACKING RETAINER (FOR LINED VALVE)**
64	-	VALVE PACKING RING (FOR LINED VALVE)**
65	-	MOTOR SHAFT BEARING**
*66	-	GASKET CEMENT (B/M 6573)
+187-02738	-	SILICONE LUBRICANT 8 OZ.

* RECOMMENDED SPARE PARTS ** NOT SHOWN ON DRAWING *** ALL PORT PLATES ARE SHIPPED WITH GASKET ATTACHED. PLASTISOL LINED VALVES HAVE NO PORT PLATE GASKET.

NOTE: SPECIFY FLANGED OR SCREW TYPE FOR 2" VALVES. ALL OTHER FLANGED ONLY. WHEN ORDERING PARTS ALWAYS SUPPLY VALVE SIZE AND PERMIT JOB NUMBER OF ORIGINAL INSTALLATION. ORDERS FOR ALL DESIGN 5 MULTI-PORT VALVES STARTING WITH SERIAL NO. 15120 MUST ALSO INCLUDE THE B/M NUMBER FOLLOWING THE SERIAL NUMBER IN THE INSTRUCTION PLATE. FOLLOW INSTRUCTIONS ON FRONT PAGE.

OPERATING INSTRUCTIONS

for WATER CONDITIONING EQUIPMENT

Date FEBRUARY, 1985

Job No. A141E39857

Prepared for MARINE BASE

CAMP LEJEUNE, NORTH CAROLINA

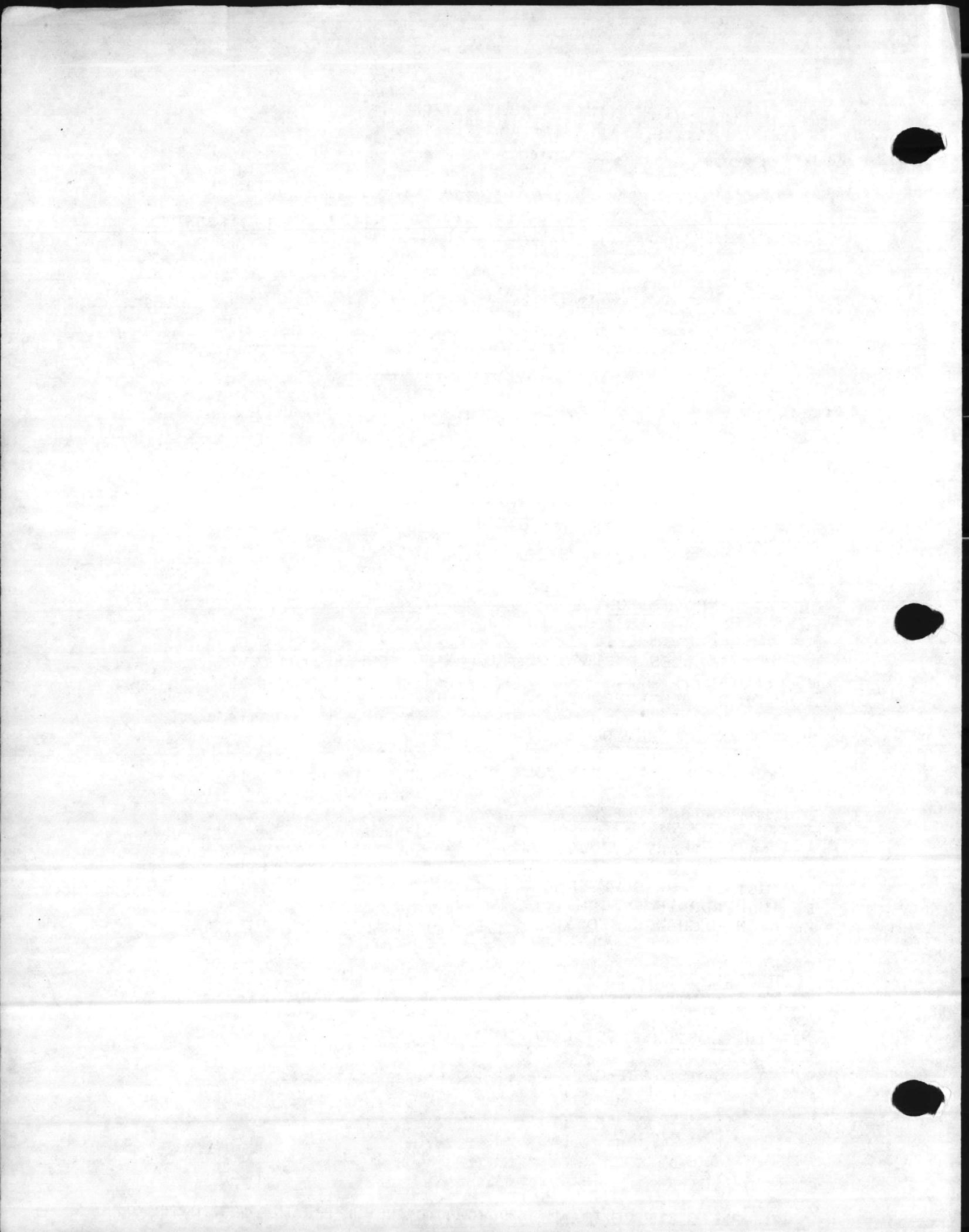
SECTION A

WATER SOFTENERS

PART II

TABLE OF CONTENTS

	<u>PAGE</u>
I. <u>GENERAL INFORMATION:</u>	
A. INTRODUCTION.....	1
B. GENERAL DESCRIPTION OF SOFTENING PROCESS.....	2-3
C. MEDIA.....	4
D. ION EXCHANGE PROCESS.....	5-7
II. <u>DESIGN AND OPERATING DATA:</u>	
A. OPERATING DATA FOR YOUR MODEL.....	8-9
III. <u>EQUIPMENT INSTALLATION:</u>	
A. PRELIMINARY.....	10-11
B. FOUNDATION.....	12
C. SET-UP PRESSURE TANK & OTHER SYSTEM EQUIPMENT.....	12
D. UNDERDRAIN SYSTEM.....	12
E. ION EXCHANGE MEDIA.....	13
IV. <u>OPERATION:</u>	
A. DESCRIPTION OF OPERATION.....	14
V. <u>PLACING SOFTENER IN OPERATION:</u>	
A. INITIAL START-UP.....	15-16



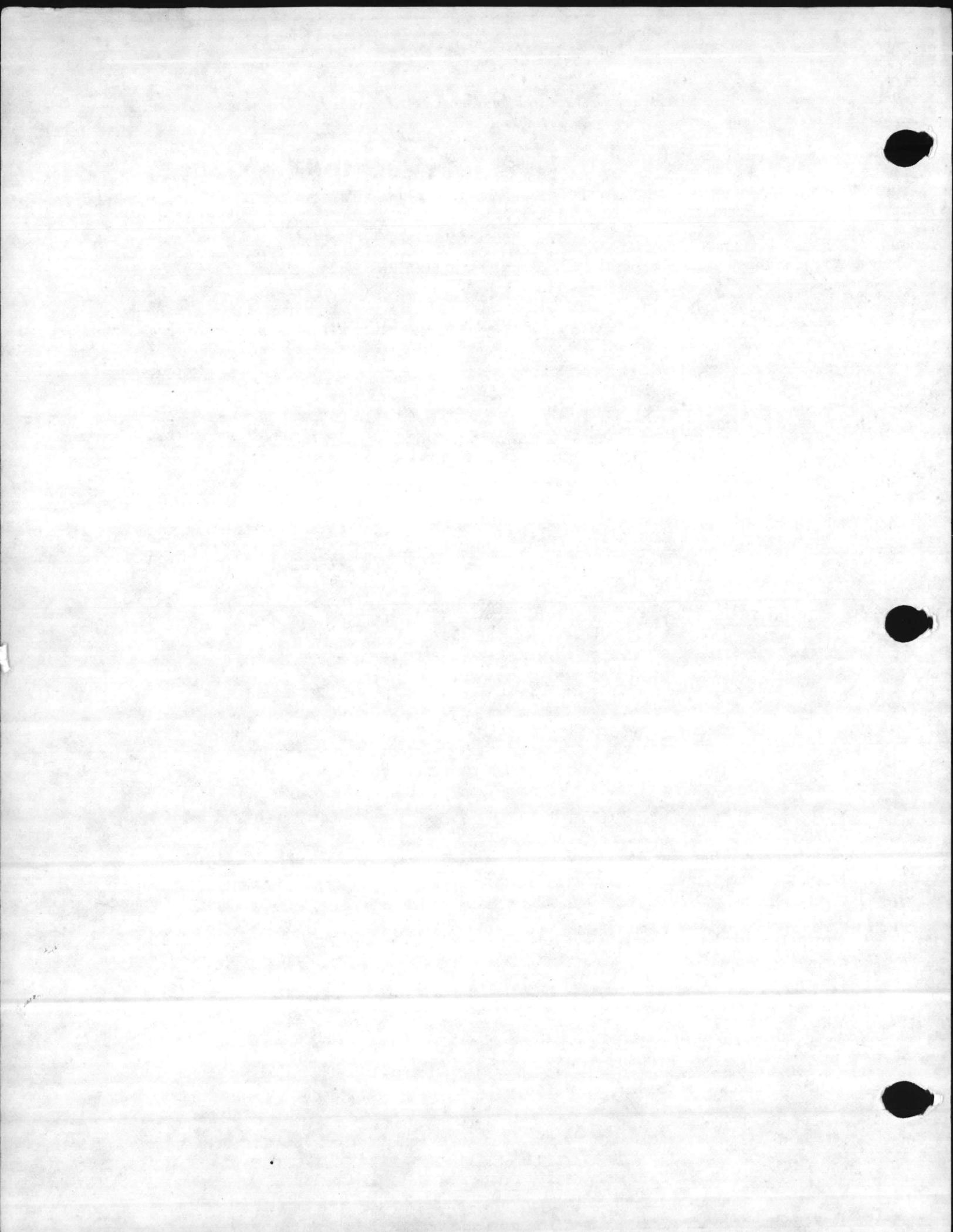
OPERATING INSTRUCTIONS

SECTION A

WATER SOFTENERS

TABLE OF CONTENTS (CONT'D.)

	<u>PAGE</u>
VI. <u>MAINTENANCE</u> :.....	17-18
A. SALT SPECIFICATIONS.....	19
VII. <u>DIAGRAMS</u> :	
INTERNAL ASSEMBLY.....	20
INLET-OUTLET DRAIN ORIENTATION.....	21
VIII. <u>CHEMICAL TEST FOR QUALITY CONTROL</u> :.....	22-23



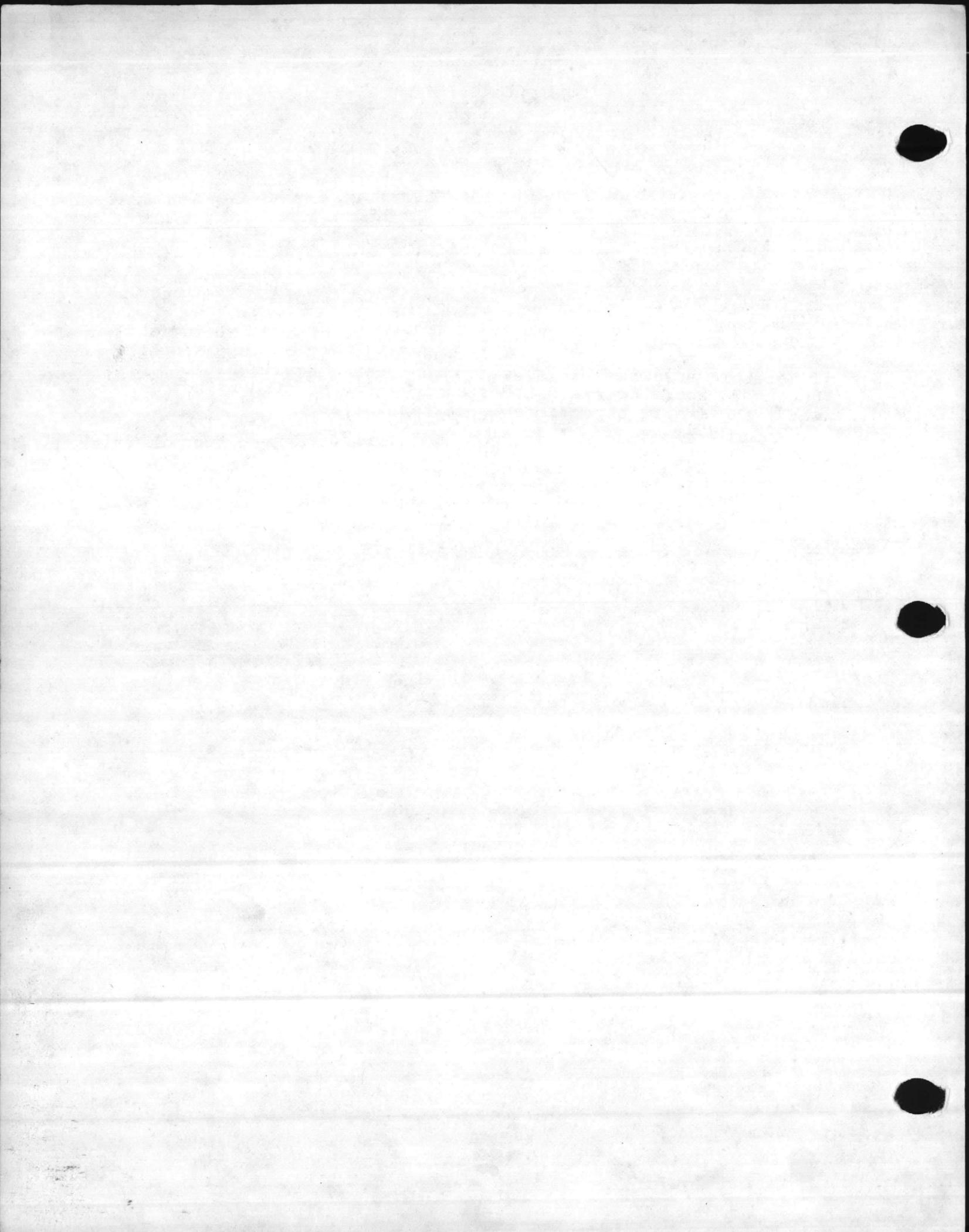
OPERATING INSTRUCTIONS

I. GENERAL INFORMATION

A. INTRODUCTION:

The most common impurities found in the water are calcium and magnesium ions commonly known as hardness. These are also the least tolerable impurities since they cause scaling in boilers, household appliances and other equipment contacted by hot water and impart objectionable tastes for food.

The Permutit pressure ion exchange softener removes such impurities and produces softened water of superior quality to find its use in varied applications such as laundries, hospitals, homes, canneries, restaurants, breweries, etc.



OPERATING INSTRUCTIONS

I. GENERAL INFORMATION

B. GENERAL DESCRIPTION OF SOFTENING PROCESS:

A pressure ion exchange water softener is a vertical cylindrical steel pressure tank containing a bed of softening media (resin) to remove impurities, mainly hardness (calcium and magnesium) from a pressurized water supply. Since softened water is under pressure, re-pumping to the point of use is eliminated.

Service:

The raw water (water to be softened) enters at the top of the tank under pressure. It is distributed downward through the upper inlet distributor/backwash collector assembly and downward through the softening media. The softened water is collected at the bottom of the unit by means of the lower outlet collector/backwash distributor assembly. This lower assembly is covered with a layered gravel subfill for optimum collection and distribution of water.

Regeneration Cycle:

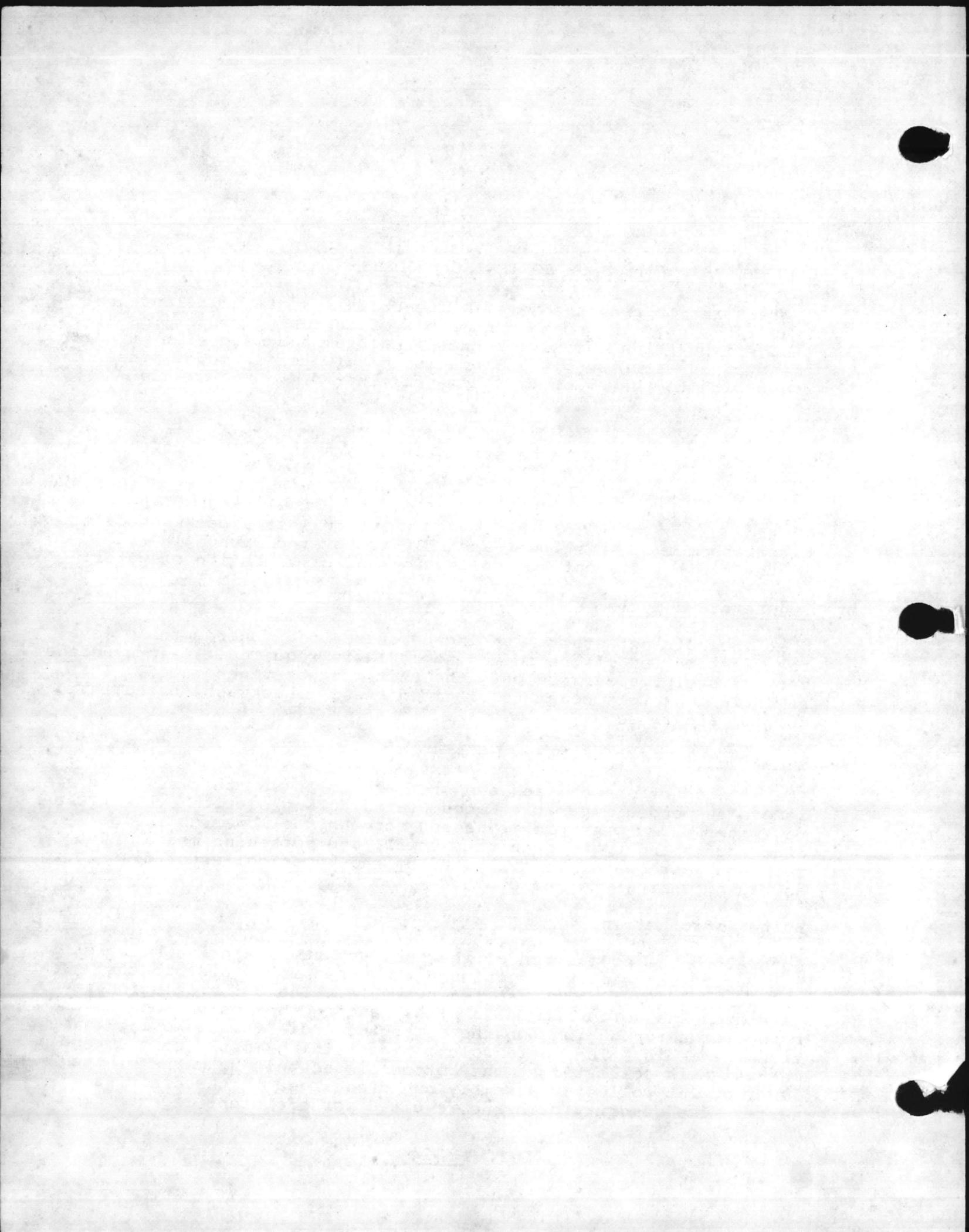
When the softener starts leaking hardness to an unacceptable level, the regeneration of the softening media is required. Before another service cycle is carried out, the unit must be regenerated. The regeneration cycle consists of timed steps - backwash, brine introduction and rinse.

Backwash:

The main functions of backwash step are to loosen the media and remove suspended impurities accumulated during service cycle. The raw water under pressure is passed through the lower collector/distributor and up through the subfill and softening media. The backwash waste water is collected by the upper collector/distributor and is discharged to the drain.

Brine Introduction:

Soon after the completion of the backwash step, a brine solution is introduced under pressure through the upper inlet distributor assembly and downward through the softening media. The brine solution regenerates the softening media by exchanging the sodium ions in the brine for hardness ions on the softening media thus removing them from the media. The waste solution containing mostly calcium and magnesium is collected at the bottom of the unit by means of the lower outlet collector assembly and discharged to the drain as waste. The quantity of brine required for efficient regeneration



OPERATING INSTRUCTIONS

I. GENERAL INFORMATION

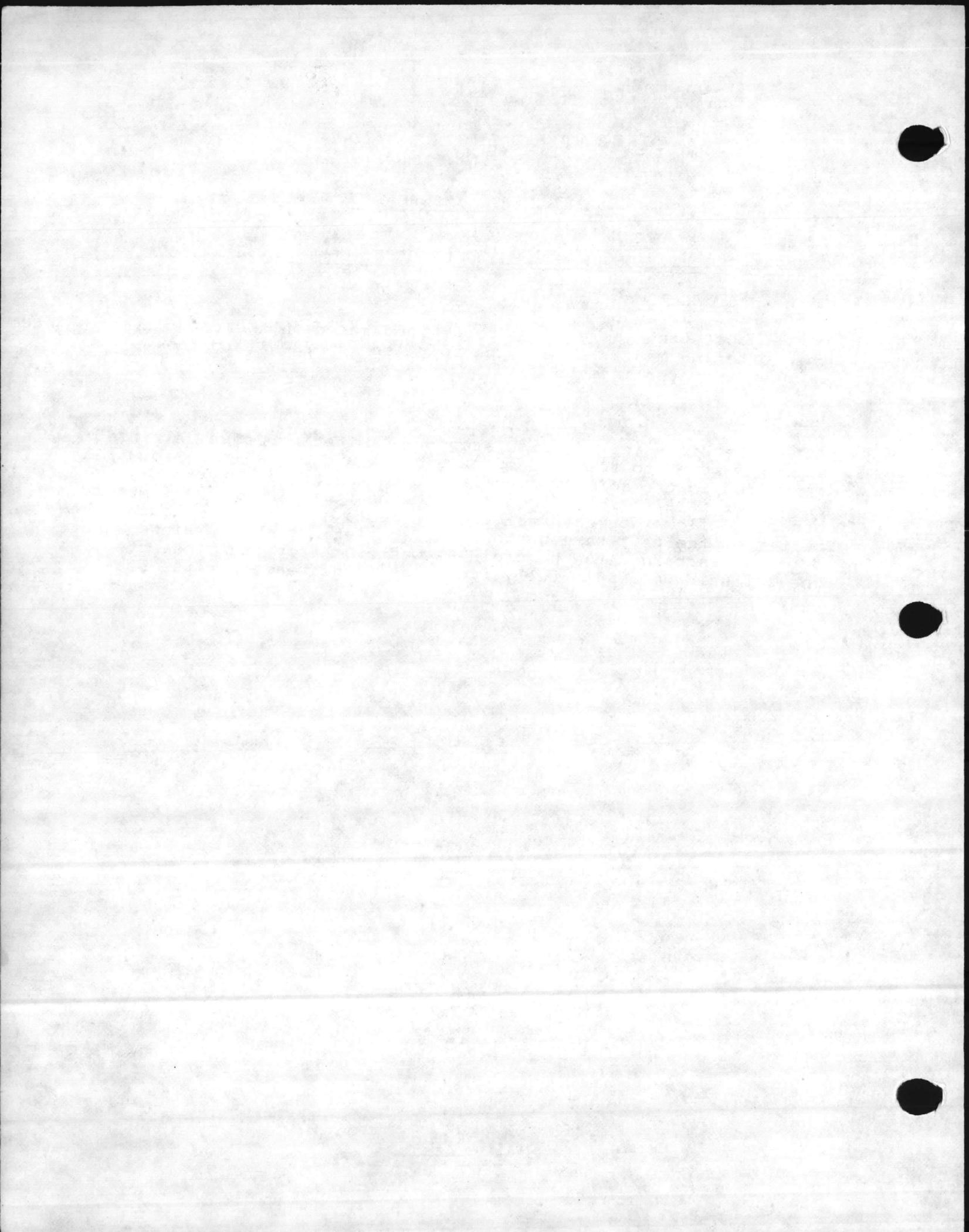
B. GENERAL DESCRIPTION OF SOFTENING PROCESS (CONT'D.):

Brine Introduction (Cont'd.):

of the softening media is predetermined based on the capacity of the softening media. The brine solution is drawn into the unit by a water operated injector.

Rinse:

After the brine introduction step, the softening media is rinsed with raw water to remove remaining brine and brine waste solution contained in the softening media. Like the brine solution, rinse raw water is also introduced through the upper inlet distributor assembly, flows downward through the media and is collected at the bottom of the unit through the lower outlet assembly. Rinse water is also discharged to the drain as waste. After the rinse step, the softening media is fully regenerated and ready for the subsequent service run.



OPERATING INSTRUCTIONS

I. GENERAL INFORMATION

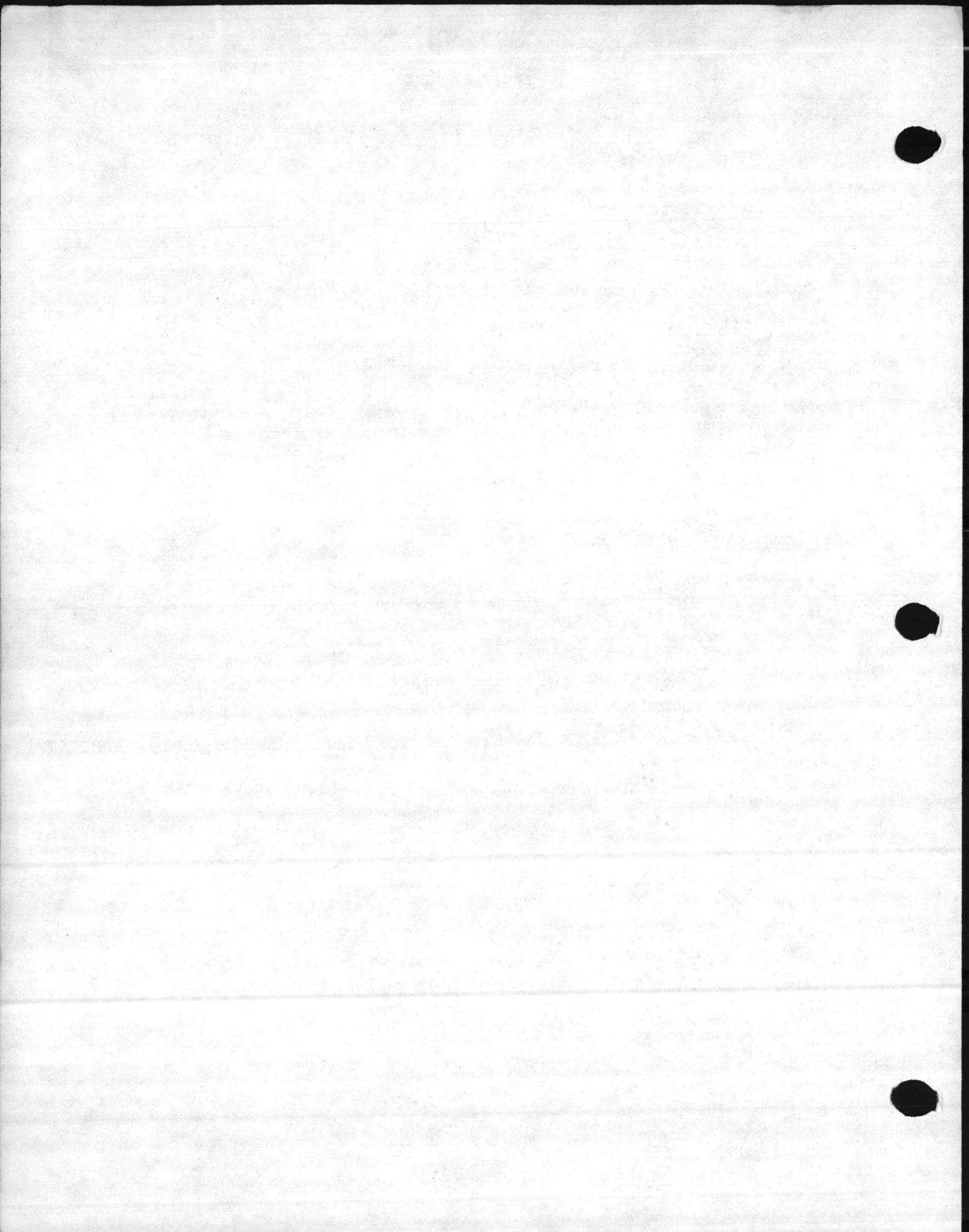
C. MEDIA:

Permutit Q is a premium grade, synthetic, gelular, strong acid, cation exchange resin with an established record of performance. It is produced in the form of hard, spherical beads and is supplied in the sodium form. The resin is sulfonated polystyrene with a standard crosslinkage of 8% divinylbenzene by weight.

The extremely high capacity and stability of Permutit Q permits its use for industrial, municipal and household softening of water. Its ability to withstand high temperatures without experiencing any adverse effects, makes it suitable for softening hot water.

Limitations on Water Being Treated:

pH Range of Influent.....	0-14
Maximum Allowable Operating Temperature	
Waters without Oxygen (Deaerated).....	280°F
Waters With Oxygen (Saturated).....	130°F
Maximum Turbidity of Influent Water.....	5JTU
Maximum Iron in Influent Water.....	CONSULT PERMUTIT
Maximum H ₂ S in Influent Water.....	0.5 mg/l
Maximum Cl ₂ in Influent Water.....	0.5 mg/l
Raw Water Hardness Range.....	ALL HARDNESS



I. GENERAL INFORMATION

D. ION EXCHANGE PROCESS

In order to understand what happens in the ion exchange softening process, it will first be necessary to understand the meaning of the terms which are used in the explanation. **HARD WATER**, **CATION EXCHANGER**, and **BRINE** are therefore defined below and then used to show how the ion exchange process works.

Hard Water

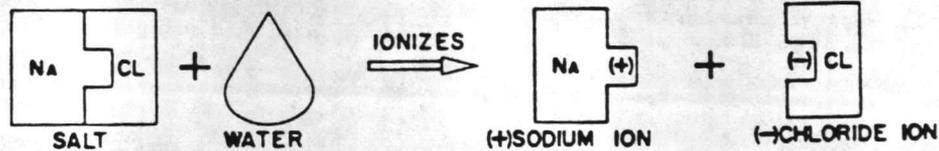
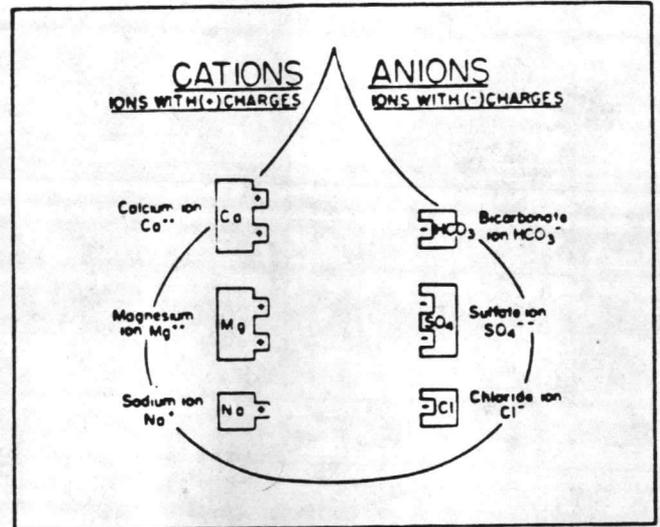
All natural waters contain much the same dissolved impurities, but in widely varying amounts.

There are always enough ANIONS present to balance the CATIONS, but anions have no effect on the ion exchange softening process.

Water will be **HARD**, if it contains large amounts of Calcium (Ca^{++}) and/or magnesium (Mg^{++}) ions.

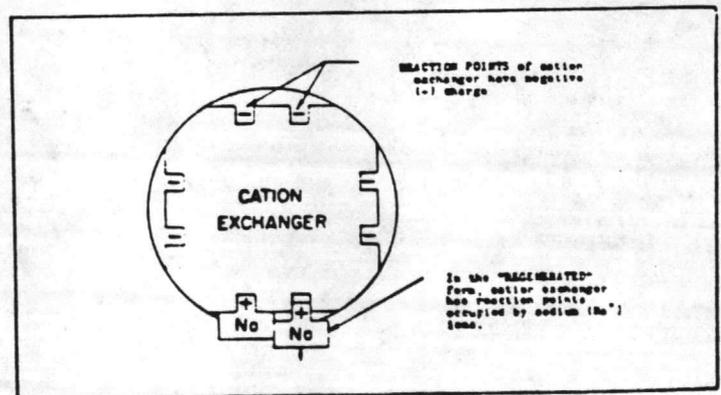
Brine – is water which has **SALT** dissolved in it. **SATURATED** brine contains as much salt as it is possible to hold in solution.

SALT – is **SODIUM CHLORIDE** (NaCl). When dissolved in water it splits up (ionizes) into Sodium (Na^+) ions and Chloride (Cl^-)

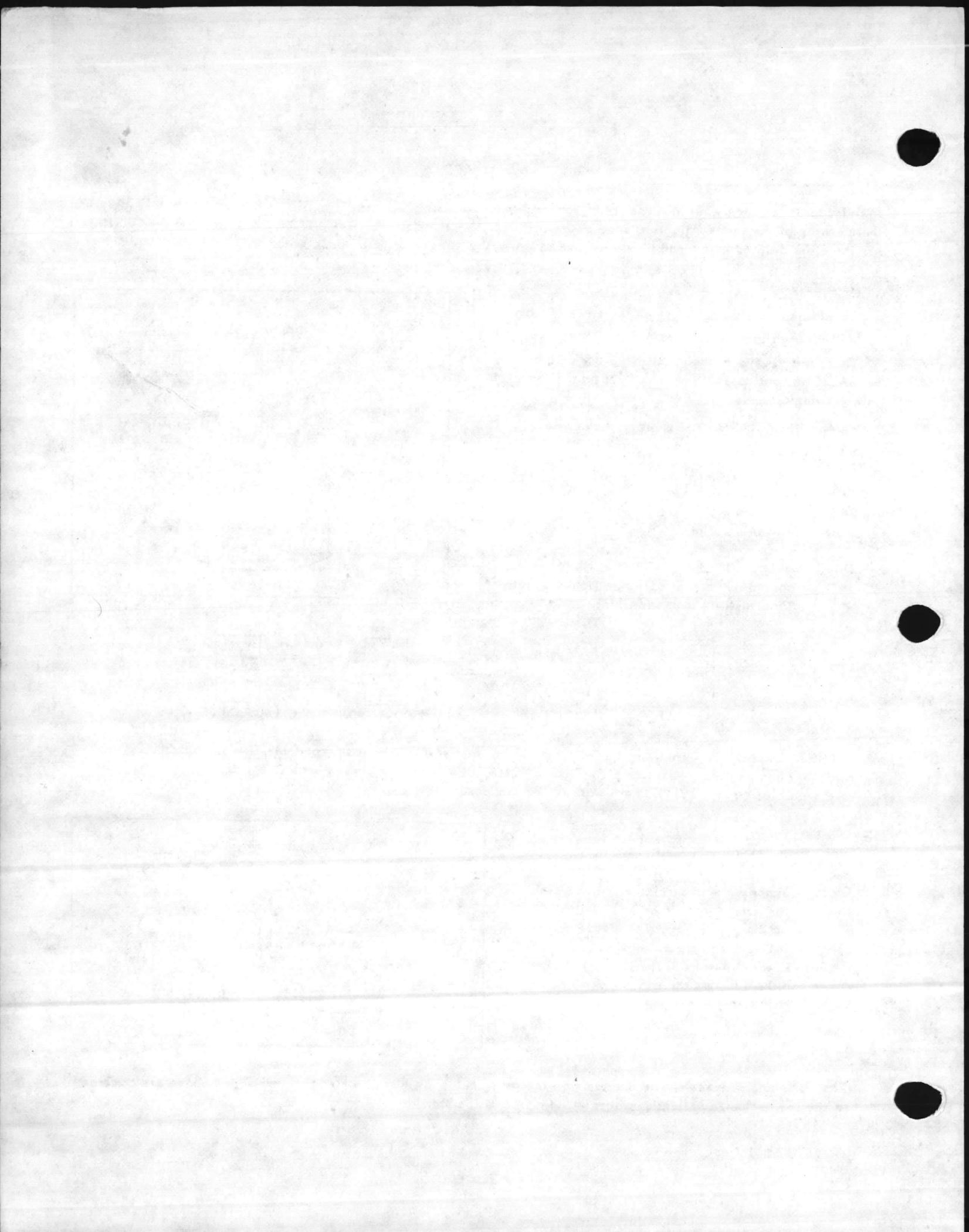


SATURATED BRINE – contains a very great number of Na^+ and Cl^- ions (concentration is over 200,000 ppm). When used to regenerate a **CATION EXCHANGER**, only the Sodium ions (Na^+) are put to use. The Chloride ions (Cl^-) do not work in the process.

Cation Exchanger – is a solid material which has a very large number of "REACTION POINTS". These reaction points have **NEGATIVE (-)** electric charges, and are able to attract and hold **CATIONS**, which are **POSITIVELY (+)** charged,.... (much the same as the way opposite poles of a magnet attract each other.)

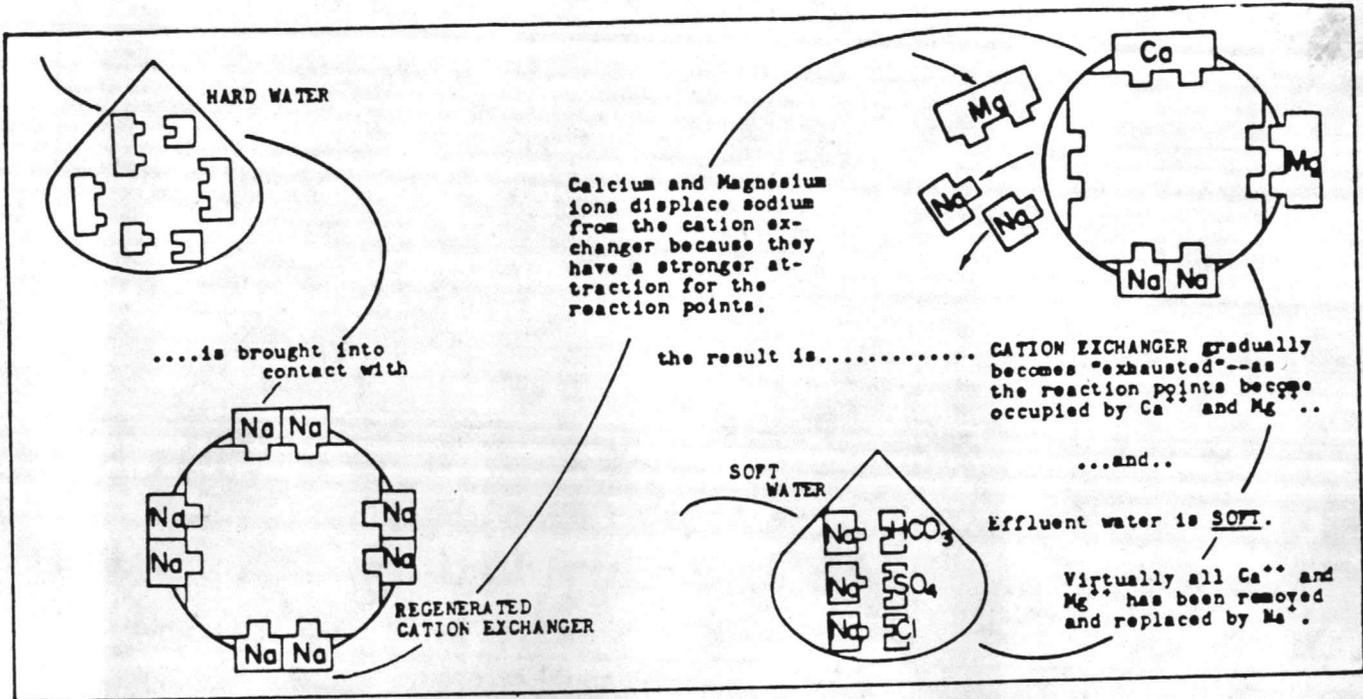


The Softening Process – The diagrams on the next page show how the elements explained above are combined in the ion exchange softening process to produce soft water.



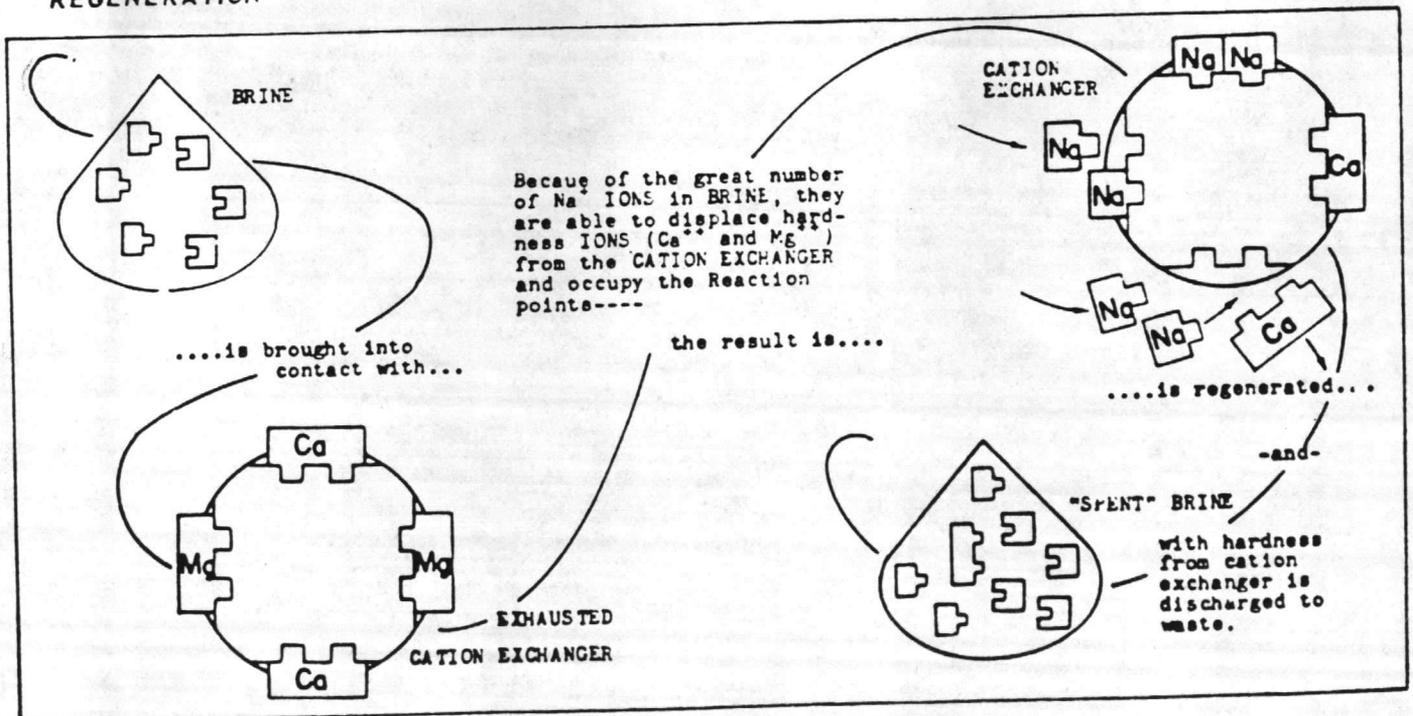
I. GENERAL INFORMATION

D. ION EXCHANGE PROCESS (CONT'D.)

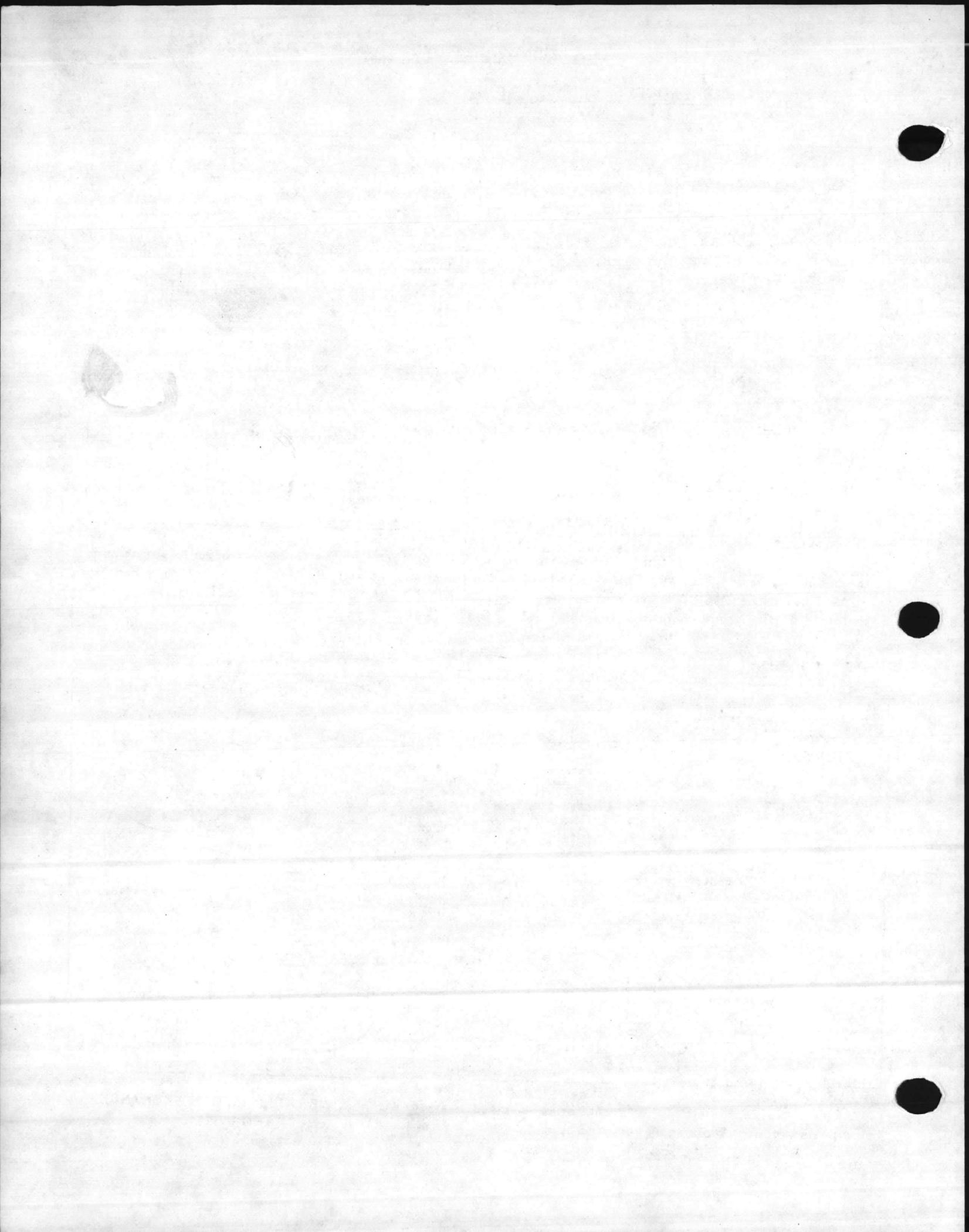


When most of the reaction points have been occupied by Ca^{++} or Mg^{++} ions, hardness will begin to slip through the bed in increasing amounts. This rise in hardness in the effluent is an indication that the effective capacity of the CATION EXCHANGER has been reached. The CATION EXCHANGER must then be regenerated to restore it to its original condition.

REGENERATION



At the end of regeneration, the "spent" brine is rinsed away and the REGENERATED CATION EXCHANGER, with its reaction points again occupied by sodium ions - is again able to soften HARD WATER.



I. GENERAL INFORMATION

D. ION EXCHANGE PROCESS (CONT'D.)

CAPACITY OF ION EXCHANGER

The capacity for the removal of calcium and magnesium depends mainly upon the type of ion exchanger which is used. It is further influenced by the amounts of hardness and sodium ions in the raw water, and by the amount of salt used for regeneration.

- A. *Raw Water* – The effect of the amounts of hardness and sodium ions in the raw water on capacity, is expressed in terms of COMPENSATED HARDNESS.

The hardness of the raw water is considered to be greater than it actually is for capacity determinations, whenever: (a) the total hardness is greater than 400 ppm (as CaCO_3), or (b) the sodium salts are over 100 ppm (as CaCO_3). This "greater-than-actual" hardness is referred to as COMPENSATED HARDNESS, and its value may be calculated using the following formula.

$$\text{PPM COMPENSATED HARDNESS} = \left[\text{PPM ACTUAL HARDNESS} \right] \times \left[\frac{9000}{9000 - \text{PPM TOTAL CATIONS}} \right]$$

(all ppm – as CaCO_3)

- B. *Salt Dosage* – The capacity which will be obtained from a cation exchanger is also determined by the amount of salt used during regeneration. The Kilograins (KGR) of hardness which can be removed by each cubic foot of ion exchanger between regenerations, increases as more salt is used for regeneration.

At the same time, the efficiency of salt usage decreases with the higher regenerant dosages. That is, a greater number of Kilograins of hardness are removed for each pound of salt used at the lower salt dosages, (and consequently, at the lower capacities). Thus, greater economy may be obtained at the expense of the number of gallons of water softened between regenerations. Figure 7 illustrates the effect of salt dosage on capacity and efficiency.

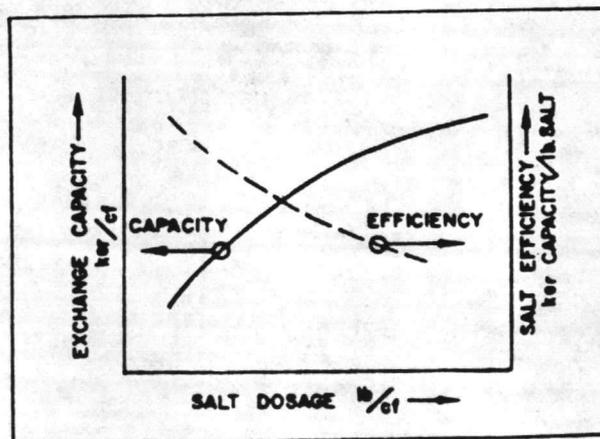


Figure 7

$$882 \times 11.7 = 10,319.4$$

6443.1623

OPERATING INSTRUCTIONS

II. DESIGN AND OPERATING DATA

B. OPERATING DATA FOR YOUR MODEL:

NUMBER OF UNITS.....	<u>FOUR (4)</u>
SIZE (DIAMETER).....	<u>60"</u>
TANK DESIGN PRESSURE.....	<u>100 psi ASME</u>
OPERATION.....	<u>AUTOMATIC & MANUAL</u>
TANK LINING.....	<u>*</u>
OPERATING TEMPERATURE (MAX.).....	<u>100°F</u>
UNDERDRAIN.....	<u>DOUBLE DISH W/316SS STRAINERS</u>
VALVE TYPE.....SIZES.	<u>4" DESIGN #5 MPV</u>
MEDIA.....	<u>PERMUTIT Q-102 RESIN</u>
MEDIA BED VOLUME PERMUTIT..(CU. FT.).....	<u>49</u>
MEDIA SUPPORTING BED.....	<u>NONE</u>
** CAPACITY.....(KILOGRAINS PER CU. FT.).....	<u>18</u>
** (TOTAL KILOGRAINS PER UNIT).....	<u>882</u>
** GALLONS SOFTENED PER CYCLE (HARDNESS <u>11.7</u> GR/GAL)	<u>75,385</u>
BRINE TANK SIZE.....	<u>54" DIA. X 48" HT.</u>
WASH AND RINSE CONTROL.....	<u>RATE SET COCKS</u>

* Two coats LAW AWWA D102-78 Inside Paint System #1.

** Based on average flow rate.

Handwritten calculations:

$\frac{120}{17.1} = \text{GPG}$

$\frac{17.1}{17.1} = \text{GPG}$

$\frac{PPM}{17.1} = \text{GPG}$

$\frac{11.7}{75,385}$

$\frac{7.0175}{100,000}$

1,000,552 0000701

Softeners l/min

BW - 10

ROG - 15 - 38

RINSE - 35

Filters

1501

BW 10

R 5

OPERATING INSTRUCTIONS

II. DESIGN AND OPERATING DATA

B. OPERATING DATA FOR YOUR MODEL:

NUMBER OF UNITS.....	<u>FOUR (4)</u>
SIZE (DIAMETER).....	<u>60"</u>
TANK DESIGN PRESSURE.....	<u>100 psi ASME</u>
OPERATION.....	<u>AUTOMATIC & MANUAL</u>
TANK LINING.....	<u>*</u>
OPERATING TEMPERATURE (MAX.).....	<u>100°F</u>
UNDERDRAIN.....	<u>DOUBLE DISH W/316SS STRAINERS</u>
VALVE TYPE.....SIZES.	<u>4" DESIGN #5 MPV</u>
MEDIA.....	<u>PERMUTIT Q-102 RESIN</u>
MEDIA BED VOLUME PERMUTIT..(CU. FT.).....	<u>49</u>
MEDIA SUPPORTING BED.....	<u>NONE</u>
** CAPACITY.....(KILOGRAINS PER CU. FT.).....	<u>18</u>
** (TOTAL KILOGRAINS PER UNIT).....	<u>882</u>
** GALLONS SOFTENED PER CYCLE (HARDNESS <u>11.7</u> GR/GAL)	<u>75,385</u>
BRINE TANK SIZE.....	<u>54" DIA. X 48" HT.</u>
WASH AND RINSE CONTROL.....	<u>RATE SET COCKS</u>

* Two coats 1AW AWWA D102-78 Inside Paint System #1.

** Based on average flow rate.

Handwritten calculations:

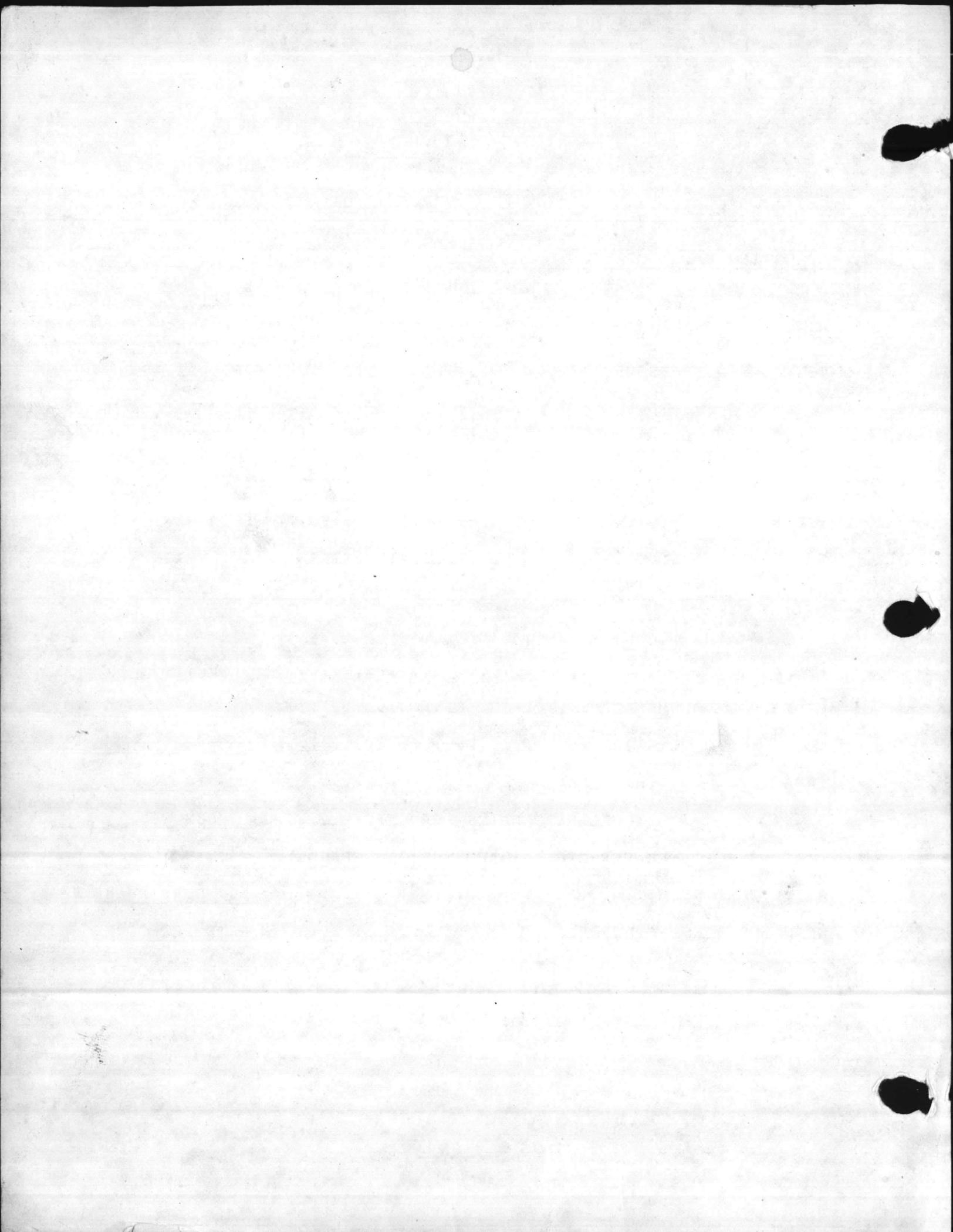
$\frac{120}{17.1} = \text{GPG}$

$\frac{170}{17.1} = \text{GPG}$

$\frac{\text{PPM}}{17.1} = \text{GPG}$

$\frac{11.7}{75,385} = \frac{7.0175}{100,000}$

0.0001552 0.000701



#4 SOFTNER MEDIA

16" Below INFLUENT

Manifold - 22 1/2"

Added 43 bags

#3 SOFTNER MEDIA

23 1/2" Below INFLUENT

Added 25 bags

5-4-04 5/6/04

#2 SOFTNER

22" Below INFLUENT

Added 13 bags 7/19/04

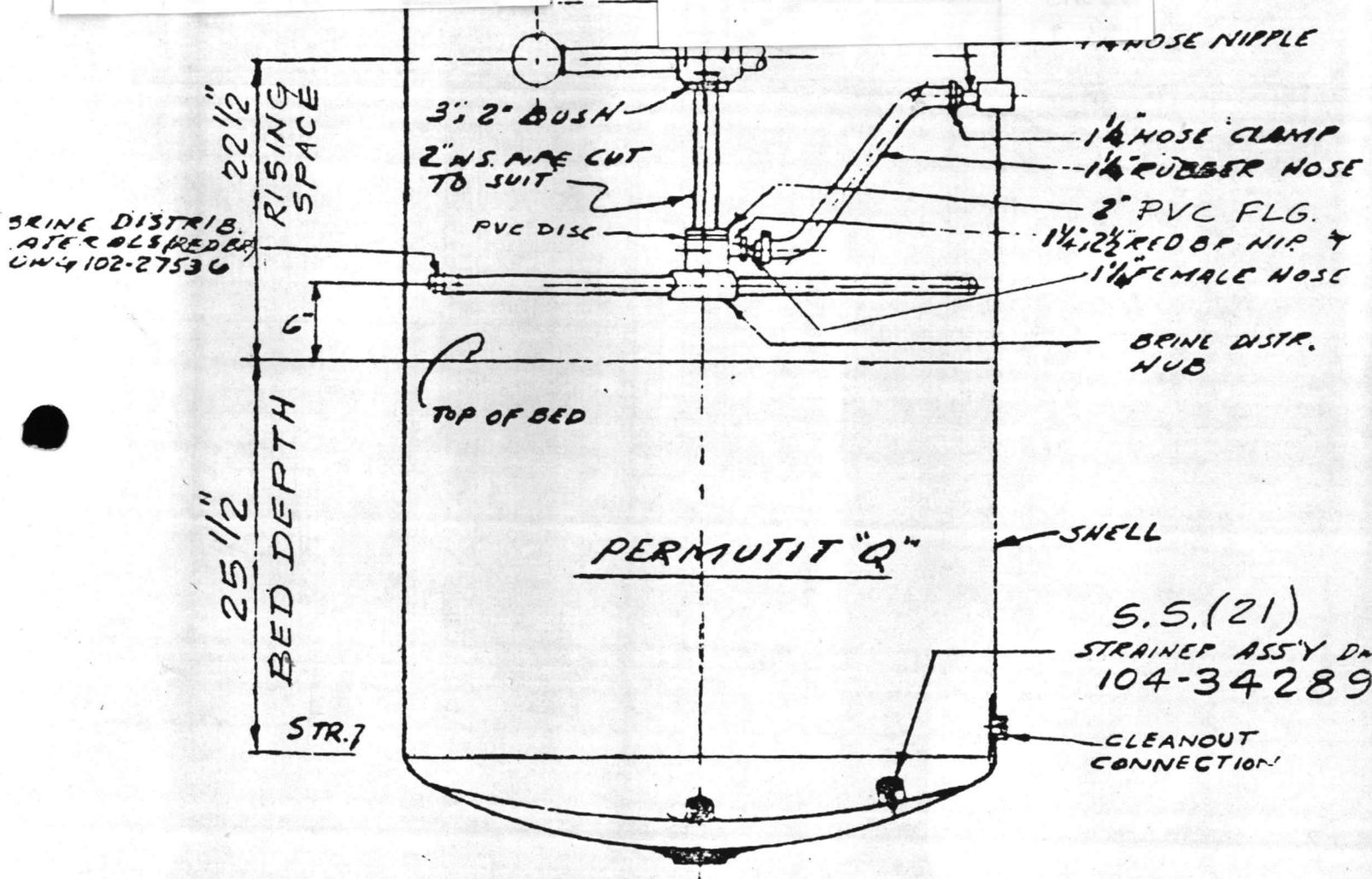
#1 SOFTNER

22" Below INFLUENT

Added 20 bags 8/11/04

TERNA
FOR
RMUTIT

2" x 2"



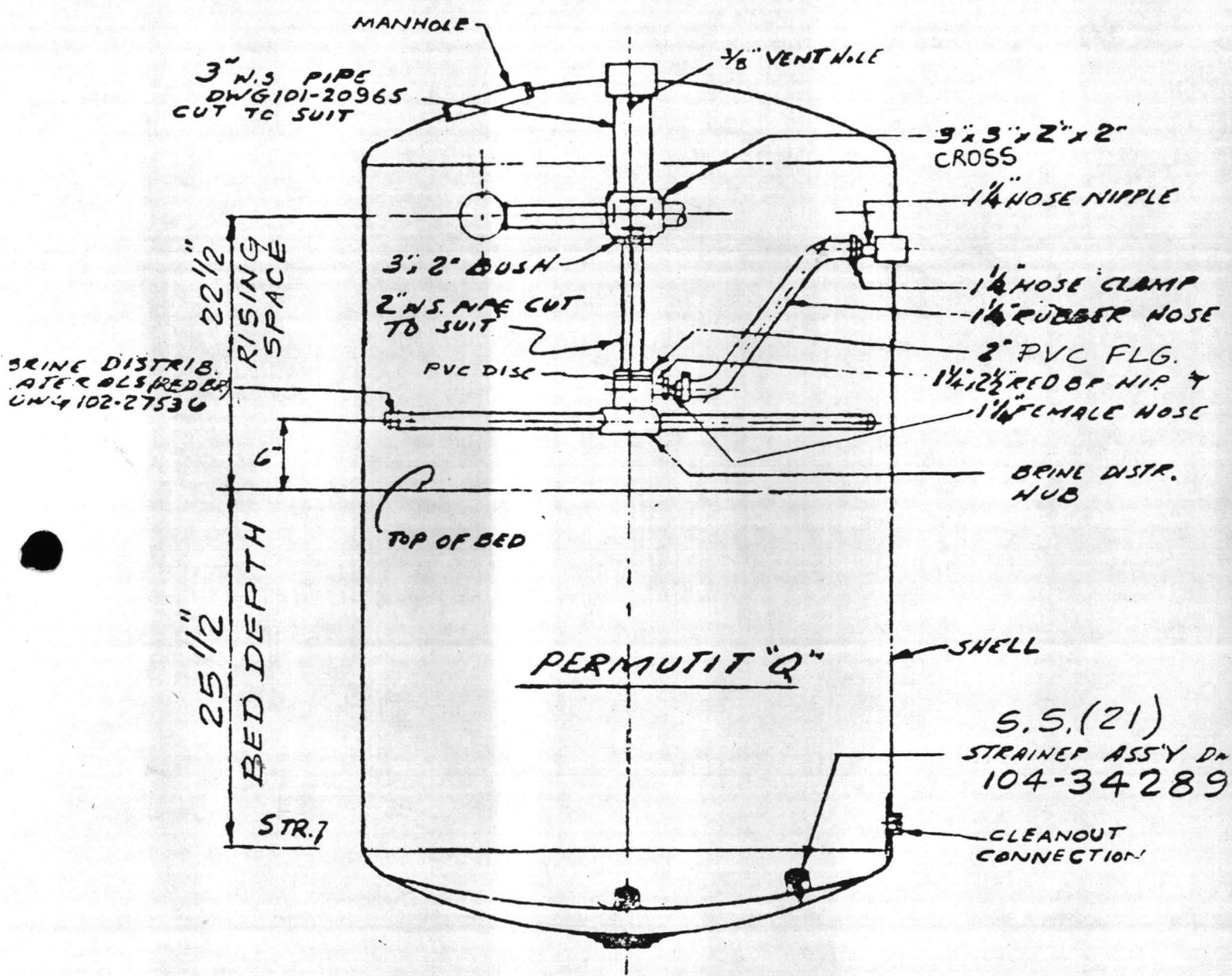
CAUTION

BEFORE ADDING FILL MATERIAL IN TANK. INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS. STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE LIP GAP

STATE OF MICHIGAN
DEPARTMENT OF REVENUE
DIVISION OF TAXATION

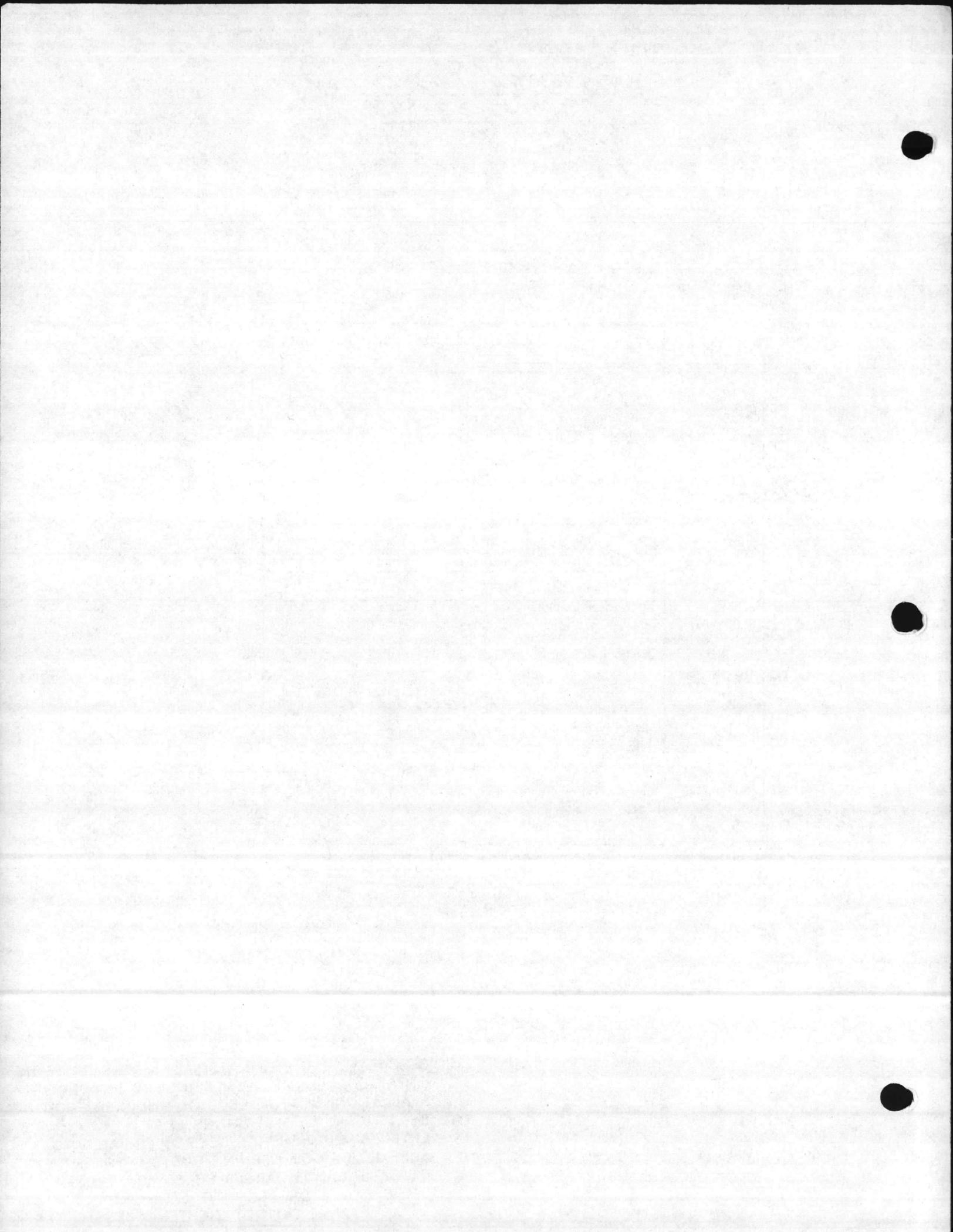
INVESTMENT
STATE OF MICHIGAN
DEPARTMENT OF REVENUE
DIVISION OF TAXATION

INTERNAL ASSEMBLY
FOR 5'-0" Ø
PERMUTIT 'Q' SOFTENERS

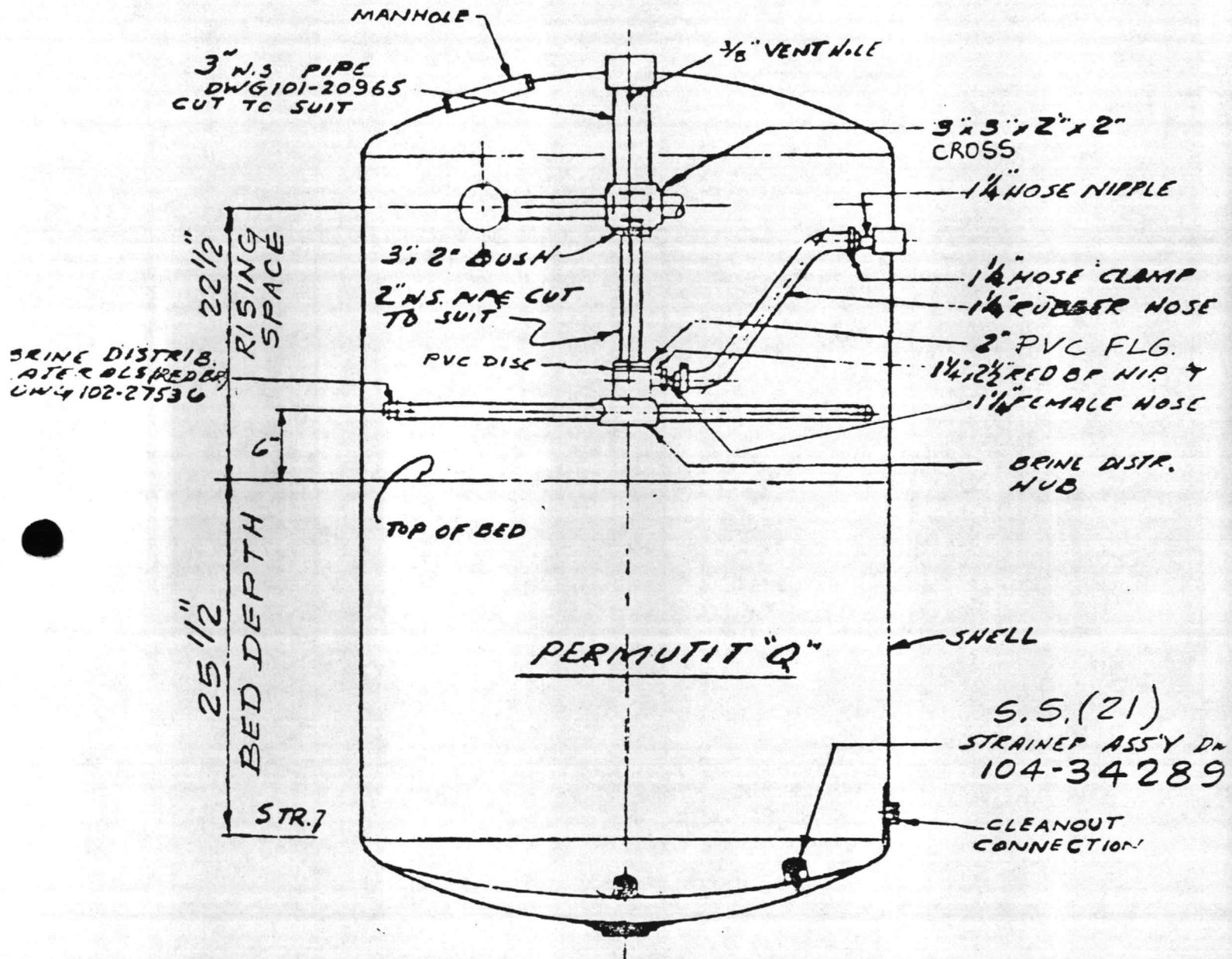


CAUTION

BEFORE ADDING FILL MATERIAL IN TANK. INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS. STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE LIP GAP

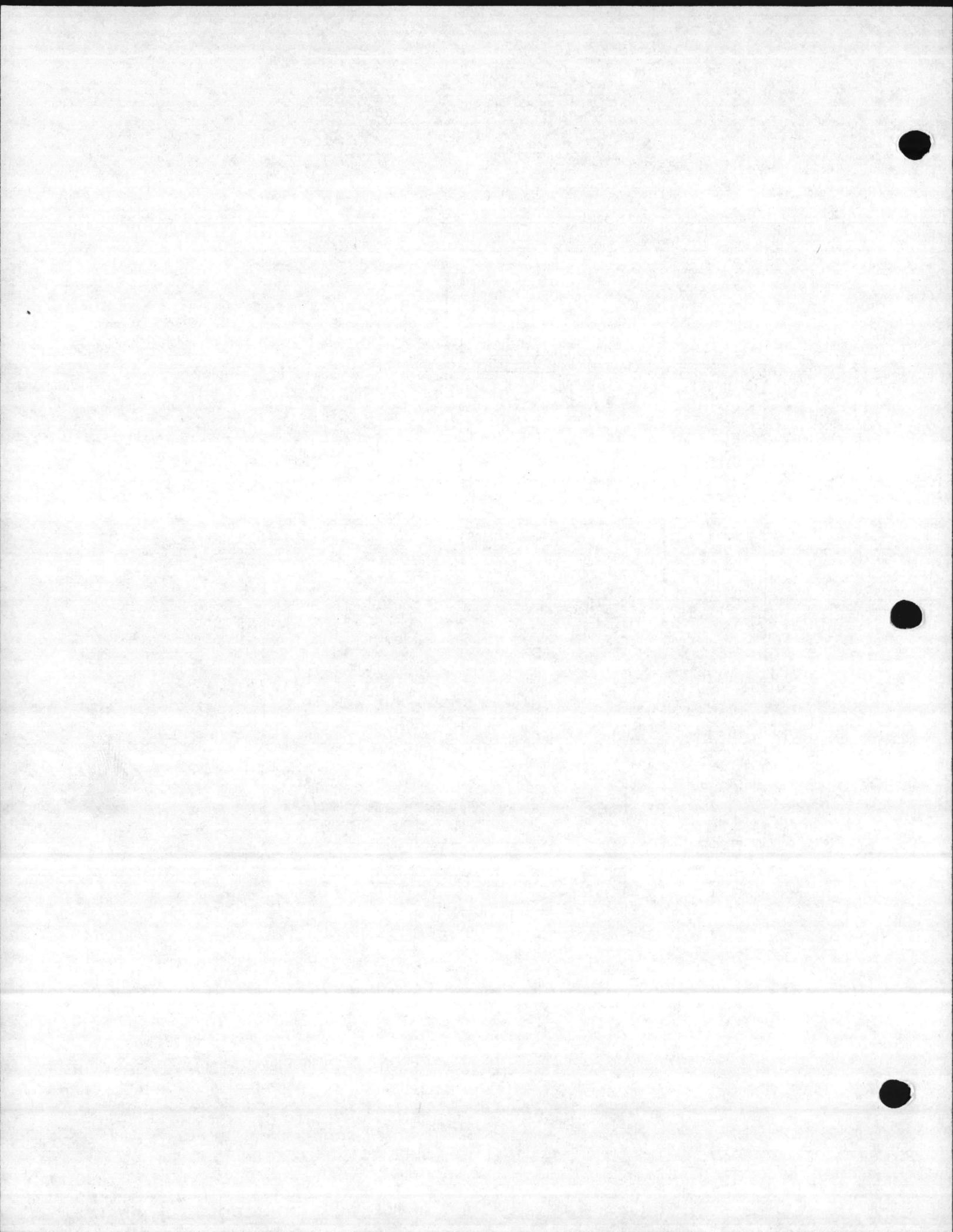


INTERNAL ASSEMBLY
FOR 5'-0" Ø
PERMUTIT 'Q' SOFTENERS



CAUTION

BEFORE ADDING FILL MATERIAL IN TANK. INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS. STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE UP GAP



PERMUTIT

A ZURN COMPANY

OPERATING INSTRUCTIONS

II. DESIGN AND OPERATING DATA

B. OPERATING DATA FOR YOUR MODEL (CONT'D.):

FLOW RATES (GPM EACH UNIT)

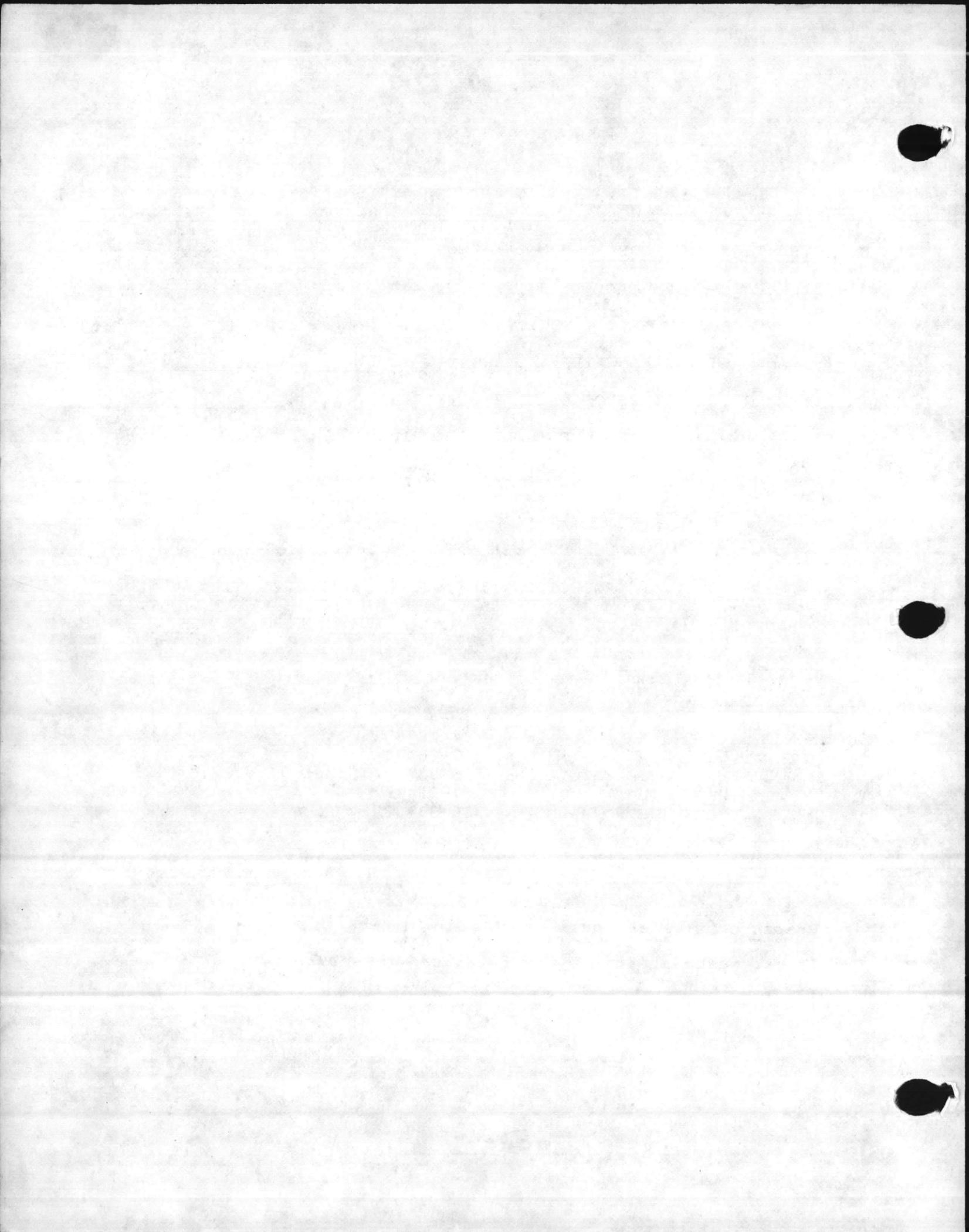
SERVICE... (NORM)..... (PEAK).....	102 GPM - 136 GPM
** BACKWASH (50°F. WATER).....	<u>98 GPM</u> FOR <u>10</u> MINS.
REGEN..... (POUNDS OF SALT PER REGEN).....	<u>291/735</u>
(GALS. OF SATURATED BRINE).....	<u>118/</u> <u>296 GALLONS</u>
(BRINE RATE).....	<u>9 GPM</u>
(BRINE DRAW).....	<u>13.6 INCHES</u>
* (DILUTION WATER RATE).....	<u>17 GPM</u>
(INTRODUCTION TIME).....	<u>15/</u> <u>38 MINUTES</u>
RINSE.....	<u>35 GPM</u> FOR <u>35</u> MINS.

REFERENCE DRAWINGS:

LAYOUT	- 184-18785
INTERNAL ASSEMBLY	- 157-33474
SCHEMATIC DIAGRAM	- 556-33732 (Sheet 9 to 12 of 12)
BRINE TANK ASSEMBLY	- 157-33419
CONTROL ENCLOSURE ASSEMBLY	- 556-33733

* Pressure of water shall be 20 psig.

** If backwash water is below 50°F. use lesser rate.



OPERATING INSTRUCTIONS

III. EQUIPMENT INSTALLATION

A. PRELIMINARY - BEFORE YOU BEGIN:

Caution:

Flush all lines before connecting them to unit. Do not use undue force when screwing pipes into valve pipe connections. Ream and clean all new piping free of chips.

Food, Beverage, and Drug Manufacture:

If the water to be treated by this equipment is to be used in connection with the commercial manufacture of any food, beverage or drug product, check first with the Service Department of The Permutit Company for any special instructions which may be required.

Filters:

The Softener is designed to soften clear, cold hard water that is free of suspended iron, turbidity and other foreign matter. If your water supply is not as specified above, a filter should be installed to correct this problem.

Pressure Regulating Valves:

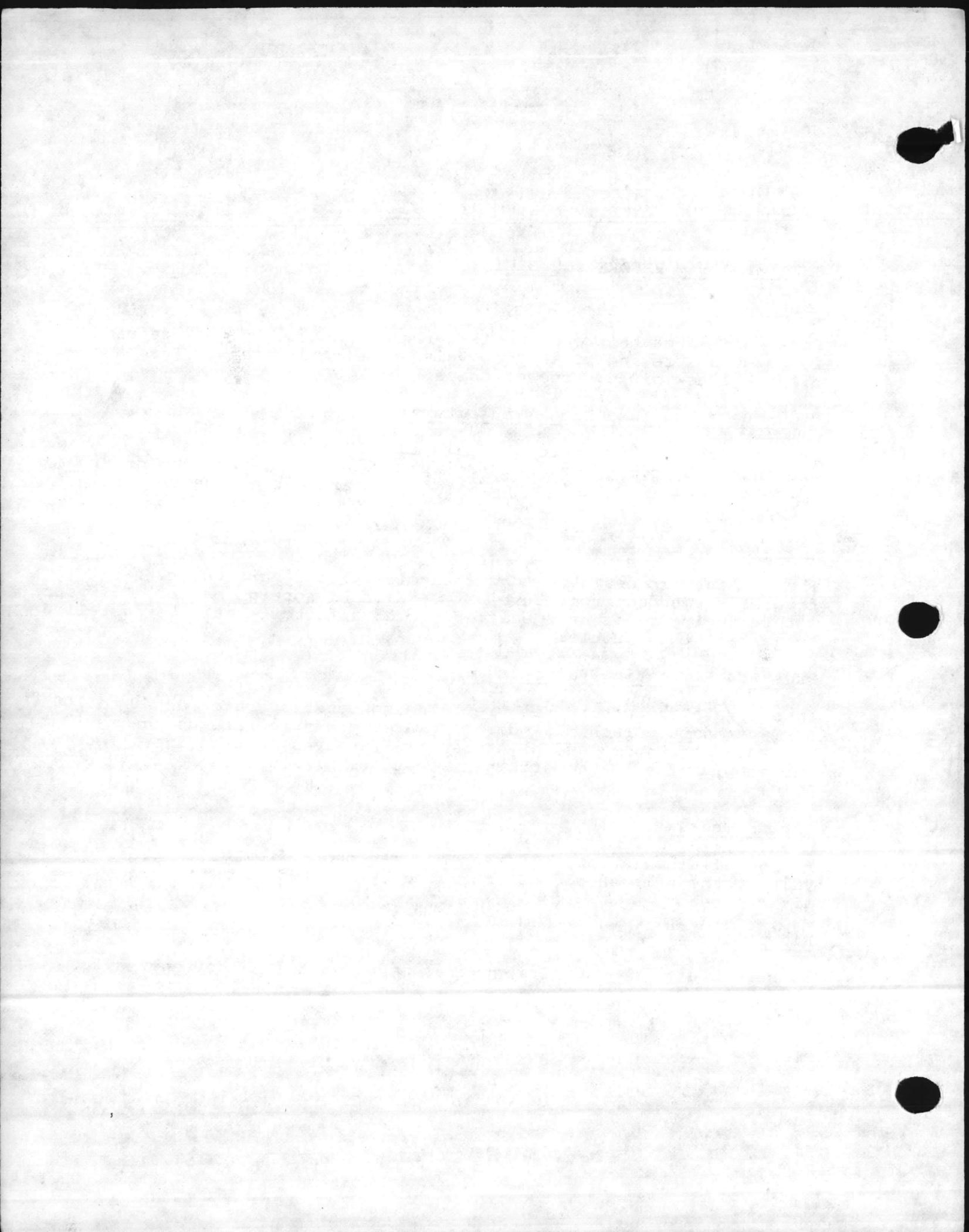
Investigate the water pressure. The softener operates on 40 to 100 lbs. per square inch maximum. If water pressure exceeds the maximum, pressure regulating and pressure relief valves must be installed in the supply line to the softener. Optimum pressure range is 40 to 70 PSIG.

Air Chambers:

In installations where water-hammer may occur from quick-closing valves, the unit should be protected by the addition of an adequate air chamber.

Flow Rate:

Be sure there is a sufficient flow of water to the softener system.



PERMUTIT[®]

A ZURN COMPANY

OPERATING INSTRUCTIONS

III. EQUIPMENT INSTALLATION

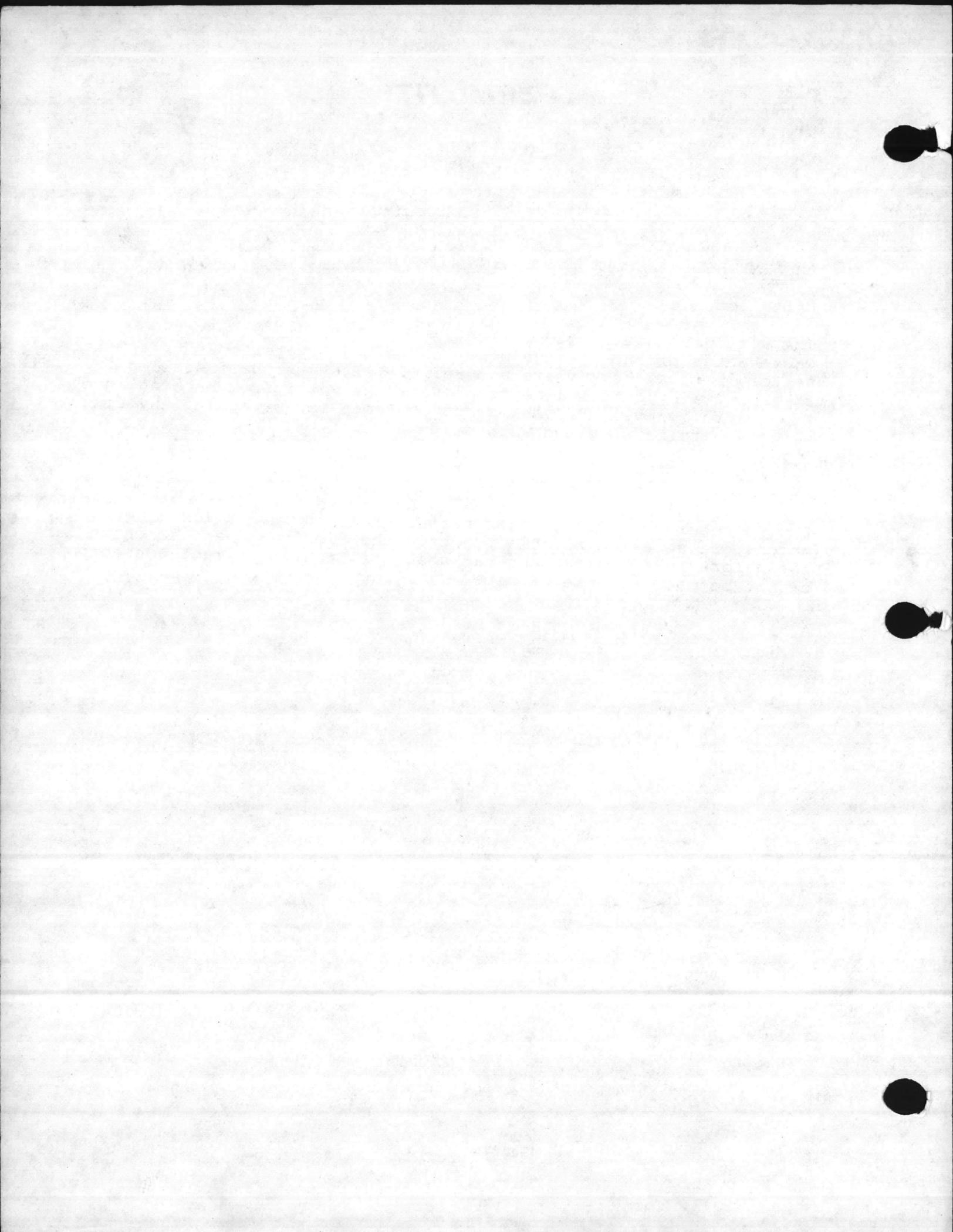
A. PRELIMINARY - BEFORE YOU BEGIN (CONT'D.):

Unit Location:

The softener unit should be located at a convenient point near a waste water drain. If the softener effluent water goes to a water heater, both a check valve and relief valve must be installed in the soft water outlet line to prevent hot water from backing into the control valve. Provision must be made for bypassing any fixtures which are to be supplied with hard water.

Waste Water Disposal:

A pipe for disposal of waste water during regeneration must run from the softener to a waste water drain. Keep the waste line open and accessible so as to be able to check the flow rates and to check for resin loss in the rinse and backwash position. A direct connection cannot be made to a sewer pipe.



OPERATING INSTRUCTIONS

III. EQUIPMENT INSTALLATION

B. FOUNDATION:

A foundation should be constructed sufficient to sustain the operating weight of each individual unit without settling. The drain size should be large enough to receive the maximum waste flow without flooding. See tables and drawings.

C. SET-UP PRESSURE TANK AND OTHER SYSTEM EQUIPMENT:

Set the component as shown on the layout drawing (see installation specifications) taking care that it is installed level and plumb. Unit supports such as tank legs are located to allow piping to pass to the front of the tank.

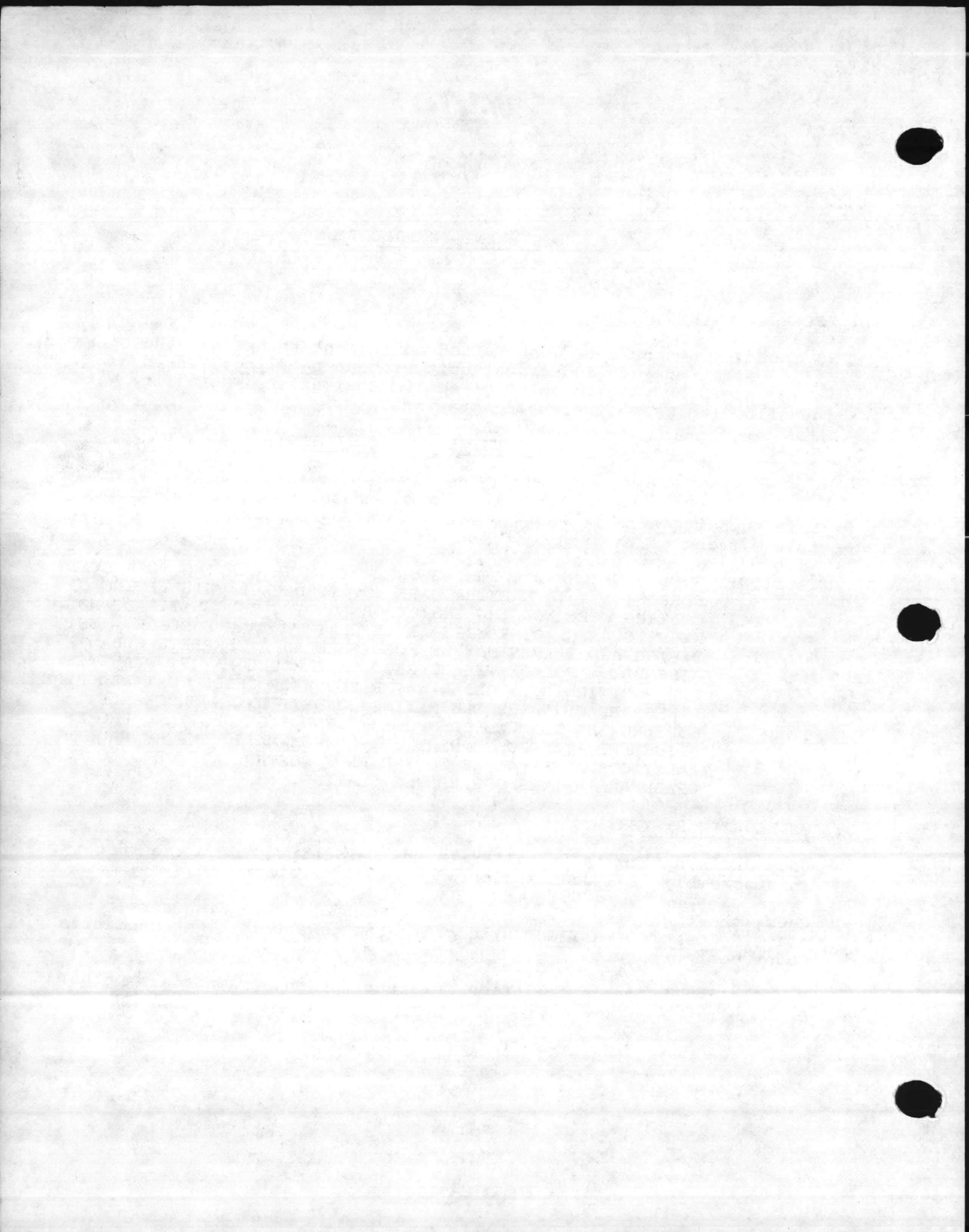
CAUTION: SOME TANKS HAVE A LINING OR PROTECTIVE COATING TO PREVENT CORROSION. TAKE EXTRA CARE NOT TO DAMAGE THIS LINING OR COATING WHEN WORKING INSIDE OR LOADING THE UNIT. DO NOT WELD, BURN OR OTHERWISE APPLY HEAT TO TANK SURFACE. UNIT PIPING AND VALVES MAY BE FURNISHED AS A COMPLETE SUB-ASSEMBLY. FOLLOW THE CORRECT UNIT MODEL LAYOUT DRAWINGS FOR POSITIONING. CLEAN WATER FLUSH OR CHECK THAT ALL PIPE LINES ARE CLEAR BEFORE MAKING CONNECTIONS. CHECK ALL SCREWED AND FLANGED CONNECTIONS FOR TIGHTNESS AND PROPER ALIGNMENT. CHECK CONNECTIONS OF PNEUMATIC AND HYDRAULICALLY OPERATED VALVES TO AND FROM CONTROL DEVICES. CHECK DIAPHRAGM VALVES FOR PROPER SEATING.

D. UNDERDRAIN SYSTEM:

Underdrain system is installed in unit as shipped from the factory. This assembly is a double dish with 316SS strainers.

Check the tightness of each strainer to the double dish strainer plate. DO NOT OVER TIGHTEN, but tighten to a leak tight condition under test pressure.

See Section B for installation instructions on strainer assembly.

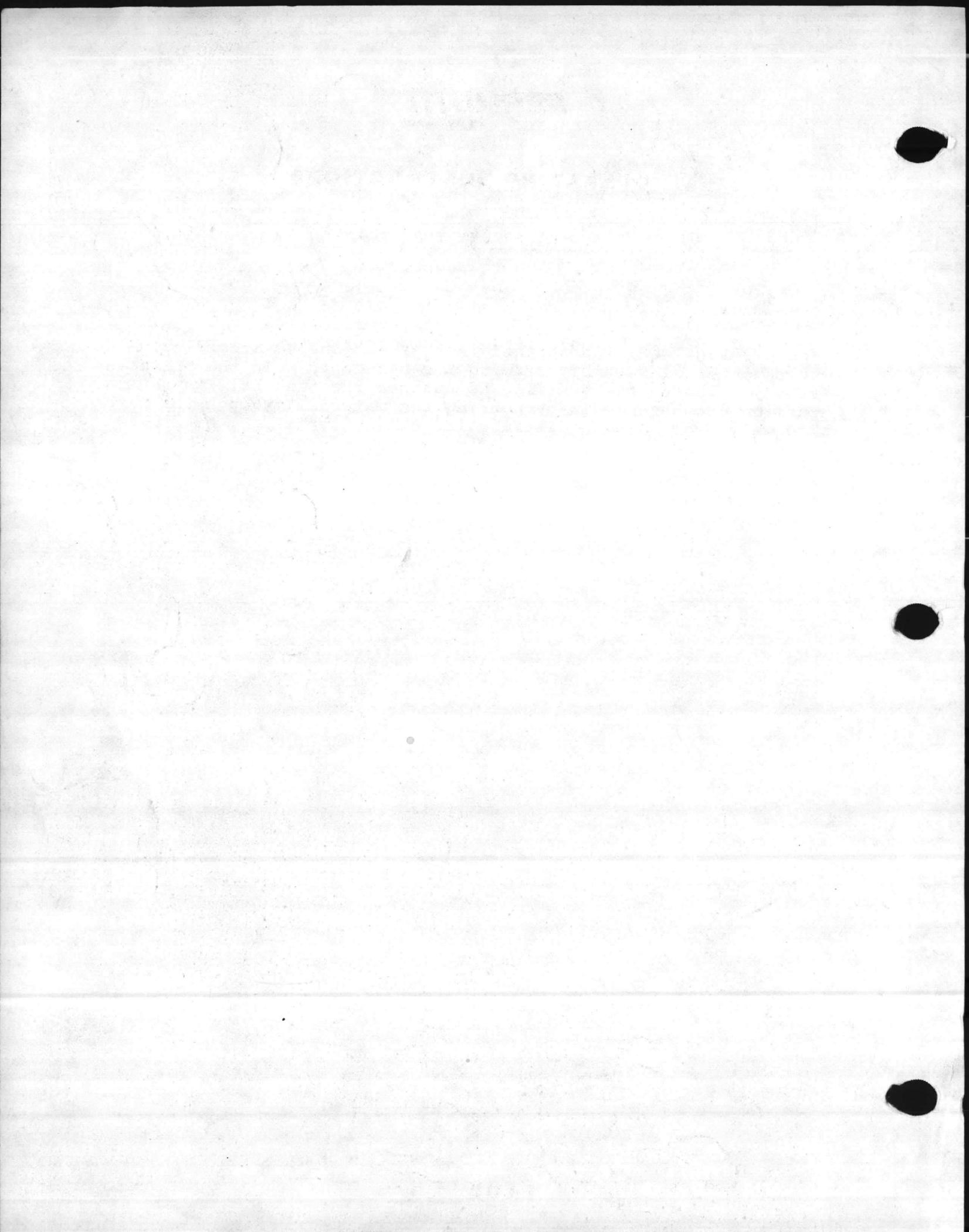


OPERATING INSTRUCTIONS

III. EQUIPMENT INSTALLATION

E. ION EXCHANGE MEDIA:

Ion exchange media is shipped in bags and labeled accordingly. Check internal assembly drawing for bed depth. In the previous step you loaded the subfill and drained the tank half-way. Load the ion exchange media by pouring the material through the manhole. The water will aid in distributing this material.



OPERATING INSTRUCTIONS

IV. OPERATION

A. DESCRIPTION OF OPERATION:

The softeners are automatically operated with provisions for manual control consisting of manually indexing the multiport valve through the regeneration steps. Inlet water flow to the softener is observed on the impact rate of flow indicator prior to entering the multiport valve which directs the flow to the top of the vessel. Water is distributed evenly over the resin bed and passes through the strainers and departs the bottom of the vessel. The effluent passes through the MPV to the customer's service.

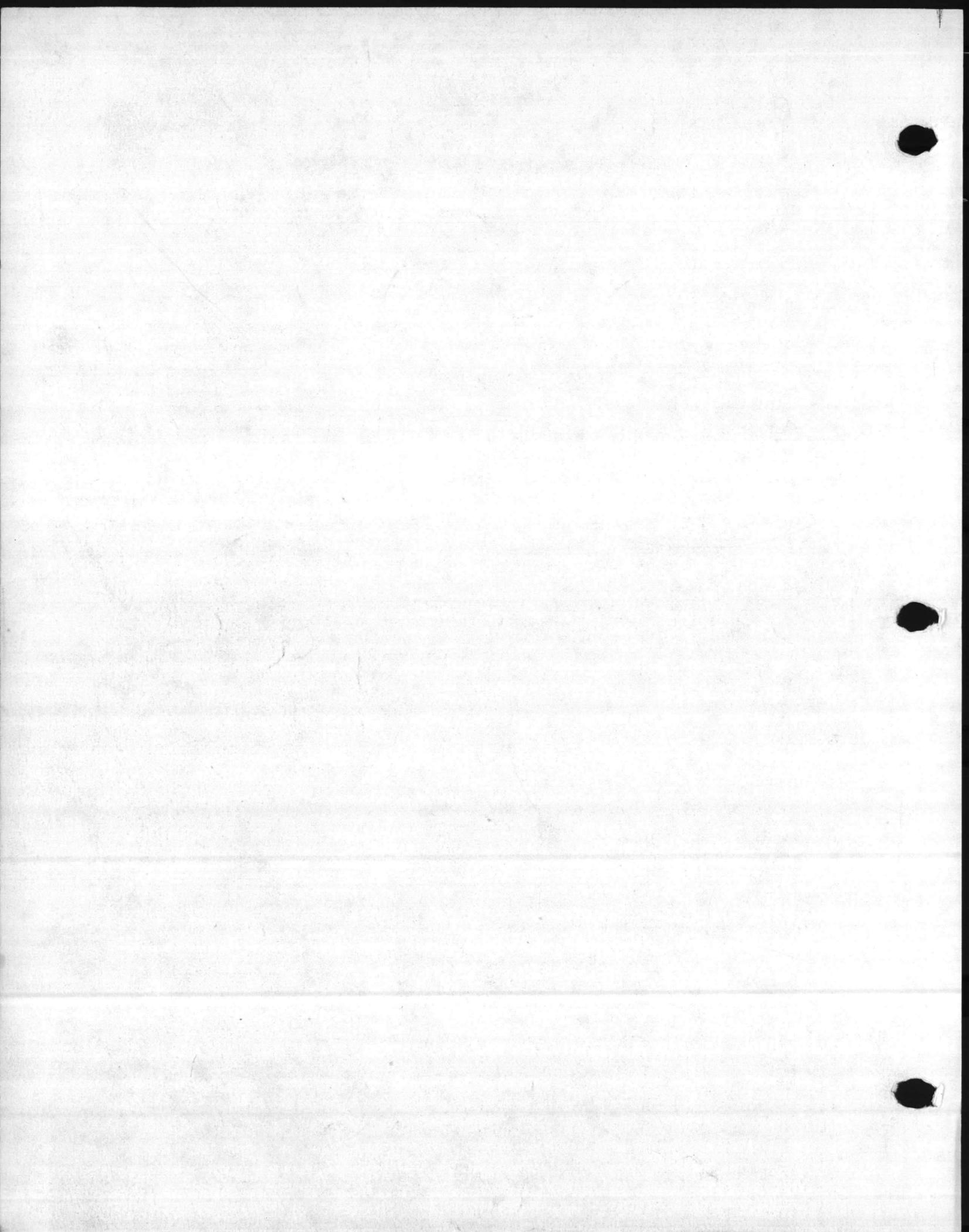
On the inlet line to each softener is a flow meter which registers total gallonage treated by the vessel during a softening cycle. When a preset volume treated is reached a contact closure energizes a flashing light on the panel; sounds an alarm; and hold light is "ON" for 45 seconds. The MPV rotates to the backwash position where the regeneration sequence commences. Interlocks are provided so that two or more softeners cannot regenerate simultaneously.

An ATC regeneration cycle timer of 75 minute duration controls the sequencing action of the MPV when the cycle is in the backwash position. While in backwash which runs for 10 minutes a "BACKWASH" panel light is on.

The next step is the brine introduction of a concentration of 10%. A concentrated brine solution (25%) is drawn from the brine tank at a rate of 9 GPM by the ejector just prior to entry into the softener. This flow is diluted with water at a rate of 17 GPM to obtain the desired concentration required for regeneration. The level in the brine tank is maintained by a feed of concentrated brine by a Goulds brine pump. When the level reaches a preset low level the pump starts until the level reaches a high point whereupon the pump stops. Two (2) pumps are provided. The pumps alternate on low level. A level gauge on the tank may be utilized to observe brine level.

When regeneration is terminated the MPV rotates to the rinse position. The media is rinsed for 35 minutes and the rate is set by the rate set valve on the rinse outlet line.

The unit returns to service at rinse completion with the service light "ON". The inlet meter is reset to begin registering gallonage treated by the respective softener. The interlock is de-energized to permit another softener to enter regeneration.



OPERATING INSTRUCTIONS

V. PLACING SOFTENER IN OPERATION

A. INITIAL START-UP:

At this stage the softener is piped up, the internals have been checked, the media loaded, the tank bolted up (manhole and handhole secured and drain plug in place), and the electrical connections made to the unit.

Hook up the brine equipment. Use the drawings supplied. Pipe up the water supply to the brine tank. A stop valve should be installed in this line.

Refer to data page for regen information. Set the brine draw to allow the required amount of brine into the softener in the specified time. To do this, set the MPV manually to regen and adjust the rate set valve on dilution water line to achieve the brine draw in the required time.

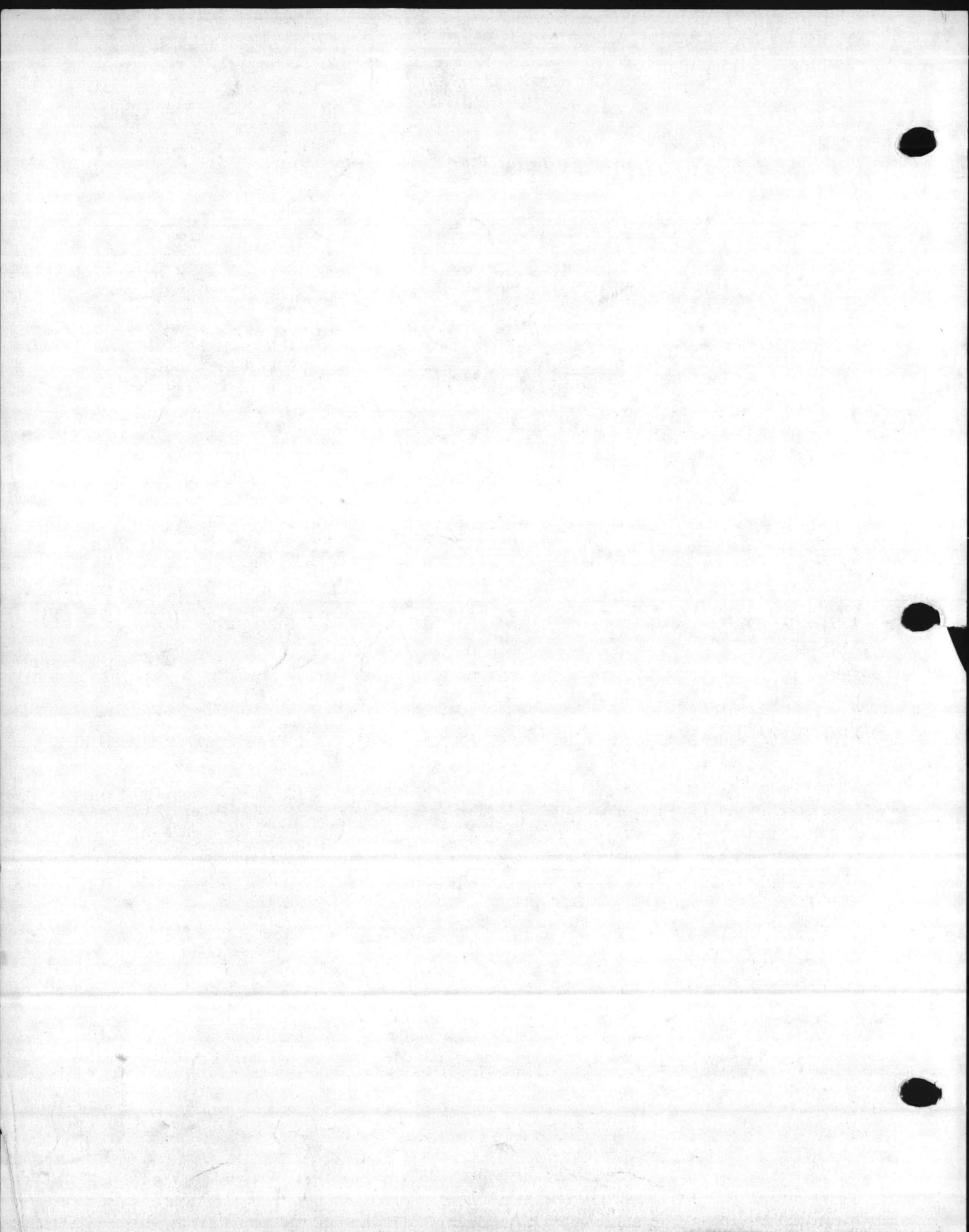
Now put the softener through a regen sequence manually. Refer to Operating Data Page for regen steps. (Backwash, regen and rinse.)

A manual operation is accomplished by manually indexing the multiport valve through the steps.

Maximum backwash rate is fixed by the "Wash Outlet Rate Set Valve". Check to see that sufficient water is available for the backwash rate.

Refer to the Manufacturer's information on the timer that is included in this manual. Cycle time has been factory set and need not be adjusted unless a step time needs to be modified. Adjustment of the cam switch is easy and precise. Refer to Drawing 556-33732 Sheet 9 of 12 for cam switch settings.

All timer adjustments are made with the power off. Also keep in mind that the timer and MPV are synchronized and it is possible to manually move the MPV. Before any power is returned to the controls, be sure the timer and MPV are properly synchronized. The regen timer should be in pre-start position and the multiport valve in the service position.



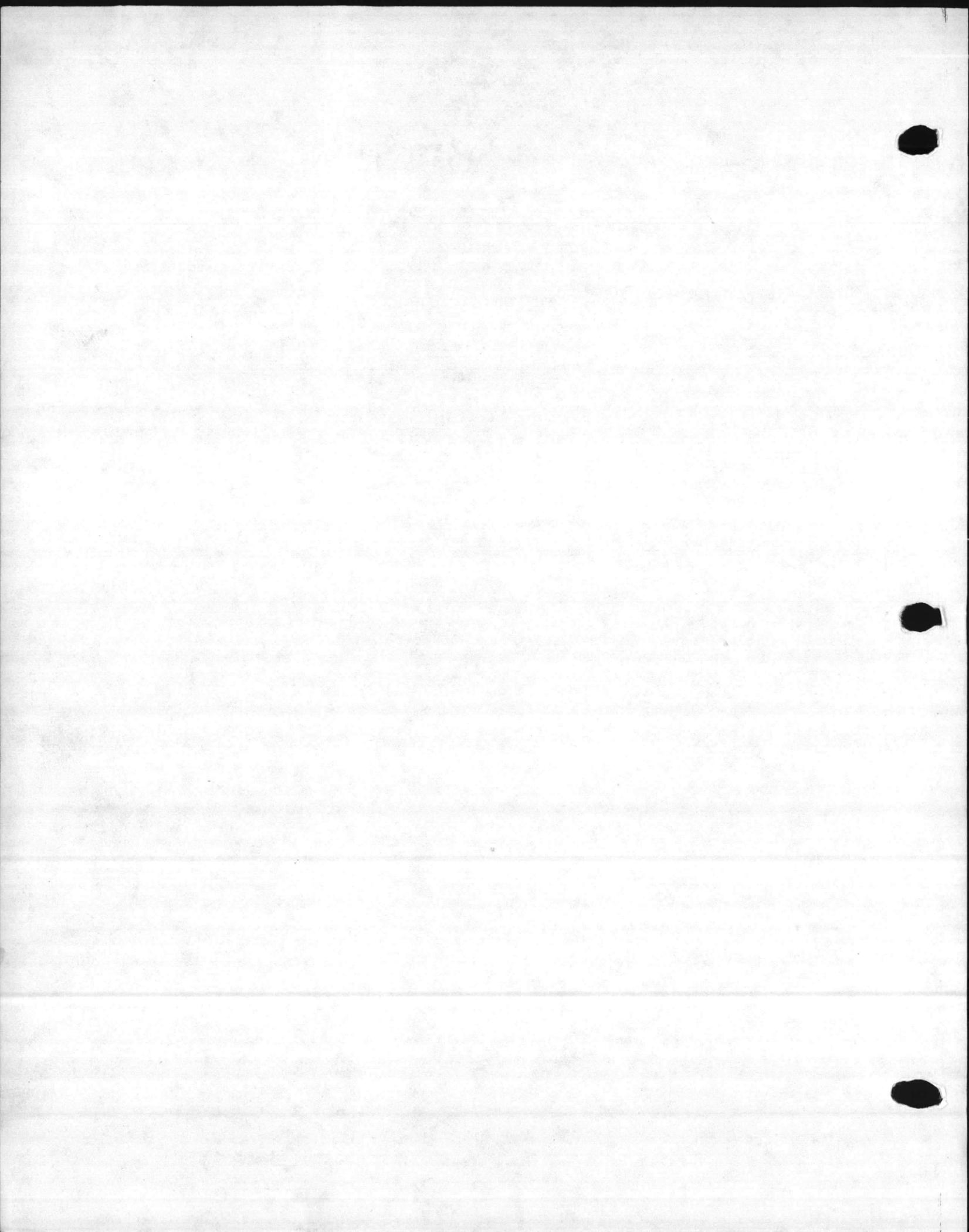
OPERATING INSTRUCTIONS

V. PLACING SOFTENER IN OPERATION

A. INITIAL START-UP (CONT'D.):

"Filter Mode" selector switch provides the power to the softener units. By placing the switch in the "semi-auto or manual" position, power is applied to softener vessel controls. A separate power source provides power to the brine pumps and alternator.

A manual initiation of regeneration can begin by rotating the setting disc on the cam timer for the respective softener until the contact on the cam switch is made, that is power is supplied to the timer motor through the N.O. contact. The timer is now energized and will proceed through a regeneration cycle. The circuitry for the brine system must be energized. The softener will return to service automatically.



PERMUTIT[®]

A ZURN COMPANY

OPERATING INSTRUCTIONS

VI. MAINTENANCE

HARD WATER SUPPLY - should be within the quality limitations.

HOUSING - Softener must be properly housed to protect it against freezing, rain, dust or other abnormal conditions.

TEMPERATURE - Allowable water temperature is also limited by materials of construction. See DATA SHEET for maximum allowable temperature.

If soft water passes directly into a hot water heater or other heat producing apparatus, a swing check valve must be installed in line to prevent hot water backing into softener or meter. A pop valve should be placed between check valve and heater in order to protect softener shell.

CAPACITY - Do not run softener at flow rates higher than allowable. Test hardness of raw water periodically to avoid running unit past its capacity for hardness removal. If overrun, a double regeneration is required to restore ion exchanger to normal condition.

AIR - It is very important to keep air out of backwash water, since it may cause upset bed. Be sure all pipe flanges, pipe joints, packing glands of pumps, etc. are tight.

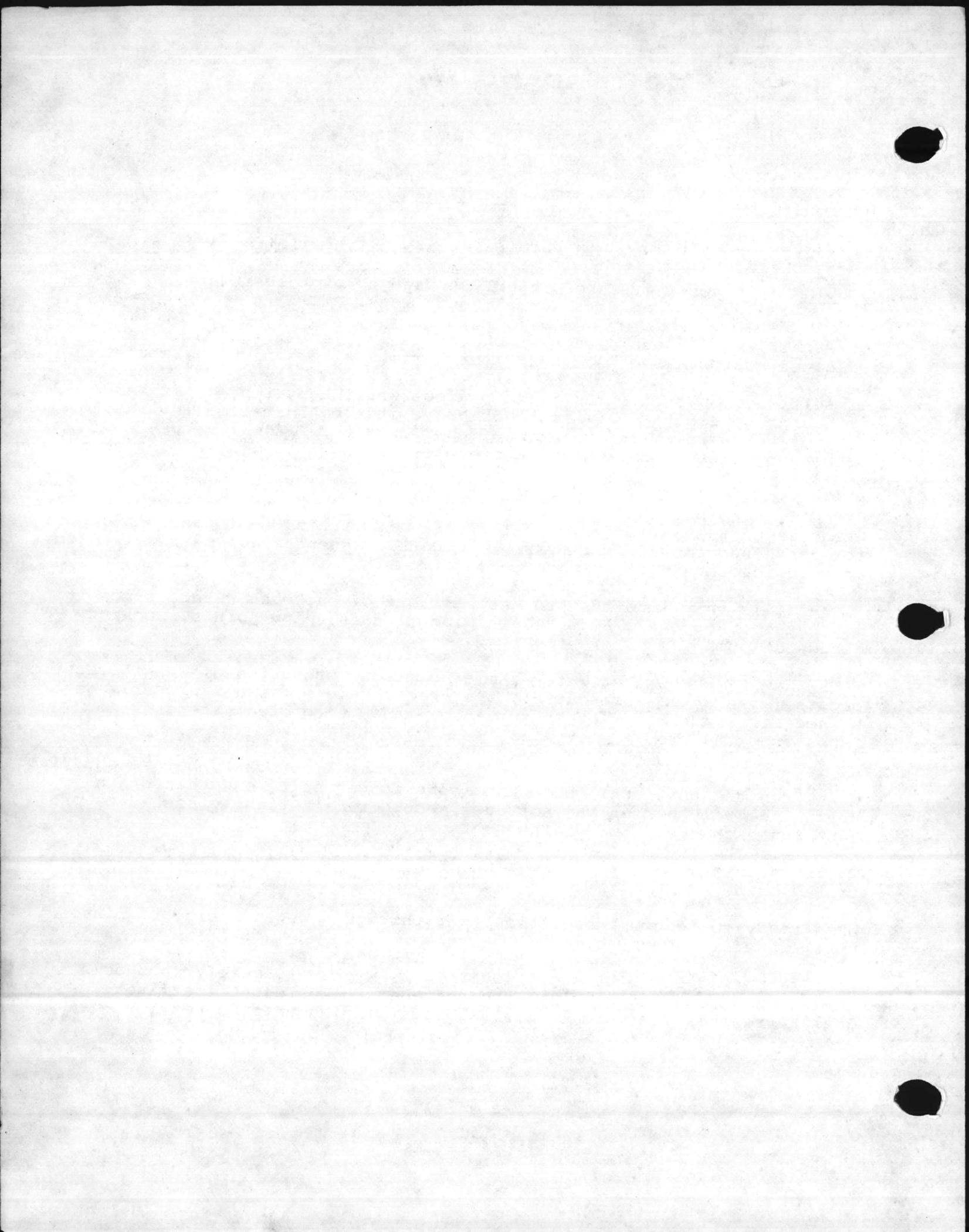
WATER HAMMER - Wherever water hammer or rapid pulsation of water pressure occurs (even at low pressures), the user should provide a properly designed air chamber, or other suitable means, to protect the softener tanks from rupture.

IDLE PERIODS - If idle period is long (one week or more), before shutting down, run the unit until effluent is no longer soft, and then drain. During the idle period the softener should remain tightly sealed to prevent ion exchanger from drying out.

If there is any danger of freezing, keep inside of tank filled with saturated brine.

When ready to reassume operation, put through a regen cycle and rinse until water is acceptable.

If idle period is to be short (overnight, weekend), merely shut down unit. When restarting, rinse the softener to waste until effluent quality reaches its normal level, before placing unit in service.



OPERATING INSTRUCTIONS

VI. MAINTENANCE

BOILER BLOWOFF CONTROL - Ion exchange softening does not reduce total solids in water. If the soft water is used for boiler feed, it is still necessary to periodically blowdown the boiler in order to maintain concentrations within required limits.

PREVENTION OF CORROSION:

BOILER FEED - should be deaerated to avoid corrosion. Sufficient deaeration for protection of the boiler proper can be accomplished in the usual open heater, if large enough and properly operated. If steel tube economizers are used, the water must be completely deaerated, and special equipment should be added to the ordinary open heater for this purpose.

HOT WATER SUPPLY PIPING - Deaeration should also be employed. If corrosion occurs and deaeration cannot be adopted, feeding of SODIUM SILICATE into the inlet of the heater for the hot water supply (NOT BOILER FEED) will be found helpful.

SALT TANK:

The salt tank should be inspected periodically and cleaned whenever necessary. All salt contains impurities or dirt which accumulates in the lower part of the tank and can cause incomplete regeneration by restricting the brine flow or by delivering weak brine.

To clean, follow this procedure:

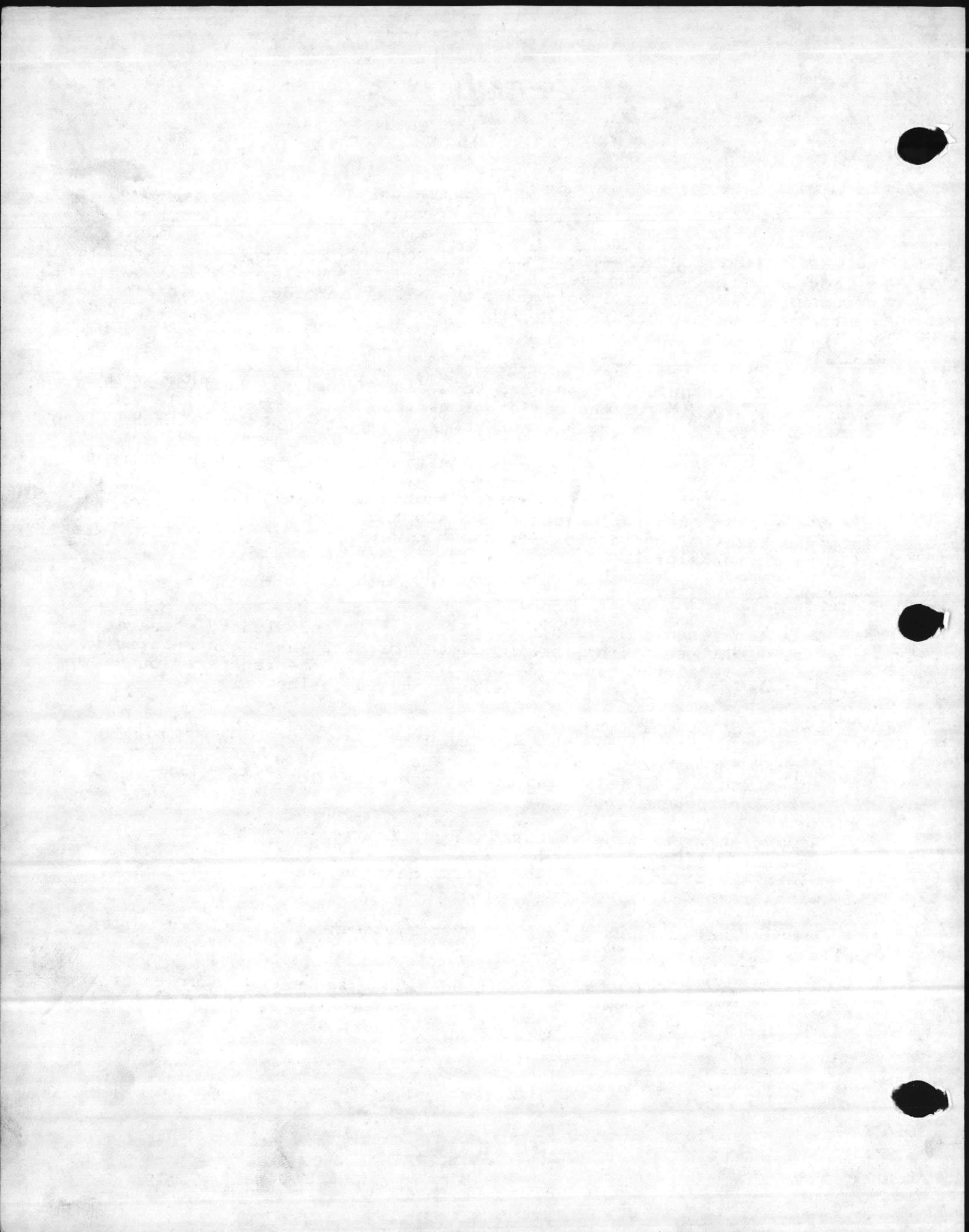
Syphon the water from the brine tank with a hose (or shut off the brine refill valve and permit the water level to lower as units are regenerated).

Remove any remaining salt and the impurities from the tank.

Clean the brine suction strainer. Wash out the tank and refill with fresh salt.

If an inlet meter is used in your system, check it's accuracy periodically.

Manufacturers' Literature is included with this text. Refer to it for information on the timer, stager, multiport valve and individual valves.



SALT SPECIFICATIONS

- A. Type**
Rock Salt or Evaporated Salt.
- B. Color**
White to grayish white.
- C. Composition**
(1) Not less than 98% sodium chloride, with a minimum of calcium and magnesium salts.
(2) Zero phenolphthalein alkalinity (Alkalinity B).
(3) No grease, fat, or oil content.
- D. Fineness**
Between 3 mesh and 50 mesh. Evaporated salts may have up to 15% thru 60 mesh.
Softeners using polyethylene brine tanks, with no gravel in the bottom, must use a fairly coarse grade of rock salt such as CC or KD coarse, or larger.
- E. Solubility**
The salt should dissolve rapidly without packing, to form a clear solution.
- F. Comparative Solubility and Packing Tendency**
Salt should dissolve completely in not more than 15 minutes in the STANDARD FLOAT experiment described below.
- Standard Float Equipment**
Place a 20 gram sample on a float consisting of a cork ring about 2" inside diameter, 1/4" thick, and with a single piece of cheese cloth across the hole, forming a floating screen. Place into a beaker containing 200 c.c. of water.
Determine time for complete solution of the salt.
Coarse salts usually take less than 15 minutes and fine salts more than 20 minutes to dissolve.
- G. Samples**
The Permutit Company will test and report on any samples of salt considered for regenerating purposes.

CHARGING SALT TANKS

A. Salt Saturator

Load Salt into tank whenever salt depth has dropped to about 12 inches. To avoid possibility of weak brine being used for regeneration, never let salt depth fall below 12".

- Allow brine level to drop by regenerating a few times without refilling with makeup water.
- Brine draw can be measured with a ruler during these regenerations.
- When brine level is low enough so tank will not overflow when salt is added - refill with salt to within about 15" of rim of tank.
- Then fill with water through filling line to 1" from top of tank.

A more desirable procedure is to add salt whenever the level has dropped more than several inches below its highest level. This will avoid the danger of drawing weak brine when salt level is too low.

B. Salt Storage Tank - Brine Measuring Tank

Load salt into the Salt Storage Tank (SST) as soon as the salt level has dropped 24" below the top of this tank. Salt must be added before the liquid level in the SST can be seen, otherwise water will overflow the constant head box when salt is added.

A more desirable method of charging, is to add salt whenever the level falls 5" or 6" below the top of the SST. By keeping the SST filled with salt at all times, the danger of providing weak brine for regeneration will be avoided.

The density of brine in the Brine Measuring Tank (BMT) should be checked frequently by placing a hydrometer in the BMT. The reading obtained should be 22° to 23° Baume.

C. Salt Storage Basin

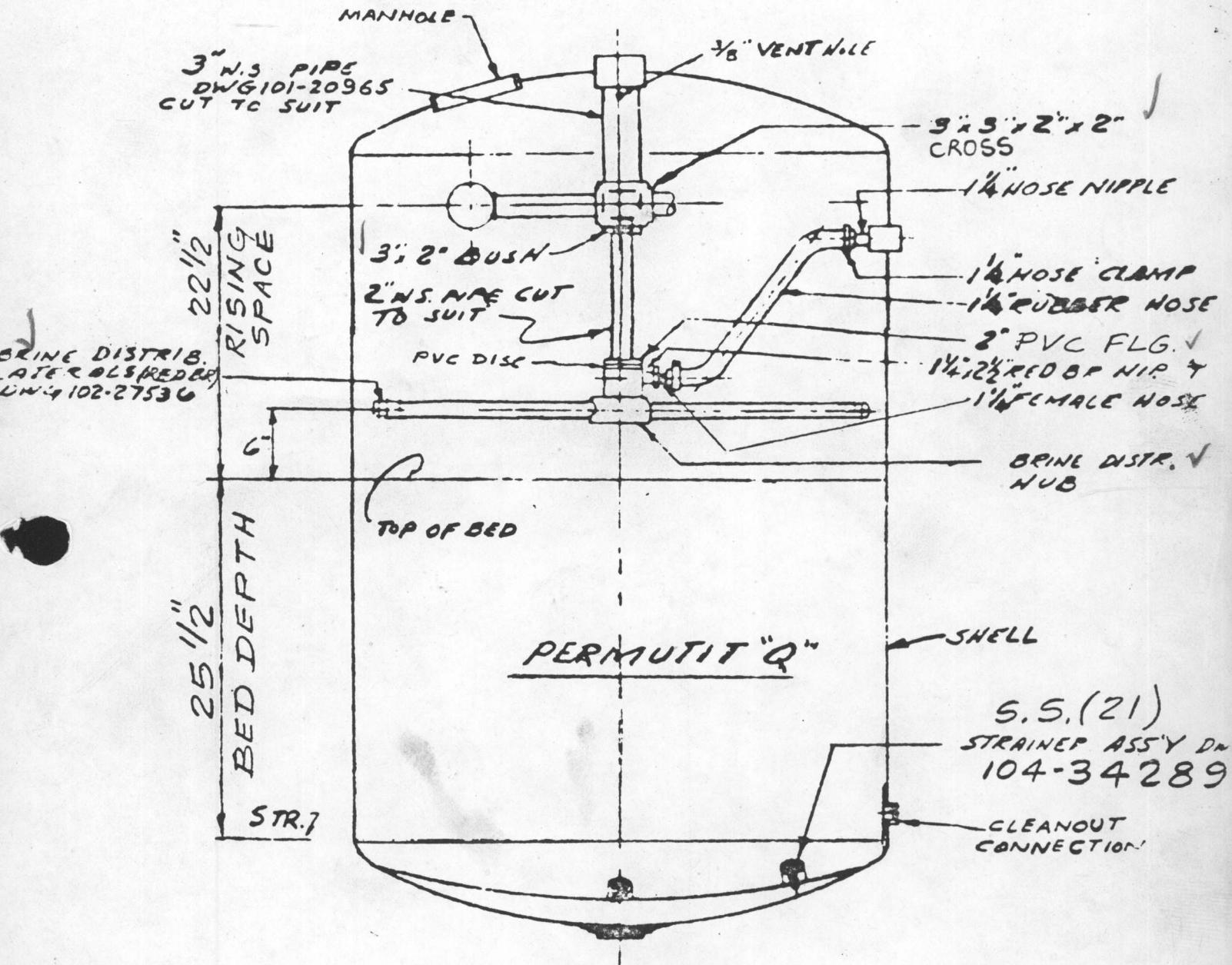
When a concrete wet salt storage basin is used, a sufficient depth of undissolved salt must be maintained to provide a saturated brine solution at all times. Check brine frequently with a hydrometer. A reading of 22° to 23° Baume indicates saturated brine.



T

2 pieces
2 "

ASSEMBLY 9 3/4" Long
SOFTENERS



CAUTION

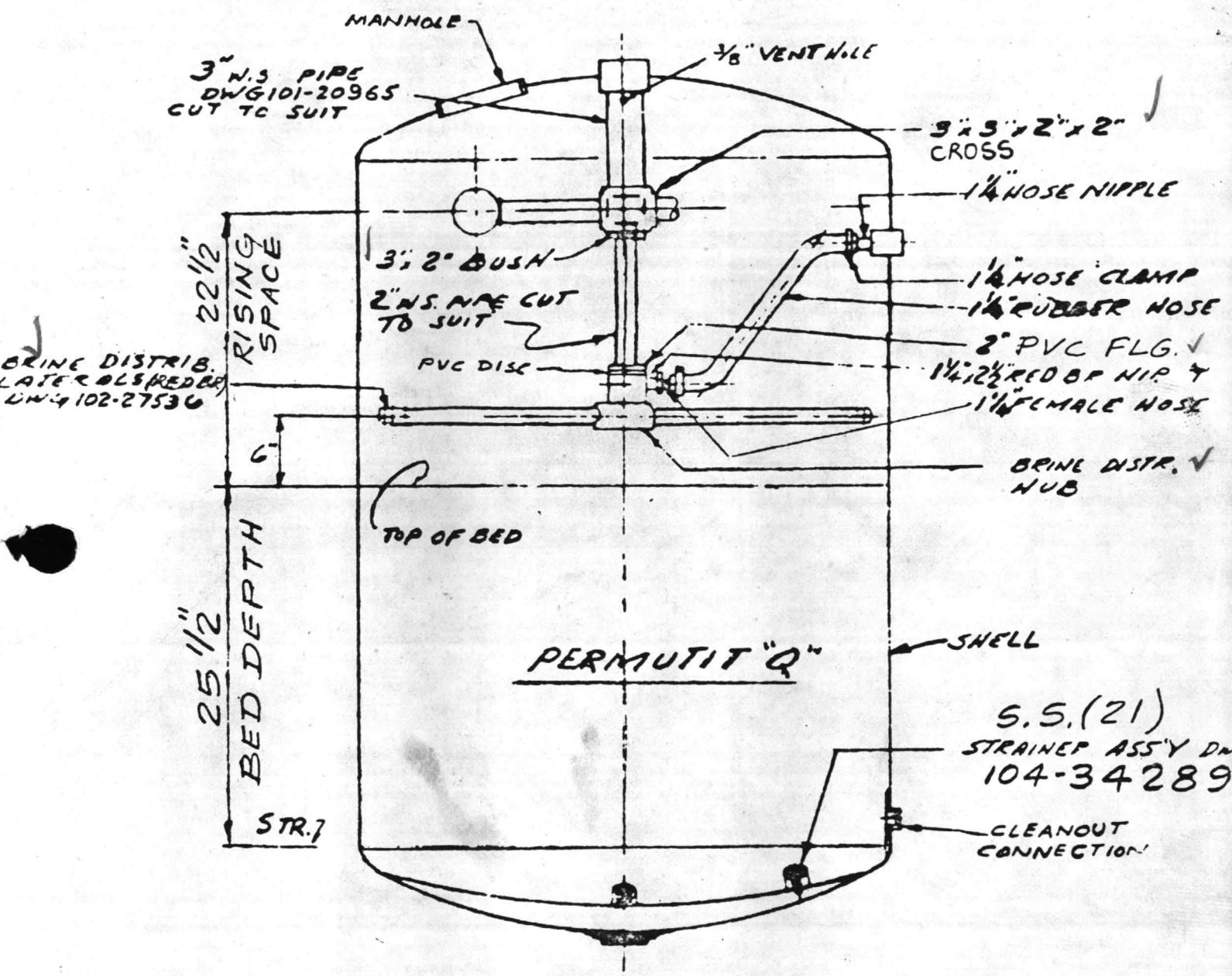
BEFORE ADDING FILL MATERIAL IN TANK. INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS. STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE UP GAP.

Fragment of paper with illegible handwritten text.

Handwritten text on the main sheet, including a date and possibly a name or address. The text is very faint and difficult to read.

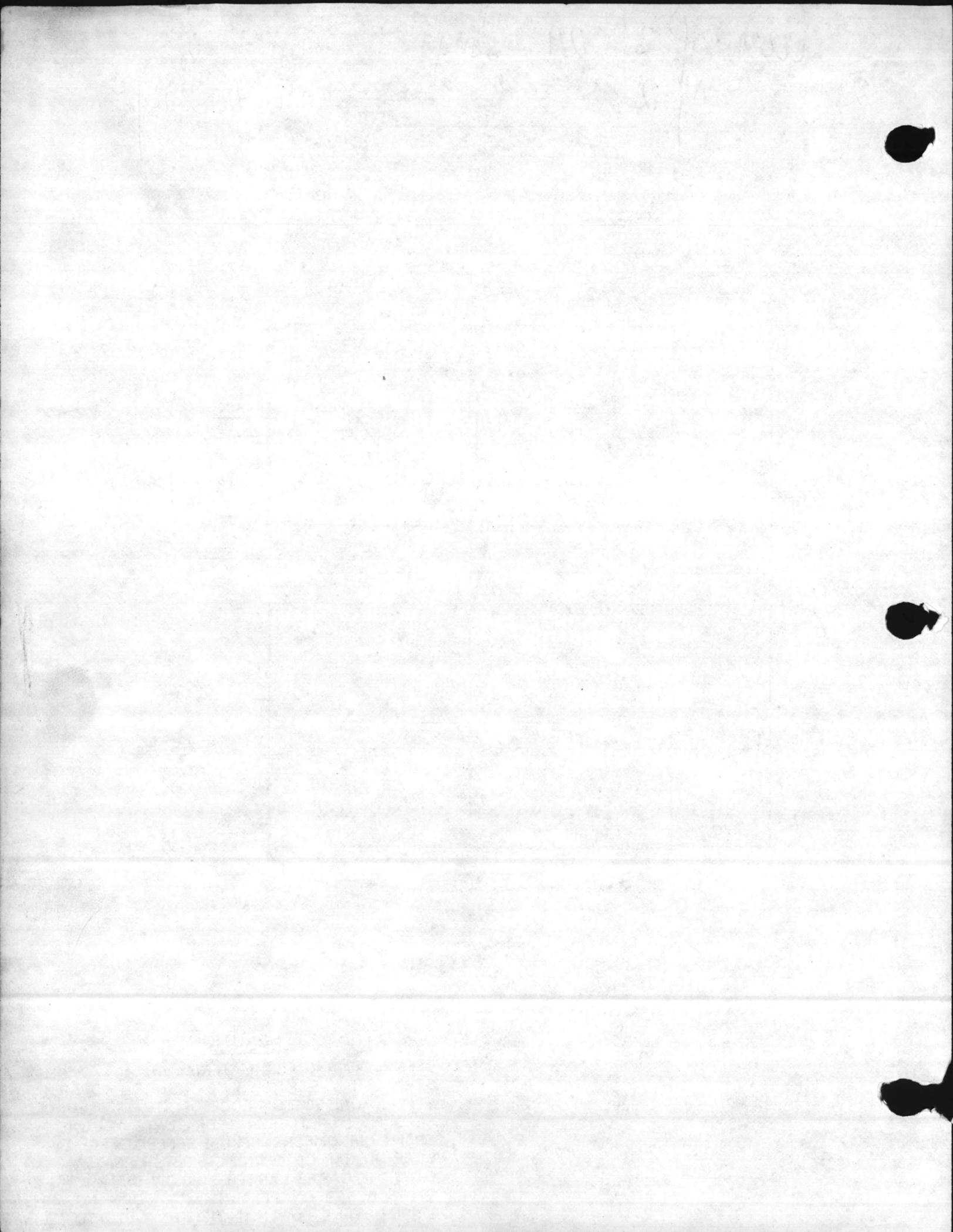


2 pieces of 3" 29" Long
 2 " of 2" INTERNAL ASSEMBLY 9 3/4" Long
 FOR 5'-0" PERMUTIT 'Q' SOFTENERS

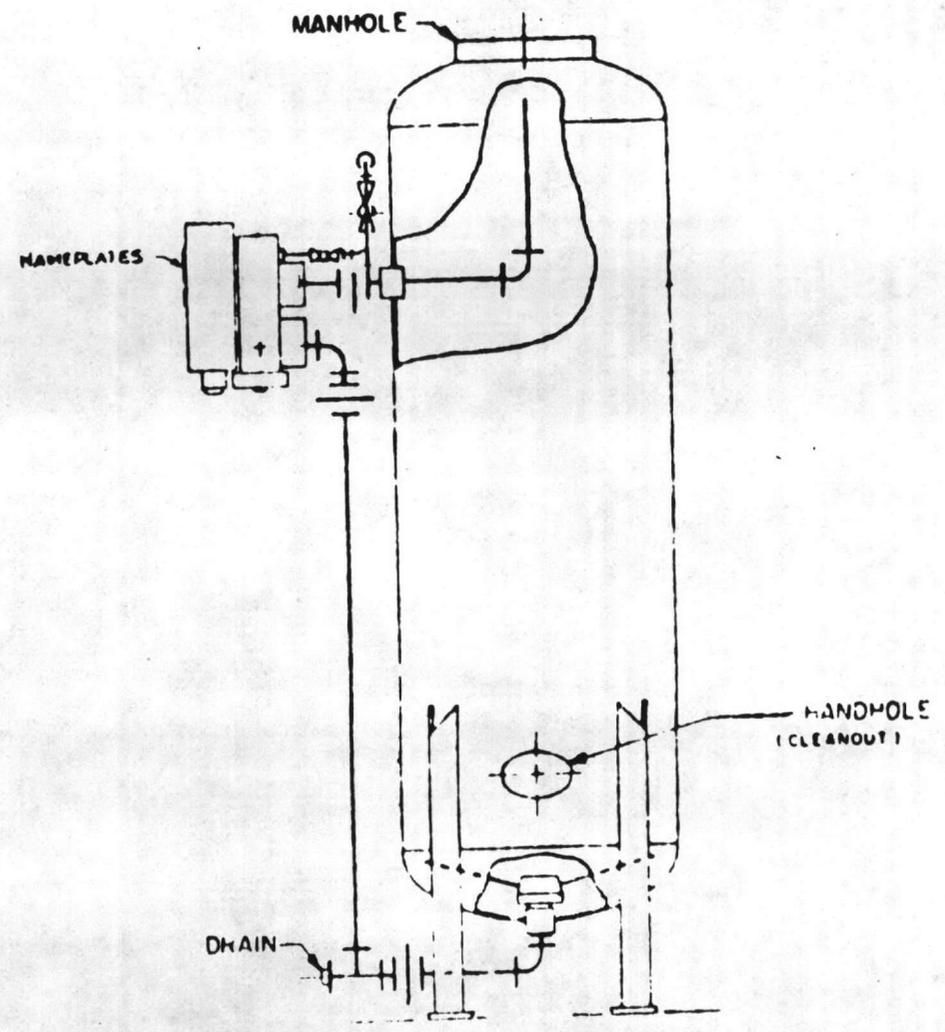
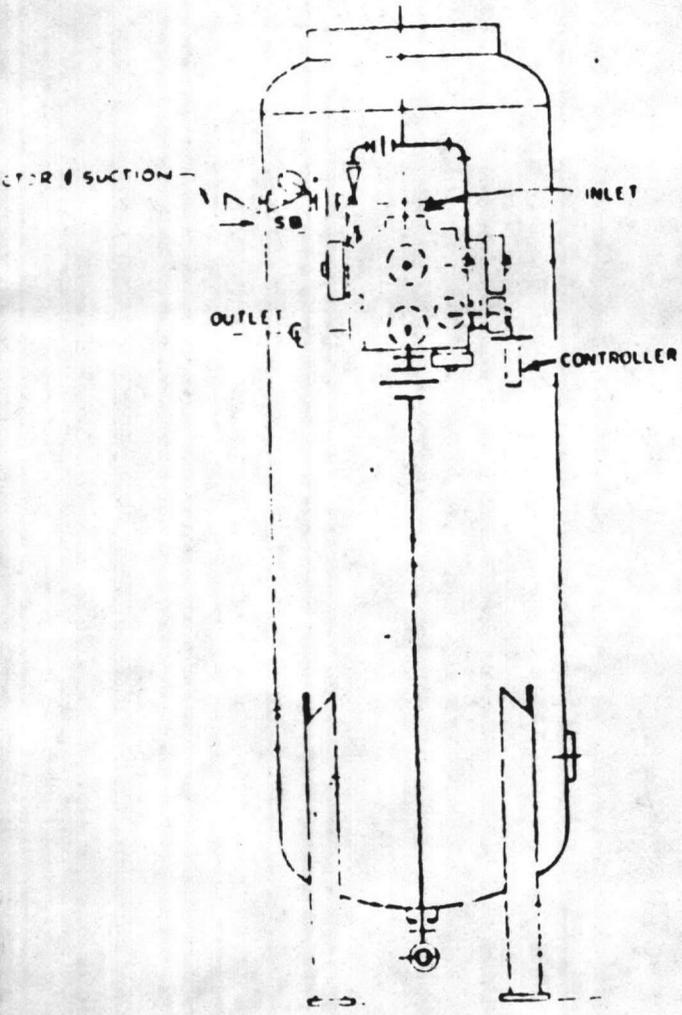
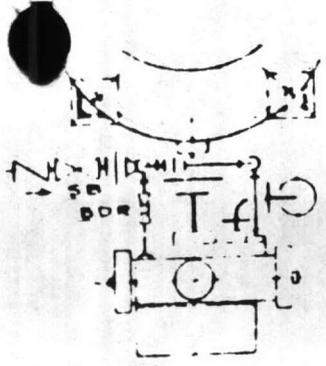


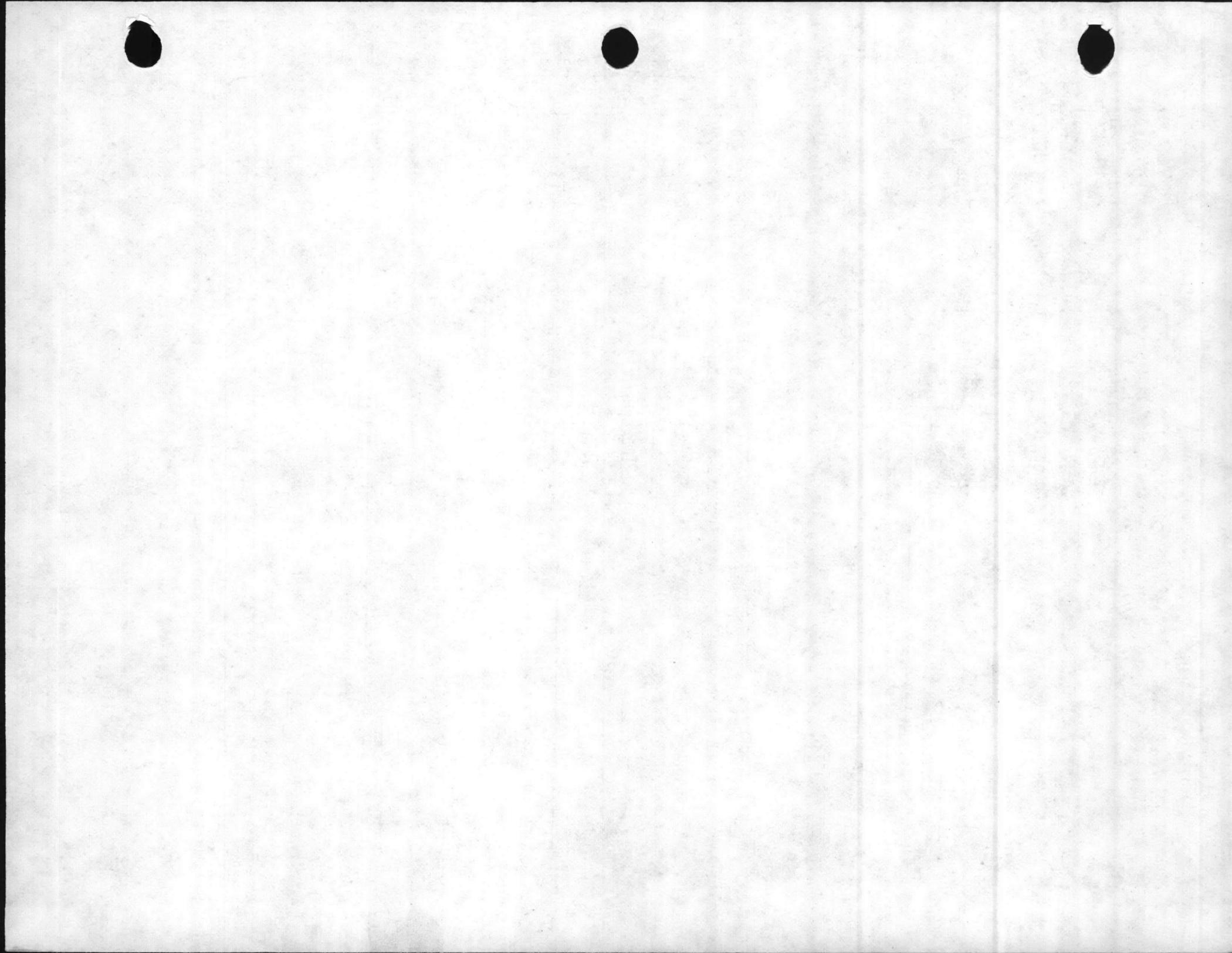
CAUTION

BEFORE ADDING FILL MATERIAL IN TANK. INSPECT STRAINER ASSEMBLIES TO INSURE PROPER INSTALLATION. BOTTOM EDGE OF STRAINER SHOULD SEAT TIGHTLY TO STRAINER PLATE AROUND ITS ENTIRE CIRCUMFERENCE. USE FEELER GAUGE TO INSURE NO GAP OR OPENING EXISTS GREATER THAN 0.006." IF GAP IS LARGER FOLLOW INSTRUCTIONS. STEPS 8 & 9 ON PERMUTIT CO. FORM NO. 4938 (INSIDE TANK) DO NOT TIGHTEN NUTS TO TAKE UP GAP



SORTENER WITH MULTIPORT CONTROL
INLET - OUTLET - DRAIN ORIENTATION





OPERATING INSTRUCTIONS

Chemical Test for Quality Control

- The DATA SHEET indicates which chemical test is to be used for control of softener operation (SOAP TEST or TOTAL HARDNESS TEST).
 - The chemical test is to be used to determine when a softener should be regenerated, and when a rinse may be ended.
 - The sample to be tested should be drawn from the soft water sampling cock during a softening run, and from the sump (or rinse outlet) during a rinse.
 - Once the correct length of run, and length and rate of rinse have been determined, these figures may be used for standard operation as long as the raw water characteristics do not change. The chemical test should be used to periodically check on the operation of the softener and adjustments made whenever necessary.
-
-

1. SOAP TEST

Permutit Test Set #1
Hardness Soap Demonstration

Hach Model S0-11
Cat. No. 2253-00

Apparatus

- 1 Test Tube
- 1 Stopper
- 1 Dropper bottle

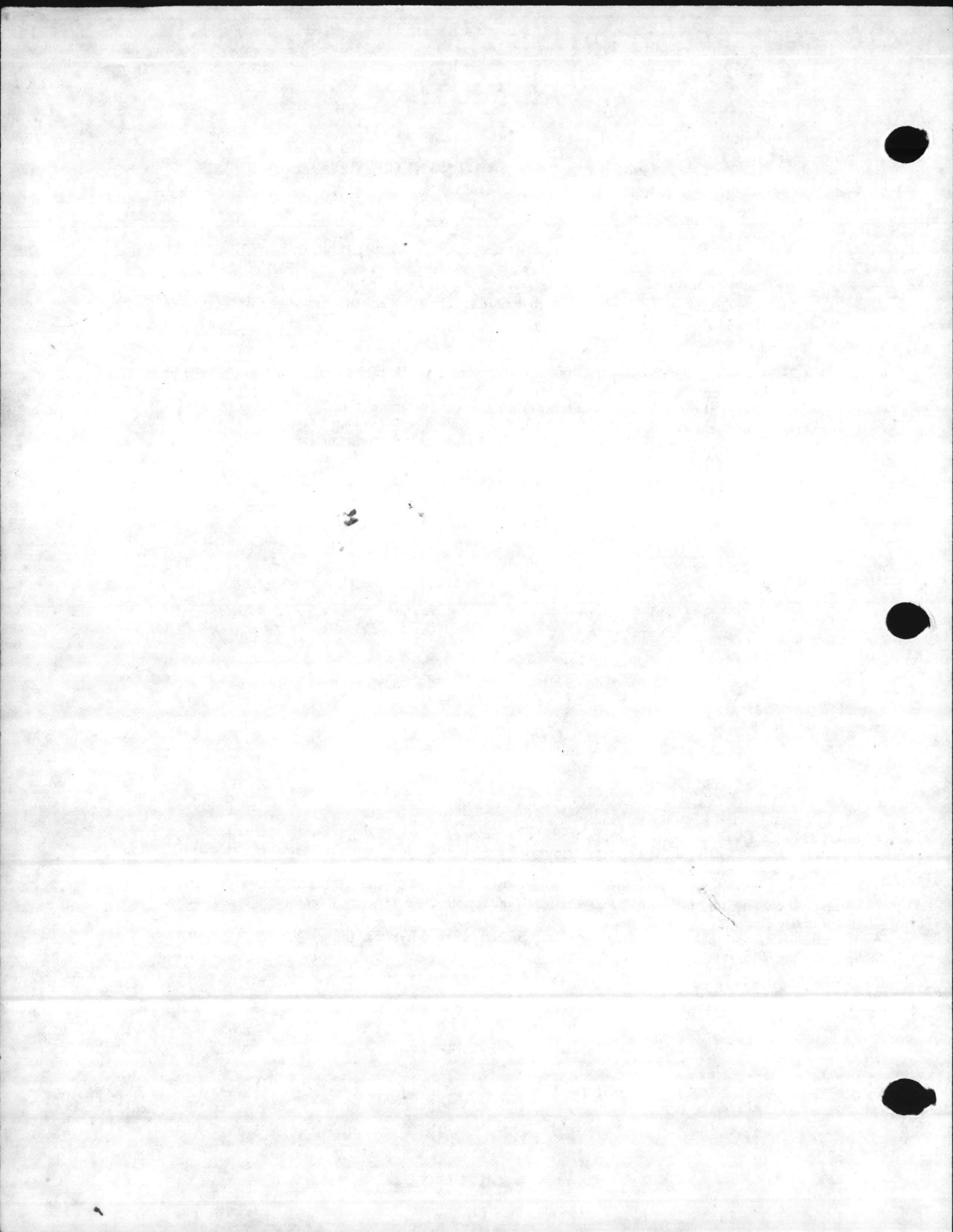
Reagents

- 2 oz. Soap Solution

Procedure

- Fill the test tube to the mark with hard water.
- After addition of specified number of drops of soap solution (see DATA SHEET), stopper, shake test tube vigorously and place on its side. If water is soft, a permanent lather will form, covering the entire surface and lasting for at least 5 minutes.
- If a lather does not form and remain for 5 minutes, the water being tested is hard. If the sample was taken from the softener effluent, the unit should be regenerated. If the sample was rinse water, it indicates that the rinse is still incomplete.
- The test should be made at room temperature; if the sample is close to freezing temperatures, allow it to warm up before the test is run.

CAUTION: The soap solution contains free caustic and should not come in contact with the skin, fabrics, etc. If spilled, rinse thoroughly with water.



OPERATING INSTRUCTIONS

2. TOTAL HARDNESS TEST

Hach Model HA-71A
Cat. No. 1452-01

Apparatus

- 1 - Mixing bottle
- 1 - Erlenmeyer flask, 125 ml.
- 1 - Plastic measuring tube, 5.83 ml

Reagents

- 4 oz. Buffer solution, Hardness 1 in dropper bottle
- 4 oz. ManVer[®] II hardness indicator Hardness 2 in dropper bottle
- 4 oz. Titrant Reagent, Hardness 3 in dropper bottle

Procedure

Two procedures are outlined. Procedure A for low range when testing the softener effluent or rinse water. Use procedure B for relatively high range when testing a sample of raw water.

A. Low Hardness Water

Low Range (1 drop equals 1 mg/l)

- Fill the flask to the 100-ml mark with the water sample.
- Add 2 dropperfuls of Buffer Solution, Hardness 1. Swirl to mix.
- Add 4 drops of ManVer[®] II Hardness Indicator, Hardness 2. Swirl the flask to mix. A blue color indicates soft water. If a red color is produced, proceed to add Titrant Reagent, Hardness 3, dropwise with constant swirling of the flask. Count the drops until the color changes from red to blue. Each drop of the titrant used is equal to 1mg/l as calcium carbonate (CaCO₃).

B. High Hardness Water

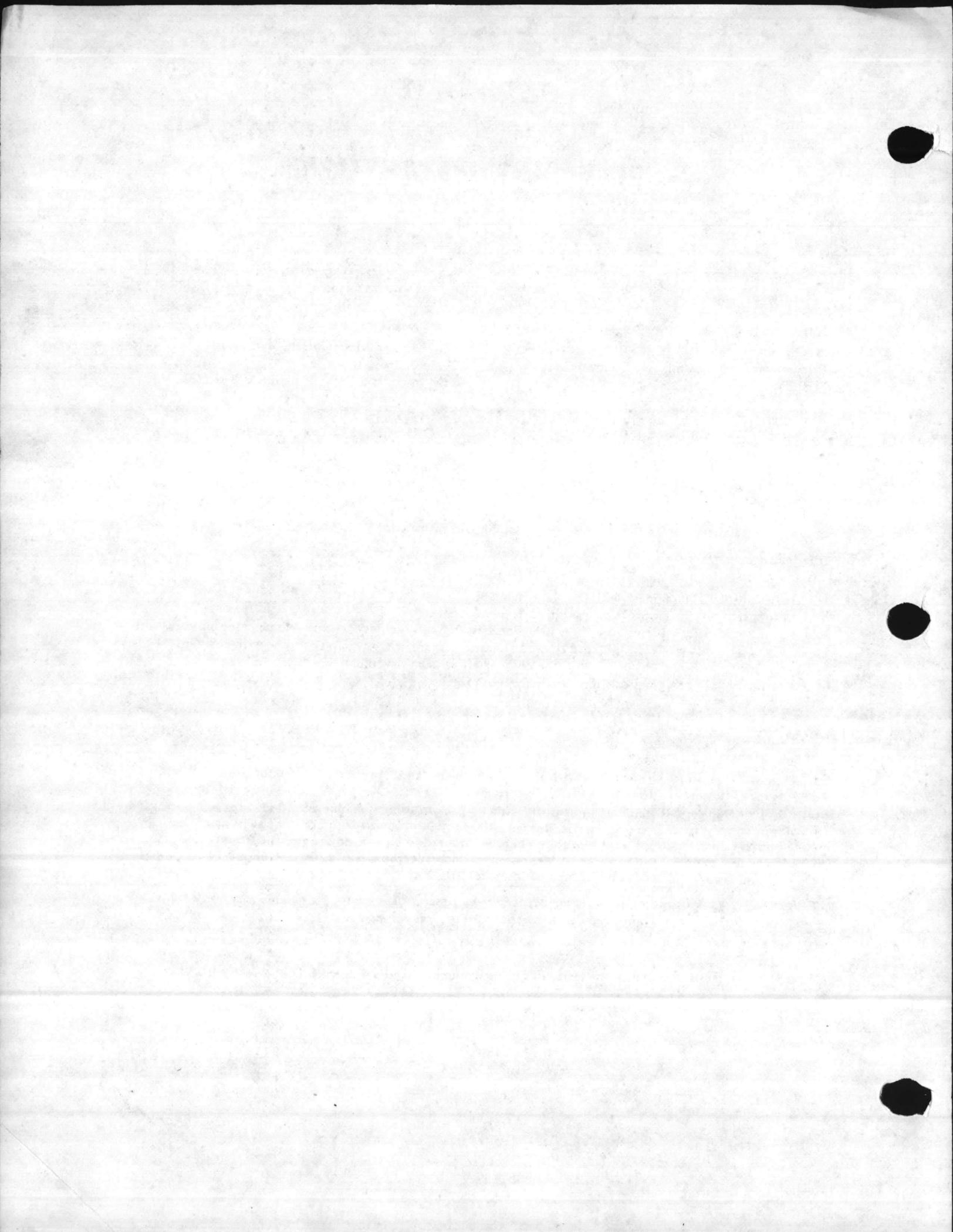
High Range (1 drop equals 1 gpg)

- Fill the plastic measuring tube level full with the water to be tested. Pour it into the mixing bottle.
- Add 3 drops of Buffer Solution, Hardness 1. Swirl to mix.
- Add 1 drop of ManVer[®] II Hardness Indicator, Hardness 2. Swirl to mix. A blue color indicates soft water. If a red color develops, proceed to add Titrant Reagent, Hardness 3, dropwise with constant swirling of the mixing bottle. Count the drops until the color changes from red to blue. Each drop of the titrant used is equal to 1 grain per gallon hardness, expressed as calcium carbonate (CaCO₃). [One grain per gallon (gpg) equals 17.1 milligrams per liter (mg/l)].

NOTE: It is suggested that reagent accuracy be checked from time to time by using a reliable standard hardness solution (not included in kit). Follow regular instructions using standard instead of sample.

Replacement equipment and reagents, the latter in varying volumes, may be ordered F.O.B. directly from:

HACH CHEMICAL COMPANY
P.O. Box 907
Ames, Iowa 50010
Tel. 515-232-2533
TWX 910-520-1158



SECTION B.

INSTALLATION and MAINTENANCE

CONTENTS

	Page
PRELIMINARY	B - 1
INSTALLATION DIRECTIONS	B - 2
STARTUP	B - 6
PRECAUTIONS	B - 7
MAINTENANCE OF MECHANICAL EQUIPMENT	B - 9
TROUBLE SHOOTING	B - 12

PERMUTIT

THE PERMUTIT COMPANY, INC., E49 MIDLAND AVENUE, PARAMUS, N.J.

PRELIMINARY

BEFORE YOU BEGIN . . .

CAUTION

Flush all lines before connecting them to unit. Do not use undue force when screwing pipes into valve pipe connections. Ream and clean all new piping free of chips.

FOOD, BEVERAGE, AND DRUG MANUFACTURE

If the water to be treated by this equipment is to be used in connection with the commercial manufacture of any food, beverage or drug product, check first with the Service Department of The Permutit Company for any special instructions which may be required.

FILTERS

The Softener is designed to soften clear, cold hard water that is free of suspended iron, turbidity and other foreign matter. If your water supply is not as specified above, a filter should be installed to correct this problem.

PRESSURE REGULATING VALVES

Investigate the water pressure. The softener operates on 25 to 100 lbs. per square inch maximum. If water pressure exceeds the maximum, pressure regulating and pressure relief valves must be installed in the supply line to the softener. Optimum pressure range is 40 to 70 PSIG.

AIR CHAMBERS

In installations where water-hammer may occur from quick-closing valves, such as flushometers, the unit should be protected by the addition of an adequate air chamber.

FLOW RATE

Be sure there is a sufficient flow of water to the softener system.

UNIT LOCATION

The softener unit should be located at a convenient point near a waste water drain. If the softener effluent water goes to a water heater, both a check valve and relief valve must be installed in the soft water outlet line to prevent hot water from backing into control valve. Provision must be made for bypassing any fixtures which are to be supplied with hard water.

WASTE WATER DISPOSAL

A pipe for disposal of waste water during regeneration must be run from the softener to a waste water drain: Keep the waste line open and accessible so as to be able to check the flow rates and to check for resin loss in the rinse and back wash position. A direct connection cannot be made to a sewer pipe.

STEP 1 - PREPARE FOUNDATIONS

- See Foundation or Layout Drawing. DATA SHEET gives the weight of equipment.
- Drain line or sump outlet must be large enough to avoid flooding of area.

STEP 2 - ERECT TANKS

- Tanks must be plumb and legs set so that piping from bottom passes between legs.

STEP 3 - INSTALL PIPING, VALVES AND METER

- Refer Layout Drawing
- Always place shutoff valves on INLET AND EFFLUENT line of each softener.
- Before installing a Multiport Valve, flush tank and piping to prevent damage to valve slide.
- LUBRICATE Multiport Valve before placing in operation (see MAINTENANCE.)

STEP 4 - INSTALL STRAINER SYSTEM

- See DATA Sheet for TYPE UNDERDRAIN Provided.
- A. Double-Dish System
 - On small diameter units, plastic strainers will be in place when tank is shipped. Each strainer assembly must be checked to be sure all are properly seated and hand-tight.
 - On larger units, strainer assemblies will be shipped separately for installation at the job site. SEE FIGURE 1 for assembly and installation procedure.
 - Test the system as described in STEP #6.

STEP 5 - INSTALL UPPER INTERNALS

- REFER INTERNAL ASSEMBLY drawing(s).
- From inside bottom of tank measure off required distances for location of top of bed and internal piping, and mark each location in 3 or 4 places around inside of tank.
- Install brine and wash piping carefully at required elevations, using marks as check points.
- If necessary, several of the lateral pipes may be temporarily removed to provide working room for loading ion exchanger and supporting bed.

STEP 6 - TEST UNDERDRAIN SYSTEM

- Set all valves for BACKWASH (see OPERATION). Keep shut-off valve in inlet line closed until ready to start test.
- If equipment is AUTOMATIC, open disconnect switch.
- With a man at manhole to observe UNDERDRAIN system, open inlet valve to admit water to bottom of unit.
- Note whether water comes freely from every strainer. Several trials will be necessary, and after each trial drain water from tank through the drain plug.
- Any clogged strainers should be thoroughly flushed out.

Installation of Strainer Assembly

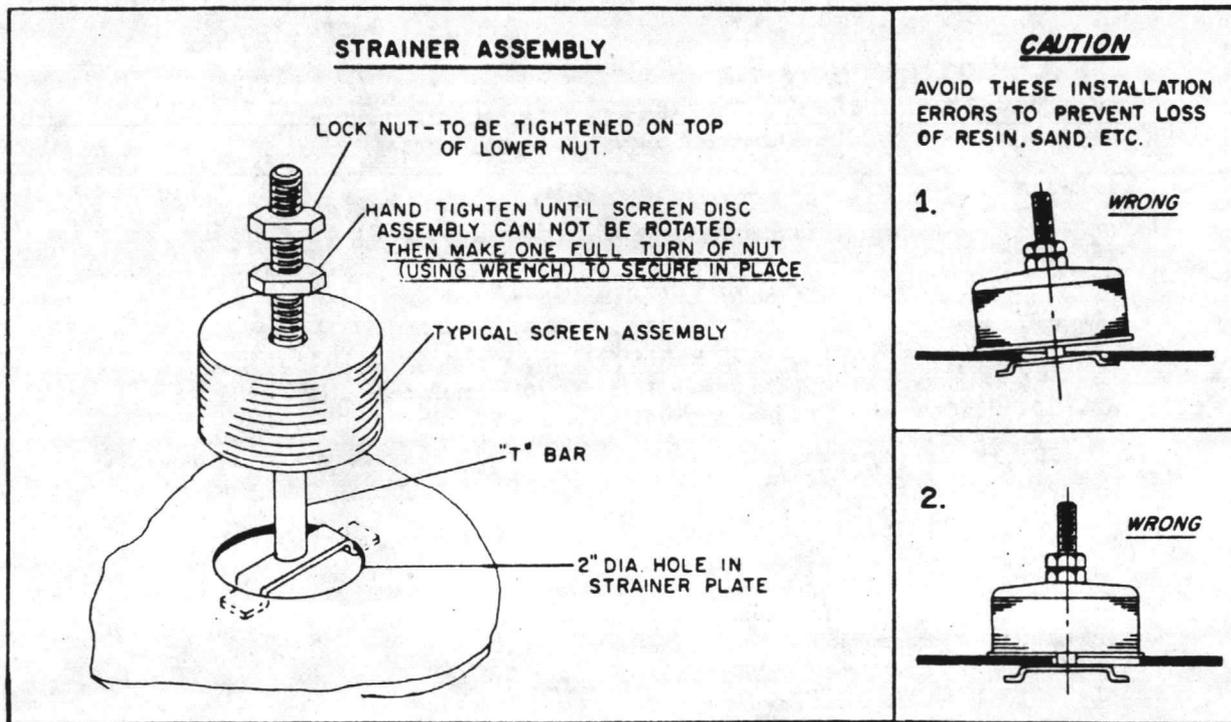


Figure 1.

Strainers are shipped assembled with SCREEN ASSEMBLY and nuts in place on T-BAR.

IMPORTANT NOTE: Before installing strainers, inspect holes for any burrs, weld spatter, etc., which would prevent proper seating of assembly. Correct as necessary. EACH STRAINER MUST SEAT TIGHTLY AROUND ITS ENTIRE CIRCUMFERENCE BEFORE INSTALLING FILL MATERIAL.

To install these assemblies proceed as follows:

- 1) Remove any plastic tape used to hold the assembly together during shipping.
- 2) Back off nuts to top of T-BAR to free SCREEN ASSEMBLY.
- 3) Tilt T-BAR and insert into 2" hole in the strainer plate. Center the rod in the hole and pull up on stem, so that the shoulders of the T-BAR are up inside the hole.
- 4) Tighten first nut by hand until SCREEN DISC ASSEMBLY is very lightly seated against strainer plate. Try to *shift* the assembly as a means of checking whether the T-BAR has slipped out of its position in the hole.
- 5) After T-BAR is center in the hole, tighten down the first nut by hand until entire assembly can't be *rotated* by hand, then make one full turn of nut, using wrench, to secure in place.
- 6) Place the second nut on the stem of the T-BAR and tighten with a small wrench on top of first nut. This nut serves as a lock nut.
- 7) Final inspection should include use of 0.006" feeler gauge between:
 - a) strainer plate and strainer
 - b) lower nut and strainer
 This procedure will insure proper seal.
- 8) If gap is larger than 0.006", back off nuts and repeat steps 3 thru 7.
- 9) If gap is still larger than 0.006", call the Permutit Company, Service Dept., Area Code: 201 262-8900.

CAUTION: IN NO CASE SHOULD NUTS BE TIGHTENED MORE THAN INDICATED IN STEP 5 TO CLOSE GAP.

STEP 7 - LAY SUPPORTING BED (IF ANY)

- Double Dish underdrain requires NO supporting bed unless specifically noted in Section A, DATA. Header-Lateral type has either gravel or anthracite.
- Gravel or anthracite is shipped in bags, labeled according to size. With some softeners a layer of coarse sand is also provided. Do not put gravel supplied for SALT TANK into softener by mistake.
- Place supporting bed in separate graded layers (SEE INTERNAL ASSEMBLY drawing), and carefully level each layer before placing the next one.
- For aid in leveling, let water into bottom of tank VERY SLOWLY until it just reaches the top of the layer. Then use the water surface to level the supporting bed material.
- Place first two layers carefully by hand. Other layers may be poured slowly into tank if a board is placed in the bottom to break the fall. Do not allow material to damage underdrain system or disturb other material already in the tank.
- If the shell is lined with a special protective coating, all supporting bed material should be placed by hand. It is very important that such a lining is not damaged.
- When entire bed has been placed and leveled, measure the vertical distance from the top of supporting bed to lowest point on lip of manhole. Record this measurement (for each softener) for future reference.

STEP 8 - LOAD ION EXCHANGER

- Fill tank half-full with water added VERY SLOWLY through the bottom.
- Pour ion exchanger into tank through the manhole.
- If ion exchanger provided is ZEO-KARB, allow it to soak at least two hours. ZEO-KARB swells when wet to expand its volume by about 25%.
- After exchanger is in place (after 2 hours in the case of ZEO-KARB), close the manhole and fill the tank SLOWLY with water entering through the bottom.
- When water flows out of the wash water outlet pipe into the sump, SLOWLY open the inlet valve until wide open.
- Backwash the softener at the rate of flow specified (SEE DATA SECTION) by adjusting the backwash rate controller.

STEP 9 - REGULATE BACKWASH RATE

- See DATA SHEET for type of RATE CONTROL provided.
- Before making any adjustment, first be sure the inlet valve is fully opened.

A. Rate Set Valve

- Measure the flow rate (gallons per minute) using the meter and a clock. When no meter is provided, check rate by timing the waste water collected in a container of known volume.
- Adjust the valve in the wash outlet line to give the backwash rate specified (see OPERATION).
- During this first wash, some ion exchanger "fines" will appear in the wash water. This is normal, but during this and future washings, there should be no loss of normal sized particles when the softener is backwashed at the specified rate.
- Continue the wash for about 30 minutes, or until the wash water contains no appreciable amount of fine material.

STEP 10 - CHECK BED DEPTH

- End backwash by closing valve in inlet line slowly.
- Remove manhole and partially drain tank through wash or rinse line (MULTIPOINT VALVE in REGEN position).
- Stop draining when water level is estimated to be 8" to 12" below top of exchanger bed. Bed should be smooth and level.
- Measure vertical distance from top of bed to lowest point on lip of manhole. Record for future reference.
- Calculate the bed depth of ion exchanger by subtracting this measurement from the dimension obtained when the distance to top of supporting bed was measured (STEP 7). Record the bed depth thus calculated.

STEP 11 - REGULATE RINSE RATE

- Replace manhole and refill tank SLOWLY through the bottom.
- When water flows through outlet pipe into sump, open inlet valve fully, and backwash at full rate for 3 or 4 minutes.
- Set the softener valve(s) for RINSE (see OPERATION for procedure).
- Control of the rinse rate uses the same type of equipment as used for control of backwash rate. See OPERATION sheet for type of control provided and for specified rate of flow.
- See STEP 9 for instructions for adjusting the rate.

STEP 12 - INSTALL METER REGISTER

- Place change gears on meter and register drive spindles. Use description on shipping instructions to identify each gear (by the number of teeth).
- Attach register to meter. Be sure register is plumb and change gears mesh.
- Remove rear cover; open front cover. Rotate indicator hand CLOCKWISE (when viewed from front) Neptune Only and observe operation of the switch.
- Switch should (a) CLOSE at the ZERO position of indicator hand, and (b) OPEN when hand is rotated about 1/8 turn in a clockwise direction.
- Badger & Hersey Registers should be operated counter clockwise.
- Fully AUTOMATIC softeners are provided with slightly different register operation. SECTION D-AUTOMATIC EQUIPMENT gives additional INSTALLATION details for that type register.

STEP 13 - ASSEMBLE REGENERATION EQUIPMENT AND LOAD SALT

- Assemble tanks, piping, valves and related equipment as shown on LAYOUT or REGENERATION EQUIPMENT DRAWINGS. The Polyethelene Brine Tank should be set on a clean, solid, flat surface.
- DATA SHEET indicates which of the following regeneration systems has been supplied. Refer to appropriate section below for installation instructions.

A. Salt Saturator

- Install brine suction piping, connect water line to float (refill) valve on salt tank.
- Load salt into salt tank to provide at least 18" depth in the tank. Clean, white, pea-sized rock, solar or approved grades of pellet salt are recommended. Keep salt clean and free from all foreign matter that may contaminate water. Open BRINE REFILL valve to add water to salt until 2" below overflow fitting of tank. Note level of brine in salt tank and adjust float by adjusting float rod up or down until level is maintained at approximately 2" below overflow.

STEP 14 - REGULATE BRINE DRAW

- Adjust brine draw so that brine level in salt tank drops at rate shown in "OPERATION". Turn BRINE ADJUSTER screw counter clockwise to increase rate of brine draw. Turn BRINE ADJUSTER screw clockwise to decrease brine draw rate.

A. Rotate Multiport Valve to RINSE (R) position and rinse until free of possible salt brine and then rotate to original SOFTENING (S) position.

- Open BRINE REFILL valve and fill salt tank with water. Adjust float rod, if necessary.
- Close BRINE REFILL valve.

B. Salt Storage Tank - Brine Measuring Tank

- Install BRINE COLLECTOR in Salt Storage Tank (SST).
- Place 6" of gravel in bottom of SST and level top surface. Gravel should cover the brine collector.
- Place BRINE DRAW DISC and COLLAR on brine suction line in Brine Measuring Tank (BMT)
- Load salt into SST until it is full.
- Open isolating valve in make-up water supply line and allow water to flow through the float valve and constant head box - into the SST.
- Throttle SETCOCK in line between the SST and BMT, so that it takes about 2 HOURS to fill the BMT (or, one of the BMT's, if more than one is provided). If BMT fills too quickly, brine will be too weak.
- Adjust float valve in constant head box to close when level of water in box is 1" from top. (Brine level in BMT is always below this level because of difference in densities).
- When highest level of brine in BMT has been reached place BRINE DRAW DISC at correct elevation to indicate specified brine draw.
- If equipment is automatic, adjust the float switch or electrode in the BMT, to give specified brine draw.

STARTUP

When all equipment has been installed, follow the procedure outlined below before placing the softener(s) in service.

- Check operation of all mechanical components.
- If equipment is AUTOMATIC, check operation of electrical components. See SECTION D-AUTOMATIC EQUIPMENT, for test procedure for electrical equipment.
- When all components are found to operate properly, regenerate each softener as specified - see OPERATION sheet. Set dilution rates, brine draw rates, etc., at this time.
- Rinse each softener according to instructions in OPERATION.
- After rinse, the softener is ready to be placed in service.

PRECAUTIONS

To obtain the best operating results from the softeners and to avoid damage, the precautions listed below should be observed at all times.

1. **HARD WATER SUPPLY** – should be within the quality limitations indicated.

	CATION EXCHANGER		
	Q	ZEO-KARB	ZEO-DUR
Maximum Temp. (°F)	250	140	140
pH Maximum	11	11	8.3
Minimum	–	–	6.2
Max. Total Hardness (grains/gallon)	All	All	All
Turbidity (Max.) ppm	5	5	5
Oil	None	None	None
Hydrogen Sulfide ppm (Max.)	0.5	0.5	0.5
Free Chlorine ppm Max.	0.5	0.0	10

Iron and Manganese in the water must be in the dissolved form (WATER clear when first drawn) to avoid damage to the ion exchanger. Oxidizing agents (such as Chlorine) should not be added to water before softening, if iron and manganese are present. Air leaks in piping on pump suction should also be eliminated.

2. **HOUSING** – Softener must be properly housed to protect it against freezing, rain, dust or other abnormal conditions.
3. **TEMPERATURE** – Allowable water temperature is also limited by materials of construction of multiport valve and softener itself. See DATA SHEET for maximum allowable temperature.

If soft water passes directly into a hot water heater or other heat producing apparatus, a swing check valve must be installed in line to prevent hot water backing into softener or meter. A pop valve should be placed between check valve and heater in order to protect softener shell.

4. **CAPACITY** – Do not run softener at flow rates higher than allowable. Test hardness of raw water periodically to avoid running unit past its capacity for hardness removal. If overrun, a double regeneration (as at STARTUP) is required to restore ion exchanger to normal condition.
5. **AIR** – It is very important to keep air out of backwash water, since it may cause upset bed. Be sure all pipe flanges, pipe joints, packing glands of pumps, etc. are tight.

PRECAUTIONS

6. **WATER HAMMER** – Wherever water hammer or rapid pulsation of water pressure occurs (even at low pressures), the user should provide a properly designed air chamber, or other suitable means, to protect the softener tanks from rupture.
7. **IDLE PERIODS** – If idle period is long (one week or more), before shutting down, run the unit until effluent is no longer soft, and then drain. During the idle period the softener should remain tightly sealed to prevent ion exchanger from drying out.

If there is any danger of freezing, keep inside of tank filled with saturated brine.

When ready to resume operation, proceed as described under STARTUP.

If idle period is to be short (overnight, weekend), merely shut down unit. When restarting, rinse the softener to waste until effluent quality reaches its normal level, before placing unit in service.

8. **BOILER BLOWOFF CONTROL** – Ion exchange softening does not reduce total solids in water. If the soft water is used for boiler feed, it is still necessary to periodically blowdown the boiler in order to maintain concentrations within required limits.

9. PREVENTION OF CORROSION

BOILER FEED – should be deaerated to avoid corrosion. Sufficient deaeration for protection of the boiler proper can be accomplished in the usual open heater, if large enough and properly operated. If steel tube economizers are used, the water must be completely deaerated, and special equipment should be added to the ordinary open heater for this purpose.

HOTWATER SUPPLY PIPING – Deaeration should also be employed. If corrosion occurs and deaeration cannot be adopted, feeding of SODIUM SILICATE into the inlet of the heater for the hot water supply (NOT BOILER FEED) will be found helpful.

MAINTENANCE - MECHANICAL EQUIPMENT

If equipment is AUTOMATIC, also see "Section D-AUTOMATIC EQUIPMENT for additional instructions covering electrical equipment.

1. MULTIPORT VALVE

General

- Water pressure on valve must not exceed maximum operating pressure listed on DATA SHEET.
- Keep stuffing gland around valve stem leak tight, but do not tighten gland nut too much.
- Take valve apart at least once a year to inspect slide and port plate. Coat contact surfaces lightly with grease before reassembling.

General Lubrication

- Check oil in valve case occasionally to keep at level of 1/4" plug on left side of valve. Change oil in gear case every 6 months. Use 600-W oil (purchase at service station).
- In manually operated 2" and 3" valves, use grease (such as Gargoyle AA-3), instead of oil.
- Occasionally oil the motor coupling and drive shaft bearing located below the coupling. (AUTOMATIC VALVES ONLY).
- Do not allow dirt or water to get into gear case.

Lubrication of Slide

- Lubricate slide before valve turns hard or clatters. Required frequency will depend on operating water pressure.
- Slide LUBRICATING PROCEDURE and recommended LUBRICANT are given on reverse of MULTIPORT VALVE PARTS LIST, in Section A of instructions.

2. SALT TANK

- Salt storage tank or saturator must be inspected periodically and cleaned whenever necessary.
- Impurities and dirt accumulate in lower part of tank and in gravel. Can cause incomplete regeneration by restricting brine flow or by delivering weak brine.
- To clean, remove gravel and old salt from tank. Wash gravel and carefully replace in bottom of cleaned tank. Refill with clean salt.
- Frequency of cleaning depends on type of salt used and frequency of regeneration. Usually, should be done at least every 3 months.

3. MISCELLANEOUS EQUIPMENT

- The following equipment, when provided with the softener, will require periodic mechanical maintenance.

Diaphragm Valves

- Inspect about every 6 months to determine that diaphragm is intact, valve seats properly, and packing gland (if any) is leak tight.

Float Switches

- The electrical contacts require periodic cleaning to have good electrical contact at all times.

Pumps

- Period inspection of packing gland is required to prevent excessive leakage. Repack glands as often as necessary.

4. ION EXCHANGER

- If softener is not delivering full capacity, and the cause seems to be the resin, samples of resin will be analyzed by the Permutit Laboratories. Consult Permutit Company for prices and shipping instructions. A RESIN SAMPLE TAG, completely filled in, must accompany each sample. This tag contains instructions for sampling and for mailing.
- **DIRECTIONS FOR SAMPLING:** – Backwash and drain the unit or units in question and inspect the beds. Collect 1 pint samples from (a) the top of the bed, (b) 9'' below top of bed, and (c) 18'' below top of bed. Samples may be packed in pint Mason Jars, or in quart size polyethylene bags such as are used as liners for frozen food containers. The bag may be sealed with cellophane tape. Drain as much water as possible before sealing bag. Do not dry. The Sample must be packed so that it will not dry in transit. Be sure to label each jar or bag with a completed RESIN SAMPLE TAG.

WATER SAMPLES

- When condition of resin is checked, it is usually advisable to have samples of raw and treated water analyzed at the same time. This service is also performed by The Permutit Laboratories. Consult Permutit Company for prices.
- Each water sample must be accompanied by a WATER SAMPLE TAG (see Figure 2). This tag gives complete directions for collecting samples and for mailing.
- Permutit will supply water sample polyethylene cubitainers, tags, and shipping cartons – free upon request.

WATER SAMPLE TAG

Sample From: _____

Sent by: _____

Source of Water: _____

Sampling Point: _____

Date Sampled: _____ Time: _____

Sample clear when drawn Yes () No ()

Type of Analysis: _____

Field Data & Remarks: _____

Report to: _____

**Sampling Instructions
Routine Analysis**

1. Volume – two quarts from each source.
2. Inflate cubitainers with either water to be sampled or distilled or deionized water.
3. When sampling from a faucet or pump, permit the water to flow sufficiently to thoroughly flush the pipe lines. When sampling from a stream or pond, draw the sample below the water surface at the approximate location of the proposed intake.
4. Rinse sample bottle at least twice with water to be sampled. Fill sample bottles, leaving only a small air space. If possible, acidify one of the two containers with 5 ml. of reagent-grade hydrochloric or nitric acid. Cap tightly. Identify acidified bottle and type of acid used.
5. Carefully fill in the information requested on the other side of this tag and attach the tag securely to the appropriate bottle.
6. Assemble carton, place bottles in carton, and seal with the tape provided. During cold weather, pack to avoid freezing. Attach shipping label.

Ship to: The Permutit Company
 R&D Center
 P.O. Box 220
 Princeton, New Jersey 08540

5709

Figure 2 - WATER TAG SAMPLE

TROUBLE SHOOTING

Some commonly encountered operating difficulties and their usual causes are listed below. If the cause of trouble cannot be determined, or if there is doubt about the cause or about the proper corrective action to take – contact Pemutit's SERVICE DEPT.

1. REDUCED CAPACITY OR POOR EFFLUENT QUALITY

<u>SOURCE OF TROUBLE</u>	<u>POSSIBLE CAUSE</u>	<u>CORRECTIVE ACTION</u>
CHANGE IN CHEMICAL COMPOSITION OF RAW WATER	<ul style="list-style-type: none"> • Higher hardness in raw water 	<ul style="list-style-type: none"> • Check hardness by chemical test. If it has changed, compute new capacity and use new meter setting.
SOFTENER BEING OVERFLOUN CONSISTENTLY	<ul style="list-style-type: none"> • Raw water has more hardness than realized. • Meter setting is incorrect. 	<ul style="list-style-type: none"> • Check raw water hardness and meter setting. Give unit a "double-regeneration" (see STARTUP)
INCORRECT CHEMICAL TEST RESULTS	<ul style="list-style-type: none"> • Test procedure in error. • Chemicals for test cause error. 	<ul style="list-style-type: none"> • Follow instructions carefully. • Use only special soap solution. • Replace weak or contaminated test solutions.
METER SLIPPAGE	<ul style="list-style-type: none"> • Meter is not accurate at very low flow rates. • Worn or damaged meter. 	<ul style="list-style-type: none"> • Use higher flows, or replace with smaller meter. • Repair or replace as necessary.
INADEQUATE REGENERATION	<ul style="list-style-type: none"> • Using a weak (less than 22° Bé) brine solution • Not using enough salt. 	<ul style="list-style-type: none"> • Clean salt tank. • Recharge at required times. • Use salt which meets specification. • Use correct amount of dilution water (IF APPLICABLE). • Check Operation Sheet for specified amount. Use correct saturated brine draw, (or pumpage).
LOSS OF ION EXCHANGER	<ul style="list-style-type: none"> • Backwash rate too high • Surges during backwash • Presence of gravel hills 	<ul style="list-style-type: none"> • Eliminate the cause. • Replace lost ion exchanger.

FOULING OF ION EXCHANGER

- Oxidized iron (Fe) or manganese (Mn) coating exchanger
- Organic matter (slime) coating exchanger.
- If Fe & Mn are in oxidized form at source, provide filters to remove. If water supply is clear when first drawn (Fe & Mn are in soluble form) – eliminate any air leaks from suction piping, and do not feed chlorine or other oxidizing chemicals before softening the water. Provide treatment to destroy organic matter.

NOTE: It is sometimes possible to restore a fouled bed to its original condition, or very nearly so. Contact Permutit for recommendations.

DAMAGE TO ION EXCHANGER

- High concentrations of chlorine (or other oxidizing agents) in water
- Add reducing agent (such as Sodium Sulfit) or otherwise remove.

CHANNELING—caused by

A. Dirty or packed bed

- Backwash rate too low
- Dirty inlet water or backwash water.
- Careless placement of supporting bed.
- Surges during backwash
- Air in backwash water.

B. Gravel hills, tipped bed or potholes

- Adjust controller to correct rate.
- May require pre-treatment.
- Inspect and probe bed.
- If serious, must relay supporting bed.
- Eliminate any air leaks and cause of surges.

2. INCREASED PRESSURE LOSS OR DECREASE IN FLOW RATE

DIRTY OR PACKED BED

See above for possible causes and corrective action

RESTRICTED FLOW

- Obstruction in meter, piping, or multi-port valve.
- Isolating valves throttled
- Inspect and clean as required.
- All valves (except control valves) should be fully open.

PUMPS NOT DELIVERING CAPACITY

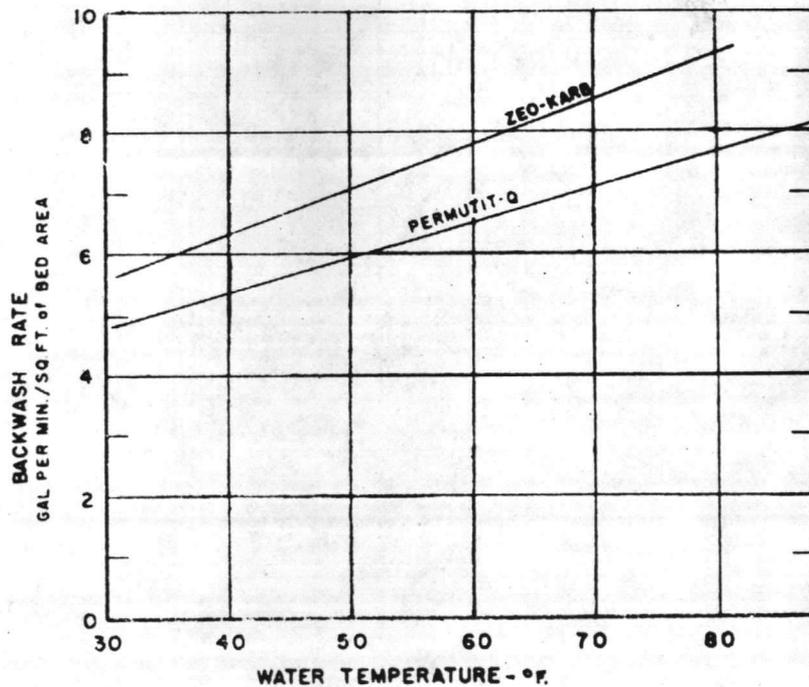
- Clearance in pump impeller has changed (from wear, etc.)
- Change in pump suction or discharge head conditions
- Leakage
- Check manufacturers drawings and adjust if necessary.
- May require installation of a booster pump.
- Repack stuffing box or seal piping leaks as necessary.

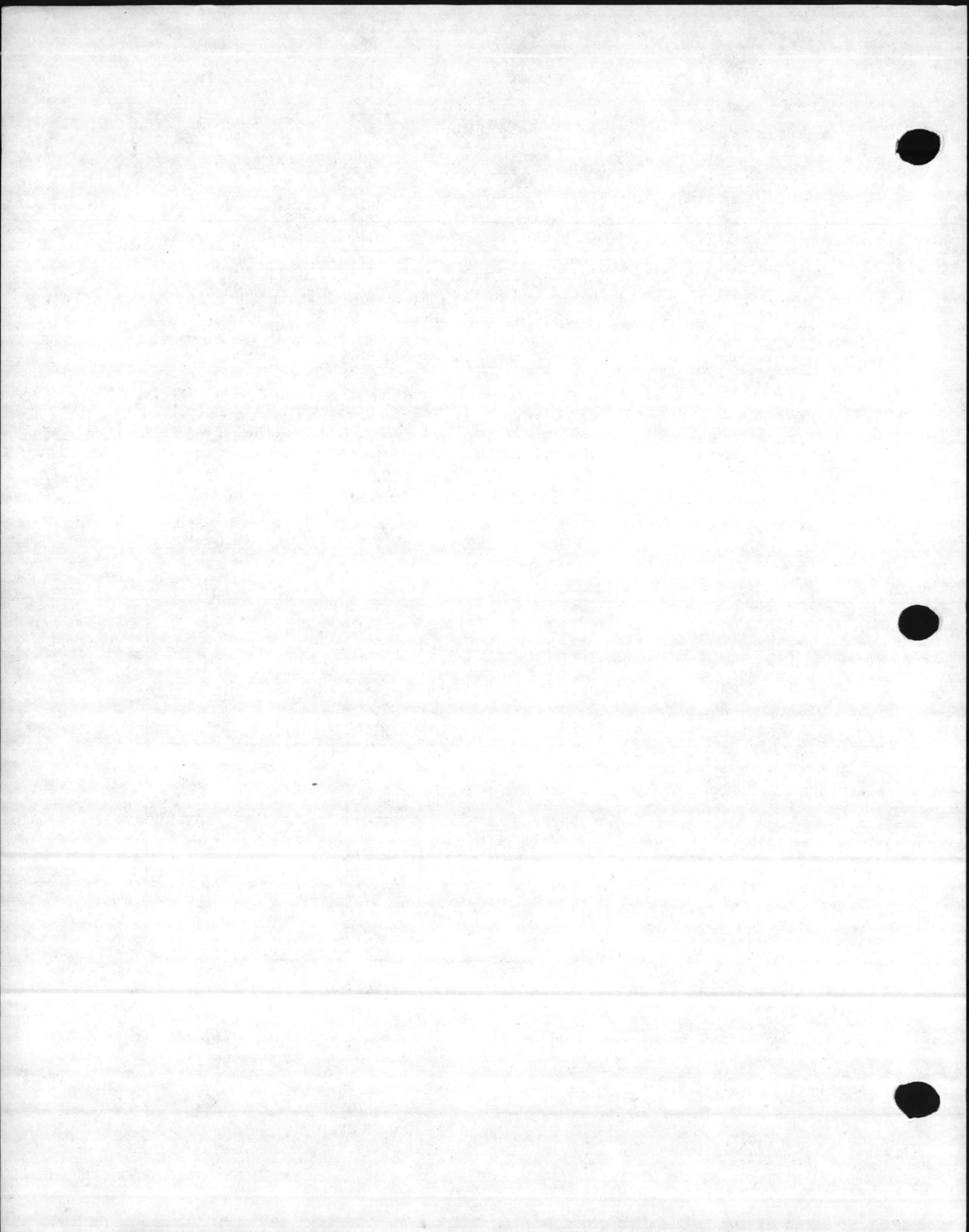
BACKWASH

Regeneration of any ion exchange unit is always preceded by a backwash step. In this operation, an upward flow of water is used to loosen and regrade the ion exchange bed and wash out dirt or suspended matter which may accumulate during the run. Careful regulation of the backwash flow rate is important since too low a rate will not clean the bed adequately, while a flow rate which is too high may wash out exchange particles of normal size. Some very finely sized ion exchanger particles or fragments may be washed out of the unit during backwash at normal flow rates, particularly when the unit is first placed in service, or if the system is being subjected to aggressive chemical agents. In such circumstances, it is desirable that these ion exchanger "fines" be removed in order to avoid other operating difficulties (see Trouble Shooting - Section B). If a small sample of each ion exchanger is set aside when the units are first installed, these samples can be used to determine whether any material which may be washed from a unit consists of normal sized particles or "fines".

Temperature of the water is an important consideration in selection of the proper backwash rate, because cold water has a greater lifting effect than does warmer water. Where water temperature is subject to seasonal variations, backwash rate may have to be adjusted two or three times a year. Fig. below indicates backwash rates which have been found adequate to keep exchanger beds clean under conditions normally encountered. However, any unit may be backwashed at as high a rate as can be obtained without washing out normal sized particles or plugging the "No-Resin-Loss" backwash collector strainers with resin. In practice, backwash should be started at a low rate and gradually increased until the maximum practical rate is reached.

VARIATION IN
NORMAL BACKWASH RATE
WITH
WATER TEMPERATURE





SECTION C.

GENERAL INFORMATION
on
ION EXCHANGE SOFTENING

CONTENTS

	Page
I ION EXCHANGE SOFTENING PROCESS.....	C-1
II QUALITY OF EFFLUENT.....	C-3
III CAPACITY FOR HARDNESS REMOVAL	C-4

PERMUTIT

THE PERMUTIT COMPANY, E49 MIDLAND AVENUE, PARAMUS, N. J.

I. ION EXCHANGE SOFTENING PROCESS

In order to understand what happens in the ion exchange softening process, it will first be necessary to understand the meaning of the terms which are used in the explanation. **HARD WATER**, **CATION EXCHANGER**, and **BRINE** are therefore defined below and then used to show how the ion exchange process works.

A. Hard Water

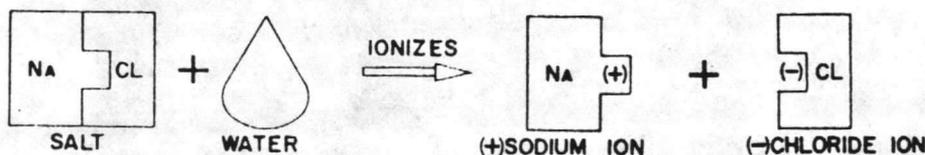
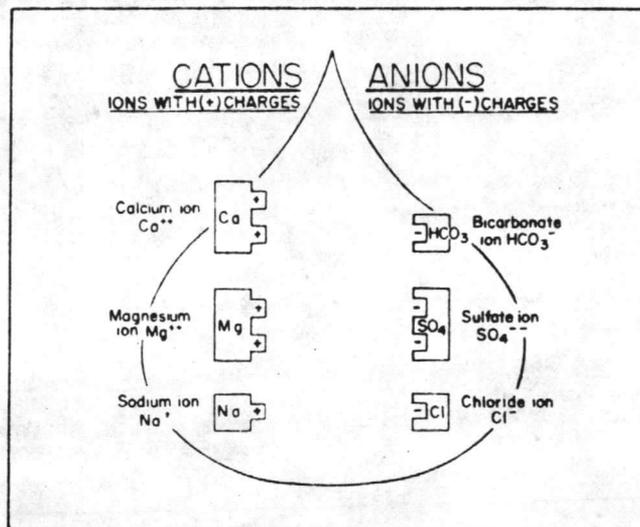
All natural waters contain much the same dissolved impurities, but in widely varying amounts.

There are always enough **ANIONS** present to balance the **CATIONS**, but anions have no effect on the ion exchange softening process.

Water will be **HARD**, if it contains large amounts of Calcium (Ca^{++}) and/or magnesium (Mg^{++}) ions.

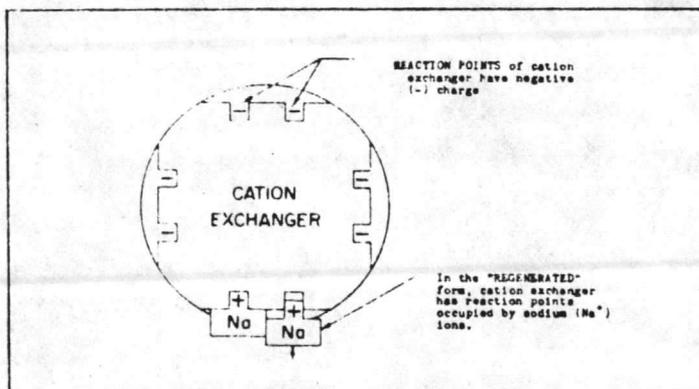
B. Brine – is water which has **SALT** dissolved in it. **SATURATED** brine contains as much salt as it is possible to hold in solution.

SALT – is **SODIUM CHLORIDE** (NaCl). When dissolved in water it splits up (ionizes) into Sodium (Na^+) ions and Chloride (Cl^-)



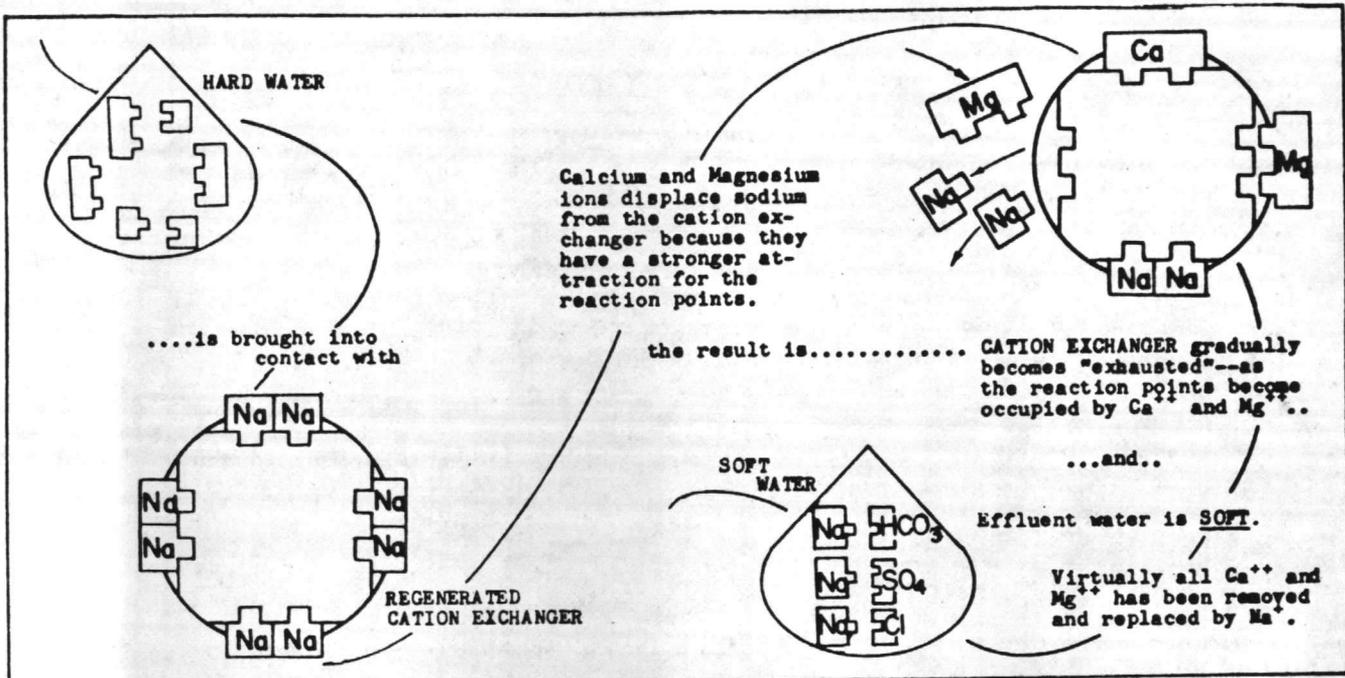
SATURATED BRINE – contains a very great number of Na^+ and Cl^- ions (concentration is over 200,000 ppm). When used to regenerate a **CATION EXCHANGER**, only the Sodium ions (Na^+) are put to use. The Chloride ions (Cl^-) do not work in the process.

C. Cation Exchanger – is a solid material which has a very large number of "REACTION POINTS". These reaction points have **NEGATIVE (-)** electric charges, and are able to attract and hold **CATIONS**, which are **POSITIVELY (+)** charged,.... (much the same as the way opposite poles of a magnet attract each other.)



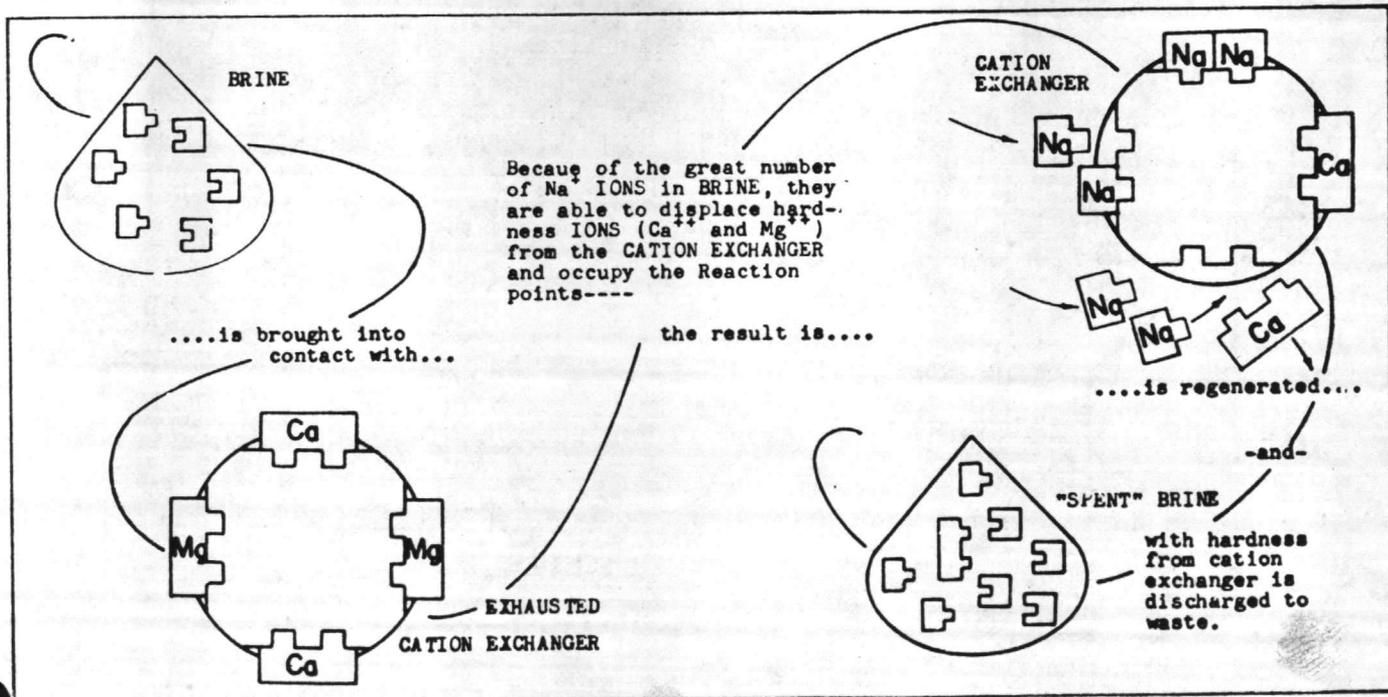
D. The Softening Process – The diagrams on the next page show how the elements explained above are combined in the ion exchange softening process to produce soft water.

GENERAL INFORMATION



When most of the reaction points have been occupied by Ca^{++} or Mg^{++} ions, hardness will begin to slip through the bed in increasing amounts. This rise in hardness in the effluent is an indication that the effective capacity of the CATION EXCHANGER has been reached. The CATION EXCHANGER must then be regenerated to restore it to its original condition.

E. REGENERATION



At the end of regeneration, the "spent" brine is rinsed away and the REGENERATED CATION EXCHANGER, with its reaction points again occupied by sodium ions - is again able to soften HARD WATER.

II. QUALITY OF EFFLUENT

If the hard water contains less than 500 ppm (about 30 grains) of Calcium, Magnesium and Sodium salts, all expressed as CaCO_3 , it will be found that the effluent from a softener will contain an average of not more than 2 ppm actual total hardness (Zero hardness by the SOAP TEST). However, as the total CATION concentration in the hard water increases above 500 ppm, the average hardness in the effluent will also increase proportionately.

The reason for this is that when the sodium salts, – those present in the raw water plus those formed by the exchange reactions, – are present in high enough concentrations, they cause a “back-regeneration” effect at the same time as the softening process is taking place. This effect prevents as complete a removal of calcium and magnesium as would otherwise be possible.

It is often possible to reduce the average hardness in the effluent below normally expected concentrations, by using a greater amount of salt than usual for regeneration.

NORMAL SOFTENING CYCLE

At the start of a normal softening cycle, the hardness in the effluent drops rapidly as the residue of hardness ions left in the bed at the end of the rinse are forced out. As indicated by FIGURE 6, the effluent hardness reaches a certain minimum value and remains at approximately this concentration for the major part of the softening run.

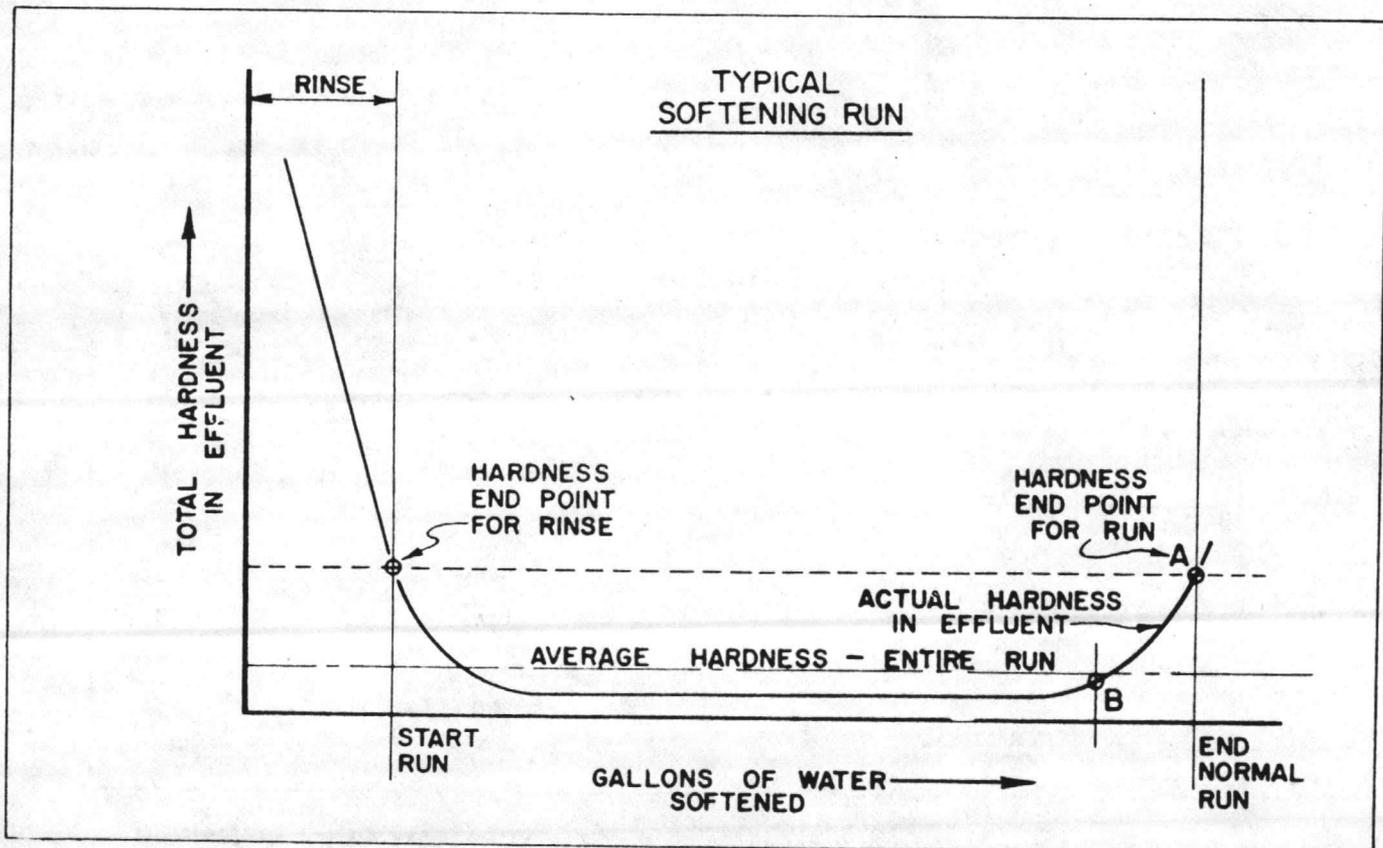


Figure 6

Toward the end of the effective run, hardness in the effluent begins to increase fairly rapidly. If the cycle is stopped at the unit regenerated when the effluent reaches the hardness indicated by point "A" in FIGURE 6, then the average hardness during the overall softening run will be equal to the value indicated by the "AVERAGE" line. From FIGURE 6, it is apparent that a lower average hardness can be obtained if the softening run is ended at some earlier point in the cycle (for example, at point "B")

III. CAPACITY OF ION EXCHANGER

The capacity for the removal of calcium and magnesium depends mainly upon the type of ion exchanger which is used. It is further influenced by the amounts of hardness and sodium ions in the raw water, and by the amount of salt used for regeneration.

- A. **Raw Water** – The effect of the amounts of hardness and sodium ions in the raw water on capacity, is expressed in terms of COMPENSATED HARDNESS.

The hardness of the raw water is considered to be greater than it actually is for capacity determinations, whenever: (a) the total hardness is greater than 400 ppm (as CaCO₃), or (b) the sodium salts are over 100 ppm (as CaCO₃). This "greater-than-actual" hardness is referred to as COMPENSATED HARDNESS, and its value may be calculated using the following formula.

$$\text{ppm COMPENSATED HARDNESS} = \left[\text{ppm ACTUAL HARDNESS} \right] \times \left[\frac{9000}{9000 - \text{ppm TOTAL CATIONS}} \right]$$

(all ppm – as CaCO₃)

- B. **Salt Dosage** – The capacity which will be obtained from a cation exchanger is also determined by the amount of salt used during regeneration. The Kilograins (KGR) of hardness which can be removed by each cubic foot of ion exchanger between regenerations, increases as more salt is used for regeneration.

At the same time, the efficiency of salt usage decreases with the higher regenerant dosages. That is, a greater number of Kilograins of hardness are removed for each pound of salt used at the lower salt dosages, (and consequently, at the lower capacities). Thus, greater economy may be obtained at the expense of the number of gallons of water softened between regenerations. Figure 7 illustrates the effect of salt dosage on capacity and efficiency.

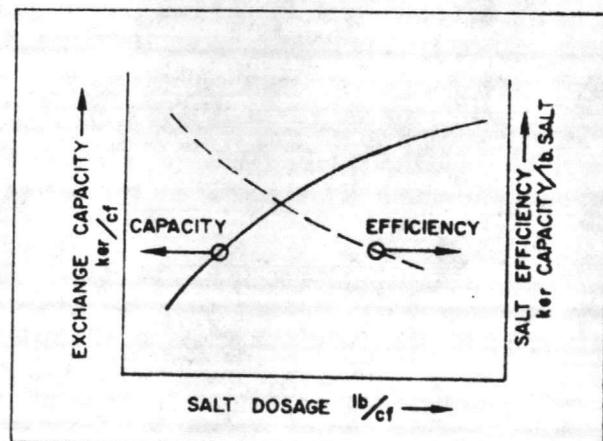


Figure 7

C. **Calculation of Capacity** – To determine the capacity of any cation exchanger, follow the procedure outlined below:

- From the analysis of the raw water, determine the actual total hardness as the sum of the calcium and magnesium concentrations expressed as CaCO_3 .
- If necessary, calculate the compensated hardness in accordance with the formula given above.
- Express parts per million (ppm) of total hardness as grains per gallon by means of the conversion:

$$\frac{\text{ppm}}{17.1} = \text{grains per gallon (gpg)}$$

- For greater accuracy, the bed depth of ion exchanger should be measured and the actual volume of ion exchanger calculated. This will prevent introducing an error in case the actual volume differs from the volume listed on the DATA SHEET.

Calculate the ion exchanger volume (in cubic feet) using the bed depth and the tank diameter.

$$\text{VOLUME (cu. ft.)} = \frac{[\text{BED DEPTH (inches)}] \times [\text{DIAMETER (feet)}]^2}{15}$$

- Record the total gallons of water softened during a normal run, which was ended in accordance with instructions given for CHEMICAL TEST.
- With the above information, the actual capacity of the ion exchanger can be computed using the formula:

$$\text{CAPACITY (KGR/cu. ft.)} = \frac{\text{RAW WATER HARDNESS (GRAINS/GAL)} \times \frac{\text{LENGTH OF RUN (GALLONS)}}{1000}}{\text{VOLUME OF ION EXCHANGER (CUBIC FEET)}}$$

NOTE: KGR = Kilograins
1 KGR = 1000 Grains

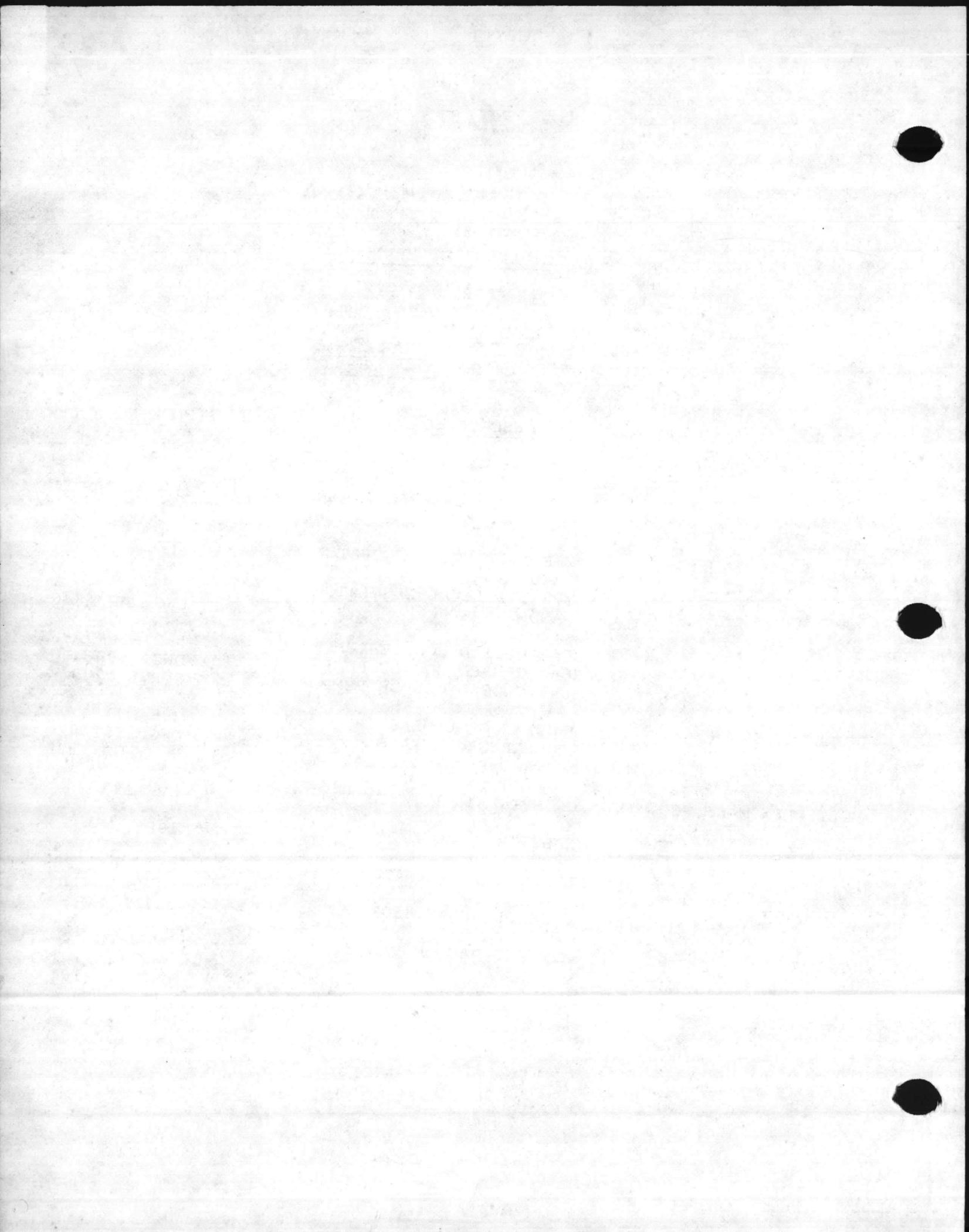
OPERATING INSTRUCTIONS

PART III
MANUFACTURERS' LITERATURE

FOR

MARINE BASE
CAMP LEJEUNE, NORTH CAROLINA
PERMUTIT JOB NO. A141E39857

<u>VENDOR</u>	<u>DESCRIPTION</u>	<u>FORM NO.</u>
A. ASHCROFT	PRESSURE GAUGES	250-1997-A
B. ATC	SERIES 324 CAM PROGRAMMER	INSTALLATION 10 SHEETS
C. FISHER CONTROLS	TYPE 171 LEVEL REGULATOR AND VALVE	1891
	TYPE 171 LEVEL REGULATOR AND VALVE	DWG. AP 1846
D. GOULDS PUMPS	3642 CLOSED COUPLE PUMP	5-21-80-1A-WS
	3642 CLOSED COUPLE PUMP	DWG. 89464
	3642 CLOSED COUPLE PUMP	CURVE 1275
E. JERGUSON GAGE	TUBULAR GAGE GLASS	399
	TUBULAR GAGE GLASS	DWG. 561602
	PROTECTOR FOR TUBULAR VALVE	DWG. GD-1598
F. MULTIPLEX MANF. CO.	CRISPIN AIR RELEASE VALVE	CV-1183
G. PENBERTHY	EJECTOR - LM	1950
H. SQUARE D	ELECTRIC ALTERNATOR	DWG. B31128-
	CONTROL RELAY 8501	499
	AIR AND VACUUM VALVE	531AS
I. VALMATIC		DWG. VM-AV-1, DWG. VM-101, & DWG. VM-101-M



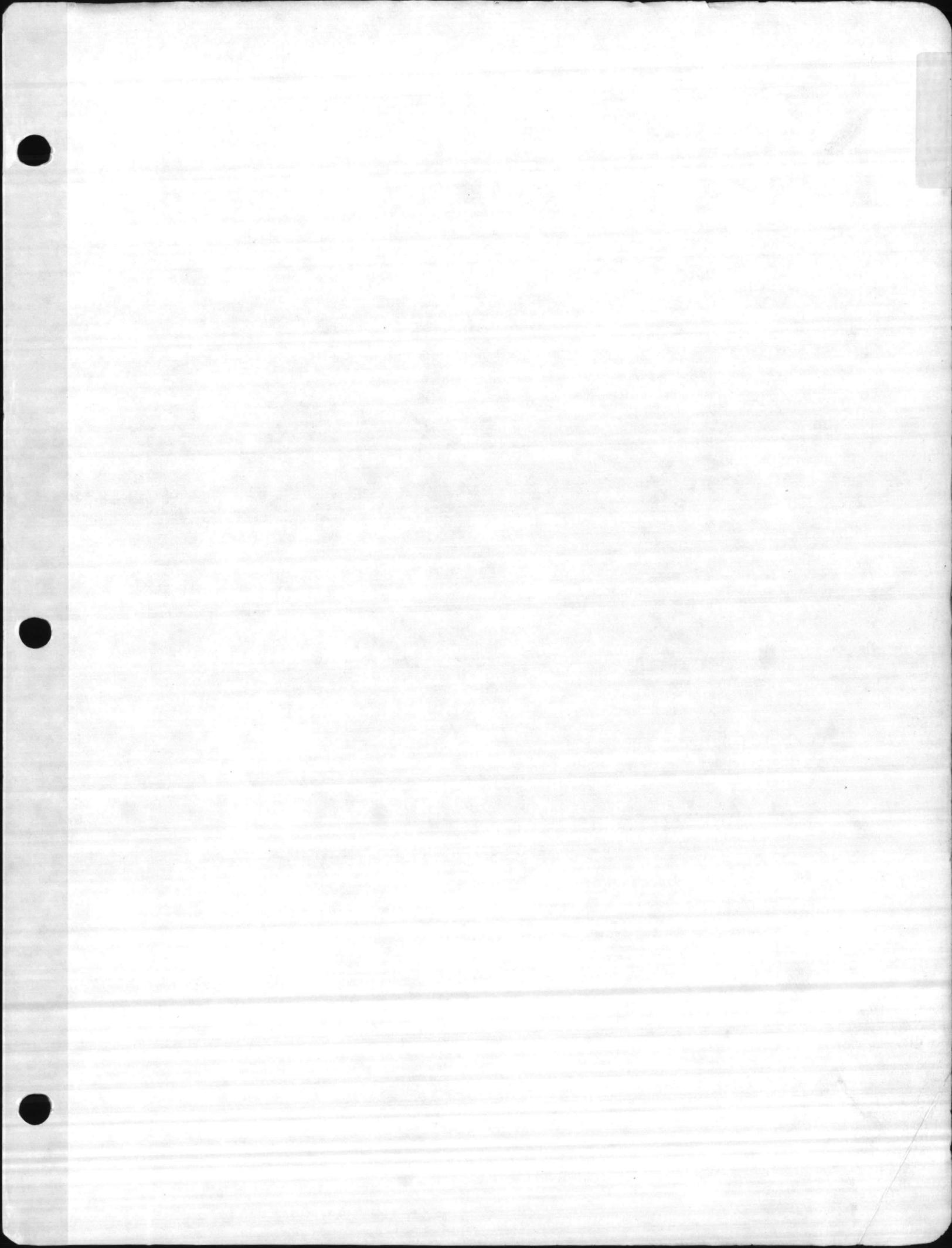
TAB PLACEMENT HERE

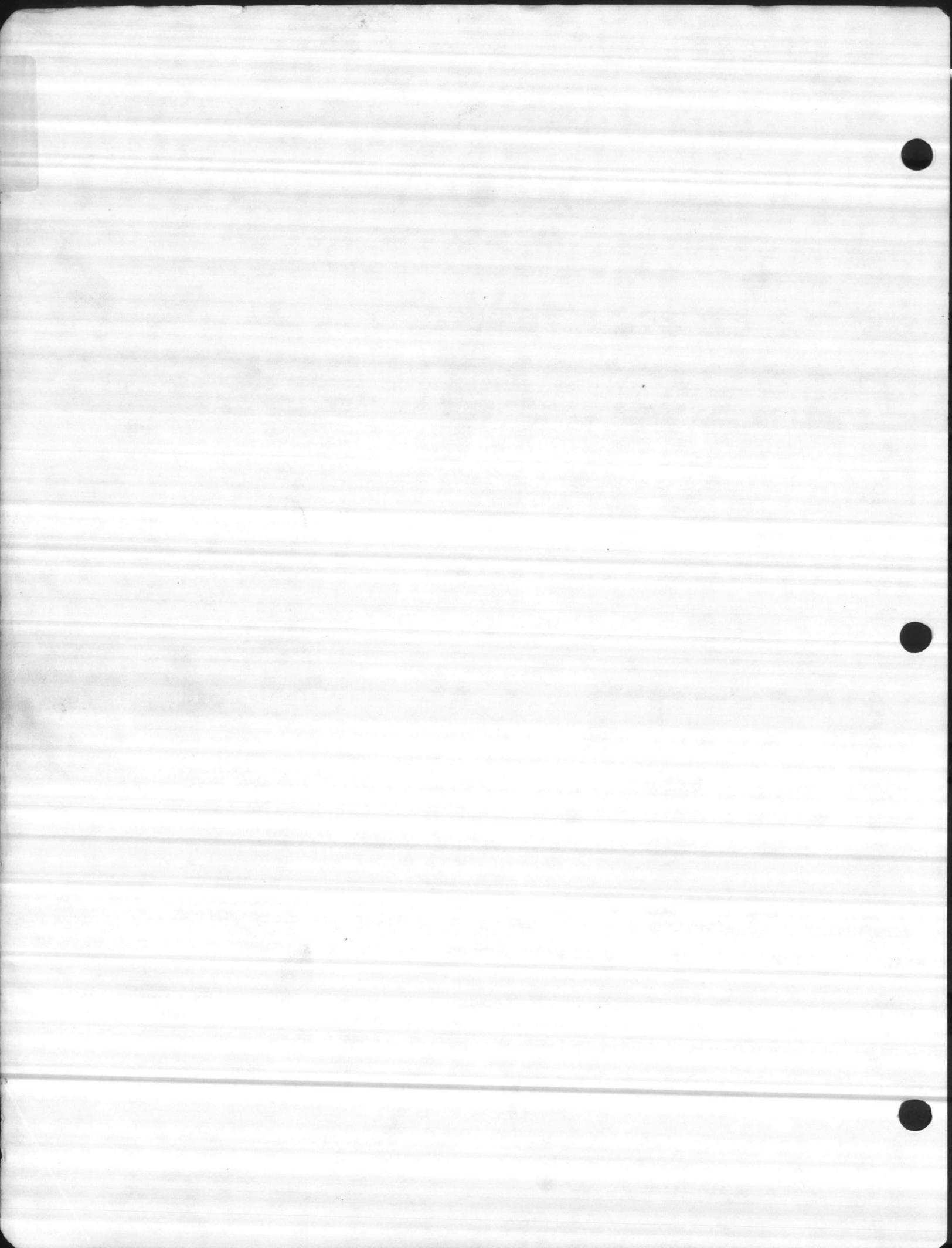
DESCRIPTION:

N/A

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image





ASHCROFT® PRESSURE GAUGE INSTALLATION INSTRUCTIONS

GAUGES ARE INSTRUMENTS. HANDLE THEM CAREFULLY

SELECTION

Pressure Ranges—Select a gauge with a full scale pressure range of approximately twice the normal operating pressure. The maximum operating pressure should not exceed approximately 75% of the full scale range. Failure to select a gauge range within this criteria may ultimately result in fatigue failure of the Bourdon tube component.

INSTALLATION

Always use a wrench on the flats of the gauge socket to screw the gauge in place. When a fitting is being screwed to the gauge, hold a wrench on the socket flats instead of twisting against the gauge socket screws which are intended to hold the gauge mechanism in the case.

When gauges are mounted on a wall or panel, make sure they are connected free from piping strains. Also see that the mounting surface is flat, or insert washers under the flange of the gauge case to obtain three-point suspension. Preferably, the last length of piping leading up to the gauge should be flexible tubing. This will insure that the gauge is free from strain.

Install gauges where they will be free from the effects of mechanical vibration as this will wear out any gauge quickly. Try to mount the gauge on a wall nearby and connect the gauge to the machine which vibrates badly by means of flexible line assembly.

Protect gauges from frequent pressure pulsations by using throttle screws in the socket of the gauge, needle valves, pulsation dampeners, or pressure snubbers.

When any gauge is used for steam pressures, a siphon filled with water must be installed between the gauge and the line. When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg to enable occasional cleaning out of the sediment. The head effect of this piping leg should be compensated for by resetting the pointer of the gauge.

OPERATING CONDITIONS

The operating conditions to which a gauge will be subjected must be considered. If the gauge will be subjected to severe vibration or pressure pulsations, liquid filling the gauge may be necessary to obtain normal product life. Other than discoloration of the dial and hardening of the gasketing that will occur as ambient temperatures exceed 150° F, metal case Duragauges (that are not liquid filled) can withstand continuous ambient temperatures as high as 350° F. Phenol and polypropylene case gauges can withstand ambient temperatures up to 250° F. Accuracy will be affected by approximately 1.5% per 100° F. Gauges with welded joints will withstand 750° F (450° F with silver brazed joints) for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For temperature limits on other gauges see General Service Bulletin GS1, Special Service SG1 and Test Gauge Bulletin TG-1.

PROPER USE

Apply pressure slowly. Do not open the gauge cock or valve too quickly—this imparts a severe strain on the Bourdon tube which may rupture it, or result in shortened life. When the service itself is subject to sudden pressure applications, use a needle valve, or the Ashcroft Gauge Saver.

Avoid over-pressure. See that the apparatus is provided with a relief valve and that the range of the gauge is higher than the set pressure of the relief valve.

Sudden pressure release has the same detrimental effect and should be compensated for in the same manner as for pressure applications mentioned above. On hydraulic presses, Catalog Number 1056 or 1009DH Gauges with slotted link should be specified. See Special Service bulletin SG-1.

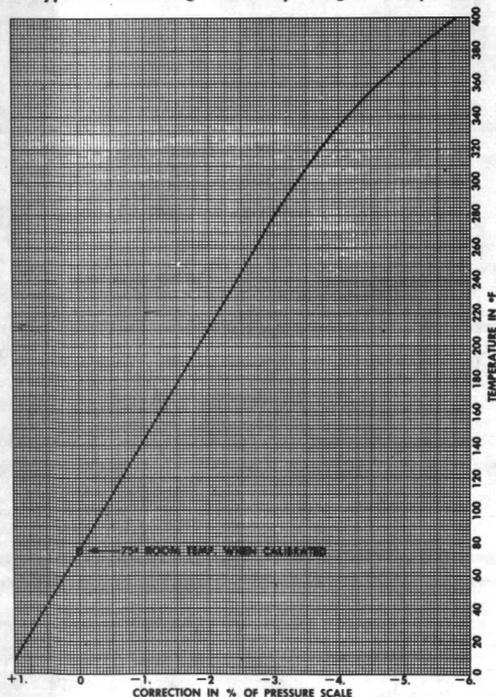
MAINTENANCE

Replace broken glasses and thus keep dirt out of the working bearings and teeth of the movement mechanism.

Never oil gauge movements or linkages except with high grade instrument oil. Regular oil attracts dirt and becomes gummy, thus causing the gauge to act sluggish and inaccurate.

HEAT AFFECTS GAUGE ACCURACY

Approximate error or change in calibration of a Bourdon tube type Pressure Gauge caused by changes in temperature.



Example: Gauge working at 500 p.s.i. pressure and at 280° F. temperature would have a -3% correction and would read 3% or 15 p.s.i. fast.

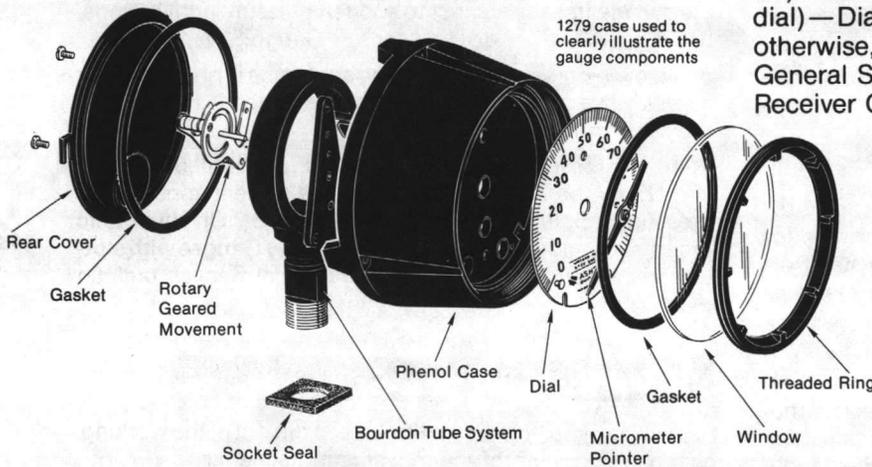
NAMES OF GAUGE PARTS AND RING DESIGNS

ENGINEERING DATA

The drawing below shows a typical solid front lower connection Duragauge with all of the parts designated by their standard names. The use of these names will facilitate the ordering of parts and eliminate any misunderstanding in describing gauge construction.

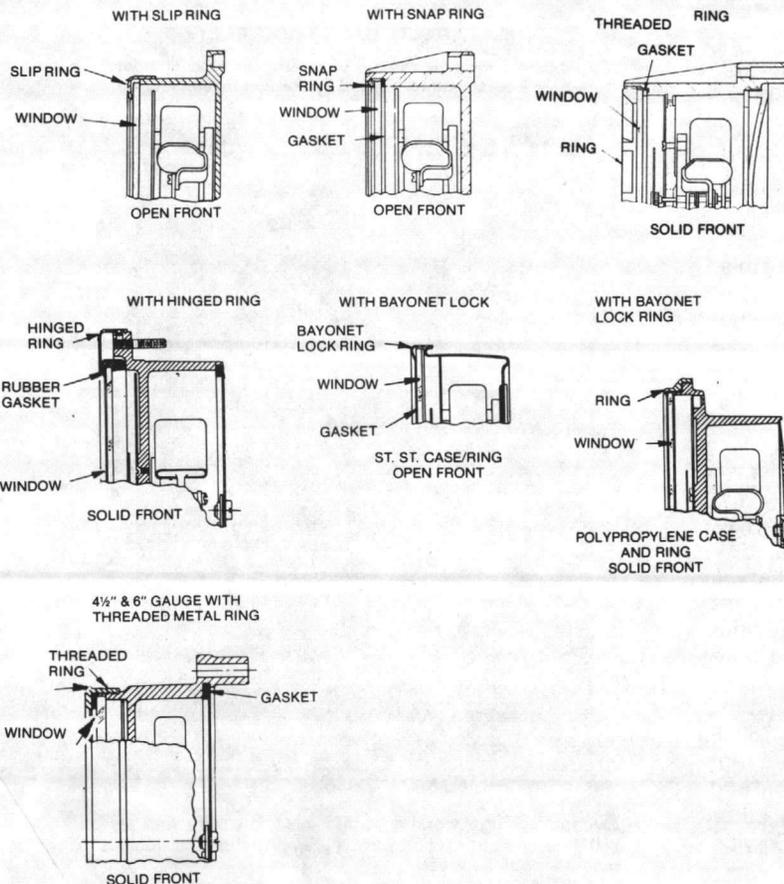
When ordering parts—specify as much of the following data as possible:

Size (dial diameter)—Case Material (Stainless Steel, Polypropylene, Aluminum or Phenol)—Ring Design (Slip, Threaded, Snap or Hinged)—Connection Location (Lower or Back)—Connection Size ($\frac{1}{4}$ " or $\frac{1}{2}$ ")—Bourdon Tube/Socket (Material indicated on dial)—Dial Range. Specify Type Number if possible; otherwise, mention whether parts are for Duragauge, General Service Gauge, Special Application Gauge, Receiver Gauge or Test Gauge.



NOTE: The socket, tube and tip assembly is furnished as one integral unit. The movement is supplied complete.

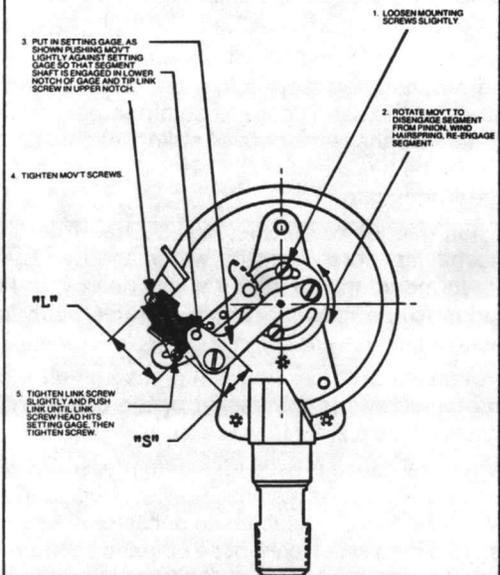
TYPICAL CONSTRUCTION DETAILS



CALIBRATION PROCEDURE

1. Preliminary Gauge Calibration Setting —

(SOLID FRONT GAUGE SHOWN)



2. Calibration —

- At zero pressure (or at full vacuum for compound or vacuum gauges), assemble pointer to pinion shaft in the horizontal position.
- Apply pressure equal to full range and adjust the slide in the segment slot until the pointer has rotated 270 degrees (vertical position).
- Reduce pressure to zero and reset pointer if necessary to horizontal position. If pointer adjustment was required, repeat step (b) above.
- Apply pressure equal to mid-scale and drive pointer firmly onto pinion.
- Recheck calibration at the lower and upper ends of the scale.

- Linearity Adjustment — Although the procedure outlined above should produce a correctly calibrated gauge, linearity adjustment may be required. If the pointer reads correctly at the bottom of the scale and low at the top of the scale, rotate the movement to increase the angle between the link and the segment. If the pointer reads high, rotate the movement in the opposite direction.



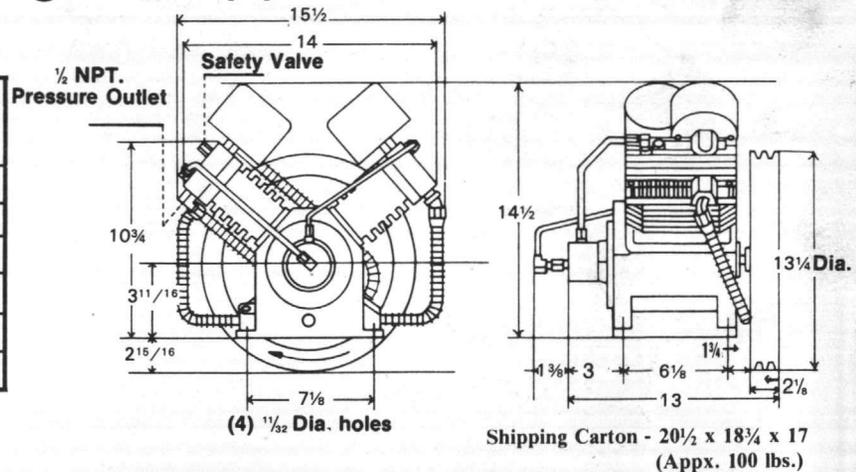
INSTRUMENT DIVISION
DRESSER INDUSTRIES INC.
STRATFORD, CONNECTICUT 06497

MODEL EQ AIR COMPRESSOR

(Model EQU With Intake Valve Unloading Head)

Four Cylinder Two Stage 2 1/2(3) - 2 1/2 Bore x 2 Stroke

HP	PRESSURE (PSI)	RPM	CFM DISPL.	1725 RPM Motor Pulley 2 GR. A Pitch
1 1/2	100	520	8.8	3.8
	175	470	8.0	3.5
2	100	680	11.6	5.0
	175	570	9.7	4.2
3	100	947	16.1	7.0
	175	824	14.0	6.2



INSTALLATION AND STARTING

INSPECTION: Check for possible damage in transit and see that flywheel turns freely by hand. Flywheel run-out or wobble may be due to a flywheel cracked in handling. Report any damage to delivering carrier at once.

MOUNTING: Locate to provide the compressor intake and flywheel fan with cool, clean, dry air. Remove all shipping skids. Place the unit on a solid base with the flywheel at least 6 inches from a wall.

HORIZONTAL TANKS: Use one of the following: 1) Mount legs on properly selected vibration isolators (consult dealer for recommendations). 2) Mount and level the assembly using Englo tank levelers. 3) Carefully shim legs to level and allow the assembly to stand free (not bolted to floor).

VERTICAL TANKS: Level the assembly and bolt the legs directly to the floor.

AIR PIPING: For maximum noise isolation, include a section of rubber or flex-metal hose between the tank and shop air system.

LUBRICATION: Compressor is shipped without oil. Before starting compressor, fill the crankcase to the upper or full oil level mark. Compressor must be reasonably level for proper lubrication.

Crankcase capacity: Approx. 1 Qt. (1 Liter)

For heavy duty operation, the use of a good grade of compressor oil meeting the following specifications will provide superior lubrication and extend the life of your compressor. Compressor oil is available from the factory or most oil distributors.

Air Compressor Oil:

Napthenic Base

500 S.U.S. @ 100° F for 55 to 120° F ambient.

350 S.U.S. @ 100° F for 32 to 55° F ambient.

225 S.U.S. @ 100° F for 0 to 32° F ambient.

For normal duty, including intermittent operation, a quality grade of non-detergent automotive oil will provide suitable lubrication:

SAE 30 for 55 to 120° F ambient.

SAE 20 for 32 to 55° F ambient.

SAE 10 for 0 to 32° F ambient.

Multi-viscosity oils are not recommended for air compressors.

ROTATION: Facing the pulley side of pump, direction of rotation should be counter-clockwise (see arrow on pulley) for efficient cooling action.

OPERATION AND CARE

PRESSURE AND SPEED: Never operate pump at pressures or speeds in excess of those recommended by the factory. A safety valve must be installed in every compressor assembly.

DAILY: Check for any unusual noise, failure to compress, overheating, vibration or belt slippage and correct before damage of a serious nature can develop.

WEEKLY: Examine filter elements and if dirty, remove, tap filters on hard surface to remove dust. Replace if necessary.

Check oil level and if necessary add sufficient oil to bring level in base to the upper mark on oil gauge. Keep compressor clean for efficient operation.

MONTHLY: Check and tighten all bolts as required. Check air connections and joints for leaks — tighten if necessary.

EVERY THREE MONTHS: Drain and refill base with new oil. Continuously operating compressors in daily use and units subject to heavy duty should have oil changed monthly.

NOTE: TROUBLE SHOOTING GUIDE LOCATED ON BACK COVER

NOTE: The () number indicates the total number of pieces required for a complete pump repair.

PARTS LIST MODEL EQ & EQU

SERIAL - 090684011

IMPORTANT

When ordering parts, please give compressor model, serial number and part number. Order assemblies when possible.

MINIMUM CHARGE \$5.00

PART NO.	DESCRIPTION	PRICE EACH	PART NO.	DESCRIPTION	PRICE EACH
L1	Crankcase	\$89.00	K43	Valve Retainer (8)	.35
L2	Bearing Cap	16.00	K44	Valve Bumper (8)	1.90
L3	Bearing Cap Gasket (.031)	.80	K45	Valve Spring-Light (3)	.70
L4	Bearing Cap Gasket (.016)	.80	K46	Valve Spring-Heavy (5)	.70
L5	1/4 x 1/8 Tube EL Conn.	2.00	K47	Valve Disc (8)	.70
K6	Bearing Cap Bolt [10 ft.-lb.] (3) 1/4-20x3/4	.20	L50	Left Head	22.00
L7	1/4 x 1/8 Tube Conn.	1.35	EQ50	Right Head	31.50
K8	Crankcase Bolt [15 ft.-lb.](12) 5/16-18x3/4	.25	L51	Left Head Gasket	1.75
K9	Bearing Flywheel End	12.00	EQ51	Right Head Gasket	1.95
L9	Bearing w/Outboard Shield	13.00	K52	Head Bolt [22 ft.-lb.](12) 5/16-18x2	.40
K11E	Oil Seal	5.00	L53	Filter Mount (2)	5.95
L13	Oil Drain Plug, 3/8NPT	.60	L54	Filter Cover (2)	4.75
F14	Fill Cap [includes F15]	2.35	L54E	Filter Element (2)	6.25
F15	Fill Cap Gasket	.55	L55	Filter Nut (2)	.30
L16	Oil Fill Elbow Assy.	3.95	EQ56	Safety Valve	10.00
L18	Breather Tube	2.45	EQ57	Plug 1/2NPT	.55
EQ20	Crankshaft	54.00	EQ60	1/2 x 3/8 Flare 45 Deg. EL	3.60
L21L	Connecting Rod w/Dipper Assy. (3)	13.00	EQ61	1/2 x 3/8 Flare EL (3)	2.90
L21W	Connecting Rod HP Assy. w/ EQ38 Bearing	32.50	EQ62	Finned Intercooler w/Flare Nuts	32.50
L22	Rod Bolt w/Lock Washer [10 ft.-lb] (8) 1/4-20x1 1/4	.35	EQ65	Finned Intercooler w/Flare Nuts	31.50
EQ23	Flywheel [1 3/4 O.D.] w. K25 Key	75.00	ASSEMBLIES		
K25	Flywheel Spirol Pin Key	.45	EQ100	Gasket Set Includes L3, L4, 2 of K31, 2 of L41, L51, EQ51	9.75
K30	Cylinder (2)	44.00	K132	Piston, Pin, Rings LP (3)	27.25
K31	Cylinder Gasket (2)	.65	EQ132	Piston, Pin Rings HP	35.00
K32	Piston LP (3)	14.00	K133	Piston Ring Set for two Pistons (2)	18.00
K32W	Piston HP	15.50	L140	Left Valve Plate w/Valves installed w/L41, L51 Gaskets	33.50
K33	Compression Ring (8)	2.75	EQ140	Right Valve Plate w/Valves installed w/L41, EQ51 Gaskets	33.75
K34	Oil Control Ring Assy. (4)	4.00	K145	Valve Assy. - Light (3)	3.50
K35	Piston Pin LP (3)	4.75	K146	Valve Assy. - Heavy (5)	3.50
EQ35	Piston Pin HP	11.25	L154	Filter Assy. includes L53, L54, L54E, L55 (2)	17.75
K36	Pin Retainer LP (6)	.20	L0	LO Oil Level Sight Guage, Factory Instl.	17.50
EQ37	Roll Pin	.45			
EQ38	Bearing	21.50			
L40	Valve Plate (2)	17.00			
L41	Valve Plate Gasket (2)	1.75			

CENTRIFUGAL UNLOADER

PART NO.	DESCRIPTION	PRICE EACH
EQ2	Bearing Cap	20.50
EQ70	Weight, Pair	18.00
EQ71	Operating Tube	4.00
EQ72	Spring	1.50
EQ73	Pivot Pin w/ Cotter Pin	2.25
EQ73B	Cotter Pin	.20
EQ74A	Air Valve (Milton #404-100)	1.00
EQ74B	Unloader Body	9.00
EQ74C	Hex Nut	.50
EQ74D	Operating Pin	1.20
EQ76	1/4 x 1/8 Tube Conn.	1.35
EQ77	1/4 x 1/8 Tube EL	2.00
EQ78	Centrifugal Unloader Tube	3.50

ASSEMBLIES

EQ170	Centr. Unloader Weight Assy. w/Gasket, includes EQ70, 71, 72, 73, L3, L4	27.00
EQ174	Centr. Unloader Valve Assy. includes EQ74A, B, C, D, EQ76	15.00
EQ175	Centr. Unloader Complete Assy. w/Bearing Cap, Tubing and Gasket	63.50

INTAKE VALVE UNLOADING HEAD

PART NO.	DESCRIPTION	PRICE EACH
LU80	Left Head-Unloading Type	24.00
EQ80	Right Head-Unloading Type	37.00
KU81	Unloader Piston (4)	2.25
KU82	O Ring (4)	.50
KU83	Unloader Spring (4)	.50
KU84	Unloader Washer (4)	.50
KU85	Unloader Retainer (4)	.25
LU86	1/4 x 1/8 Tube EL Conn.	2.00
LU87	1/4 x 1/4 x 1/8 Tube Tee	3.65
LU88	Unloader Manifold Tube	2.95

ASSEMBLIES

LU180	Left Unloading Head Complete w/Unloaders	32.50
EQ180	Right Unloading Head Complete w/Unloaders	44.75
KU181	Unloader Assy. includes KU81, 82, 83, 84, 85 (4)	4.00

AIR COMPRESSOR MAINTENANCE AND TROUBLE SHOOTING

A. COMPRESSOR "NOT PRODUCING ENOUGH AIR"

1. Drain air tank and measure pump up time. Compare with proper time for compressor model (see factory guide). If time is O.K., compressor may be too small for application. **Increasing operating pressure** will exaggerate the problem.
2. Test for leaks in air lines, tank, or compressor fittings. Soap suds solution works well.
3. Clogged filter element — remove, clean or replace. Intake air must be free of contamination such as paint mist.
4. Hot air blows out of intake. **Intake** valves not sealing. Remove and clean. Polish disc on fine emery cloth (#400). Replace worn parts. A complete valve plate assembly can be obtained as a factory exchange at low cost.
5. Check valve or discharge tubing clogged. Clean or replace.

B. AIR LEAKS FROM CENTRIFUGAL UNLOADER (BACK OF COMPRESSOR - PART EQ74B)

1. To provide "loadless starting", this device **opens** air valve (EQ74A) when the compressor stops — thus bleeding off air contained between the compressor and tank check valve.
If air leaks continuously when compressor stops, the tank check valve is leaking. Drain tank — remove and repair check valve. **If air leak is steady when compressor runs**, adjust air release. Remove tube from EQ76. Loosen lock nut EQ74C. Turn EQ74B out one turn (CCW). Valve should seal when running and open when stopped. Repeat adjustment if necessary.

C. INTERSTAGE SAFETY VALVE LEAKS (EQ56) (VALVE FACTORY SET TO OPEN AT 65 PSIG)

1. Head gasket or hi pressure inlet valve leak. Examine, clean valve or replace.
2. Defective safety valve; Replace. Do not adjust safety valve.

D. EXCESSIVE OIL CONSUMPTION (Measure oil consumed per hour of operation.)

1. Clogged air intake filter. Clean or replace.
2. Inferior or dirty oil — see recommendations in instructions.
3. Crankcase not sealed — air leaks in. Check oil fill cap and shaft oil seal. Replace if necessary. Tighten crankcase bolts (15 Ft. lb.)
4. Piston rings worn or sticking. Remove rings, clean grooves. Check ring wear by pushing ring into cylinder bore. New ring end gap is approximately .007 to .017 inches. (Operation is O.K. to .060.) Stagger ring gaps when installing.
5. Deep scratch on cylinder wall. Caused by lack of oil or dirt in oil. Hone (.015 max. on diameter) or replace.
6. Oil in discharge air. Some oil is always present. Clean accumulation in air lines and tank. Add air line filter or clean element.
7. Compressor unloaded more than 60% with constant running control. Consider start-stop or dual control.

E. MILKY OIL IN RESERVOIR

1. Normal result of water mixing with oil in tank or possibly in crankcase. Change oil and/or drain tank.
2. Move compressor or pipe intake to lower humidity source or cooler area. Increase intake pipe one size for every 3 feet of length — keep short.

F. NOISE, KNOCK OR VIBRATION

1. Assembly-vibrating. See mounting instruction.
2. Flywheel wobbles. Cracked flywheel or bent shaft. Replace.
3. Flywheel or pulley loose. Remove, apply loctite on shaft, re-install with new key.
4. Loose or worn connecting rod or piston pin. **Tighten or replace.**
5. Pressure switch or magnetic starter chatter. Adjust switch for greater differential or replace.
6. Loose vee belt. Adjust tension on slotted platform.
7. Foreign matter (carbon, dirt, piece of gasket) on top of piston. Remove cylinder head and check. To increase head clearance, add crankcase gaskets . . . not head gaskets.

G. RUNS HOT (Head and discharge line normally are hot enough to burn if touched)

1. Compressor operating in excess of rated discharge pressure. Reset pressure control.
2. Poor ventilation. Provide cooler location. Allow minimum 6" flywheel clearance.
3. Incorrect rotation. Check flywheel arrow. Reverse motor.
4. **Discharge** valve or head gasket leak. Remove and clean valve. Replace.
5. Restriction in discharge line or check valve. Clean or replace.

H. COMPRESSOR "SLOWDOWN" OR "FROZE UP"

1. Check that supply voltage matches motor, i.e., 115 volt supply with motor connected for 230 volts or 208 supply with 230 volt motor.
2. Measure actual voltage at the motor while the compressor is **under load** (starting up or at high pressure). If voltage is more than 10% below motor nameplate rating, relocate compressor closer to main switch panel and/or provide heavier wiring. Check with electric power company.
3. Vee belt slipping. Adjust tension by moving motor. Clean oil from belt and pulleys .
4. Operating pressure set higher than design pressure. Reset control.
5. If flywheel cannot be turned by hand (drain tank to eliminate back pressure), check oil level. If "frozen" condition exists after cooling down and adding oil, disassemble compressor and replace damaged components. After compressor "run in" period, freezing is caused by lack of adequate clean lubrication.
6. Gas Engine Driven Compressors: If engine stalls during acceleration, increase engine idle speed. On engines equipped with a clutch, maintain idle speed below clutch engagement speed, (approx. 1900 RPM).

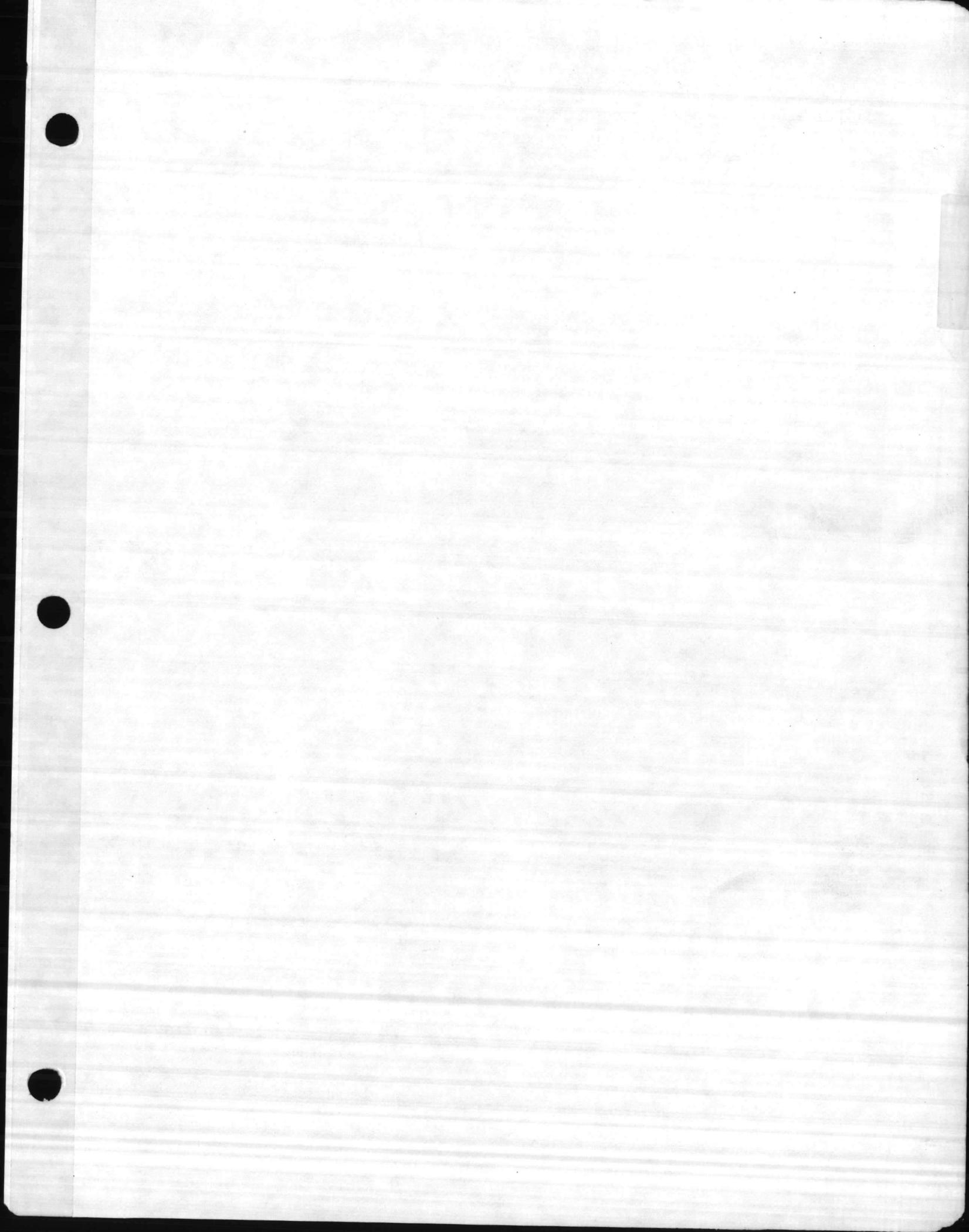
TAB PLACEMENT HERE

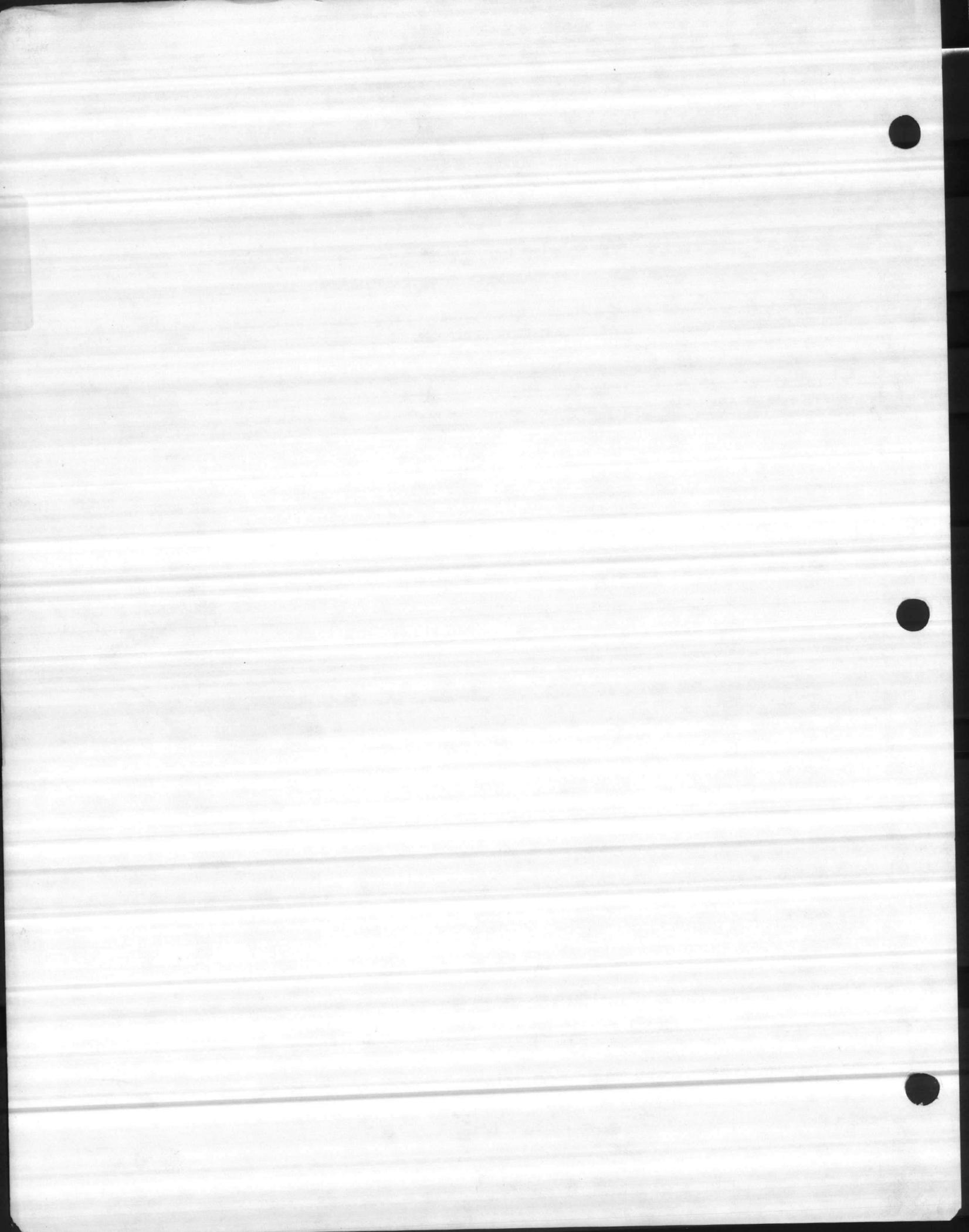
DESCRIPTION:

N/A

Tab page did not contain hand written information

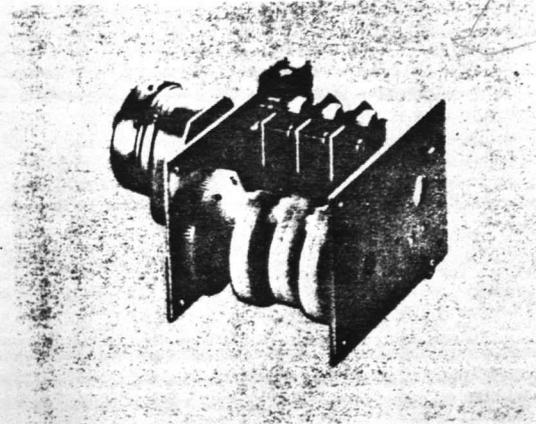
Tab page contained hand written information
*Scanned as next image





A COMPACT AND ECONOMICAL MOTOR-DRIVEN CAM TIMER, THE 324C PRECISELY CONTROLS ONE TO TWELVE LOAD CIRCUITS THROUGH EASILY-SET SCREWDRIVER-ADJUSTABLE CAMS. EACH TIMER PROVIDES A WIDE RANGE OF CYCLE TIMES THROUGH A SET OF INTERCHANGEABLE GEARS. THE 324C CAN ALSO BE USED WITHOUT A MOTOR AS A ROTARY CAM LIMIT SWITCH WITH BIDIRECTIONAL SWITCHES.

SERIES
atc 324 CAMTIME
PRECISION SWITCH
CAM PROGRAMMER



PRODUCT HIGHLIGHTS

EASY AND PRECISE CAM ADJUSTMENT

With ATC's unique split-cam design, each side of the cam is separately screwdriver-adjustable in either direction: either side determines the precise instant during the cycle when the switch will actuate, the other side determines how long the switch will remain actuated. Adjustments are easy and precise: 1/4 turn of the adjusting screw equals 1/2% of cycle time. A setting disc, calibrated in 1% increments, facilitates program set-up and indicates cycle progress.

ONE TO TWELVE PRECISION SWITCHES

Whether used as a time or sequence programmer, the 324C can be ordered with any number of cam-operated switches from one to twelve. Each SPDT precision switch is rated at 10 amps, 120V AC and is 1/3 hp rated at 120 or 240V AC.

TOP ACCURACY

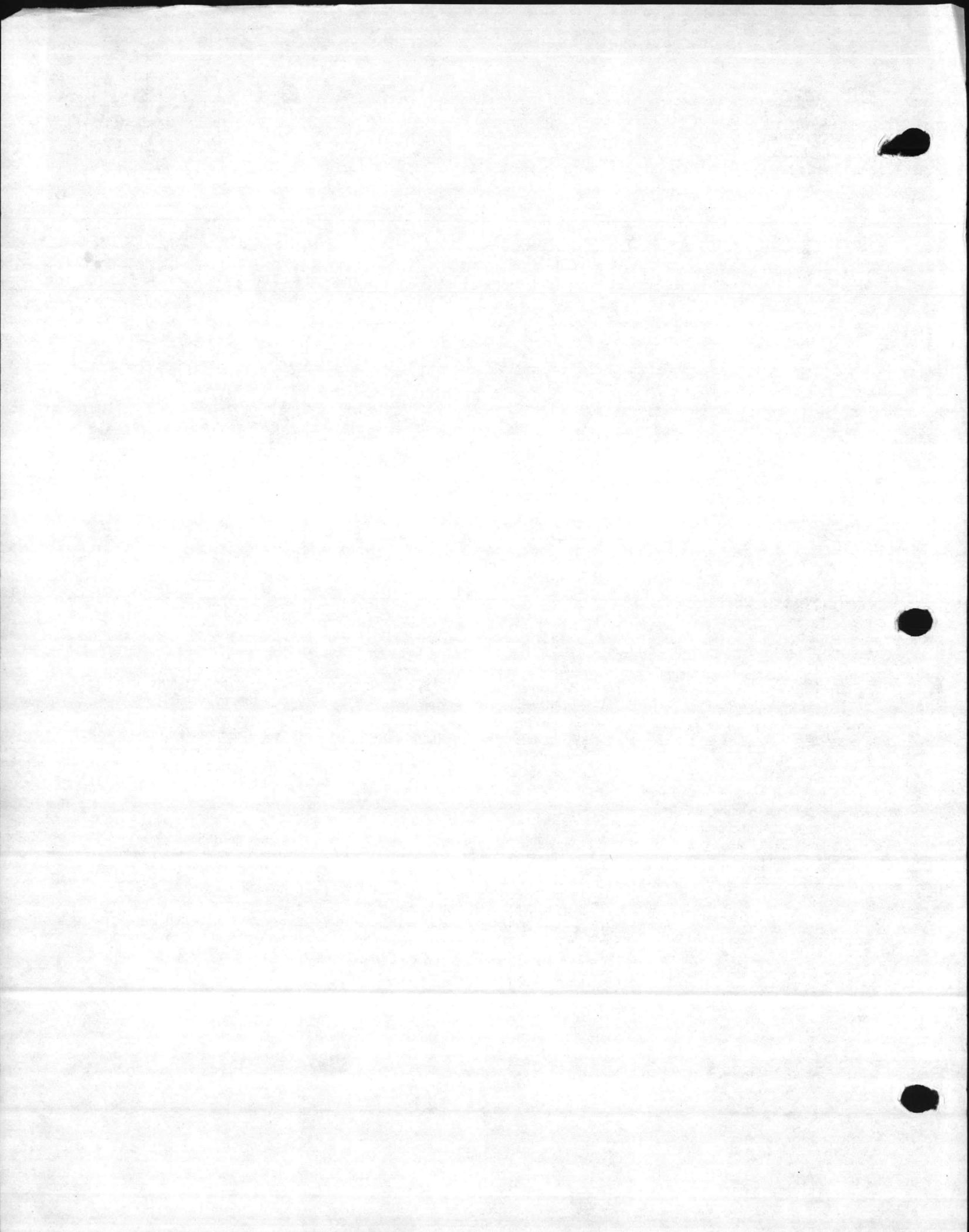
The repeat accuracy and setting accuracy of the 324C are both within $\pm 1/4\%$, tops in its field. Follower fingers precisely track the contour of the cams, accurately operating the precision switches with quick-make and quick-break action.

WIDE RANGE OF CYCLE TIMES

The 324C is available with a choice of 14 synchronous motors that provide more than 270 cycle times between 3 sec and 60 hrs. Each motor provides an adjustable range of 21 cycle times, with a ratio of over 3:1, through a set of interchangeable gears. Changing gears is a simple operation that takes only a few minutes.

SEQUENCE CONTROL

The 324C can be ordered without a motor and with a 1-inch long shaft extension on one end, for use as a rotary cam limit switch. The unit is then fitted with bidirectional switches.



SPEED CHARTS

	CAM SHAFT GEAR	15 RPM MOTOR P												5 RPM MOTOR A												150 RPH MOTOR B						1 RPM MOTOR C						1/2 RPM MOTOR D						15 RPH MOTOR E													
		MOTOR PINION # TOOTH	CODE																																																						
SECONDS resulting speed at 60 cycles	30	3	P3A	4	P2A	5	P1A	6	P1B	7	P1C	8	P1D	9	P1E	10	P1F	11	P1G	12	P1H	13	P1I	14	P1J	15	P1K	16	P1L	17	P1M	18	P1N	19	P1O	20	P1P	21	P1Q	22	P1R	23	P1S	24	P1T	25	P1U	26	P1V	27	P1W	28	P1X	29	P1Y	30	P1Z
	36	3.6	P3B	4.8	P2B	6	P1B	7.2	P1C	8.4	P1D	9.6	P1E	10.8	P1F	12	P1G	13.2	P1H	14.4	P1I	15.6	P1J	16.8	P1K	18	P1L	19.2	P1M	20.4	P1N	21.6	P1O	22.8	P1P	24	P1Q	25.2	P1R	26.4	P1S	27.6	P1T	28.8	P1U	30	P1V	31.2	P1W	32.4	P1X	33.6	P1Y	34.8	P1Z		
	40	4.5	P3C	5.33	P2C	6.66	P1C	7.5	P1D	8.33	P1E	9.16	P1F	10	P1G	11	P1H	11.8	P1I	12.6	P1J	13.4	P1K	14.2	P1L	15	P1M	15.8	P1N	16.6	P1O	17.4	P1P	18.2	P1Q	19	P1R	19.8	P1S	20.6	P1T	21.4	P1U	22.2	P1V	23	P1W	23.8	P1X	24.6	P1Y	25.4	P1Z				
	45	5	P3D	6	P2D	7.5	P1D	8.33	P1E	9.16	P1F	10	P1G	11	P1H	11.8	P1I	12.6	P1J	13.4	P1K	14.2	P1L	15	P1M	15.8	P1N	16.6	P1O	17.4	P1P	18.2	P1Q	19	P1R	19.8	P1S	20.6	P1T	21.4	P1U	22.2	P1V	23	P1W	23.8	P1X	24.6	P1Y	25.4	P1Z						
	50	5.5	P3E	6.66	P2E	8.33	P1E	9.16	P1F	10	P1G	11	P1H	11.8	P1I	12.6	P1J	13.4	P1K	14.2	P1L	15	P1M	15.8	P1N	16.6	P1O	17.4	P1P	18.2	P1Q	19	P1R	19.8	P1S	20.6	P1T	21.4	P1U	22.2	P1V	23	P1W	23.8	P1X	24.6	P1Y	25.4	P1Z								
	60	6	P3F	7.33	P2F	9.16	P1F	10	P1G	11	P1H	11.8	P1I	12.6	P1J	13.4	P1K	14.2	P1L	15	P1M	15.8	P1N	16.6	P1O	17.4	P1P	18.2	P1Q	19	P1R	19.8	P1S	20.6	P1T	21.4	P1U	22.2	P1V	23	P1W	23.8	P1X	24.6	P1Y	25.4	P1Z										

	CAM SHAFT GEAR	5 RPM MOTOR F												2.5 RPM MOTOR G												1 RPH MOTOR H						1/2 RPM MOTOR J																									
		MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE	MOTOR PINION # TOOTH	CODE																																						
MINUTES resulting speed at 60 cycles	30	9	F3A	12	F2A	15	F1A	18	F1B	21	F1C	24	F1D	27	F1E	30	F1F	33	F1G	36	F1H	39	F1I	42	F1J	45	F1K	48	F1L	51	F1M	54	F1N	57	F1O	60	F1P	63	F1Q	66	F1R	69	F1S	72	F1T	75	F1U	78	F1V	81	F1W	84	F1X	87	F1Y	90	F1Z
	36	10.8	F3B	14.4	F2B	18	F1B	21.6	F1C	25.2	F1D	28.8	F1E	32.4	F1F	36	F1G	39.6	F1H	43.2	F1I	46.8	F1J	50.4	F1K	54	F1L	57.6	F1M	61.2	F1N	64.8	F1O	68.4	F1P	72	F1Q	75.6	F1R	79.2	F1S	82.8	F1T	86.4	F1U	90	F1V	93.6	F1W	97.2	F1X	100.8	F1Y	104.4	F1Z		
	40	12	F3C	16	F2C	20	F1C	24	F1D	28.8	F1E	33.6	F1F	38.4	F1G	43.2	F1H	48	F1I	52.8	F1J	57.6	F1K	62.4	F1L	67.2	F1M	72	F1N	76.8	F1O	81.6	F1P	86.4	F1Q	91.2	F1R	96	F1S	100.8	F1T	105.6	F1U	110.4	F1V	115.2	F1W	120	F1X	124.8	F1Y	129.6	F1Z				
	45	13.5	F3D	18	F2D	22.5	F1D	27	F1E	32.4	F1F	37.2	F1G	42	F1H	46.8	F1I	51.6	F1J	56.4	F1K	61.2	F1L	66	F1M	70.8	F1N	75.6	F1O	80.4	F1P	85.2	F1Q	90	F1R	94.8	F1S	99.6	F1T	104.4	F1U	109.2	F1V	114	F1W	118.8	F1X	123.6	F1Y	128.4	F1Z						
	50	15	F3E	20	F2E	25	F1E	30	F1F	36	F1G	42	F1H	48	F1I	54	F1J	60	F1K	66	F1L	72	F1M	78	F1N	84	F1O	90	F1P	96	F1Q	102	F1R	108	F1S	114	F1T	120	F1U	126	F1V	132	F1W	138	F1X	144	F1Y	150	F1Z								
	55	16.5	F3F	22	F2F	27.5	F1F	33	F1G	39.6	F1H	46.8	F1I	54	F1J	61.2	F1K	68.4	F1L	75.6	F1M	82.8	F1N	90	F1O	97.2	F1P	104.4	F1Q	111.6	F1R	118.8	F1S	126	F1T	133.2	F1U	140.4	F1V	147.6	F1W	154.8	F1X	162	F1Y	169.2	F1Z										
60	18	F3G	24	F2G	30	F1G	36	F1H	43.2	F1I	50.4	F1J	57.6	F1K	64.8	F1L	72	F1M	79.2	F1N	86.4	F1O	93.6	F1P	100.8	F1Q	108	F1R	115.2	F1S	122.4	F1T	129.6	F1U	136.8	F1V	144	F1W	151.2	F1X	158.4	F1Y	165.6	F1Z													

TORQUE—SPEED CAPABILITIES:

The ability of the 324C to trip a number of load contacts simultaneously is determined in the chart below. Pick the vertical column that corresponds to the total number of contacts you need and proceed down the column to a point where it intersects the horizontal column that corresponds to the fastest time cycle you intend to use. If the intersection of the two columns is in the gray, there is no limitation to the 324's ability to trip contacts simultaneously; if not, the limit is noted in the intersected square.

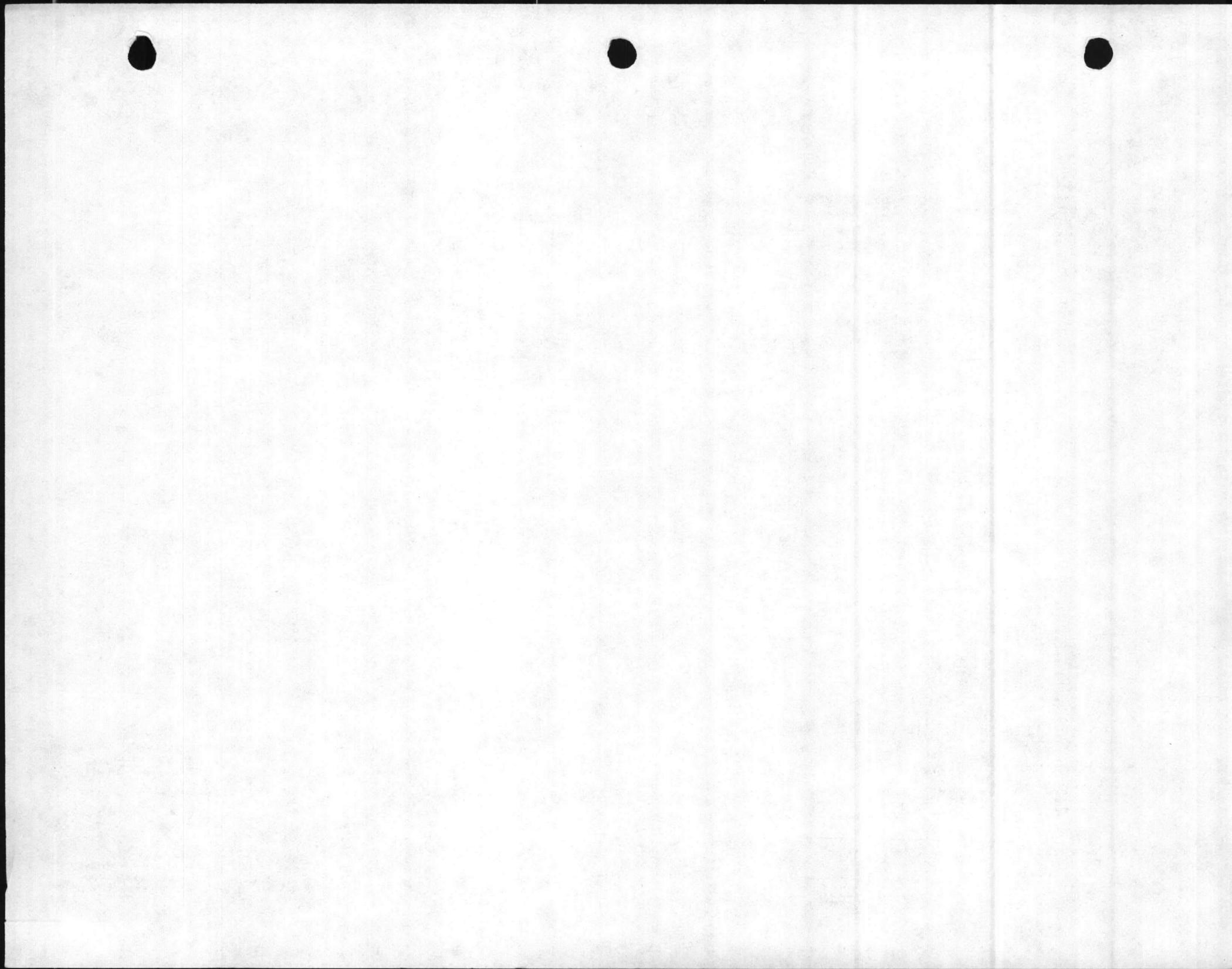
TIME CYCLE (Seconds)	MAXIMUM NUMBER OF CONTACTS SWITCHING TOGETHER												
	Total Number of Contacts												
Two Motors	One Motor	1	2	3	4	5	6	7	8	9	10	11	12
—	5	1	1	1	1	1	1	1	1	1	1	1	1
3 1/2	7	1	1	1	1	1	1	1	1	1	1	1	1
4	8	1	1	1	1	1	1	1	1	1	1	1	1
4 1/2	9	1	1	1	1	1	1	1	1	1	1	1	1
5	10	1	1	1	1	1	1	1	1	1	1	1	1
7 1/2	15	1	1	1	1	1	1	1	1	1	1	1	1
10	20	1	1	1	1	1	1	1	1	1	1	1	1
12 1/2	25	1	1	1	1	1	1	1	1	1	1	1	1
15	30	1	1	1	1	1	1	1	1	1	1	1	1
17 1/2	35	1	1	1	1	1	1	1	1	1	1	1	1
20	40	1	1	1	1	1	1	1	1	1	1	1	1
NO LIMIT													

*** THIS TABLE APPLIES TO Q MOTOR ONLY**

TIME CYCLE (Seconds)	MAXIMUM NUMBER OF CONTACTS SWITCHING TOGETHER												
	Total Number of Contacts												
Two Motors	One Motor	1	2	3	4	5	6	7	8	9	10	11	12
5.0	5	1	1	1	1	1	1	1	1	1	1	1	1
7.5	7	1	1	1	1	1	1	1	1	1	1	1	1
10.0	10	1	1	1	1	1	1	1	1	1	1	1	1
15.0	15	1	1	1	1	1	1	1	1	1	1	1	1
20.0	20	1	1	1	1	1	1	1	1	1	1	1	1
NO LIMIT													

15 RPM Motor—Q—High torque permanent magnet, no brake diode required on stop cycle units.

	CAM SHAFT GEAR	1/4 RPM MOTOR L												1/2 RPM MOTOR M												3/4 RPM MOTOR N																														
		MOTOR PINION # TOOTH	CODE																																																					
HOURS resulting speed at 60 cycles	30	4.5	L3A	6	L2A	7.5	L1A	9	M3A	12	M2A	15	M1A	18	N3A	24	N2A	30	N1A	36	M3B	14.4	M2B	18	M1B	21.6	N3B	28.8	N2B	36	N1B	43.2	M3C	16	M2C	20	M1C	24	N3C	32	N2C	40	N1C	48	M3D	18	M2D	22.5	M1D	27	N3D	36	N2D	45	N1D	54
	40	6	L3B	8	L2B	10	L1B	12	M3B	16	M2B	20	M1B	24	N3B	32	N2B	40	N1B	48	M3C	18	M2C	22.5	M1C	27	N3C	36	N2C	45	N1C	54	M3D	20	M2D	25	M1D	30	N3D	40	N2D	50	N1D	60	M3E	22.5	M2E	28.33	M1E	33	N3E	44	N2E	55	N1E	66
	45	6.75	L3C	9	L2C	11.25	L1C	13.5	M3C	18	M2C	22.5	M1C	27	N3C	36	N2C	45	N1C	54	M3D	21	M2D	26.25	M1D	31.5	N3D	42	N2D	52.5	N1D	63	M3E	22.5	M2E	28.33	M1E	33	N3E	44	N2E	55	N1E	66	M3F	24	M2F	30	M1F	36	N3F	48	N2F	60	N1F	72
	50	7.5	L3D	10	L2D	12.5	L1D	15	M3D	20	M2D	25	M1D	30	N3D	40	N2D	50	N1D	60	M3E	24	M2E	30	M1E	36	N3E	48	N2E	60	N1E	72	M3F	25	M2F	31.25	M1F	37.5	N3F	50	N2F	62.5	N1F	75	M3G	27	M2G	33.75	M1G	41.25	N3G	54	N2G	67.5	N1G	81
	55	8.25	L3E	11	L2E	13.75	L1E	16.5	M3E	22	M2E	27.5	M1E	33	N3E	44	N2E	55	N1E	66	M3F	24	M2F	30	M1F	36	N3F	48	N2F	60	N1F	72	M3G	25	M2G	31.25	M1G	37.5	N3G	50	N2G	62.5	N1G	75	M3H	26.25	M2H	32.81	M1H</							



SPECIFICATIONS

CYCLE TIMES

More than 270 cycle times, from 3 sec to 60 hrs, from a choice of interchangeable motors and gears; each motor provides more than 20 cycle times. (see Speed Charts).

REPEAT ACCURACY

± ¼ % of cycle time.

SETTING ACCURACY

± ¼ % of cycle time.

FRAME SIZES

3, 6, 9 and 12 cam frame sizes are provided.

CAMS

NUMBER: 1 to 12 (or multiples up to 12, by combining timer assemblies); cams may be factory-set.

CUT: Standard or "50% cut", as specified (standard cams allow contact closure adjustment of 1 to 45% or 55 to 99%, "50% cut" cams allow contact closure adjustment of 12 to 52% or 48 to 88%; custom cams available with 2, 3, 4 or more cuts.

CONSTRUCTION: Two-inch diameter; split type; made of Delrin.

LIFE EXPECTANCY

MECHANICAL: over 10,000,000 operations.
CONTACTS: over 1,000,000 operations at less than 1 amp.

LOAD SWITCHES

TYPE: Precision switches; one for each cam.
CONTACT ACTION: SPDT (Form C).
CONTACT RATING: 10 A at 120 V AC (non-inductive). 1/3 HP at 125/250 V AC.
MINIMUM CONTACT ACTUATION TIME: 1% of cycle time.

DRIVE MOTORS

SPEED: choice of 14 (see Time Cycle Ordering Codes).
TYPE: Synchronous; permanently lubricated; integral slip clutch for manual advance; anti-backup to prevent damage to switches.
VOLTAGE: 120V AC, 50 or 60 cycles; optional: 24 or 240 V AC, 50 or 60 cycles.
POWER CONSUMPTION: 12 watts max.
DUAL DRIVE: two motors may be used, for dual-speed and special applications.

TORQUE-SPEED CAPABILITIES: At cycle times of 30 sec or longer, the 324 can drive and switch 12 contacts simultaneously; below 30 sec, the motor may be limited in its ability to drive or switch a number of contacts simultaneously. (See speed chart tables).

TEMPERATURE RATING

32 to 140°F. (0 to 60°C.)

WEIGHT

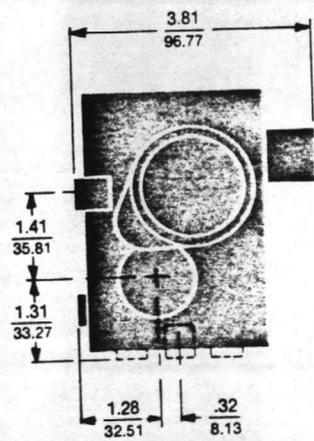
NET: from 1 ½ lbs. for the 3 cam unit up to 3 ½ lbs. for the 12 cam unit
SHIPPING: from two lbs. for the 3 cam unit up to 4 lbs. for the 12 cam unit

ENCLOSURES (Optional)

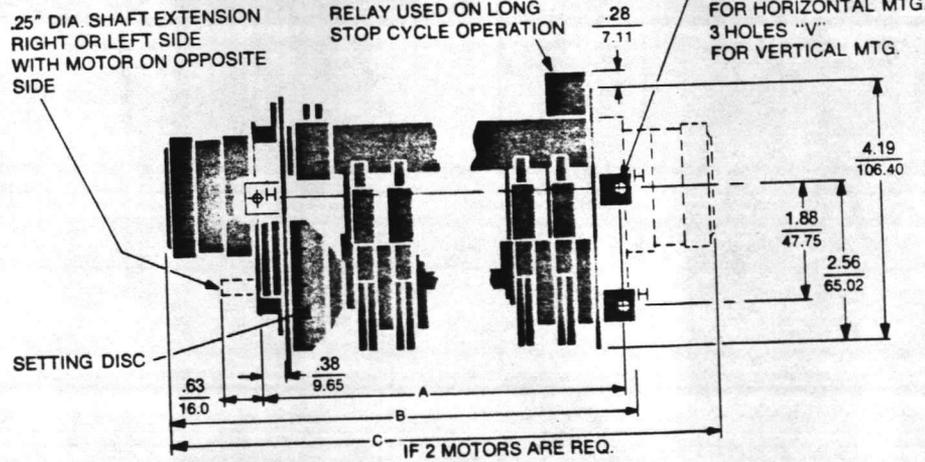
(See last pages of Catalog for detailed description).
NEMA 12 molded case for one model 324 with maximum of 3 cams.

DIMENSIONS

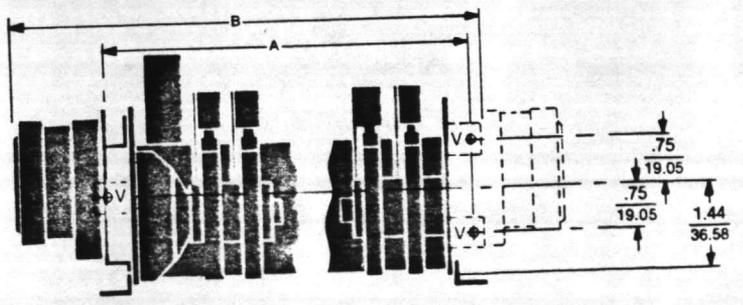
INCHES
MILLIMETERS

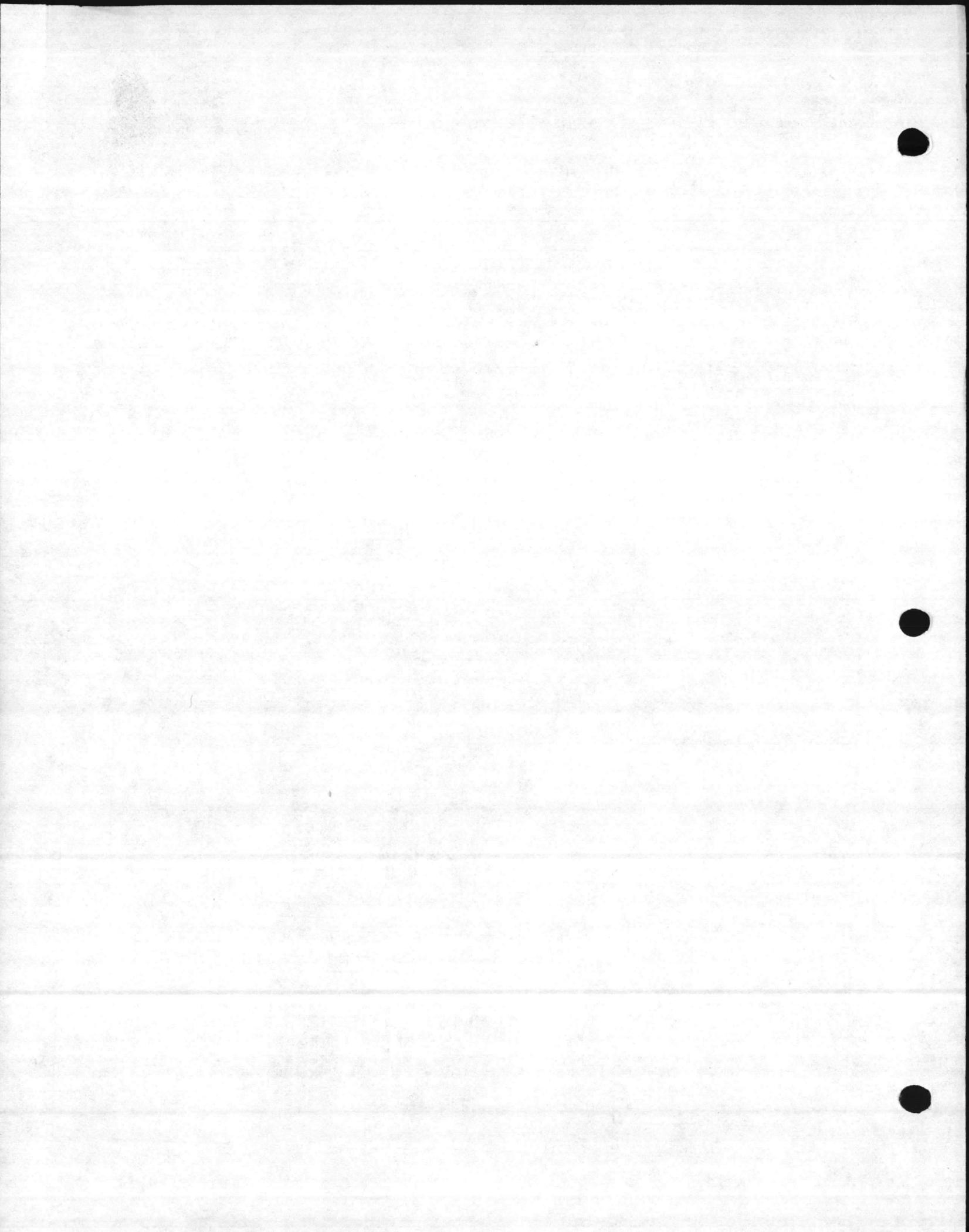


NOTE: THREE MOUNTING FEET, LOCKWASHERS AND SCREWS SUPPLIED WITH EACH TIMER. TIMER CAN BE MOUNTED HORIZONTAL OR VERTICAL. HORIZONTAL MOUNTING SHOWN. VERTICAL MOUNTING SHOWN BY DOTTED LINES.

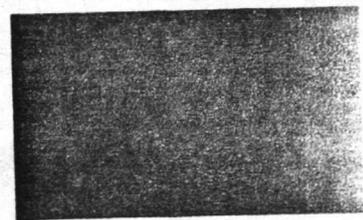


Number of Cams	Dim. A	Dim. B	Dim. C
3	3.19 / 81.03	5.72 / 145.29	7.22 / 183.39
6	5.69 / 144.5	7.59 / 192.79	9.09 / 230.89
9	7.56 / 192.02	9.47 / 240.54	10.97 / 278.64
12	9.44 / 239.78	11.34 / 288.04	12.84 / 326.14





PRECISION SWITCH CAM PROGRAMMER



ORDERING CODE	324C	06	B2F
BASIC TYPE	_____		
NUMBER OF SWITCHES	_____		
01	1 switch, 3 cams		
02	2 switches, 3 cams		
03	3 switches, 3 cams		
04	4 switches, 6 cams		
05	5 switches, 6 cams		
06	6 switches, 6 cams		
07	7 switches, 9 cams		
08	8 switches, 9 cams		
09	9 switches, 9 cams		
10	10 switches, 12 cams		
11	11 switches, 12 cams		
12	12 switches, 12 cams		
TIME CYCLE	_____		
---	Fill in here the appropriate letter, number, letter combination, selecting a letter for motor speed, a number for the motor pinion, and a letter for the cam shaft gear from the speed charts.		
000	No motor, or special time cycle.		
CAMS	Factory setting cams to 1/4% tolerance. 50% cams = allow 12-5 2% adjustment of switch actuation. 2, 3, or 4 cuts equally spaced. Have limited adjustability. (Does not include 50% cams with multiple cuts). Multiple cuts, unequally spaced. Multiple cuts — over 4. Specially cut or specially molded cams		
LUGS	Bag of 50 push-on terminal lugs — un-insulated Part No. 23002605900		
BRAKE	Diode brake assembly, Part No. 23002605600		
GEARS	Extra camshaft gear or pinion gear.		

OPERATION	_____	R	1	A	01	X
R	Repeat cycle, Stop cycle, Dynamic Brake ¹					
L	Long Stop Cycle ¹					
E	External drive by user, no motor					
F	Bi-directional operation cams & switches — No motor ²					
K	Special					
MOTORS	_____					
1	1 motor (Add \$12.00 for 15 RPM motor, type Q, \$2.00 for motors J through N)					
2	2 motors (Add \$4.00 for motor codes J through N)					
3	No motor					
0	Special					
VOLTAGE AND FREQUENCY	_____					
A	120/60					
B	240/60					
C	120/50					
D	240/50					
X	No motor					
K	Special					
OPTIONS	_____					
01	None					
02	1/4" dia. x 1" long shaft extension, right end (Units with one or no motor, or bidirectional operation).					
03	1/4" dia. x 1" long shaft extension, left end (Units with one or no motor, or bidirectional operation).					
04	1/4" dia. x 1" long shaft extension, both ends (On motorless units only, or for bidirectional operation)					
00	Special					
FEATURES	_____					
S	Screw terminal adapters mounted on all switches (Not U.L. listed with these adapters).					
X	Standard (Other than cam settings.)					
K	Special					

¹For Stop Cycle, or Brake operation, specify a 324 with one more switch than you need for your load circuits. (Do not exceed 12 switches total!)
²You interwire this switch to the motor according to the installation instruction for the unit.
³Be sure to specify shaft extension under OPTIONS.

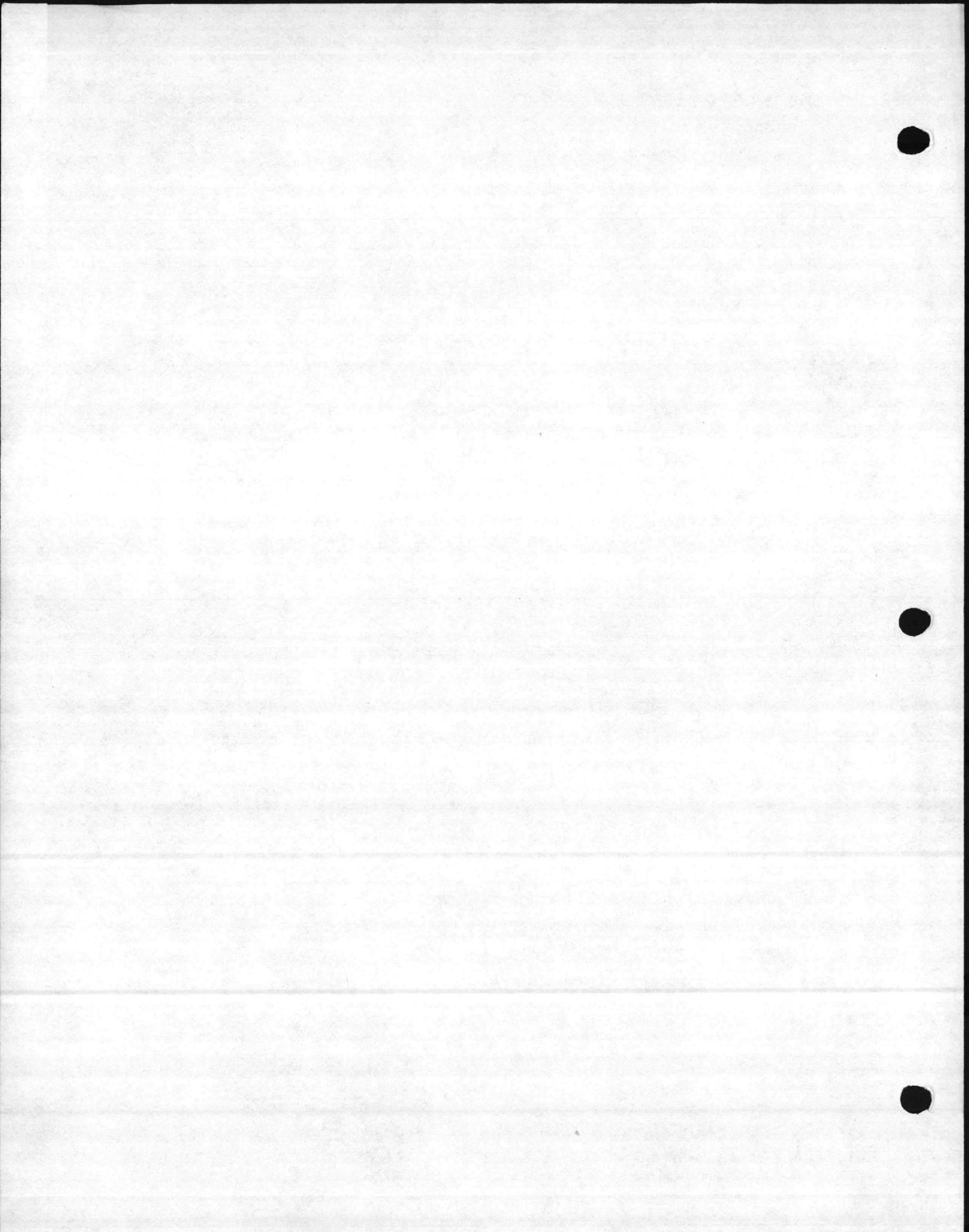


AUTOMATIC TIMING & CONTROLS CO.

KING OF PRUSSIA, PENNSYLVANIA 19406

Phone (215) 265-0200 Telex 84-6437

a division of American Manufacturing Co. Inc.



MOUNTING:

Three mounting feet and screws are packed separately. They screw into threaded holes at the bottom of the timer. The 324C can be three-point mounted either on

its end or on its base, but the main shaft must be horizontal for best operation and long life. For best switch operation, install the timer on a vibration-free surface.

MOTOR:

Standard 324C motors are equipped with one-way slip clutches. They allow the motor and cam shaft to be turned freely by hand *only* in the normal direction—

that is, so the drop-off edges of the cams move away from the tips of the switch actuator fingers. Rotation in the opposite direction can damage clutch and motor.

CAM ASSEMBLIES:

The two halves of the split cam are independently adjustable to permit programming of (1) the point *where* the switch will be actuated in the cycle, and (2) *how long* it will be actuated. Since these precision switches are single-pole, double-throw, they can be wired to provide either normally-open or normally-closed operation.

Switch action occurs at two points: (1) when the actuator finger drops off the sharp edge of the cam, and (2) when the finger travels back up the rise to the higher cam surface. The switch will be actuated whenever the follower is on the high portion; not actuated when it is on the low.

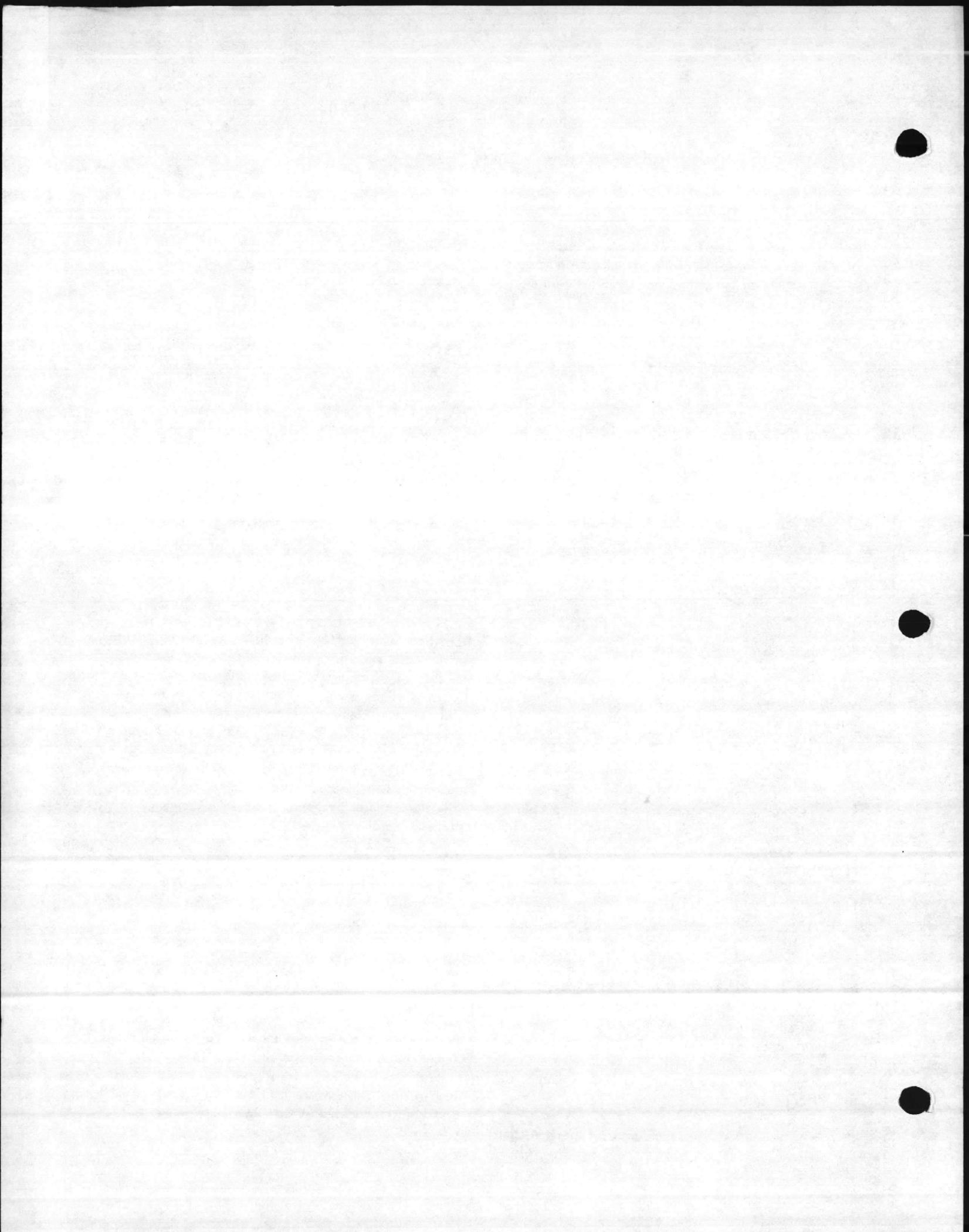
Either half of the cam can be used to set the START actuation point, and the other half will then be used to set the END actuation point in the program. Each quarter turn of the adjusting screw changes the cam setting by 1/2% of the cycle. To actuate earlier in the cycle, turn the screw clockwise; to actuate later, turn it counter-clockwise. Use a screwdriver with a blade no more than 1/8" wide, to avoid damage. As you adjust, be sure that the drop-off portion of the cam does not press against the switch actuator finger and deform it. Either raise the actuator by hand, or advance the cam nearly all the way around by hand.

USE THE SETTING DISC IN ADJUSTING THE CAMS:

1. Lay out your program on a straight line chart with 100 equal divisions representing 0-100% of the program cycle. Note the points on this line where each action should begin and end. The divisions correspond to the marks on the setting disc.

2. With power off the timer, advance the cam shaft

so the setting disc shows the number where the first contact actuation should occur. Turn the adjusting screws clockwise for either cam-half (or both, if necessary) until the actuator finger just drops off the high point. Advance the cam shaft all the way around and adjust as necessary to "fine tune" your setting.



3. Advance the cam shaft so the setting disc shows the number where the contact actuation should *end*. Turn the adjusting screw for the other half of the cam assembly and listen carefully until you hear the pre-

cision switch click. Then the cam is set for the two operate-points in the program you have selected.

4. Repeat with all cams for all switches.

PREVENTIVE MAINTENANCE:

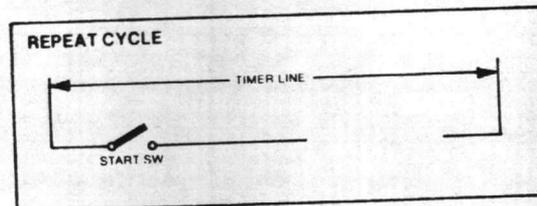
Cams should be kept clean, *but not lubricated*, as lubricant picks up grit and causes increased wear of the actuator fingers.

The sealed, permanently lubricated motor requires no maintenance.

BASIC APPLICATIONS:

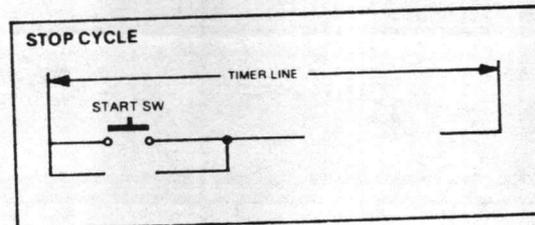
Repeat Cycle

The timer runs continuously, repeating cycles as long as power is applied to the motor through an external *start* switch. The timer stops when power is cut off, and resumes the interrupted cycle when power is restored.



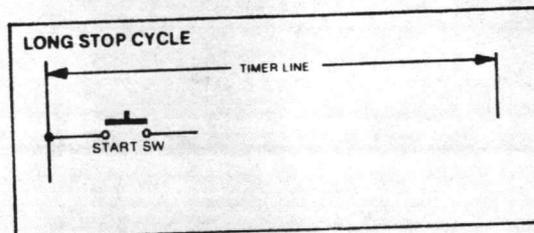
Stop Cycle

Power is applied to the motor through a *start* switch which the user wires in parallel with one of the timer's cam-operated *stop* contacts and in series with the motor. Whenever the *start* switch is closed for at least 1% of cycle, the *stop* contact maintains the motor circuit for one full cycle; the timer then stops.



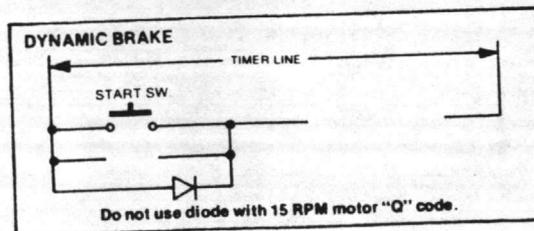
Long Stop Cycle

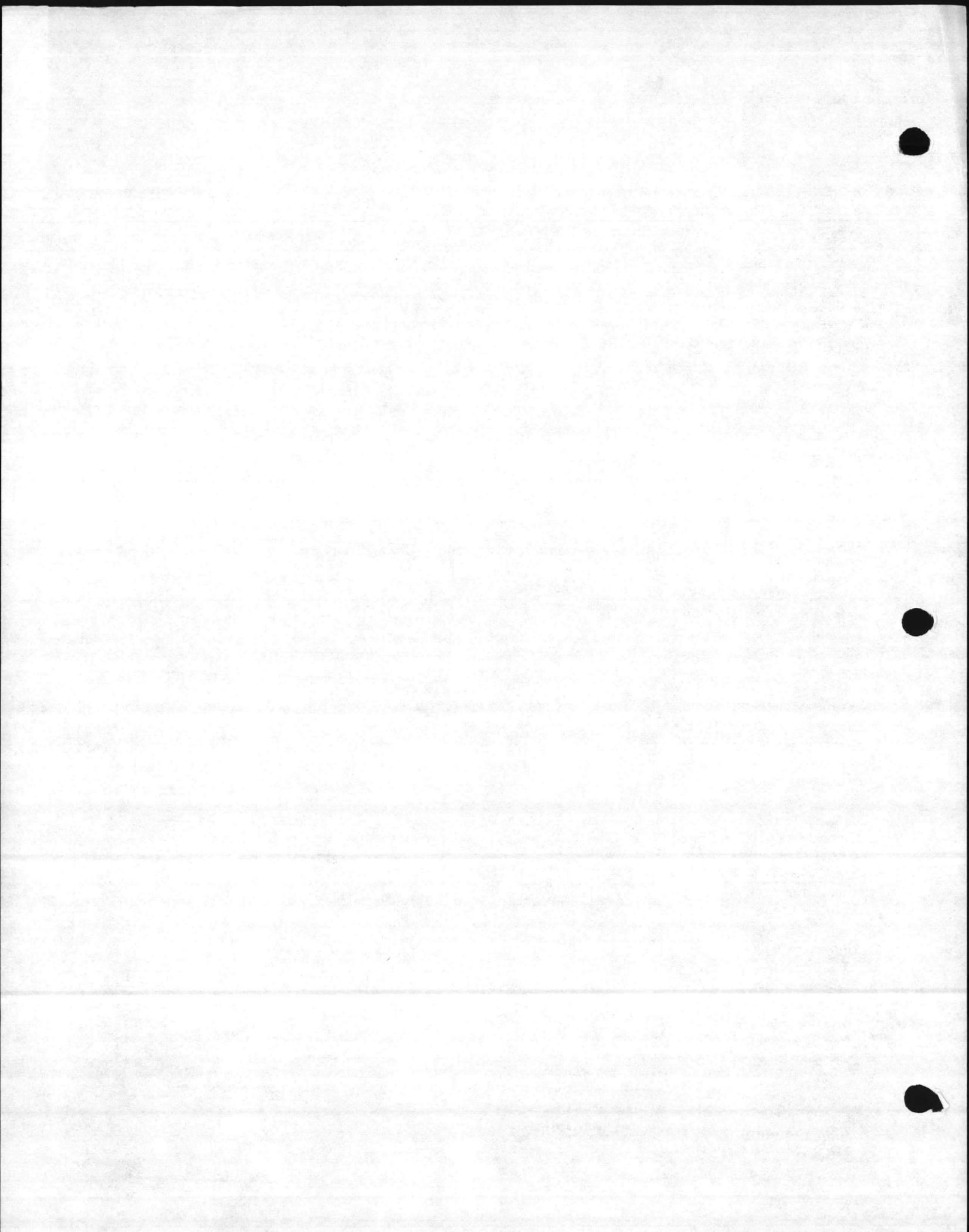
Used when the timer must operate from a momentary *start* signal that is less than 1% of cycle time, this circuit includes a factory-supplied and wired holding relay. The relay maintains the motor circuit for 1% of cycle until the cam switch transfers. The cam switch maintains the motor circuit for the balance of the cam rotation, ending the cycle when the cam switch opens.



Dynamic Brake

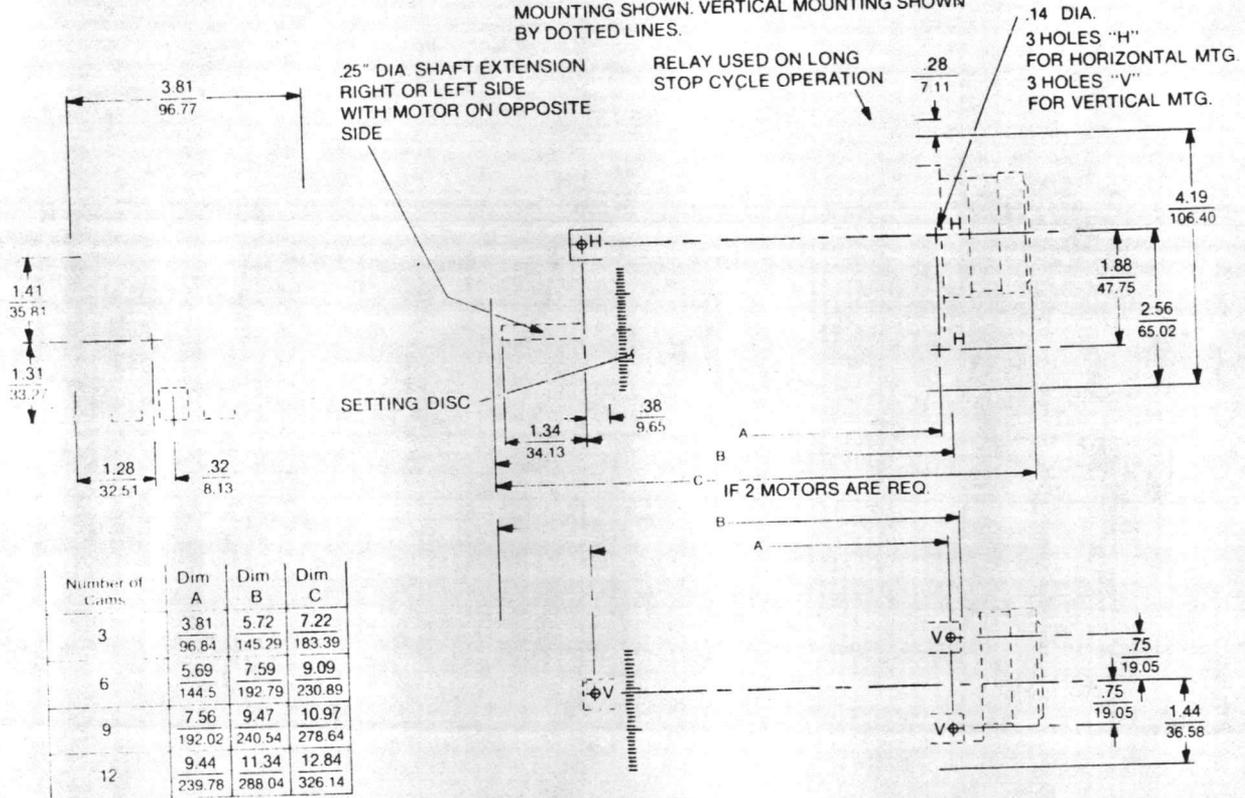
This circuit prevents coasting, stopping the timer instantly when power is removed from the motor. The brake consists of a diode assembly (Part No. 230026056) which the user wires in parallel with one of the timer's cam operated *stop* contacts. It is required in all stop cycle timers with a cycle time of 120 seconds or less, except those that use the 15 RPM permanent magnet motor Q which needs no brake.



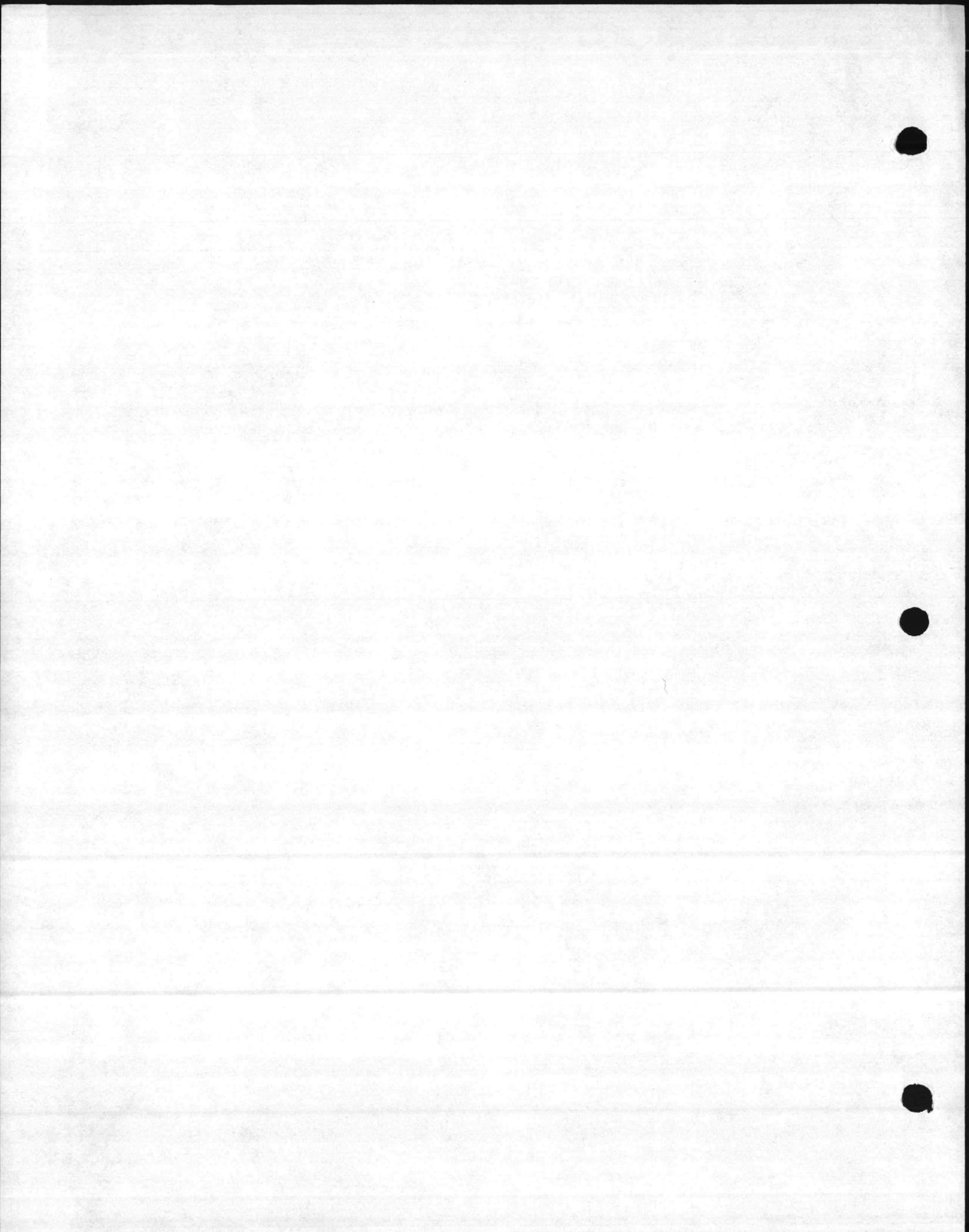


DIMENSIONS:

NOTE: THREE MOUNTING FEET, LOCKWASHERS AND SCREWS SUPPLIED WITH EACH TIMER. TIMER CAN BE MOUNTED HORIZONTAL OR VERTICAL. HORIZONTAL MOUNTING SHOWN. VERTICAL MOUNTING SHOWN BY DOTTED LINES.



Number of Cams	Dim A	Dim B	Dim C
3	3.81 96.84	5.72 145.29	7.22 183.39
6	5.69 144.5	7.59 192.79	9.09 230.89
9	7.56 192.02	9.47 240.54	10.97 278.64
12	9.44 239.78	11.34 288.04	12.84 326.14



INSTALLATION INSTRUCTIONS – 324C Camtime

ORDERING CODE	324C	06	B2F	R	1	A	01	X												
BASIC TYPE																				
NUMBER OF SWITCHES																				
01	1 switch, 3 cams																			
02	2 switches, 3 cams																			
03	3 switches, 3 cams																			
04	4 switches, 6 cams																			
05	5 switches, 6 cams																			
06	6 switches, 6 cams																			
07	7 switches, 9 cams																			
08	8 switches, 9 cams																			
09	9 switches, 9 cams																			
10	10 switches, 12 cams																			
11	11 switches, 12 cams																			
12	12 switches, 12 cams																			
TIME CYCLE	Fill in here the appropriate letter, number, letter combination, selecting a letter for motor speed, a number for the motor pinion, and a letter for the cam shaft gear from the speed charts.																			
000	No motor, or special time cycle.																			
CAMS	Factory setting cams to 1/4% tolerance. 50% cams = allow 12.5 2% adjustment of switch actuation. 2, 3, or 4 cuts equally spaced. Have limited adjustability. (Does not include 50% cams with multiple cuts) Multiple cuts, unequally spaced Multiple cuts — over 4 Specially cut or specially molded cams																			
LUGS	Bag of 50 push-on terminal lugs — insulated Part No. 23002605900																			
BRAKE	Diode brake assembly. Part No. 23002605600																			
GEARS	Extra camshaft gear or pinion gear																			
OPERATION	<table border="0"> <tr> <td>R</td> <td>Repeat cycle, Stop cycle, Dynamic Brake¹</td> </tr> <tr> <td>L</td> <td>Long Stop Cycle¹</td> </tr> <tr> <td>E</td> <td>External drive by user, no motor</td> </tr> <tr> <td>F</td> <td>Bi-directional operation cams & switches — No motor¹</td> </tr> <tr> <td>K</td> <td>Special</td> </tr> </table>								R	Repeat cycle, Stop cycle, Dynamic Brake ¹	L	Long Stop Cycle ¹	E	External drive by user, no motor	F	Bi-directional operation cams & switches — No motor ¹	K	Special		
R	Repeat cycle, Stop cycle, Dynamic Brake ¹																			
L	Long Stop Cycle ¹																			
E	External drive by user, no motor																			
F	Bi-directional operation cams & switches — No motor ¹																			
K	Special																			
MOTORS	<table border="0"> <tr> <td>1</td> <td>1 motor</td> </tr> <tr> <td>2</td> <td>2 motors</td> </tr> <tr> <td>3</td> <td>No motor</td> </tr> <tr> <td>0</td> <td>Special</td> </tr> </table>								1	1 motor	2	2 motors	3	No motor	0	Special				
1	1 motor																			
2	2 motors																			
3	No motor																			
0	Special																			
VOLTAGE AND FREQUENCY	<table border="0"> <tr> <td>A</td> <td>120/60</td> </tr> <tr> <td>B</td> <td>240/60</td> </tr> <tr> <td>C</td> <td>120/50</td> </tr> <tr> <td>D</td> <td>240/50</td> </tr> <tr> <td>X</td> <td>No motor</td> </tr> <tr> <td>K</td> <td>Special</td> </tr> </table>								A	120/60	B	240/60	C	120/50	D	240/50	X	No motor	K	Special
A	120/60																			
B	240/60																			
C	120/50																			
D	240/50																			
X	No motor																			
K	Special																			
OPTIONS	<table border="0"> <tr> <td>01</td> <td>None</td> </tr> <tr> <td>02</td> <td>1/4" dia. x 1" long shaft extension, right end (Units with one or no motor, or bidirectional operation).</td> </tr> <tr> <td>03</td> <td>1/4" dia. x 1" long shaft extension, left end (Units with one or no motor, or bidirectional operation).</td> </tr> <tr> <td>04</td> <td>1/4" dia. x 1" long shaft extension, both ends (On motorless units only, or for bidirectional operation).</td> </tr> <tr> <td>00</td> <td>Special</td> </tr> </table>								01	None	02	1/4" dia. x 1" long shaft extension, right end (Units with one or no motor, or bidirectional operation).	03	1/4" dia. x 1" long shaft extension, left end (Units with one or no motor, or bidirectional operation).	04	1/4" dia. x 1" long shaft extension, both ends (On motorless units only, or for bidirectional operation).	00	Special		
01	None																			
02	1/4" dia. x 1" long shaft extension, right end (Units with one or no motor, or bidirectional operation).																			
03	1/4" dia. x 1" long shaft extension, left end (Units with one or no motor, or bidirectional operation).																			
04	1/4" dia. x 1" long shaft extension, both ends (On motorless units only, or for bidirectional operation).																			
00	Special																			
FEATURES	<table border="0"> <tr> <td>S</td> <td>Screw terminal adapters mounted on all switches (Not U.L. listed with these adapters)</td> </tr> <tr> <td>X</td> <td>Standard (Other than cam settings.)</td> </tr> <tr> <td>K</td> <td>Special</td> </tr> </table>								S	Screw terminal adapters mounted on all switches (Not U.L. listed with these adapters)	X	Standard (Other than cam settings.)	K	Special						
S	Screw terminal adapters mounted on all switches (Not U.L. listed with these adapters)																			
X	Standard (Other than cam settings.)																			
K	Special																			

¹For Stop Cycle, or Brake operation, specify a 324 with one more switch than you need for your load circuits. (Do not exceed 12 switches total!)
 You interwire this switch to the motor according to the installation instruction for the unit.
²Be sure to specify shaft extension under OPTIONS.

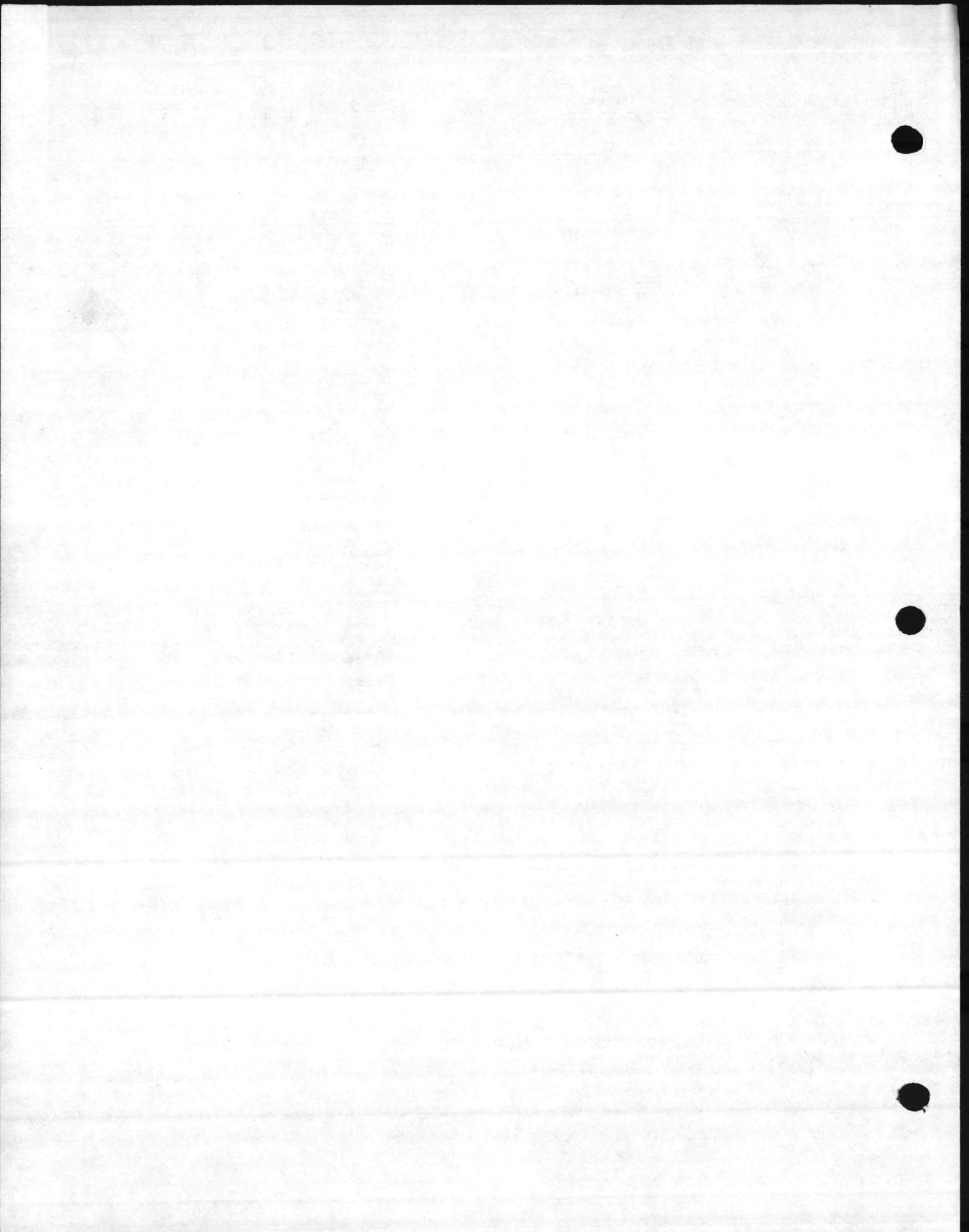


AUTOMATIC TIMING & CONTROLS CO.

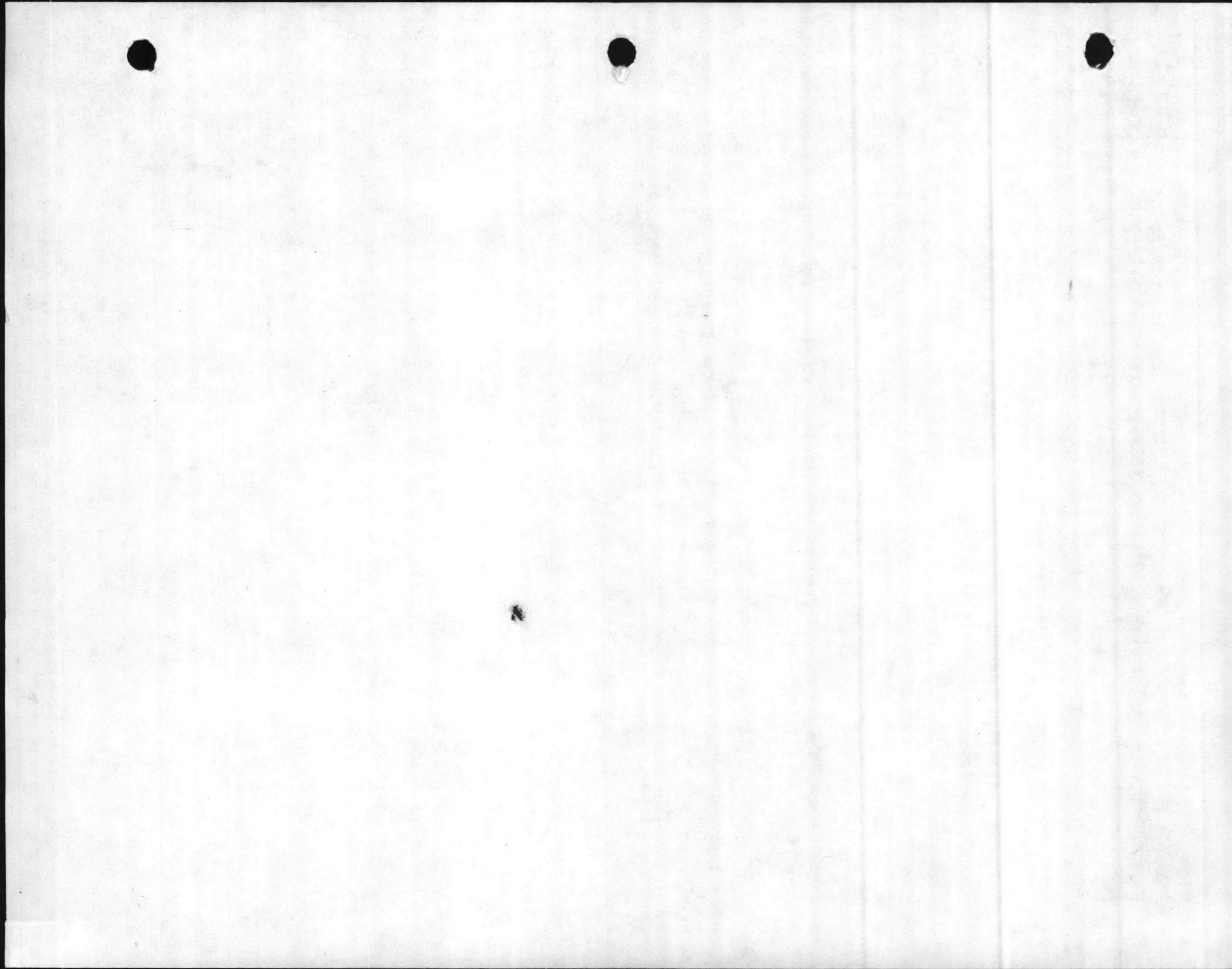
KING OF PRUSSIA, PENNSYLVANIA 19406

Phone (215) 337-5500 Telex 84 6437

Printed in U.S.A.







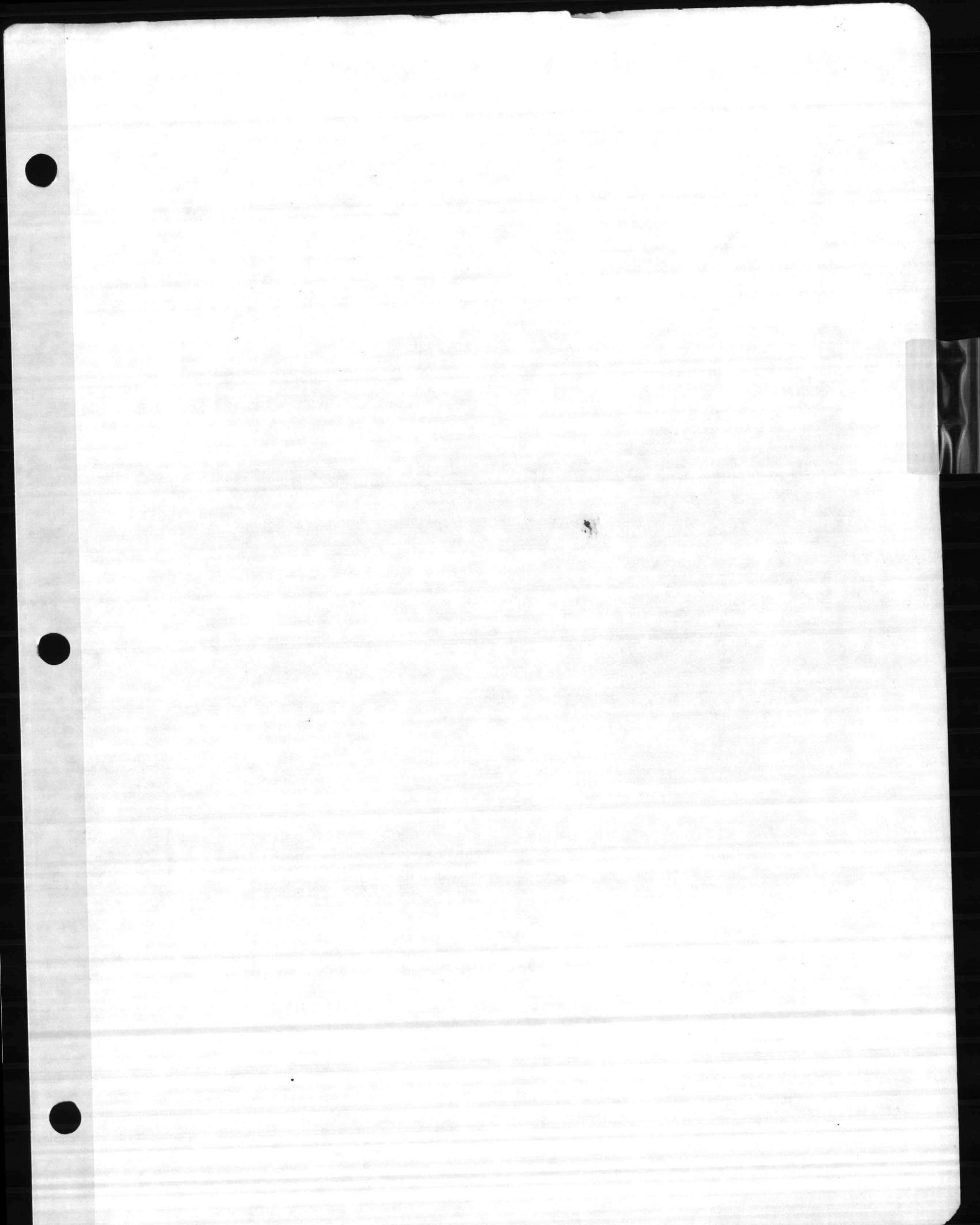
TAB PLACEMENT HERE

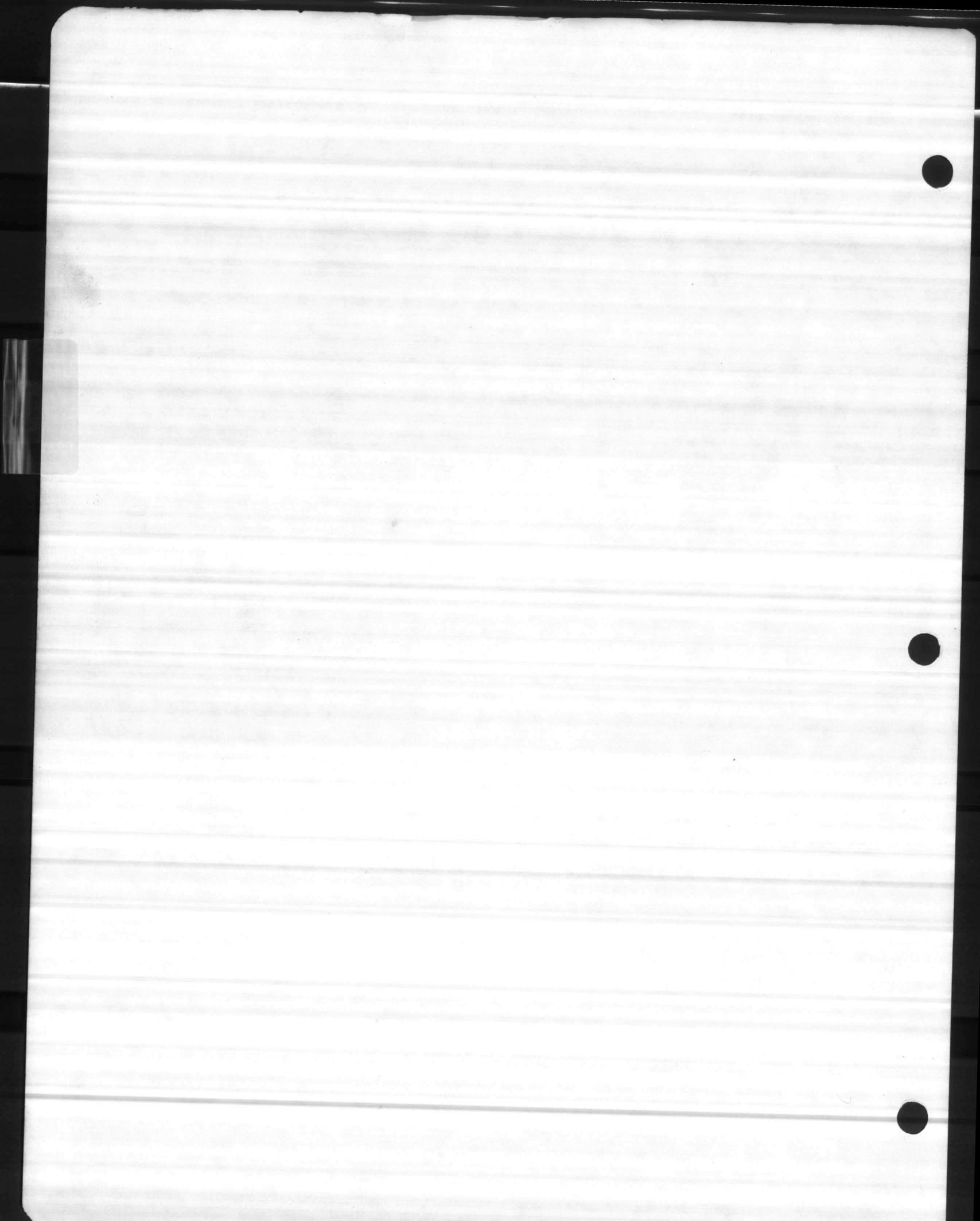
DESCRIPTION:

N/A

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image





Fisher Controls

Instruction Manual

Type 171F Level Regulator and Type 171L Lever Valve



July 1980

Form 1891

INTRODUCTION

Scope of Manual

This instruction manual provides installation, maintenance, and parts ordering information for the Type 171F level regulator and for the Type 171L lever valve. Information for other equipment used with the level regulator or lever valve is found in separate instruction manuals.

Description

The Type 171F level regulator and Type 171L lever valve both consist of single-port, cage-guided, bronze globe valves. A lever-rod-float assembly actuates the Type 171F level regulator (figure 1) when liquid level changes. The length and angle of the Type 171F float rod are adjustable. Type 171F lever action is always rising-lever-closes-valve. The Type 171L lever and weight assembly, which is connected to a separate, mechanically-operated device that senses changing liquid level, operates the Type 171L valve when liquid level changes. The weight can be placed on the lever to act either with or against the motion of the lever. In addition, the Type 171L lever can be positioned for either rising-lever-closes-valve or rising-lever-opens-valve action.

Specifications

Specifications for Type 171F level regulators and for Type 171L lever valves are listed in table 1.

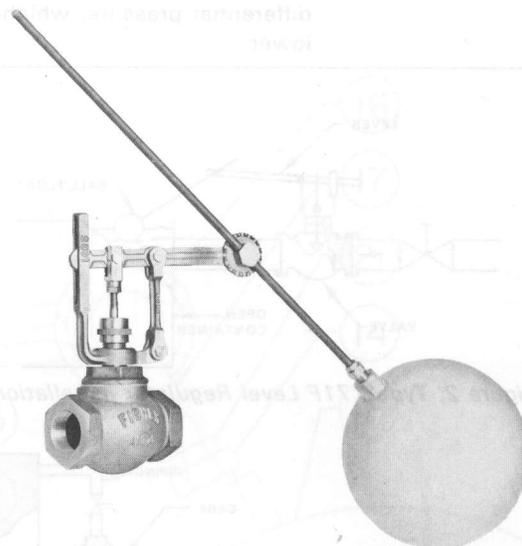


Figure 1. Type 171F Level Regulator

INSTALLATION

1. Before installing the unit, inspect it to be certain that no foreign material has collected in the valve body. Also, check that the pipeline is clean and free of foreign material.
2. The registration hole in the piston (key 2A, figure 4) has a diameter of 0.052 inch (1.32 mm) in 3/8 through 1-inch valve bodies and a diameter of 0.062 inch (1.59 mm) in 1-1/4 through 2-inch valve bodies. If the process fluid contains particles that may clog the piston registration hole or damage the seat ring, install a strainer upstream of the regulator or valve.

Types 171F and 171L

Table 1. Specifications

END CONNECTION	NPT Screwed					
MAXIMUM INLET PRESSURE	150 psig (10.3 bar)					
MAXIMUM PRESSURE DROP	150 psi (10.3 bar)					
MATERIAL TEMPERATURE CAPABILITIES	-50 to 150°F (-46 to 66°C)					
SHUTOFF CLASSIFICATION	ANSI Class VI (B16.104-1976). Leakage as listed in following table. Tested with air or nitrogen at 50 to 125°F (10 to 52°C) and 50 psid (3.4 bar differential) or maximum rated differential pressure, whichever is lower.					
		BODY SIZE, IN.	PORT DIAMETER		LEAK RATE	
			In.	mm	Bubbles/Minute	mL/Minute
		3/8, 1/2, 3/4	3/4	19.1	1	0.15
		1	1	25.4	1	0.15
		1-1/4, 1-1/2	1-1/2	38.1	2	0.30
		2	2	50.8	3	0.45
		APPROXIMATE WEIGHTS	BODY SIZE, IN.		WEIGHT	
					Lb	kg
			3/8, 1/2, 3/4, 1		8	4
			1-1/4		19	9
			1-1/2		25	11
			2		30	14

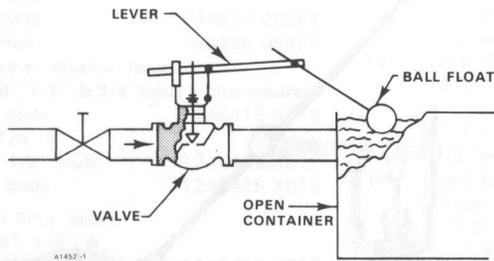


Figure 2. Type 171F Level Regulator Installation

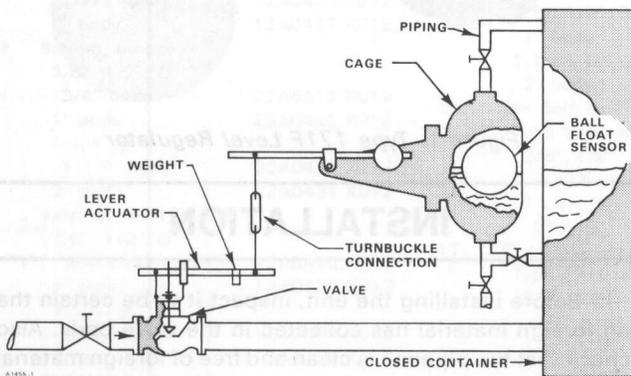


Figure 3. Type 171L Lever Valve Installation

3. Install the valve body in a horizontal pipeline with the bonnet vertically above the valve body. Be sure that flow through the unit matches the direction of the flow arrow on the valve body. Also, make sure the connecting linkage to the Type 171L lever is either directly above or below the lever. Typical installations are shown in figures 2 and 3.

4. Install an upstream shutoff valve for use in inspection and maintenance operations.

ADJUSTMENT

This section provides instructions for either raising or lowering liquid level in a container controlled by the Type 171F level regulator or Type 171L lever valve.

Key numbers refer to figure 4.

To adjust liquid level with a Type 171F level regulator, determine the desired liquid level. Loosen the eye bolt (key 16). With the piston (key 2A) and the pilot valve (key 5) seated, position the float in the tank so that the float will be half-submerged when the liquid reaches the desired level. Be sure the float and rod (keys 18 and 17) can move freely over the full travel. Tighten the eye bolt.

To adjust liquid level with a Type 171L lever valve, determine the desired liquid level. Adjustment is the same for both lever actions, rising-lever-closes-valve and rising-lever-opens-valve. To lower the level, lengthen the turnbuckle connection (shown in figure 3) until the ball float sensor (figure 3) reaches the desired lower level. To raise the liquid level, shorten the turnbuckle connection until the ball float sensor reaches the desired higher level. Horizontal orientation of the lever allows best operation.

After adjusting the turnbuckle connection, move the weight (key 24) either toward the yoke to add shutoff force to a lever valve with rising-lever-closes-valve action or away from the yoke to add shutoff force to a lever valve with rising-lever-opens-valve action.

If adjustments do not produce the desired level, check the instruction manual of the device that is connected to the Type 171L lever valve.

MAINTENANCE

WARNING

Avoid personal injury or damage to property from sudden release of pressure or uncontrolled process fluid. Before starting to disassemble, isolate the valve from the process and release process pressure.

The float in this unit is a sealed container and, if penetrated by the process fluid, may retain pressure or fluid for an extended period. Such a float may contain pressure as a result of being in a pressurized vessel or fluid that becomes pressurized due to a change in temperature or fluid that is hazardous or flammable. Sudden release of pressure, contact with hazardous fluid, fire, or explosion resulting in personal injury or property damage can occur if a float that is retaining pressure or fluid is punctured, subjected to heat, or repaired. Handle the float with care in removing, storing, or disposing, taking into consideration the characteristics of the process fluid.

Level regulator and lever valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and parts replacement depends on the severity of service conditions.

CAUTION

The Type 171L lever valve is usually connected to a ball float sensor (see figure 3). Before isolating the Type 171L lever valve and breaking the turnbuckle connection (figure 3) to the Type 171L lever valve, consult the instruction manual of the ball float sensor for shutdown procedures.

Key numbers refer to figure 4.

Maintenance procedures can be completed with the Type 171F or 171L valve body (key 1) installed in the line.

Replacing Packing

1. Unscrew the elastic stop nuts on the two lever bolts (key 15) at the top of both the vertical link (key 12) and the lever connection (key 13).

2. Disconnect the lever (key 11) from the vertical link (key 12) and lever connection (key 13).

3. If the float (key 18) bottoms or appears to be overweight, it may have been penetrated by the process fluid. If it is necessary to remove the float for any reason, be sure that the inlet to the tank has been closed. If necessary, loosen the eye bolt (key 16), and remove the float and rod (keys 18 and 17) of the Type 171F level regulator.

4. Unscrew just the lever connection (key 13) from the valve stem (key 4).

5. Measure and record for later use the amount of thread visible below the hex nut (key 23). Remove the hex nut.

6. Unscrew the packing nut (key 9), and lift it straight up until it clears the valve stem (key 4).

7. Remove the packing follower (key 8), and then remove the packing (key 7) with a sharp, thin object or with a packing hook.

8. Inspect the valve stem for nicks and scratches, and, if the valve stem (key 4) shows wear, replace it by following the procedures in the "Replacing Trim" section.

9. Apply silicon grease to the packing. Taking care that the packing (key 7) is not damaged on the valve stem threads, slide the packing onto the stem. The v-notch in the packing must open toward the valve body.

10. Slide the packing follower (key 8) onto the stem, and push the packing (key 7) and the packing follower (key 8) into the bonnet (key 3) as shown in figure 4.

11. Screw the packing nut (key 9) onto the bonnet until the nut is finger-tight.

12. Screw the hex nut (key 23) onto the stem so that the amount of thread measured in step 4 is visible. Thread the lever connection onto the stem, and tighten the lever connection (key 13) against the hex nut (key 23).

13. Insert the lever (key 11) into the yoke (key 10), and attach the lever to the lever connection (key 13) and to the vertical link (key 12). Secure the parts with the lever bolts (key 15) and elastic stop nuts (not shown in figure 4).

14. Make the necessary adjustments by referring to the "Adjustment" section.

Types 171F and 171L

Replacing Trim

Disassembly

1. Complete steps 1 through 6 of the "Replacing Packing" section.
2. Loosen the set screw (key 22), and thread the yoke (key 10) and vertical link (key 12) subassembly off the bonnet (key 3).
3. Pull the valve stem (key 4) up to its top travel stop (as far up as it will go). Unscrew the bonnet (key 3).

CAUTION

Make sure that the two-piece piston ring (key 26) does not fall off the piston and become damaged.

4. Remove the valve stem (key 4) and attached parts from the bonnet.
5. Remove the piston ring (key 26) and expander (key 27) from the piston.
6. Unscrew the seat ring (key 2E) from the piston. On a 1, 1-1/4, 1-1/2, or 2-inch body, also remove the retainer washer (key 2C).

CAUTION

Use care to avoid damaging the valve stem (key 4) or pilot valve assembly (key 5) when separating them.

7. Slide the piston (key 2A) off the valve stem (key 4). Separate the valve stem and pilot valve assembly (key 5) if either the disc in the pilot valve assembly or the valve stem (key 4) needs replacement.
8. Remove the O-ring (key 2B) from the piston (key 2A). On a 1, 1-1/4, 1-1/2, or 2-inch body, also remove the O-ring (key 28).
9. Unplug and clean the piston registration hole.

Assembly

1. Place the O-ring (key 2B) in the piston as shown in figure 4. For a 1, 1-1/4, 1-1/2, or 2-inch body, also install the O-ring (key 28) as shown in figure 4.
2. Apply a thread locking compound to the threads of the pilot valve assembly (key 5), and tightly screw it into the valve stem (key 4).

3. Place the expander (key 27) on the piston, then slide the assembled valve stem and pilot valve assembly into the piston until the pilot valve assembly is pushed completely into the piston.

4. On a 1, 1-1/4, 1-1/2, or 2-inch body, slip the retainer washer (key 2C) over the lip of the seat ring. Screw the seat ring into the piston.

5. Install the piston ring (key 26) halves around the piston groove so that the split ends match. To break a new one-piece ring into halves for installation, place the ring on a flat surface. Using a sharp edge, score two notches in the piston ring opposite each other. Keep the sharp edge on the notches, and tap it to break the ring at both notches at the same time.

6. Hold the piston ring halves in place on the piston, and insert the end of the valve stem through the bonnet (key 3). Pull on the end of the stem to draw the piston up into the bonnet and secure the ring.

Note

Make sure that the seating surfaces of the body (key 1) are smooth and undamaged. Repair or replace the body as necessary.

7. Lubricate the bonnet threads with pipe compound, and securely install the bonnet into the body. Stroke the valve stem to make sure no piston binding occurs.

8. Screw the vertical link (key 12) and yoke (key 10) down until they are in the desired position relative to the valve body and as close to the body as possible. Tighten the machine screw (key 22).

9. Complete assembly by following steps 9 through 14 in the "Replacing Packing" section.

Replacing the Float

1. If the float (key 7) bottoms or appears to be overweight, it may have been penetrated by the process fluid. When removing the float, be sure that the input to the tank has been closed.

2. Loosen the eye bolt (key 16).

3. Remove the float and rod (keys 18 and 17).

4. Unscrew the float (key 18) from the float spud (key 14).

5. Screw the new float onto the float spud.

6. Insert the rod and attached float in the eye bolt (key 16), and adjust the float by following the "Adjustment" section procedures.

Reversing the Lever Action

1. Remove the top two lever bolts (key 15) in the vertical link (key 12) and the lever connection (key 13). Remove the lever (key 11).

2. Loosen the set screw (key 22) in the yoke (key 10), and rotate only the yoke 180°.

3. Tighten the set screw (key 22).

4. Insert the lever (key 11) in the yoke, returning the float to its original position. Align the holes in the lever, in the vertical link, and in the lever connection, and secure the lever with the two lever bolts and elastic stop nuts.

5. Refer to the "Adjustment" section for adjustment procedures.

PARTS ORDERING

Always refer to the serial number of the regulator or valve whenever corresponding with the Fisher representative about this equipment. When ordering replacement parts, also specify the complete 11-character part number of each part required as found in the following parts list.

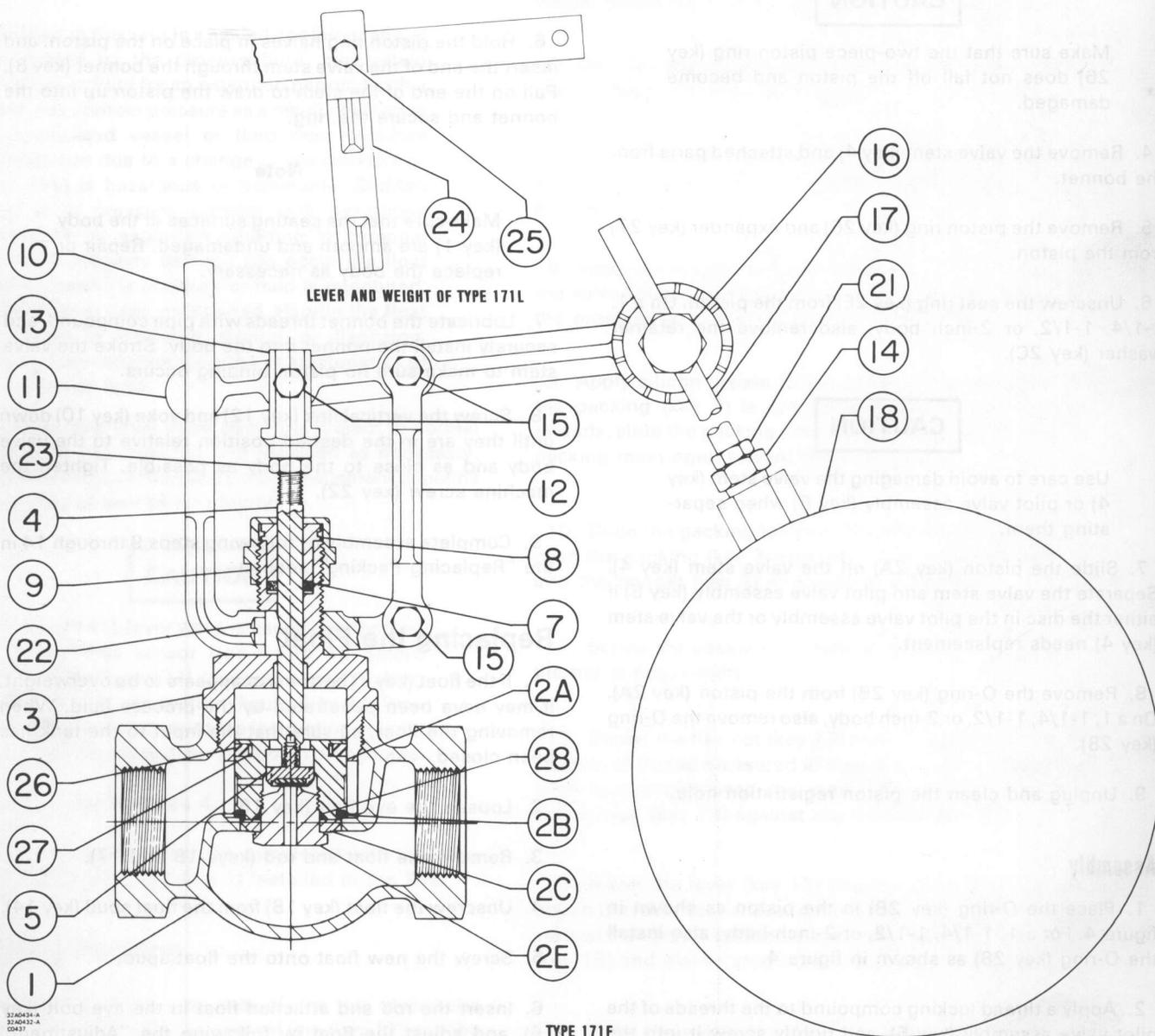


Figure 4. Type 171F and 171L Constructions

3240431-A
3240432-A
00437

PARTS LIST

Key	Description	Part Number	Key	Description	Part Number
1	Valve Body, bronze 3/8" NPT 1/2" NPT 3/4" NPT 1" NPT 1-1/4" NPT 1-1/2" NPT 2" NPT	1R5353 12012 1R5354 12012 1R5355 12012 1R5364 12012 2R5373 12012 2R5374 12012 2R5384 12012	8†	Packing Follower, brass 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	12A0409 X012 12A0411 X012
2A†	Piston, brass 3/8", 1/2", & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	12A0413 X012 12A0417 X012 22A0425 X012 22A0430 X012	9	Packing Nut, brass 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1B7293 14012 1A6842 14012
2B*	O-Ring 3/8", 1/2", & 3/4" body Nitrile Viton 1" body Nitrile Viton 1-1/4" & 1-1/2" body Nitrile Viton 2" body Nitrile Viton	1K1499 06992 1N4303 06382 1B8855 06992 1N1629 06382 1C4157 06992 1K7562 06382 1H4820 06562 1N3325 06382	10	Yoke, bronze 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1A4663 12012 006630 12012
2C†	Retainer Washer, brass 3/8", 1/2", & 3/4" body (none required) 1" body 1-1/4" & 1-1/2" body 2" body	12A0419 X012 12A0422 X012 12A0428 X012	11	Lever 171F, bronze 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	000999 12012 000998 12012 004190 25092 008813 25092
2E†	Seat Ring, brass 3/8", 1/2", & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	12A0414 X012 12A0418 X012 12A0423 X012 12A0427 X012	12	Vertical Link, brass 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1R5363 14012 1A7172 12012
3†	Bonnet, bronze 3/8", 1/2", & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	22A0416 X012 22A0421 X012 22A0426 X012 22A0431 X012	13	Lever Connection, brass 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2" & 2" body	1E5185 14012 1B3271 14012
4	Valve Stem, 316 SST 3/8", 1/2", & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	12A0415 X012 12A0420 X012 12A0424 X012 12A0429 X012	14	Float Spud, brass Type 171F only 3/8", 1/2", & 3/4" body 1", 1-1/4", 1-1/2", & 2" body	1E5184 14012 1E7952 14012
5*	Pilot Valve Assembly 3/8", 1/2", 3/4", & 1" body Nitrile disc Viton disc 1-1/4", 1-1/2", & 2" body Nitrile disc Viton disc	1R5360 000A2 1R5360 X0012 1R5380 000A2 1R5380 X00A2	15	Lever Bolt, brass (3 req'd) 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	0D0024 14012 1E4539 14012
7*†	Packing, nitrile 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	12A0410 X012 12A0412 X012	16	Eye Bolt, brass Type 171F only 3/8", 1/2", & 3/4" body 1", 1-1/4", 1-1/2", & 2" body	0H0037 14012 1E7957 14012
			17	Float Rod, steel Type 171F only 3/8", 1/2", & 3/4" body 1", 1-1/4", 1-1/2", & 2" body	1E5180 24092 1H3877 24092
			18	Float, copper Type 171F only 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1A4219 15062 1A4223 15062
			19	Elastic Stop Nut, brass (3 req'd, not shown) 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1B1003 18992 1A9447 18992
			20	Hex Nut, brass (not shown) Type 171F only	1A3421 14012
			21	Hex Nut, steel, Cd pl Type 171F only 3/8", 1/2", & 3/4" body 1", 1-1/4", 1-1/2", & 2" body	1A4117 24122 1A3522 24122
			22	Machine Screw, brass 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1B1005 16022 1A7352 18992
			23	Hex Nut 3/8", 1/2", 3/4", & 1" body Steel, Cd pl 1-1/4", 1-1/2", & 2" body Brass	1A4117 24122 1A5180 14012
			24	Weight, cast iron Type 171L only 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	0Y0570 19032 2F8629 19032
			25	Cap Screw, steel, pl Type 171L only 3/8", 1/2", 3/4", & 1" body 1-1/4", 1-1/2", & 2" body	1A3449 24052 1A3684 24052
			26*	Piston Ring, graphite 3/8", 1/2" & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	1V3675 05102 1V3677 05102 1V3678 05102 1V3679 05102
			27*	Expander, phosphor bronze 3/8", 1/2", 3/4", & 1" body 1-1/4" & 1-1/2" body 2" body	1V3683 15092 1V3684 15092 1V3687 15092
			28*†	O-Ring 3/8", 1/2", & 3/4" body (none required) 1" body Nitrile † Viton 1-1/4", 1-1/2", & 2" body Nitrile † Viton	1D5415 06992 1R6201 06382 1J1085 06992 1N3779 06382
			29	Subassembly (not shown), contains a kit made of keys 2A, 2C, 2E, 3, 7, 8, and 28 3/8", 1/2", & 3/4" body 1" body 1-1/4" & 1-1/2" body 2" body	32A0432 X0B2 32A0432 X0A2 32A0432 X0C2 32A0432 X0D2

*Recommended spare part.

†Part included in conversion kit which can be ordered as key 29. For key 28, only nitrile O-ring included in kit.

While this information is presented in good faith and believed to be accurate, Fisher Controls does not guarantee satisfactory results from reliance upon such information. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding the performance,

merchantability, fitness or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Fisher Controls reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

FISHER

Fisher Controls

For information write:
P.O. Box 190, Marshalltown, Iowa 50158, U.S.A.
or Brenchley House, Maidstone, Kent ME 14 1UQ, England

April 1983

Errata Sheet
for
 TYPE 171F LEVEL REGULATOR AND TYPE
 171L LEVER VALVE INSTRUCTION MANUAL
 Form 1891, July 1980

Standard elastomer material for Type 171F level regulator and Type 171L lever valve is now ethylene propylene rather than nitrile. Add the following part numbers to page 6 of the instruction manual:

Key	Description	Part Number
2B	O-Ring, ethylene propylene	
	3/8, 1/2, & 3/4 in. bodies	12A8344 X012
	1 in. body	1B8855 X0022
	1-1/4 & 1-1/2 in. bodies	1P6994 X0012
5	2 in. body	1P9155 X0012
	Pilot Valve Assembly w/ ethylene propylene disc	
	3/8, 1/2, 3/4, & 1 in. bodies	1R5360 X0022
7	1-1/4, 1-1/2, & 2 in. bodies	1R5380 X0012
	Packing, ethylene propylene	12A0410 X022
28	O-Ring, ethylene propylene	
	1 in. body	1V8029 06572
	1-1/4, 1-1/2, & 2 in. bodies	12A6291 X012

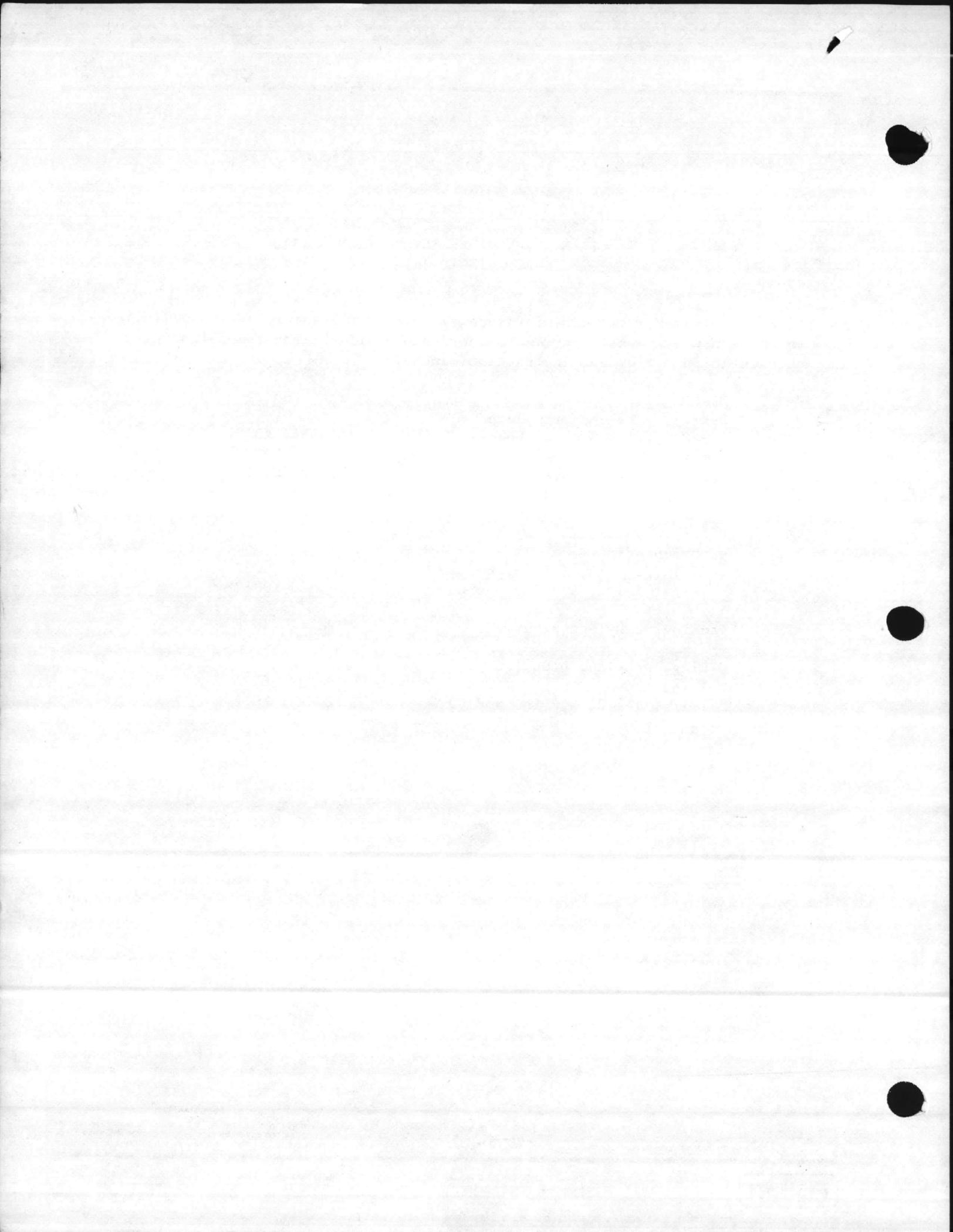
Printed in U.S.A.

While this information is presented in good faith and believed to be accurate, Fisher Controls does not guarantee satisfactory results from reliance upon such information. *Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding the performance,*

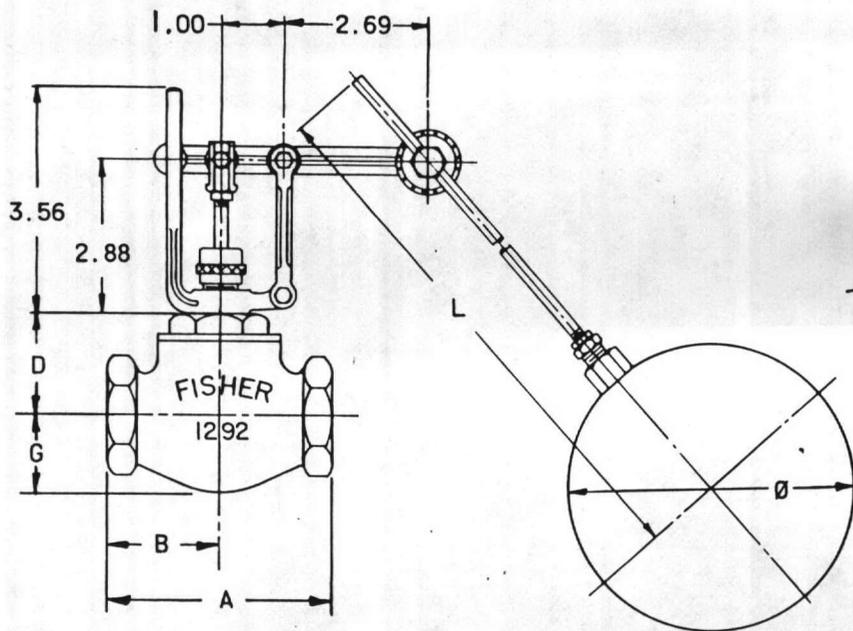
merchantability, fitness or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Fisher Controls reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

FISHER®**Fisher Controls**

For information write:
 P.O. Box 190, Marshalltown, Iowa 50158, U.S.A.
 or Brenchley House, Maidstone, Kent ME 14 1UQ, England



FEATURES PICTORIALY
TYPICAL-ORIENTATION
MAY DIFFER



SIZE	A	B	D	G	L			
					FLOAT Ø			
					4 1/2	6	8	10
3/8	3.50	1.75	1.62	1.06	21.44	21.88	23.12	24.00
1/2	3.50	1.75	1.62	1.06	21.44	21.88	23.12	24.00
3/4	3.50	1.75	1.62	1.06	21.44	21.88	23.12	24.00
1	3.75	1.88	2.00	1.31	26.44	26.88	27.94	29.00

CUSTOMER: The Permutit Company
 P.O. NO.: H39857-3506
 JOB NO.:
 TAG NO.:

REQN NO.:
 SERIAL NO.: 9319488
 OUR NO.: 1-A08033055
 DIMENSIONS CERTIFIED CORRECT
 DATE 6-22-84 BY J M-Coy



MARSHALLTOWN, IOWA

FLOAT VALVE

TYPE
171F

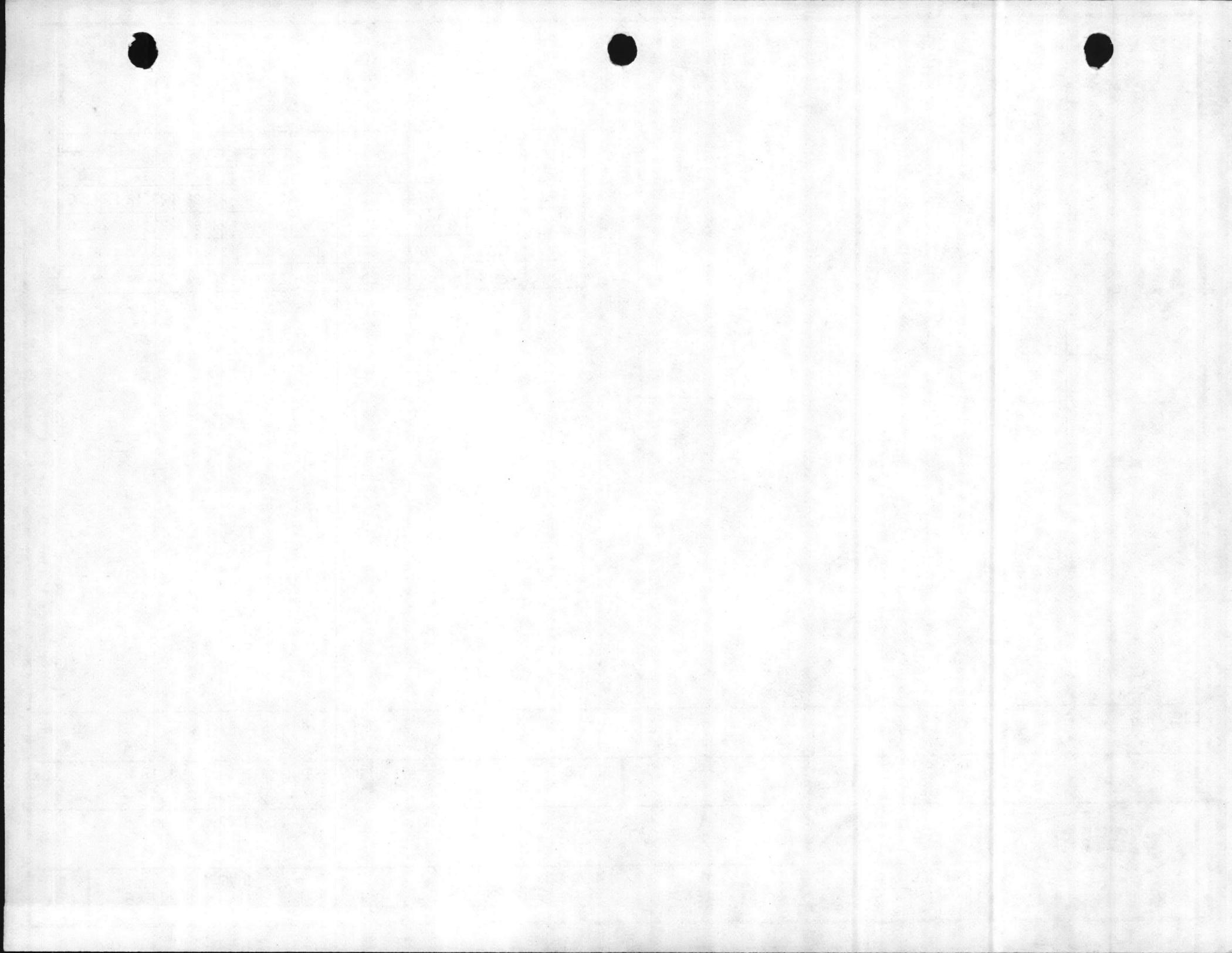
DWN MLD 6-14-74
 CHKD ~~RM~~ 6-14-74
 APVD ~~RM~~ 6-14-74

SCALE-NONE

REVISIONS
 B GEK 2-21-79

DWG NO.
AP1846

REV.
B



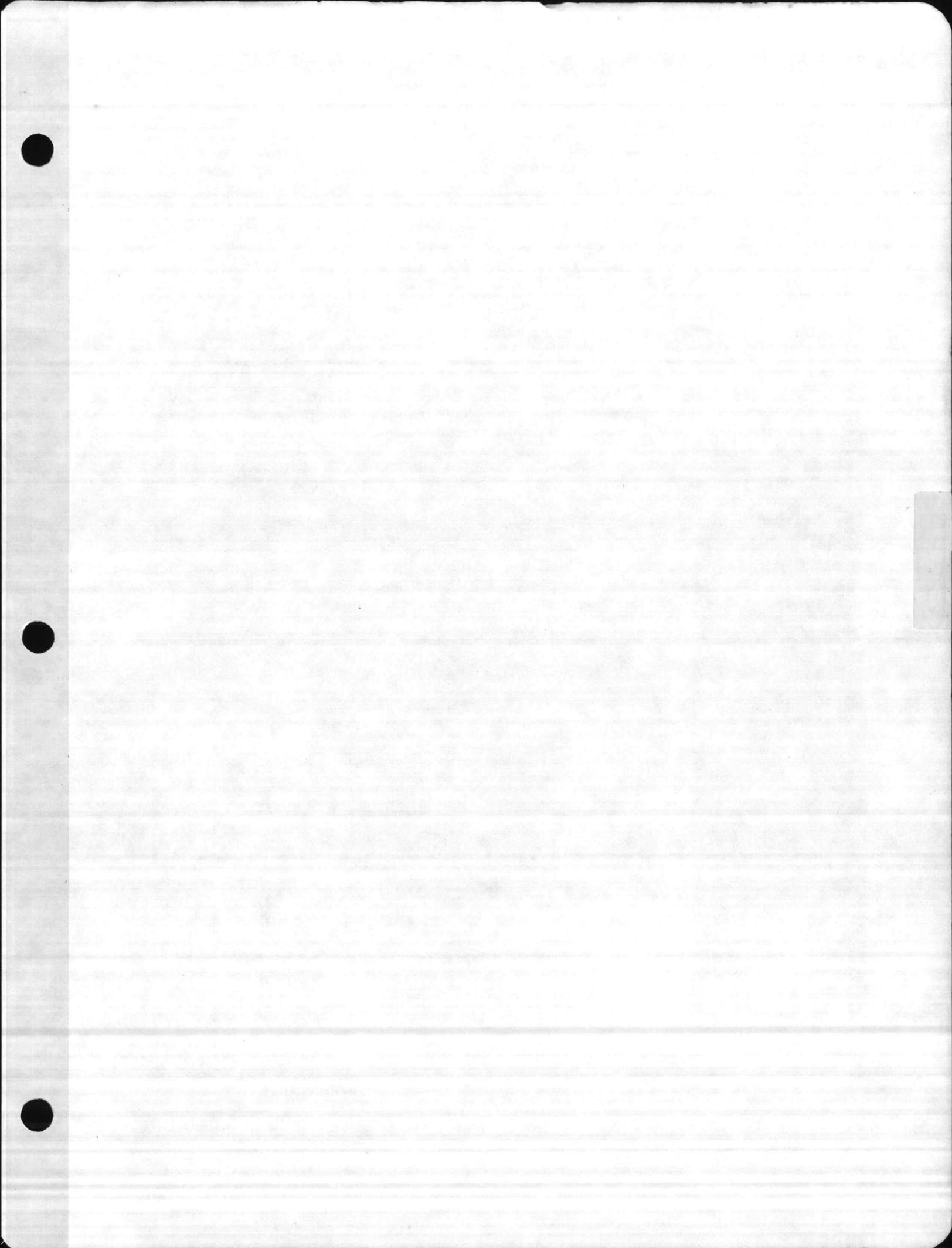
TAB PLACEMENT HERE

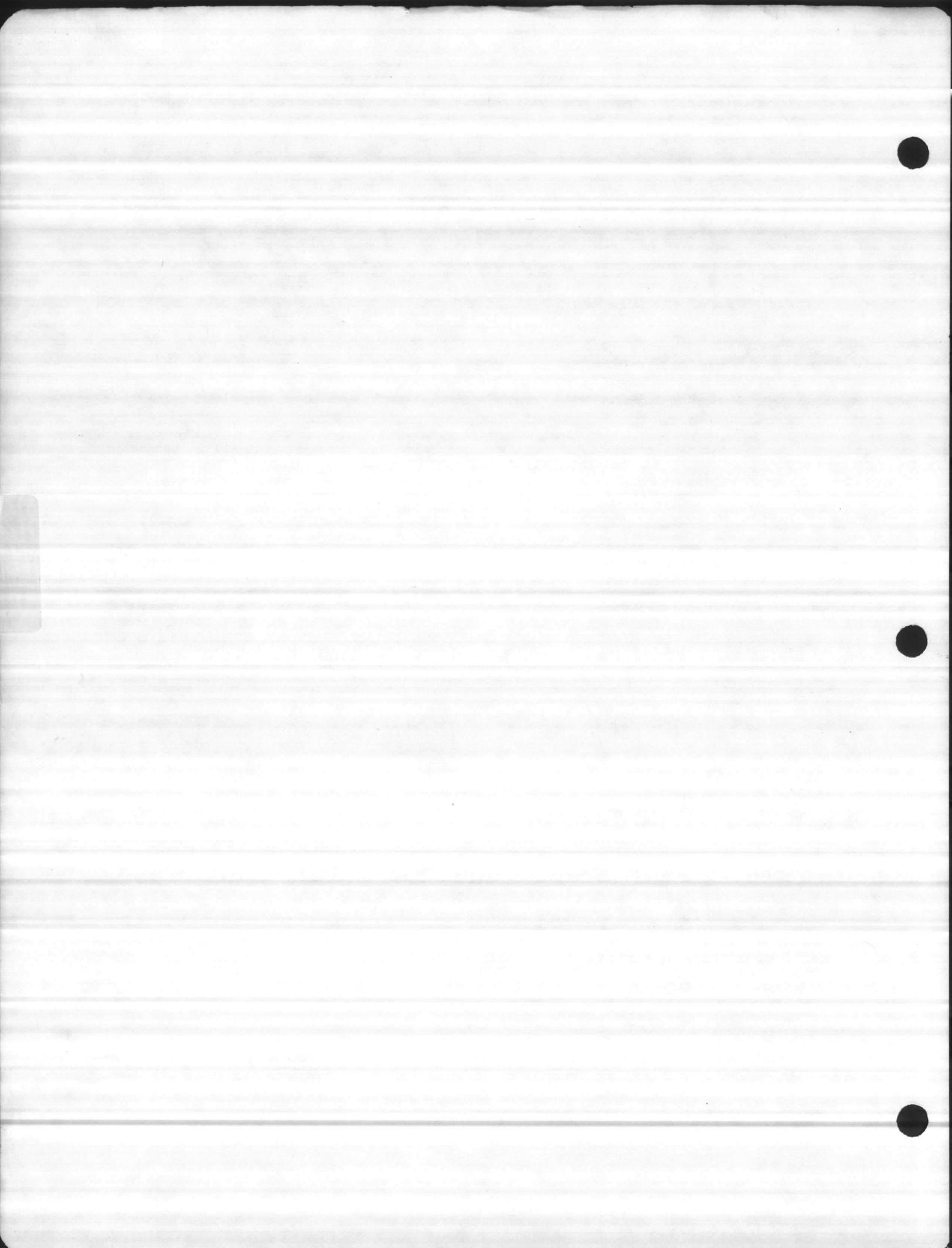
DESCRIPTION:

D

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image





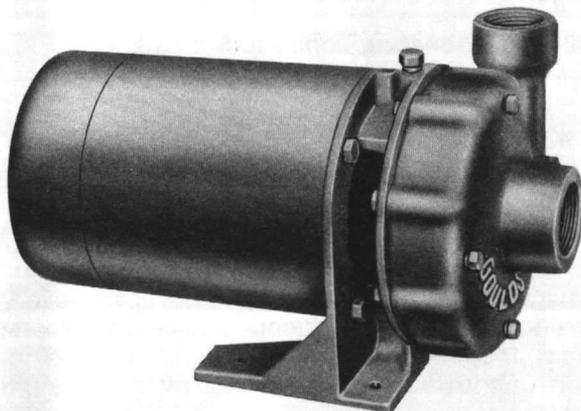


GOULDS PUMPS

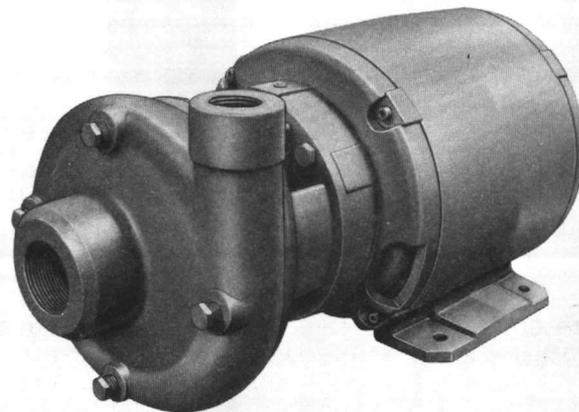
JUNE 1980

Installation, Operation and Maintenance Instructions

Models 3642 and 3656 Close Coupled Centrifugal Pumps



Model 3642



Model 3656

GENERAL INFORMATION

Models 3642 and 3656, both are single stage, end suction, volute type, general purpose centrifugal pumps with enclosed impellers applicable to clear liquids. Also appropriate for general machinery and industrial services up to 212° F, particularly suited to air conditioning, condensate, booster service and water transfer.

Both models are close coupled to an electric motor having NEMA standard face mounting and shaft extension dimensions, and designed for continuous service

with prelubricated ball bearings. Model 3642 has a standard jet pump motor with stainless steel threaded shaft extension. Model 3656 steel shaft is protected by a stainless steel sleeve.

Both models are equipped with mechanical seals. Single, unbalanced J. Crane seals are standard. The back-pull-out design (the entire rotating elements and motor can be pulled from the pump casing) facilitates inspection and repair without disturbing the piping.

The pumps are shipped completely assembled.

INSTALLATION

Location — Locate pump as near the liquid source as practical (and below the level of liquid storage if automatic operation is contemplated). Protect the unit from weather and against water damage due to flooding. Low static lift and short, direct suction and discharge pipes are desirable. At suction lift higher than 15 ft. consult the pump performance curve for NPSHR. (Net Positive Suction Head — Required). The suction pipe should be at least equal in size to the suction connection of the pump and slope upward to the pump avoiding air pockets. If pipe larger than pump suction is used, an eccentric pipe reducer should be used at the pump. Gate valve in the suction is necessary only on positive suction head installation and must not be used to throttle the pump.

Allow adequate room for servicing and ventilation.

Foundation — Bolt unit to foundation by removable hold-down bolts for easy dismantling. Foundation surface must be flat so there is no distortion and/or strain developed when tightening the bolts. The pumps are inherently quiet and smooth running, but rubber mounting is desirable on foundation susceptible to sound effect.

Alignment — No field alignment of these pumps is necessary, since they are close coupled.

Wiring — National Electric Code and local codes should be followed. Motor branch circuit should be protected by a suitable manual or magnetic starter and it is desirable to have low voltage protection. Proper fusing and sufficient time delay for starting must also be selected according to codes.

All single phase motors furnished with model 3642 pumps are dual voltage, 115/230 V, 60 Hz., A.C. All pumps are tested at the factory. Upon installation in the field correct rotation (3 phase), phase, frequency and voltage of power supply should be checked. The power lines should be of proper size to carry the required amperage.

Model 3656 single phase 3HP motors are dual voltage 115/230 V., 60 Hz, A.C. and single phase 5HP motors are 230 V. only, 60 Hz, A.C. All other motors are three phase dual voltage 230/460 V. 60 Hz, A.C. Higher voltages are always recommended wherever available.

The rotation must be checked upon installation. Close, then break the contacts quickly and observe rotation of the exposed portion of rotating parts. Rotation must agree with the arrow cast on the pump casing. For all pumps the standard rotation is counter clockwise viewed from the suction end. Motor wiring is easily changed in the field by following the wiring diagram on the inside of the terminal box cover, or on the motor nameplate.

OPERATION

Fill the suction pipe and casing with the liquid to be pumped to insure that the mechanical seal will not run dry. Four plugs are provided in the casing so that in any position one will be on the top for priming and/or venting and another at the bottom for draining. With the pump primed and the motor properly wired, the unit may be started. Be sure that the pump is not started against a closed controlling valve in the discharge line.

For possible leaks, check flange bolting, piping connections and pipe plugs. Tighten if necessary. The maximum temperature — 212° F limitation — is imposed by the mechanical seal material. Optional, high temperature seals might be used.

MAINTENANCE — MODEL 3642

I. LUBRICATION

Pumps should require no maintenance, other than the motor bearings, according to the following instructions:

- **Ball-sleeve bearing construction (G.E.).**
- **Ball bearing-drive end.**
Clean and remove grease plug. Add grease until housing is filled. Operate with plug removed until excess grease escaped. Replace plug.
- **Sleeve bearing-opposite drive end.**
Oil bearing while motor is **not** running. Add SEA 10 oil until wicking is saturated. Restart motor. In hot environment lubrication may be necessary every 2-3 months, otherwise lubrication once a year is sufficient. Inspect periodically to determine the condition of the lubricant and how often it should be replaced.
- **Ball-ball bearing construction (A.O. Smith, Century)**
Double shielded, prelubricated bearings are used. For the life of the bearings no additional lubrication is required.

II. REPLACING MECHANICAL SEAL

A) Dismantling:

1. Turn off power.
2. Drain system.
3. Remove bolts holding motor adapter to foundation.
4. Remove casing bolts.
5. Withdraw motor and rotating element from casing, leaving casing and piping undisturbed.
6. Insert a screwdriver in one of the impeller waterway passages and back off the impeller nut with a socket wrench (5/8" across flats), as shown in Fig. 1.

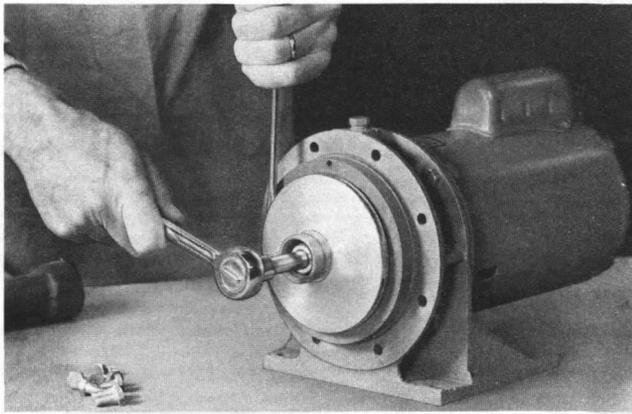


Figure 1

7. Remove impeller from shaft as follows:

a) G.E. and Century motors:

Remove motor shaft end cap. Insert a screwdriver in slot of motor shaft and while holding shaft against rotation with screwdriver, unscrew impeller from shaft by turning counter clockwise when facing it (Fig. 2). To loosen impeller, it might be required to apply heat to exposed shaft thread and impeller hub since loctite was used to secure impeller in place.

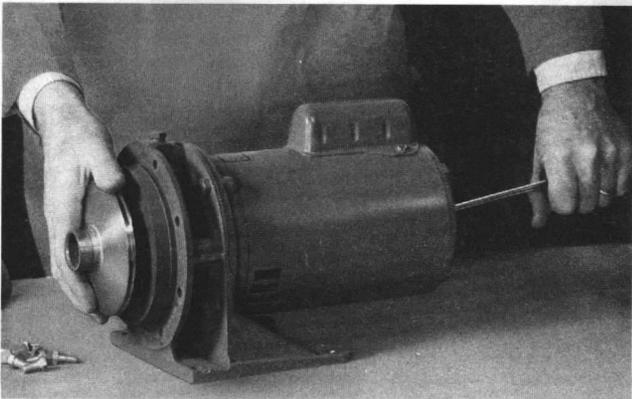


Figure 2

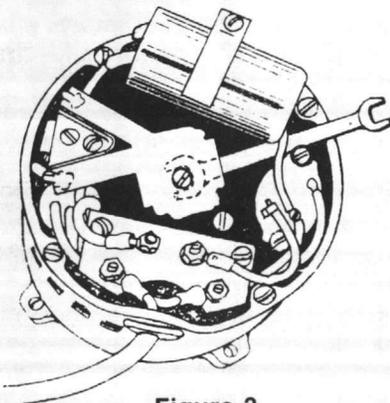


Figure 3

b) A.O. Smith motors:

Remove motor end cover. Insert 7/16" open end wrench under switch mechanism onto flats on motor shaft and while holding shaft against rotation unscrew impeller from shaft (Fig. 3). Heat might be applied as indicated in paragraph 7a.

8. Pry off rotating member of mechanical seal from shaft by using two (2) screwdrivers (Fig. 4).

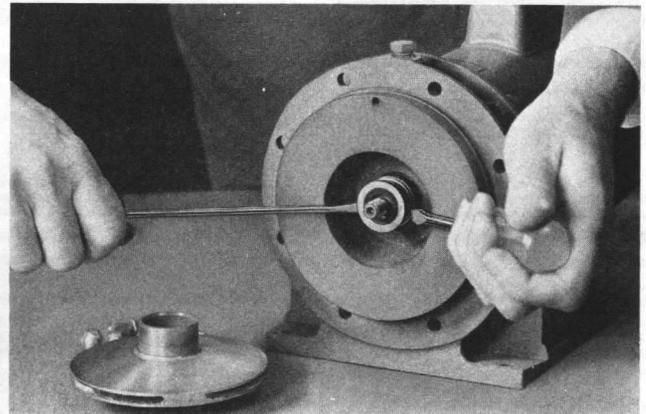


Figure 4

9. Remove bolts holding adapter to motor and take off adapter.
10. Place adapter on a flat surface and push out stationary parts of mechanical seal.

B) Reassembly:

1. Clean gasket and flange faces, male and female locks, seal seat counterbore and shaft, in particular shaft shoulder fitting against impeller.
2. Wet counterbore of adapter and rubber bushing of stationary seal with water or light oil, and press stationary seat in counterbore squarely and evenly with caution not to mar the lapped face of seat.
3. Remount adapter on motor, making sure the motor shaft does not dislocate the stationary seat of the seal.
4. Apply a thin coat of light oil or water to the motor shaft and the rubber seal member of seal and slide rotating member of mechanical seal on motor shaft. Be sure the rotating seal face stays in the holding collar during installation. Also take extra care not to damage the seal lapped faces.
5. Spray both shaft and impeller threads with LOCQUIC, Primer "T" — Loctite product Item No. 74756. (Purchased at Automotive Parts or Hardware store). Let parts dry and then apply Loctite #271 on same parts.
6. Hold shaft against rotation as described in paragraph 7 of dismantling procedure, and thread impeller on shaft until it is tight against the shaft shoulder.

7. Replace impeller nut holding impeller against rotation as indicated in paragraph 6 of dismantling procedure.
8. Remove any burrs caused by screwdriver on the periphery of impeller in waterway passages.
9. Replace motor and rotating element in casing. Be sure that any damaged gasket is replaced.
10. Tighten casing bolts alternately and evenly.
11. Replace hold-down bolts.
12. Check for free rotation after assembly is completed.
13. Replace motor shaft end cap or end cover.
14. Close all drain openings using pipe joint compound on male threads.
15. Reprime before starting. Do not start unit until pump is completely filled with water.

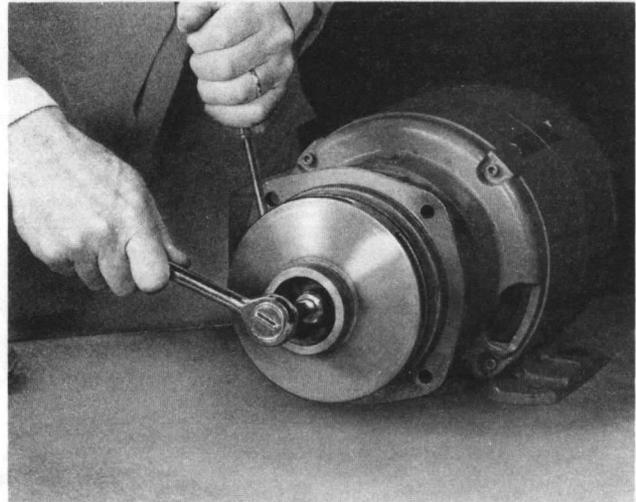


Figure 5

MAINTENANCE—MODEL 3656

I. LUBRICATION

Pumps should require no maintenance, other than the motor bearings, according to the following instruction:

Double shielded, pre-lubricated bearings are used and for the life of the bearings no additional lubrication is required. However, in hot environment, lubrication may be necessary every 2-3 months; otherwise once-a-year lubrication is sufficient. Inspect periodically to determine the condition of the lubricant and how often it should be replaced.

II. REPLACING MECHANICAL SEAL

A) Dismantling:

1. Turn off power.
2. Drain system.
3. Remove bolts holding down motor to foundation.
4. Remove casing bolts.
5. Remove motor and rotating element from casing, leaving casing and piping undisturbed.
6. Insert a screwdriver in one of the impeller waterway passages and back off the impeller bolt with a socket wrench, as shown in Fig. 5.
7. Remove washer and impeller from shaft, being careful not to lose the impeller key. If impeller is difficult to remove, it may be necessary to insert two (2) screwdrivers, between impeller and adapter, 180° apart to pry off impeller.
8. Remove bolts holding adapter to motor and take off adapter, pulling with it the rotating seal part from sleeve.
9. Place adapter on flat surface and push out stationary parts of mechanical seal.
10. Inspect shaft sleeve. If damaged, remove from shaft by heating with torch and using a bearing puller or other similar device.

B) Reassembly:

1. Clean parts, and male and female locks, seal seat counterbore and shaft, in particular shaft where sleeve fits (if sleeve was removed).

2. Spray both shaft sleeve fit and sleeve inside with LOCQUIC, Primer "T" — Loctite product Item No. 74756. (Purchased at Automotive Parts, or Hardware store). Let parts dry and then apply Loctite #271 on same parts. Slide sleeve over shaft, twist sleeve back and forth a couple times. Wipe off excess loctite and let it cure according to manufacturer's instruction.
3. Wet counterbore of adapter and rubber bushing of stationary seat with water or light oil and press stationary seat in counterbore squarely and evenly, with caution not to mar the lapped face of seat.
4. With motor preferably in vertical position, remount adapter on motor, making sure the motor shaft does not dislocate the stationary seat of the seal.
5. Apply a thin coat of light oil or water to the sleeve and the rubber seal member of rotating seal and slide rotating member of mechanical seal on sleeve, and attach spring. Be sure the rotating seal face stays in the holding collar during installation. Also take extra care not to damage the seal lapped faces.
6. Place key in keyway slot and slide impeller on shaft. Place impeller washer on impeller hub and start threading impeller bolt into motor shaft. This bolt has a teflon thread coating and should be reused only two or three times.
7. Insert a screwdriver in a waterway passage of the impeller holding it against rotation and tighten bolt.
8. Remove any burrs caused by screwdriver on the periphery of impeller in waterway passages.
9. Slide motor and rotating element in casing. Be sure that any damaged O-ring was replaced.
10. Tighten casing bolts alternately and evenly.
11. Replace hold down bolts.
12. Check for free rotation after assembly is completed.
13. Close all drain openings, using pipe joint compound on male threads.
14. Reprime before starting. Do not start unit until pump is completely filled with water.



GOULDS PUMPS, INC.
SENECA FALLS, N.Y.

CENTRIFUGAL PUMP CHARACTERISTICS

RPM 3500 CDS 1275

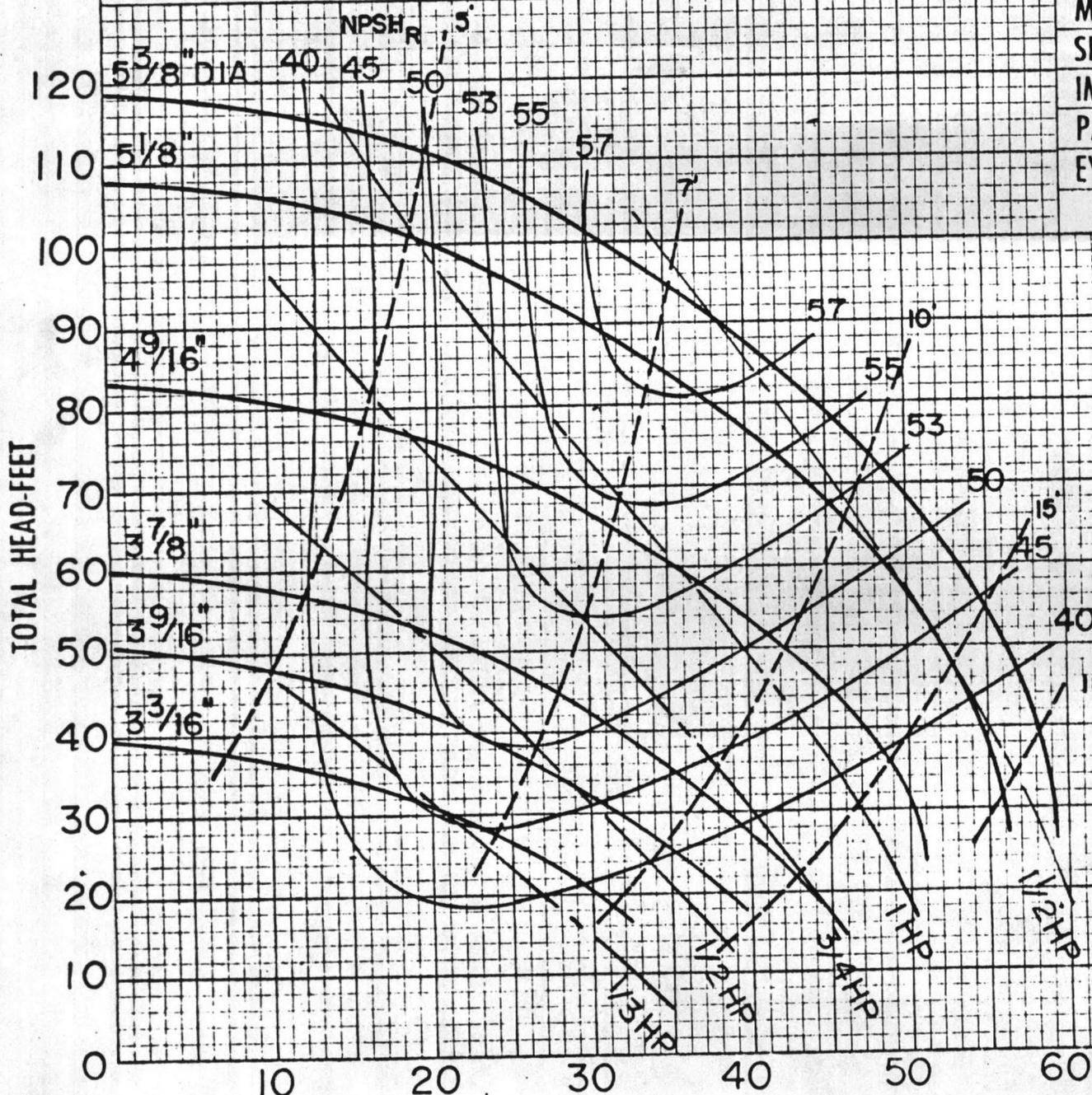
MODEL 3642-3742

SIZE 1"

IMP. DWG. 78-98

PATTERN 52355

EYE AREA



CERTIFIED
PERFORMANCE CURVE
DEC 3 1982
GOULDS PUMPS INC. SENECA FALLS, N.Y.
WATER SYSTEMS DIV.
SIGNED *R. L. Maerz*

DATE: 11-10-52

CAPACITY - GPM

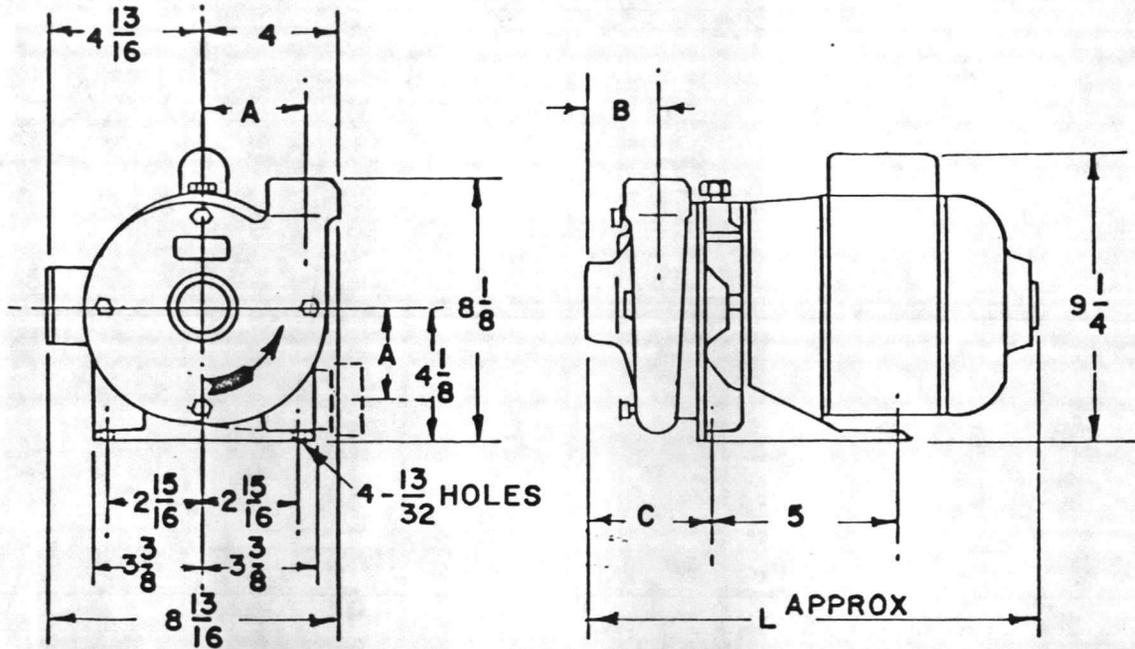
CDS: 1275





GOULDS PUMPS, INC.
 SENECA FALLS NEW YORK 13148

MODEL 3642



SIZE	SUCT	DISCH	A	B	C	HP	L	WEIGHT LBS.
1"	1-1/4 PIPE TAP	1 PIPE TAP	3-1/16	2-3/16	3-5/8	1/4	13-5/8	52
						1/3	13-7/8	53
						1/2	14-1/8	55
						3/4	14-5/8	63
						1	15-3/8	64
1-1/4	1-1/2 PIPE TAP	1-1/4 PIPE TAP	2-15/16	2-1/4	3-7/8	1-1/2	16-3/4	64
						1/2	14-3/8	56
						3/4	14-7/8	64
						1	15-5/8	65
						1-1/2	17-1/8	65
						2	17-1/8	65

CERTIFIED DRAWING
 THIS DRAWING IS APPROVED
 FOR CONSTRUCTION PURPOSES
 GOULDS PUMPS INC. SENECA FALLS, N. Y.
 WATER SYSTEMS DIV.
 Signed R. A. MARTIN
 Date 2/23/84

GOULDS SER. NO. _____
 CUST. _____
 P. O. NO. _____
 ITEM NO. _____
 SERVICE _____

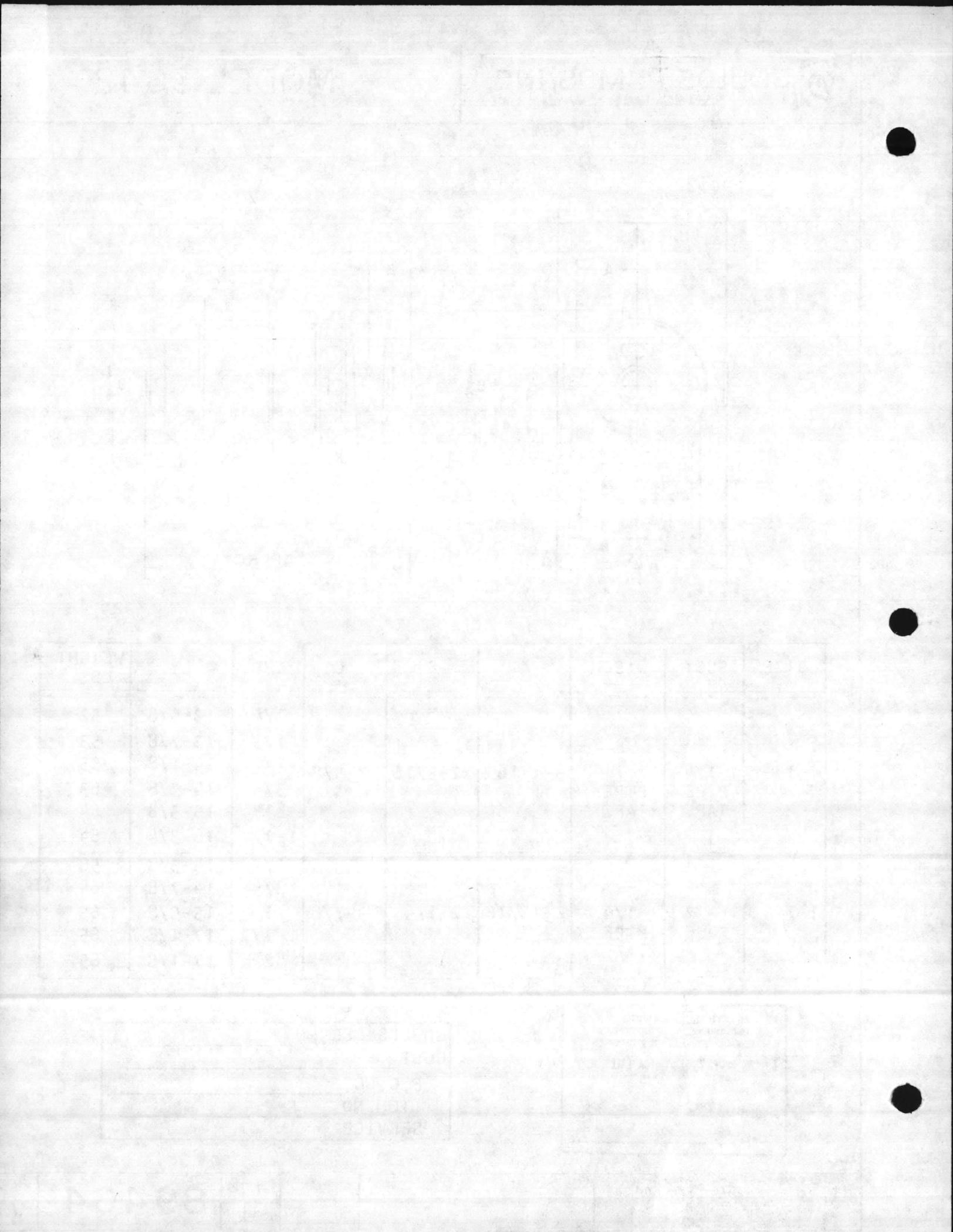
REV

1	REDRAWN - SEE MICRO FILM FOR PREVIOUS ISSUES 7-24-72 DER
---	-------------------------------------------------------------

1-7-72
 DER

89464

REV.
 1



TAB PLACEMENT HERE

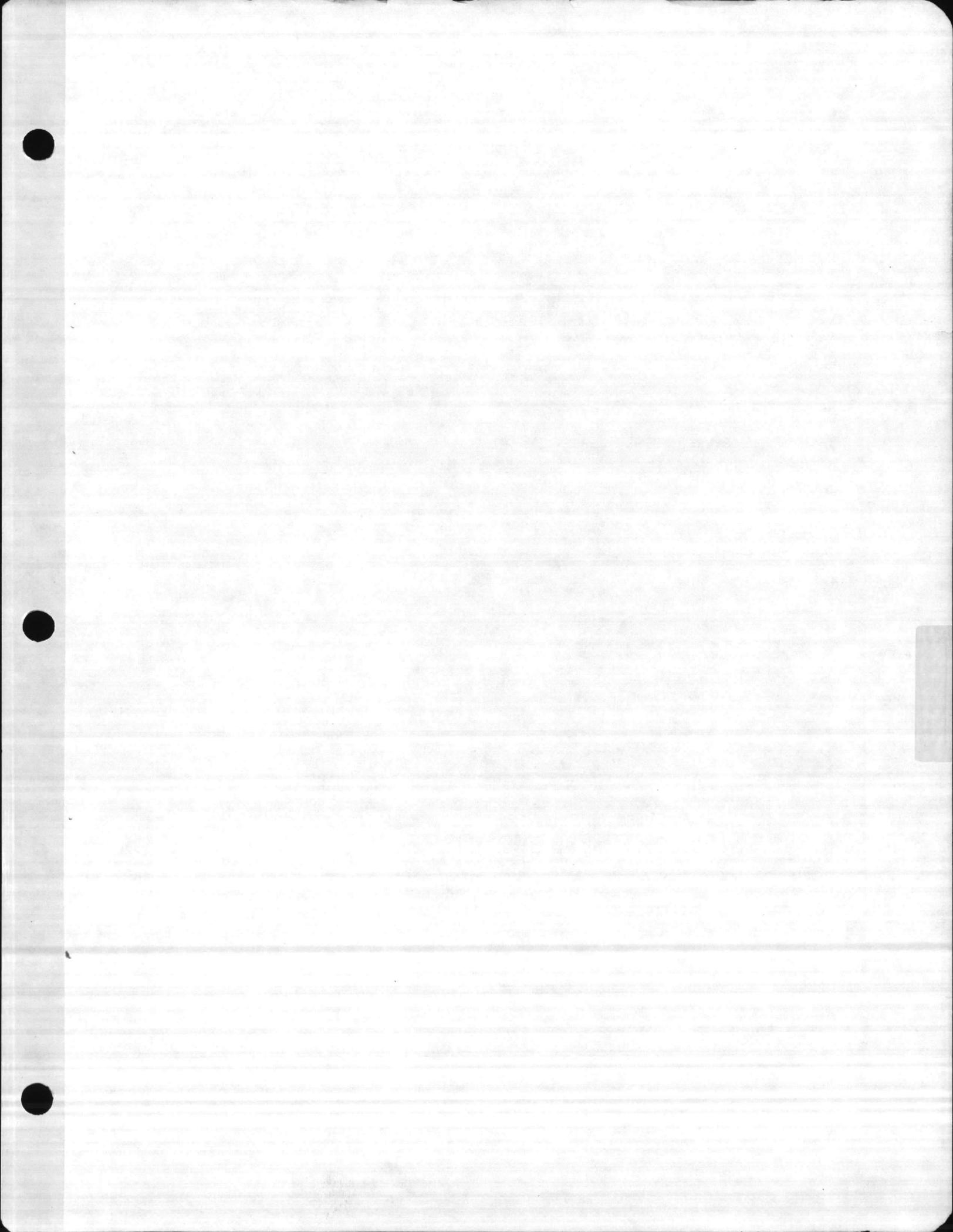
DESCRIPTION:

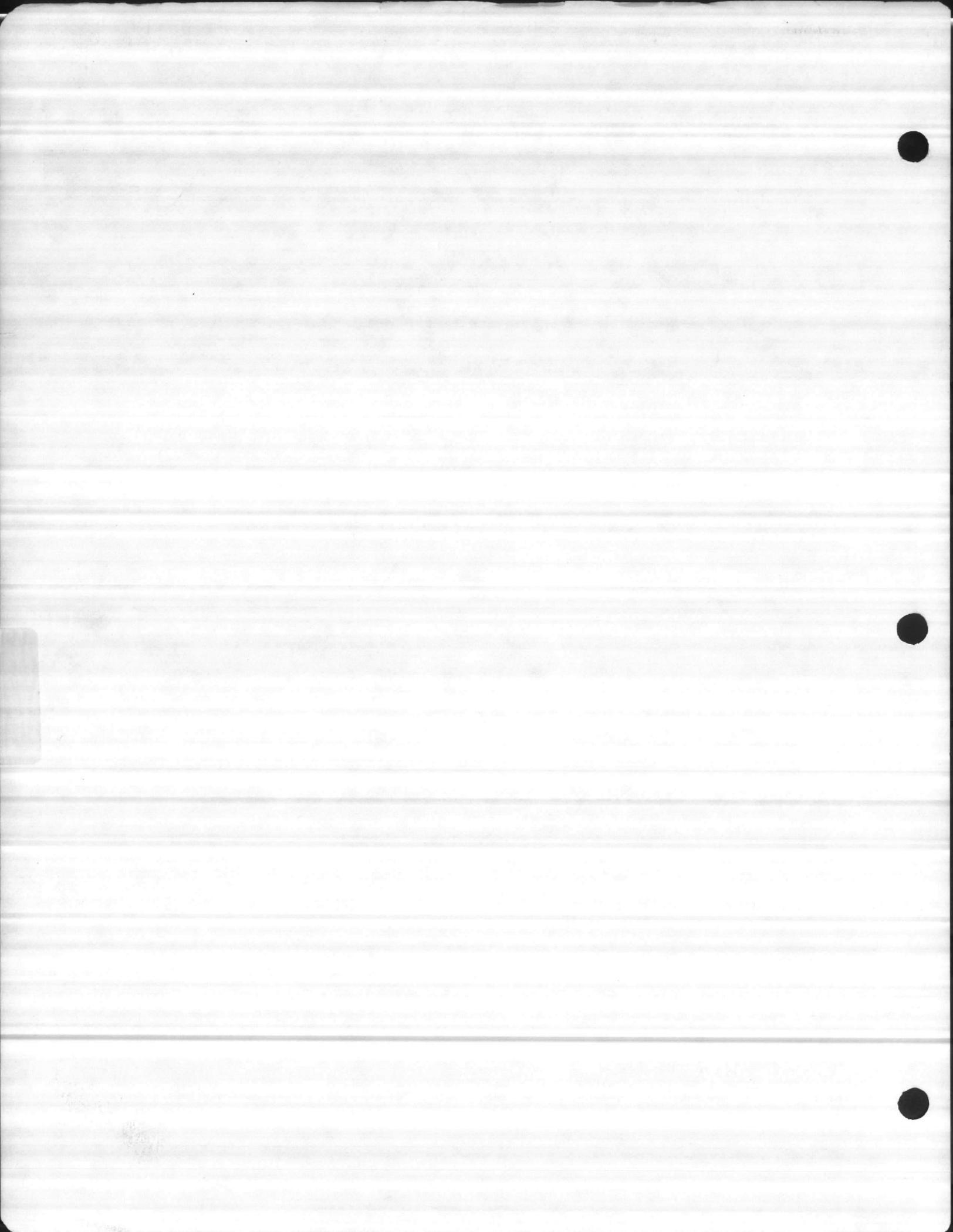
N/A

Tab page did not contain hand written information

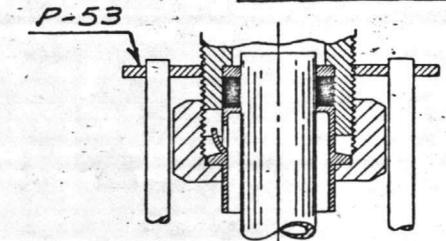
Tab page contained hand written information

*Scanned as next image

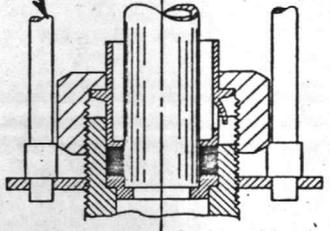




ASSEMBLY	VALVE TYPE	VISIBLE GLASS	LENGTH OF PROTECTOR
A	36 & 56	C TO C - 5 5/8"	GUARD ROD = C TO C - 2 1/8"
C	36 & 56	C TO C - 5 5/8"	SAFETY GLASS = C TO C - 2 3/4"
E	36 & 56	C TO C - 5 5/8"	PLASTIC TUBE = C TO C - 5 5/8"

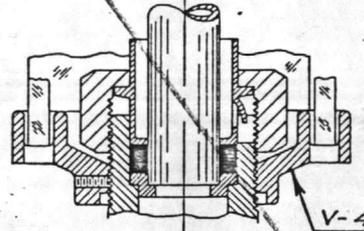
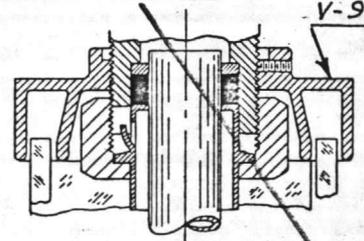


(4) RODS
S-5224



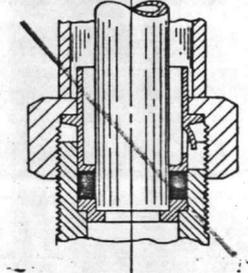
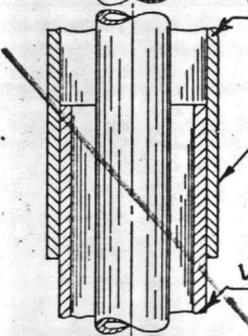
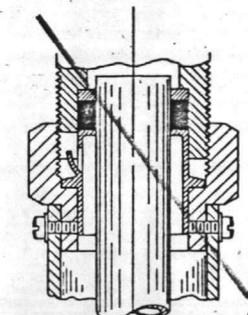
ASSEMBLY A

GUARD ROD PROTECTOR



ASSEMBLY C

SAFETY GLASS PROTECTOR



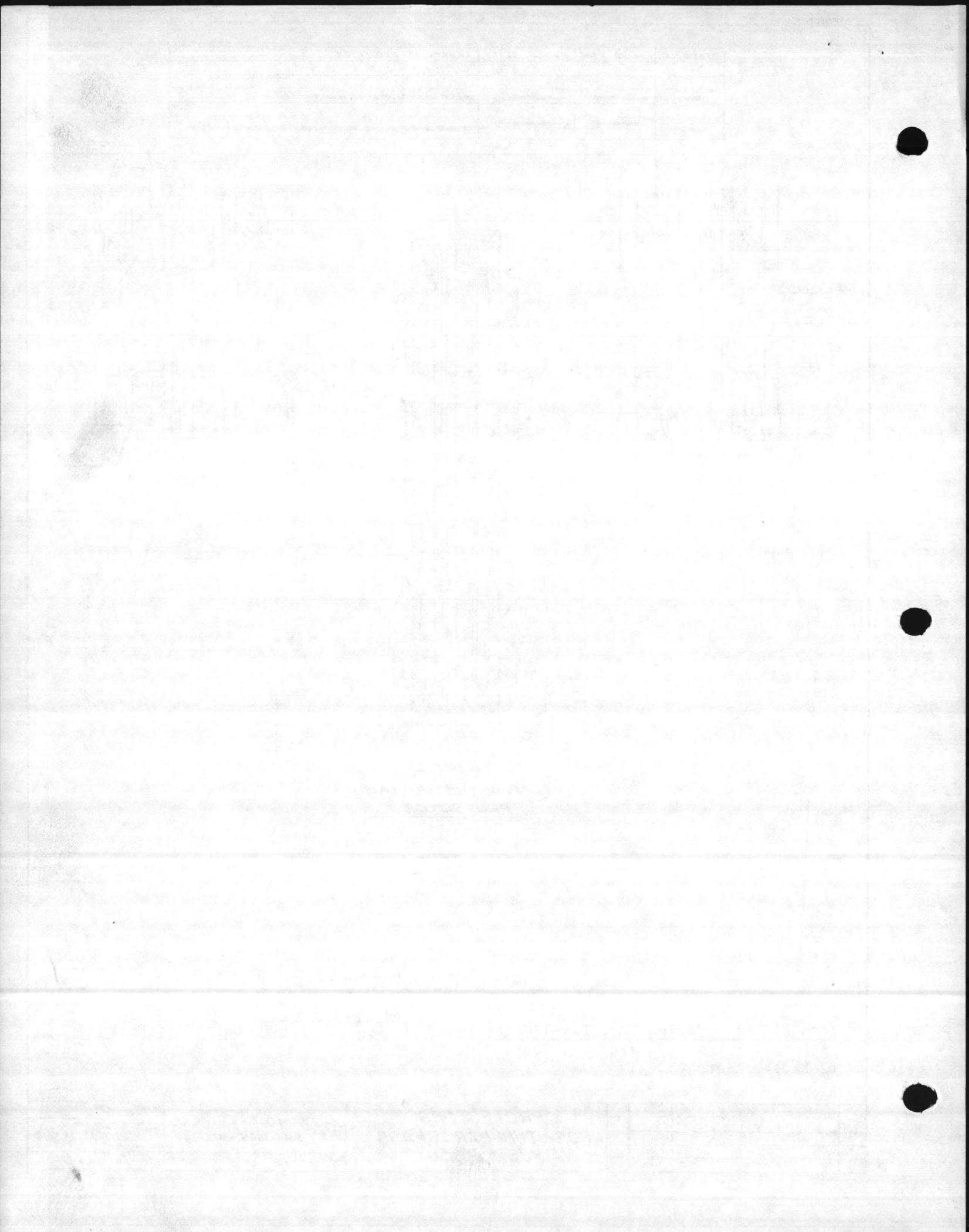
ASSEMBLY E
PLASTIC TUBULAR PROTECTOR

Marine Corps. Base
Camp Lejeune, N.C.
A141E-39857

Certified For:
The Permutit Co., Inc.
P.O. H39857-3507
JergusonJ46762

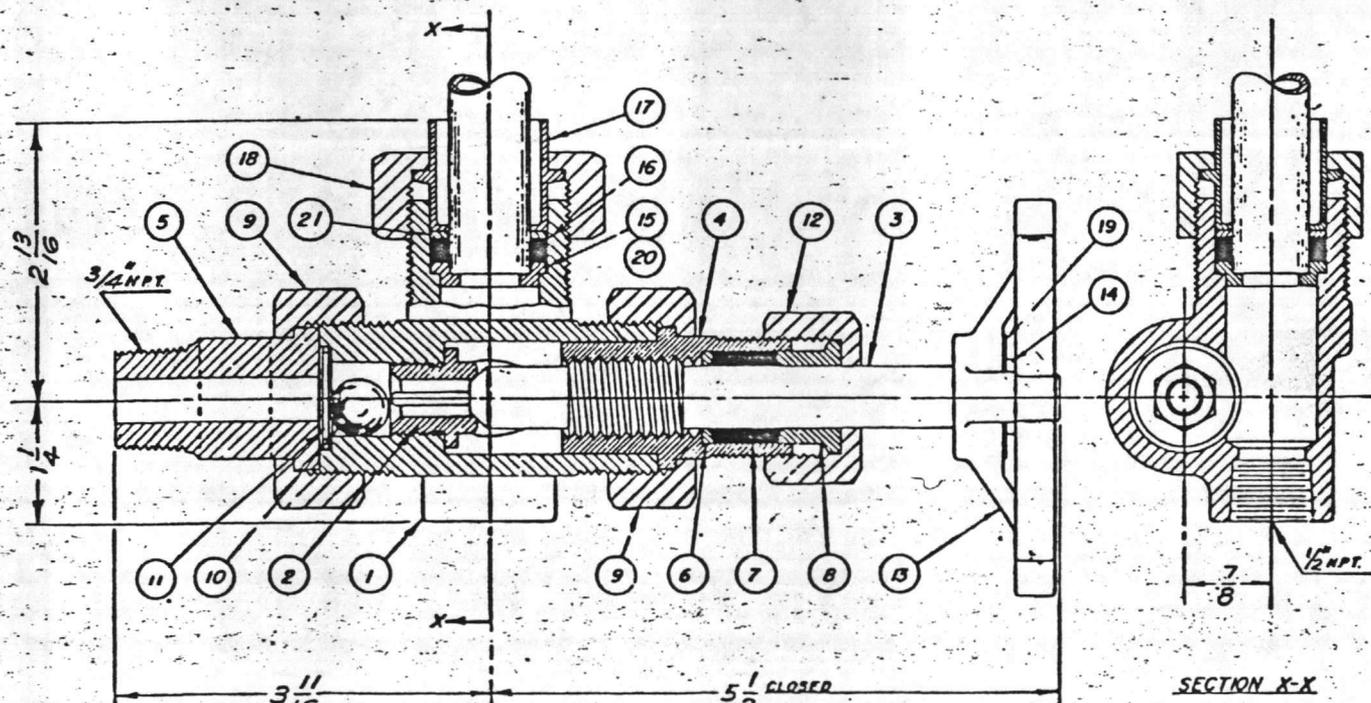
Item #1 Tag: Brine Tank Level Gage
(1 Set) (4) 1/4 x 37 7/8" Lg. Guard Rods S5224
(2 Ea.) Holders P53-A1

<p style="text-align: center;">PROTECTORS FOR TUBULAR GLASS VALVES #36, 56</p>				DRAWN FILE NO.	
				CHECKED DRAWING NO. GD-1598	
SYM REVISION		DATE APP.		SCALE 12 = 1' - 0"	
JERGUSON GAGE & VALVE CO. BURLINGTON, MASS.				APPROVED REV. 0	



PC NO.	NAME OF PART	QUAN.	NO. 56-1-6-02-A			NO. 56-1-6-02-R			NO. 56-1-6-02-T		
			MATERIAL	SPECIFICATION	PART NO.	MATERIAL	SPECIFICATION	PART NO.	MATERIAL	SPECIFICATION	PART NO.
1	VALVE BODY TOP	1	STEEL	ASTM A-105 GR.2	V-11200	304 SS	AISI TYPE 304	V-11200	316 SS	AISI TYPE 316	V-11200
	VALVE BODY BOT	1	STEEL	ASTM A-105 GR.2	V-11201	304 SS	AISI TYPE 304	V-11201	316 SS	AISI TYPE 316	V-11201
2	SEAT	1	416 SS	00-S-763	P-125-U3	304 SS	AISI TYPE 304	P-125-R2	316 SS	AISI TYPE 316	P-125-T2
3	STEM	1	303 SS	AISI TYPE 303	S-121-Q	304 SS	AISI TYPE 304	S-121-R2	316 SS	AISI TYPE 316	S-121-T2
4	SLEEVE	1	416 SS	00-S-763	P-182-U3	304 SS	AISI TYPE 304	P-182-R2	316 SS	AISI TYPE 316	P-182-T2
	TAILPIECE	1	STEEL	AISI C-12L14	P-120-A39	304 SS	AISI TYPE 304	P-120-R2	316 SS	AISI TYPE 316	P-120-T2
	PACKING RING	1	STEEL	AISI C-12L14	P-254-1A39	304 SS	AISI TYPE 304	P-254-1-R2	316 SS	AISI TYPE 316	P-254-1-T2
7	PACKING	1	ASB B GPN	----	6-01	ARAMID/TFE	----	G-244	ARAMID/TFE	----	G-244
8	GLAND	1	STEEL	AISI C-12L14	P-39-A39	304 SS	AISI TYPE 304	P-39-R2	316 SS	AISI TYPE 316	P-39-T2
9	NUT	2	STEEL	AISI C-12L14	P-70-6-A39	STEEL	AISI C-12L14	P-70-6-A39	STEEL	AISI C-12L14	P-70-6-A39
10	BALL CHECK	1	440 SS	AISI TYPE 440	P-1-I	302 SS	AISI TYPE	P-1-P	316 SS	AISI TYPE 316	P-1-T
11	BALL CHECK STOP	1	316 SS	----	V-13113-T	316 SS	----	V-13113-T	316 SS	----	V-13113-T
12	NUT-GLAND	1	STEEL	AISI C-12L14	P-70-3-A39	STEEL	AISI C-12L14	P-70-3-A39	STEEL	AISI C-12L14	P-70-3-A39
13	HANDWHEEL	1	NAL IRON	A47 GR 32510	PD-325-D1	NAL IRON	A47 GR 32510	PD-325-D1	NAL IRON	A47 GR 32510	PD-325-D1
14	NUT-STEM	1	STEEL	AISI C-1015	P-78-6-A1	STEEL	AISI C-1015	P-78-6-A1	STEEL	AISI C-1015	P-78-6-A1
15	RING-GLASS-BOT.	1	STEEL	AISI C-12L14	P-1173-3-A39	304 SS	AISI TYPE 304	P-1173-3-R2	316 SS	AISI TYPE 316	P-1173-3-T2
16	PACKING		NYCAR	----	6-24	NYCAR	----	6-24	NYCAR	----	6-24
17	GLAND-GLASS	1	STEEL	AISI C-12L14	V-11208-A39	304 SS	AISI TYPE 304	V-11208-R2	316 SS	AISI TYPE 316	V-11208-T2
18	NUT-GLAND	1	STEEL	AISI C-12L14	P-70-6-A39	STEEL	AISI C-12L14	P-70-6-A39	STEEL	AISI C-12L14	P-70-6-A39
19	RATING TAG	1	SS	CONN'L	V-8981-56	SS	CONN'L	V-8980-56	SS	CONN'L	V-8980-56
20	RING-GLASS-TOP	1	STEEL	AISI C-12L14	P-1155-3-A39	304 SS	AISI TYPE 304	P-1155-3-R2	316 SS	AISI TYPE 316	P-1155-3-T2
21	GASKET	1	TEFLON	----	V-11211	TEFLON	----	V-11211	TEFLON	----	V-11211

NOTES:
 1. BOTTOM & TOP VALVES SAME, EXCEPT OPPOSITE HANDING.
 TOP VALVE 56-1-6-01.
 BOT VALVE 56-1-6-02 (SHOWN)
 2. GUARD ROD OR SAFTY GLASS PROTECTORS FURNISHED ON REQUEST.



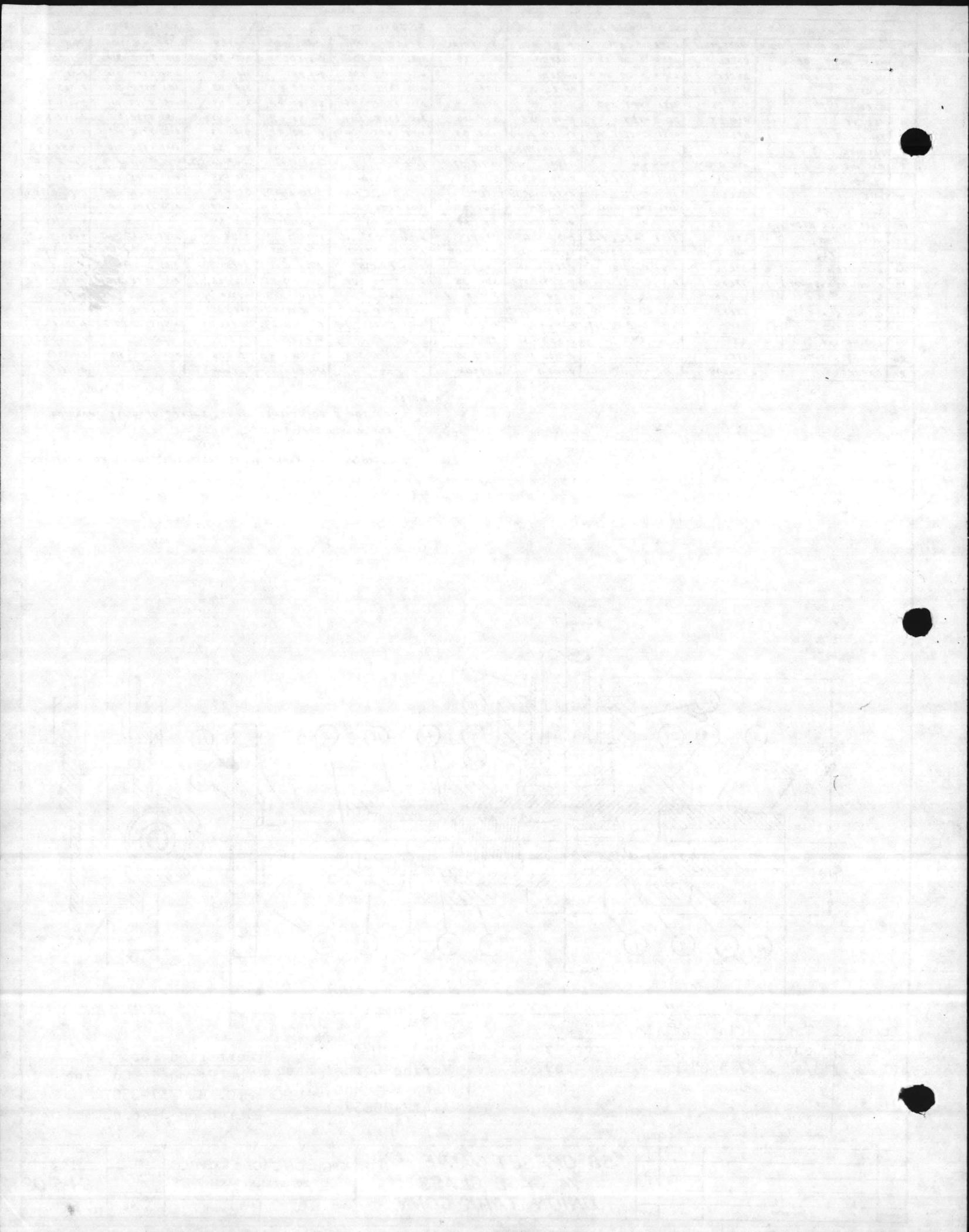
Item #1. Tag: Brine Tank Level Gage

For 40" Centers (1 Set) #56 Valves 56-1-6-01A, 56-1-6-02A
 (1 Ea.) 3/4" x 37 5/8" Lg. Glass P697

Marine Corps. Base
 Camp Lejeune, N.C.
 A141E-39857

Certified For:
 The Permutit Co., Inc.
 P.O. H39857-3507
 Jerguson J-46762

*56 OFFSET VALVE P/C 3/4" GAGE GLASS UNION TANK CONN.				JERGUSON GAGE & VALVE CO. BURLINGTON, MASS.		DRAWN GFL	PLI NO
						CHECKED	DRAWING NO 56-1-6-02
				SCALE FULL		DATE 1 JULY 77	REV 0
						APPROVED W/JG	



JERGUSON

JERGUSON GAGE & VALVE CO.

15 Adams Street • Burlington, Massachusetts 01803

Telephone BOSTON: 272-3600

BURLINGTON, MASS. • TELEX 094-9463

Unit No. 399

Replaces No. IS-6

Subject: **INSTALLATION, OPERATING AND
MAINTENANCE INSTRUCTIONS
FOR TUBULAR GAGE GLASS ASSEMBLIES**

Index:
Date: 3-8-61
Page: 1

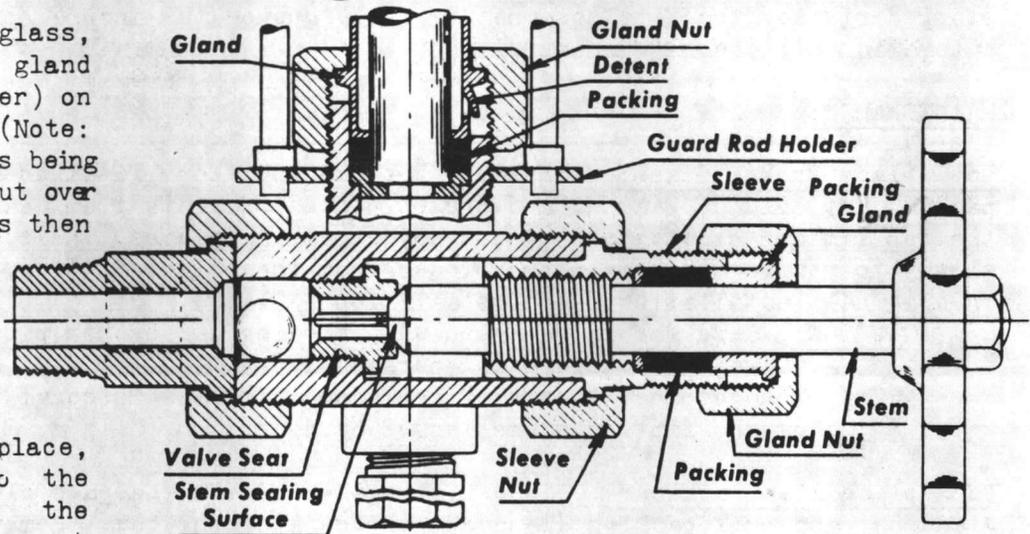
INSTALLATION:

Fittings: The gage glass fittings (valves) are supplied as assembled units complete with holders for protectors specified. Before mounting each fitting to the vessel connection, remove the packing nut, packing gland and packing from the glass side. Mount each fitting to the vessel connection, paying particular attention to the alignment of the glass connections.

NOTE: Fittings with glass connections out of line will cause glass breakage. Connect drain cocks or other piping to the fitting before installing the glass.

Glass: To install the glass, first place a gland nut, gland and packing (in that order) on each end of the glass. (Note: If a plastic protector is being used, it must first be put over the glass). The glass is then inserted up into the stuffing box in the top fitting, centered over the stuffing box in the bottom fitting, and inserted into position.

With the glass in place, slide the packing into the stuffing box, position the packing gland with its detent in the slot of the fitting body, and engage the packing nut. Lift the glass slightly to prevent contact with the metal seat in the bottom fitting and tighten both packing nuts only enough to prevent leakage, but not so much that expansion or contraction of the glass is restricted.



Protectors (when specified):

Guard Rods: Insert the large dia. end of the guard rod through the hole in the holder on the top fitting from the underside. The rod is then centered over the corresponding hole in the holder on the bottom fitting and dropped into place.

NOTE: Rod length equals center to center of fitting stems less 2-1/8".

Safety Glass Protector: Insert safety glass into groove of holder on the top fitting from the under side. The glass is then positioned over the corresponding groove in the holder on the bottom fitting and lowered into place.

NOTE: Length of safety glass equals center to center of the fitting stems less 3-3/8".

Protectors (Con.)

Plastic Protector: Place the plastic protector over the glass before the packing nut, gland and packing are placed on the ends of the glass. Install the glass (see Installation - Glass) and adjust the plastic protector. Lock in position by means of two (2) machine screws.

HYDROSTATIC TEST: A hydrostatic test of 1-1/2 times the operating pressure should be made before the gage is put into operation, to check for leakage.

OPERATING INSTRUCTIONS:

Placing the Gage in Operation: Preheating of glass is required when used with hot liquid or steam. To minimize thermal shock, heat the glass slowly by opening the drain, and carefully blowing down through the top fitting.

Close the drain and open top and bottom fittings slightly. This procedure will allow the liquid to rise to its proper level in the gage glass without a sudden surge which would close the automatic safety ball check (when supplied). When the liquid has stopped rising, the fittings must be fully opened to insure proper operation of the automatic ball check (when supplied).

MAINTENANCE:

To Replace Broken Glass: Shut off bottom and top fittings and open drain. Remove packing nut, gland, packing and broken pieces of glass from each fitting. Then open the top fitting slowly to blow out any remaining pieces. Next open the bottom fitting slowly to remove any remaining pieces from the bottom fitting. Install new glass as in original installation (see Installation - Glass).

CAUTION: Care should be taken when blowing out broken pieces of glass to prevent injury to operating personnel.

NOTE: The required length of replacement glass is equal to the center to center of the fitting stems less 2-3/8".

To Replace Stem Packing: Close fittings and drain the gage glass. Disengage packing gland nut and pull packing gland out of the stuffing box. Remove old packing and insert new. Put the packing gland and packing gland nut into position and tighten the nut. The gland nut should be tightened enough to stop leakage around the stem without causing excessive binding of the stem during operation.

THE NO. 56 VALVE HAS A REGRINDABLE AND RENEWABLE SEAT:

To Reface the Stem and Seat: Disengage sleeve nut from fitting body and remove stem, sleeve, sleeve nut, gland, gland nut, etc. as a unit from the fitting. Apply grinding compound to the seating surface of the stem and replace unit in fitting (Do not engage sleeve nut). Using the sleeve as a guide, grind the seat by rotating the handwheel. When grinding has been completed, remove the unit from the fitting and clean all compound from the seat and stem. Replace the stem unit in the body and tighten the sleeve nut.

To Replace the Seat: Remove the stem unit as above, and using a standard 5/8" socket wrench, remove the seat. Before replacing the seat, apply Neolube (a suspension of colloidal electric-furnace graphite in iso-butyl alcohol) to the threads, to prevent seizure of metals. The seat is then replaced and tightened well to prevent leakage. Replace the stem unit in the body and tighten the sleeve nut.

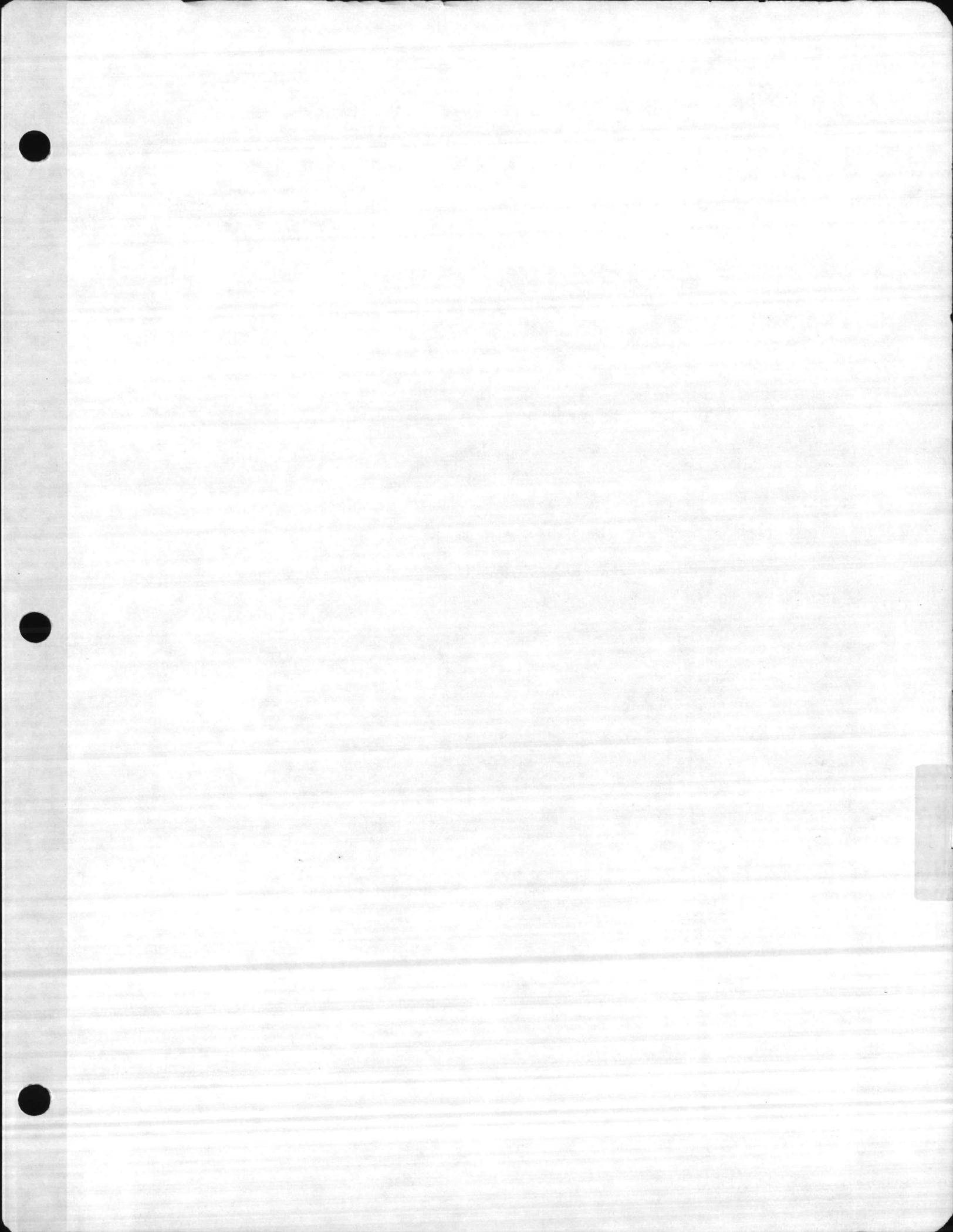
TAB PLACEMENT HERE

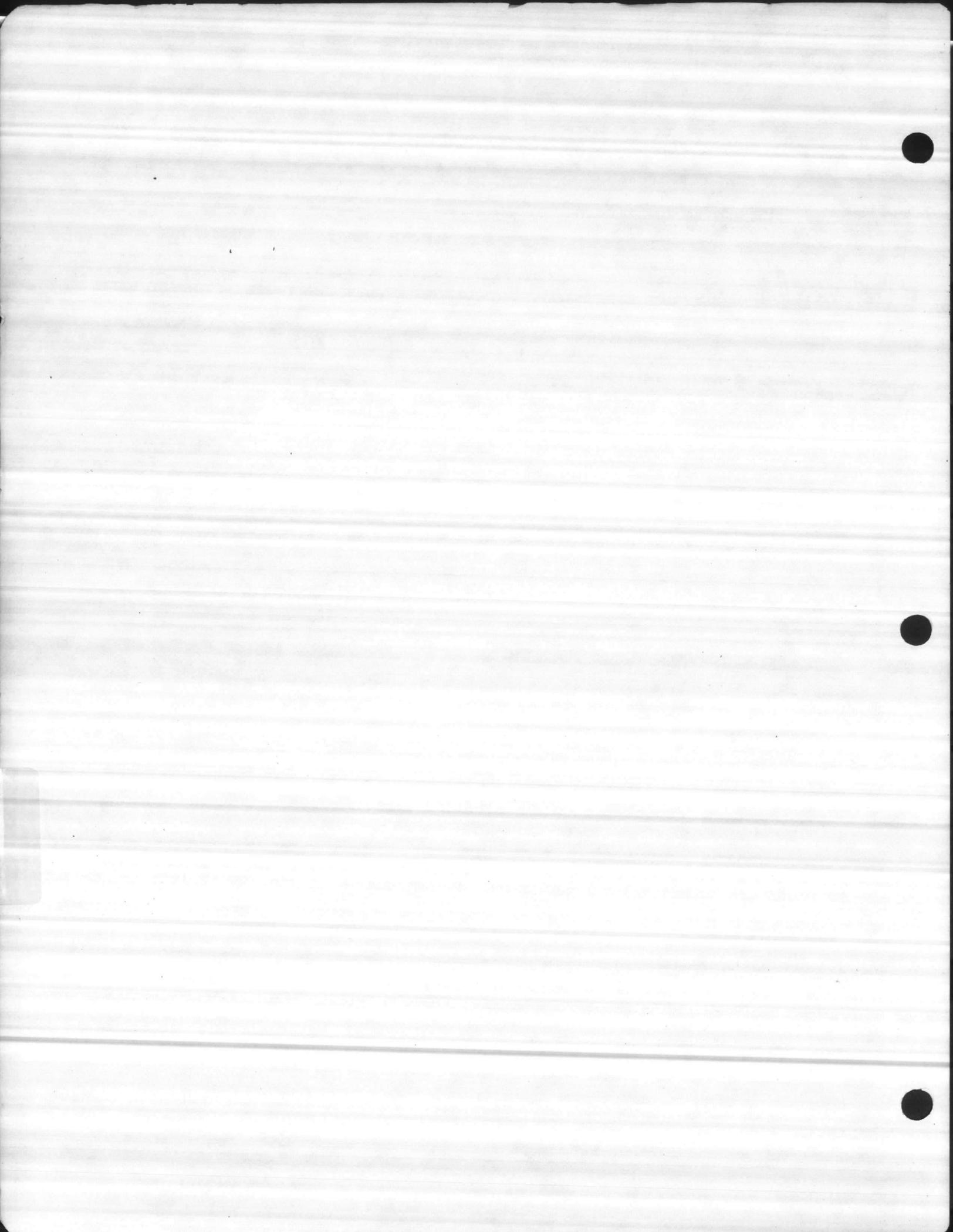
DESCRIPTION:

F

Tab page did not contain hand written information

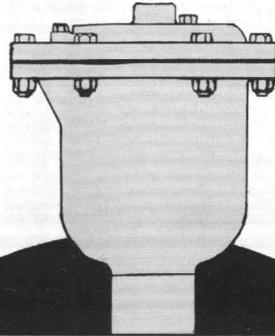
Tab page contained hand written information
*Scanned as next image





Crispin Announces Silverline Air Release Valves

STAINLESS STEEL TRIM STANDARD



**SILVERLINE
PROTECTION**

Crispin

The CRISPIN Valve Division of Multiplex Manufacturing Co. has been producing high quality air release valves for more than 78 years. CRISPIN is now offering stainless steel as standard construction of internal parts in a variety of valves while maintaining original product quality, integrity and performance.

Because of stainless steel's high resistance to deformation and abrasion, low maintenance is assured.

Furthermore, stainless steel is less susceptible to corrosion in arduous environments where corrosion protection is normally a consideration.

MULTIPLEX Manufacturing Co.

600 Fowler Ave., P.O. Box 427, BERWICK, PA 18603 / 717-752-4524



**BULLETIN
CV-1183**

PRESSURE AIR RELEASE VALVES

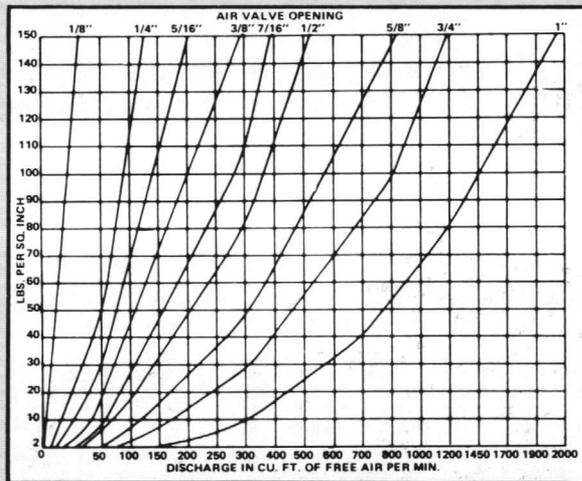
Air can accumulate in a liquid pumping system, under pressure, from a variety of sources. If this air is allowed to accumulate without provision for release, system efficiency and performance can suffer.

The CRISPIN "Silverline" Pressure Air Release Valves provide the same orifice capacities as our original standard pressure valve with bronze and stainless steel trim.

The Crispin Midget Pressure Air Release Valve is also offered with stainless steel trim as standard with inlet sizes of 3/8", 1/2", 3/4" and 1". Orifice sizes are listed in the chart below.

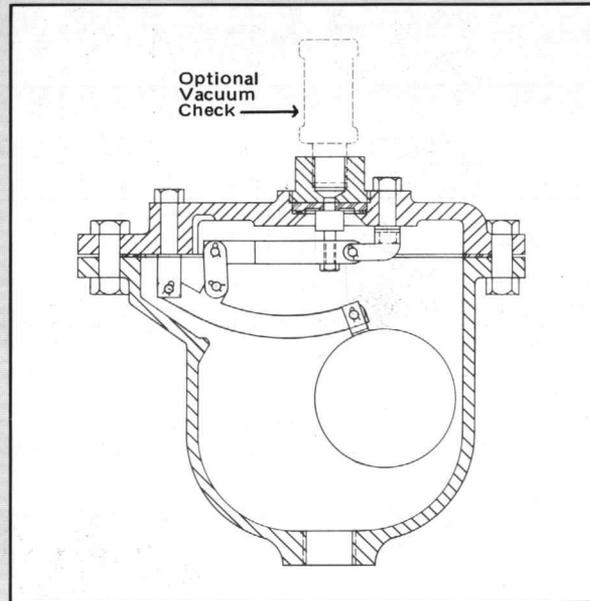
Correct valve sizing can be obtained from CRISPIN Bulletin CV-183 or The CRISPIN Catalog.

PERFORMANCE CURVES



ORIFICE SIZE FOR VARIOUS PRESSURE RANGES

Valve Size	OPERATING PRESSURE IN LBS.					
	0 to 50	0 to 100	0 to 150	0 to 200	0 to 250	0 to 300
Midget	1/8"	1/16"	1/16"	3/64"	1/32"	1/32"
M10R	7/32"	9/64"	1/8"	7/64"	3/32"	5/64"
1"	5/16"	5/16"	1/4"	3/16"	5/32"	1/8"
2"	3/8"	3/8"	5/16"	1/4"	3/16"	5/32"
2-1/2"	5/8"	1/2"	7/16"	3/8"	5/16"	1/4"
3"	3/4"	5/8"	1/2"	7/16"	3/8"	5/16"
4"	1"	3/4"	5/8"	1/2"	7/16"	3/8"



Model	Inlet NPT	Trim	Height	Width	Wt. (lbs.)
*PL10	1" NPT	S/S	9-1/8"	9-3/4"	22
P10	1" NPT	IBBT	9-1/8"	9-3/4"	22
*PL10A	2" NPT	S/S	9-1/8"	9-3/4"	22
P10A	2" NPT	IBBT	9-1/8"	9-3/4"	22
*PL20	2" NPT	S/S	10-1/2"	10-1/8"	45
*PL21	2" 125# Flg.	S/S	12-13/16"	10-1/8"	51
*PL22	2" 250# Flg.	S/S	13-1/16"	10-1/8"	52
P20	2" NPT	IBBT	10-1/2"	10-1/8"	45
P21	2" 125# Flg.	IBBT	12-13/16"	10-1/8"	51
P22	2" 250# Flg.	IBBT	13-1/16"	10-1/8"	52
P250	2-1/2" NPT	IBBT	11-1/8"	11-1/2"	58
P251	2-1/2" 125# Flg.	IBBT	14-1/8"	11-1/2"	68
P252	2-1/2" 250# Flg.	IBBT	14-5/16"	11-1/2"	70
P30	3" NPT	IBBT	13-1/2"	12-1/2"	87
P31	3" 125# Flg.	IBBT	16-3/16"	12-1/2"	100
P32	3" 250# Flg.	IBBT	—	12-1/2"	103
P40	4" NPT	IBBT	16-5/8"	14-1/4"	132
P41	4" 125# Flg.	IBBT	18-7/8"	14-1/4"	145
P42	4" 250# Flg.	IBBT	19-3/16"	14-1/4"	149

*Silverline

PRESSURE AIR VALVES

The pressure air release valve(s) shall be installed at high points in the line or at points selected by the engineer to vent the accumulation of air and other gases with the line under pressure.

The valve(s) shall operate through a compound lever system and shall have a _____" orifice with valve sealing faces of an adjustable Hy-Car rubber valve and stainless steel or PVC and shall operate at _____ psi. and be capable of passing _____ scfm. of air.

The valve(s) shall be _____" NPT screwed or _____ lb. flanged inlet connection and shall be cast iron body, top and inlet flange (where required) with stainless steel trim. (1" and 2" only) or bronze and brass trim with stainless steel float (1" through 4").

Valves which use a needle valve to seal the orifice will not be acceptable.

The valve(s) shall be CRISPIN Model _____, Pressure Air Valve, Type N (PVC seat and Hy-Car rubber valve) or Type P (stainless steel seat and Buna-N rubber valve) as manufactured by Multiplex Manufacturing Co., Berwick, PA.

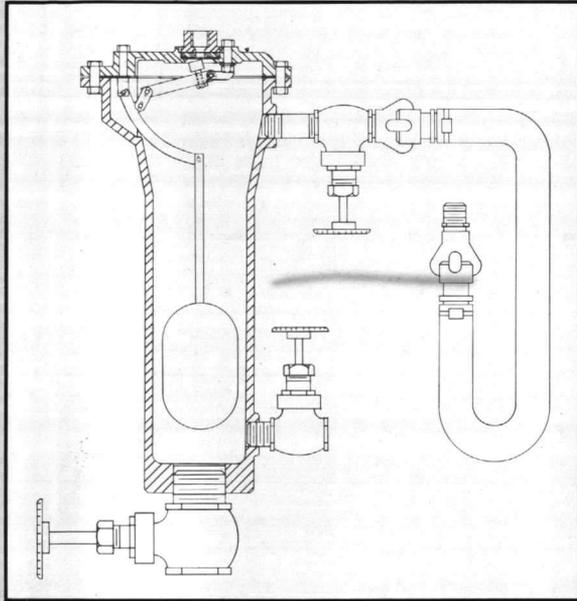
Sewer Air Release Valves: STAINLESS STEEL TRIM STANDARD

Air can accumulate in a sewage collection system under pressure from a variety of sources. The nature of sewage is such that gas can also be generated and accumulate at the high points in the system. The gas and air accumulation should be exhausted to promote system performance and efficiency and help prevent system shut downs.

The CRISPIN "Silverline" Pressure Sewer Air Release Valves provide a range of air release orifices through 5/8" in diameter.

Correct valve sizing can be determined by referring to CRISPIN Bulletin CV-183, or The CRISPIN Catalog.

The CRISPIN "Silverline" pressure sewer valve weighs only 49 lbs. as compared to the weight of our standard high capacity series of 93 lbs. The light body is designed for a maximum of 300 psig. cold water working pressure. A choice of two operating pressures is available.



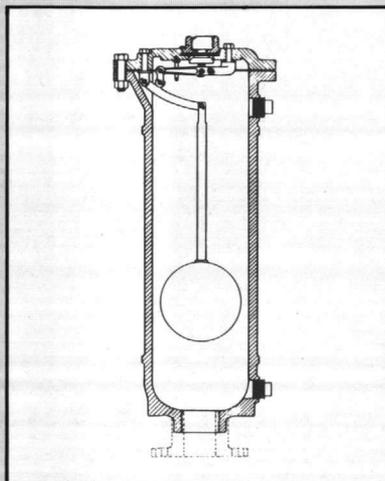
Model	Inlet NPT	Orifice	Height	Height With Back Flush	Width	Width With Back Flush	Wt. (lbs)	Wt. With Back Flush
SL-20	2"	1/4"@175psi.	21-1/2"	24-7/8"	9-11/16"	15-1/2"	49	60
SL-30	3"		21-1/2"	26-1/2"	9-11/16"	15-1/2"	49	66
SL-40	4"	1/8"@300psi.	21-1/2"	27-5/8"	9-11/16"	15-19/32"	49	73

The original CRISPIN "high capacity" sewer air release valves are also offered in the "Silverline" Series with standard stainless steel trim, as well as with the traditional standard bronze and stainless steel trim.

The "high capacity" pressure sewer air release valves are available with the orifice sizes indicated below and are selected according to the operating pressure of the system.

If the system dictates specific air release requirements, then the sewer valve should be sized and selected accordingly.

"High Capacity"
Pressure Sewer Valve



Model	Inlet	Outlet NPT	Height	Width	Height W/Back Flush	Width W/Back Flush	Wt. (lbs.)	Wt. (lbs) W/Back Flush
S-20	2" NPT	1"	25-1/8"	10-1/16"	28-7/16"	15-1/2"	93	105
S-21	2" 125 # Flg.		26-7/16"	10-1/16"	33-7/16"	19-1/4"	106	136
S-30	3" NPT	1"	25-1/8"	10-1/16"	30"	17"	100	117
S-31	3" 125 # Flg.		27-3/16"	10-1/16"	35-3/16"	24-1/2"	110	163
S-40	4" NPT	1"	25-1/8"	10-1/16"	30-3/16"	20"	102	126
S-41	4" 125 # Flg.		27-3/8"	10-1/16"	36-3/8"	27-1/2"	116	193
S-61	4" 125 # Flg.	1"	27-7/16"	10-1/16"	37-15/16"	35-1/2"	125	258

PRESSURE SEWER VALVE ORIFICE DATA CHART

ORIFICE DIA.	RANGE OF WORKING PRESSURE
5/8"	0 TO 100 LBS.
1/2"	0 TO 150 LBS.
7/16"	0 TO 200 LBS.
3/8"	0 TO 250 LBS.
1/4"	0 TO 300 LBS.

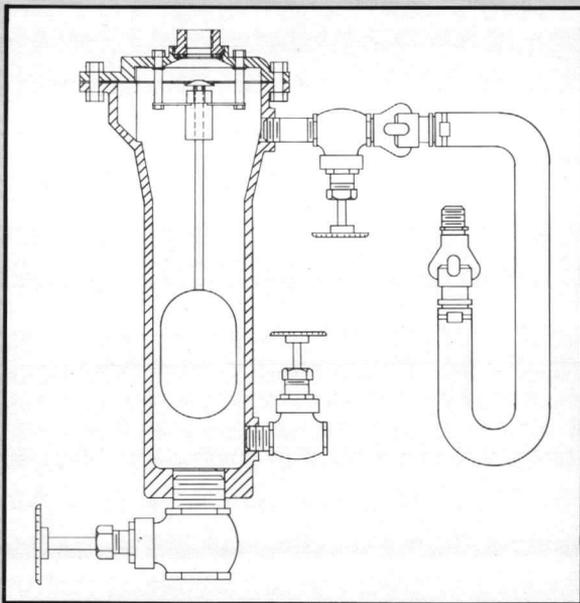
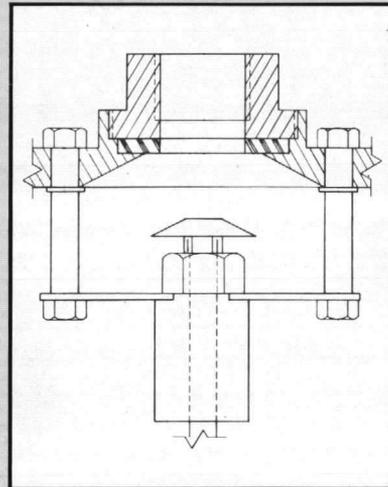
Other Working Pressures May Be Obtained By Re-sizing Orifice Diameter.

SEWER AIR & VACUUM VALVES

Air and Vacuum Sewer Valves permit a large volume of air to be released from a pipeline when filling as well as allowing air into a system when draining.

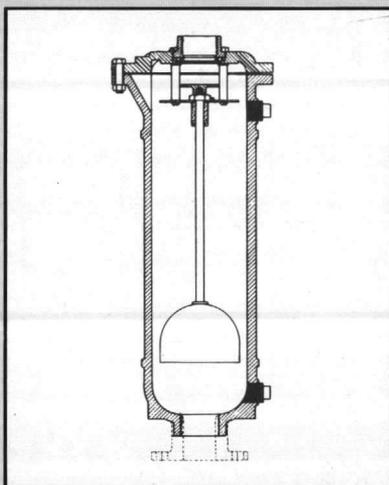
CRISPIN Air and Vacuum Sewer Valves incorporate the integrity of a rigid stainless steel valve plug to seal off the outlet orifice. Subsequently, damage to the seating surface is much less likely to occur in surge conditions.

A drawing of a typical sewer air and vacuum valve seating area is shown, the valve plug is protected from a rush of air by a stainless steel baffle. The baffle provides a rigid support for the float guide bushing while allowing the float rod enough clearance for self seating operation.



The CRISPIN "Silverline" air and vacuum sewer valve like the light body pressure sewer valve is designed for a maximum cold water working pressure of 300 psig.

Model	Inlet NPT	Outlet NPT	Width	Width With Back Flush	Height	Height With Back Flush	Wt. (lbs.)	Weight With Back Flush
SL-20A-1	2"	1"	9-11/16"	15-1/2"	21-1/2"	25-1/4"	49	60



Model	Inlet	Outlet NPT	Height	Width	Height W/Back Flush	Width W/Back Flush	Wt. (lbs.)	Wt. (lbs) W/Back Flush
S-20A	2" NPT	2"	25-1/16"	10-1/16"	28-3/4"	14-9/16"	93	105
S-21A	2" 125 # Flg.	2"	26-11/16"	10-1/16"	33-11/16"	14-9/16"	106	136
S-30A	3" NPT	3"	21-7/16"	10"	26-7/16"	14-1/2"	100	117
S-31A	3" 125 # Flg.	3"	21-7/16"	10"	29-7/16"	20"	110	163
S-40A	4" NPT	4"	22-15/16"	11-1/2"	28-15/16"	16-1/2"	102	126
S-41A	5" 125 # Flg.	4"	22-15/16"	11-1/2"	31-15/16"	20-1/2"	116	193
S-61A	6" 125 # Flg.	6"	26-3/8"	14-1/2"	36-7/8"	27"	120	258
S-81A	8" 125 # Flg.	8"	25-5/16"	17-3/4"	36-13/16"	33-1/8"	200	411

Where height restrictions do not permit the use of the standard height valve, a short body sewer air and vacuum or pressure air release valve can be applied. Their function is identical to the standard sewer valves except they operate in a shorter body.

Any combination of the sewer air and vacuum valve and sewer pressure air release valve can be made with the appropriate piping arrangements to accommodate the specific application.

Back flushing attachments are available with any sewer valve arrangement and include: isolation gate valve. 2-1" blowoff valves and 5' of 1" hose with quick disconnect attachments.

PRESSURE SEWER VALVES

The pressure air release valve(s) shall be installed at high points in the line or at points selected by the engineer to vent the accumulation of air and other gases with the line under pressure.

The valve(s) shall be of the long body design and shall have a _____" orifice with an adjustable Hy-Car rubber valve and a sealing face of PVC and shall operate at _____ psi. and be capable of passing _____ scfm. of air.

They shall also be _____" NPT screwed or _____ lb. flanged connection and shall be cast iron body, top and flange, (where required) and stainless steel trim.

The valve(s) shall be CRISPIN Model _____ pressure sewer valve as manufactured by Multiplex Manufacturing Co., Berwick, PA.

AIR AND VACUUM SEWER VALVES

Air and vacuum release valve(s) shall be installed at high points in the main line or as directed by the engineer. This will permit the release of air as the main is filling or relieve the vacuum as the main is draining or is under negative pressure.

The valve(s) shall be of the long body design, and shall operate by sealing the Hy-Car rubber seat with a stainless steel valve disc as the float rises when water enters the valve body. The valve(s) shall automatically open when the system drains, or is under negative pressure, so that, air may enter the line.

Valve construction shall be _____" NPT screwed or _____ lb. flanged inlet connection and shall be cast iron body, top and inlet flange (where required), with stainless steel trim.

The valve(s) shall be CRISPIN Model _____ Air and Vacuum Sewer Valves, as manufactured by Multiplex Manufacturing Co., Berwick, PA.

OPTION: The valve(s) shall be supplied with back flushing attachments so that the interior body can be flushed periodically for proper operation.

OPTION: The valve(s) shall be a special short body sewer valve with an overall height not to exceed 12-1/4".

OPTION: A protectop shall be supplied to prevent debris from entering the outlet of the valve.

OPTION: (Where pressures are greater than 300 psi.)

The valve(s) shall be _____ lb. flanged inlet connection and shall have a (steel, stainless steel, or ductile iron) body, top and inlet flange with stainless steel float and bronze and brass trim.

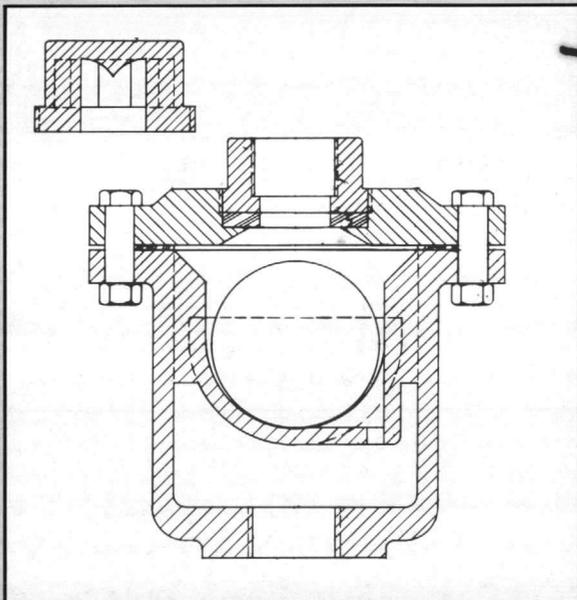
AIR AND VACUUM VALVES

CRISPIN valve offers a unique and proven design in air and vacuum valves. Most sizes are available with stainless steel trim as standard construction.

CRISPIN air and vacuum valves incorporate "peripheral" float guides which will not obstruct the float from providing a self-centered drip tight seal.

These peripheral guides direct the float onto the seating area and permit it to position itself for optimum seat contact. This means that there are no guide shafts or bushings to bind or deform and, subsequently, prevent a tight seal between the seat and the float.

The Spherical Float is weighted internally, so that, the smoothest section of the sphere is in contact with the seat with every cycle.



Stainless steel trim is standard with the 1", 2" and 6" through 10" air and vacuum valves.

Model	Inlet	Outlet NPT	Trim	Height	Width	Wt. (lbs.)
A5	1/2" NPT	1/2"	IBBT	4-7/8"	4-3/4"	7
A10	1" NPT	1"	IBBT	6-1/8"	6-1/4"	16
*AL10	1" NPT	1"	S/S	6-1/8"	6-1/4"	16
A20	2" NPT	2"	IBBT	9-1/2"	8-3/4"	42
*AL20	2" NPT	2"	S/S	9-1/2"	8-3/4"	42
A21	2" 125# Flg.	2"	IBBT	11-11/16"	8-3/4"	48
A22	2" 250# Flg.	2"	IBBT	12-1/16"	8-3/4"	48
A30	3" NPT	3"	IBBT	11-5/8"	11-1/2"	79
A31	3" 125# Flg.	3"	IBBT	15-3/4"	11-1/2"	93
A32	3" 250# Flg.	3"	IBBT	15-15/16"	11-1/2"	94
A40	4" NPT	4"	IBBT	14-1/4"	14"	145
A41	4" 125# Flg.	4"	IBBT	17-5/16"	14"	158
A42	4" 250# Flg.	4"	IBBT	17-5/8"	14"	160
*AL61	6" 125# Flg.	6"	S/S	15-13/16"	15"	148
*AL62	6" 250# Flg.	6"	S/S	16-1/4"	15"	170
*AL81	8" 125# Flg.	8"	S/S	18-1/16"	17-3/4"	224
*AL82	8" 250# Flg.	8"	S/S	18-9/16"	17-3/4"	240
*AL101	10" 125# Flg.	10"	S/S	22-1/16"	21"	320
*AL102	10" 250# Flg.	10"	S/S	22-3/4"	21"	345

*Silverline

AIR AND VACUUM VALVES

Air and Vacuum Valve(s) shall be installed at high points in the main line or as directed by the engineer to release the air in the main as the main is draining or is subject to negative pressure.

The valve(s) shall operate by sealing the Hy-Car rubber outlet seat with an unguided float as the liquid enters the valve chamber to raise the float. The valve(s) shall satisfactorily withstand hydrostatic pressures of 300 psi.

1/2" - 4" The valve(s) shall be constructed of cast iron body, and top flange with a choice of stainless steel or bronze and brass trim with stainless steel float and shall be _____" NPT screwed inlet and outlet or _____ lb. flanged inlet with NPT screwed outlet.

6" - 10" The valve(s) shall be constructed of cast iron body, top and _____ lb. flange with a stainless steel unguided float. The outlet shall be a _____" NPT threaded connection.

The valve(s) shall be CRISPIN Model _____ as manufactured by Multiplex Manufacturing Co., Berwick, PA.

OPERATION: Air & Vacuum

The CRISPIN Air and Vacuum relief valves exhaust large volumes of air as the system is filling and permits air to enter the line when a vacuum is drawn.

The air and vacuum valve permits the passage of a volume of air equal to the volume being displaced in the line as the system is filling. As the liquid enters the valve body the float begins to rise until it seats itself at the orifice. If a vacuum is drawn due to column separation, break in the line, etc., the float drops away from the orifice to relieve the vacuum and prevent system damage.

MAINTENANCE:

Inspect seating area for leaks while the valve is in service. Replace seat when required by following the instructions below.

SEAT REPLACEMENT:

The air and vacuum valve top may be held fast by either one of two methods. A screw may be threaded through the threads or the thread may be punch pricked to prevent the top from spinning itself out.

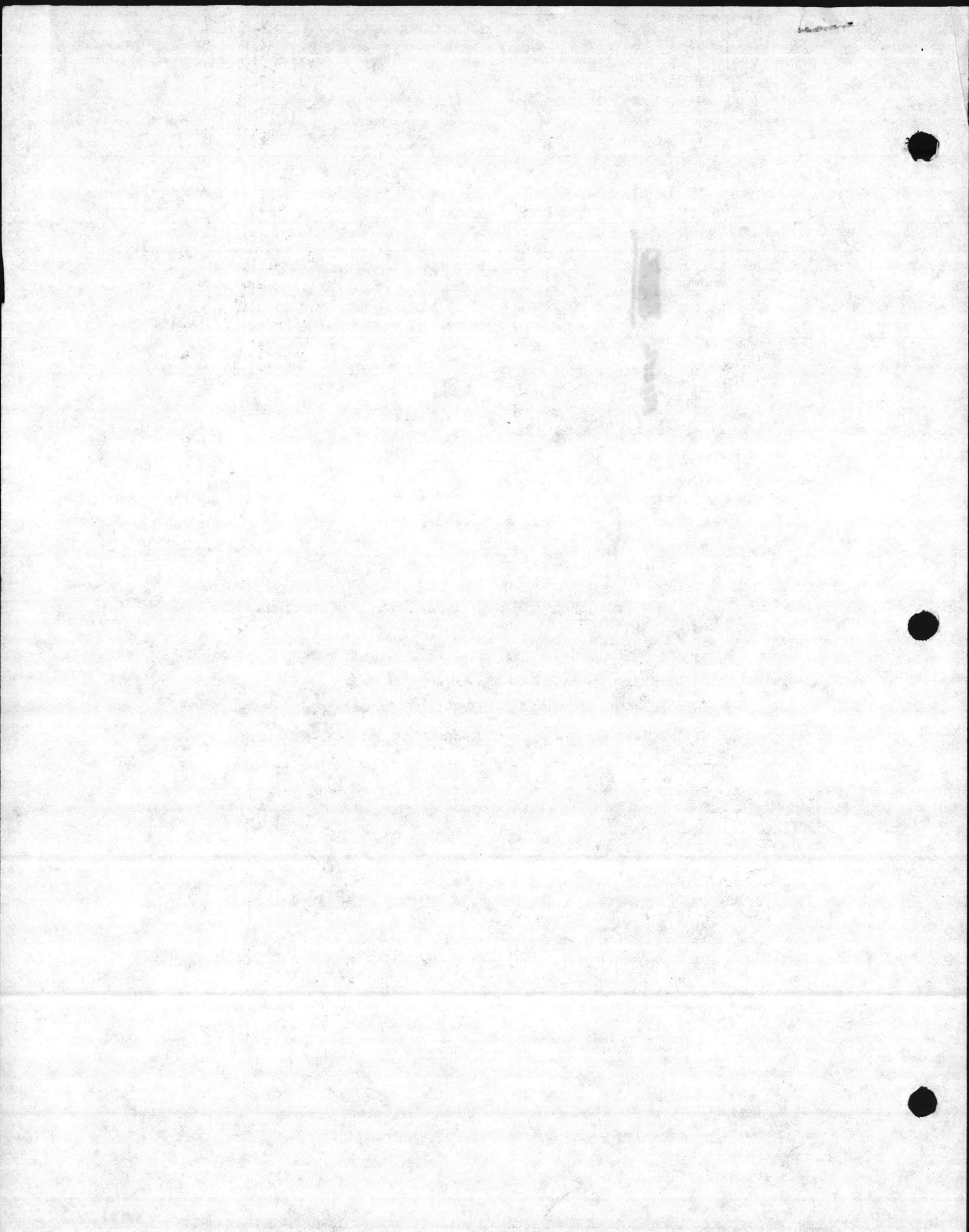
Once the top is removed, the Buna-N seat will be exposed and may be replaced, if necessary.

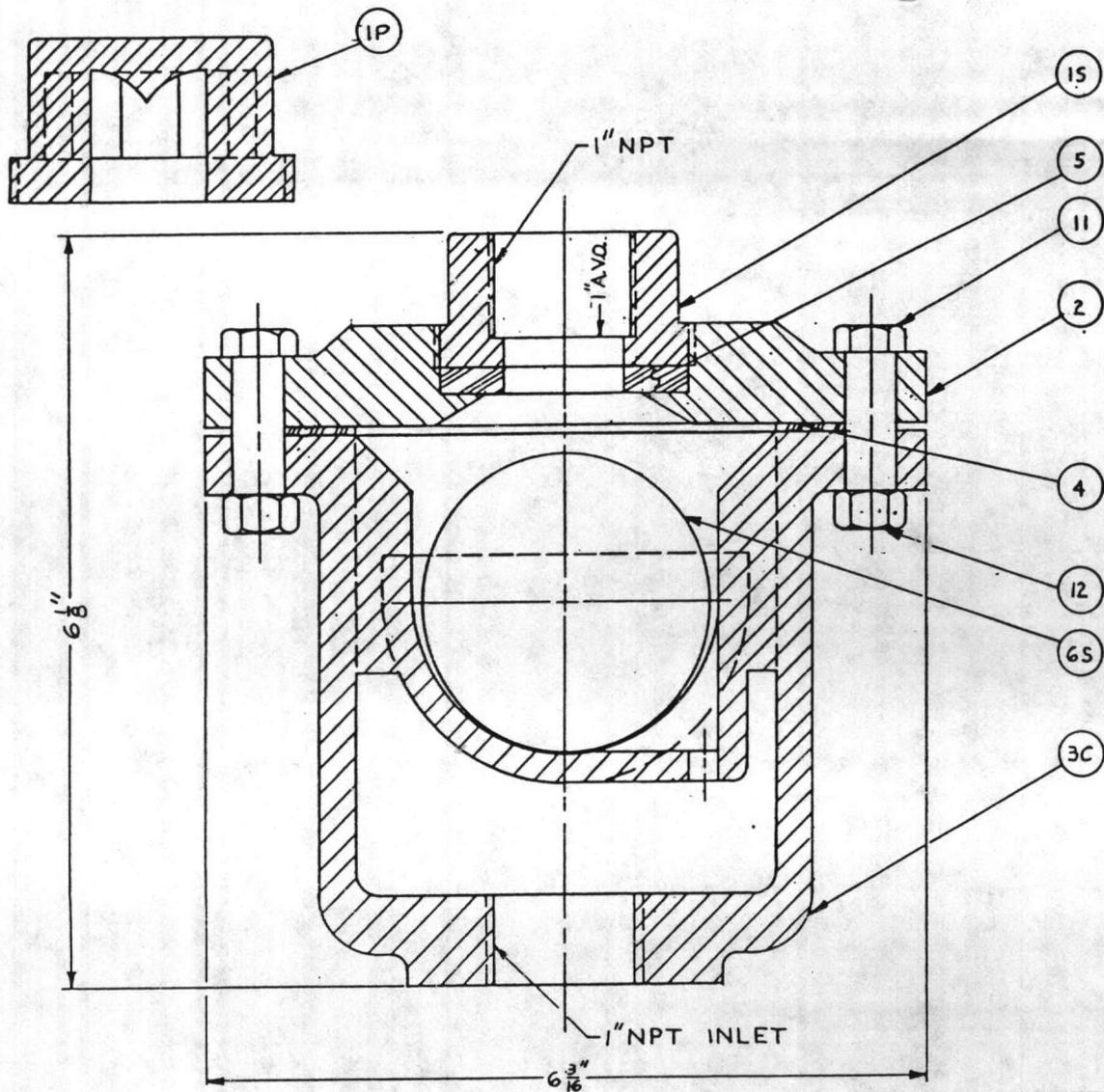
The top is replaced by threading it back into the top flange and tightened snugly but not over tightened, so as to deform the seat.

The threads may again be punch pricked to assure it being secure.

INSTALLATION:

The valves shall be installed at the high points in the line and mounted vertically. The inlet of the valve should be at the same elevation or greater than the elevation at the top of the pipe with the piping to the inlet on a continuous upward slope. Valve should be protected from freezing.





PART NO.	DWG. NO.	ITEM	M.	QTY. PER UNIT
* 15	2-15	TOP	CAST IRON	1
* 1P	2-1P	TOP	CAST IRON	1
2	2-2C	FLANGE	CAST IRON	1
3C	2-3C	BODY	CAST IRON	1
4	2-4	GASKET	ACCOPAC	1
5	2-5	SEAT	HY-CAR RUBBER	1
65	2-65	FLOAT	STAINLESS STEEL	1
11	2-11	BOLT	STEEL	6
12	2-12	NUT	STEEL	6

MOOFL ~~MOOFL~~

* OPTIONAL

APPROXIMATE WEIGHT 16 LBS.

MULTIPLEX MFG. CO.		Berwick, Pa.
THIS DRAWING SUPERSEDES DRAWING NO.		
DRAWN BY	MAT	NAME OF PART 1" CRISPIN AIR & VACUUM
TRACED BY	MAT	ASSEMBLY NO.
APPROVED		PART USED ON
DATE	5-6-83	SCALE FULL SIZE

DATE	CHARGE NO.	CHANGES

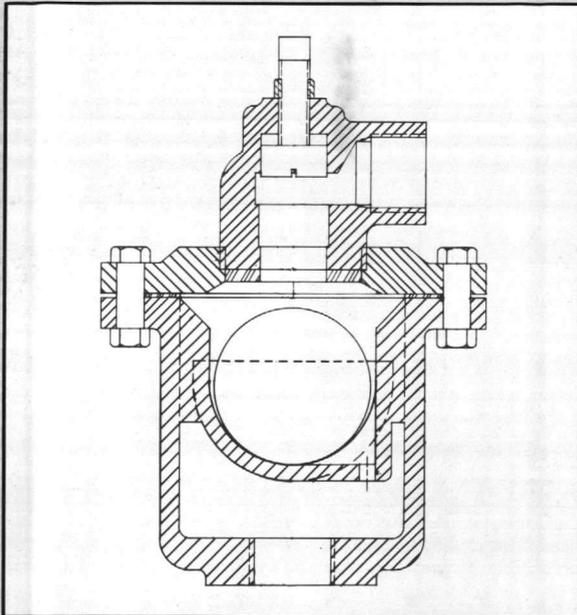
DR NO CV-2C

1944 1944

DEEP WELL AIR RELEASE VALVES

The CRISPIN Deep Well Valve, normally installed at the top of the pump discharge column between the pump and the check or control valve, provides the ability to throttle the discharge of an air and vacuum valve to maintain efficient air release valve operation.

Crispin valve provides the same unique design in the deep well valve as in the air and vacuum valve. That is, the float is peripherally guided to the seat which permits the float to self center and tightly seal the orifice.



Stainless steel trim is standard with the 1", 2" and 6" deep well air release valves.

Model	Inlet	Outlet	Trim	Height	Width	Wt. (lbs.)
D5	1/2"	1/2"	IBBT	6-13/16"	4-3/4"	7-1/2"
D10	1"	1"	IBBT	9-1/16"	6-1/4"	18
*DL10	2"	2"	S/S	9-1/16"	6-1/4"	18
D20	2"	2"	IBBT	13-15/16"	8-3/4"	50
*DL20	2"	2"	S/S	13-15/16"	8-3/4"	50
D21	2"	2"	IBBT	16-3/16"	8-3/4"	56
D22	2"	2"	IBBT	16-7/16"	8-3/4"	58
D30	3"	3"	IBBT	18-5/8"	11-1/2"	98
D31	3"	3"	IBBT	22-5/8"	11-1/2"	112
D32	3"	3"	IBBT	23"	11-1/2"	115
D40	4"	4"	IBBT	22-7/8"	14"	176
D41	4"	4"	IBBT	25-13/16"	14"	189
D42	4"	4"	IBBT	26-1/8"	14"	210
*DL61	6"	6"	S/S	27-5/16"	15"	295
*DL62	6"	6"	S/S	28"	15"	304

*Silverline

DEEP WELL AIR VALVES

The deep well air release valve(s) shall be installed on the discharge side of the pump, so that, the volume of air exiting the pump along with the liquid can be easily vented and controlled without hampering the operation of the air release valve. This shall be accomplished by means of a throttling device on the discharge side of the valve.

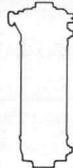
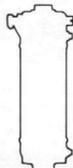
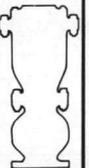
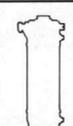
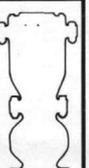
The valve(s) shall operate by sealing the Hy-car rubber orifice with an unguided ball float as the air exits the valve at an adjustable and controlled rate and the liquid enters the chamber to raise the float. The valves shall satisfactorily withstand a hydrostatic pressure of 300 psi. and operating pressures of _____ psi.

The valve(s) shall be CRISPIN Model _____ Deep Well Air Valves as manufactured by Multiplex Manufacturing Co., of Berwick, PA.

1/2" - 4" The valve(s) shall be _____" NPT screwed inlet and outlet or _____ lb. flanged inlet connection with cast iron body and top, a choice of stainless steel or bronze and brass trim and stainless steel ball float.

6" The valve(s) shall be _____ lb. flanged inlet connection with cast iron body and top flange and stainless steel float.

VALVE TYPE AND SERIES

	Air & Vacuum	Deep Well	Pressure High Volume	Midget Pressure Low Volume	Pressure Sewer	Air & Vacuum Sewer	Combination	Universal	Dual A & V & Pressure	Negative Pressure	Combination Sewer	Surge Check	
APPLICATION	Dramatic Change In Pipeline Grade												
	Peaks In The Line												
	Long Ascents												
	Long Descents												
	Long Horizontals												
	Pump Discharge Before Check						 with throttling device	 with throttling device		 with throttling device		 with throttling device	
	System High Points Above Hydraulic Gradient												
	Hydro-Pneumatic Tank Level Control												
	Vacuum Priming												

For sizing information, please refer to the CRISPIN Catalog or Bulletin CV-183.
NOTE: Materials and Prices Subject to Change without Notice.
 This chart provides information for those applications typically found in the field.

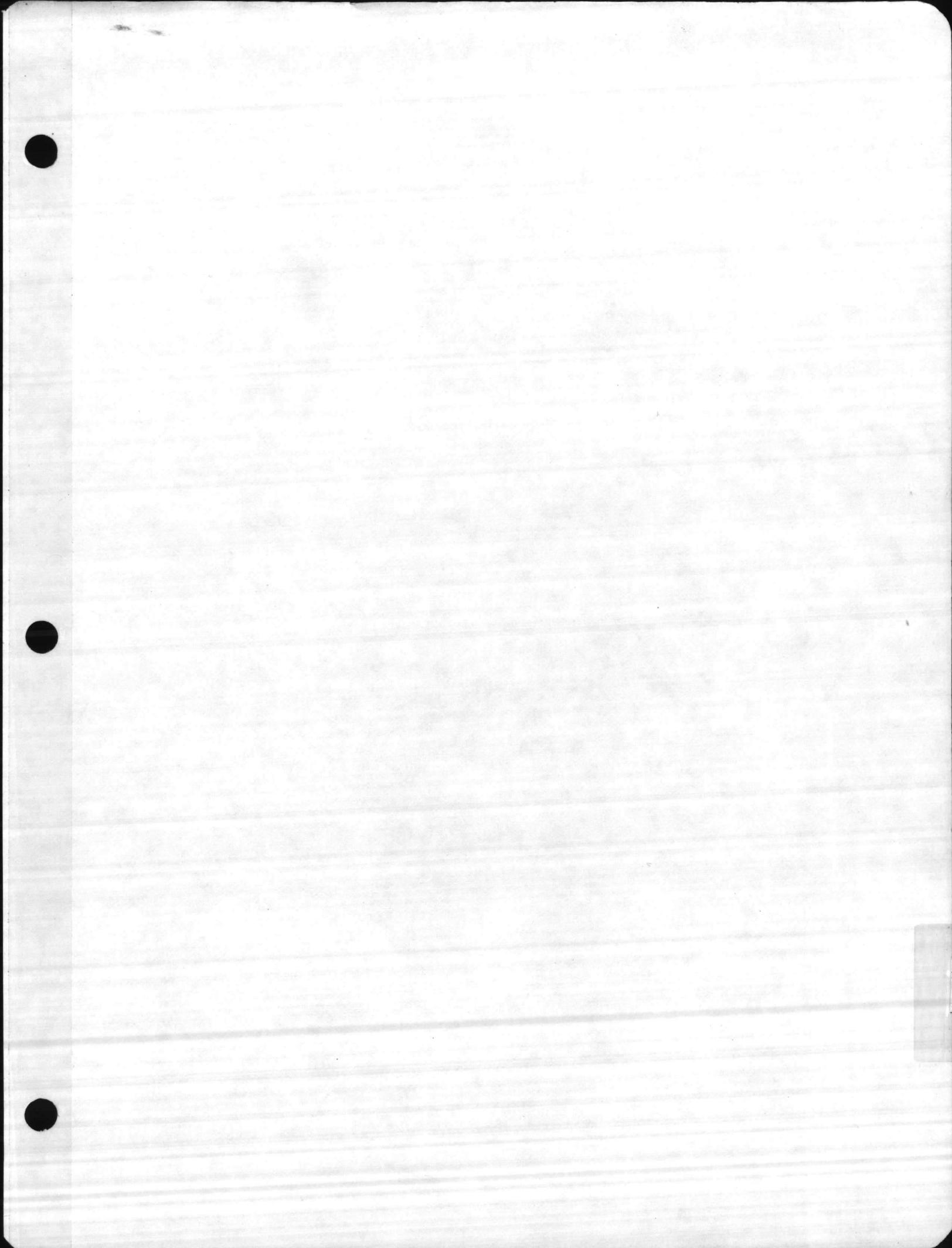
TAB PLACEMENT HERE

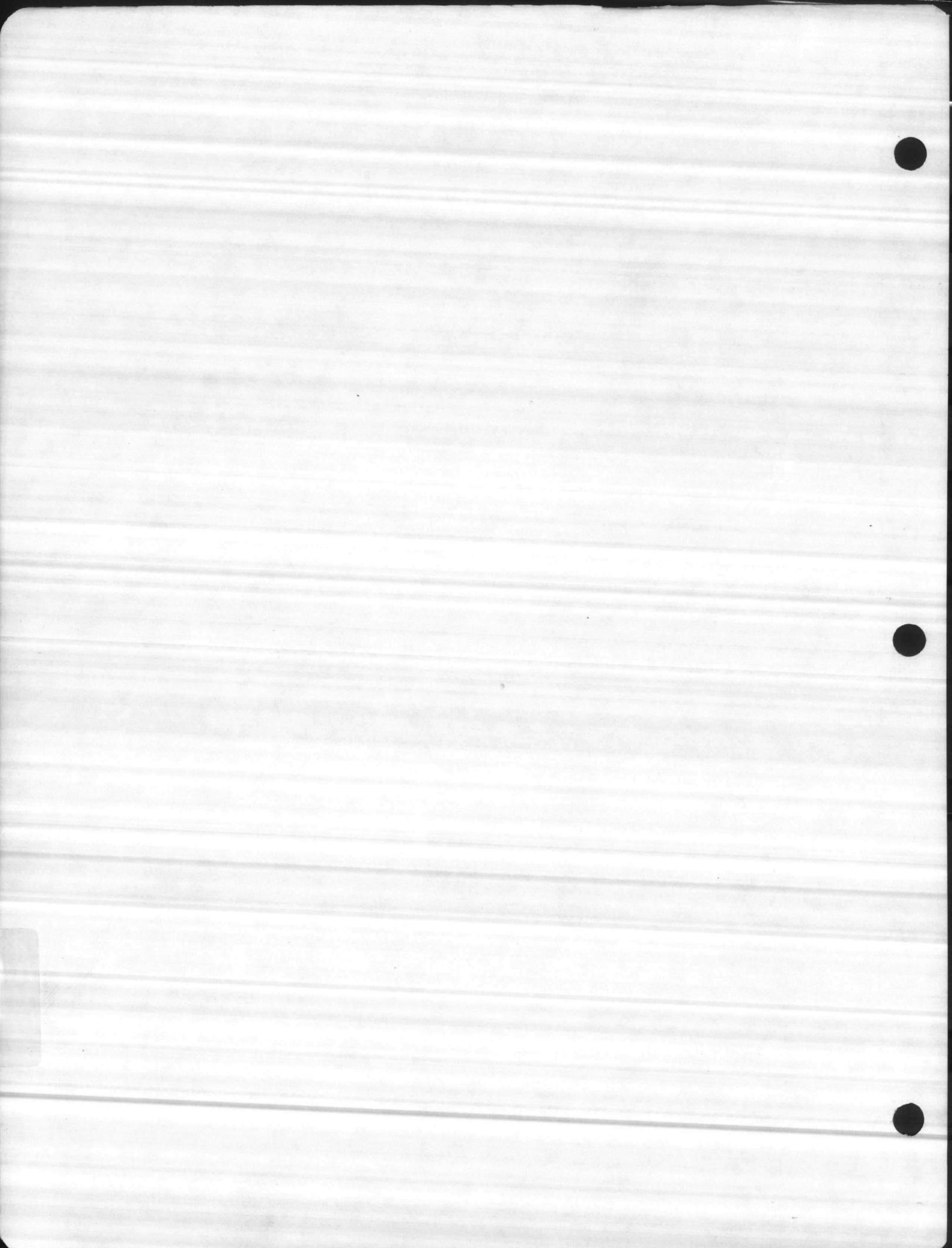
DESCRIPTION:

G

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image



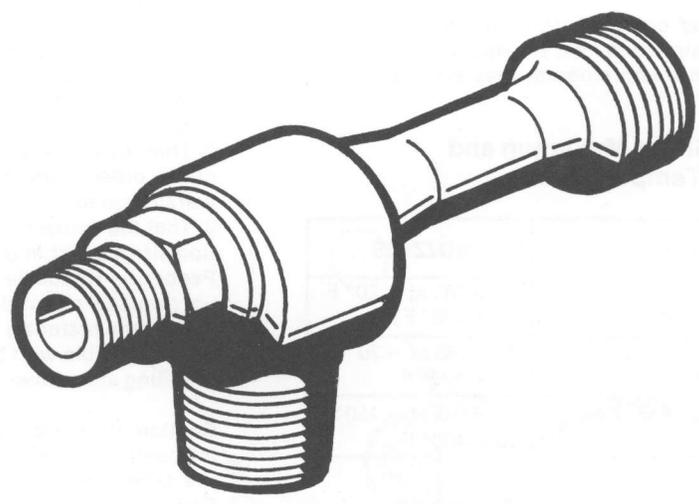


Section 1000
Instal. Instr. 1950
Issued 5/82
Replaces 6/78

PENBERTHY  OUDAILLE[®]

Jet Pumps

Models LL, LM, LH, ELL & HLM
CAST METAL CONSTRUCTION



PENBERTHY HOUDAILLE

INSTALLATION / OPERATION / MAINTENANCE FOR MODELS LL, LM, LH, ELL, & HLM JET PUMPS CAST METAL CONSTRUCTION

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow any instruction could possibly result in a malfunction of the jet pump resulting in leakage of the contained fluid, property damage or physical injury to personnel.

Caution: Penberthy Houdaille does not have any control over the manner in which its jet pump is handled, installed, or used, and Penberthy Houdaille cannot and does not warrant or guarantee that a jet pump is suitable or compatible with the user's specific application.

WARNING: Safety glasses should be worn when in the area of a jet pump installation.

I. INTRODUCTION:

A. Features and Specifications

Penberthy Houdaille liquid operated jet pump models LL, LM, LH, and ELL are designed to pump a secondary fluid using a liquid as the operating medium.

Penberthy Houdaille liquid operated jet pump models ELL, LM, and HLM are designed to heat the operating liquid by direct contact with steam, whereby they are also called steam jet heaters.

B. Design Ratings PSIG at Maximum and Minimum Operating Temperatures

MATERIAL	BODIES	NOZZLES
Iron	80 PSIG at - 20° F to + 150° F 50 PSIG at + 350° F	200 PSIG at - 20° F to + 400° F
Bronze	200 PSIG at - 20° F to + 150° F 125 PSIG at + 400° F	200 PSIG at - 20° F to + 400° F
316 STS	200 PSIG at - 150° F to + 150° F 125 PSIG at + 400° F	200 PSIG at - 150° F to + 400° F

To determine the maximum allowable working pressure for a specific temperature within the design limits stated above, the user should refer to Penberthy Houdaille dimension sheets, or when provided, the specifically stated design limits on a Penberthy Houdaille product proposal.

C. Application Data

Penberthy Houdaille models LL, LM, and LH are liquid operated jet pumps for pumping liquids against low, medium and high discharge pressures respectively.

Penberthy Houdaille models LM and ELL are liquid operated jet pumps for exhausting gases. Model ELL is self priming and has greater suction capacity at vacuum.

Penberthy Houdaille models ELL, LM, and HLM are liquid operated jet pumps for heating the operating liquid at low, medium, and high steam pressures respectively.

For specific application data within the above ranges, the user should consult the Penberthy Houdaille product proposal for the specific model and size jet pump, or should request Penberthy Houdaille to supply the applicable technical data bulletin.

WARNING: Under no circumstances should these design ratings or application data be exceeded. Exceeding design ratings or application data may cause property damage or physical injury to personnel.

II. INSPECTION AND PERFORMANCE CONFIRMATION:

A. Receiving Inspection

Upon receipt of jet pump, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

B. User's Rating Inspection

The user should confirm:

1. That the jet pump size (cast on side of body) and model designation (stamped on nozzle hex flats) conforms to the description on the user's purchase order.
2. That the operating conditions described in the purchase order agree with the actual conditions at the installation site.
3. That the actual operating conditions at the installation site are within the application data shown on the Penberthy Houdaille Technical Data Bulletin or product proposal referred to above.
4. That the materials of construction of the jet pump are compatible with both the contained fluid and surrounding atmosphere in the specific application.

Caution: If the size model or performance data of the jet pump as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy Houdaille distributor for direction on what to do.

III. INSTALLATION:

Installation should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

The user should refer to Penberthy Houdaille dimension sheets or Penberthy Houdaille product proposal to obtain dimensional information for the specific size and model jet pump.

Check the exploded view Figure 3 for the location of operating, suction, and discharge connections to insure correct hook up.

A. Effect of Related Piping and Precautions

1. For Pumping Fluids

a. Penberthy Houdaille liquid operated jet pump models LL, LM, LH, and ELL are installed and operated in any position. For applications handling gases, it is more desirable to install the models of LM and ELL with the discharge pointing down at 45° or more. This prevents back splash of motive liquid into the suction line.

b. Jet pumps should be installed with pipe and fittings which provide minimum resistance to fluid flow. Pipe line friction losses must always be a consideration when estimating jet pump performance.

c. It is recommended that provisions be made for pressure gauge connections near the operating inlet, suction and discharge connections of the jet pump. If operating difficulties are encountered at any time, it may become necessary to install pressure gauges to identify the problem.

d. When pumping liquids, suction piping should be sized so that the velocity of the liquid does not exceed 4 feet per second. This is almost always automatically obtained when the suction line is the same pipe size as the suction connection.

e. Some back pressure is necessary to prime models LL, LM, and LH when pumping liquids, and when using the model LM as an exhauster. A simple arrangement which would provide the minimum necessary back pressure is the installation of two consecutive 90° elbows in the discharge line.

f. When flow reversal into the suction must be prevented, a check valve should be installed in the suction line close to the jet pump. Pressure drop created by the check valve must be considered when applying the jet pump.

g. Install a valve in the suction line if it is desirable to:

- a. Prevent contamination of suction fluid by motive fluid at start up.
- b. Prime a centrifugal pump.
- c. Throttle suction flow.

h. Discharge piping should be sized as short as possible and with the least number of turns and restrictions. Discharge piping friction losses must always be considered when estimating jet pump performance. Increase discharge line pipe size if necessary to minimize loss.

i. Do not impose system piping loads on jet pump. The unit is NOT designed to be a load bearing fitting.

j. All piping should be free of foreign materials which could clog the jet pump.

2. For Heating Liquids

a. Penberthy Houdaille steam jet heaters can be installed and operated in any position. It is more desirable, however, to install the heater unit with the suction connection pointing up, to aid in the removal of condensate in the steam line at start up.

b. The steam jet heater should be installed with pipe and fittings which provide minimum resistance to fluid flow. Pipe line friction losses must always be a consideration when estimating steam jet heater performance.

c. It is recommended that provisions be made for pressure gauge connections near the operating inlet, suction and discharge connections of the steam jet heater. If operating difficulties are encountered at any time, it may become necessary to install pressure gauges to identify the problem.

d. Steam must not have over 20° F of superheat, or performance will differ from that published on Penberthy Houdaille Technical Data Bulletin or product proposal referred to above.

e. Steam line must be clean, and provided with a strainer to prevent foreign materials from clogging the steam jet heater.

f. Steam line should be insulated and as short as possible to prevent condensation and line friction losses.

g. A check valve in the steam line located as close to the steam jet heater as possible will help prevent water from being driven into the steam line at shut down.

h. Some installations require the addition of a pressure relief line to reduce discharge pressure at start up, see Figure 2. If appropriate for the application, the line can be connected to a tank, drain, or the suction side of the pump supplying liquid pressure to the inlet of the heater. Back pressure limitations at start up are as follows:

- 1) Model HLM, 1 ft. of water head for every psi of operating liquid pressure.
- 2) Model LM ½ ft of water head for every psi of operating liquid pressure.
- 3) Model ELL, atmospheric pressure.

i. Do not impose system piping loads on steam jet heater. Unit is NOT designed to be a load bearing component.

j. All piping should be free of foreign materials which could clog the jet pump.

WARNING: Failure to provide a pressure relief line on applications exceeding the start up back pressure limitations stated above may cause property damage or physical injury to personnel.

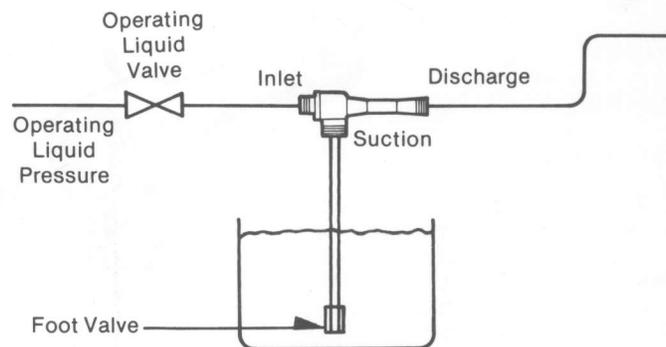


Figure 1. — Typical Installation Schematic
Liquid Operated Pumping Liquids

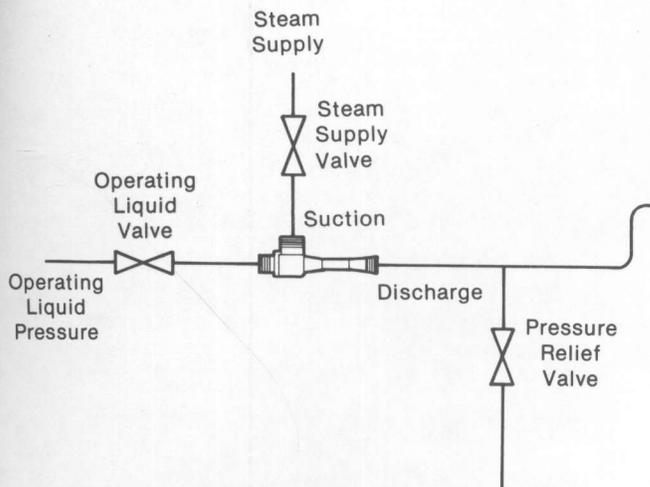


Figure 2. —Typical Installation Schematic Heating Operating Liquid

IV. OPERATION:

A. Pre-Operational Check

1. For Pumping Liquids
 - a. Assure that all installation procedures have been completed.
 - b. Assure that any restrictions in the discharge line have been removed.
 - c. Assure that any discharge line valves are fully open.
 - d. Assure that suction line valve, if installed, is fully closed.

2. For Heating Liquids

- a. Assure that all installation instructions have been completed.
- b. Assure that any restrictions in the discharge line have been removed.
- c. Assure that discharge line valves are fully open. (Including the pressure relief line valve when applicable.)

B. Operating

1. For Pumping Liquids

- a. Open the Operating liquid valve quickly.
- b. Open the suction line valve, if any.
- c. Regulate the discharge pressure as desired, to a value within capability published on Penberthy Houdaille Technical Data Bulletin or product proposal referred to above.
- d. For pump priming applications, when evacuation is completed, close the suction valve and immediately start the centrifugal pump. Then shut off the operating fluid valve to the jet pump.

2. For Heating Liquids

- a. Turn operating liquid valve fully open.
- b. Turn steam supply valve slowly on until the desired discharge liquid temperature is reached.
- c. Regulate line discharge pressure or close the pressure relief line valve when applicable.

V. MAINTENANCE:

Maintenance should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

Caution: Do not proceed with any maintenance unless the jet pump has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids.

A. Preventative Maintenance

The user must create maintenance schedules, safety manuals and inspection details for each specific installation of a jet pump or heater.

On all installations, the following items should be regularly evaluated by the user for purposes of maintenance.

1. Jet pump units for corrosion or debris build up.
2. Piping and fittings for corrosion or debris build up.
3. All connections for tightness.
4. Units for wear.
5. Strainers for debris build up.

The user must determine upon evaluation of his or her own operating experience an appropriate maintenance schedule necessary for his or her specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

B. Troubleshooting

1. For Pumping

Problem

The suction flow is less than expected.

Cause

Suction piping is too restrictive.

Discharge pressure is too high

Operating liquid pressure is lower than required.

Suction or motive liquid is at much higher than ambient temperature.

Suction piping leaks.

Cure

Remove restriction.

Remove restriction.

Increase pressure.

Lower temperature or size larger jet pump.

Tighten fittings.

2. For Heating

Problem

Discharge of live steam, objectionable noise and vibration, and inlet flow reversal.

Cause

Operating liquid pressure too low.

Attempted operation beyond discharge pressure capability

Cure

Increase pressure.

Reduce discharge pressure.

Attempted start up without
pressure relief line

Install pressure
relief line.

Problem

Surges in liquid outlet temperature.

Cause

Operating liquid pressure too low.

Cure

Increase pressure.

C. Disassembly—Reassembly

Caution: Do not proceed with the removal of jet pump from connecting piping unless the jet pump has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids.

To disassemble the unit, first attach a short piece of pipe to the suction connection as a handle. then grip the nozzle flats and rotate in a counterclockwise direction.

When ready to reassemble unit, be sure the seal face of the nozzle and body are free of foreign material and raised metal due to nicks. A non-hardening pipe seal compound may be applied to the threads to further promote sealing. Thread the body back on to the nozzle turning in a clockwise direction.

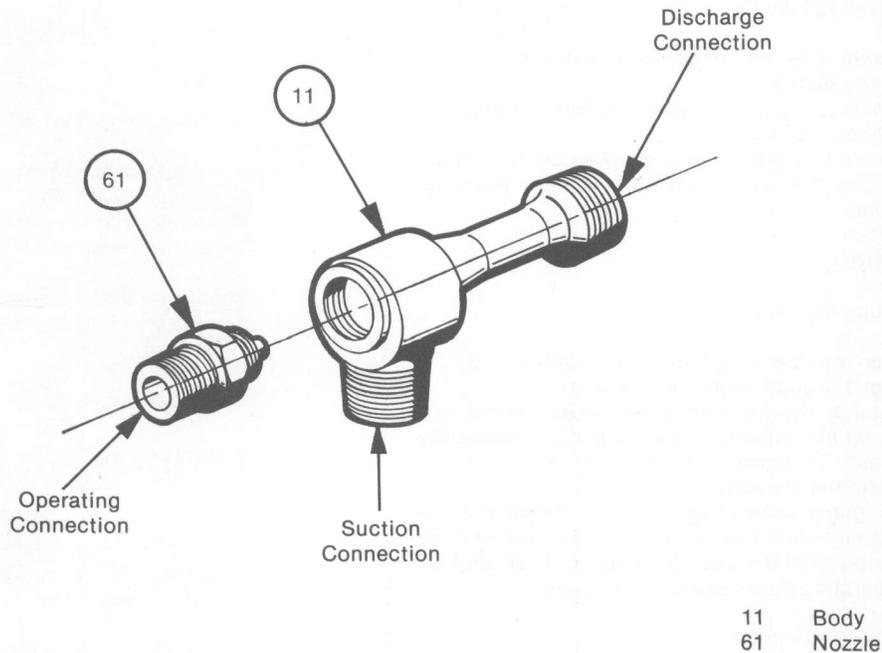


Figure 3.

PENBERTHY HOUDAILLE

Penberthy Division/Houdaille Industries
P.O. Box 112, Prophetstown, Illinois 61277
Telephone: 815/537-2311 Telex 25 7339
Printed in U.S.A. Form No. 14868-009

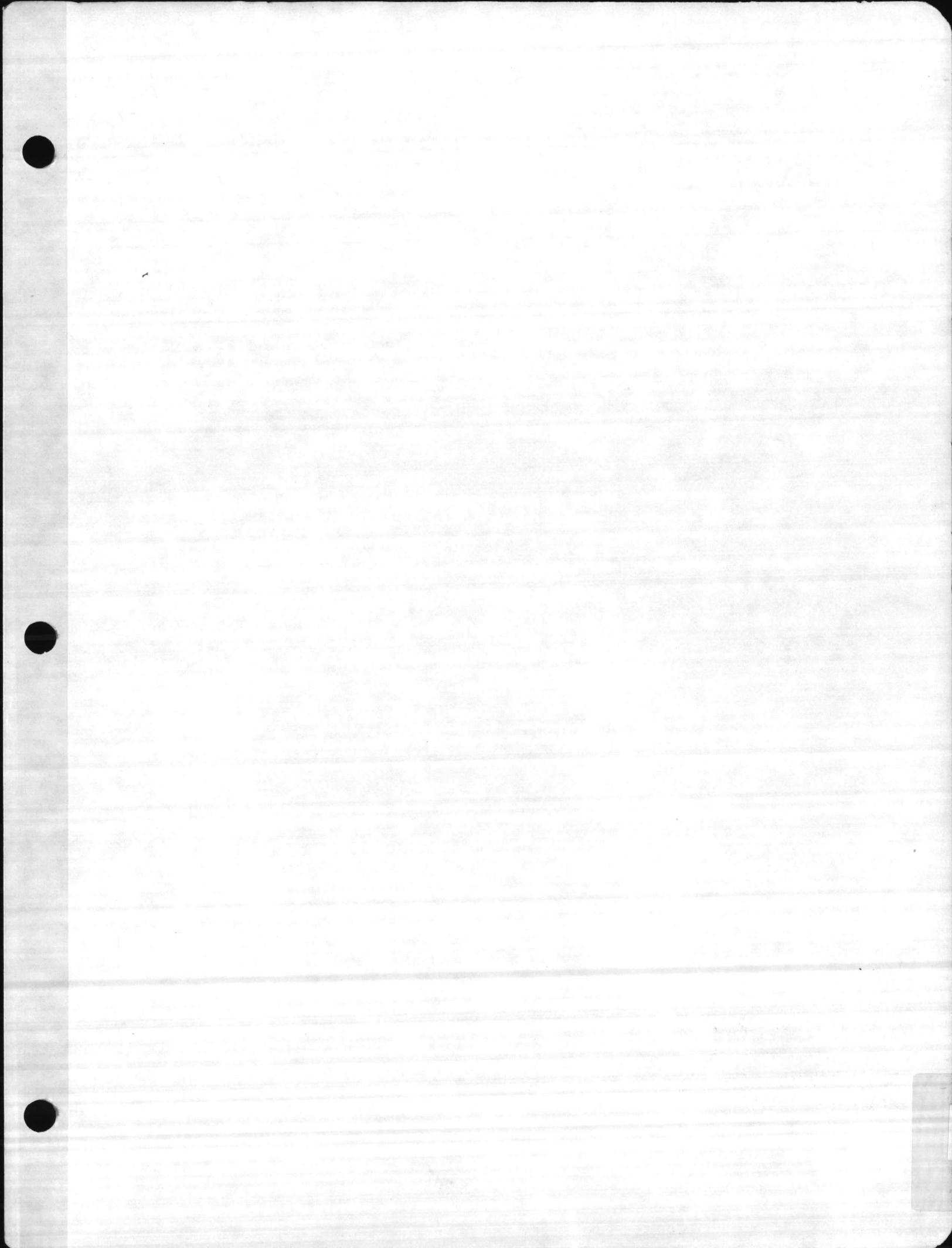
TAB PLACEMENT HERE

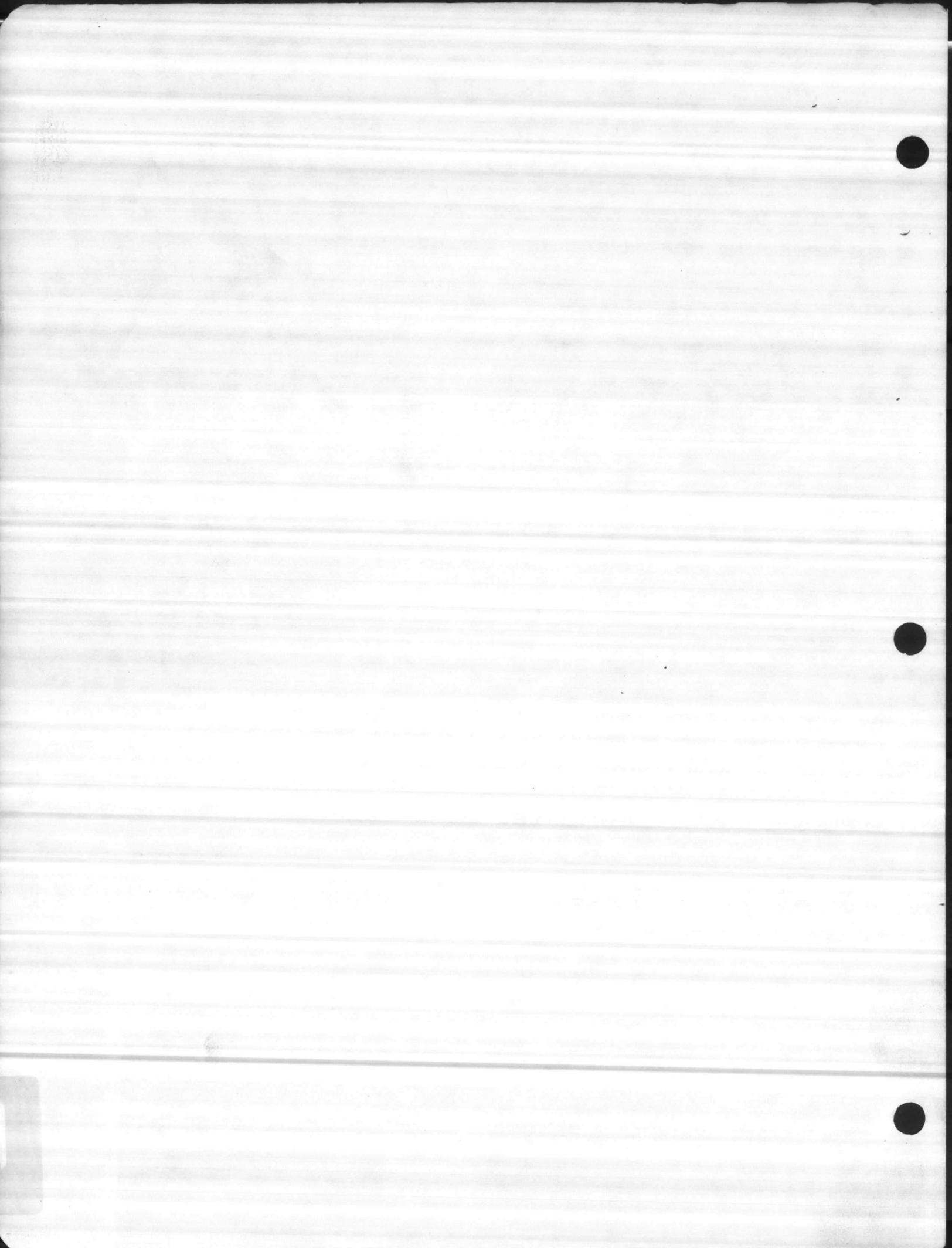
DESCRIPTION:

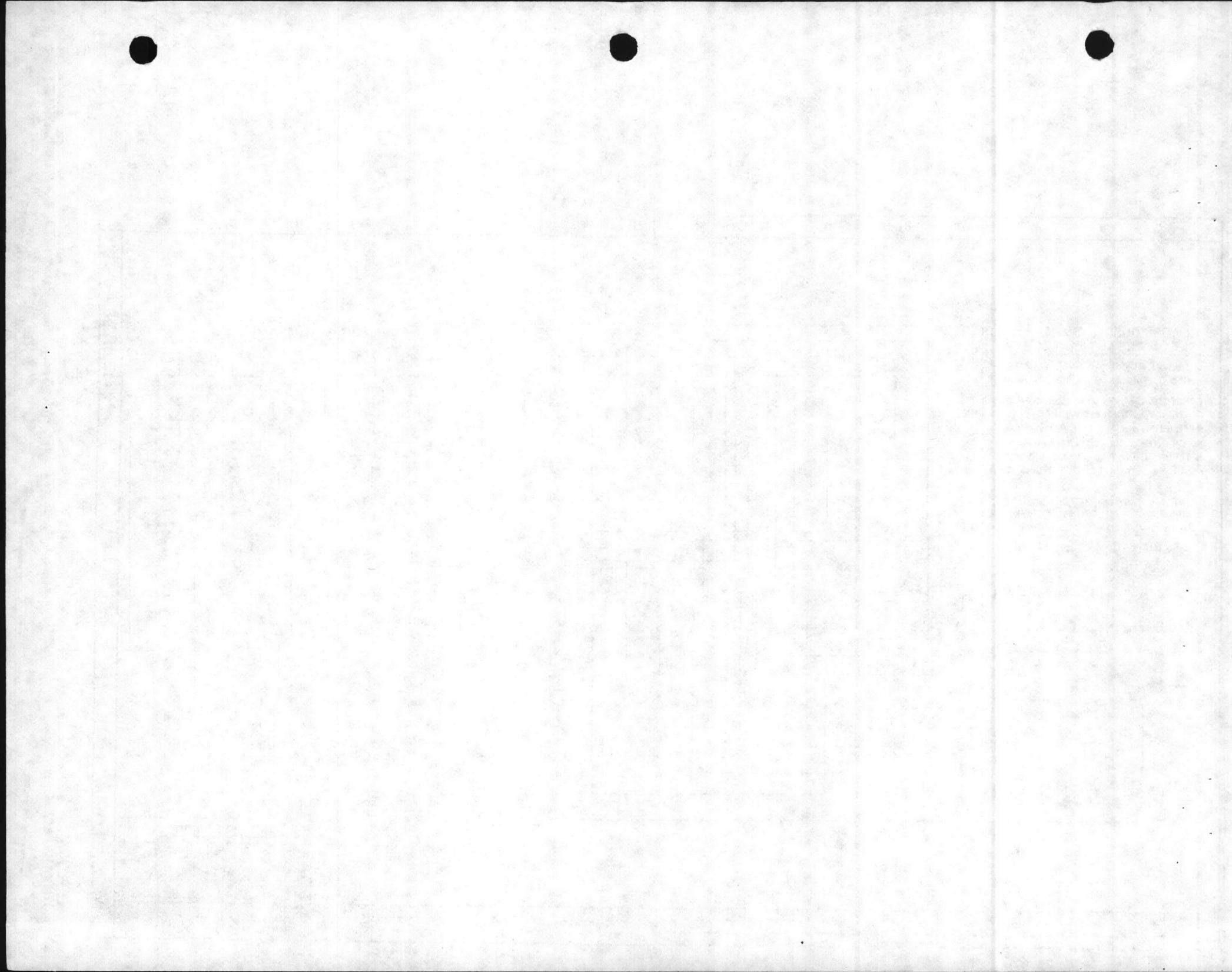
H

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image









Class 8501 Type X Control Relay

GENERAL

The Class 8501 Type X relay is a 600 volt ac, 300 volt dc, industrial control relay. It is available in 2 to 12 poles (ac operated), with a maximum of 8 of those normally closed, and 2-8 poles (dc operated). All contacts are easily convertible.

The Type X relay with standard cartridges (black cases) is designed to have a significant degree of non-overlap between the normally open and normally closed contacts during normal operation. In addition, all cartridges are linked together by a common mechanical tie.

The Type X relay family includes a number of accessory kits (see Table 1). See catalog for further description of accessory kits.

TABLE 1 — ACCESSORY KITS

Kit Description	Class 8501 Type
Mechanical Latch Attachment (ac)	XL
Mechanical Latch Attachment (dc)	XDL
Pneumatic Timer Attachment (On Delay, 0.1 to 60 sec.)	XTE1
Pneumatic Timer Attachment (Off Delay, 0.1 to 60 sec.)	XTD1
Pneumatic Timer Attachment (On Delay, 5 to 180 sec.)	XTE2
Pneumatic Timer Attachment (Off Delay, 5 to 180 sec.)	XTD2
Standard Contact Cartridge	XC-1
Overlapping Contact Cartridge	XC-2
Master Contact Cartridge	XC-4
Manual Test Tool	XA-1
Transient Suppressor	XS-1
Mounting Track (for 4 relays)	XM-4
Mounting Track (for 8 relays)	XM-8
Mounting Track (for 12 relays)	XM-12
Mounting Track (for 16 relays)	XM-16
Mounting Track (for 32 relays)	XM-32
Universal Adder Deck (with 2 N.O. convertible cont.)	XB-20
Universal Adder Deck (with 4 N.O. convertible cont.)	XB-40
Logic Reed Adder Deck (with 2 N.O. fixed logic reed contacts)	XBR-20
Logic Reed Adder Deck (with 1 N.O. and 1 N.C. fixed logic reed contacts)	XBR-11
Logic Reed Adder Deck (with 1 N.O. fixed logic reed contact)	XBR-10
Logic Reed Adder Deck (with 1 N.C. fixed logic reed contact)	XBR-01
Logic Reed Adder Deck (with 2 N.C. fixed logic reed contacts)	XBR-02

CONTACTS

All contacts are color coded. When the conventional symbol ---| for normally open contacts on a green background is visible between the cover and the terminal, the contact is in the normally open mode. When the conventional symbol ---| for normally closed on a yellow background is visible, it is in the normally closed mode.

Three types of contact cartridges are available for use with the Type X relay: standard, overlapping, and master. Each is color coded to indicate the type of cartridge — see Table 2. In addition, the normally open or normally closed contact symbol appearing through the green or yellow background will be the same color as the contact cartridge.

TABLE 2 — CONTACT CARTRIDGES

Description	Class 8501 Type	Cartridge Color
Standard	XC-1	black
Overlapping	XC-2	red
Master*	XC-4	blue

INSTALLATION AND WIRING OF RELAY

Type X relays are designed for two-point mounting on a vertical panel with coil terminals upward. However, the relay can be mounted with the coil terminals down if required.

Mounting track, which simplifies installation, is available as an accessory kit (see Table 1). These tracks are designed to accommodate 4, 8, 12, 16 or 32 relays. They can easily be cut to any length. Mount each track horizontally using #8 screws with 2 screws at each end position and with screws at spacings of 4 1/2" in alternate upper and lower horizontal slots. Torque relay mounting screws to 18-21 in-lbs.

Wiring on the Type X relay is straight through. The terminals are self-lifting pressure wire connectors.

MANUAL OPERATION

WARNING: Manual operation should be performed only by QUALIFIED personnel. Manual operation with the power turned on is dangerous because of possible electric arcing, burn or shock — REMAIN ALERT!

Type X relays can be manually operated by depressing the red T-bar actuator visible in the center of the nameplate with an insulated tool. This red T-bar actuator also gives a visual indication of relay operation. It is flush with the nameplate when the relay is de-energized and recessed when the relay is energized. A manual test tool is available (Table 1) that simplifies the checking of control circuits without power on the coil. To use manual test tool, insert end marked "RELAY" diagonally on the red T-bar actuator, push down and rotate 1/8 turn (Figure 1).

Manual test tool must be removed before normal operation of the relay.



Figure 1

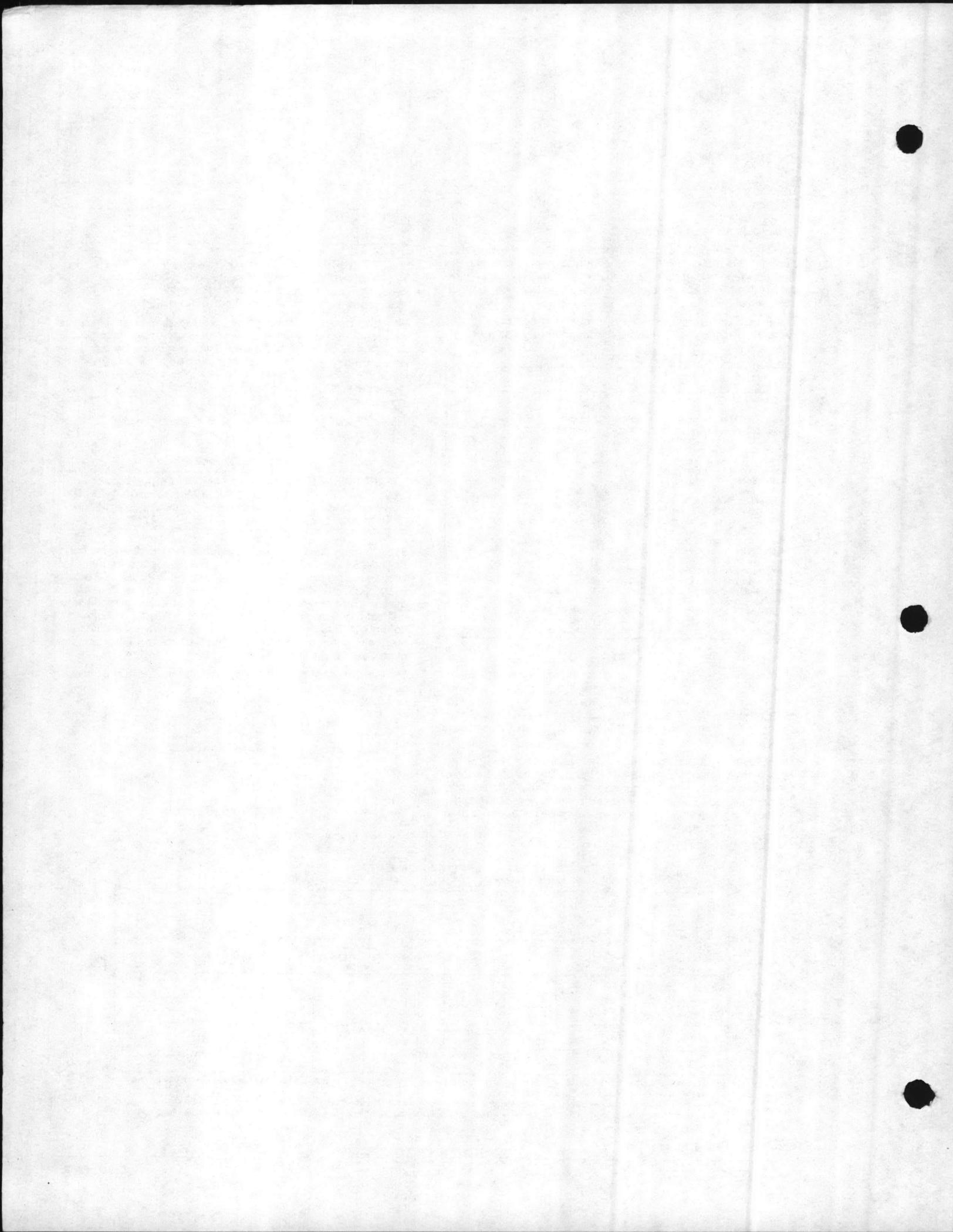
APPLICATION DATA
MAXIMUM ELECTRICAL CONTACT RATINGS

Type of Cartridge	AC Ratings							DC Ratings				
	Volts	NEMA Rating	Inductive 35% Power Factor				Resistive 75% Power Factor	Inductive				
			Make		Break			Volts	NEMA Rating	Make and Break Amperes 138VA Max.	Continuous Amperes	
Standard	120	A600	60	7200	6	720	10					10
	240		30	7200	3	720	10	10				
Overlapping	480		15	7200	1.5	720	10	10	125	P150	1.1	5
	600		12	7200	1.2	720	10	10				
Master*	—	A600	Same as standard cartridge above except substitute 20 ampere for the continuous ampere rating					125	10	P300	1.1	5
								250	10		0.55	5
Logic Reed**	—	—	150 VAC, 150 MA, 8 VA Maximum Resistive Only					—	—	—	30 VDC, 60 MA Resistive Only	

* Maximum of 6 Class 8501 Type XC-4 Master Contact Cartridges may be used on any 7 or 8 pole ac-operated devices. Do not use any master cartridges on 9-12 pole ac or any dc-operated relays.
 ** The operation of the reed switch may be affected by the presence of magnetic fields. Provide series resistance to protect the contacts against inrush currents exceeding 350 MA, such as those caused by the distributed capacitance of long wire runs and by incandescent lamp continuity checkers.

Supersedes 531AS dated July, 1982

SQUARE D COMPANY





Class 8501 Type X — AC Control Relay — Series A

Class 8501 Type XM — AC Master Relay — Series A

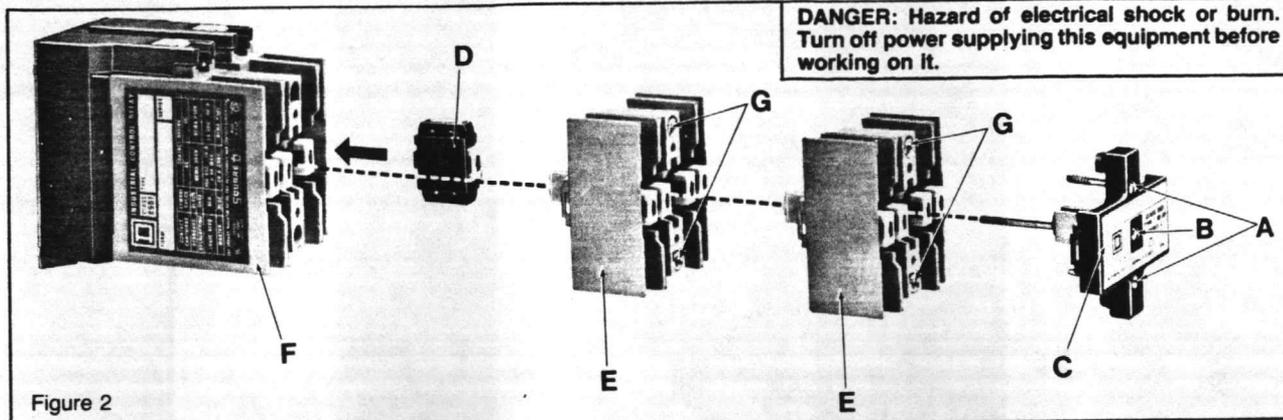


Figure 2

ADDING DECKS

The standard Type X 4 pole relay can be easily converted to an 8 pole or 12 pole standard relay (Figure 2) by installing one or two standard adder decks (Table 1). Logic reed adder decks (Table 1) can also be installed to standard 0-8 pole relays. The same Type XB standard adder deck and Type XBR logic reed adder deck is used for both the middle and upper decks. See Table 3 for factory recommended tightening torques.

Adding A Deck To A Basic 4 Pole Relay

To convert a 4 pole relay into a 6-8 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
Loosen 2 captive cover screws (A) and remove cover assembly (C).
2. Place the adder deck (E) on the basic 4 pole relay (F). The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
3. Place the cover assembly on the adder deck. Tighten 2 cover screws (A).
4. Thread shorter screw (2.50 inches) from adder deck kit through the red T-bar actuator in the cover assembly and tighten. Longer screw (3.75 inches) is not used.

Adding A Deck To An 8 Pole Relay

To convert an 8 pole relay into a 10-12 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
2. Loosen 2 captive cover screws (A) and remove cover assembly (C).
3. Place the adder deck (E) on the 8 pole relay. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
4. Place the cover assembly on the adder deck. Tighten 2 cover screws (A).
5. Thread longer screw (3.75 inches) from adder deck kit through the red T-bar actuator in the cover assembly and tighten. Shorter screw (2.50 inches) is not used.

Adding Two Decks to Basic 4 Pole Relay

To convert a 4 pole relay into a 10-12 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
2. Loosen 2 captive cover screws (A) and remove cover assembly (C).
3. Place the first adder deck (E) on the 4 pole relay. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
4. Place the second adder deck (E) on the first adder deck. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
5. Place the cover assembly on the upper deck. Tighten 2 cover screws (A).

6. Thread longer screw (3.75 inches) from either adder deck kit through the red T-bar actuator in the cover assembly and tighten. Shorter screw (2.50 inches) is not used.

CONTACT CONVERSION/REPLACEMENT

Contact conversion from normally open to normally closed, or vice versa, can be done without removing any wires or terminal screws (Figure 2). A maximum of 8 normally closed contacts are allowed on 9-12 pole relays. Gray logic reed cartridges are non-convertible. See Table 3 for factory recommended tightening torques. To convert contacts on the:

Basic 4 Pole Relay Or Upper Deck Of An 8 Or 12 Pole Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Remove cartridge (D), invert to opposite color and re-insert.
3. Replace cover assembly (C) and tighten 2 cover screws (A) and T-bar actuator screw (B).

Lower Deck Of An 8 Pole Relay Or Middle Deck Of A 12 Pole Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Loosen 2 captive deck mounting screws (G) and lift off upper deck (E).
3. Remove cartridge (D), invert to opposite color and re-insert.
4. Replace upper deck (E) and tighten 2 deck mounting screws (G).
5. Replace cover assembly (C) and tighten 2 cover screws (A) and T-bar actuator screw (B).

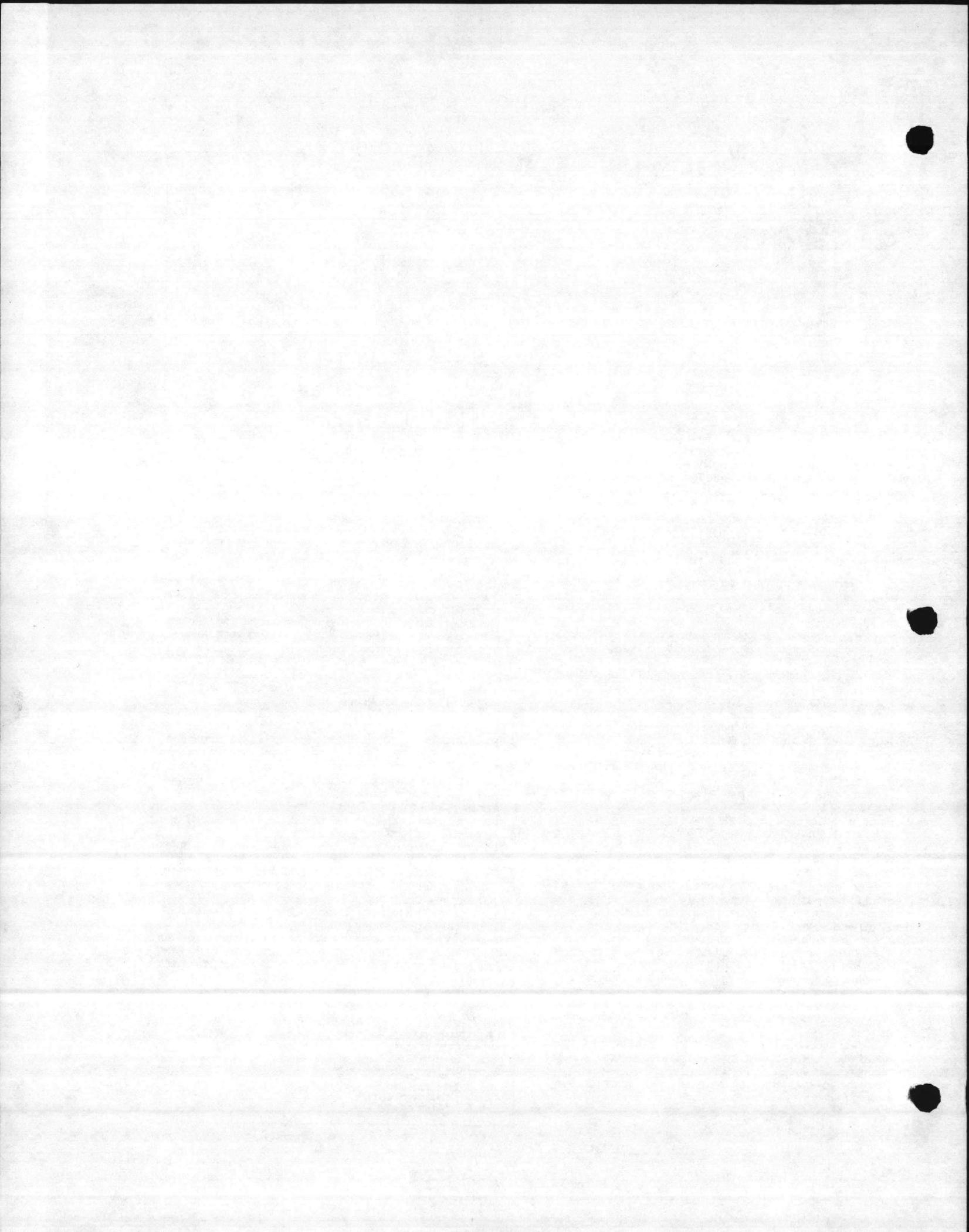
Lower Deck of a 12 Pole Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Loosen 2 deck captive mounting screws (G) and lift off upper deck (E). Remove middle deck (E) in similar manner.
3. Remove cartridge (D), invert to opposite color and re-insert.
4. Replace middle deck (E) and tighten 2 deck mounting screws (G). Replace upper deck (E) in similar manner.
5. Replace cover assembly (C) and tighten 2 cover screws (A) and T-bar actuator screw (B).

To replace a contact, follow the procedure for conversion except remove the cartridge and insert replacement. Gray logic reed cartridges are non-replaceable. The logic reed adder deck (Table 1) must be replaced. Note: Maximum of 6 master contact cartridges may be used on 7 or 8 pole relays. Do not use any master cartridges on 9-12 pole relays.

TABLE 3 —
FACTORY RECOMMENDED TIGHTENING TORQUES

Item	Description	Driving Torque (in-lb)
A	Cover screw	6-9
B	T-bar actuator screw	6-9
G	Deck mounting screws	9-11
H	Baseplate screws	12-15
—	Relay mounting screws	18-21





Class 8501 Type X — AC Control Relay — Series A
Class 8501 Type XM — AC Master Relay — Series A

COIL REPLACEMENT

DANGER: Hazard of electrical shock or burn. Turn off power supplying this equipment before working on it.

The coil on the Type X relay is easy to replace from the back of the device without having to remove the contact block assembly from the basic relay (Figure 3). To replace the coil:

1. Loosen 4 captive baseplate screws (H).
2. Lift off baseplate (J) and lower housing assembly (K).
3. Lift out coil (L) and slide out magnet (M). Re-install magnet (M) (note orientation in Figure 3) in new coil and replace coil in relay.
4. When replacing baseplate and lower housing assembly, make sure the coil terminals (N) slide into the lower housing slots before the assembly is re-installed on the relay (Figure 3).
5. Tighten the 4 baseplate screws (H). See Table 3 (page 2) for factory recommended tightening torques.

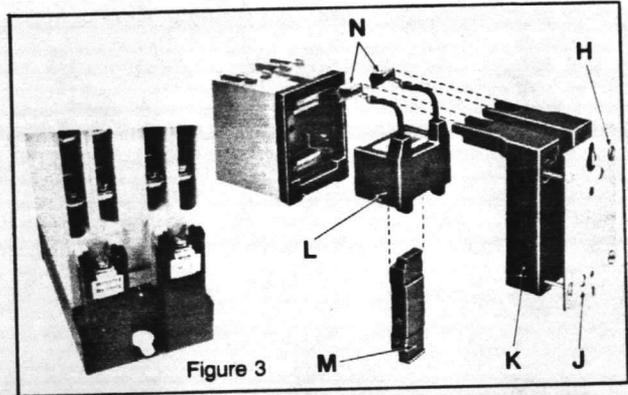


Figure 3

TABLE 4 — AC MAGNET COILS

Heavy-duty, molded coils are used. These coils are designed to operate on line-voltage fluctuations as much as 15% below and 10% above nominal voltage.

Coil Prefix	Hertz	SUFFIX NUMBERS (Coil part numbers consist of coil prefix followed by suffix number)												Coil Volt-Amps		
		12 Volts	24 Volts	48 Volts	110 Volts	120 Volts	208 Volts	220 Volts	240 Volts	277 Volts	440 Volts	480 Volts	550 Volts	600 Volts	In-Rush	Sealed
Class 9998	60	14	23	32	...	44	51	...	53	55	...	62	...	65	148	23
Type X	50	15	24	33	44	53	62	...	65	...	143	25

Class 8501 Type XD — DC Control Relay — Series A
Class 8501 Type XUD — Utility Auxiliary Relay — Series A

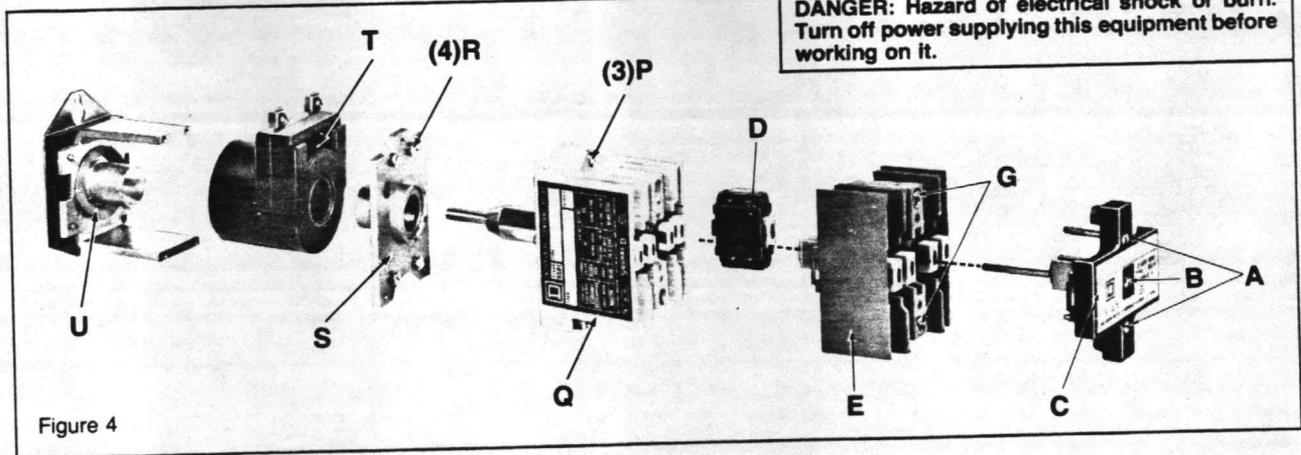


Figure 4

DANGER: Hazard of electrical shock or burn. Turn off power supplying this equipment before working on it.

DC COIL REPLACEMENT

The coil on a dc-operated Type XD or XUD relay is easy to replace from the front of the device (Figure 4). See Table 6 (Page 4) for factory recommended tightening torques. To replace the dc coil:

1. Loosen three captive housing screws (P). Lift off housing assembly (Q).
2. Remove four magnet plate screws (R) and lift off magnet plate (S).
3. Lift out coil (T) and replace with new coil. See Figure 4 for proper orientation. Be sure not to remove spring washer (U).
4. Replace magnet plate (S) and tighten four screws (R).
5. Replace housing assembly (Q) and tighten three housing screws (P).

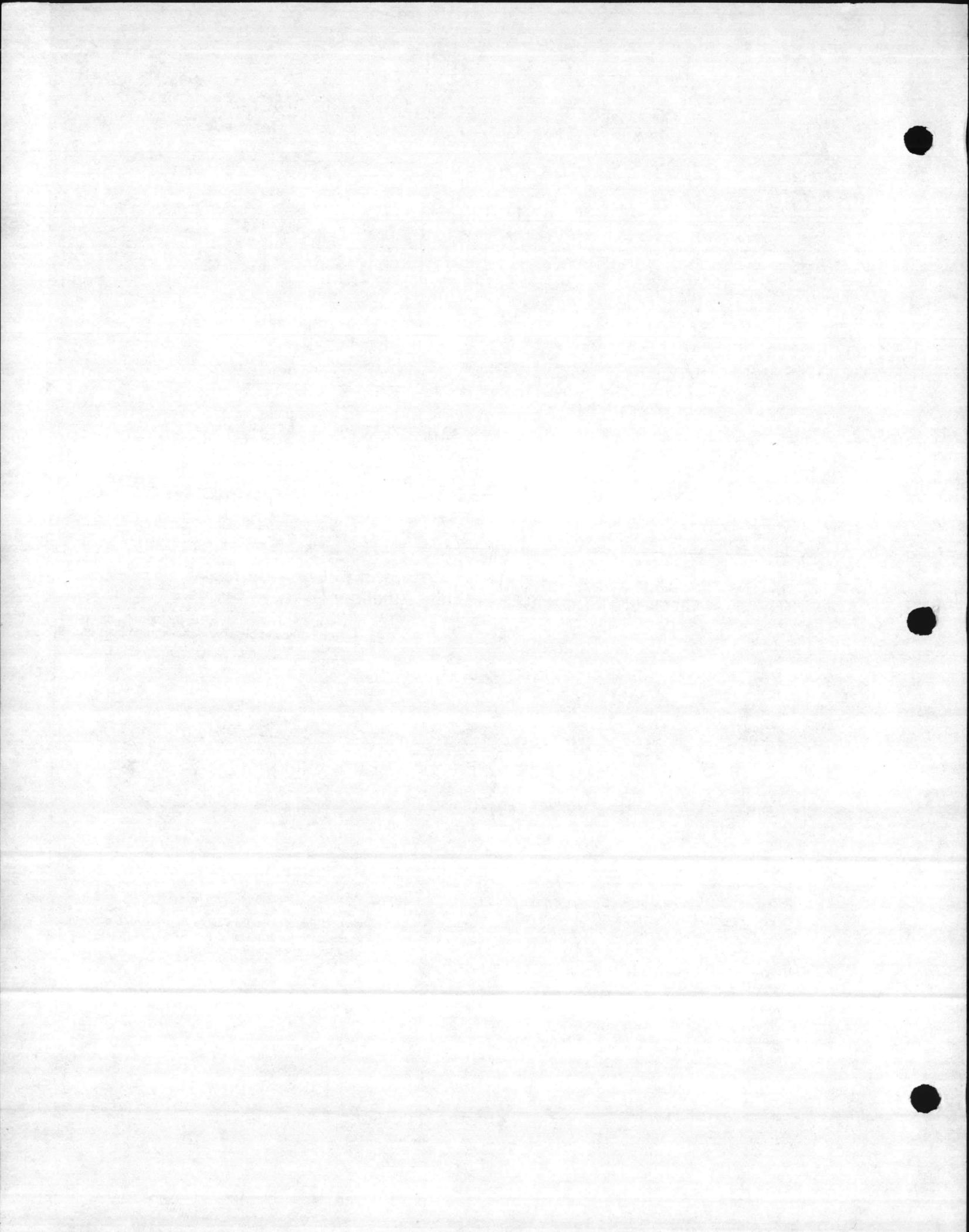
NOTE: Do not use Class 9998 Type XD coils (Table 5 page 4) on Class 8501 Type XUD Utility Auxiliary Relays. Class 9998 Type XUD coils (Table 5 page 4) are designed specifically for the Utility Auxiliary Relay and must be used to assure proper operation.

Supersedes 531AS dated July, 1982

MARCH, 1983

SQUARE D COMPANY

PRINTED IN U.S.A. COO
 P.O. Box 472
 Milwaukee, Wis. 53201-0472
 (414) 332-2000





Class 8501 Type XD — DC Control Relay — Series A
Class 8501 Type XUD — Utility Auxiliary Relay — Series A

TABLE 5 — DC Control Relay and Utility Auxiliary Relay Coils

Heavy-duty, molded coils are used. When ordering replacement magnet coil give Class and Type Number and voltage of coil being replaced.

Coil Prefix	SUFFIX NUMBERS (Coil part numbers consist of coil prefix followed by suffix number)											Coil Watts
	6 Volts	12 Volts	18 Volts	24 Volts	32 Volts	48 Volts	64 Volts	72 Volts	90 Volts	115/125 Volts	230/250 Volts	
Class 9998 Type XD	19	28	34	37	40	46	49	52	55	58	67	13
Class 9998 Type XUD	19	28	—	37	—	46	—	—	—	58	67	13

CONTACT CONVERSION/REPLACEMENT

Contact conversion from normally open to normally closed, or vice versa, can be done without removing any wires or terminal screws (Figure 4 page 3). **Gray logic reed cartridges are non-convertible.** See Table 6 for factory recommended tightening torques. To convert contacts on the:

4 Pole Relay or Upper Deck of an 8 Pole Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Remove cartridge (D), invert to opposite color and re-insert.
3. Replace cover assembly (C) and tighten two cover screws (A) and T-bar actuator screw (B).

Lower Deck Of An 8 Pole Relay or Middle Deck Of A 12 Pole Type XUD Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Loosen 2 captive deck-mounting screws (G) and lift off upper deck (E).
3. Remove cartridge (D), invert to opposite color and re-insert. Replace upper deck (E) and tighten two deck-mounting screws (G).
5. Replace cover assembly (C) and tighten two cover screws (A) and T-bar actuator screw (B).

Lower Deck of A 12 Pole Type XUD Relay

1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B), and remove cover assembly (C).
2. Loosen 2 captive deck-mounting screws (G) and lift off upper deck (E). Remove middle deck (E) in similar manner.
3. Remove cartridge (D), invert to opposite color and re-insert.
4. Replace middle deck (E) and tighten 2 deck-mounting screws (G). Replace upper deck (E) in similar manner.
5. Replace cover assembly (C) and tighten 2 cover screws (A) and T-bar actuator screw (B).

To replace a contact, follow the procedure for conversion except remove the cartridge and insert replacement. **Gray logic reed cartridges are non-replaceable. The logic reed adder deck (Table 1) must be replaced. Note: Do not use any master contact cartridges on dc-operated relays.**

**TABLE 6 —
FACTORY-RECOMMENDED TIGHTENING TORQUES**

Item	Description	Driving Torque (in-lb)
A	Cover screw	6-9
B	T-bar actuator screw	6-9
G	Deck-mounting screws	9-11
P	Housing screws	9-11
R	Magnet-plate screws	9-11

ADDING DECKS — Figure 4 Page 3

The basic dc-operated Type XD 4-pole relay can be easily converted to a 6 or 8 pole relay by installing one adder deck kit (Table 1). **Do not add a second deck — dc-operated Type XD relay restricted to 8 poles.** Type XUD 4-pole relays can be easily converted to an 8 pole or 12 pole relay by installing one or two adder deck kits (Table 1). Logic reed adder decks (Table 1) can also be installed on standard 0-4 pole dc-operated Type XD relays and 4-8 pole dc-operated Type XUD relays. See Table 6 for factory recommended tightening torques.

Adding A Deck To A Basic 4 Pole Relay

To convert a 4 pole relay into a 6-8 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
2. Loosen 2 captive cover screws (A) and remove cover assembly (C).
3. Place the adder deck (E) on the basic 4 pole relay (F). The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
4. Place the cover assembly on the adder deck. Tighten 2 cover screws (A).
5. Thread shorter screw (2.50 inches) from adder deck kit through the red T-bar actuator in the cover assembly and tighten. Longer screw (3.75 inches) is not used.

Adding A Deck To An 8 Pole Type XUD Relay

To convert an 8 pole Type XUD relay into a 10-12 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
2. Loosen 2 captive cover screws (A) and remove cover assembly (C).
3. Place the adder deck (E) on the 8 pole relay. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
4. Place the cover assembly on the adder deck. Tighten 2 cover screws (A).
5. Thread longer screw (3.75 inches) from adder deck kit through the red T-bar actuator in the cover assembly and tighten. Shorter screw (2.50 inches) is not used.

Adding Two Decks To Basic 4 Pole Type XUD Relay

To convert a 4 pole Type XUD relay into a 10-12 pole relay:

1. Loosen and remove T-bar actuator screw (B) from cover assembly (C) and discard.
2. Loosen 2 captive cover screws (A) and remove cover assembly (C).
3. Place the first adder deck (E) on the 4 pole relay. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
4. Place the second adder deck (E) on the first adder deck. The adder deck is keyed for proper orientation. Tighten 2 deck mounting screws (G).
5. Place the cover assembly on the upper deck. Tighten 2 cover screws (A).
6. Thread longer screw (3.75 inches) from either adder deck kit through the red T-bar actuator in the cover assembly and tighten. Shorter screw (2.50 inches) is not used.

Supersedes 531AS dated July, 1982

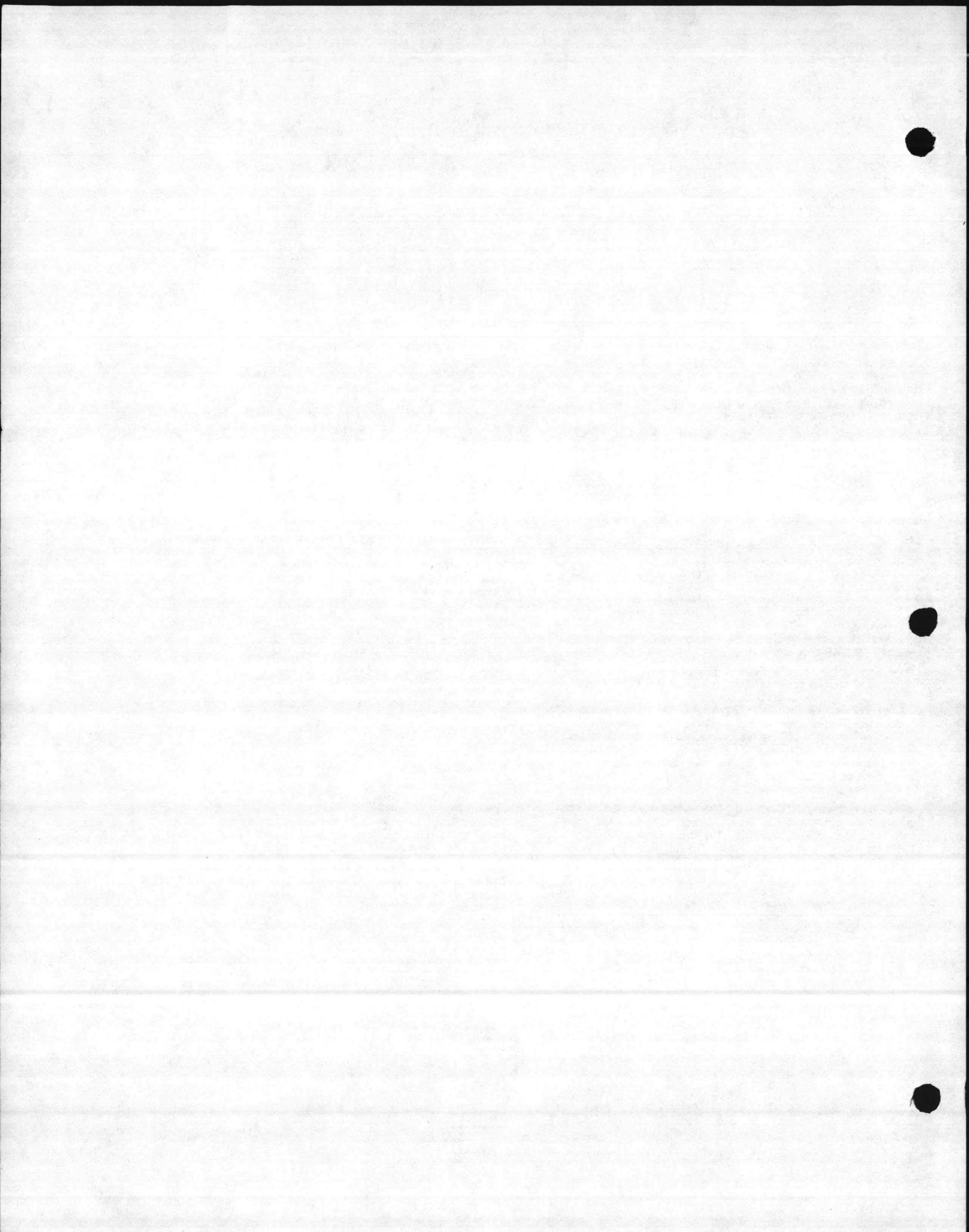
SQUARE D COMPANY

P.O. Box 472
Milwaukee, Wis. 53201-0472
(414) 332-2000

PRINTED IN U.S.A. CPO

PAGE 4

MARCH, 1983





Class 8501 Types XTE and XTD — Pneumatic Timer Attachments — Series A

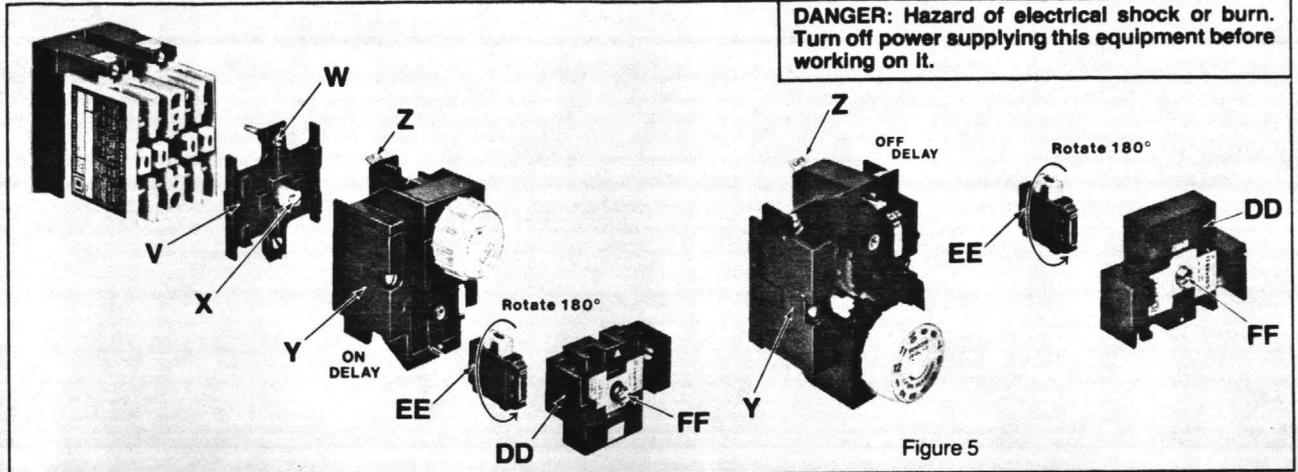


Figure 5

INSTALLATION

- To add a timer attachment to a 0-4 pole relay:
1. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B) (Figure 2, page 2). Remove cover assembly (C) and discard.
 2. Install adapter assembly (V) on relay (Figure 5). Adapter assembly is keyed for proper orientation. Tighten 2 captive screws (W) and T-bar actuator screw (X). Refer to Table 7 for factory-recommended tightening torques.
 3. Orient timer attachment (Y) with "LIFT" tab (Z) on top as shown in Figure 5. Place timer attachment on relay and slide down. Timer attachment will lock in place.
- To remove timer attachment, lift up on "LIFT" tab (Z), slide attachment up and lift off.

TIMING-MODE CONVERSION (Figure 6)

1. Loosen 2 captive screws (AA).
2. Remove timing head (BB) and rotate 180°.
3. Carefully replace timing head (BB). Make sure that the 2 screws (AA) are lined up with D-shaped posts (CC). Tighten 2 screws (AA).
4. Check timing-mode (ON DELAY or OFF DELAY) visible through a window in the cover (DD Figure 5) to insure that the desired timing-mode is indicated.
5. With timer attachment installed on relay, check contact symbols which are visible through windows in the cover (DD Figure 5) to insure that the desired function is indicated.

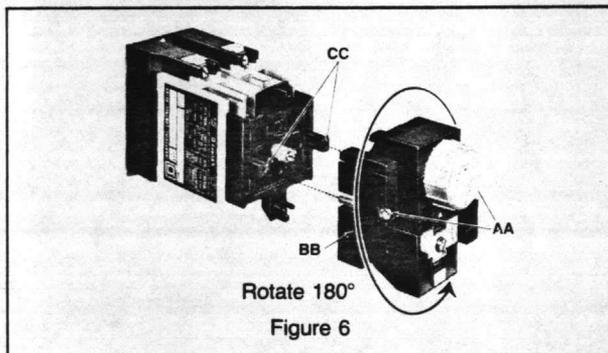


Figure 6

TABLE 7 — FACTORY-RECOMMENDED TIGHTENING TORQUES

Item	Description	Driving Torque (in-lb)
W	Adapter assembly screw	9-11
X	T-bar actuator screw	6-9
AA	Timing-head screw	6-9
FF	Contact-cover screw	9-11

TIMED-CONTACT CONVERSION (Figure 5)

1. Loosen captive cover screw (FF) and remove cover (DD).
2. Remove cartridge (EE), rotate so that the contact symbols and colors are reversed from their original positions, and reinsert.
3. Replace cover (DD) and tighten cover screw (FF). Refer to Table 7 for factory-recommended tightening torques.
4. With the timer attachment installed on relay, check contact symbols which are visible through windows in the cover (DD) to insure that the desired function is indicated.
5. Must have 2 cartridges in any combination of N.O. or N.C. installed in timer attachment for proper operation.

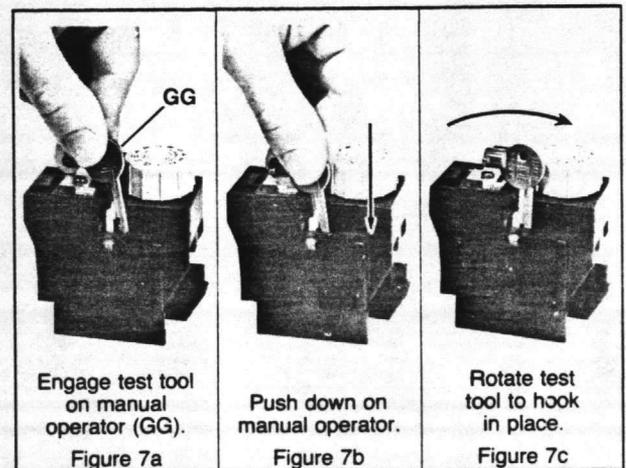
MANUAL OPERATION (Figure 7)

WARNING: Manual operation should be performed only by QUALIFIED personnel. Manual operation with the power turned on is dangerous because of possible electric arcing, burn or shock — REMAIN ALERT!

Type XT timing relays can be manually operated by depressing the red manual operator (GG) with an insulated tool. A manual test tool is available (Table 1 page 1) that simplifies the checking of control circuits without power on the coil. To use, follow steps shown in Figure 7.

Note — when used with the Type XT timing relay, the manual test tool is **not** twisted like a key.

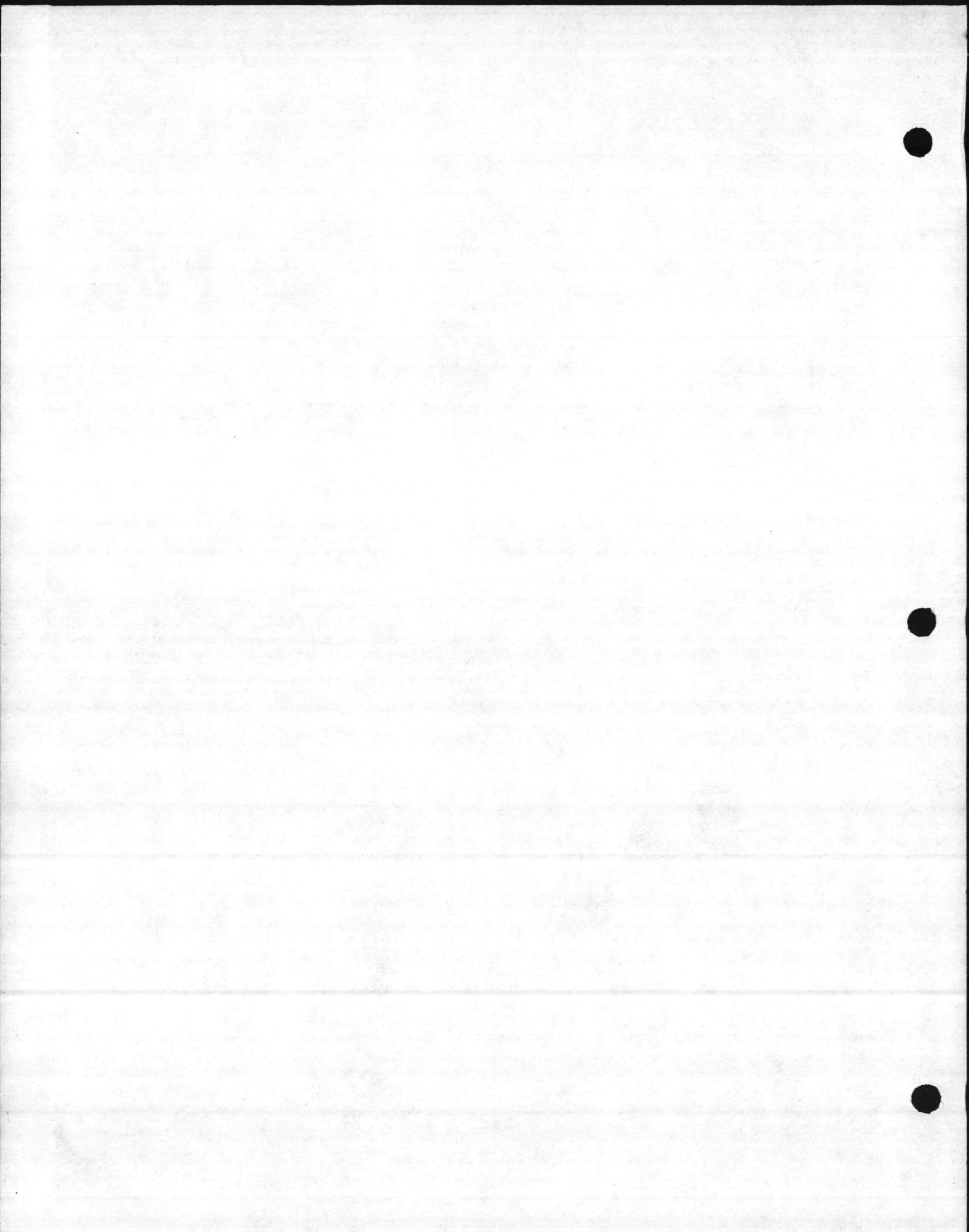
Manual test tool must be removed before normal operation of the timing relay.



Engage test tool on manual operator (GG).
Figure 7a

Push down on manual operator.
Figure 7b

Rotate test tool to hook in place.
Figure 7c





Class 8501 Type XL — AC Latch Attachment — Series A
Class 8501 Type XDL — DC Latch Attachment — Series A

DANGER: Hazard of electrical shock or burn. Turn off power supplying this equipment before working on it.

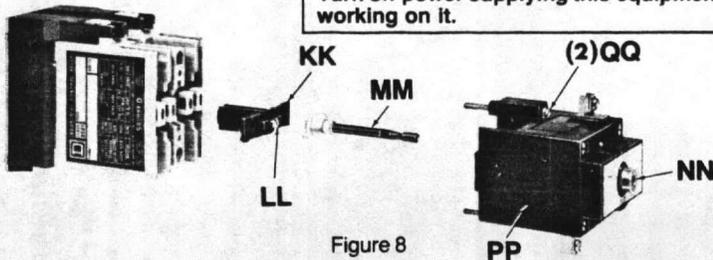


Figure 8

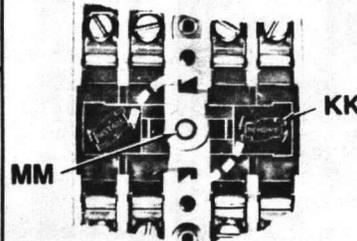


Figure 9

INSTALLATION

To add a latch attachment to any 2-8 pole Type X or XD relay:

- See Figure 2, page 2. Loosen 2 captive cover screws (A) and captive T-bar actuator screw (B). Remove cover assembly (C) and discard.
- If adding latch attachment to 2-4 pole relay, proceed to Step 3. If adding latch attachment to a 6-8 pole relay, remove short screw (1.25 inches) from black T-bar actuator (KK Figure 8), discard and replace with longer screw (2.50 inches) supplied separately with latch attachment.
- Install black T-bar actuator (KK) from latch attachment on relay (Figure 8). T-bar actuator is keyed for proper orientation. Tighten T-bar actuator screw (LL). Refer to Table 8 for factory recommended tightening torques.
- Place latch rod assembly (MM) on T-bar actuator (Figure 9) and rotate 90° clockwise to lock under mounting feet on T-bar actuator.
- Push down on latch armature ring (NN) and hold (Figure 8). Slide latch attachment (PP) on to latch rod assembly (MM) and relay. Latch attachment is keyed for proper orientation. Release latch armature ring (NN).
- Tighten 2 mounting screws (QQ).
- Manually operate (see below) to check operation.

UNLATCH COIL REPLACEMENT

- Remove latch attachment by loosening 2 mounting screws (QQ, Figure 8), and lifting off attachment.
- Loosen 4 captive screws (RR) and remove cover (SS) (Figure 11).
- Remove latch mechanism (TT).
- Lift out unlatch coil (UU) and replace. Do not remove magnet frame (VV).
- Push down and hold latch armature ring (NN) and replace latch mechanism (TT). Release latch armature ring.
- Replace cover and tighten 4 screws (RR).
- Manually operate (see left) to check operation.
- Replace latch attachment (see steps 5-7 "Installation" at left).

WARNING: Manual operation should be performed only by QUALIFIED personnel. Manual operation with the power turned on is dangerous because of possible electric arcing, burn or shock — REMAIN ALERT!

MANUAL OPERATION OF LATCHING RELAY (FIGURE 10)

- To manually latch relay, depress latch rod (MM) with small insulated tool.
- To manually unlatch relay, depress latch armature ring (NN) with small insulated tool.

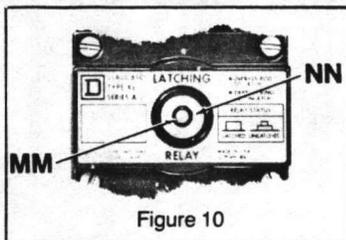


Figure 10

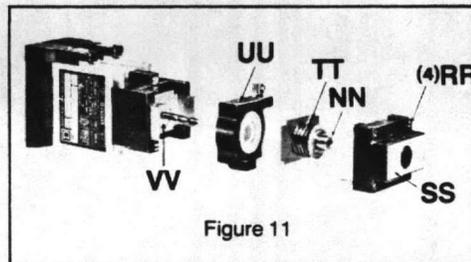


Figure 11

TABLE 8 — FACTORY-RECOMMENDED TIGHTENING TORQUES

Item	Description	Driving Torque (in-lb)
LL	T-bar Actuator Screw	6-9
QQ	Latch-Attachment Mounting Screws	9-11
RR	Cover Screws	6-9

NOTE: Do not use ac unlatch coils on dc latch attachments or dc unlatch coils on ac latch attachments. Class 8501 Type XL and XDL latch attachments cannot be converted from ac to dc operation or vice versa.

TABLE 9 — AC UNLATCH COILS

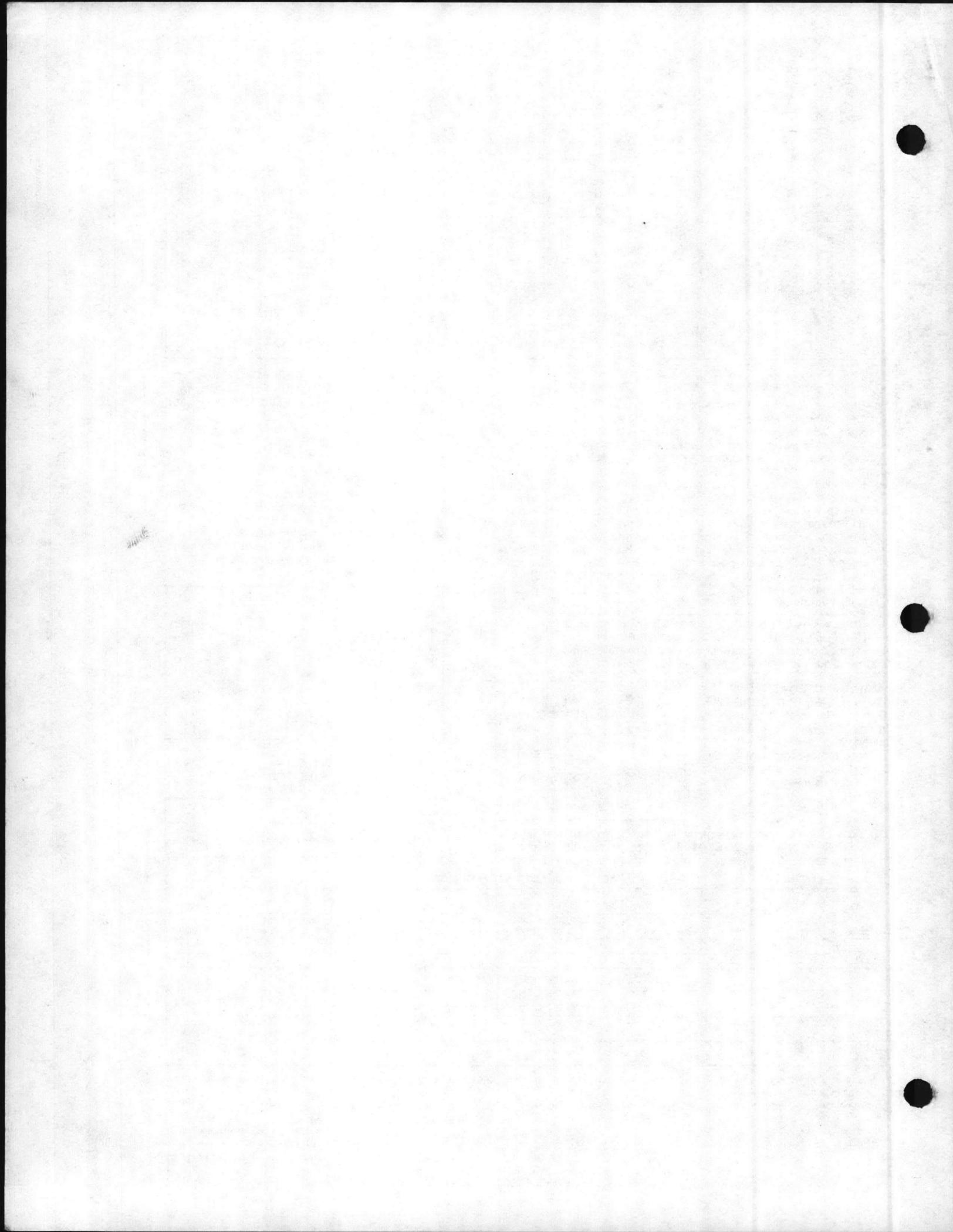
Coil Prefix	Hertz	SUFFIX NUMBERS (Coil part numbers consist of coil prefix followed by suffix number)													Coil Volt-Amps	
		12 Volts	24 Volts	48 Volts	110 Volts	120 Volts	208 Volts	220 Volts	240 Volts	277 Volts	440 Volts	480 Volts	550 Volts	600 Volts	In-Rush	Sealed
Class 9998 Type XL	60	14	23	32	...	44	51	...	53	55	...	62	...	65	25	12
	50	15	24	33	44	53	62	...	65	...	24

TABLE 10 — DC UNLATCH COILS

Coil Prefix	SUFFIX NUMBERS (Coil part numbers consist of coil prefix followed by suffix number)											Coil Watts
	6 Volts	12 Volts	18 Volts	24 Volts	32 Volts	48 Volts	64 Volts	72 Volts	90 Volts	115/125 Volts	230/250 Volts	
Class 9998 Type XDL	19	28	34	37	40	46	49	52	55	58	67	36

Heavy-duty, molded coils are used. These coils are designed to operate on line-voltage fluctuations as much as 15% (20% for dc) below and 10% above nominal voltage.

When ordering replacement magnet coil give Class and Type Number, voltage and frequency of coil being replaced.



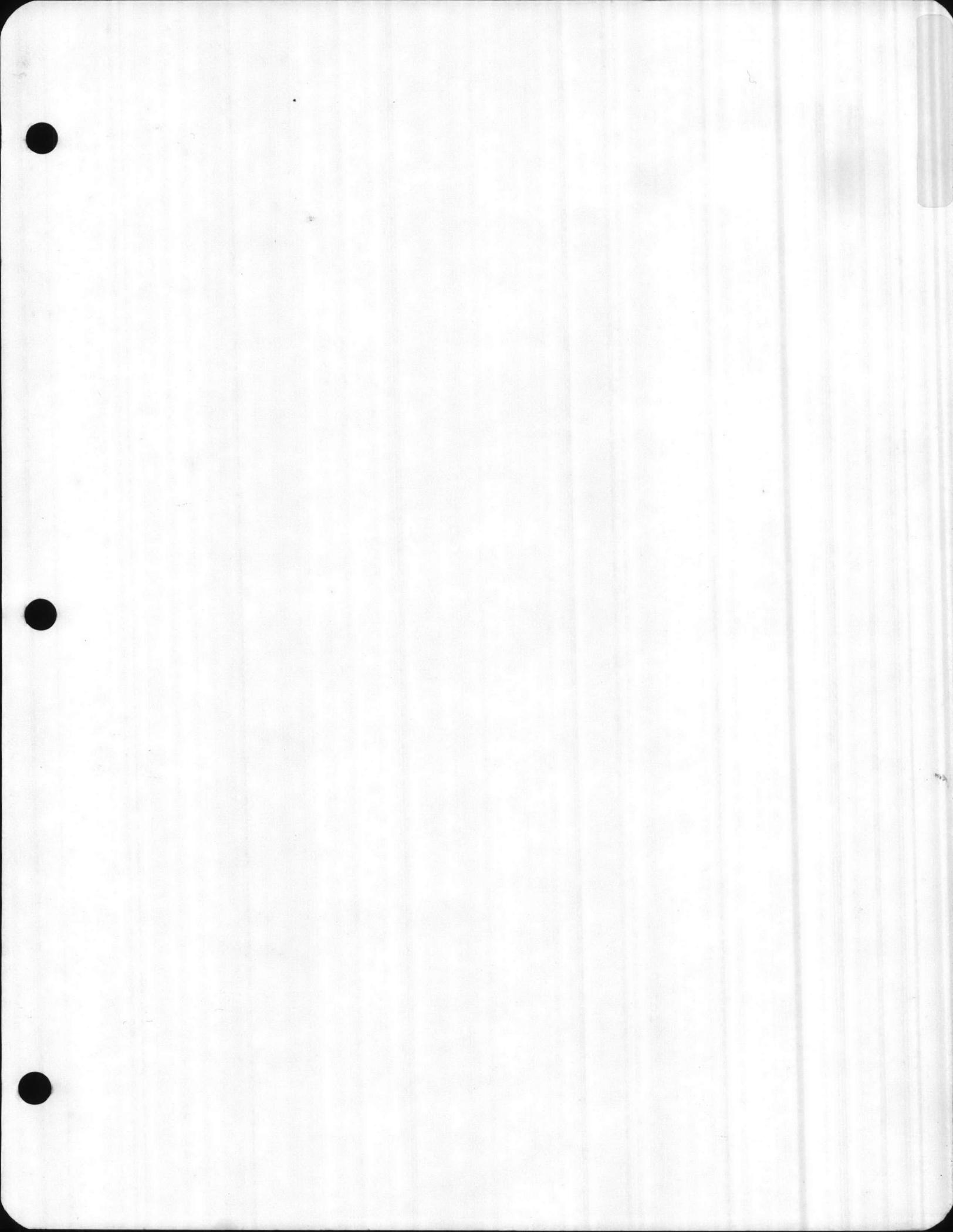
TAB PLACEMENT HERE

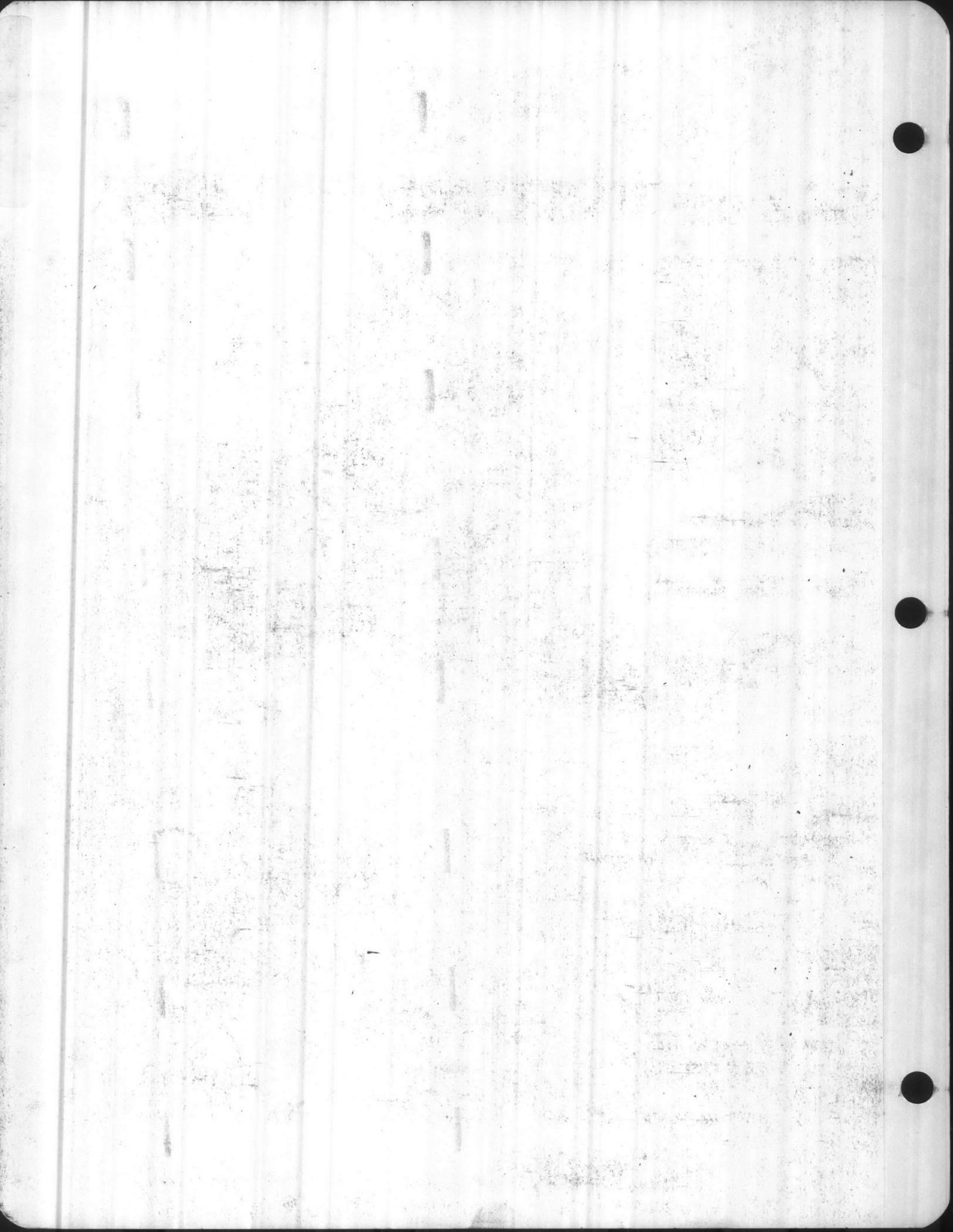
DESCRIPTION:

N/A

Tab page did not contain hand written information

Tab page contained hand written information
*Scanned as next image

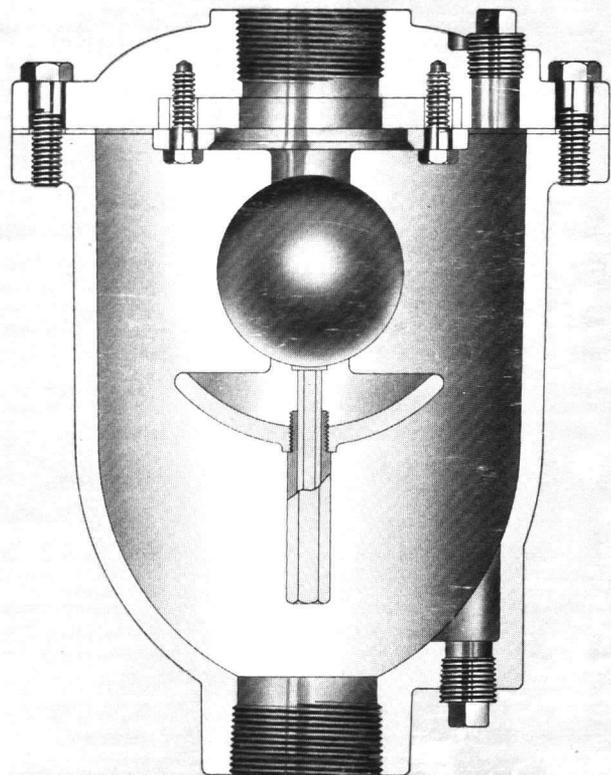




AIR and VACUUM VALVES

FOR HIGH CAPACITY
VENTING & PIPELINE
PROTECTION

Exclusive
**STAINLESS STEEL
TRIM-STANDARD**



- ALL S.S. TRIM ELIMINATES DESTRUCTIVE ELECTROLYTIC ACTION WHICH CAN OCCUR WHEN DISSIMILAR METALS SUCH AS S.S. & BRONZE ARE USED TOGETHER

Other Features

- FULL PORTED VALVES — NO RESTRICTIVE AREAS
- STAINLESS STEEL TRIM ASSURES LOW MAINTENANCE
- STAINLESS STEEL FLOATS UNCONDITIONALLY GUARANTEED
- COMPLETE INTERCHANGEABILITY OF ALL PARTS
- RUGGED CAST IRON BODY AND COVER
- SYNTHETIC SEATING ASSURES DROP TIGHT SEAL AT VERY LOW PRESSURES
- EASILY MAINTAINED WITHOUT SPECIAL TOOLS

WHY YOU SHOULD USE VAL-MATIC AIR & VACUUM VALVES

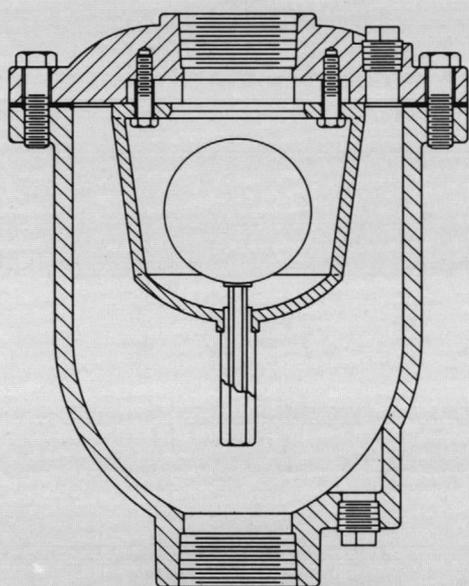
These valves perform two important functions when mounted at high points on pipe lines.

First of all, they allow large quantities of air within the line to be exhausted as that line is being filled. When the air has been vented and the fluid level reaches the valve, the float rises and seals tightly against a synthetic seat.

Secondly, in the event of the line being drained, either inten-

tionally or through a fracture in the system, the valve responds to the loss of pressure and opens. This allows air to re-enter the pipeline and prevents a potentially damaging vacuum from developing.

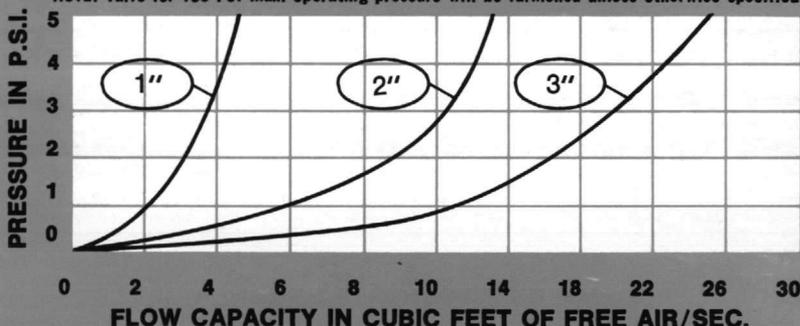
NOTE: These valves, by their nature, do not open under pressure to exhaust small quantities of air which may collect at high points while the system is in operation. Air release valves are required for this function. (See Bulletin No. 15)



THREADED INLET

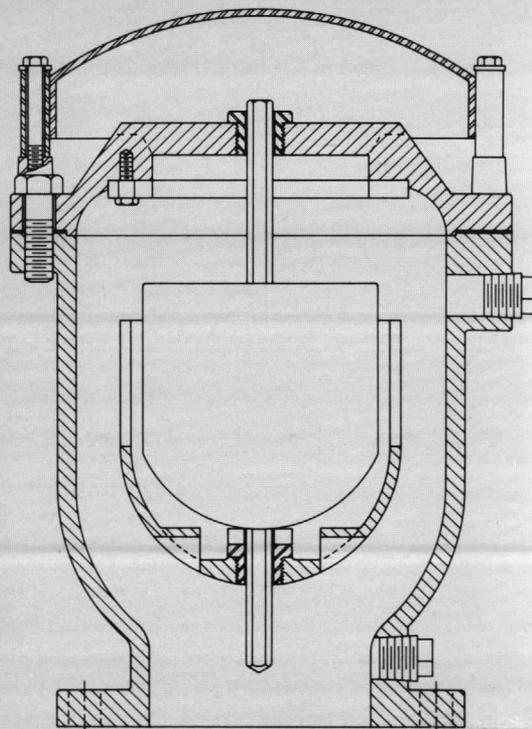
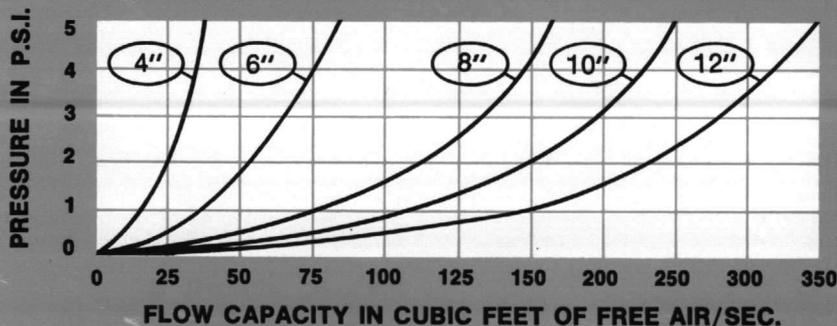
MODEL NO.	HEIGHT	WIDTH	INLET SIZE	OUTLET SIZE	MAX. W.P.	WT. LBS.
101	9½"	7"	1" NPT	1" NPT	150 PSI	24
					300 PSI	
102	12"	9½"	2" NPT	2" NPT	150 PSI	50
					300 PSI	
103	12"	9½"	3" NPT	3" NPT	150 PSI	55
					300 PSI	

NOTE: Valve for 150 PSI max. operating pressure will be furnished unless otherwise specified.



MODEL NO.	HEIGHT	WIDTH	INLET SIZE	OUTLET SIZE	MAX. W.P.	WT. LBS.
104	17"	12"	4" FLG.	4"	150 PSI	105
					300 PSI	
106	20"	14"	6" FLG.	6"	150 PSI	160
					300 PSI	
108	23"	18"	8" FLG.	8"	150 PSI	208
					300 PSI	
110	26"	20"	10" FLG.	10"	150 PSI	370
					300 PSI	
112	31"	24"	12" FLG.	12"	150 PSI	590
					300 PSI	

AVAILABLE IN 125 LB. FLG. OR 250 LB. FLG.



FLANGED INLET

DISTRIBUTED BY



VAL-MATIC

VALVE AND MANUFACTURING CORP.
8448 WEST 45th STREET • LYONS, ILLINOIS 60534
(Area Code 312) 447-1990

PRINTED IN U.S.A.

VAL-MATIC AIR AND VACUUM VALVES

Operation, Installation and Maintenance

The Val-Matic Air & Vacuum Valves are fully automatic valves and require no regular maintenance.

The purpose of the Air & Vacuum Valve is to exhaust large quantities of air during the filling of a pipeline and to allow air to re-enter the system during the draining. This re-entry of air prevents a potentially damaging vacuum from developing.

OPERATION: The valve, as shipped, is a normally open valve. As the system is being filled, air is exhausted thru the valve discharge. When the fluid enters the valve, the float raises and shuts off the discharge port, preventing any leakage. The valve will remain closed during system operation and will only open to allow air to re-enter the system when drained intentionally or due to a fracture in the system.

INSTALLATION: Air & Vacuum Valves should be installed in a vertical position at high points on a piping system. A vault with adequate venting and drainage should be provided. A full ported shut-off valve should be installed below each valve in the event servicing is required.

MAINTENANCE: No regular maintenance is necessary; however, periodic inspection for leakage and function can be performed. A gate valve may be installed in the valve drain plug to perform this operation. First, close the inlet shut-off valve. Then open the drain valve on the Air & Vacuum Valve to allow the valve to drain. Now, by closing the drain and opening the inlet shut-off valve slowly, the function and seating can be observed. If the valve does not function properly or leaks, the valve should be removed and inspected for wear and or possible damage from foreign matter.

Replacement parts can be ordered from the enclosed drawings and bill of materials.

USER: MARINE CORPS. BASE
LOCATION: CAMP LEJEUNE, NC
PERMUTIT JOB NO.: A141E-39857

OPERATION, INSTALLATION AND MAINTENANCE

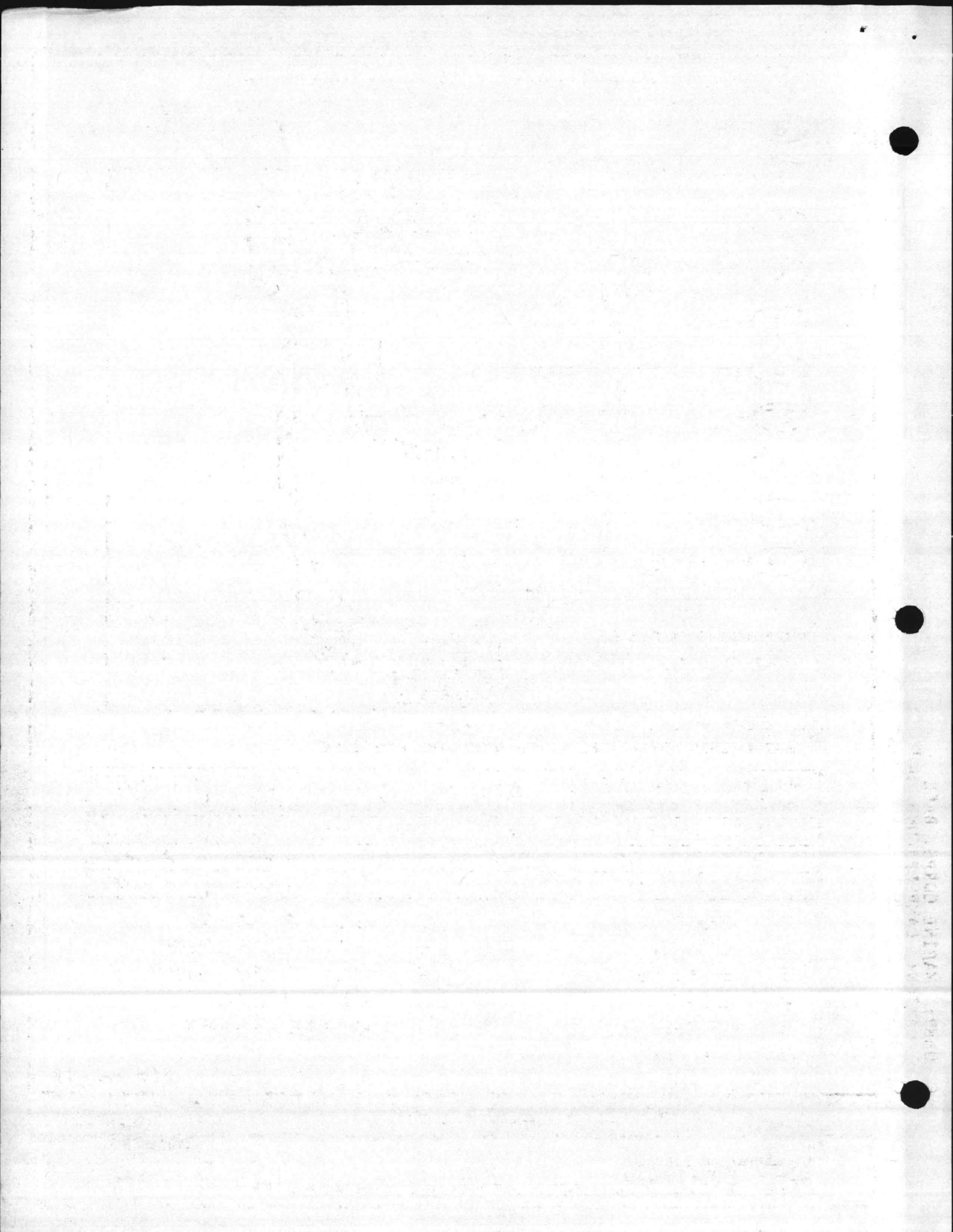
DATE
7-22-69

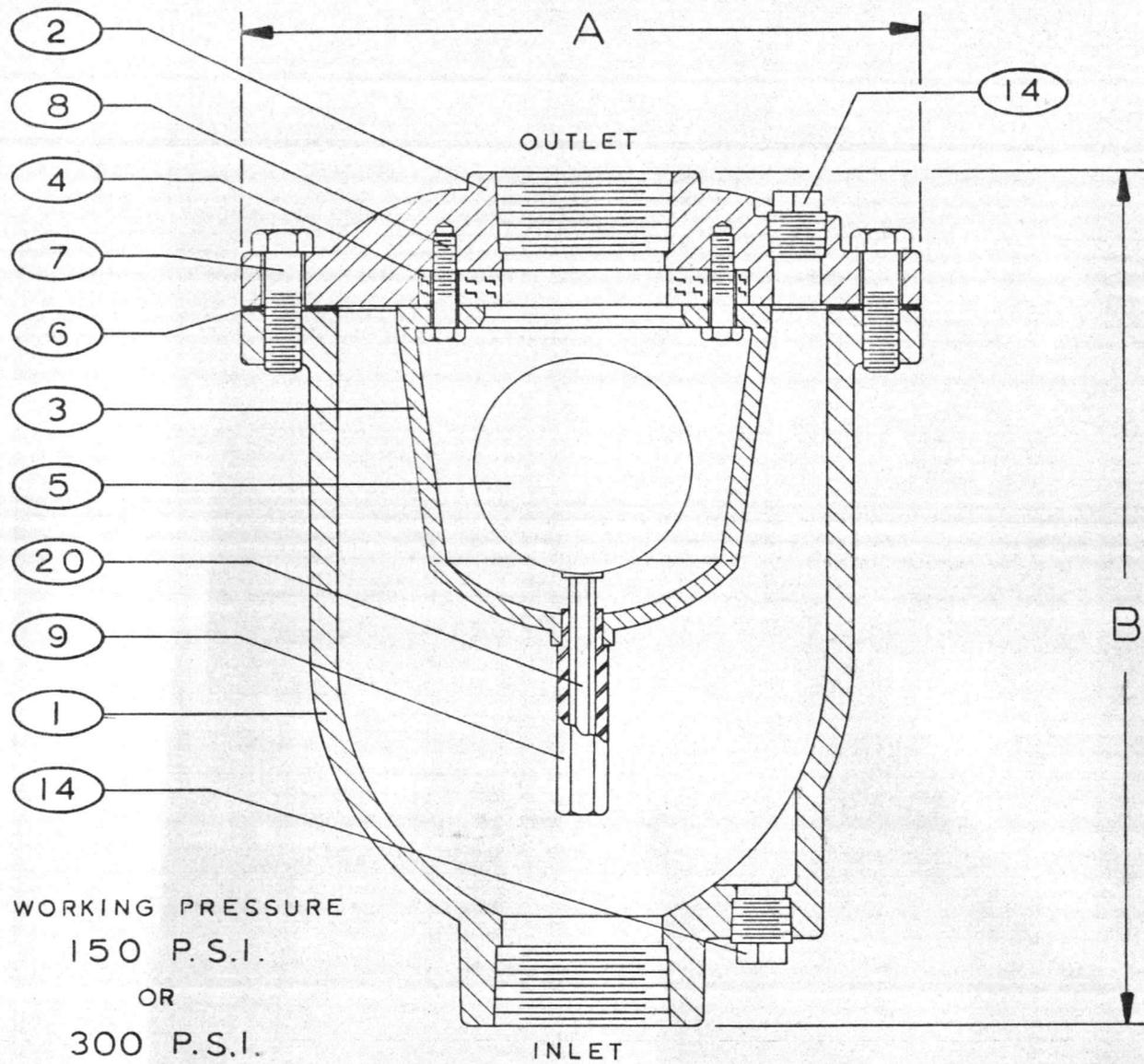
VAL-MATIC

VALVE AND MANUFACTURING CORP.

DRWG. NO.

VM-AV-1





WORKING PRESSURE
 150 P.S.I.
 OR
 300 P.S.I.
 TEST PRESSURE - MIN. 1.5 TIMES WORKING PRESSURE

VALVE SIZE	VALVE NO.	A	B	INLET SIZE	OUTLET SIZE
1"	101	7"	9 1/2"	1" N.P.T.	1" N.P.T.
2"	102	9 1/2"	12"	2" N.P.T.	2" N.P.T.
3"	103	9 1/2"	12"	3" N.P.T.	3" N.P.T.

- | | | | |
|---|--------|----|---------------|
| 1 | BODY | 7 | COVER BOLT |
| 2 | COVER | 8 | BAFFLE SCREW |
| 3 | BAFFLE | 9 | GUIDE BUSHING |
| 4 | SEAT | 14 | PIPE PLUG |
| 5 | FLOAT | 20 | GUIDE SHAFT |
| 6 | GASKET | | |

REV. 6-14-78

AIR AND VACUUM VALVES

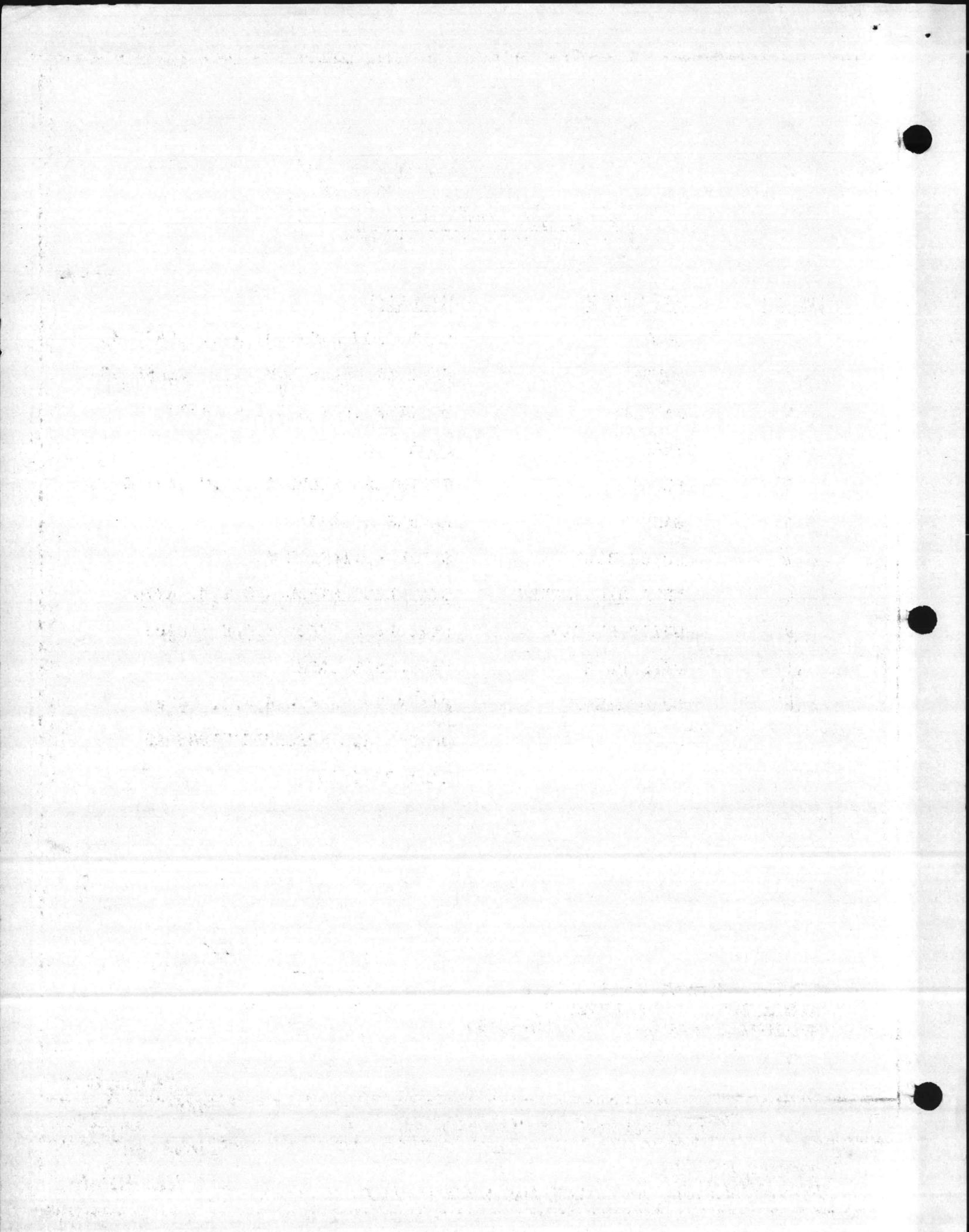


VALVE AND MANUFACTURING CORP.

DATE 4-18-69

DRWG. NO. VM-101

USER: MARINE CORPS. BASE
 LOCATION: CAMP LEJEUNE, NC
 PERMUTIT JOB NO.: A141E-39857



VALVE NOS. 101 - 102 - 103

<u>PART NO.</u>	<u>PART NAME</u>	<u>MATERIAL</u>
1	BODY	CAST IRON A.S.T.M. A48, CLASS 35
2	COVER	CAST IRON A.S.T.M. A48, CLASS 35
3	BAFFLE	DUCTILE IRON A.S.T.M. A536
4	SEAT	BUNA - N
5	FLOAT	STAINLESS STEEL A.S.T.M. A-240
6	GASKET	RAYBESTOS #73
7	COVER BOLT	STEEL - #1035 H.T.
8	RETAINING SCREW	STAINLESS STEEL A.S.T.M. A276
9	GUIDE BUSHING	STAINLESS STEEL S.A.E. 30303
14	PIPE PLUG	MALLEABLE IRON
20	GUIDE SHAFT	STAINLESS STEEL S.A.E. 30303

NOTE: ALL SPECIFICATIONS AS
LAST REVISED.

USER: MARINE CORPS. BASE
LOCATION: CAMP LEJEUNE, NC
PERMUTIT JOB NO.: A141E-39857

REV. 11-28-77

MATERIALS OF CONSTRUCTION

DATE
4-18-69

VAL-MATIC

VALVE AND MANUFACTURING CORP.

DRWG. NO.

VM-101-M

