Site Operation and Maintenance Plan

Volume II of II

McKesson Envirosystems
Bear Street Facility
Syracuse, New York

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BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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Appendix F
Manufacturer's Specifications and/or Operation Manuals

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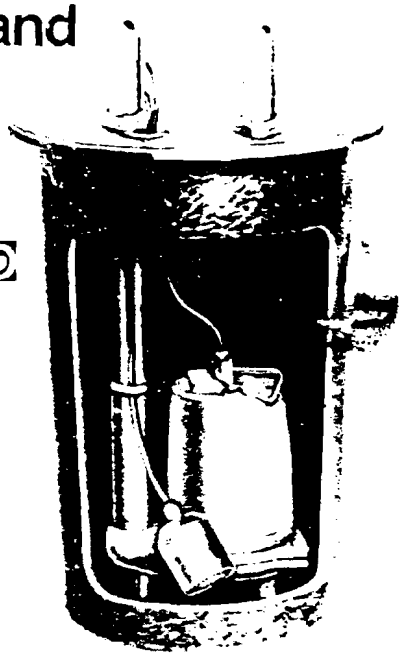
Collection Sump Submersible Pump

Installation and Operation Instructions

Goulds

MODELS

3885
3885D
3886
3886D



IMPORTANT

1. Inspect unit for damage. Report damage to carrier.
2. Electrical supply must be a separate branch circuit with proper fuses or circuit breakers, wire size, etc., conforming to National and Local Electrical Codes. Power supply voltage, phase and controls must match pump nameplate.
3. **Always** disconnect electrical power supply when handling pump or controls.
4. Do **not** use pump in swimming pools or hazardous liquids.
5. Liquid temperature not to exceed 160°F. (71°C)
6. Do **not** remove ground prong or use extension cords.
7. Use Goulds Pumps accessories.

Pump & Piping

1. Thread discharge pipe into discharge connection. If a check valve is used try to avoid installing it vertically. Position horizontally or at a 45° angle with valve pivot on top. This guards against small solids lodging on valve preventing it from opening. Drill a 3/16" hole in discharge pipe 2" above pump discharge connection to prevent air locking the pump. A gate valve should be installed in the system, after the check valve, to permit removal of pump or check valve for servicing. A union should be installed between check valve and pump.
2. **Rotation:** Check rotation after wiring is complete. Rotation must be counter-clockwise looking into pump suction.
   Caution: Do not feel for rotation. Will cause severe injury.
3. **Single-phase** pumps have built-in thermal overload protection with automatic reset. **Three-phase** units must be protected by a starter with proper overload protection:

Furnas Overloads Sizes Starter Size 00, 14BF32BCB1				
HP, Ph., Volts	HP	Volts	Heaters	
			E	K
0532	½	230	E41	K32
0534		460	E29	K22
0732	¾	230	E48	K39
0734		460	E38	K28
1032	1	230	E51	K43
1034		460	E41	K32
1532	1½	230	E55	K50
1534		460	E46	K36

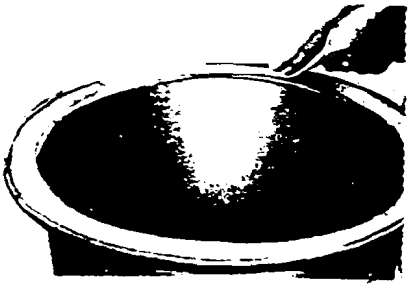
Basin

Basin should have a sturdy bottom to give legs of pump adequate support. Leg height elevates pump above bottom of basin to allow effluent reach suction opening.

When using basins without hubs, attach 4" cast iron inlet hub as required. For duplex basins seal second hub if not used.

Basin Cover

Remove protective strip from gasket and press onto recessed portion of basin rim. With a pointed tool, poke holes through gasket into tapped holes. Do not damage threads. Route electrical cords through appropriate opening in basin cover.



Fit basin cover over discharge pipe. Power cords are sealed with split rubber stopper. Rubber ring is placed over discharge pipe and compressed between pipe and cover by the flange (chamfered side down) to form a seal. Thread vent pipe into flange on basin cover.

Manual Operation

On pumps equipped with a molded plug, insert into a suitable outlet controlled by a switch. If a separate controller is used, turn "Hand-Off-Auto" switch to "Hand" operation.

Automatic Operation

1. Diaphragm Control Switch: A pressure activated switch providing automatic operation with 6" differential in liquid level. Turns on when liquid is 10" above bottom of switch and turns off at 4" above bottom of switch.

Caution: This switch has a vent tube which must be unobstructed and protected from moisture, dirt, etc. Mount power cord so vent tube hangs down.

NOTE: ⅓-½HP, 1ϕ pumps require Switch only.
¾-2HP, 1ϕ pumps require a Contactor.
All 3ϕ pumps require a Mag Starter.

2. Mercury Switches: Single float switches. As the liquid-level rises and falls, the float changes angle until the mercury switch makes or breaks circuit. See NOTE 1A above.

Float Switch Model	Application	HP Range	Electrical Rating	Wir Cor ura
A2-3	Pilot Duty	⅓-5	Single or Three Phase w/Contactor or Starter	Bar Lea
A2-5	Direct Connection, Differential Level	⅓-½	115 V.1 Phase	3-P Ser Plu
A2-6		⅓-¾	230 V.1 Phase	
A2-7	Pilot Duty, Differential Level	⅓-5	Single or Three Phase w/Contactor or Starter	Ba Le
A2-9	Direct Connection, Differential Level	⅓-½	115 V.1 Phase	3-F Se Pl

Goulds

Submersible Effluent Pumps

MODEL

3885

AVAILABLE CERTIFICATIONS

ETL LISTED SUBMERSIBLE PUMP
CLASS I AND II DIV. 2 AND
CLASS II DIV. 1 AND 2
ETL TESTING LABORATORIES, INC.
CORTLAND, NEW YORK 13045 G1086131480

CANADIAN STANDARD ASSOCIATION

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Farms
- Trailer courts
- Motels
- Schools
- Hospitals
- Industry
- Effluent systems

SPECIFICATIONS

Pump:

- Solids handling capabilities: ¾" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 114 GPM.
- Total heads: up to 123 feet TDH.
- Mechanical seal: carbon-rotary seat/ceramic-stationary seat, 300 series stainless steel metal parts, BUNA-N elastomers.
- Temperature: 104°F (40°C) continuous 140°F (60°C) intermittent.
- Fasteners: 300 series stainless steel.
- Capable of running dry without damage to components.

Motor:

- Single phase: ⅓ HP, 115 or 230 V 60 Hz, 1750 RPM; ½ HP, 115V, 60 Hz, 3500 RPM; ½ HP – 1½ HP, 230 V, 60 Hz, 3500 RPM. Built-in overload with automatic reset. Class B insulation.
- Three Phase: ½ HP – 1½ HP 208/230 V, 460 V, 60 Hz, 3500 RPM. Class B insulation, overload protection must be provided in starter unit.
- Shaft: threaded, 400 series stainless steel.
- Bearings: ball bearings upper and lower.
- Power cord: 20 foot standard length (optional lengths available). Single Phase: ⅓ and ½ HP-16/3 SJTO with three prong plug. ¾ – 1½ HP-14/3 STO with bare leads. Three phase: ½ – 1½ HP-14/4 STO with bare leads. On CSA listed models – 20 foot length SJTW and STW are standard.

FEATURES

Impeller: Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balance for smooth operation. Bronze impeller available as an option.

Casing: Cast iron volute type for maximum efficiency. 2" NPT discharge adaptable for slide rail systems.

Mechanical Seal: Ceramic vs carbon sealing faces. Stainless stee metal parts, BUNA-N elastomers.

Shaft: Corrosion-resistant stainless steel. Threaded design. Locknut on three phase models to guard against component damage on accidental reverse rotation.

Motor: Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

Designed for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage.

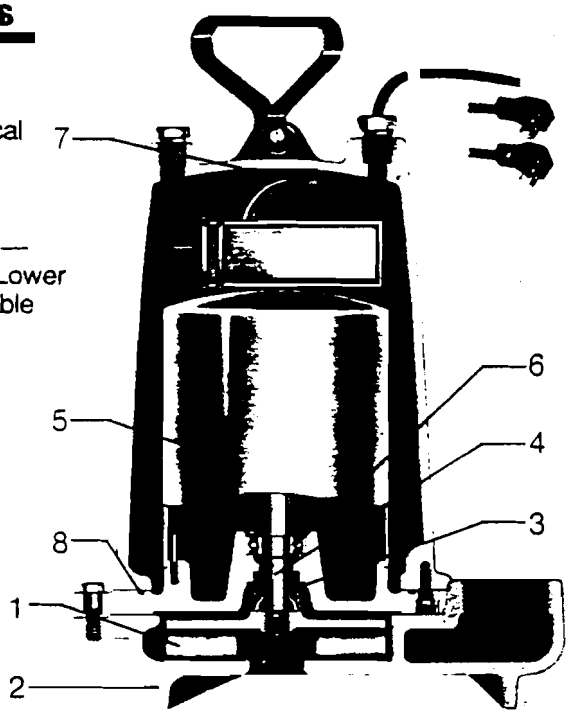
Bearings: Upper and lower hea duty ball bearing construction.

Power Cable: Severe duty rate oil and water resistant. Epoxy seal on motor-end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking.

O-Ring: Assures positive sealin against contaminants and oil leak

FEATURES

1. Impeller
2. Casing
3. Mechanical Seal
4. Shaft
5. Motor
6. Bearings — Upper & Lower
7. Power cable
8. O-Ring



Goulds
Submersible Effluent Pumps

MODEL

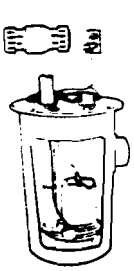
3885

MODELS

Series	HP	Volts	Phase	Max. Amp.	RPM	Solids	Wt. (lbs.)
WE0311L	⅓	115	1	9.4	1750	¼"	56
WE0312L		230		4.7			
WE0311M		115		9.4			
WE0312M		230		4.7			
WE0511H	½	115	1	13.0			60
WE0512H		230		6.5			
WE0532H		208 – 230	3	3.4			
WE0534H		460		1.7			
WE0511HH		115	1	13.0			
WE0512HH		230		6.5			
WE0532HH		208 – 230	3	3.3			
WE0534HH		460		1.65			
WE0712H	¾	230	1	10.0	3500		70
WE0732H		208 – 230	3	5.4			
WE0734H		460		2.7			
WE1012H	1	230	1	12.5			
WE1032H		208 – 230	3	7.0			
WE1034H		460		3.5			
WE1512H	1½	230	1	15.0			80
WE1532H		208 – 230	3	9.2			
WE1534H		460		4.6			
WE1512HH		230	1	15.0			
WE1532HH		208 – 230	3	9.2			
WE1534HH		460		4.6			

EFFLUENT EJECTOR SYSTEM

Effluent ejector system offers ease of ordering and installation. A single ordering number specifies a complete system designed for most residential and commercial sump and effluent pump applications.



Package Includes:
Submersible Effluent Pump, WE0311L, 12L or WE0311M, 12M, WE0511HH, 12HH
Mercury Level Control Switch A2-5 (115V), A2-6 (230V)
Basin A7-1801S
Basin Cover A8-1822
Check Valve A9-2P
Order No.: SWE0311L, SWE0312L, SWE0311M, SWE0312M, SWE0511HH, SWE0512HH.

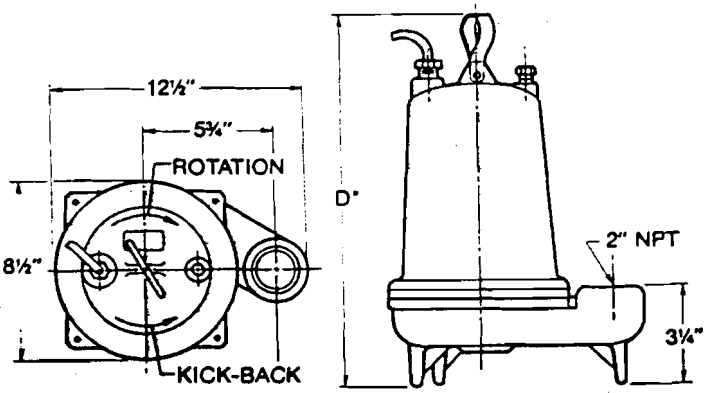
PERFORMANCE RATINGS (gallons per minute)

Series No.	WE0311L WE0312L	WE0311M WE0312M	WE0511H WE0512H WE0532H WE0534H	WE0712H WE0732H WE0734H	WE1012H WE1032H WE1034H	WE1512H WE1532H WE1534H	WE0511HH WE0512HH WE0532HH WE0534HH	WE1512HH WE1532HH WE1534HH
HP	⅓	⅓	½	¾	1	1½	½	1½
RPM	1750	1750	3500	3500	3500	3500	3500	3500
5	100	70	80	90	106	—	60	—
10	80	65	76	87	102	112	56	84
15	60	57	72	84	100	108	53	82
20	36	45	65	79	95	105	48	77
25		25	59	74	91	100	45	75
30			50	67	85	96	40	72
35			40	61	79	92	35	70
40			26	52	72	86	30	67
45			10	43	64	80	25	64
50				30	54	73	18	60
55				17	42	65	12	58
60				6	30	54	3	54
65					16	40		51
70					5	26		47
75						14		43
80						4		40
90								33
100								24
110								15
120								5

Total Head Feet of Water

DIMENSIONS

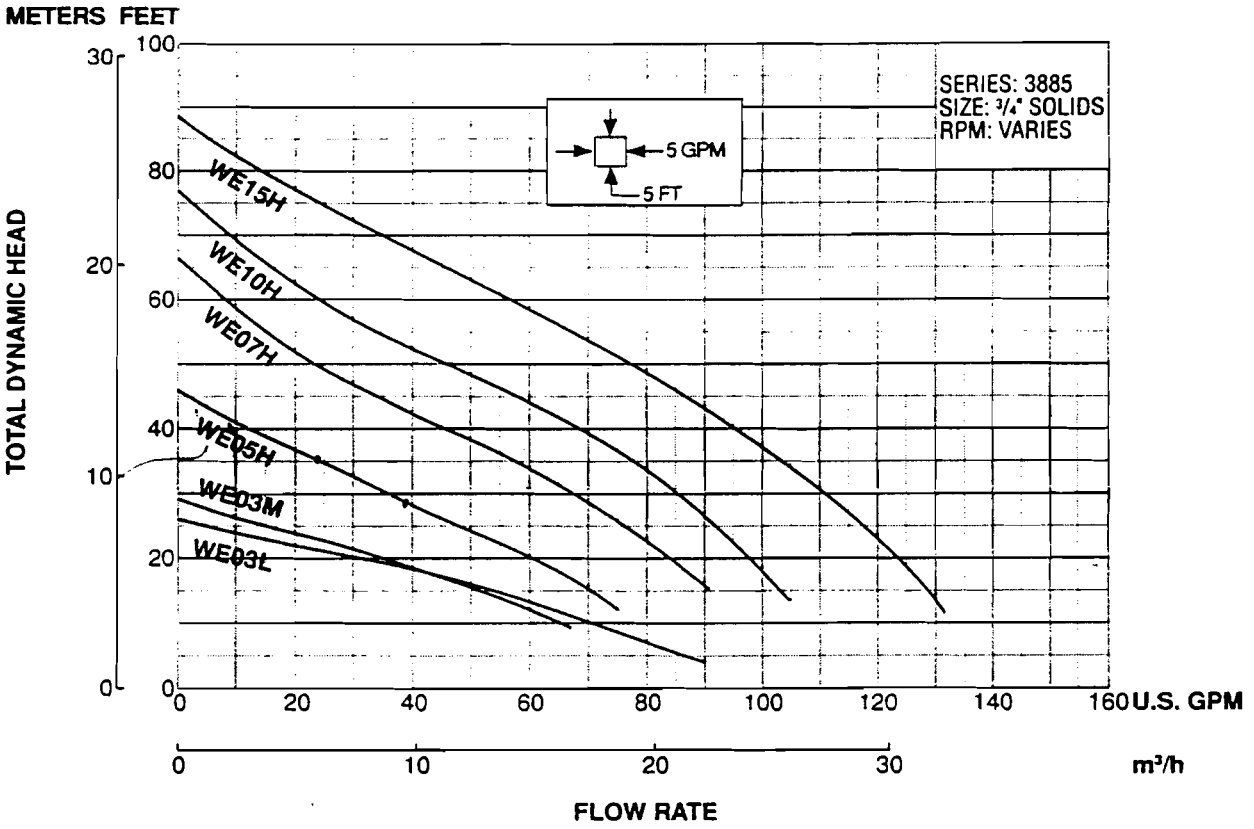
(All dimensions are in inches. Do not use for construction purposes.)



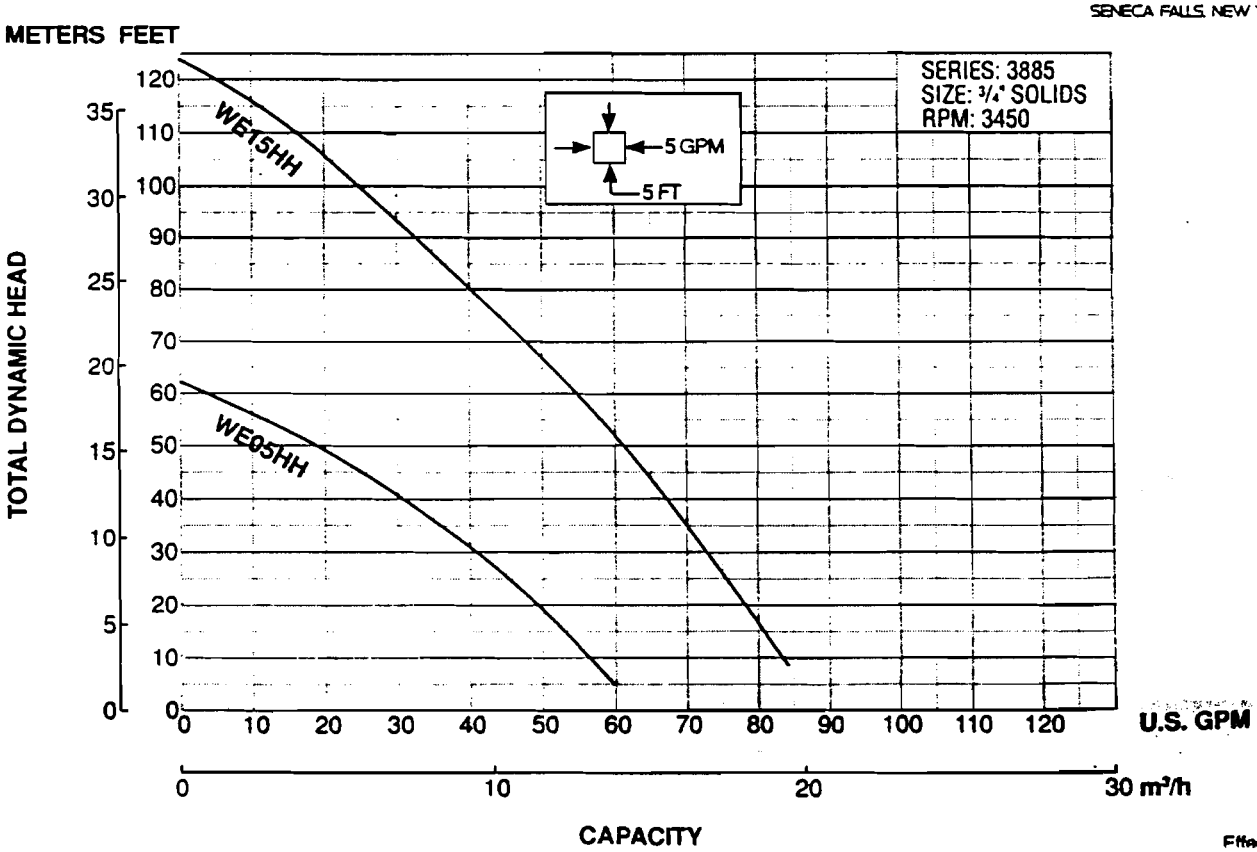
D* ⅓, ½, ¾ and 1 HP = 15" except for model WE0712H and WE1012H = 18"; 1½ HP = 18"

Performance Curves

Submersible Effluent Pumps



GOULDS PUMPS, INC.
WATER TECHNOLOGIES GROUP
SENECA FALLS, NEW YORK 13148

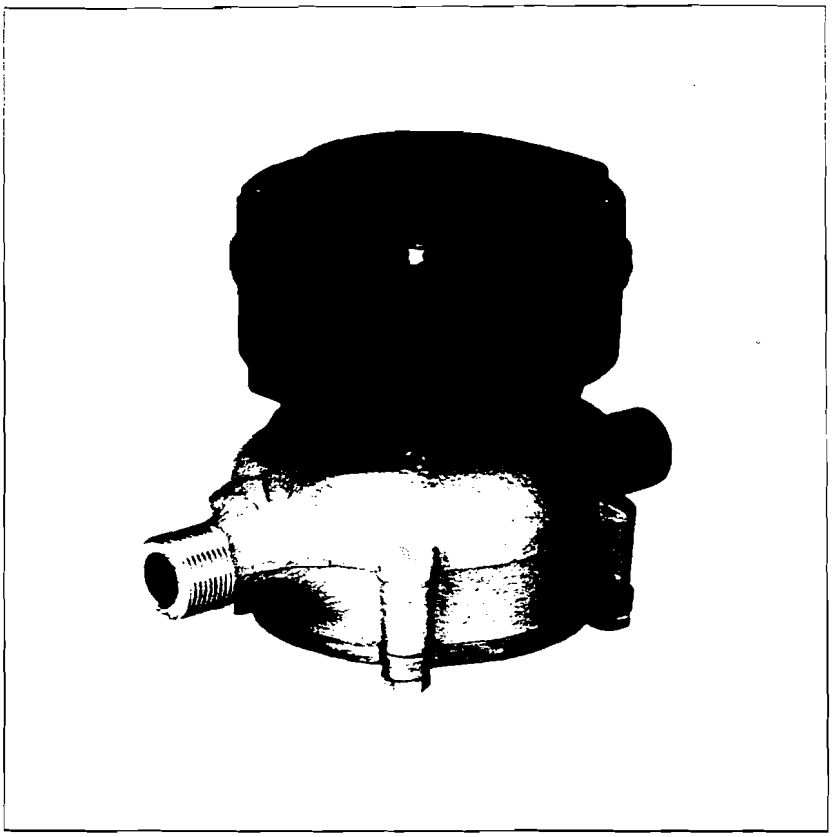


Disc Flow Meter

Model Industrial RCDL

Nutating Disc Meters

Installation & Operation Manual



BadgerMeter,Inc.
Industrial Division

Bulletin No. IOM-067-02
Part No. 53400-067
March 1997

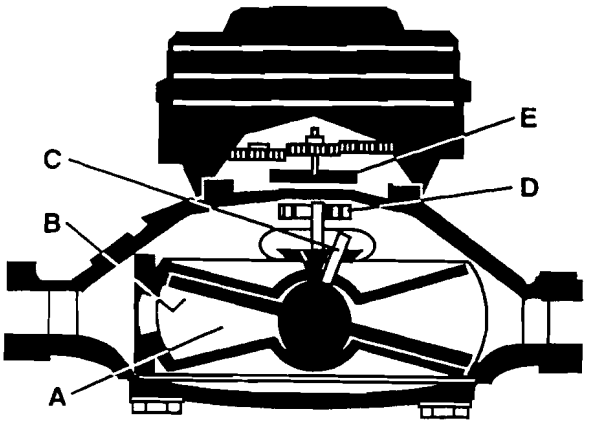
Badger's RCDL positive displacement meters are one of the most cost effective methods in metering industrial fluids. RCDL meter's simple but efficient design assures high accuracy and repeatability over the entire meter flow range.

Available in five sizes, 1/2" through 2" for flows up to 170 GPM, these meters are extremely rugged and reliable. Maintenance is seldom required, but if necessary, takes only a few minutes. All parts are designed and built of materials to meet your application, providing you with long life and a trouble-free, precision flow meter.

To complement the RCDL meter line, Badger offers a complete line of accessories that includes totalizers, electromechanical and electronic transmitters, rate of flow indicators and batch/process controllers.

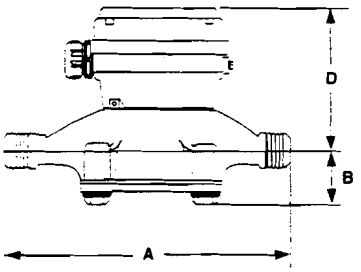
The metering principle, known as positive displacement, is based on the continuous filling and discharging of the measuring chamber. Controlled clearances between the disc and the chamber insure precise measurement of each volume cycle. As the disc nutates, the center spindle rotates a magnet, whose movement is sensed through the meter wall by a follower magnet or by various sensors. Each revolution of the magnet is equivalent to a fixed volume of fluid, which is converted to any engineering unit of measure for totalization, indication or process control.

Figure 1.



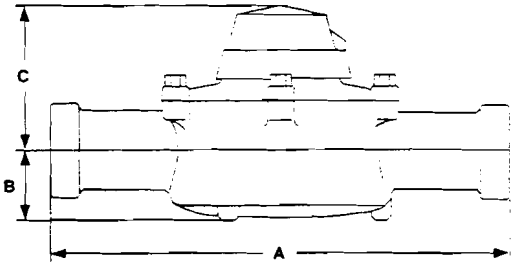
Liquid flowing through the meter chamber (A) causes a disc (B) to nutate or wobble. This motion, in turn, results in the rotation of a spindle (C) and drive magnet (D). Rotation is transmitted through the wall of the meter to a second magnet (E) or varied style of sensor pickup.

Meter with Transmitter



MODEL 25, 35 & 70

Meter with Register



MODEL 120 & 170

Meter Model	Meter Size Inches	Flow Range GPM	Housing Material	End Connections	DIMENSIONS (INCHES) Laying Length A	Center Line to Base B	Register Height C	Transmitter Height D	Approximate Weight Pounds
M 25	5/8	1/2 - 25 1 - 25	BZ or PL Corrosion Resistant Internal	NPT - Male	7.5	1.7	3.3	4.4	5
M 25	3/4	1/2 - 30 1 - 30	BZ or PL Corrosion Resistant Internal	NPT - Male	7.5	1.7	3.3	4.4	5
M 35	3/4	3/4 - 35	BZ	NPT - Male	9.0	1.7	3.6	5.0	6
M 40	1	3/4 - 50	PL	NPT - Male	10.75	1.9	3.8	5.5	5
M 70	1	1 - 70 5 - 70	BZ or PL Corrosion Resistant Internal	NPT - Male	10.75	2.3	4.2	5.6	12
M 120	1 1/2	2 - 120	BZ	NPT - Female	12.62	2.4	4.6	6.0	20
M 170	2	2 - 170	BZ	NPT - Female	15.25	2.9	5.1	6.5	30

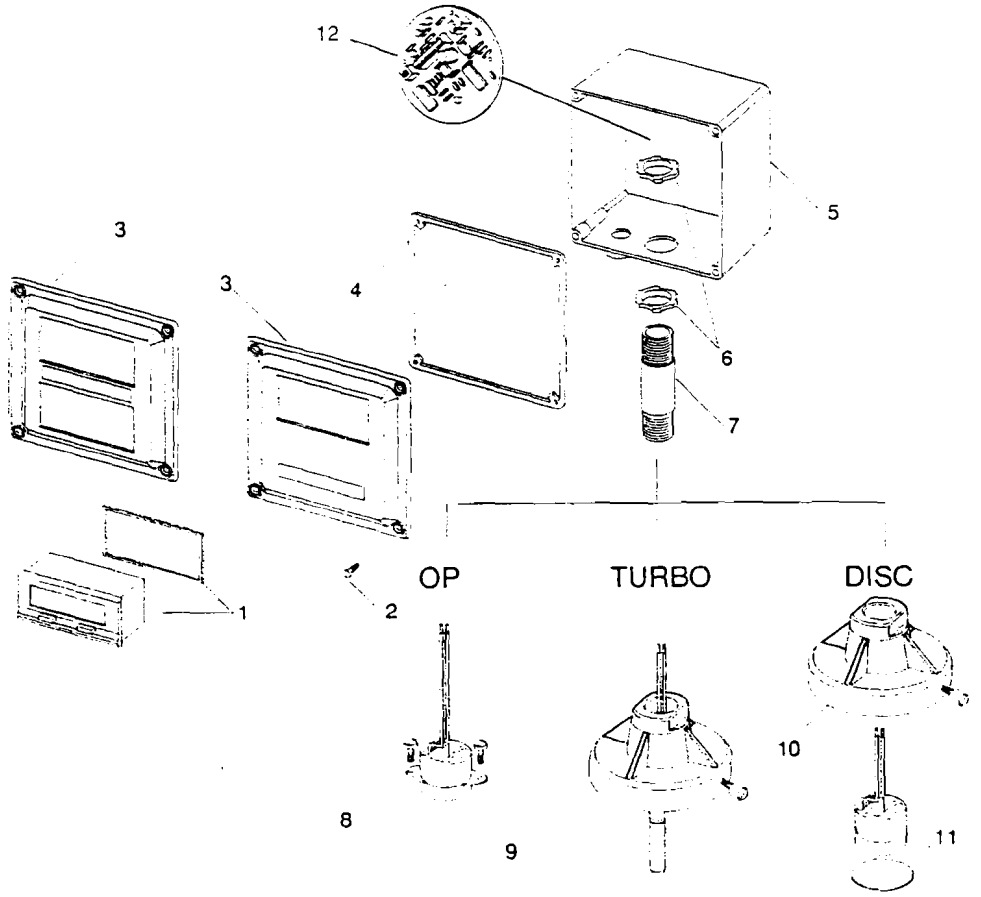
BZ = Bronze; PL = Plastic

Model 25 and Model 70 are available with optional corrosion resistant internals: temperature limit with this option is increased on the bronze housing model to 250° F.

Table 1 - Configuration and Specification Data for Model RCDL Disc Meters

Model ER-6 (Remote Totalizer Only)
Models ER-8 and ER-9 Meter Mount and Remote
Digital Resettable Totalizer and
Digital Rate of Flow Indicator

Repair Parts



ITEM NO.	PART DESCRIPTION	PART NUMBER
1	ER-6 Register (with gasket, remote)	63019-001
1	ER-7 Register (with gasket)	62025-001
1	ER-8 Register (with gasket)	62822-001
1	ER-9 Register (with gasket)	62822-002
	Battery (ER-6, ER-8 & ER-9), 3V Lithium	62576-001
2	Cover Screw	55046-171
3	Cover (Single)	62118-001
3	Cover (Dual)	62118-006
4	Housing Gasket	59833-001
5	Housing (Meter Mount)	62233-002
5	Housing (Remote); including remote screws and bracket	62918-001
6	Conduit Nut	62027-001

ITEM NO.	PART DESCRIPTION	PART NUMBER
7	Drop Pipe	14711-131
8	Reed Switch Assy-1/2" OP	62719-001
8	Reed Switch Assy-1"&2" OP	62704-001
9	Adapter Assy Complete with pickup, 2"&3" Turbo	62897-001
9	Adapter Assy Complete with pickup, 4" Turbo	62897-002
9	Adapter Assy Complete with pickup, 6" Turbo	62897-003
10	Adapter Assy with screw (Disc)	62897-005
11	Reed Switch Pickup Assy (Disc) with pad	62897-004
12	4-20 mA PC Board	58882-002

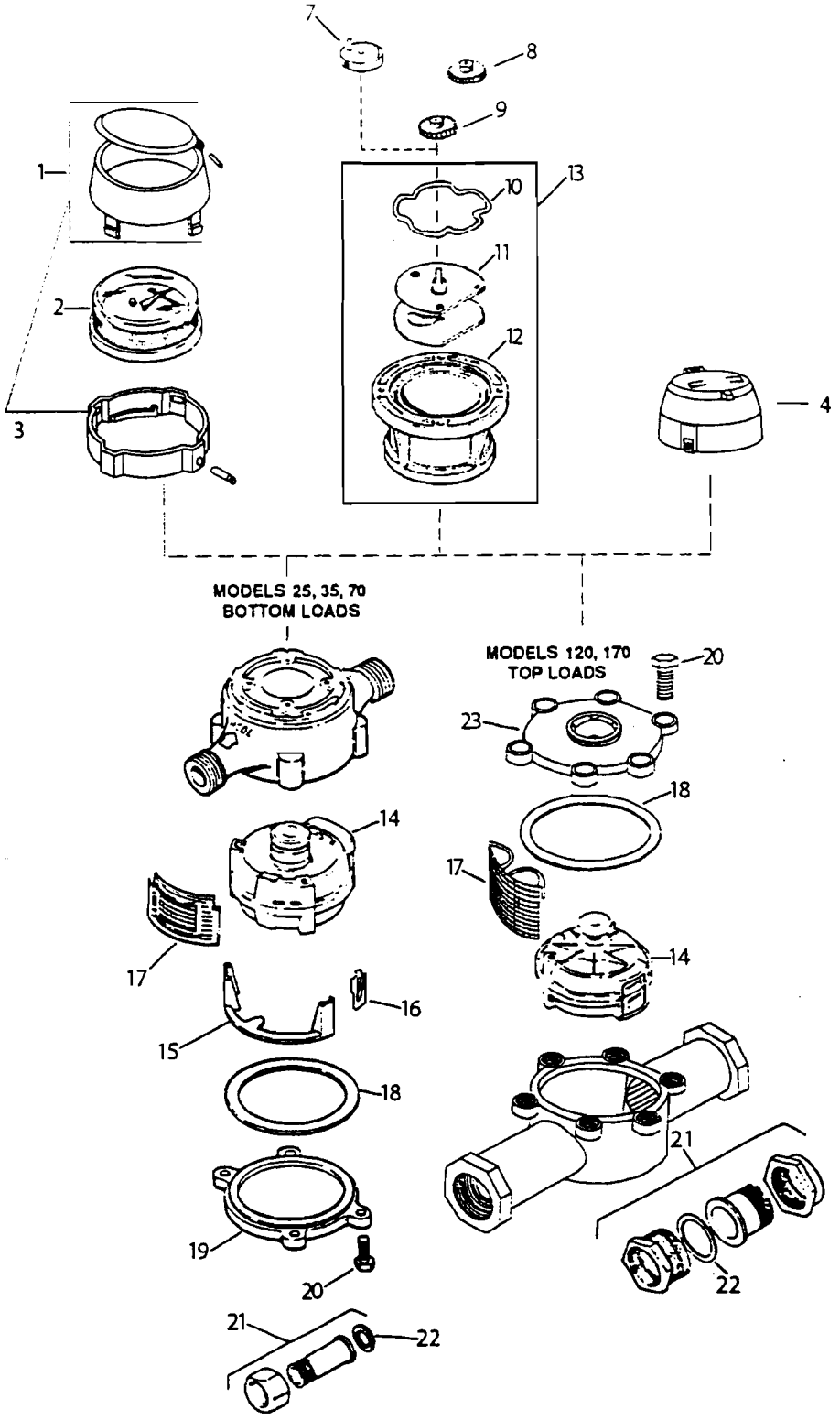
BadgerMeter,Inc. Industrial Division
4545 W. Brown Deer Road, P. O. Box 23099 Milwaukee, WI 53223-0099
Telephone: (414) 355-0400
Fax: (414) 355-7499

Bulletin No. IRP-070-03
Part No. 53401-070
March 1997

Models 25, 35, 70, 120 and 170

5/8" - 2" Industrial Disc Meters – Bronze

Repair Parts



BadgerMeter, Inc.
Industrial Division

Bulletin No. IRP-104-0
Part No. 53401-10
April 19

Upon receipt of meter, perform the following:

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

A. Carefully open the shipping container. Remove all the cushioning material surrounding the meter and carefully lift the meter from the container.

Retain all of the packing material for possible use in reshipment or storage of the meter.

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

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

Any special instructions required for the installation and/or electrical connection of any meter-mounted or free-standing accessory devices such as registers, pulse transmitters, and remote batch controllers, will be provided as a supplement to this manual.

A. Please read the following instructions to become familiar with the requirements and the recommended procedures involved.

CAUTION: The meter must be operated in an application within the specified temperature range to obtain optimum accuracy and prevent damage to any internal components.

1. Verify the fluid operating temperature range is compatible with the materials of construction of the meter received.

CAUTION: The life of the meter will be impaired if it is operated at flow rates in excess of those indicated in the product specifications.

2. If any solid material is present in the liquid, installation of a strainer is recommended upstream of the meter.

3. Locate the meter installation with consideration for sufficient space for cleaning and maintenance of the meter.

B. Review the overall dimensions (including laying length requirements) of the meter as listed in Table 1 of this manual on page 2. If necessary, consideration may also need to be given for height dimensions including the meter mounted accessory. Then proceed as follows:

1. Measure the overall length of the meter with the connection pieces attached to the inlet and outlet spuds of the meter.

2. Be sure to provide this proper gap length in the facility piping.

CAUTION: Excess gap length may cause excessive strain on connection assemblies.

3. Remove the connections and install one connection piece in each end of the facility pipe gap provided in step #2. Allow for the gaskets at the inlet and the outlet spuds of the meter.

4. Install the meter making sure that the flow arrow marking on the meter housing is in the correct relationship to the direction of the fluid flow in the system.

5. Tighten the meter connections.

Note instructions on packaging from connection assembly when tightening.

6. To relieve any possible strain on the facility piping that might be caused by the weight of any of the large size meters, it is recommended that consideration be given to incorporating a meter support to be placed under the housing of the meter.

To ensure that the meter has been properly installed and operational:

A. Slowly open the upstream valve to apply fluid pressure to the meter. Check the connections for any possible leakage. Retighten the connections as required.

B. Perform a functional test of the meter utilizing the adjustment and calibration procedures that are included later in this manual.

In general, the operation of a Model RCDL disc meter is either manually controlled or accessory controlled. Manual operation applies to the applications employing hand-operated valves or other manually activated, flow-regulating devices that are not functionally controlled by a meter accessory. Accessory controlled operation applies to applications when a meter accessory provides a signal output to activate and/or deactivate a valve or other flow control device.

CAUTION: Valves controlling the fluid flow through the meter should be opened and closed slowly to prevent shock loads that may damage the meter measuring element.

A. MANUAL OPERATION. The following procedures are for use in simple metering applications where the flow of fluid is controlled by hand-operated valves located upstream and downstream of the meter.

1. Slowly open the upstream valve to apply fluid to the meter.

2. Slowly open the downstream valve to initiate the metering operation.

3. Adjust downstream valve so the flow rate of the fluid does not exceed the maximum continuous flow rate specification of the meter. (Refer to Table 1 of this manual.)

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

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

B. ACCESSORY CONTROLLED OPERATION. Operating procedures for accessory controlled applications are dependent on the specific function of that accessory employed and its electrical interconnection with a flow control device or devices. Refer to the bulletin or bulletins covering the applicable accessories for specific operating instructions (included as a supplement to this manual when required.)

SHUTDOWN INSTRUCTIONS

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

PREVENTIVE MAINTENANCE

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 further operation of the meter.

PERIODIC INSPECTION

A. Visually inspect meter and accessory for missing hardware, loose connections, broken register glass, damaged wiring, or other signs of wear or deterioration. Repair or replace components as required.

B. Verify proper flow rate and pressure for meter. A loss in pressure, with the resulting flow rate decrease, may indicate the meter screen is clogged and requires cleaning.

CLEANING

Clean all dust, dirt, grease, moisture, or other foreign material from exterior of meter and applicable accessory.

CALIBRATION CHECK AND ADJUSTMENT

The following instructions are provided to assist in performing on-site calibration check and/or adjustment.

ACCURACY TEST

A. Place a test tank of known volume at output of meter.

B. Fill test tank to calibrated level. Make test run at same flow rate to be used in actual operation.

C. Record quantity indicated on applicable accessory.

D. Repeat test three times and average recorded results.

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

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

Example 1.

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

The meter-mounted accessory is slow and reading low so it must be speeded up by a calibration adjustment.

Example 2.

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

In this example, the meter accessory is fast and running high se it must be slowed down by calibration adjustment.

CHANGE GEAR CALIBRATION

If the accuracy test of a meter-accessory combination indicates that adjustment is required and change gears are the medium; proceed as follows:

A. Remove applicable Driver (Accessory) change gear and Driven (Meter) change gear.

NOTE: The number of teeth and outside diameter is stamped on each gear.

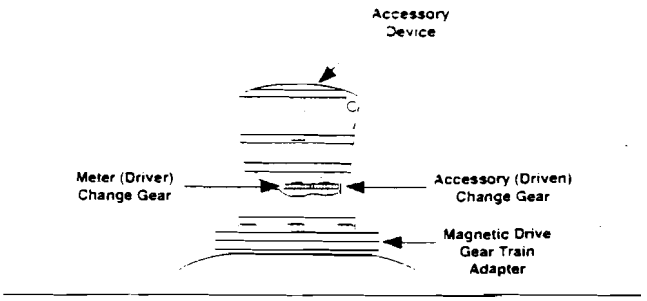


Figure 3 - Change Gear Locations on Model RCDL Meters

B. Calculate ratio of existing change gears as follows:

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

C. Calculate new change gear ratio required by multiplying the ratio of existing change gears by the percent-of-meter accuracy determined in the accuracy test.

Example

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

Meter Accuracy = 95%

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

D. If change gear charts are available, select a new change gear combination that matches corrected change gear ratio. If new gears are not available, submit order for corrective change gears to nearest Badger Meter Representative or contact the Industrial Division of Badger Meter, Inc.

NOTE: When ordering, specify serial number of meter, meter model and size, accessory device employed, number of teeth and diameter of existing change gears, and corrected change gear ratio required.

E. Observe the position of old change gears on spindles before removing. Install new change gears on meter and accessory spindles and assemble accessory to meter. Care should be taken to obtain full mesh when assembling accessory to meter gear train adapter. Note position information from old gears.

ELECTRONIC CALIBRATION

If electronic scaling is the accessory medium for calibration, see accessory technical brief for instructions.

SERVICING

The following instructions are for removal, inspection and installation of meter parts/assemblies. Refer to applicable illustrated parts list for part numbers of components and ordering information. Accessory service and repair procedures are provided in literature specific to that device.

METER ASSEMBLY

These procedures are for disassembly of the meter:

A. Shut off fluid flow to meter. Place container under meter and relieve fluid pressure in the meter by uniformly loosening bolts (bronze meter) or retaining ring (plastic meter). Fluid will run out into container.

B. Remove bolts or retaining ring while holding housing bottom in place. Remove housing bottom. Chamber assembly may drop from housing as bottom is removed.

C. If chamber assembly is out, set aside. If not, first remove chamber strap and then chamber assembly.

D. Remove meter screen. Inspect screen for dirt and corrosion. Clean or replace as necessary.

E. Inspect the chamber assembly:

1. Check the disc in the chamber assembly for warpage, cracks or wear. A severely worn disc can cause over delivery of the fluid being metered.

2. Check the thrust roller and thrust roller insert for excessive wear.

After inspection, clean or replace the chamber assembly as necessary. If chamber is worn or corroded, it is always recommended that the entire chamber and disc assembly be replaced.

F. Re-install housing chamber assembly, screen, chamber strap and bottom as follows:

1. Assemble screen in proper location.

2. Locate chamber assembly in proper orientation. Add chamber strap.

3. Position housing bottom with the correct seal. (Replacement of seal is always recommended.)

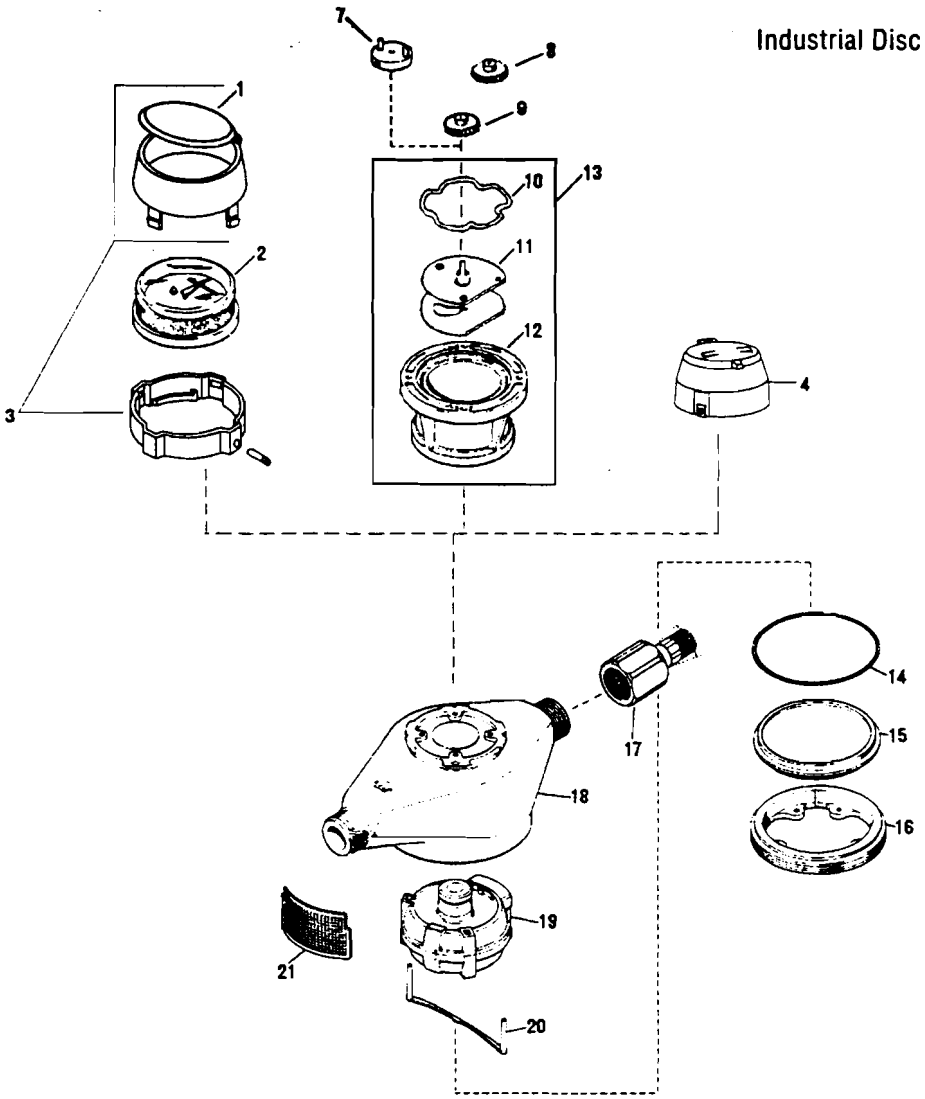
4. Assemble bolts or retaining ring and tighten.

ALTERNATIVE DISASSEMBLY METHOD FOR SERVICE

Loosen connection pieces slightly. Turn meter upside down, putting gravity on your side. This will help eliminate the possibility of the chamber assembly and/or screen component dropping during disassembly and causing damage.

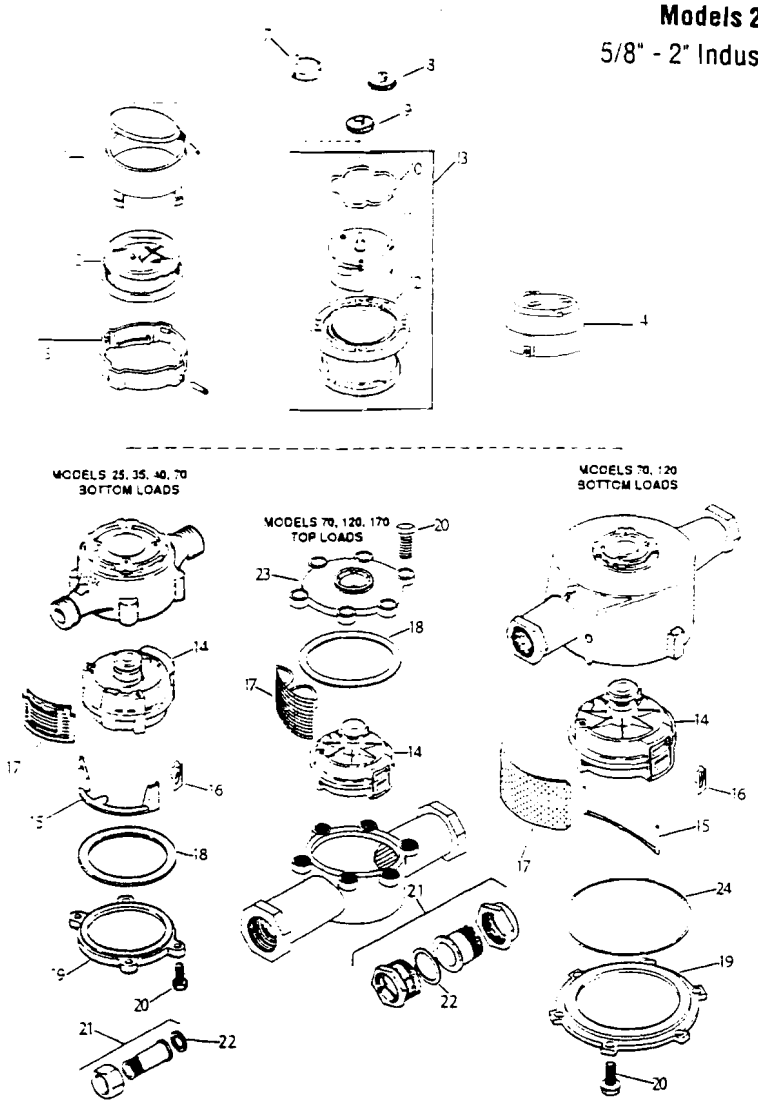
RECALIBRATION

After repair or replacement of a meter component or assembly, perform the calibration check and adjustment procedure to ensure that the meter is properly calibrated and will operate in accordance with published specifications.



Item No.	Part Description
1	Shroud Assembly, Plastic (Cover, top and roll pin, no btm.)
2	Register Assembly, U.S. Gallons Register Assembly, Liters/M3
3	Shroud Assembly, Plastic (Cover, top, btm., roll pin)
4	Pulse Transmitter Register RTR
7	Coupling (Series 76 Register)
8	Change Gear, Driver
9	Change Gear, Driven
10	Retaining Ring
11	Gear Train (234:1)
11	Gear Train (30:1)
12	Housing, Mach.
13	Gear Train Assy. (234:1)
13	Gear Train Assy. (30:1)

Item No.	Part Description
14	Housing Bottom "O" Ring Seal
15	Housing Bottom
16	Retaining Ring
17	Connection Assembly, 1/2" Plastic Connection Assembly, 3/4" Plastic Connection Assembly, 1" Plastic Connection Assembly, 1/2" Bronze Connection Assembly, 3/4" Bronze Connection Assembly, 1" Bronze
18	Housing 5/8" x 1/2", 7 1/2" LL Housing 5/8" x 3/4", 7 1/2" LL Housing 1" x 1", 10 3/4" LL
19	Chamber and Disc Assembly, Plastic Chamber and Disc Assembly, LCP
20	Chamber Retainer Strap
21	Screen



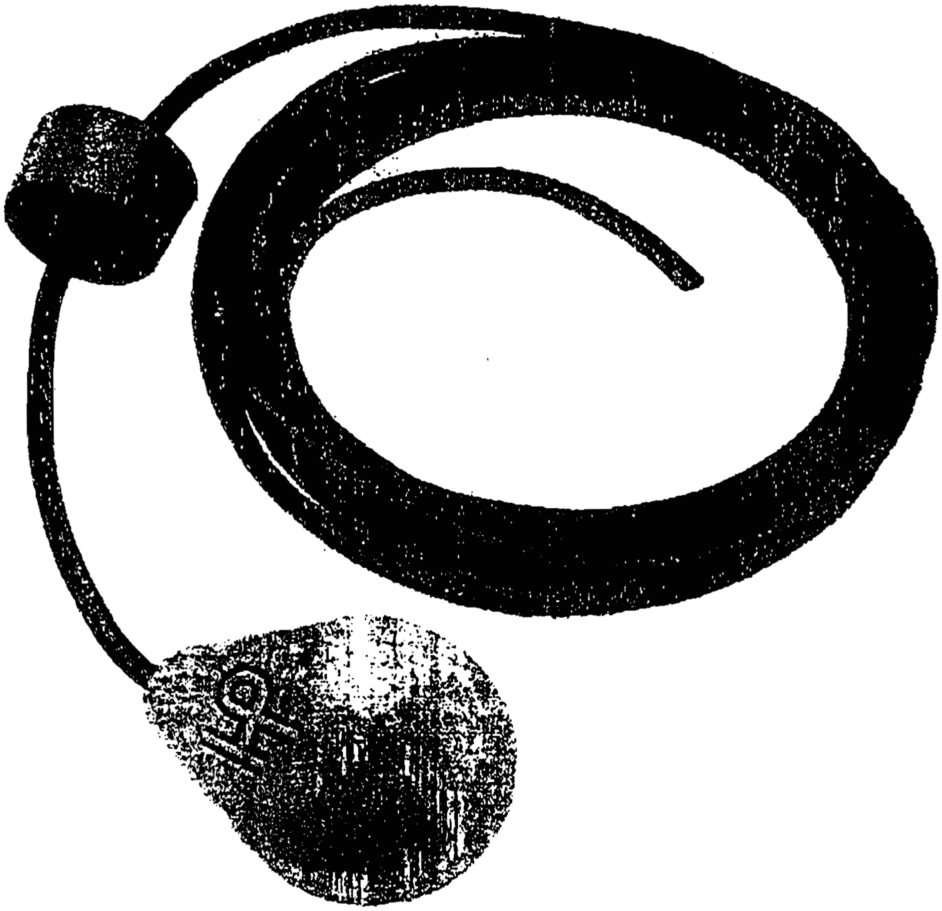
Item No.	Part Description
1	Shroud Assembly, Plastic (Cover, top & roll pin) (No btm.)
2	Register Assembly, Gallons Register Assembly, Liters/M3
3	Shroud Assembly, Plastic (Cover, top, btm. & roll pin)
4	Pulse Transmitter Register RTR
7	Coupling (Series 76 Reg.)
8	Change Gear, Driver
9	Change Gear Driven
10	Retaining Ring
11	Gear Train (234:1)
11	Gear Train (30:1)
12	Housing, Mach.
13	Gear Train Assy. (234:1)
13	Gear Train Assy. (30:1)
14	Chamber & Disc Assy., Std. Chamber & Disc Assy., LCP

Item No.	Part Description
15	Chamber Retainer Strap
16	Spring Clip (High Temp. Only) (Model 25 and 70 Only)
17	Screen
18	Housing Gasket , Buna N Housing Gasket, Viton
19	Housing Bottom
19A	Washers (6 needed)
20	Housing Bolt
21	Conn. Assembly (2) 1/2" Conn. Assembly (2) 3/4" Conn. Assembly (2) 1" Conn. Assembly (2) 1 1/2" Conn. Assembly (2) 2"
22	Conn. Washer (1) 1/2" Conn. Washer (1) 3/4" Conn. Washer (1)
23	Housing Top
24	Bottom Seal "O" Ring

Float Level Controls

HYDROMATIC® 3900
Mercury Switch Level Control

- Sealed steel tube mercury switch
- Most trouble-free control ever designed.
- For use in sewage and practically all chemical solutions.
- Designed for over one million cycles of operation.
- Weight outside float holds switch at any desired height in sump.
- Weighted cords prevent the floats from hanging up on rails, ladders and other obstructions under turbulent wet well conditions.



HYDROMATIC®
PENTAIR PUMP GROUP

Engineering Details - 3900

3900 Specifications

GENERAL — Designed for operating sewage pumps to control liquid level in sumps. Can also be used to operate alarms to indicate high water conditions in sumps or tanks.

TYPES — 3900 Controls can be supplied with normally open or normally closed contacts.

Two normally open controls are used to control operation of a single pump. One control is set for turn off level and one control is set for turn on level. A magnetic starter or contactor with a holding contact holds the circuit in after level drops below turn on control.

For two-pump operation 3 controls are used; one for turn off, one for turn on one pump, and one for turn on two pumps. An electric alternator is supplied to alternate pumps.

Normally closed switches can be supplied for pump up applications such as filling surface or elevated tanks. Normally closed switches are 3900-1.

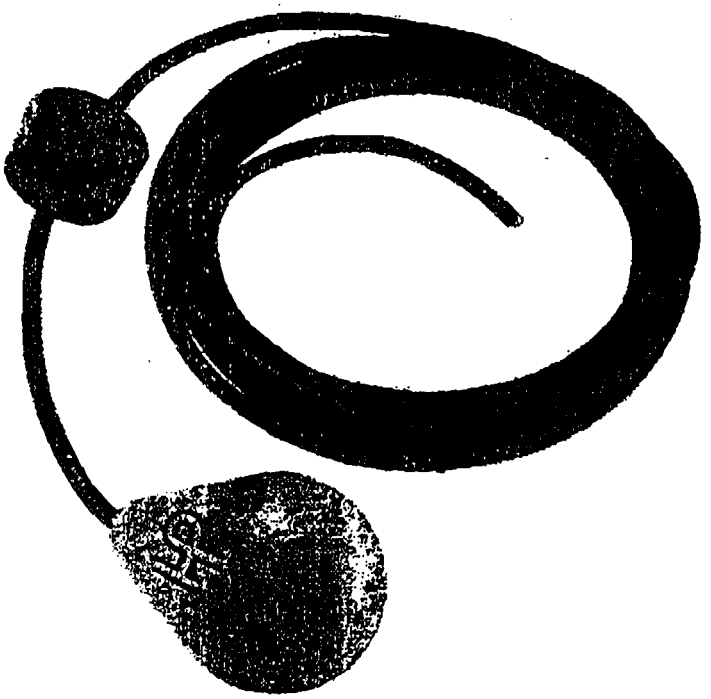
SWITCH SPECIFICATION — The Mercury glass tube switch is manufactured by Honeywell-Micro Division and has a rating of 12 AMPS at 115 or 230 Volts, A.C.

POWER CORD — Is 2-conductor #16 flexible cord type SJO oilproof, 300-Volt.

FLOAT — The Mercury switch is potted in a solid polyurethane float that is leakproof, shockproof and corrosion resistant to sewage and most chemicals. Consult factory for use with chemicals.

WEIGHT — The cast iron weight coated with baked on epoxy paint holds switch in sump at desired height. Height can be easily adjusted from the surface by raising or lowering the cord in the cord snubber. Weights of special materials can be supplied for use in chemicals.

SUPPORT BRACKET — A special support bracket is bolted to the junction box (if used), otherwise it bolts to the discharge pipe. Bracket has plastic cord snubber that holds the switches at the required height. Cords are spaced apart to prevent tangling.



HYDROMATIC®

PENTAIR PUMP GROUP

1840 Bleary Road Ashland, Ohio 44805 Tel: 419-289-3042 Fax: 419-281-4087

SALES OFFICES IN ALL MAJOR CITIES AND COUNTRIES

Refer to "Pumps" in the yellow pages of your phone directory for your local Distributor

- Your Authorized Local Distributor -

Stock#: HW-FCP-6400-1 (7/98) 5M (8/98)

100 Gallon Mix Tank

Vertical Bulk Storage Tanks

Manufactured from linear polyethylene in one piece, seamless construction, this tank series is designed for either indoor or outdoor applications. Translucent* for convenient product level viewing. Flat bottom design provides for easy and cost efficient installation.

Two styles to choose from:

IC – Commercial Series is designed to handle contents that have a maximum specific gravity of 1.5 at 73° F.

IA – Industrial Series is designed to handle contents that have a specific gravity of 1.9 at 73° F.

• Excellent chemical and impact resistance. • Resin complies with U.S. Food and Drug Administration regulation 21 CFR 177.1520 (c) 3.1 and 3.2. See page 43 for more information. • 54 sizes 45 gallons to 12,000 gallons. • Molded in calibrations. • Most sizes are available with molded in tie down slots. • UV stabilized for outdoor use

• Seismic zone 4 restraint kits available. See page 29. • Comply with Federal Spill Containment 40CFR 264.193 requirements, see pages 25, 26 and 27. • Dimensional drawings available for all tanks

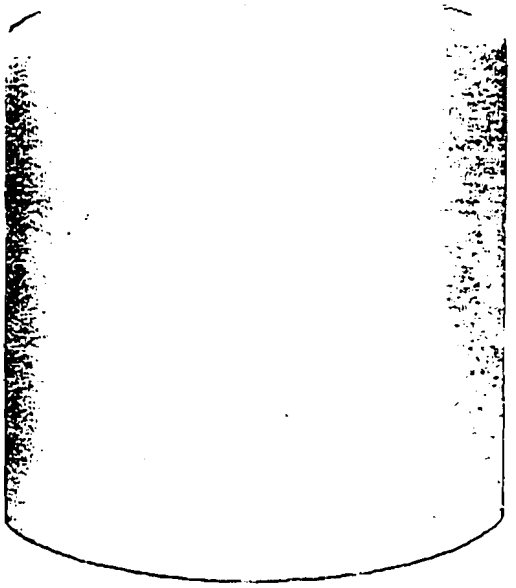
*The degree of translucency varies with wall thickness and tank color

CAPACITY	SIZE DIA. X HT (IN.)	MANWAY (IN)	IC TANK PART #	IA TANK PART #	FOB POINTS (1)
45 *	18 x 51 (3)	4	—	TC1851IA	TCIPF,Tn
55 *	20 x 38 (4)	8	—	TC2038IA	TCIPF,Tn
65 *	23 x 38	8	—	TN2338IA	TCIPF,Tn
65 *	23 x 42	8	—	TC2342IA	TCIPF,Tn
75 *	23 x 49	8	—	TC2349IA	TCIPF,Tn
100	23 x 64	8	—	TC2364IA	TCIPF,Tn
110	35 x 35 (5)	8	TC3535IC	TC3535IA	TCIPF,Tn
130	23 x 76	8	TC2376IC	TC2376IA	C
165	31 x 58	8	TC3158IC	TC3158IA	TCIPF,Tn
220	35 x 63 (5)	8	TC3563IC	TC3563IA	TCIPF,Tn
300	35 x 78	16	TN3578IC	—	TCIPF,Tn
300	35 x 81	16	TC3581IC	TC3581IA	TCIPF,Tn
300	42 x 59	8	TC4259IC	TC4259IA	TCIPF,Tn
300	45 x 60	16	TC4560IC	TC4560IA	CF
305	46 x 48	16	TN4648IC	—	TCIPF,Tn
500	46 x 76	16	TC4676IC	TC4676IA	TCIPF,Tn
500	48 x 71	16	TN4871IC	—	TIP,Tn
500	52 x 66	16	TC5266IC	TC5266IA	F
500	64 x 42	16	TC6442IC	TC6442IA	TCIPF,Tn
550	45 x 94	16	TC4594IC	TC4594IA	CF
550	67 x 42	16	TN6742IC	—	TCIPF,Tn
650	56 x 70	16	TC5670IC	TC5670IA	C
700	64 x 60	16	TC6460IC	TC6460IA	F
750	46 x 119	16	TC750XIC	TC750XIA	TCIPF,Tn
850	48 x 124	16	TC850XIC	TC850XIA	TCIPF,Tn
1000	64 x 79	16	TN6479IC	TN6479IA (2)	TCIPF,Tn
1000	64 x 81	16	TC6481IC	TC6481IA	TCIPF,Tn
1000	69 x 74	16	TC6974IC	TC6974IA	C
1100	87 x 51	16	TN8751IC	TN8751IA (2)	TCIPF,Tn
1150	68 x 156	16	TC11501C	TC1150IA	TCIPF,Tn
1200	86 x 52	16	TC8652IC	TC8652IA	TCIPF,Tn
1300	87 x 58	16	TN8758IC	—	TCIPF,Tn
1500	64 x 115	16	TN1500IC	TN1500IA (2)	TCIPF,Tn
1500	64 x 121	16	TC1500IC	TC1500IA	TCIPF,Tn
1550	87 x 65	16	TN8765IC	TN8765IA	TCIPF,Tn
1700	86 x 74	16	TC8674IC	TC8674IA	TCIPF,Tn
2000	64 x 144	16	TC2000IC	TC2000IA	TCIPF,Tn
2100	87 x 87	16	TN8787IC	TN8787IA (2)	TCIPF,Tn
2200	86 x 96	16	TC8696IC	TC8696IA	TCIPF,Tn
2500	95 x 89	16	TN9589IC	TN9589IA (2)	TCIPF,Tn
2800	95 x 98	16	TC9598IC	TC9598IA	TCIPF,Tn
3000	95 x 105	16	TN3000IC	TN3000IA (2)	TCIPF,Tn
3200	95 x 112	16	TC3200IC	TC3200IA	TCIPF,Tn
3600	86 x 156	16	TC3600IC	TC3600IA	TCIPF,Tn
4000	95 x 140	16	—	TN4000IA (2)	TI
4000	92 x 126	16	TN4011IC	TN4011IA (2)	TCIPF,Tn
4300	77 x 105	16	TC4300IC	TC4300IA	TCIPF,Tn
4500	95 x 156	16	TC4500IC	TC4500IA	TCIPF,Tn
5000	132 x 91	16	TN5000IC	TN5000IA (2)	TCIPF,Tn
5600	120 x 138	16	TC5600IC	TC5600IA	TCIP,Tn
6000	132 x 132	16	TN6000IC	TN6000IA (2)	TCIPF,Tn
6500	120 x 147	16	TN6500IC	TN6500IA (2)	TCIP,Tn
6800	120 x 150	16	TC6800IC	TC6800IA	TCIP,Tn
9000	141 x 144	16	TN9000IC	TN9000IA (2)	TCIP,Tn
10,000	141 x 159	16	T100001C	T100001A (2)	TCIP,Tn
12,000	141 x 192	16	T120001C	T120001A (2)	TCIP,Tn

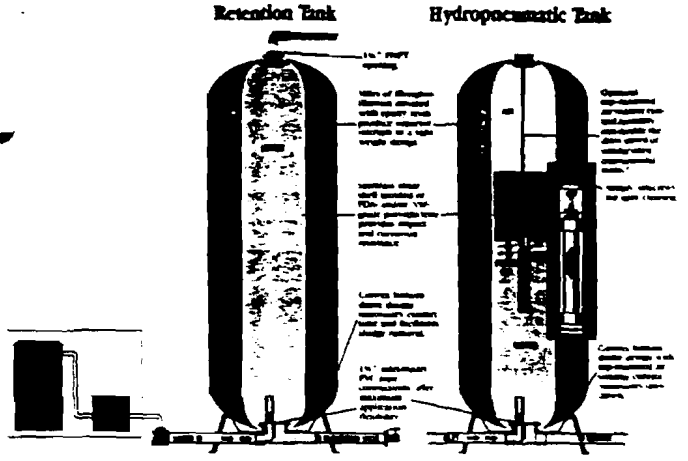
(1) Subject to stocking inventory
(2) Available only in blue color
* Within UPS dimensions [illegible] See page 30
(3) 45 gallon has inverted calibrations which indicates amount used
(4) 55 gallon has no calibrations and flat top
(5) 110 & 220 gals. have side indents for fork lift handling

CHEMTAINER

45 gal - 500 gal (46x76) and 550 gal (45x94), 650 gal, 750 gal have center manways (shown above). All others have offset manways.



FOB Codes N=NY, T=TX, I=IL, C=CA, F=FL, P=PA, Tn=TN
How to select & order tanks, see page 33.



Fiberglass Pressure Tanks - Corrosion-Proof

- **Ideal for chemical treatment and aggressive water conditions**
- **Up to 119 gallon residential, 454 gallon commercial**
- **Code and non-code vessels available**
- **5 year warranty**

Seamless inner shell is FDA and/or NSF grade polyethylene with an outer cover composed of miles of fiberglass filament covered with epoxy resin. Vertical tanks with replaceable polyetherurethane air cells range from 15 gallon to 119 gallon in capacity. Universal vertical tanks without air cells, which are used both for retention or hydropneumatic service, are available in 30, 40, 80, and 120 gallon capacities. Do not use the bladder tanks for shock loading.

Commercial and industrial models offer maximum operating pressure ratings up to 150 psig and capacities from 119 gallon to 460 gallon in both ASME code and non-code models.

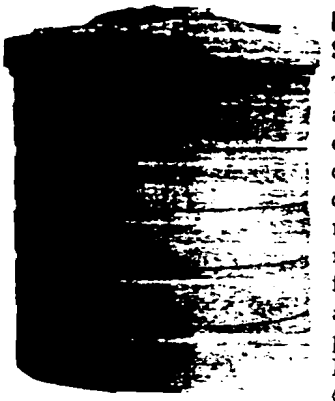
Selected popular sizes utilized by small water systems are listed below. Call for information on other sizes and drawdown capacity tables.

VERTICALLY MOUNTED FIBERGLASS TANKS

SERVICE TYPE	BLADDER	CAPACITY	PSIG	HT in.	D in.	WT lbs.	PIPE in.	STOCK#	EACH
RESIDENTIAL	YES	47	125	41	21	47	1¼	27400	$285.95
RESIDENTIAL	YES	62	125	42	24	57	1¼	27401	331.84
RESIDENTIAL	YES	87	125	55	24	77	1¼	27402	389.03
RESIDENTIAL	YES	119	125	74	24	112	1¼	27403	565.25
UNIVERSAL*	NO	40	75	32	16	35	1¼	27408	135.66
UNIVERSAL*	NO	80	75	67	21	43	1¼	27409	220.78
UNIVERSAL*	NO	120	75	73	24	63	1¼	27410	293.27
COMMERCIAL	YES	200	125	80	30	214	2	27411	2,059.38
COMMERCIAL	YES	270	125	81	36	302	2	27412	2,493.75
COMMERCIAL	NO	200	125	80	30	183	2	27413	1,453.13
COMMERCIAL	NO	270	125	81	36	240	2	27414	1,718.75

**To use the Universal Tank as a hydropneumatic tank, we recommend the optional, internally mounted White Water Mfg. Air Volume Control and Top Vent Adapter below.*

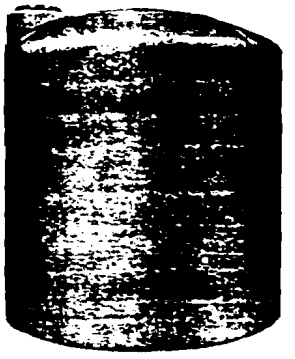
AIR VOLUME CONTROL	27420	$25.54
TOP VENT ADAPTER	27421	7.49



Double Wall Bulk Storage Tanks

These molded double walled tanks are designed for stringent environmental concerns and codes. Outer containment tank capacity complies with federal regulation 40CFR-264 requirements. They are designed for both indoor and outdoor applications. Constructed of linear polyethylene. Resin complies with FDS regulation 21 CFR 177.1570 (c) 3.1 & 3.2. Outer tank wall is translucent. Six sizes ranging from 100 to 5000 gallons are currently available. It should be noted that you cannot install bulkhead fittings in the side of these double wall tanks. Call for more information.

REFERENCE STOCK #65980



Bulk Storage Tanks

Our bulk storage tanks are of linear polyethylene which is translucent for product viewing. Excellent chemical impact resistance. Molded-in calibrations. One piece/seamless construction. **Popular sizes are featured here. Many other sizes available.**

GALLONS	DIA. x HT	STOCK #	EACH
300	42" x 59"	69569	$324.19
550	67" x 42"	69570	443.89
1200	86" x 52"	69571	658.35
1700	86" x 74"	69572	912.71
2200	86" x 96"	69573	1,241.89
2800	95" x 98"	69574	1,556.10
4500	95" x 156"	69575	3,256.84

Need a different size or shape storage tank?

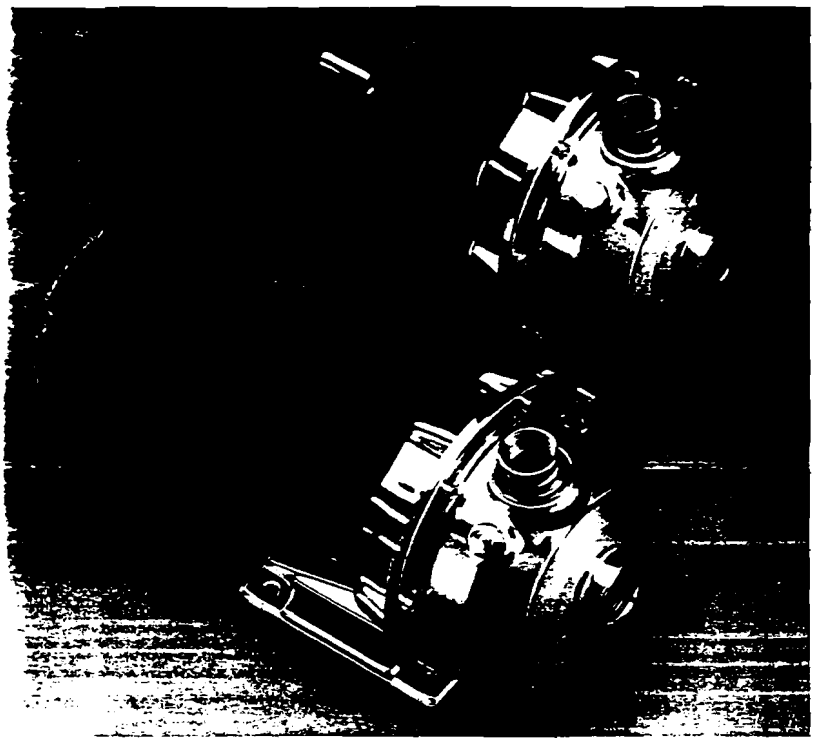
Choose from eight different styles: vertical, horizontal, closed top, open top, flat bottom, cone bottom, single wall, or double wall. Choose cross-linked polyethylene or polypropylene. Capacities to 12,000 gallons.

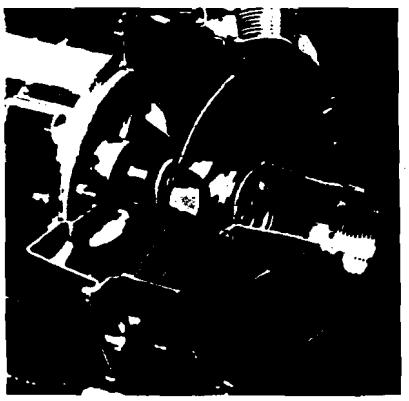
To select the right tank, please call us with the following information and we will quote you a delivered price:

1. Capacity range
2. Liquid to be stored
3. Liquid temperature
4. Outlets Fittings required
5. Indoor Outdoor
6. Shipping Zip Code

BULK STORAGE TANKS REFERENCE #69580 CALL FOR QUOTE

Transfer Pump





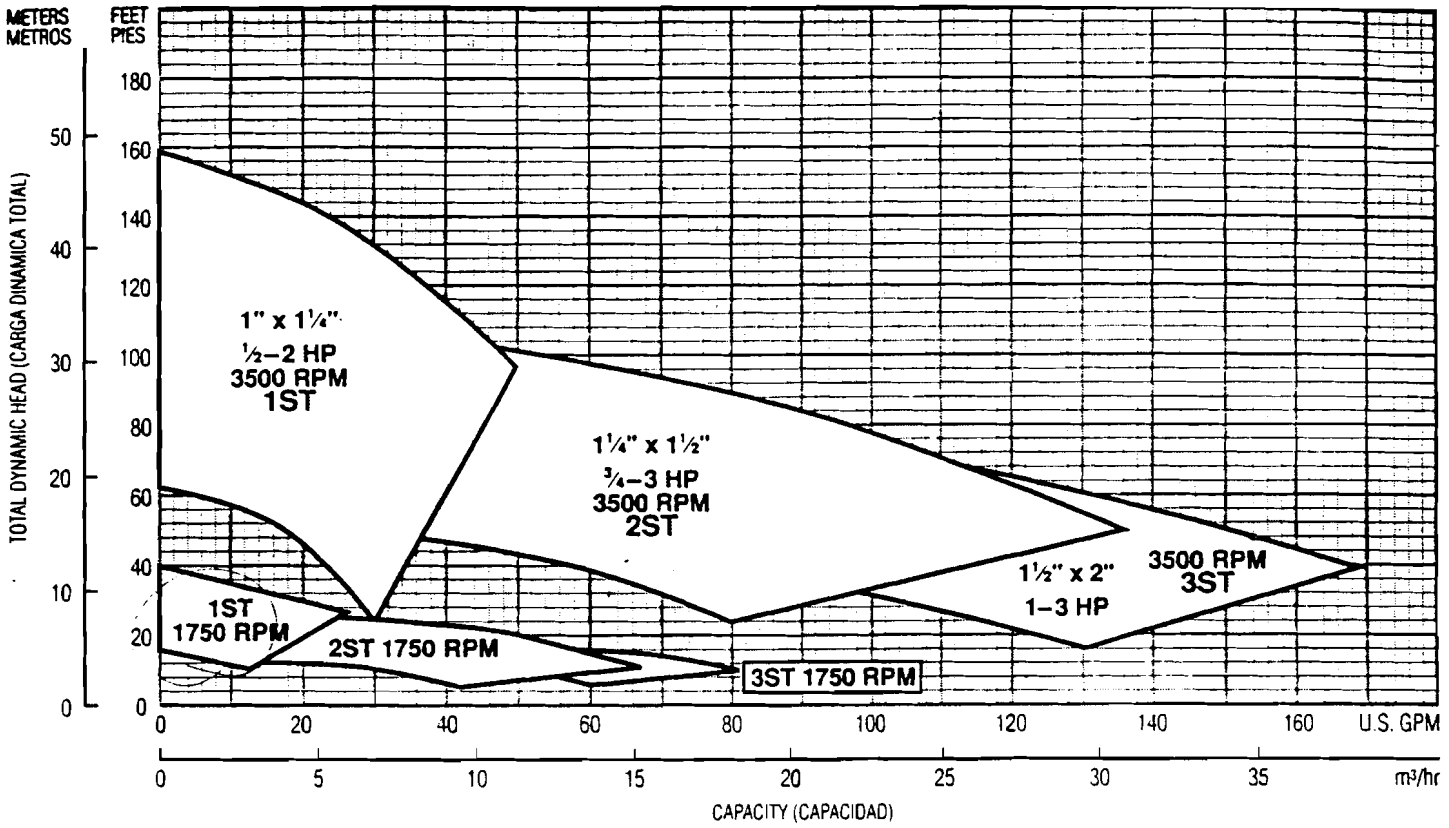
NPE

NPE Series End Suction Centrifugal Pumps

Bombas Centrífugas de Succión Final Serie NPE

G&L
A GOULDS PUMPS COMPANY

Performance Coverage (60 Hz)
Alcance de Funcionamiento (60 Hz)



NOTES:

Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

NOTAS:

No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

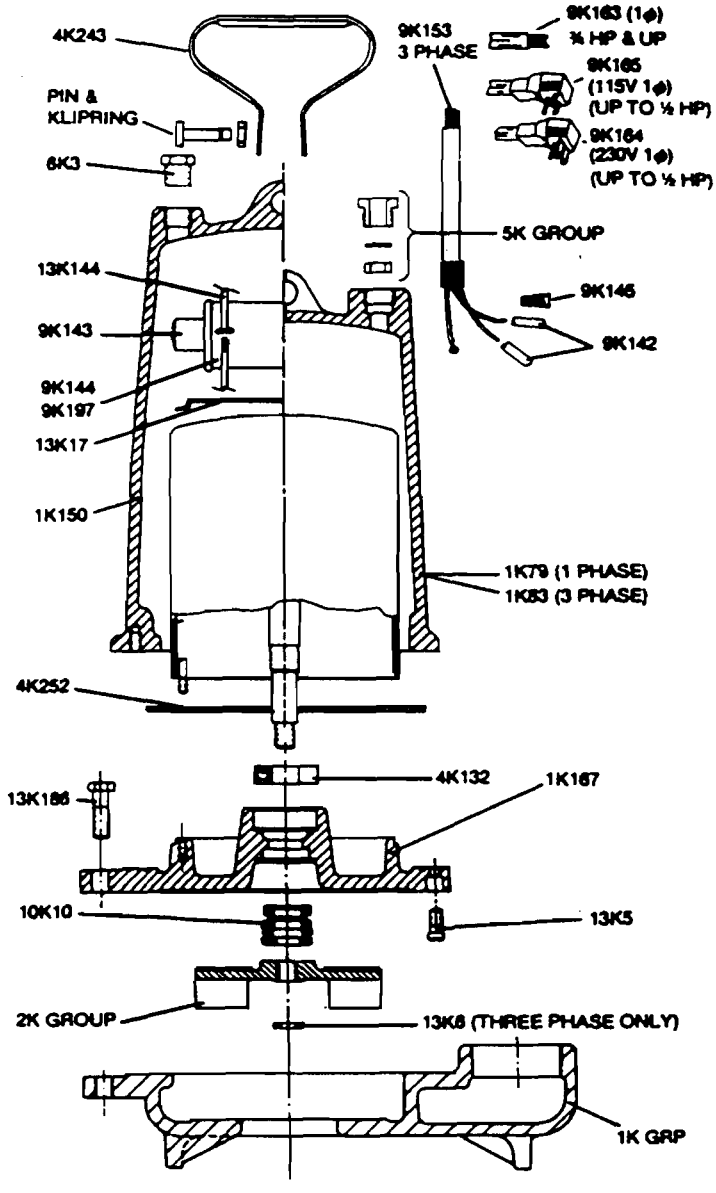
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Repair Parts

MODEL GL885

PART NO.		PART NAME	PATTERN NO.
1K170		Casing–All Medium (M), High (H), High–High (HH), Head Models	59114
1K171		Casing–WE0311L, WE0312 Low Head/High Flow Models Only	59115
1K79		Motor Cover–⅓ HP and ½ HP Single Phase	56867
1K83		Motor Cover–½ HP–1 HP Three Phase	56867
1K150		Motor Cover–¾ HP–1½ HP Single and 1½ HP Three Phase	59055
1K167		Stuffing Box	59113
2K158	Cast Iron	Impeller All ⅓ HP	59049
2K220	Cast Iron	Impeller ½ HP WE05(H)	59086
2K219	Cast Iron	Impeller ¾ HP WE07(H)	59051
2K218	Cast Iron	Impeller 1 HP WE10(H)	59050
2K217	Cast Iron	Impeller 1½ HP WE15(H)	59050
2K225	Cast Iron	Impeller ½ HP WE05(HH)	59097
2K221	Cast Iron	Impeller 1½ HP WE15(HH)	59076
2K271	Bronze	Impeller All ⅓ HP	59049
2K272	Bronze	Impeller ½ HP WE05(H)	59086
2K273	Bronze	Impeller ¾ HP WE07(H)	59051
2K274	Bronze	Impeller 1 HP WE10(H)	59050
2K275	Bronze	Impeller 1½ HP WE15(H)	59050
2K276	Bronze	Impeller ½ HP WE05(HH)	59097
2K277	Bronze	Impeller 1½ HP WE15(HH)	59076
4K132		Ball Bearing	
4K243		Lift Handle Assembly	
4K245		Insulating Oil (Gal.) ⅓ & ½ HP 6 Pts. Req.; ¾–1½ HP 8 Pts. Req.	
4K252		"O" Ring	
5K111		Strain Relief Assembly–¾–1½ HP 1 Phase & All 3 Phase	
5K113		Strain Relief Assembly–⅓, ½ HP 1 Phase	
6K3		Plug–⅛" NPT	
9K142		Heat Shrink Tubing–1 Phase Models Only	
9K143		Capacitor Cap	
9K144		Capacitor	
9K145		Insulating Connector–3 Phase Models Only	
9K153		Cord Set–All 3 Phase (Except CSA)	
9K163		Cord Set–¾–1½ HP 1 Phase (Except CSA)	
9K164		Cord Set–⅓ & ½ HP 1 Phase 230 Volt (Except CSA)	
9K165		Cord Set–⅓ & ½ HP 1 Phase 115 Volt (Except CSA)	
9K195		Cord Set–⅓ & ½ HP 1 Phase 115 Volt–CSA	
9K196		Cord Set–⅓ & ½ HP 1 Phase 230 Volt–CSA	
9K180		Cord Set–¾–1½ HP 1 Phase–CSA	
9K181		Cord Set–All 3 Phase–CSA	
9K197		Capacitor ½ HP Single Phase Only	
10K10		Mechanical Seal Assembly	
13K5		Fillister Head Screw–St. Box to Motor Cover	
13K6		Impeller Locknut–3 Phase Only	
13K17		Capacitor Bracket	
13K144		Strap–Capacitor	
13K186		Hex Cap Screw–St. Box to Casing	
AL27121		Loctite #271	

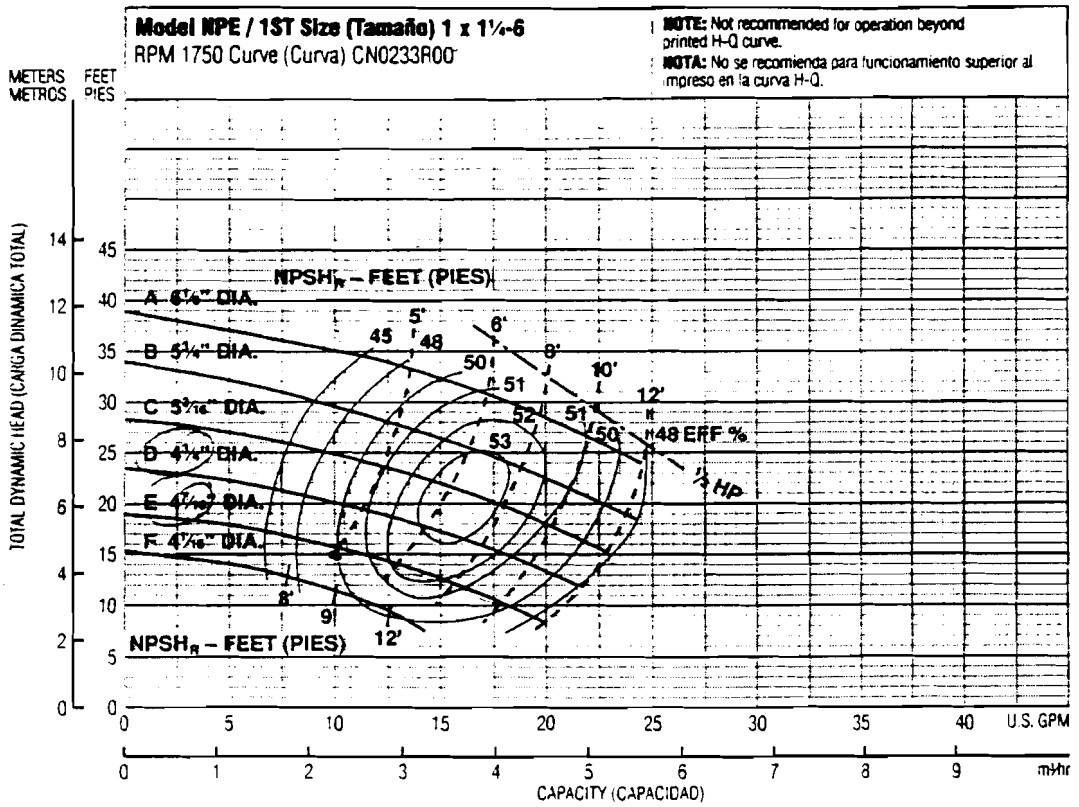
Note: Impellers on 3 ϕ units are Loctited to motor shaft. Impellers and locknuts must be heated to be removed. When replacing impeller, use Loctite AL271121. See instruction manual.



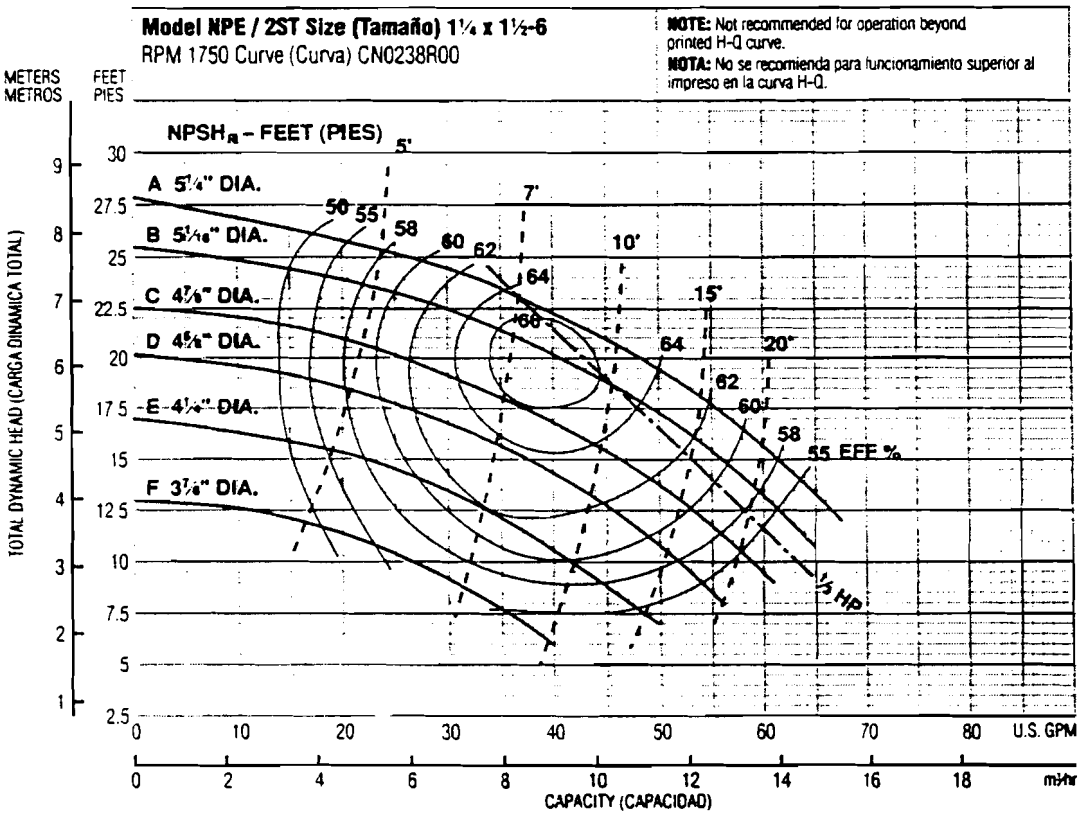
Repair Motor Numbers				
HP	Phase	Voltage	RPM	Order #
⅓	1	115	1750	118-12-01
⅓	1	230	1750	118-12-02
½	1	115	3500	118-12-22
½	1	230	3500	118-12-23
¾	1	230	3500	118-12-24
1	1	230	3500	118-12-25
1½	1	230	3500	118-12-26
½	3	208/230/460	3500	118-13-21
¾	3	208/230/460	3500	118-13-22
1	3	208/230/460	3500	118-13-23
1½	3	208/230/460	3500	118-13-24

Effective January,

Performance Curves – 60 Hz, 1750 RPM
Curvas de Funcionamiento – 60 Hz, 1750 RPM

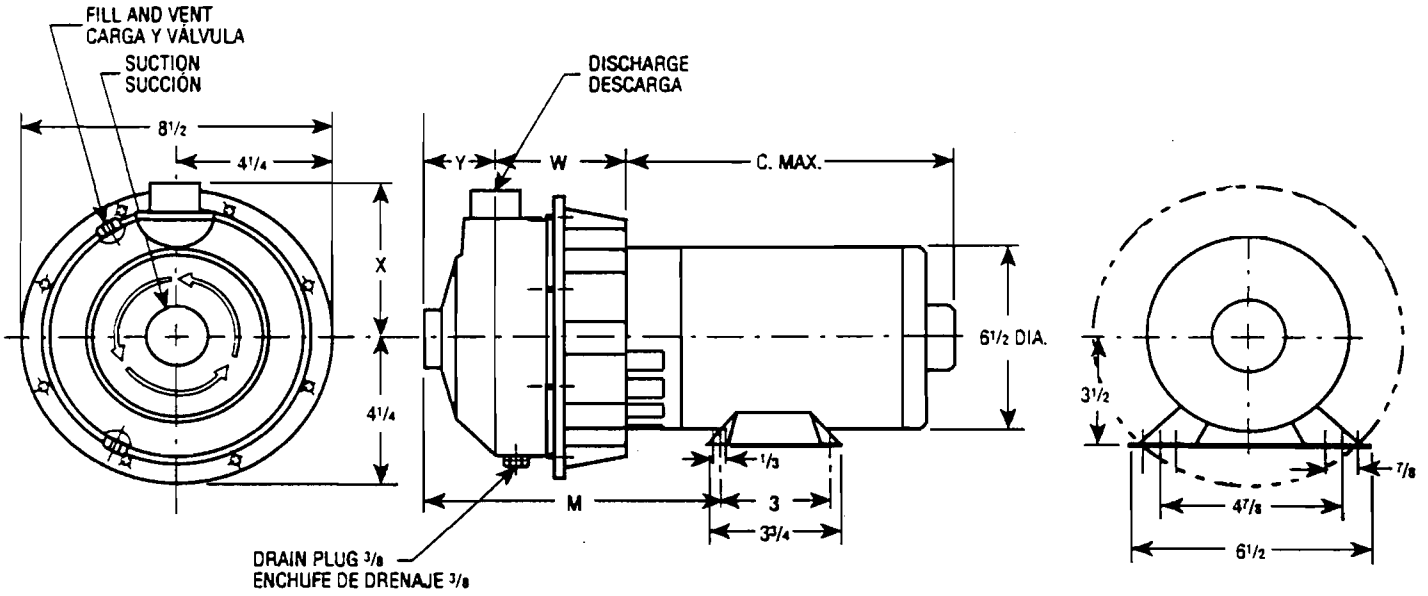


Optional Impeller, Impulsor Opcional	
Ordering Code, Código de Pedido	Dia.
A	6⅛"
B	5¾
C	5⅜
D	4¾
E	4⅜
F	4⅛



Optional Impeller, Impulsor Opcional	
Ordering Code, Código de Pedido	Dia.
A	5¼"
B	5⅛
C	4⅞
D	4⅝
E	4¼
F	3⅞

NPE Close Coupled with Footed Motor, Explosion-proof Motors
NPE Acople Cerrado con Motor con Patas, Motores a Prueba de Explosión



Dimensions – Determined by Pump,
Dimensiones – Determinadas por la Bomba

Pump, Bomba	Suction, Succión	Discharge, Descarga	HP	W	X	Y	L	M
1ST	1¼	1	1½ – 2	3 5/16	4 3/8	2	4 5/16	7 5/16
2ST	1½	1¼	¾ – 3	3¼	4½	2⅛	5⅛	7⅞
3ST	2	1½	1 – 3	3¼	4⅜	2⅛	5⅛	7⅞

Available Motor Weights and Dimensions,
Pesos y Dimensiones Disponibles del Motor

HP	Motor Weights, Pesos del Motor						C Max. Length, (Longitud)
	1 Phase, Monofásicos			3 Phase, Trifásicos			
	ODP	TEFC	EXP	ODP	TEFC	EXP	
½	16	21	47	19	18	27	9 15/16
¾	19	24	41	21	21	30	10¼
1	22	26	49	23	21	30	11
1½	28	35	56	27	27	37	11 5/16
2	33	39	60	32	33	44	12 1/16
3	40	43	—	41	37	—	12 7/16

Dimensions in inches, weights in pounds.
Dimensiones en pulgadas, pesos en libras.

NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

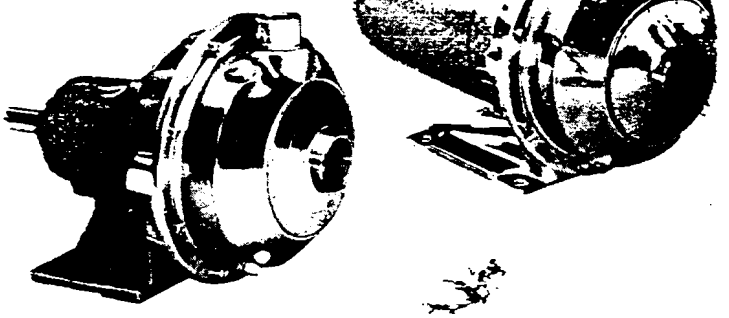
NOTAS:

1. Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.
2. Las dimensiones del motor puede que varíen con los fabricantes.
3. Dimensiones en pulgadas, pesos en libras.
4. Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.
5. No usar para propósitos de construcción sin certificar.

GOULDS PUMPS
Seneca Falls, New York 13148

Installation, Operation and Maintenance Instructions

Model NPE/ NPE-F



DESCRIPTION & SPECIFICATIONS:

The Models NPE (close-coupled) and NPE-F (frame-mounted) are end suction, single stage centrifugal pumps for general liquid transfer service, booster applications, etc. Liquid-end construction is all AISI Type 304 stainless steel, stamped and welded. Impellers are fully enclosed, non-trimable to intermediate diameters. Casings are fitted with a diffuser for efficiency and for negligible radial shaft loading.

Close-coupled units have NEMA 48J or 56J motors with C-face mounting and threaded shaft extension. Frame-mounted units can be coupled to motors through a spacer coupling, or belt driven.

1. Important:

1.1. Inspect unit for damage. Report any damage to carrier/dealer immediately.

1.2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per National and Local electrical codes. Install an all-leg disconnect switch near pump.

CAUTION

Always disconnect electrical power when handling pump or controls.

1.3. Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.

1.4. Always use horsepower-rated switches, contactor and starters.

1.5. Motor Protection

1.5.1. Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper overload. Fusing is permissible.

1.5.2. Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.

1.6. Maximum Operating Limits:

Liquid Temperature:	212 F (100 C) with standard seal.
	250 F (120 C) with optional high temp seal.
Pressure:	75 PSI.
Starts Per Hour:	20, evenly distributed.

1.7. Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. Installation:

2.1. General

2.1.1. Locate pump as near liquid source as possible (below level of liquid for automatic operation).

2.1.2. Protect from freezing or flooding.

2.1.3. Allow adequate space for servicing and ventilation.

2.1.4. All piping must be supported independently of the pump, and must "line-up" naturally.

CAUTION

Never draw piping into place by forcing the pump suction and discharge connections.

2.1.5. Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.

2.2. Close-Coupled Units:

2.2.1. Units may be installed horizontally, inclined or vertically.

CAUTION

Do not install with motor below pump. Any leakage or condensation will affect the motor.

2.2.2. Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.

2.2.3. Tighten motor hold-down bolts before connecting piping to pump.

2.3. Frame-Mounted Units:

2.3.1. Bedplate must be grouted to a foundation with solid footing. Refer to Fig. 1.

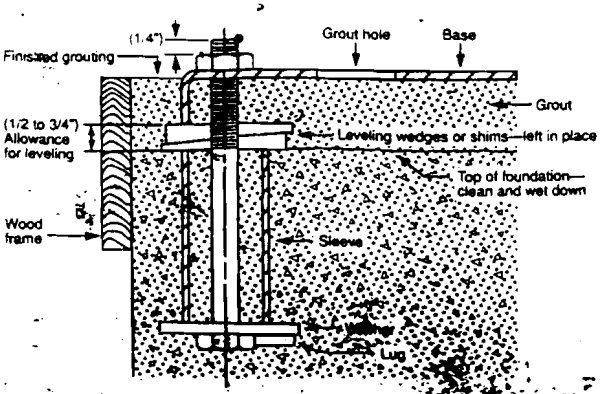


Figure 1

2.3.2. Place unit in position on wedges located at four points (two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit. Level or plumb suction and discharge flanges.

2.3.3. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming, if necessary.

2.3.4. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before fully tightening foundation bolts.

2.3.5. Tighten pump and motor hold-down bolts before connecting the piping to pump.

3. Suction Piping:

3.1. Low static suction lift and short, direct, suction piping is desired. For suction lift over 10 feet and liquid temperatures over 120 F, consult pump performance curve for Net Positive Suction Head Required.

3.2. Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.

3.3. If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.

3.4. Installation with pump below source of supply:

3.4.1. Install full flow isolation valve in piping for inspection and maintenance.

CAUTION

Do not use suction isolation valve to throttle pump.

3.5. Installation with pump above source of supply:

3.5.1. Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.

3.5.2. All joints must be airtight.

3.5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.

3.5.4. Suction strainer open area must be at least triple the pipe area.

3.6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figs. 2-5

3.7. Use 3-4 wraps of Teflon tape to seal threaded connections.

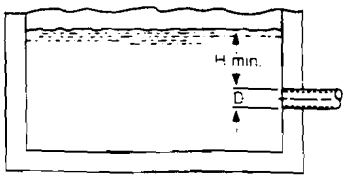


Figure 2

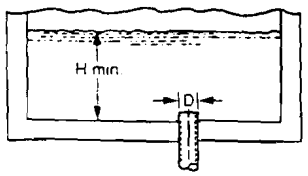


Figure 3

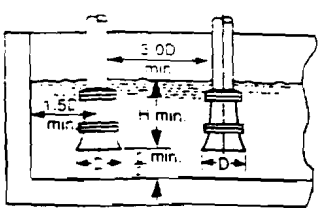


Figure 4

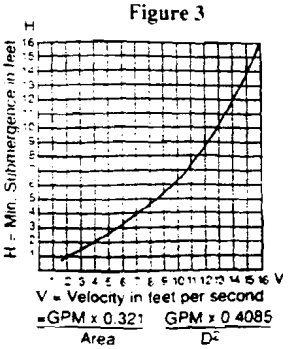


Figure 5

4. Discharge Piping:

4.1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.

4.2. If an increaser is required, place between check valve and pump.

4.3. Use 3-4 wraps of Teflon tape to seal threaded connections.

5. Motor-To-Pump Shaft Alignment:

5.1. Close-Coupled Units:

5.1.1. No field alignment necessary.

5.2. Frame-Mounted Units:

5.2.1. Even though the pump-motor unit may have a factory alignment, this could be disturbed in transit and must be checked prior to running. See Fig. 6.

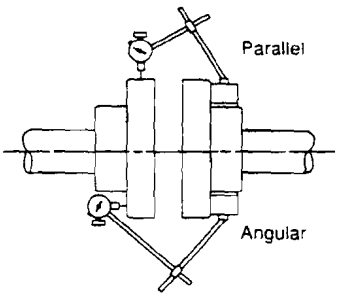


Figure 6

5.2.2. Tighten all hold-down bolts before checking the alignment.

5.2.3. If re-alignment is necessary, always move the motor. Shim as required.

5.2.4. Parallel misalignment - shafts with axis parallel but not concentric. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005", or less.

5.2.5. Angular misalignment - shafts with axis concentric but not parallel. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005", or less.

5.2.6. Final alignment is achieved when parallel and angular requirements are satisfied with motor hold-down bolts tight.

CAUTION

Always recheck both alignments after making any adjustment.

6. Rotation:

6.1. Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. To change rotation:

6.1.1. Single-phase motor: Non-reversible.

6.1.2. Three-phase motor: Interchange any two power supply leads.

7. Operation:

7.1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

CAUTION

Pumped liquid provides lubrication. If pump is run dry, rotating parts will seize and mechanical seal will be damaged. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.

7.2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. On frame-mounted units coupling alignment may have changed due to the temperature differential between pump and motor. Recheck alignment.

8. Maintenance:

8.1. Close-Coupled Unit. Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

8.2. Frame-Mounted Units:

8.2.1. Bearing frame should be regreased every 2,000 hours or 3 month interval, whichever occurs first. Use a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seals, then wipe off excess.

8.2.2. Follow motor and coupling manufacturers' lubrication instructions.

8.2.3. Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

9. Disassembly:

Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work needed.

9.1. Turn off power.

9.2. Drain system. Flush if necessary.

9.3. Close-Coupled Units: Remove motor hold-down bolts.

Frame-Mounted Units: Remove coupling, spacer, coupling guard and frame hold-down bolts.

9.4. Disassembly of Liquid End:

9.4.1. Remove casing bolts (370).

9.4.2. Remove back pull-out assembly from casing (100).

9.4.3. Remove impeller locknut (304).

CAUTION

Do not insert screwdriver between impeller vanes to prevent rotation of close-coupled units. Remove cap at opposite end of motor. A screwdriver slot or a pair of flats will be exposed. Using them will prevent impeller damage.

9.4.4. Remove impeller (101) by turning counter-clockwise when looking at the front of the pump. Protect hand with rag or glove.

CAUTION

Failure to remove the impeller in a counter-clockwise direction may damage threading on the impeller, shaft or both.

9.4.5. With two pry bars 180 degrees apart and inserted between the seal housing (184) and the motor adapter (108), carefully separate the two parts. The mechanical seal rotary unit (383) should come off the shaft with the seal housing.

9.4.6. Push out the mechanical seal stationary seat from the motor side of the seal housing.

9.5. Disassembly of Bearing Frame:

9.5.1. Remove bearing cover (109).

9.5.2. Remove shaft assembly from frame (228).

9.5.3. Remove lip seals (138 & 139) from bearing frame and bearing cover if worn and are being replaced.

9.5.5. Use bearing puller or arbor press to remove ball bearings (112 & 168).

10. Reassembly:

10.1. All parts should be cleaned before assembly.

10.2. Refer to parts list to identify required replacement items. Specify pump index or catalog number when ordering parts.

10.3. Reassembly is the reverse of disassembly.

10.4. Observe the following when reassembling the bearing frame:

10.4.1. Replace lip seals if worn or damaged.

10.4.2. Replace ball bearings if loose, rough or noisy when rotated.

10.4.3. Check shaft for runout. Maximum permissible is .002" T.I.R.

10.5. Observe the following when reassembling the liquid-end:

10.5.1. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.

It is permissible to use a light lubricant, such as glycerin, to facilitate assembly. Do not contaminate the mechanical seal faces with lubricant.

10.5.2. Inspect casing O-ring (513) and replace if damaged. This O-ring may be lubricated with petroleum jelly to ease assembly.

10.5.3. Inspect guidevane O-ring (349) and replace if worn.

CAUTION

Do not lubricate guidevane O-ring (349). Insure it is not pinched by the impeller on reassembly.

10.6. Check reassembled unit for binding. Correct as required.

10.7. Tighten casing bolts in a star pattern to prevent O-ring binding.

11. Trouble Shooting Chart:

MOTOR NOT RUNNING
(See causes 1 thru 6)

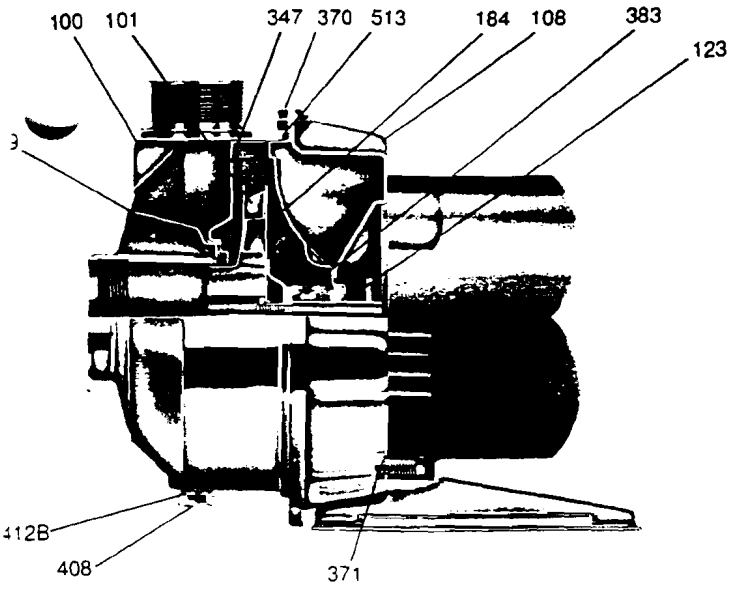
LITTLE OR NO LIQUID DELIVERED:
(See causes 7 thru 17)

POWER CONSUMPTION TOO HIGH:
(See causes 4, 17, 18, 19, 22)

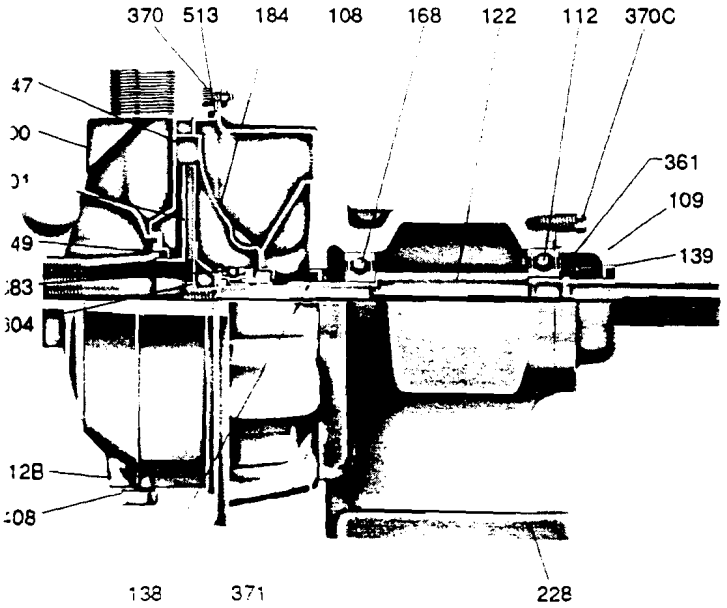
EXCESSIVE NOISE AND VIBRATION:
(See causes 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

PROBABLE CAUSE:

1. Tripped thermal protector
2. Open circuit breaker
3. Blown fuse
4. Rotating parts binding
5. Motor wired improperly
6. Defective motor
7. Not primed
8. Discharge plugged or valve closed
9. Incorrect rotation
10. Foot valve too small, suction not submerged, inlet screen plugged.
11. Low voltage
12. Phase loss (3-phase only)
13. Air or gasses in liquid
14. System head too high
15. NPSHA too low:
    Suction lift too high or suction losses excessive. Check with vacuum gauge.
16. Impeller worn or plugged
17. Incorrect impeller diameter
18. Head too low causing excessive flow rate
19. Viscosity or specific gravity too high
20. Worn bearings
21. Pump or piping loose
22. Pump and motor misaligned



NPE



NPE-F

Liquid End Components		
Item No.	**Description**	**Materials**
100	Casing	AISI 304 Stainless Steel
101	Impeller	
184	Seal Housing	
304	Impeller Locknut	
347	Guidevane	
349	O-Ring, Guidevane	Buna-N
370	Socket Hd. Screws, Casing	AISI 304 S.S.
383	Mechanical Seal	** see chart
408	Drain & Vent Plug, Casing	AISI 304 S.S.
412B	O-Ring, Drain & Vent Plug	Buna-N
513	O-Ring, Casing	Buna-N
	Power End Components	
108	Adapter	AISI 304 S.S.
109	Bearing Cover	Cast Iron
112	Ball Bearing (Outboard)	Steel
122	Shaft	AISI 303 S.S.
138	Lip Seal (Inboard)	Buna/Steel
139	Lip Seal (Outboard)	Buna/Steel
168	Ball Bearing (Inboard)	Steel
228	Bearing Frame	Cast Iron
361	Snap Ring	Steel
370C	Hex. Hd. Cap Screw, Brg. Cvr.	Plated Steel
371	Hex. Hd. Cap Screw, Adapter	Plated Steel

**Mechanical Seals–Item 383						
Part No.	**Service**	**Rotary**	**Stationary**	**Elastomer**	**Metal Parts**	**Crane Type**
10K46	Standard	Carbon	Ceramic	Buna	18-8 S.S.	21
10K18	Option-High Temp		Ni-Resist	EPR		
10K24	Option-Chemeical Duty		Ceramic	Viton		
10K55	Option-High Temp.		Tungsten			
10K29	Option-Severe Duty	Silicon Carbon		Buna		

LIMITED WARRANTY

This warranty applies to all pumps and related accessories manufactured and/or supplied by Goulds Pumps, Inc. - Water Systems Division.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the buyer or any subsequent owner during the warranty period. The warranty period shall expire twenty-four (24) months from date of installation, or eighteen (18) months from date of manufacture, whichever expires first.

A consumer who believes a product warranty claim exists must contact the authorized dealer from whom the equipment was originally purchased and furnish complete details regarding the claim. The dealer is authorized to adjust any warranty claim utilizing Goulds Customer Relations Department and its distributor organization.

This warranty excludes and there is no liability for (a) Transportation and related costs incurred by the consumer to make the allegedly defective equipment available to the dealer for inspection. (b) Removal and installation costs of defective equipment. (c) Reinstallation costs of replacement equipment. (d) Consequential damages of any kind. (e) Reimbursement for loss caused by interruption of service.

GOULDS PUMPS

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Seneca Falls, New York 13148

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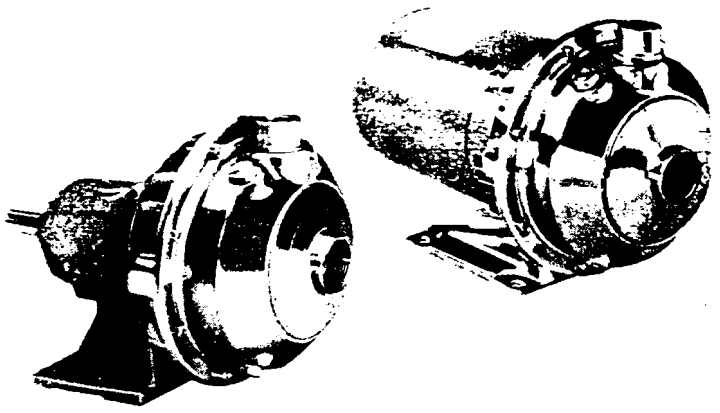
Instrucciones De Instalación, Operación Y Mantenimiento

Modelo NPE/ NPE-F



DESCRIPCIÓN Y ESPECIFICACIONES:

Los modelos NPE (compacto) y NPE-F (montado en marco) son bombas centrífugas de una etapa, de succión axial para el servicio de transferencia de líquidos en general, aplicaciones de refuerzo de presión, etc. La construcción del extremo sumergido es toda de AISI (Instituto Norteamericano del Hierro y el Acero) de acero inoxidable Tipo 304, estampada y soldada. Los impulsores son totalmente cerrados, y no se pueden recortar a diámetros intermedios. Las carcasas están equipadas con un difusor para eficiencia y que las cargas radiales sean negligibles en el eje.

Las unidades compactas tienen motores NEMA 48J o 56J, con montaje de cara C y extensión roscada del eje. Las unidades montadas en marco se pueden acoplar a los motores a través de un espaciador de acoplamiento, o ser accionadas por correa.

1. Importante:

1.1. Inspeccione si la unidad tiene daños. Informe inmediatamente de cualquier daño al transportista o al agente.

1.2. La alimentación eléctrica debe ser un circuito separado con los fusibles o interruptores automáticos, tamaños de alambres, etc., de acuerdo con los Códigos Eléctricos Nacional y Local. Instale un interruptor de desconexión en todos los alambres cerca de la bomba.

PRECAUCIÓN

Siempre desconecte la corriente eléctrica cuando maneje la bomba o los controles.

1.3. El cableado de los motores debe ser adecuado para la tensión. El diagrama del cableado del motor está en la placa del fabricante del motor. El tamaño del los alambres debe limitar la máxima caída de tensión al 10% de la tensión de la placa del fabricante en los terminales del motor, o la vida del motor y el rendimiento de la bomba se disminuirán.

1.4. Siempre use interruptores, contactores y arrancadores con clasificación de potencia nominal.

1.5. Protección del motor

1.5.1. Monofásico: La protección térmica en las unidades monofásicas a veces está incorporada (verifique la placa del fabricante). Si no se provee protección incorporada, use un contactor con la sobrecarga apropiada. Se permite usar fusible.

1.5.2. Trifásico: Proporcione protección en los tres alambres con arrancador magnético de tamaño apropiado y sobrecargas térmicas.

1.6. Límites máximos de operación:

Temperatura del líquido:	210°F (100°C) con sello estándar 250°F (120°C) con sello de alta temperatura opcional
Presión:	75 lib/pulg^2
Arranques por hora:	20, distribuidos uniformemente

1.7. La inspección y el mantenimiento regular aumentarán la vida de servicio. Establezca el programa de acuerdo al tiempo de funcionamiento. Refiérase a la Sección 8.

2. Instalación:

2.1. Generalidades

2.1.1. Coloque la bomba tan cerca de la fuente del líquido como sea posible (debajo del nivel del líquido para operación automática).

2.1.2. Proteja de la congelación o inundación.

2.1.3. Deje espacio libre adecuado para el servicio y la ventilación.

2.1.4. Toda la tubería debe estar soportada independientemente de la bomba, y debe "estar alineada" naturalmente.

PRECAUCIÓN

Nunca estire la tubería en el lugar forzando las conexiones de la succión y descarga de la bomba.

2.1.5. Evite los accesorios innecesarios. Seleccione los tamaños para mantener las pérdidas de fricción al mínimo.

2.2. Unidades compactas:

2.2.1. Estas unidades pueden instalarse horizontalmente, inclinadas o verticalmente.

PRECAUCIÓN

No instale con el motor debajo de la bomba. Cualquier fuga o condensación afectará al motor.

2.2.2. La cimentación debe ser plana y substancial para eliminar las deformaciones cuando se aprieten los pernos. Use montajes de goma para minimizar el ruido y las vibraciones.

2.2.3. Apriete los pernos de sujeción del motor antes de conectar la tubería a la bomba.

2.3. Unidades montadas en marco:

2.3.1. La placa de base debe estar unida, con lechada, a una cimentación con zapata sólida. Vea la Fig. 1.

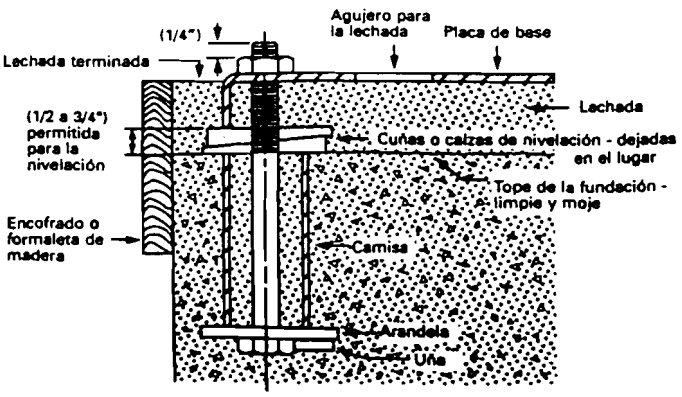


Figura 1

2.3.2. Coloque la unidad en posición sobre las cuñas ubicadas en cuatro puntos, (dos aproximadamente debajo del centro del motor y dos aproximadamente debajo del centro de la bomba). Ajuste las cuñas para nivelar la unidad. Nivele o ponga vertical las bridas de succión y de descarga.

2.3.3. Asegúrese de que la placa de base no esté distorsionada y se pueda hacer la alineación final del acoplamiento dentro de los límites ... movimiento del motor y poniendo calzas, si fuera necesario.

Apriete con los dedos los pernos de la cimentación y construya la presa alrededor de la cimentación. Vierta la lechada debajo de la placa de base asegurándose de que las áreas debajo de la bomba y de la pata del motor estén bien rellenas. Deje que la lechada fragüe por 48 horas antes de apretar totalmente los pernos de la cimentación.

2.3.5. Apriete los pernos de sujeción de la bomba y del motor antes de conectar la tubería a la bomba.

3. Tubería de succión:

3.1. Es deseable tener una tubería de succión directa, corta y una altura de aspiración estática baja. Para alturas de succión superiores a 10 pies y temperaturas del líquido superiores a 120°F, consulte la curva de rendimiento de la bomba para ver la Altura de Succión Positiva Neta requerida.

3.2. La tubería de succión debe ser por lo menos tan grande como la conexión de succión a la bomba. Un tamaño más pequeño disminuirá el rendimiento.

3.3. Si se requiere una tubería más grande, se debe instalar una reducción excéntrica (con el lado recto hacia arriba), en la bomba.

3.4. Instalación con la bomba abajo de la fuente de alimentación:

3.4.1. Instale en la tubería una válvula de aislación de todo el caudal para la inspección y mantenimiento.

PRECAUCIÓN

No use la válvula de aislación de succión para estrangular la bomba.

3.5. Instalación con la bomba arriba de la fuente de alimentación:

3.5.1. Evite las bolsas de aire. Ninguna de las partes de la tubería debe ser más alta que la conexión de succión de la bomba. Incline la tubería hacia arriba, partiendo de la fuente del líquido.

3.5.2. Todas las juntas deben ser estancas.

3.5.3. La válvula de pie debe usarse solamente si es necesario para el cebado o para mantener el cebado durante el servicio intermitente.

3.5.4. El área abierta del colador de succión debe ser por lo menos el triple del área de la tubería.

3.6. El tamaño de la entrada de la fuente del líquido, y la inmersión mínima sobre la succión, deben ser suficientes para impedir la entrada de aire a la bomba a través de vórtices. Vea las Figuras 2 a 5.

3.7. Use 3 a 4 vueltas de cinta de Teflon para sellar las conexiones roscadas.

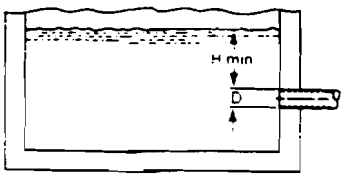


Figura 2

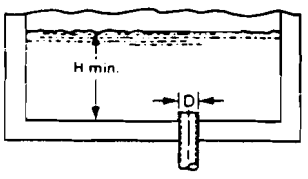


Figura 3

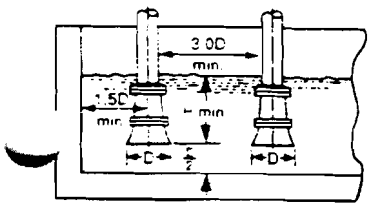


Figura 4

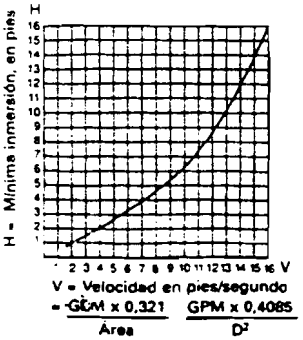


Figura 5

4. Tubería de descarga:

4.1. La disposición debe incluir una válvula de retención ubicada entre una válvula de compuerta y la bomba. La válvula de compuerta es para la regulación de la capacidad o para la inspección de la bomba o de la válvula de retención.

4.2. Si se requiere un aumentador, instale entre la válvula de retención y la bomba.

4.3. Use 3 a 4 vueltas de cinta de Teflón para sellar las conexiones roscadas.

5. Alineación del eje del motor al de la bomba:

5.1. Unidades compactas:

5.1.1. No se necesita alinear en el campo.

5.2. Unidades montadas en marco:

5.2.1. Aunque la unidad del motor y bomba pueda tener una alineación de fábrica, ésta pudo haberse alterado en tránsito y debe verificarse antes de hacer funcionar. Vea la Figura 6.

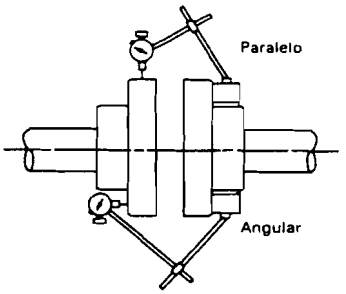


Figura 6

5.2.2. Apriete todos los pernos de sujeción antes de verificar la alineación.

5.2.3. Si es necesario realinear, siempre mueva el motor. Ponga calzas según se requiera.

5.2.4. Mala alineación paralela (ejes con ejes paralelos pero no concéntricos). Ponga el indicador de cuadrante en un cubo y gire este cubo 360° mientras hace lecturas en el diámetro exterior del otro cubo. La alineación paralela se obtiene cuando la lectura indicada total es de 0.005" (0,127 mm) o menos.

5.2.5. Mala alineación angular (ejes con ejes concéntricos pero no paralelos). Ponga el indicador de cuadrante en un cubo y gire este cubo 360° mientras hace lecturas en la cara del otro cubo. La alineación angular se obtiene cuando la lectura indicada total es de 0,005" (0.127 mm) o menos.

5.2.6. La alineación final se obtiene cuando se satisfacen los requerimientos de alineación paralela y angular, con los pernos de sujeción del motor apretados.

PRECAUCIÓN

Siempre vuelva a verificar ambas alineaciones después de hacer cualquier ajuste.

6. Rotación:

6.1. La rotación correcta es a la derecha (en sentido dextrorso cuando se mira desde el extremo del motor). Encienda y apague la corriente rápidamente. Observe la rotación del eje. Para cambiar la rotación:

6.1.1. Motores monofásicos: No reversibles.

6.1.2. Motores trifásicos: Intercambie dos cualesquiera de los conductores de alimentación de potencia.

7. Operación:

7.1. Antes de arrancar, se debe cebar la bomba (la tubería de succión llena de líquido y sin aire), y abrir parcialmente la válvula de descarga.

PRECAUCIÓN

El líquido bombeado proporciona lubricación. Si se hace funcionar la bomba en seco, las partes que giran se agarrotarán y se dañará el sello mecánico. No haga funcionar con caudal muy bajo o cerca de cero. La energía impartida al líquido se convierte en calor y el líquido puede convertirse en vapor. Las partes giratorias requieren líquido para impedir la formación de estrías o el agarrotamiento.

7.2. Haga una verificación completa después de que haya funcionado la unidad bajo condiciones de operación y se haya estabilizado la temperatura. Verifique la expansión de la tubería. En las unidades montadas en marco la alineación del acoplamiento pudo haber cambiado debido a la diferencial de temperatura entre el motor y la bomba. Vuelva a verificar la alineación.

8. Mantenimiento:

8.1. Unidad compacta. Los cojinetes de bolas están colocados adentro y son parte del motor. Están lubricados permanentemente y no requieren engrase.

8.2. Unidades montadas en marco:

8.2.1. El marco del cojinete se debe volver a engrasar cada 2,000 horas o a intervalos de 3 meses, el que ocurra primero. Use una grasa #2 con base de sodio o litio. Llene hasta que la grasa salga de las graseras o de los sellos de reborde, luego limpie el exceso.

8.2.2. Siga las instrucciones de lubricación del fabricante del motor y del acoplamiento.

8.2.3. La alineación se debe volver a verificar después de cualquier trabajo de mantenimiento que implique alguna alteración de la unidad.

9. Desmontaje:

Se describirá el desmontaje completo de la unidad. Prosiga solamente hasta donde se requiera para realizar el trabajo de mantenimiento necesario.

9.1. Apague la alimentación eléctrica.

9.2. Drene el sistema. Lave con chorro, si es necesario.

9.3. Unidades compactas: Quite los pernos de sujeción del motor.

Unidades montadas en marco: Quite el acoplamiento, el espaciador, el resguardo del acoplamiento y los pernos de sujeción del marco.

9.4. Desmontaje del extremo sumergido:

9.4.1. Quite los pernos (370) de la carcasa.

9.4.2. Quite el conjunto de desmontaje de la caja de rodamientos de la carcasa (100).

9.4.3. Quite la tuerca de seguridad (304) del impulsor.

PRECAUCIÓN

No inserte un destornillador entre los álabes del impulsor para impedir la rotación de las unidades compactas. Quite la tapa en el lado opuesto del motor. Se expondrá una ranura del destornillador o un par de filos normales al eje. Usándolos impedirá daños al impulsor.

9.4.4. Quite el impulsor (101) girando en sentido sinistrorso mirando al frente de la bomba. Protéjase las manos con telas o guantes.

PRECAUCIÓN

No quitar el impulsor en sentido sinistrorso puede dañar las roscas en el impulsor, el eje o en ambos.

9.4.5. Con dos barras de hacer palanca separadas en 180 grados e insertadas entre el alojamiento del sello (184) y el adaptador del motor (108), cuidadosamente separe las dos partes. La unidad giratoria del sello mecánico (383) debe salir del eje con el alojamiento del sello.

9.4.6. Empuje afuera el asiento estacionario del sello mecánico, del lado del motor del alojamiento del sello.

9.5. Desmontaje del marco del cojinete:

9.5.1. Quite la tapa (109) del cojinete.

9.5.2. Quite el conjunto del eje del marco (228).

9.5.3. Quite los sellos de reborde (138 y 139) del marco del cojinete y de la tapa del cojinete si están desgastados y se están cambiando.

9.5.5. Use un extractor de cojinetes o prensa de eje para quitar los cojinetes de bolas (112 y 168).

10. Reensamble:

10.1. Todas las piezas deben limpiarse antes del montaje.

10.2. Consulte la lista de piezas para identificar las piezas necesarias para la reparación. Especifique la bomba o el número de catálogo cuando pida las piezas.

10.3. Reensamblar o volver a montar es lo contrario de desmontar.

10.4. Observe lo siguiente cuando vuelva a montar el marco del cojinete:

10.4.1. Cambie los sellos de reborde si están desgastados o dañados.

10.4.2. Cambie los cojinetes de bolas si están flojos, ásperos o ruidosos al girarlos.

10.4.3. Verifique si el eje está descentrado. El máximo permisible es una lectura de indicador total de 0.002".

10.5. Observe lo siguiente cuando vuelva a montar el extremo sumergido:

10.5.1. Todos los componentes del sello mecánico deben estar en buenas condiciones o pueden haber fugas. Es buena práctica estándar cambiar todo el conjunto del sello en cualquier momento en que se haya quitado el sello.

Se permite usar un lubricante ligero, tal como glicerina, para facilitar el montaje. No contamine las caras del sello mecánico con lubricante.

10.5.2. Inspeccione el anillo en O (513) de la carcasa y cámbielo si está dañado. Este anillo en O puede lubricarse con vaselina para facilitar el montaje.

10.5.3. Inspeccione el anillo en O (349) del álabe director y cámbielo si está desgastado.

PRECAUCIÓN

No lubrique el anillo en O (349) del álabe director. Asegúrese de que no esté pellizcado por el impulsor al volver a montar.

10.6. Verifique la unidad que volvió a montarse viendo si está agarrotada. Corrija según se requiera.

10.7. Apriete los pernos de la carcasa en un patrón de estrella para impedir que se trabe el anillo en O.

11. Investigación de averías:

MOTOR NO FUNCIONA:
(Vea las causas 1 a 6)

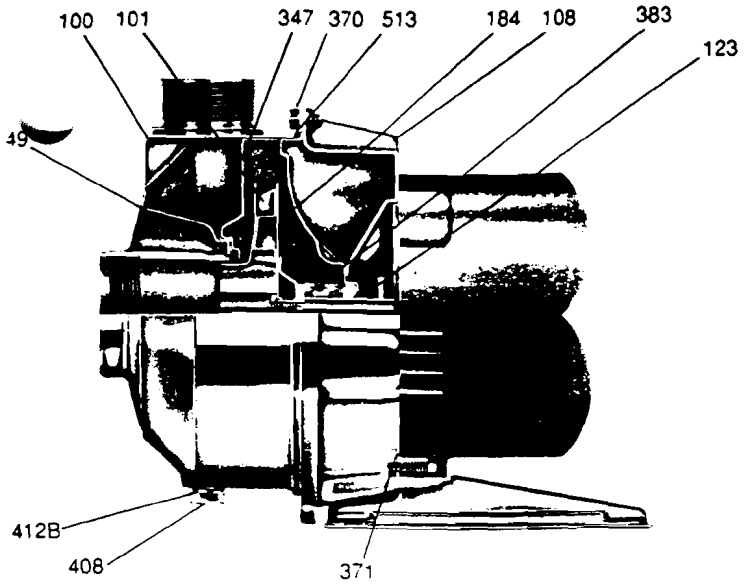
ENTREGA POCO O NADA DE LÍQUIDO:
(Vea las causas 7 a 17)

CONSUMO MUY ALTO DE CORRIENTE:
(Vea las causas 4, 17, 18, 19, 22)

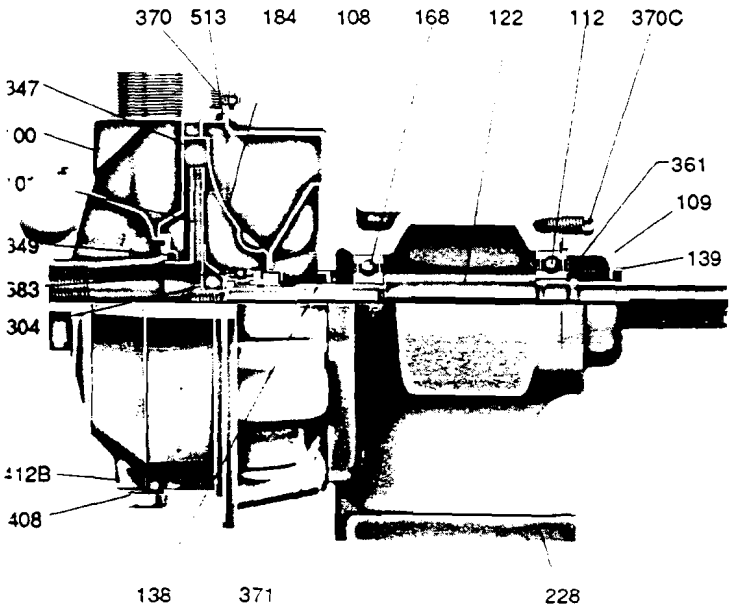
EXCESIVO RUIDO Y VIBRACIONES:
(Vea las causas 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

CAUSA PROBABLE:

1. Protector térmico del motor disparado
2. Interruptor automático abierto
3. Fusible quemado
4. Partes giratorias agarrotadas
5. Motor mal conectado
6. Motor defectuoso
7. Bomba no cebada
8. Taponada la descarga o cerrada la válvula
9. Rotación incorrecta
10. Válvula de pie demasiado pequeña, succión no sumergida, taponada la malla de entrada
11. Tensión baja
12. Pérdida de fase (trifásico solamente)
13. Aire o gases en el líquido
14. Demasiado alta la altura o carga del sistema
15. Demasiado baja la $ASPN_D$; (altura de succión positiva neta disponible);
    Demasiado alta la altura de aspiración o excesivas las pérdidas. Verifique con un calibrador de vacío.
16. Impulsor desgastado o taponado
17. Incorrecto el diámetro del impulsor
18. Demasiado baja la altura de descarga causando caudal excesivo
19. Demasiado alta la viscosidad o gravedad específica
20. Cojinetes desgastados
21. Bomba o tubería flojas
22. Bomba y motor mal alineados



NPE



NPE-F

Materiales de construcción

Componentes del extremo sumergido		
Artículo No.	**Descripción**	**Materiales**
100	Carcasa	AISI A.I. 304
101	Impulsor	
184	Alojamiento del sello	
304	Tuerca de seguridad del impulsor	
347	Álabe director	
349	Anillo en O, álabe director	Buna-N
370	Tornillos de cabeza hueca, carcasa	AISI A.I. 304
383	Sello mecánico	** vea el gráfico
408	Tapón de drenaje y ventilación, carcasa	AISI A.I. 304
412B	Anillo en O, tapón de drenaje y ventilación	Buna-N
513	Anillo en O, carcasa	Buna-N
Componentes del extremo motriz		
108	Adaptador	AISI A.I. 304
109	Tapa del cojinete	Hierro fundido
112	Cojinete de bolas (externo)	Acero
122	Eje	AISI A.I. 304
138	Sello de reborde (interno)	Buna/acero
139	Sello de reborde (externo)	Buna/acero
168	Cojinete de bolas (interno)	Acero
228	Marco del cojinete	Hierro fundido
361	Anillo de resorte	Acero
370C	Tornillo de casquete de cabeza hex., tapa cojinete	Acero enchapado
371	Tornillo de casquete de cabeza hex., adaptador	Acero enchapado

**Sellos mecánicos - Art. 383						
Pieza No.	**Servicio**	**Giratorio**	**Estacionario**	**Elastómero**	**Partes metálicas**	**Crane tipo**
10K46	Estándar	Carbono	Cerámica	Buna	18.8 S.S.	21
10K18	Alta temperatura - opcional		Resist. Ni.	EPR		
10K24	Servicio químico - opcional		Cerámica	Viton		
10K55	Alta temperatura - opcional		Tungsteno			
10K29	Servicio severo - opcional	Carbono de silicio		Buna		

GARANTÍA LIMITADA

Esta garantía se aplica a todas las bombas y accesorios relacionados fabricados y/o suministrados por Goulds Pumps, Inc.- Water Systems Division.

Cualquier pieza o piezas que se encuentre defectuosa dentro del periodo de garantía será reemplazada sin cargo al comprador o a cualquier propietario subsiguiente, durante el periodo de garantía. El periodo de garantía será por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses de la fecha de fabricación, de ambos el que expire primero.

Un cliente que crea que existe una reclamación de garantía debe comunicarse con el agente autorizado de donde se compró el equipo originalmente y suministrar detalles completos relativos a la reclamación. El agente está autorizado a ajustar cualquier reclamación de garantía utilizando el Departamento de Relaciones del Cliente de Goulds y la organización de su distribuidor.

a garantía excluye (a) La mano de obra, transporte y costos relacionados incurridos por el consumidor para poner el equipo alegadamente defectuoso a disposición del agente para la ección. (b) Los costos de reinstalación de equipo reparado. (c) Los costos de reinstalación de equipo de reemplazo (d) Los daños emergentes de cualquier clase. (e) Reembolso por didas causadas por la interrupción del servicio.

Metering Pump

PULSA Series®

DIAPHRAGM METERING PUMPS

Installation Operation Maintenance Instruction

Bulletin No. IMP-96

PULSAFEEDER
A Unit of IDEX Corporation

Manufacturers of Quality Pumps, Controls and Systems.

ENGINEERED PUMP OPERATIONS
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INTRODUCTION

GENERAL DESCRIPTION

PULSA Series metering pumps are positive displacement, reciprocating pumps. They combine the high efficiency of plunger pumps with a diaphragm seal to eliminate product leakage. Each pump consists of a power end and a liquid end separated by the hydraulically operated diaphragm. Individual pumps may vary in appearance due to various liquid ends, accessories and multiplexing. The basic principles of operation however, remain the same.

PRINCIPLES OF OPERATION

I. OVERALL OPERATION

Figure 1
A piston reciprocates within an accurately sized cylinder at a preset stroke length displacing an exact volume of liquid. This piston however does not pump various chemicals. It pumps a stable oil that has excellent lubricating qualities. A diaphragm separates the oil from the product pumped. The diaphragm is free to move within contoured support plates in exact response to the volume displaced by the piston. The diaphragm does no work but acts only as a separator. Consequently, the displacement of the oil is translated into an equal amount of product displacement. The reciprocating action of the piston causes the product to enter through the suction check valve as the piston travels to the rear of its chamber. A like quantity of product is discharged through the discharge check valve on the forward stroke of the piston.

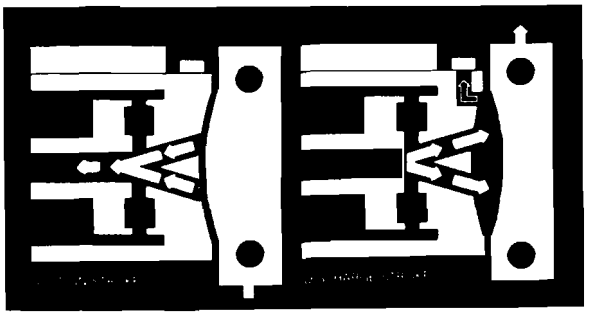


Fig. 1

II. COMPONENT OPERATION

Figure 2 illustrates a typical model fitted with a flat diaphragm head and external stroke adjustment. As mentioned previously individual pumps may vary in appearance but the operating principles are the same. Study the figure carefully and become familiar with the function of the various subassemblies and the terminology used.

A. Standard Flat Diaphragm Reagent Head Assembly

Figure 3 shows a typical flat diaphragm reagent head assembly. This assembly, consists of reagent head, diaphragm and suction and discharge check valves. The head design protects the diaphragm and maximizes flow. The valves, inserted at the top and bottom of the head contain precision ground balls or disks that assure free liquid flow. The reagent head assembly is the only part of the pump to come in contact with the liquid being pumped. Consequently proper maintenance of the reagent head assembly is critical for optimum pump performance.

B. HYDRATUBE Reagent Head Assembly

Figure 4
The HYDRATUBE Head Assembly consists of a ductile iron casting which positions the HYDRATUBE and contains the intermediate liquid, a support plate to protect the diaphragm from over-travel, and suction and discharge check valves. The HYDRATUBE is a flexible elastomer or PFA cylinder that confines and isolates the liquid pumped from any contact with the hydraulic system. The HYDRATUBE responds exactly to the action of the primary flat diaphragm through the medium of an inert intermediate liquid which can be selected for compatibility with the liquid pumped.

C. Custom Head Assemblies

Figure 5

Certain applications involve conditions which cannot be handled using a standard assembly. For these, Pulsafeeder offers a variety of custom head assemblies. They use the same basic parts as the standard assembly but incorporate different mounting arrangements and sometimes multiple parts.

D. Pump Head/Piston Assembly

Figure 6

The pump head piston assembly mounts at the end of the hydraulic oil reservoir referred to as the gearbox. This assembly contains the pumps hydraulic system which consists of a pumphead, cylinder, piston assembly, diaphragm support plate and 3 valves referred to as the automatic bleeder, hydraulic makeup valve, and hydraulic bypass valve. The automatic bleed valve is located at the top of the pumphead and is used to remove gases from the hydraulic system. The hydraulic makeup valve, depending on the type, may be located inside the gearbox or externally below the pumphead. It automatically replaces any hydraulic oil which is lost past the piston or through the automatic bleeder. The hydraulic bypass valve protects the pump from damage in case of system failure by relieving any excess pressure in the hydraulic system. Again depending on the type, it may be located inside the gearbox or externally on the pumphead.

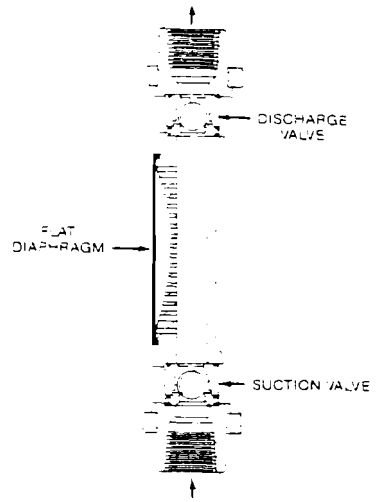


Fig. 3

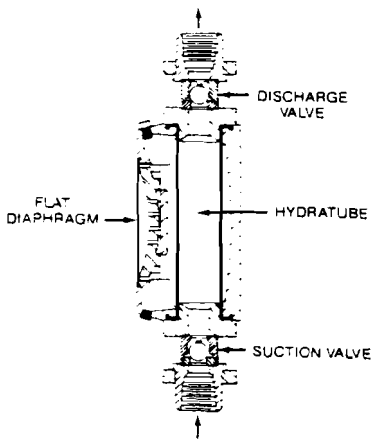


Fig. 4

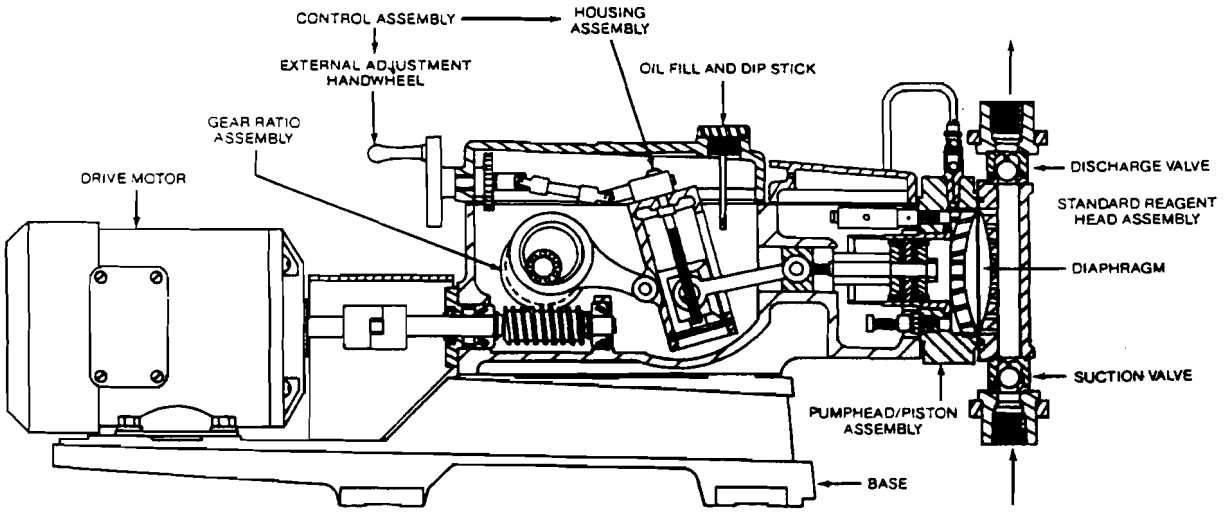
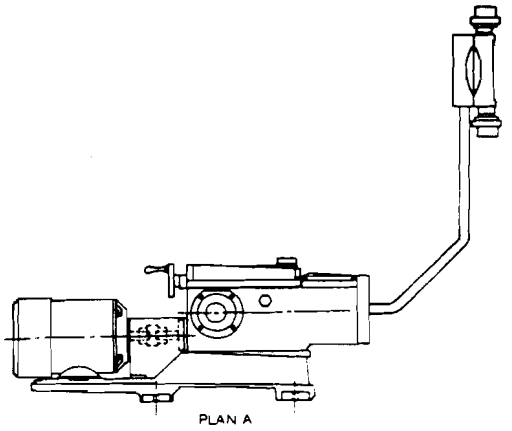
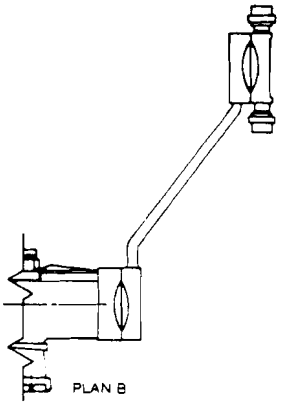
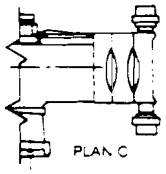
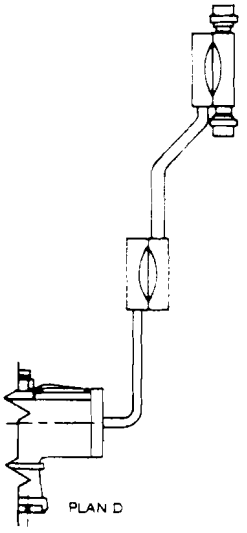


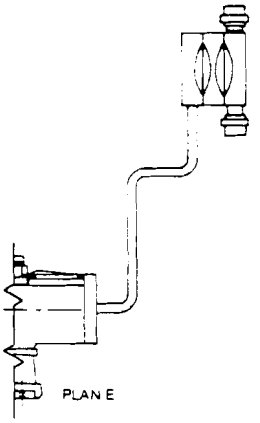
Fig. 2

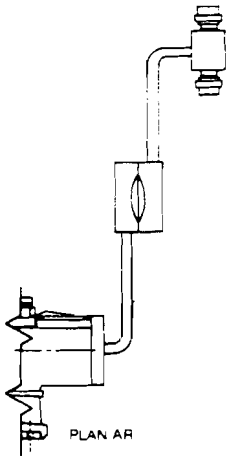












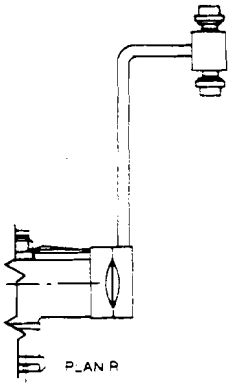


Fig. 5

E. Control Assembly

By changing the length of the piston stroke in a pump, the amount of product displaced can be increased or decreased. PULSA Series diaphragm metering pumps, Models 7120 to 8480 contain an adjustment mechanism which controls stroke length (Figure 7). The mechanism consists of an oscillating housing, a slider block which fits inside the housing and a connecting rod attached to the block. The housing pivots on horizontal bearing pins and oscillates through a fixed arc from the action of the eccentric-driven rear connecting rod. The position of the block within the housing is adjustable (through manual or automatic control). Figure 2 shows a manual control assembly, rotating the external handwheel causes a threaded shaft in the housing tc turn.

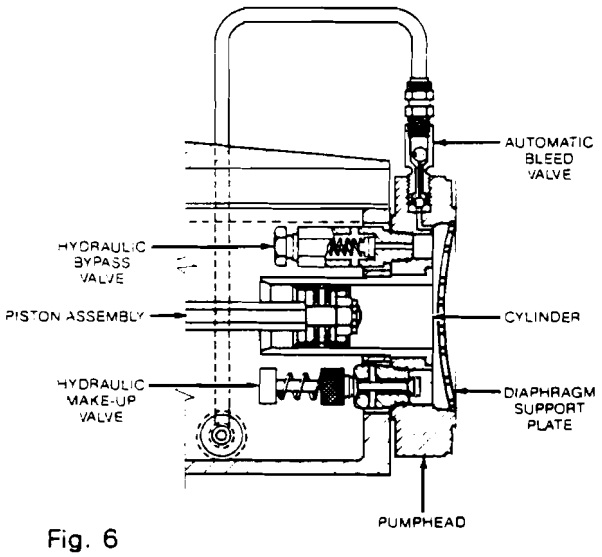


Fig. 6

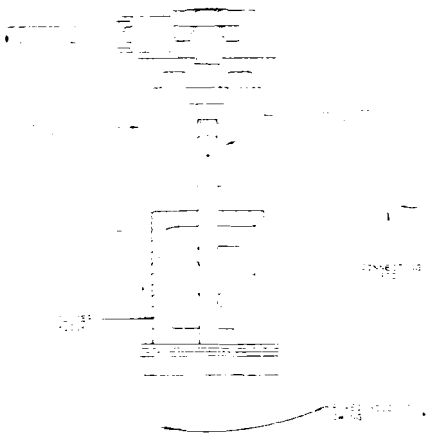


Fig. 7

This shaft is threaded through the block and raises or lowers the block as the handwheel is turned. When the block is centered on the pivot point of the housing it is motionless. As it is lowered off center it develops increasing reciprocating movement (Figure 8) which is transmitted through the connecting rod. Side thrust on the piston is eliminated by the use of a crosshead block which travels in a bore between the connecting rod and piston assembly.

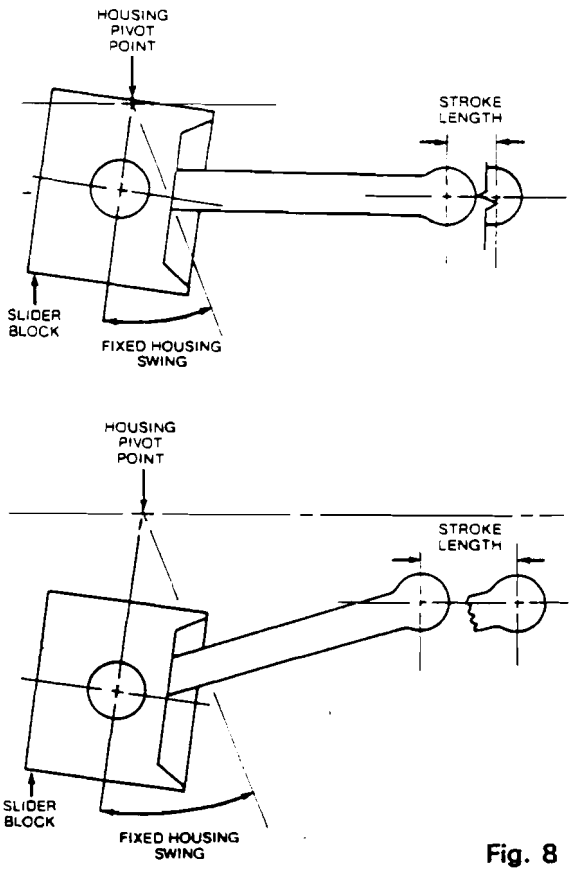


Fig. 8

F. Gear Ratio Assembly

Pulsafeeder pumps are generally driven by a standard electric motor. The motor drives a set of worm gears which convert rotational speed into torque. They in turn power the eccentric shaft assembly that converts rotary to reciprocating motion.

More than one pump can be driven through a single drive assembly. This is referred to as multiplexing. The pumps are mounted on a common base and one of two drive arrangements is used. In the first (Figure 9) one pump acts as a driver and powers the other pumps through extended eccentric shafts. The driven pumps contain no worm gears. In the second arrangement (Figure 10) an external gear reducer is used to drive all the pumps which again are connected through extended eccentric shafts. In this case none of the pumps contain worm gears.

Whenever pumps are multiplexed they are set up to cycle in a specific sequence in order to place a uniform load on the driver. Before disassembling the eccentric shaft couplings, always note the relative position of each shaft so that they can be reassembled in the same position.

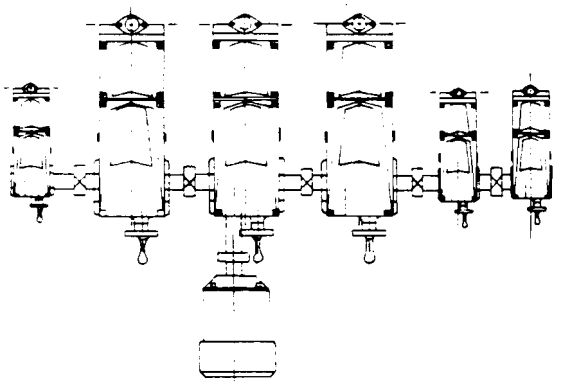


Fig. 9

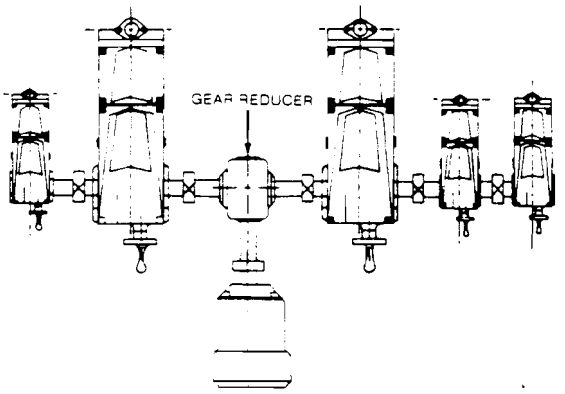


Fig. 10

EQUIPMENT INSPECTION

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage should be reported immediately to the carrier and to your PULSA Series representative.

STORAGE INSTRUCTIONS

I. SHORT TERM

Storage of PULSA Series pump for up to 12 months after shipment is considered short term. Under this condition the recommended storage procedures are as follows:

A. The pump should be stored indoors at room temperature in a dry environment.

B. Pumps with a HYDRATUBE reagent head assembly are shipped with the diaphragm in the neutral position. It must be kept in this position during storage. Refer to MAINTENANCE. Section II B.

C. The pump gearbox and hydraulic reservoir is to be completely filled with PULSAlube oil within two months after date of shipment.

D. The gearbox and hydraulic reservoir should be inspected every 3 to 6 months. Maintain the oil level and assure that no water or condensate builds up in the gearbox. If water or condensation is present, follow Procedure II, Step A below.

E. It is recommended that the stroke length of the pump be adjusted to its midpoint and that the piston be manually cycled through 3 to 6 cycles every 6 months.

F. Prior to start-up, perform a complete inspection and then start up in accordance with instructions in this manual.

II. LONG TERM

For storage longer than 12 months in addition to the above, the following procedures should be followed.

A. Every twelve months PULSAlube oil should be drained from the gearbox and hydraulic reservoir. The gearbox and hydraulic reservoir should be flushed with kerosene or petroleum base solvent, thoroughly dried out with a rag, and then refilled with fresh PULSAlube oil.

B. Every twelve months the motor should be connected to a power source and the pump operated for a minimum of one hour. It is not necessary to have liquid in the reagent head during this operation but the suction and discharge ports must be open to atmosphere.

After twelve months storage Pulsafeeder's warranty cannot cover such items as oil seals, gaskets, piston cups and other items which are subject to deterioration with age. If the pump has been in storage for longer than 12 months it is recommended that these items be replaced prior to going into service. Material and labor to recondition or replace this class of item is the purchaser's responsibility. For a one year service warranty after extended storage the refurbishment and equipment inspection must be done by a Pulsafeeder serviceman.

INSTALLATION

I. LOCATION

When selecting an installation site, or designing a skid package, consideration should be given to access in order to perform routine maintenance.

PULSA Series pumps are designed to operate indoors or outdoors but it is desirable to provide a hood or covering for outdoor service. Alternate oil or external heating is required if ambient temperatures will be below 40°F (4.4°C). Check with the factory if concerned with the suitability of the operating environment.

The pump must be rigidly bolted to a solid and flat foundation to minimize vibration. Vibration can loosen gaskets and pipe connections. When the pump is bolted down care must be taken to avoid distorting the base and affecting alignments. This is especially important for multiplex units. The pump must be level within 2°. This will assure that the oil in the gearbox is maintained at the correct level and that the check valves can operate properly.

II. PIPING SYSTEM

Figure 11 illustrates the piping system for a standard pump. Custom head assemblies require special piping arrangements, refer to separate instructions. Regardless of the arrangement required, all piping systems should include the following:

A. Shut off valves and unions (or flanges) on the suction and discharge piping. This allows routine inspection of the check valves without draining long runs of piping. The shut off valves should open to full pipe line diameter. Ball valves are preferred (do not use needle valves).

B. An inlet strainer if the product is not a slurry. Pump check valves are susceptible to dirt and other contaminants unless designed for that service. Any accumulation can cause a malfunction. The strainer should be placed between the suction shut-off valve and the pump suction valve. The sizing must accommodate the flow rate and expected contamination, one

hundred mesh screen is generally used.

C. Hangers and straps to support piping.

Do not allow the weight of the piping to be supported by the valve housings or other portion of the reagent head, or leaks will occur. Where necessary provide for thermal expansion and contraction so that no strain is placed on the pump.

D. Vacuum/pressure gauges in the suction and discharge lines are recommended in order to check system operation. All gauges should incorporate shut-off valves to isolate them when they are not being monitored.

E. In addition, a separate process relief valve should be installed in the process piping to protect piping and sensitive process equipment.

In assembly of piping, use pipe thread tape or similar compound compatible with the product being handled. Whether new or existing piping is used all lines should be flushed with a clean liquid and blown out with air before making final connections to the pump. Ensure that the flushing liquid is compatible with the liquid to be pumped.

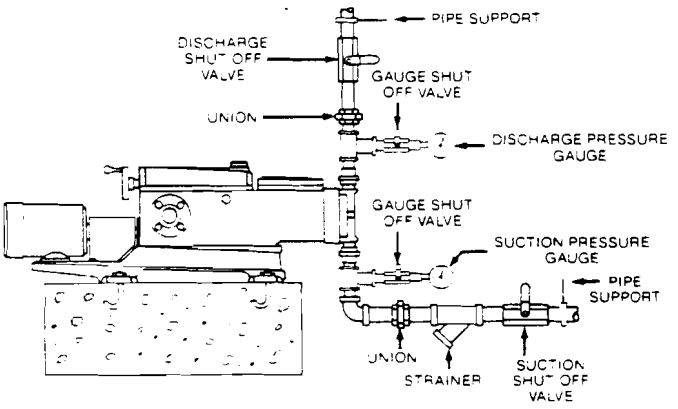


Fig. 11

III.SUCTION PRESSURE REQUIREMENTS

Although PULSA Series metering pumps have the capability of suction lift, an installation will be easier to operate with flooded suction. Wherever possible, the pump should be located below the level of the suction side reservoir and as close to it as possible.

If suction lift is required, the minimum practical suction pressure is 9.5 psia. Below this pressure the hydraulic makeup valve will not operate properly and degasification of the hydraulic oil can occur. In addition the suction pressure must be at least 5 psi above the vapor pressure of the liquid being handled.

Refer to Appendix I for information on calculating suction pressure.

IV. DISCHARGE PRESSURE REQUIREMENTS

All PULSA Series metering pumps are designed for continuous service at the rated discharge pressure. To prevent liquid flow through, it is necessary that the discharge pressure exceed suction pressure by at least 5 psi. When pumping downhill, a back pressure valve should be placed in the discharge line.

Refer to Appendix I for information on calculating discharge pressures.

V. AUTOMATIC CONTROL

Pumps equipped with either electronic or pneumatic output controls are supplied with separate instructions on hookup and adjustment. Make all required connections prior to performing a start-up procedure.

EQUIPMENT START UP

I. LUBRICATION

Every PULSA Series metering pump is tested at full capacity and operating pressure before shipment. However, for shipping purposes the gearbox and hydraulic reservoir oil has been removed. Fresh oil is included in separate container(s).

CAUTION!

1. Do not run pump without oil.

2. Do not remove main gear box cover while pump is running.

3. Do not run pump with coupling guard removed.

4. Do not put hands or fingers in gear box or reservoir when pump is running.

5. Do not remove the front gearbox cover while the pump is running (Model 7440, 3 inch piston only).

A. Oil Specifications

PULSAlube #1 is a custom blended lubricant which is suitable for most PULSA Series applications. It has an effective temperature range of 40°F to 280°F (4.4°C to 137.8°C). For adverse temperature conditions, -40°F to +400°F (-40°C to 204°C) PULSAlube #5 must be used. For complete specifications refer to Appendix II.

B. Oil Capacities

All PULSAlube oils are available in:

- 1 quart containers (.95 liters)
- 1 gallon containers (3.8 liters)
- 5 gallon containers (18.9 liters)
- 55 gallon drums (207 liters)

It is recommended that an adequate supply of PULSAlube be on hand to handle periodic oil changes and emergency requirements.

The amount of oil required to fill PULSA Series gearboxes is as follows:

- 7120 - 1.0 gallon (3.8 liters)
- 7440 - 1.0 gallons (3.8 liters)
- 7660 - 6.0 gallons (22.7 liters)
- 8480 - 8.0 gallons (30.3 liters)

C. Oil Fill

All PULSA Series pumps use a partitioned gearbox to provide oil reservoirs for the gear/control mechanism and hydraulics. Most models utilize a separate cover for each reservoir, the exception being AE (Auto Electric Control) models which have a full length cover with a removable front section. The purpose of the front cover (hydraulic reservoir) is to provide a free acting diaphragm which allows the reservoir to breathe and at the same time seals it from the atmosphere.

AG(Agricultural) models do not use this diaphragm but instead have an external breather to vent the gearbox. Also, due to the high displacement on some model 7440's an external breather is used in conjunction with a diaphragm cover.

Figure 12 portrays a typical model. Depending on the control option ordered, the covers may vary in appearance. Before filling the gearbox check Section B to determine the approximate oil capacity. Add oil through the dip stick opening labeled OIL FILL. Add oil until the level reaches the mark on the dip stick,(the dipstick must be screwed in). It may take time for the oil level to stabilize since the liquid must transfer to the front reservoir. If desired the front cover can be removed and oil poured directly in. The final oil level should be 1/2" to 3/4" from the top of the reservoir. (cover removed). Do not overfill. When replacing the cover make sure the diaphragm is properly lined up.

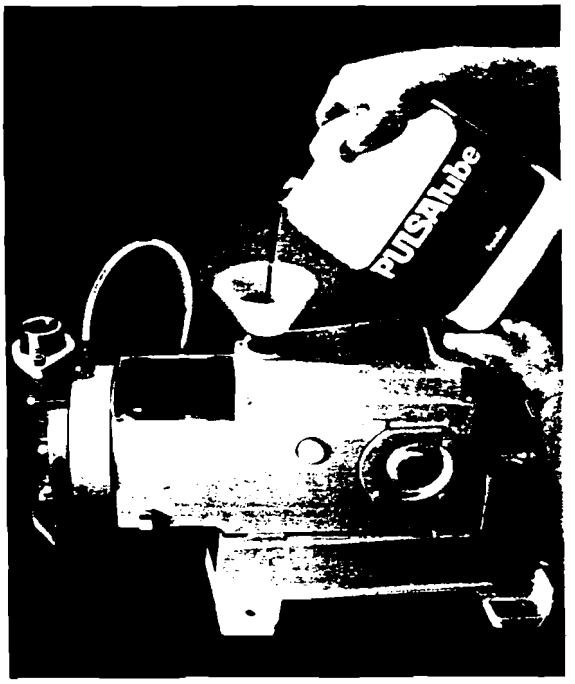


Fig. 12

D. Oil Change

The recommended oil change interval is dependent upon the operating environment, two classifications are used.

1. Normal Service: Clean/Dry atmosphere and a gearbox operating temperature of 40°F to 100°F (4.4°C to 37.7°C).

2. Severe Service: Humid atmosphere and a gearbox operating temperature below 40°F or over 100°F.

The first oil change should be done after 6 months of continuous operation (approximately 4500 hours) and then every 12 months (9000 hours) for normal service and every 6 months (4500 hours) for severe service. Follow the procedure below when changing the oil.

1. Remove all pressure from the reagent head.

2. Disconnect power to the motor.

3. Remove the motor coupling guard.

4. Set the pump stroke to 0%.

5. Remove both covers from the pump (refer to MAINTENANCE, Section XI).

6. On the side of the pump at the bottom of each reservoir is a pipe plug, remove these to drain the oil. Note, on some models an oil return tube may be piped to the drain hole, remove the tube and fitting to drain the reservoir. It is not necessary to drain the oil in the hydraulic system including any piping to remote heads unless the system has been contaminated due to a diaphragm failure.

7. Wash down the inside of the gearbox with kerosene or a petroleum base solvent. It may be helpful to rotate the motor coupling by hand in order to reach all areas of the box.

8. Flush the box and remove all traces of solvent by drying out the box with a rag. Replace the pipe plugs and/or fittings.

9. Refill both reservoirs with fresh PULSAlube oil. The level should be 1/2" to 3/4" from the top of each reservoir.

10. Reinstall the covers. Grease the slip joint and gearing on top of the oscillating housing prior to installing the rear cover. (Refer to MAINTENANCE, Section XI).

11. Reinstall the coupling guard.

II. START UP

A. Output Adjustment

Due to the possibility of piping leaks it is best to start the pump at 0% output and then slowly increase the setting to 100%.

The manually controlled PULSA Series pump is equipped with a handwheel for stroke length adjustment. Mounted on the back of the cover (Figure 13), the handwheel can be turned to any setting from zero to 100%. A digital indicator shows the setting for output reference. (See Table I for maximum indicator readings).

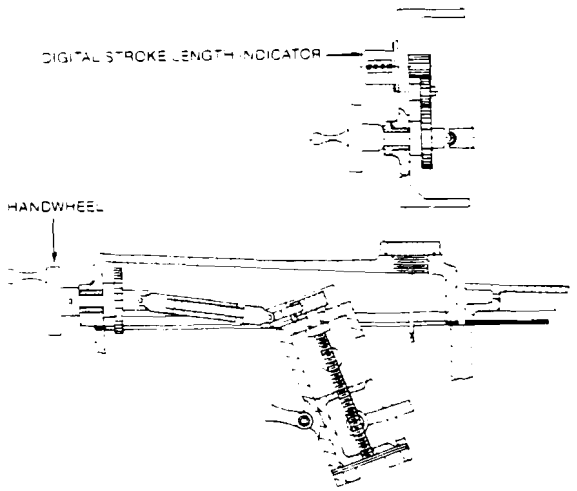


Fig. 13

MAXIMUM STROKE LENGTH
INDICATOR READINGS

PUMP MODEL	MAXIMUM READING
7120	0400
7440	0400
7660	0500
8480	01415

Table I

Pumps equipped with automatic electronic control can be adjusted either manually or through electronic control. Refer to Bulletin No. 418 for further information. Pumps equipped with pneumatic control cannot be adjusted manually therefore an instrument air signal is required for start-up. Refer to Bulletin No. 411-86 for further information.

Regardless of the type of control, pump output should only be adjusted when the pump is running.

B. Priming the Pumphead

(Standard heads only, refer to separate instructions for custom heads).

All pumps, excluding those with remote pump heads, are shipped with a fully primed hydraulic system. However, during shipping and handling some air may enter the hydraulic system due to the reservoir being empty. This air will automatically be purged after a short run-in period.

C. Priming the Reagent Head

(Standard heads only, refer to separate instructions for custom heads).

1. Open the suction line and discharge line shut-off valves.

2. If the piping system design and the storage tank are such that the product flows by gravity to the pump, no priming is required. If, however the discharge line is under high pressure with a considerable quantity of air trapped, it may be necessary to lower the discharge pressure to enable the pump to prime itself.

3. If the pump must handle a suction lift, it may be necessary to prime the reagent head and suction line. Try priming the reagent head first. Remove the discharge valve by unscrewing the two tie bar bolts and then lifting the valve out as a complete unit. Fill the head with the process liquid, or a compatible liquid, then replace the valve in the same orientation and retighten the tie bar bolts. The pump is now ready for start-up.

4. Start the pump at 0% and slowly increase the stroke setting to 100%. If the pump does not prime then the suction line will have to be filled also.

This will require the use of a foot valve or similar device on the end of the suction line so that liquid can be held in the line above the reservoir level. Remove the suction valve assembly to fill the line. Replace the valve and fill the reagent head as described in Step 3. The pump will now prime itself.

D. Calibration

All pumps must be calibrated in order for the operator to know the required stroke setting for particular outputs.

A typical displacement chart is shown in Figure 14. The output is linear with respect to indicator settings. However, an increase in discharge pressure decreases output and describes a line parallel to the line of output at atmospheric pressure.

Capacity at atmospheric pressure is a theoretical value equal to the hydraulic wipe of the piston (cross sectional area X stroke). As discharge pressure is increased there is a corresponding decrease in capacity at a rate of approximately 1% per 100 psi (7Kg/cm^2) increase in pressure. Whenever possible calibration should be performed under actual process conditions (i.e. same or similar liquid at system pressure).

To assure a completely sound hydraulic system, run the pump for one half to one hour prior to calibration. This will allow the automatic bleed valve to purge any air from the system.

To construct a calibration chart check the capacity several times at three or more stroke length settings (i.e. 25%, 50%, 75% & 100%) and record these valves on linear graph paper. For all stable conditions, these points should describe a straight line.

On models with external stroke adjustment, calibration can be disturbed when the cover is removed (Refer to MAINTENANCE, Section XI for details).

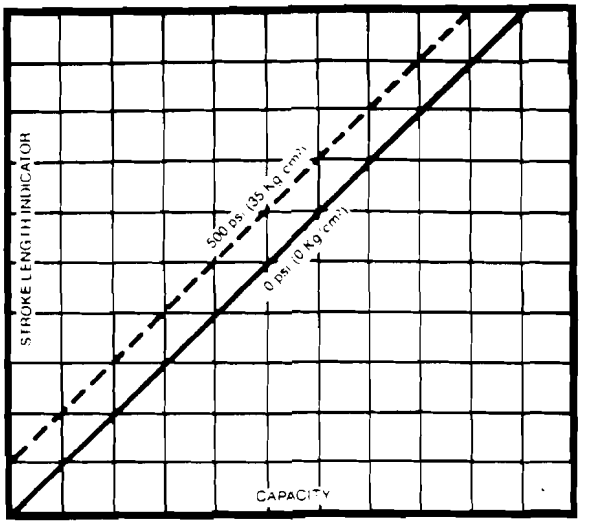


Fig. 14

MAINTENANCE

CAUTION

Before performing any maintenance requiring reagent head (wet-end) disassembly be sure to remove pressure from the piping system and flush pump thoroughly with a neutralizing liquid. Wear protective clothing and handle equipment with proper care.

Accurate records in the early stages of pump operation will reveal the type and amount of maintenance that will be required. A preventative maintenance program based on these records will insure trouble-free operation. It is not possible in these instructions to forecast the life of such parts as the diaphragm, check valves and other parts in contact with the product you are handling. Corrosion rates and conditions of operation affect the useful life of these materials so an individual metering pump must be gauged according to particular service conditions.

PULSA Series Kopkits contain all replacement parts normally used in a preventative maintenance program. It is recommended that Kopkits and PULSAlube oil be kept available at all times.

All PULSA Series pumps are shipped with an individual specification data sheet supplied in the parts list package. This data sheet contains important information relating to both the application and the pump specifications (materials, piston size, stroking rate etc.). Please refer to this sheet during maintenance operations and when ordering spare parts.

I. WET END REMOVAL, INSPECTION AND REINSTALLATION

A. Flat Diaphragm

PULSA Series flat elastomer, TFE and metal diaphragms are not subject to stress fatigue and will not fail from repeated flexure in normal use. However, long-time accumulation of foreign material or entrapment of hard sharp particles between the diaphragm and dish cavity can eventually cause failure. Failure may also occur as a result of over-pressurization or chemical attack. Periodic inspection of all flat diaphragms is desirable. (Figure 15).

Fig. 15

To remove the diaphragm the first six steps are the same for TFE or metal diaphragms, custom head assemblies included.

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous liquid.

4. Close the inlet and outlet shut-off valves.

5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if liquid is hazardous.**

6. Place a pan under the pump head to catch oil or intermediate liquid leakage.

   CAUTION: If the diaphragm has failed, product may have contaminated the pump oil. Handle with proper care.

   For plastic and elastomer diaphragms, follow Steps 7 through 15. For metal follow Steps 16 through 21.

7. Remove all but one top reagent head bolt. Oil (or intermediate liquid depending on the model), will leak out between the heads as the bolts are loosened.

8. Rotate the head and pour any residual product/neutralizing agent trapped by the check valves into a suitable receptacle. **Use extreme caution if hazardous.** Custom head assemblies utilizing remote valves may require disassembly of the pipe between the reagent head and valves.

9. Remove the last bolt and rinse the head in water or a compatible liquid.

10. PULSA Series TFE and elastomer diaphragms incorporate an integral "o" ring design which seats into the reagent head. If the diaphragm has been damaged, insert a knife along the diaphragm's periphery and pry it out. If plastic head construction, use extreme caution so as not to mar, gouge, or damage the head or sealing area during diaphragm removal. If the diaphragm cannot be removed by this method use air pressure as described in Step 11.

11. If there is no evidence of damage on the pump head side, the diaphragm can be removed for complete inspection by forcing compressed air into the suction port while plugging the discharge port. Inspect the diaphragm for damage. It may appear convex or concave as a result of conforming to the dishplates. This is a normal condition and does not require replacement. If the diaphragm appears warped, deformed or excessively dimpled replace it.

12. On diaphragm reinstallation, it is not necessary to follow the original orientation to the reagent head or pump head hole pattern. Set the diaphragm in place on the reagent head and work the integral o-ring into place by pressing around the periphery. Insure that the diaphragm sealing area is clean and free of debris.

13. Before mounting the reagent head make sure the pump head dish plate is seated in the head with the concave cavity facing the diaphragm, and one of the four holes closest to the edge of the dish plate is at the top of the pump head (Figure 16). This assures that any gases are vented out of the dish cavity.

14. Reinstall the reagent head bolts and tighten in an alternating pattern to ensure an even seating force. Refer to Appendix III for recommended torque values.

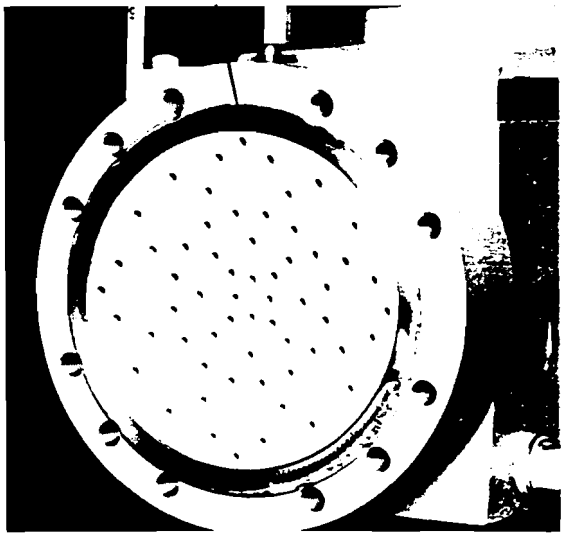


Fig. 16

15. For repriming follow procedures in MAINTENANCE, Section II.

The following steps apply to metal diaphragms:

16. As the diaphragm is sealed by "o" rings, or gaskets, at both the pump head and reagent head, leakage of both oil and product pumped can occur simultaneously when the reagent head bolts are loosened. It is, therefore, desirable to remove the inlet check valve to drain the reagent head and cavity of any residual product/neutralizing agent. **Use extreme caution if hazardous.**

17. When removing the reagent head bolts leave the two bottom ones in place but back them out until the heads can be separated and the diaphragm is exposed at the top. Carefully extract the diaphragm using needle nose pliers. If the pump is equipped with a PULSAfram, leak detection diaphragm then the vacuum tube leading from the diaphragm to the alarm will have to be disconnected at the alarm.

18. The diaphragm should appear smooth and flat. If there are any signs of damage such as dents, nicks or cracks, replace it.

19. If the "o" rings are extruded or cut, replace them. On older models with flat gaskets replace the gaskets each time the head is removed. The gaskets must be properly centered on the serrations located on the pump and reagent head. In order to facilitate installation hold the gaskets in place with a compatible adhesive.

20. Before reassembly, make sure all faces of the reagent head and pump head are clean. See Appendix III for recommended torque values.

21. For repriming follow procedures in MAINTENANCE, Section II.

B. HYDRATUBE Diaphragm

Like flat diaphragms, the HYDRATUBE is not subject to stress fatigue and will not fail from repeated flexure. Failure may occur however as a result of improper prime, over-pressurization or chemical attack.

To remove and reinstall the HYDRATUBE the first 7 steps are the same for elastomer or PFA HYDRATUBE. (See Figures 17a and b).

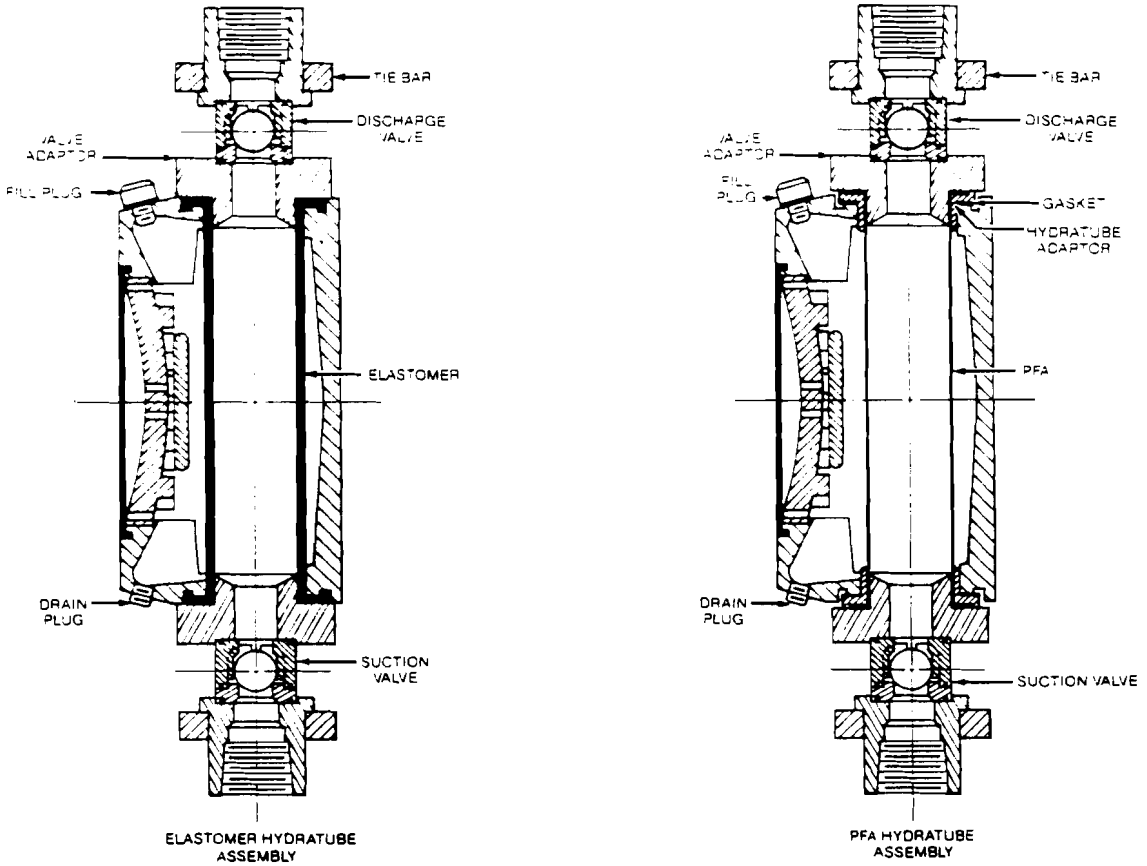


Fig. 17a and b

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.

4. Close the suction and discharge shut off valves.

5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if the product is hazardous.**

6. Remove the top fill plug from the HYDRATUBE housing. Next place a pan under the housing and remove the bottom pipe plug to drain the intermediate liquid. Note: On models equipped with a CHEMALARM the bottom pipe plug is replaced with a conduction probe. Refer to separate instructions for removal and reinstallation of the probe.

CAUTION: If the diaphragm has failed, intermediate liquid could have process liquid mixed into it. If the primary diaphragm has also failed, product may have contaminated the pump oil. Handle with proper care.

7. Remove the tie bars, valves and valve adapters from both the suction and discharge.

For elastomer HYDRATUBES follow Steps 8 through 20. For PFA HYDRATUBES follow Steps 21 through 36.

8. Pick up on edge of the HYDRATUBE flange (Figure 18) and push that same edge down the throat of the HYDRATUBE. The balance of the flange will fold and follow.

Fig. 18

9. Pull the HYDRATUBE out from the bottom of the housing by a combination of twisting and bending sideways.

10. Inspect the HYDRATUBE for any damage, i.e. cuts, cracks, chemical attack or excessive deformation. Replace if necessary.

11. When installing a HYDRATUBE do not use tools which may cut or damage the tube.

12. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

13. Fold a point on the edge of the flange upward (Figure 19). Push the edge down the throat of the HYDRATUBE (Figure 20). Fold the sides of the flange inward to form a compact 45° "nose" and wrap tightly with a rubber band (Figure 21). This wrapped nose should be reasonably compact and secure.

14. Work the wrapped nose of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the tube upward to the top of the housing.

Fig. 19

Fig. 20

15. At this stage, with a slight push at the bottom flange of the HYDRATUBE guide the nose of the HYDRATUBE to the center and out the top hole in the housing (Figure 22)

16. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded, reinstall the bottom valve adaptor and drain plug and then partially fill the housing with the appropriate liquid.

Fig. 21

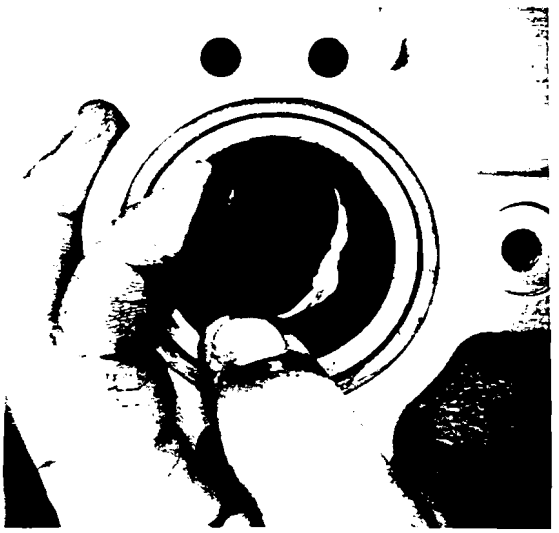


Fig. 22

17. Remove the rubber band.

18. Unfold the top flange (Figure 23) and center both the top and bottom of the HYDRATUBE.

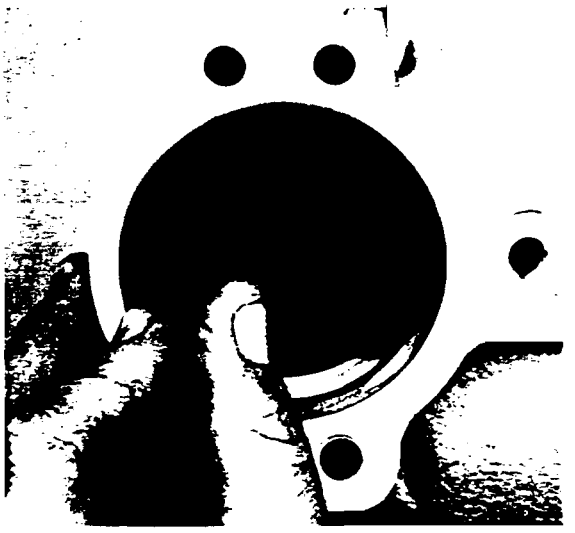


Fig. 23

19. Reassemble the top and bottom adaptor parts, torquing the tie bar bolts to the recommended value, see Appendix III. Replace the bottom drain plug.

20. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat diaphragm repriming procedure before repriming the intermediate or housing chamber. See MAINTENANCE, Section II.

The following steps apply to PFA HYDRATUBES.

21. Pick up the edge of the HYDRATUBE flange and bend it upwards so that it is even with the body of the tube (Figure 24). Avoid creasing the tube material.

22. While keeping the flange bent up, lift and remove the HYDRATUBE adaptor and any gaskets beneath it (Figure 25).

23. Pull the HYDRATUBE out from the bottom by a combination of twisting and bending sideways. Also remove any gaskets which were beneath the bottom tube adaptor.

24. Inspect the tube for any damage, i.e. cuts, cracks, chemical attack. Replace if necessary.

25. When installing a HYDRATUBE do not use tools which may cut or damage the tube.

26. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

27. Place one flat gasket in the top recess of the HYDRATUBE housing (Figure 26).

Fig. 24

Fig. 25

Fig. 26

28. Check the bottom HYDRATUBE adaptor, it should have one flat gasket on it. Carefully straighten the flange on one end of the HYDRATUBE and work it through the adaptor and gasket (Figure 27). Slide the adaptor and gasket to the opposite end of the HYDRATUBE.

29. Now tightly wrap the straightened end of the HYDRATUBE with a rubber band. (Figure 28).

Fig. 27

Fig. 28

30. Work the wrapped end of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the HYDRATUBE upward to the top of the housing.

31. At this stage, with a slight push at the bottom flange of the HYDRATUBE, guide the nose of the HYDRATUBE, to the center and out the top hole in the housing (Figure 29).

Fig. 29

32. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded, reinstall the bottom valve adaptor and drain plug and then partially fill the housing with the appropriate liquid.

33. Work the top HYDRATUBE adaptor over the top end of the HYDRATUBE. It may be necessary to remove the rubber band first.

34. Unfold the top flange (Figure 30) and center both the top and bottom of the HYDRATUBE. Make certain the HYDRATUBE flanges are seated in the HYDRATUBE adapters.

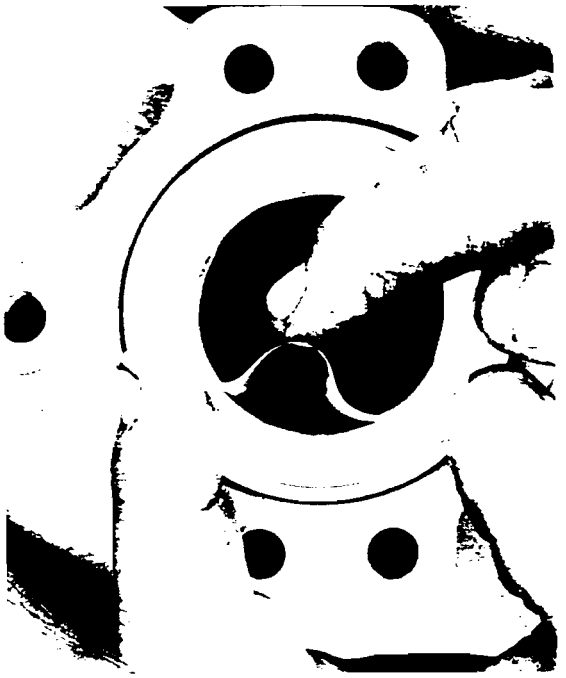


Fig. 30

35. Reassemble the top and bottom adaptor parts, torquing the tie bar bolts to the recommended value, see Appendix III. Replace the bottom plug.

36. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat diaphragm repriming procedure before repriming the intermediate or housing chamber. Refer to MAINTENANCE, Section II.

II. REPRIMING THE PUMP

(Standard heads only, refer to separate instructions for custom heads).

A. Presets

1. Adjust the stroke length (capacity) to maximum. (See "Output Adjustment" Page 12).

2. Disconnect power source.

3. Close inlet and discharge shut off valves.

4. Loosen or remove suction and discharge check valve assemblies.

5. Remove the coupling guard.

6. Remove the front reservoir cover assembly.

7. If HYDRATUBE design, remove intermediate fill plug.

B. Priming the Pumphead

1. Unscrew the tube fitting nut at the top of the automatic bleed valve and remove the plastic tube. Do not remove the actual tube fitting from the bleeder body.

2. Fill both the gearbox and hydraulic reservoir with PULSAlube oil to within 1/2" to 3/4" (13 to 19 mm) from the top.

The next step is dependent on the particular pump model. (See Figure 31). Proceed to 2(a) and 2(b).

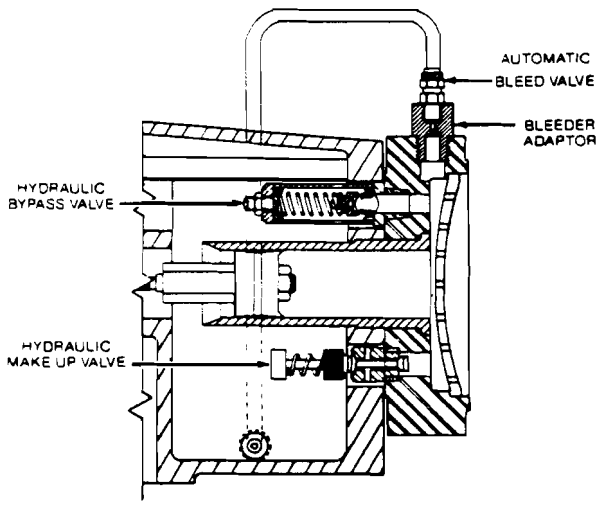


Fig. 31

2a) For all models with a bleeder adaptor: Remove the bleeder adaptor from the pumphead. Rotate the motor coupling (with bleeder attached) and as the piston is being retracted, slowly pour PULSAlube oil through the bleeder adaptor opening until the pumphead is full and the piston is in the full rearward position (proceed to Step 5).

2b) For all other models: Use a wrench on the body of the bleeder valve to remove it from the pumphead. Now place a plastic pipette (i.e., funnel,.etc.) into the threaded hole and fill it with PULSAlube oil.

3. Turn on the pump and operate it until all air has been purged from the pumphead (add oil to the pipette as required).

4. Shut off the pump and manually retract the piston to full rearward position. Remove the pipette.

5. Replace the automatic bleed valve (and adaptor if preset) into the pumphead.

6. Manually rotate the motor coupling to move the pump piston forward. If, at some point, it becomes difficult to turn the coupling loosen the hydraulic bypass valve until oil is forced back into the gear box, thus allowing the piston to move to the full forward position. Keep track of how many turns the bypass valve is loosened.

7. Retighten the bypass valve the number of turns recorded in Step 6. The primary hydraulic system is now fully primed.

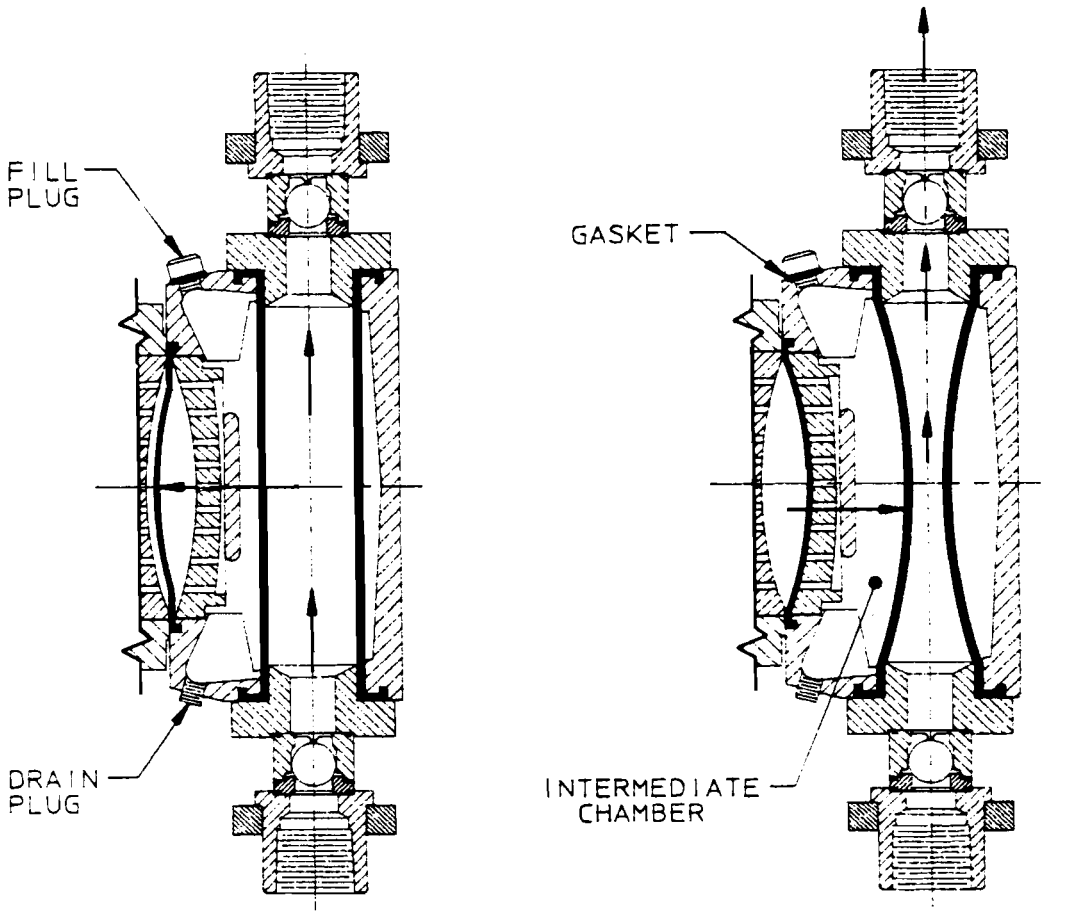
C. Priming the HYDRATUBE (Intermediate Chamber)

In priming the intermediate chamber the flat diaphragm and HYDRATUBE must be properly synchronized. For any given piston/pumphead assembly the flat diaphragm utilizes only 40 to 70% of the combined dish volume. The objective of this procedure is to have the flat diaphragm work off the front dishplate, meaning that

on every discharge stroke it just reaches the front dishplate, and on every suction stroke it moves back an amount dictated by the piston volume. The HYDRATUBE, when properly primed should be in its neutral position (fully round) when the diaphragm is in its rearmost position (as dictated by the piston, Figure 32a), and should begin to close as the diaphragm moves forward (Figure 32b). Primed in this way assures stable performance and protects the HYDRATUBE from damage during system upsets. The priming procedure is the same for elastomer and PFA HYDRATUBES. (See Figures 17a and b).

1. Make certain the primary/flat diaphragm has been hydraulically primed by referring to Priming the Pumphead before proceeding.

2. With the intermediate chamber fill plug removed manually rotate the motor coupling until the pump piston assembly is in the full rearward position.



HYDRATUBE ON SUCTION STROKE

HYDRATUBE ON DISCHARGE STROKE

Figs. 32a and b

3. Fill the intermediate chamber using a mixture of water and 1/3 ethylene glycol by volume, or other liquid selected for the particular application.

4. Check the seal on fill plug and replace if necessary. Reinstall and tighten the fill plug to the intermediate chamber.

5. Reinstall the coupling guard and front reservoir cover. Allow the pump to run for 5 to 10 minutes. Observe the action of the HYDRATUBE through the discharge valve port. It may be helpful to shine a light up through the suction port. It should go from a complete round form at the end of the suction stroke to an elliptical shape at full discharge stroke, but not closing off at the middle. The pump now has a correct intermediate prime and is ready for service.

6. Reinstall the suction and discharge valve assemblies.

III. CHECK VALVES

A. General Description

Operating experience on thousands of installations has indicated that most metering pump troubles have to do with check valves. Problems usually stem from (a) an accumulation of solids between the valve and seat, (b) corrosion which damages seating surfaces, (c) erosion from high velocity flow, or (d) physical damage.

Although several valve designs are available, the basic valve incorporates a ball, guide and seat (Figure 33). Flow in the unchecked direction lifts the ball off the seat allowing liquid to pass through the fluted areas of the guide. Flow in the opposite direction forces the ball down sealing it against the sharp edge of the valve seat. The guide allows the ball to rotate but limits its vertical and lateral movement thus minimizing slippage, or flow in the checked direction. By allowing the ball to rotate it seats on a different area each time thus prolonging its useful life. Because the ball returns to the seat by gravity the valve must be in the vertical direction to operate properly. O-rings provide a seal between all the parts. Both the ball and seat are available in a selection of materials best suited for resistance to chemical attack and physical damage.

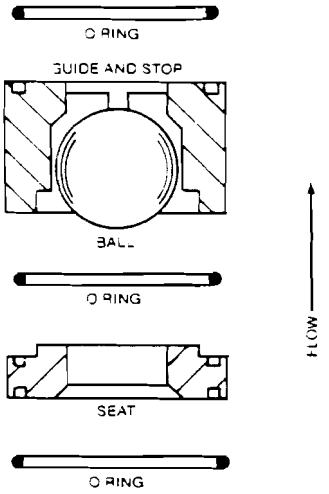


Fig. 33

Other available types of valves include:

a) Slurry Valves (Figure 34), which have an elastomer seat for use with slurries containing abrasive particles.

b) TFE Valves (Figure 35), for applications requiring the chemical resistance of TFE.

(c) Disc Valves (Figure 36), for flows over 400 gph. Also available with elastomer seats (Figure 37), and in TFE (Figure 38).

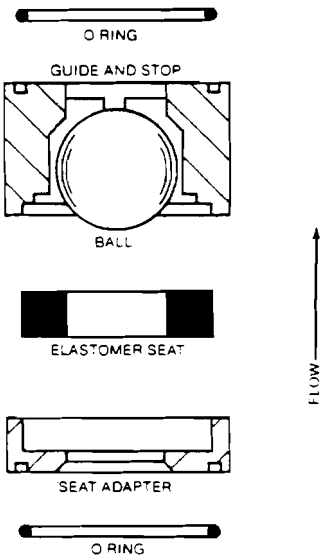


Fig. 34

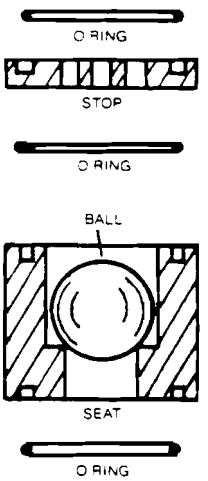


Fig. 35

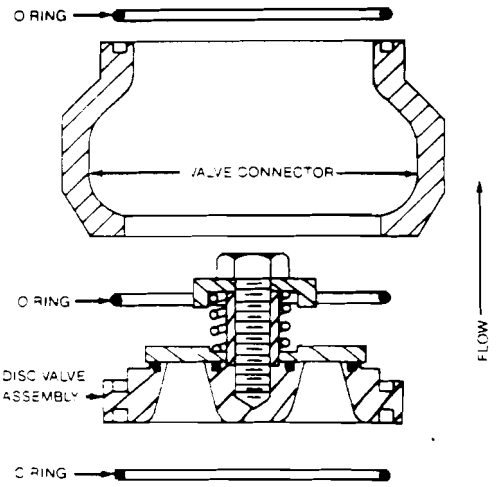


Fig. 36

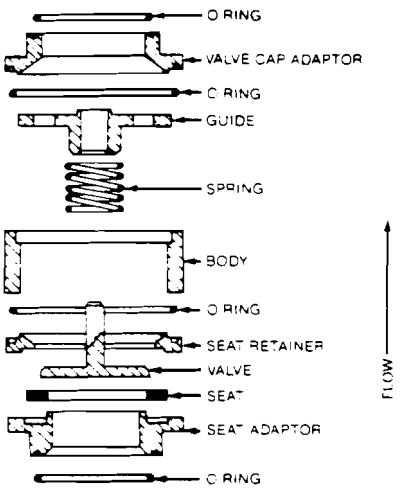


Fig. 37

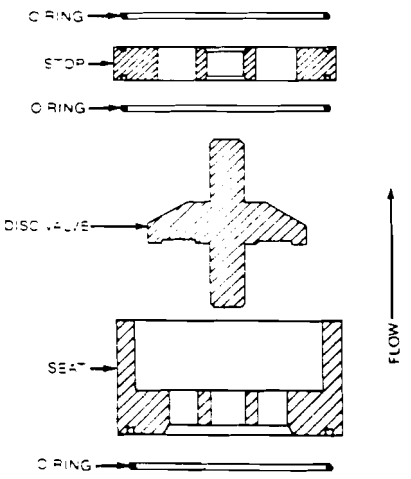


Fig. 38

B. Removal, Inspection and Reinstallation

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.

4. Close the suction and discharge shut off valves.

5. Carefully loosen the suction valve tie bar bolts. Spring the suction piping slightly to drain any liquid in the reagent head cavity. If the piping is closely connected it may be necessary to disconnect a union or flange.

6. Carefully remove the suction check valve assembly as a complete unit. (See Figures 33-38 for illustration).

7. Loosen the tie bar bolts on the discharge valve. Again, spring the piping slightly to drain any liquid.

8. Carefully remove the discharge check valve assembly as a complete unit.

9. Separate the valve assembly and examine the components for wear, damage or accumulation of solids. A ball valve seat should have a sharp 90° edge, free of any nicks or dents. Hold the ball firmly on the seat and examine against a light. If light is visible between the two then replace the seat and/or ball. Disc valves seal on a flat surface. Check to see that the sealing surfaces are clean, smooth and make full contact.

10. Reassemble each assembly using new parts as required. Note, for disc valves the entire valve assembly must be replaced, its components are not considered serviceable items. When replacing parts, use new o-rings, they cannot be removed from old parts and reused.

11. Plastic valve assemblies have metal sleeves which should be coated with a corrosion inhibitor on their interior surface prior to reassembly.

12. Reinstall both valve assemblies. Make certain the valves are not upside down, refer to Figures 33-38 for proper orientation.

13. Tighten the tie bar bolts evenly, making sure the valve assemblies are assembled squarely. Note: TFE components require very .little tightening. Refer to Appendix III for torque values.

14. Check for leaks and retighten the tie bar bolts if necessary.

IV. HYDRAULIC MAKEUP VALVE

On each discharge stroke of the pump a very small amount of oil is lost through the automatic bleeder and past the piston seals. This causes the diaphragm to be drawn back further on each successive suction stroke until it contacts the rear dish plate. When this happens the pressure in the hydraulic system becomes negative and the hydraulic makeup valve allows oil to enter the system. All hydraulic makeup valves are factory set to open at a pressure of 7.2 psia (0.51 Kg/cm^2 or approximately 1/2 atmosphere). This setting allows the pump to produce suction at the inlet valve (9.5 psia maximum) and still maintain a sound hydraulic system. If the hydraulic makeup valve is set to a lower absolute pressure, dissolved air within the hydraulic system will come out of solution forming bubbles. These bubbles are subject to compression and can cause capacity loss and erratic operation.

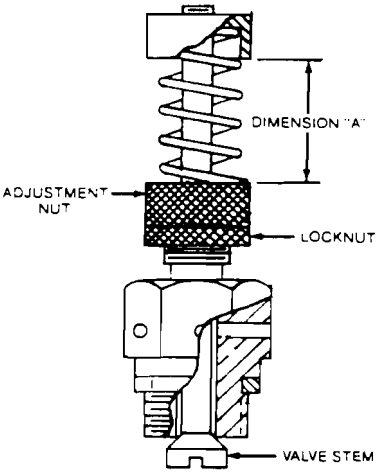


Fig. 39

Pulsafeeder pumps utilize two types of hydraulic makeup valves. The first is an internal, adjustable valve (Figure 39), located on the back of the pumphead inside the front hydraulic reservoir. The second type is external, non-adjustable valve located on the bottom of the pumphead (Figure 40).

All hydraulic make up valves are preset at the factory (parts orders included) and will typically require no maintenance provided the oil is clean and free of moisture. If however it becomes necessary to adjust the internal type follow the procedure below.

The internal type valve can be adjusted by turning the adjustment nut (Figure 39) to vary the spring tension on the valve stem. Normally the distance between the adjustment nut and endcap (dimension "A") should be set to 13/16" (20.6mm). When the valve is working properly it should just "crack" open on every third or fourth stroke of the pump. If the spring

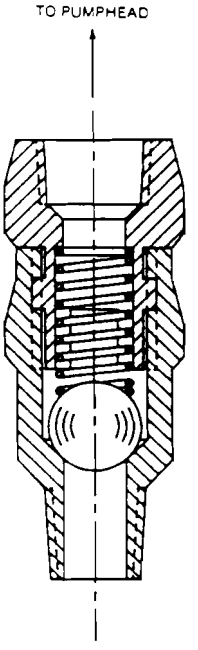


Fig. 40

is set too tight (dimension A is less than 13/16") large air bubbles will form in the hydraulic system and will be seen coming out of the automatic bleeder. If the spring is set too loosely (dimension A is greater than 13/16") then excess oil will be drawn into the hydraulic system which will cause the pressure relief valve to operate. Use dimension "A" as a starting point and carefully adjust the nut in either direction until the valve operates properly. Note: These valves are very sensitive and adjustments should be made gradually. MAKE ALL INTERNAL ADJUSTMENTS WITH THE PUMP TURNED OFF. After setting the adjustment nut tighten the locknut up against it. If the hydraulic make-up valve has to be removed make sure that the copper gasket which goes between it and the pumphead (or in some cases an adaptor bushing) is in place upon reinstallation. On models using an adaptor bushing there is also a copper gasket between it and the pumphead.

As mentioned previously, the external type make-up valve is non-adjustable or serviceable (other than cleaning) and must be replaced as an assembly.

Should either type valve require cleaning rinse with an appropriate solvent and blow dry with air.

V. HYDRAULIC BYPASS VALVE

The hydraulic bypass valve is an adjustable, spring loaded valve. It is designed to protect the pump against excessive hydraulic pressure, it is not meant to limit or regulate system pressure. The valve is factory adjusted for pressure as originally specified, or at 10% above the rated pump pressure.

All pumps, excluding the Model 7440 2 1/8" piston and up, utilize an internal hydraulic bypass valve located on the back of the pumphead, in the front hydraulic reservoir. Several variations of this internal valve are used as shown in Figures 41-43. These valves are adjusted by turning the adjustment screw clockwise (as seen facing the screw) to increase the bypass pressure and counterclockwise to decrease it. Some screws incorporate a locking nut which must be tightened after adjustment. MAKE ALL INTERNAL ADJUSTMENTS WITH THE PUMP TURNED OFF.

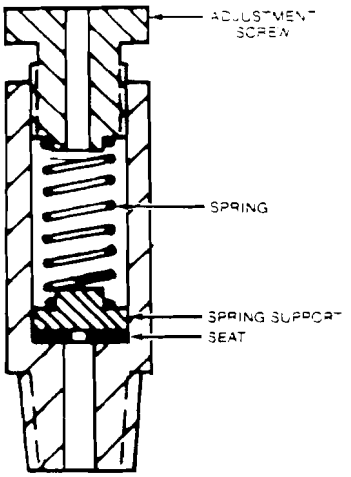


Fig. 41

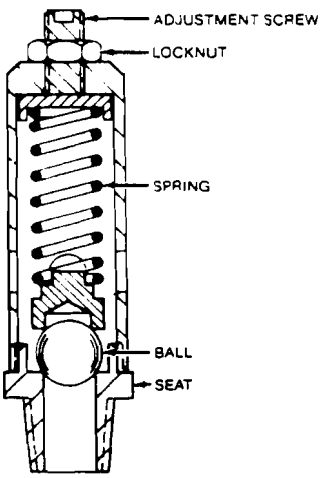


Fig. 42

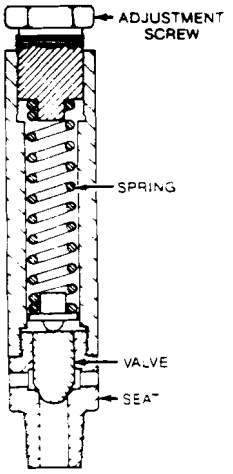


Fig. 43

If the hydraulic bypass pressure is set higher than 10% over the design pressure of the pump damage may occur during a system upset.

Conversely, if the hydraulic bypass pressure is set too low the valve will operate on each discharge stroke. This results in decreased pumping capacity and will eventually affect the efficiency of the valve.

To check the hydraulic bypass pressure setting requires a gauge and shut-off valve in the pump discharge line. The gauge must be between the pump and valve. For convenience locate the two as close to the pump as possible. With the pump operating at maximum stroke, gradually close down on the shut-off valve and observe when the hydraulic bypass valve starts to operate. When the valve operates, oil will either come out the hole in the adjusting screw or through the radial holes in the valve body (depending on what type valve is used). Because the valve is partially submerged in oil it may be necessary to drain some off so that any weeping of the valve can be detected. The cracking pressure of the valve must be at least as high as the maximum pressure of the system but no more than 10% over the pump's rated pressure.

The Model 7440, piston sizes 2 1/8" and up utilizes an external hydraulic bypass valve (Figure 44). It operates in the same manner as the internal valves, except that when it operates, the discharged oil passes through a tube to the rear reservoir. The adjustment procedure is the same as for the internal valves, to check if the valve is operating look for oil movement in the return tube. This is best done by observing any air bubbles. After adjustment always tighten the lock nut and reinstall the safety cap.

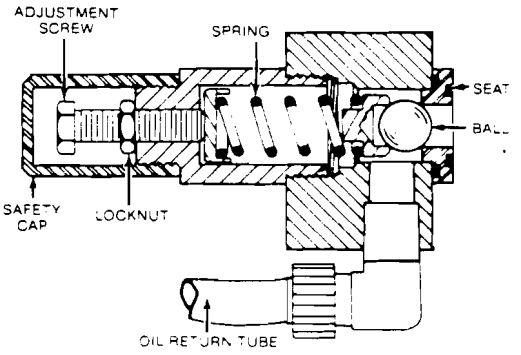


Fig. 44

Periodic inspection of the valve and seat is recommended. If either becomes worn or damaged leakage will occur regardless of how tight the valve is adjusted.

VI. AUTOMATIC BLEED VALVE

Figure 45

A. General Description

The automatic bleed valve is a gravity operated, ball check valve designed to remove gases from the hydraulic system. On each discharge stroke, pressure raises the ball off the lower seat and expels any accumulation of gases. Flow through is limited because the ball also seats against an upper seat. On the suction stroke a weight forces the ball down and prevents gas from reentering the system. When all gases have been expelled a very small quantity of oil will be displaced on each discharge stroke. This oil is returned to the gearbox reservoir through a plastic tube. This tube is only for oil transfer and will normally not be full.

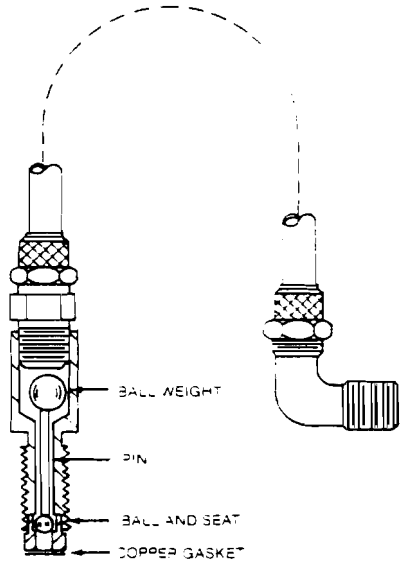


Fig. 45

B. Removal and Cleaning

Any accumulation of solids can cause the valve to malfunction and must be removed.

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Remove the motor coupling guard.

4. Unscrew the nut and remove the plastic tube from the valve. Do not remove the actual tube fitting form the bleeder body.

5. Slowly unscrew the valve, if oil begins to bleed out around the thread manually rotate the motor coupling until it stops.
6. Remove the valve and clean it in kerosene or other petroleum solvent. Blow air through the valve in both directions. You should be able to hear the ball move freely within the valve.

7. Check to see that there is a copper gasket at the bottom of the threaded hole in the pumphead.

8. Manually rotate the motor coupling until oil fills the threaded hole.

9. Reinstall the valve and tubing.

If the valve still fails to operate properly then it must be replaced as an assembly, there are no serviceable components within it.

VII. PISTON SEALS

A. General

PULSA Series pumps utilize several different piston sealing arrangements depending on the pump model and application. The most common type utilizes elastomer impregnated, leather piston cups (Figure 46). These are used on the majority of all pumps. Pumps having smaller pistons (i.e. 1" or less) may use synthetic rubber U packing (Figure 47), elastomer impregnated leather discs (Figure 48), or a plunger and elastomer impregnated leather V-rings (Figure 49). All model 7120's with 2 5/8" piston use a synthetic rubber U packing with a 1 piece piston (Figure 50).

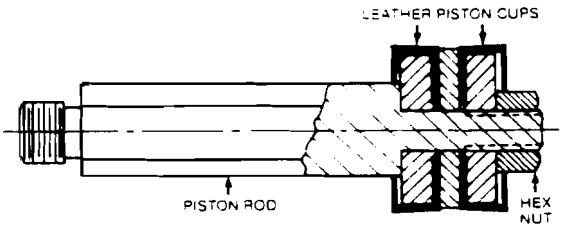


Fig. 46

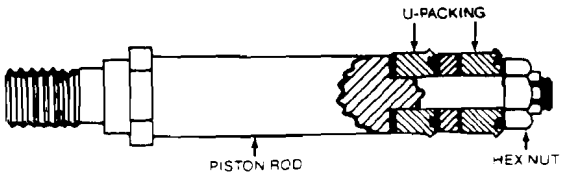


Fig. 47

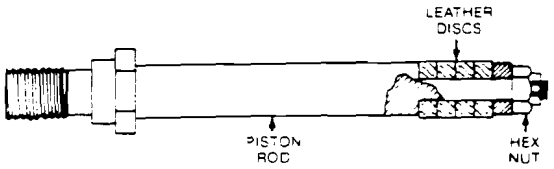


Fig. 48

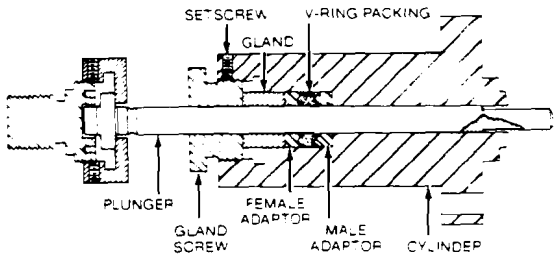


Fig. 49

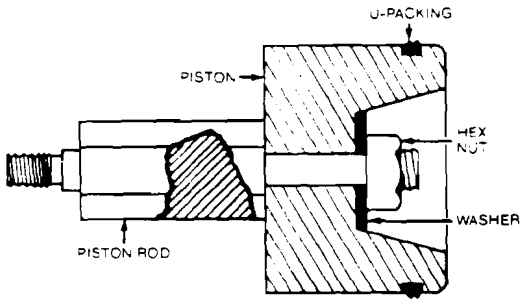


Fig. 50

The useful life of any of these seals depends on several factors such as stroking rate, temperature, pressure, and is therefore impossible to predict for every pump. When a piston seal does wear out however, it will become evident through a loss in capacity and excessive operation of the hydraulic makeup valve.

B. Removal

1a. Standard Heads and Plan C: Refer to MAINTENANCE, Section I and follow the instructions for removal of the wet end. For Plan C, remove the intermediate head also.

1b. Remote Heads: Remove all pressure from the piping system and disconnect the power source to the drive motor. The pipe which transfers hydraulic pressure to the remote head must be removed at the pumphead. There must also be sufficient room to pull the pumphead away from the gearbox.

2. Remove both gearbox covers, refer to MAINTENANCE, Section XI for removal of the rear cover. Drain the gearbox of oil.

3. Using a wrench on the hex portion of the piston rod, unscrew it from the crosshead block. Always place a wrench on the front connecting rod when loosening or tightening the piston rod in order to keep the block from turning.

4. On the Model 7440 with standard heads 1/2" piston and larger, the piston can be removed from the front of the cylinder thus eliminating the need to remove the pumphead. Remove the piston assembly and proceed with Step 7.

5. Remove the two socket head capscrews holding the pumphead to the gearbox. These screws are located on the back of the head inside the front gearbox reservoir. On some models it may be necessary to remove the hydraulic makeup valve in order to access these screws.

6. Slowly pull the pumphead away from the gearbox, keeping the piston in the cylinder. Now remove the piston from the rear of the cylinder.

7. Assemblies using piston cups should be placed in a vise while changing the seals.

C. Reinstallation

The next step is dependent on the particular type of piston assembly:

1a. Standard Piston Cups (Figure 46): Remove the hex nut on the end of the rod and replace the cups, note the direction in which the cups face. The smaller pistons normally incorporate shoulders on the expanders so that the assembly cannot be overtightened, on these the hex nut should be tightened firmly. On pistons with no shoulders, tighten the hex nut just until the piston cups cannot be rotated by hand. Overtightening will deform the cups while looseness will cause seal leakage.

1b. U-Packing (Figure 47): Remove the capscrew (or hex nut) on the end of the rod and replace the seals, note the direction in which they face. Tighten the capscrew firmly.

1c. Leather Discs (Figure 48): Remove the capscrew on the end of the rod and replace the seals. Tighten the capscrew to a snug fit so that the discs cannot be rotated by hand. Overtightening will deform the discs while looseness will cause seal leakage.

1d. Packed Plunger with Leather V-Rings (Figure 49): Loosen the setscrew and remove the gland screw from the rear of the cylinder. Remove gland, female adaptor and v-rings. Replace the v-rings with new ones. Reinstall the female adaptor, gland, gland screw and plunger. Tighten the gland screw until the plunger is snug. Overtightening will deform the seals while looseness will cause seal leakage. As the pump operates, the v-rings will loosen up therefore the gland screw must be retightened at periodic intervals. Proceed with Step 3.

1e. U-Packing, 7120 2 5/8" Piston Only (Figure 50): Use a small screwdriver or similar tool to pry the old seal out of its groove. Stretch the new seal over the piston and slide it into the groove. Now loosen the hex nut on the end of the rod.

2. If the pump is a Model 7440 1/2" piston and larger, the piston assembly can be installed from the front of the pumphead. First dip the seals in PULSAlube oil and then push the assembly into the cylinder. Proceed with Step 3.

   On all other models the piston assembly must be installed from the back of the cylinder. (Pumphead must be removed). Again, dip the seals in PULSAlube oil first. Clean the rear face of the pumphead and the front of the gearbox, use a new gasket to assure a leakproof seal and reinstall the pumphead.

3. With the pumphead back in place, screw the piston rod back into the crosshead block. On the Model 7120, 2 5/8" piston, tighten the hex nut on the end of the piston rod, which was left loose in order to center the piston.

4. Refer to MAINTENANCE, Section I for reinstallation of the wet end. For remote head pumps, reinstall the pipe connecting the pumphead and remote head.

5. Reinstall the hydraulic makeup valve if it had to be removed.

6. Refill the gearbox with oil and replace the cover assemblies. Refer to MAINTENANCE, Section XI to install the rear cover.

7. Reprime the pump as outlined in MAINTENANCE, Section II.

VIII. HOUSING ASSEMBLY

The housing assembly requires no maintenance other than keeping the gearbox oil at the proper level and periodically greasing the gears and slip shaft on top of the housing. Should the assembly ever have to be removed, follow the procedure below.

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Remove both gearbox covers, refer to MAINTENANCE Section XI. Drain the rear oil reservoir.

4a. Models 7120 and 7440 Only: Remove the allen setscrews located in the gearbox sides directly above the housing bearing pins. Use a screwdriver to pry out the pins. (Figure 51).

4b. Models 7660 & 8480: Remove the bolts which hold each bearing pin in place. To remove the pins, thread the bolts into the tapped holes and turn. The pin will then be driven out. (Figure 52).

5. Raise the housing up and remove the front connecting rod pin from the crosshead block by loosening the allen setscrew in the rear face of the block.

6. Remove the rear connecting rod pin in the back of the housing by removing one of the cotter pins.

Reinstall the assembly by following the reverse sequence of procedures described in Steps 3-6. When reinstalling the housing bearing pins make certain the o-ring is in place against the shoulder of the pin. On the Model 7120 make certain the pins are all the way in before installing the locking setscrews. Grease the gears and slip shaft on top of the housing before installing the rear cover.

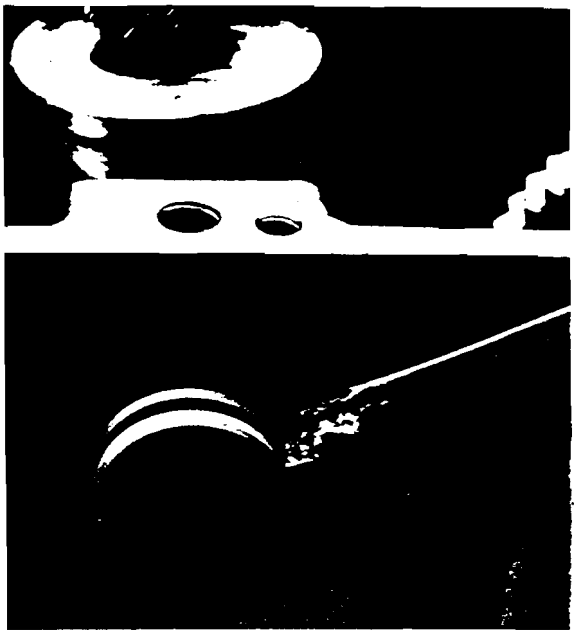


Fig. 51

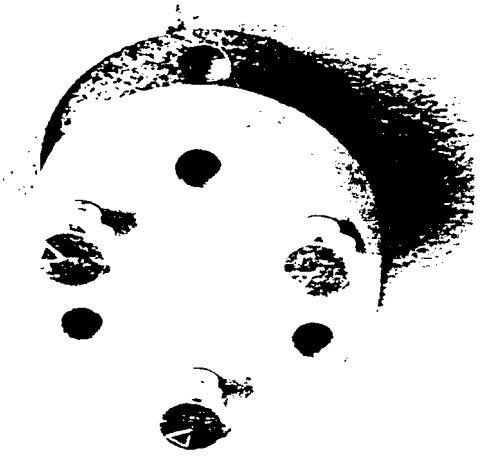


Fig. 52

IX. WORM GEARING, BEARINGS, ECCENTRIC ASSEMBLY

A. General Description

The worm gearing, bearings and eccentric assembly require no maintenance other than keeping the gearbox oil at the proper level and changing it as required.

The worm shaft assembly is a one piece shaft with a tapered roller bearing pressed on each end (Figure 53). The cup or race for the front worm shaft bearing is pressed into the gearbox and is not removable. The rear cup slides into the gearbox bore and is held in place by the bearing cap. By changing the shim thickness underneath the bearing cap, the preload on the bearings can be adjusted. All worm shaft assemblies are adjusted for zero endplay and no preload.

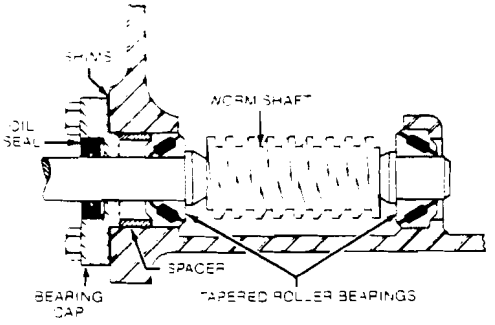


Fig. 53

The eccentric shaft assembly consists of a shaft, key, gear, eccentric cam, spacer, and two tapered roller bearings (Figure 54). All the items excluding the spacer, are pressed onto the shaft. The bearing cups are pressed into the bearing blocks and are not removable. The shims beneath each bearing block are used not only to adjust the bearing preload but also the position of the gear over the worm shaft. Again these assemblies are adjusted for zero endplay and no preload. The assemblies can be removed and replaced without readjusting the shims provided that none of the components are changed. Should a change be required, follow the procedure below to determine the correct shimming.

B. Worm Shaft Assembly Shimming

1. The eccentric shaft assembly must be removed from the gearbox. Note which side of the gearbox each bearing block goes into and also the shims used on each.

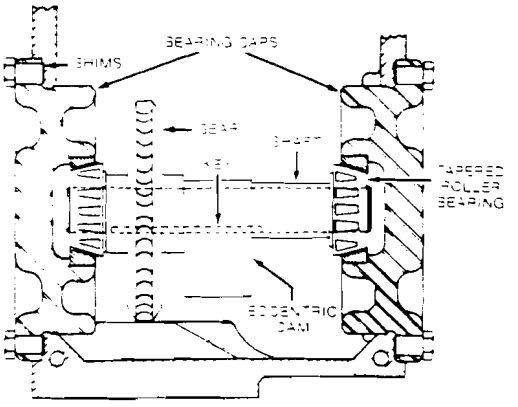


Fig. 54

2. Insert the worm shaft assembly into the gearbox.

3. Place the rear bearing cup and spacer over the worm shaft and slide them into the gearbox bore.

4. Remove any shims which are on the bearing cap. Thoroughly clean the cap and mating surface of the gearbox. Slide the cap into place, do not scratch the shaft in the area where the seal rides.

5. Place an even pressure on the bearing cap while using a feeler gauge to measure the gap between it and the gearbox.

6. Select a combination of shims which is approximately .002" to .003" less than the reading obtained. The shims are color coded for thickness as follows: Green = .003"; Blue = .005"; Clear = .0075"; and Yellow = .020".

7. Put the shims in place, insert the bolts into the bearing cap and tighten.

8. Rotate the worm shaft several times. It may be necessary to install the coupling in order to do this. Check to see that the worm shaft has no end play yet turns freely. If the shaft has visible end play, reduce the amount of shim. If the shaft is difficult to rotate increase the amount of shim.

9. After the amount of shims has been determined, remove the 4 bolts, apply a thread sealant and reinstall them.

C. Eccentric Shaft Assembly Shimming

1. The worm shaft assembly must be in place.

2. Place the eccentric shaft assembly in the gearbox without the rear connecting rod and turned 180°, so that the gears are not meshing. (Figure 55.)

3. Install each bearing block in the same side of the gearbox from which it was removed using the same shims that had been on them previously. Install all the bolts and tighten.

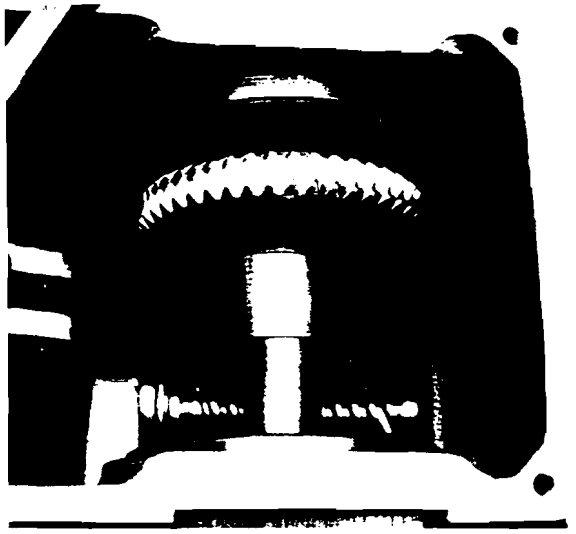


Fig. 55

4. Check to see that the shaft has no end play yet still turns freely. If the shaft has visible end play, reduce the amount of shim. If the shaft is difficult to rotate, increase the amount of shim. The shims are color coded for thickness as follows: Green = .003"; Blue = .005"; Clear = .0075; and Yellow = .020".

   Make all shim changes on the bearing block farthest from the worm shaft.

5. Remove the eccentric shaft assembly. Coat the worm threads with prussian blue, red lead or similar compound designed to check gear teeth contact.

6. Reinstall the eccentric shaft assembly in the correct position with the connecting rod installed. Do not change the amount of shims on the bearing blocks.

7. Rotate the worm shaft by hand in the direction indicated on the coupling guard (counter-clockwise looking at the end of the shaft). Rotate it until the worm wheel has gone around several times.

8. Look at the contact pattern on the driven side of the worm wheel teeth, compare it with Figure 56. Contact should appear in the center of the tooth and continue to the leaving side. If the contact pattern is not correct it can be changed by moving shims from one bearing block to the other. Remove shims on the same end of the shaft as the direction in which you want the contact pattern to move. For example, if the contact pattern is on the entering side of the wheel, remove shims from the bearing block closest to the wheel and place them on the opposite block. A different combination of shims may be used to obtain the proper adjustment however, the total thickness must be the same as determined in Step 4, or the bearing preload will be changed.

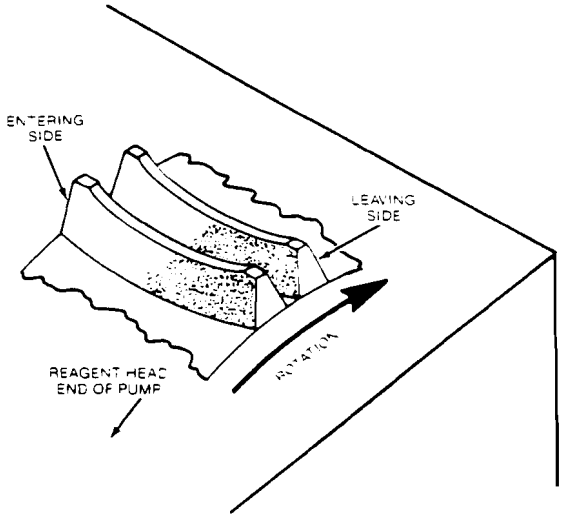


Fig. 56

9. After the correct shim combinations have been determined reassemble the bearing blocks using thread sealant on all bolts.

X. OIL SEAL

A. General

The worm shaft oil seal (Figure 53) properly installed and operating under favorable conditions, should give years of satisfactory leak-free service.

Unfavorable operating conditions such as a corrosive atmosphere, excessive dust or dirt, or contaminated lubricating oil can result in frequent replacement of the seal and worm shaft.

B. Removal and Replacement

1. Disconnect the power source to the drive motor.

2. Remove the coupling guard, electric motor and motor coupling.

3. Refer to MAINTENANCE, Section XI for removal of the rear gearbox cover. Drain the rear oil reservoir.

4. Remove four bolts from the rear bearing cap and slide the cap off the shaft. Retain the plastic shims for reassembly.

5. Using a screwdriver or other pointed tool pry the oil seal from the rear bearing cap.

6. Install a new oil seal into the rear bearing cap by gently tapping it into the counterbore, the part numbers on the seal must be facing out. If the outside edge of the seal is uncoated i.e. bare metal, coat it with a gasket sealant before installation. Seat the oil seal flush with the face of the bearing cap.

7. Before replacing the bearing cap, check the worm shaft sealing area for scratches, burrs, rust or foreign material which may have caused the seal to leak. Also check the shaft-run out, and end play. There should be no visible end play and runout must be less than .010", total indicator reading. If the sealing area is damaged or rusty try restoring it with emery cloth. The surface must be smooth and scratch free in order for the seal to work. If necessary replace the worm shaft.

8. Cover the entire length of the worm shaft keyway with plastic electricians tape. This will keep the sharp edges from damaging the seal as its slid over the shaft. A single strip is sufficient, it is not necessary to wrap tape around the shaft.

9. Apply a light coating of grease to the worm shaft and the inside of the seal. Slide the rear bearing cap over the shaft (make sure the plastic shims are in place between the bearing cap and gearbox). Replace the four bolts.

10. Remove the tape from the worm shaft. Reinstall the coupling, motor and coupling guard. Make certain the motor is properly aligned.

11. Refill the gearbox with oil and replace the rear cover. Refer to MAINTENANCE, Section XI.

XI. REAR GEARBOX COVER ASSEMBLY

A. Manual Control

The handwheel on manually controlled pumps is liked to the oscillating housing by universals and a telescoping slip joint (Figure 57). When the cover is removed the relationship between the two halves of the joint must be maintained or pump calibration will be affected.

Removal

1. Disconnect the power source to the drive motor.

Fig. 57

2. Make sure the handwheel indicator registers zero.

3. Remove the cover screws.

4. Pull the cover back toward the motor and lift off.

5. Do not disturb the relationship between the two halves of the slip joint.

Reinstallation

1. Coat all surfaces of the slip joint assembly and handwheel gearing with a light grease or corrosion inhibitor such as LPS-3.

2. Make sure the handwheel indicator registers zero. Hold the cover sideways to expose the square tube. Then, holding the tube, carefully move the cover forward to engage the shaft (Figure 57). The shaft and tube must be reassembled with the same orientation as when the cover was removed.

3. Place the cover on top of the gearbox and replace the screws.

4. Turn the handle fully counter-clockwise, the indicator should read zero. If it does not then remove the cover, turn the handle until it reads zero and reinstall it as described in Step 2.

B. Auto Electric Control (AE)

The AE actuator is linked to the oscillating housing by universals and a reciprocating shaft. (Figure 58). There is also an external handwheel which can be engaged for manual adjustment.

Fig. 58

Removal (Non-Explosion Proof)

1. Disconnect the power source to the drive motor and actuator.

2. Make sure the stroke length indicator registers zero.

3. Remove the cover screws.

4. Lift the cover slightly and hold the shaft horizontal to prevent binding. Pull the cover back towards the motor until the diamond screw shaft is disengaged from the actuator.

Reinstallation (Non-Explosion Proof)

1. Check to see that the block inside the oscillating housing is at the top by turning the shaft counterclockwise (as seen standing behind the pump).

2. If the diamond shaft is dry, lightly coat it with grease.

3. Hold the cover over the pump and carefully insert the shaft into the actuator as you lower the cover in place, (Figure 58). Be sure the stroke length indicator remains at zero.

4. Replace the cover screws.

Removal (Explosion Proof)

On explosion proof models the diamond shaft cannot be withdrawn from the front of the actuator and must therefore be removed from the oscillating housing.

1. Disconnect the power source to the drive motor and actuator.

2. Make sure the stroke length indicator registers zero.

3. Remove the coupling guard.

4. Remove the front gearbox cover.

5. Manually rotate the motor coupling until the oscillating housing is vertical. It may be necessary to remove pressure from the piping system.

6. Remove the cotter pin, nut and washer from the end of the drive shaft on top of the housing.

7. Remove the cover screws.

8. Lift the cover slightly and pull it back towards the motor. As the shaft disengages, the miter gear, bushing and bushing pin will come loose, don't allow them to fall into the gearbox.

Reinstallation (Explosion Proof)

1. Check to see that the block inside the oscillating housing is at the top by turning the miter gear clockwise.

2. If the end of the shaft is dry, coat it with grease.

3. Hold the cover over the pump and insert the shaft into the housing bore as you lower the cover. Make sure the miter gear, bushing and bushing pin are in place and that the stroke length indicator remains at zero.

4. Replace the washer and nut on the shaft. Snug the nut and then back it off to the nearest hole for insertion of a cotter pin.

5. Replace the cover screws, front cover and coupling guard.

C. Auto Pneumatic Control (AP)

The AP actuator is linked to the oscillating housing by a clevis and pin. (Figure 59). The actuator unit must be removed before the cover can be taken off.

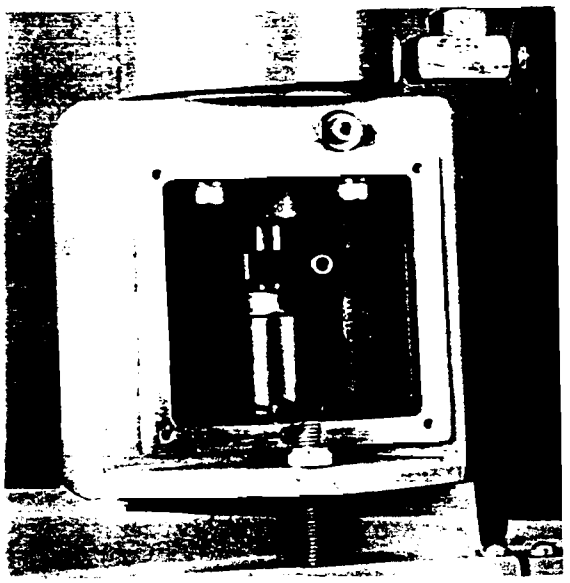


Fig.59

Removal

1. Disconnect the power to the drive motor and the air supply and air signal to the actuator.

2. Remove one of the plexiglass covers from the actuator mount.

3. The stroke length indicator should register zero.

4. Remove one of the cotter pins and drive the pin out of the clevis. The actuator and cover can now be removed.

Reinstallation

1. The gearbox cover must be in place.

2. Clean the bottom surface of the actuator mount and mating surface of the gearbox cover. Use a gasket compound on one of the surfaces.

3. Place the actuator assembly on the pump and install the lock nuts.

4. Make sure the clevis has not rotated. The holes for the clevis pin must be perpendicular to the side of the pump.

5. Pull up on the oscillating housing adjustment rod until the block is firmly against the top of the housing. Now turn the rod 1 turn counter-clockwise and reconnect it to the clevis. This positions the block just off the top of the housing to prevent stressing the parts at 0% stroke setting.

6. Install a new cotter pin in the clevis pin and replace the plexiglass cover.

I. REPLACEMENT PARTS

A. PULSA Series KOPkits Program

PULSA Series KOPkits contain all replacement parts normally used in a preventative maintenance program. (PULSAlube oil is also available for preventative maintenance programs. See Section on Equipment Start-up). There is a specific KOPkit for every PULSA Series pump model. Each KOPkit is vacuum sealed to keep the parts clean even when stored for extended periods of time. All PULSA Series pumps shipped since June 1985 have the KOPkit number on the pump nameplate, the specification data sheet and Pulsafeeder order documents. KOPkits can also be selected from the technical data sheet shipped with the pump or by a Pulsafeeder representative.

B. Ordering KOPkits or Parts

When ordering replacement parts always specify:

- Pump model and serial number (stamped on pump nameplate) e.g., 7120-S-AE with S/N 8604146-1.

- Part name and part number from the PULSA Series part list. Add the part number suffix that designates the material of construction of the wet end. (Note: PULSA Series part numbers begin with the letter "W" e.g., W094136-HYP).

TROUBLE SHOOTING CHART

Difficulty	Probable Cause	Remedy
Pump Does Not Start	1.Coupling disconnected	Connect and align
	2.Faulty power source	Check power source
	3.Blown fuse, circuit breaker	Replace - locate overload
	4.Broken wire	Locate and repair
	5.Wired improperly	Check diagram
	6.Pipe line blockage	Locate block and clear pipe lines
	7.Shutoff valves closed	Open valves
No Delivery	1.Motor not running	Check power source. Check wiring diagram.
	2.Supply tank empty	Fill with liquid
	3.Lines clogged	Clean and flush
	4.Closed line valves	Open pipeline valves
	5.Ball check valves held open with solids	Clean-inspect
	6.Vapor lock, cavitation	Increase suction pressure
	7.Prime lost	Reprime, check for leak
	8.Strainer clogged	Remove and clean. Replace screen if necessary.
	9.Hydraulic system under-primed	Refer to Pages 22 and 23
Low Delivery	1.Motor speed too low	Check voltages, hertz, wiring, and terminal connections. Check nameplate vs. specifications
	2.Check valves worn or dirty	Clean, replace if damaged
	3.Hydraulic Bypass valve operating each stroke	Refer to Pages 29 and 30.
	4.Calibration system error	Evaluate and correct
	5.Product viscosity too high	Lower viscosity by increasing product temperature. Increase pump size and/or piping.
	6.Product cavitating	Increase suction pressure. Cool product as necessary.
	7.Piston cups worn or hardened by contamination	Inspect and replace if deteriorated. Refer to Pages 31-34
Delivery Gradually Drops	1.Stroke adjustment creeping	Consult factory. Replace worn parts.
	2.Check valve leakage	Clean, replace if damaged
	3.Leak in suction line	Locate and correct
	4.Stainer fouled	Clean or replace screen
	5.Product change	Check viscosity
	6.By-pass leakage	Correct for bypass valve leakage
	7.Piston cups worn or hardened by contamination	Inspect and replace if deteriorated. Refer to Pages 31-34
	8.Hydraulic Makeup Valve improperly set	Refer to Pages 28 and 29.
	9. Supply tank vent plugged	Unplug vent

Difficulty	Probable Cause	Remedy
Delivery Erratic	1.Leak in suction line	Locate and correct
	2.Product cavitating	Increase suction pressure
	3.Entrained air or gas in product	Consult factory for suggested venting
	4.Motor speed erratic	Check voltage, hertz
	5.Fouled check valves	Clean, replace if necessary
Delivery Higher Than Rated	1.Suction Pressure higher than discharge pressure	Install back pressure valve or consult factory for piping recommendations.
	2.Discharge piping too small	Increase pipe size-install PULSAtrol at pump in discharge line
	3.Back pressure valve set too low	Increase setting
	4.Back pressure valve leaks	Repair, clean, or replace
Pump Loses Oil	1.Diaphragm ruptured	Replace
	2.Leaky oil seal	Replace
	3.Cover gasket leaks	Replace or tighten
	4.Pump head gasket leaks	Replace-tighten pump head bolts, seal with permatex
	5.Gear box overfilled	Remove excess oil
Air Continuously Bleeds From Automatic Bleeder	1.Oil in reservoir low	Refill to correct level
	2.Hydraulic Bypass Valve operating each stroke	Refer to Pages 28 and 29.
	3.Suction pressure too low	Increase pressure
	4.Breakdown of oil, temperature high	Change oil type, consult factory
Noisy Gearing, Knocking	1.Discharge pressure too high	Reduce pressure or discharge pipe size
	2.Water hammer	Install PULSAtrol
	3.Worn bearings	Replace
	4.Worn gears	Replace gears Adjust hydraulic bypass valve (see Pages 28 and 29).
	5.End play in worm shaft	Shim for thrust
	6.Eccentric or worm gear	Tighten or replace assembly
	7.Hydraulic bypass valve set too high	Readjust (see Page 28 and 29).
Piping Noisy	1.Pipe size too small	Increase size of piping. Install PULSAtrol.
	2.Pipe runs too long	Install PULSAtrol in line
	3.Surge chambers full of liquid	Recharge with air or inert gas. Replace diaphragm and recharge if PULSAtrol being used
	4.No surge chambers used	Install PULSAtrols
Motor Overheats	1.Pump overloaded	Check operating conditions against pump design
	2.Oil too viscous	Use lighter grade oil
	3.Low voltage	Check power supply
	4.Loose wire	Trace and correct
	5.Mechanical binding	Check gearbox mechanism

SUCTION HEAD REQUIREMENTS

All reciprocating metering pumps require a net positive suction head ($NPSH_R$) as shown in Table 1. The $NPSH_R$ is defined as the pressure required above the absolute vapor pressure of the process fluid at the pumping temperature. This pressure is required at the suction port of the pump throughout the entire pump stroking cycle in order to prevent cavitation of the process fluid within the reagent head. The $NPSH_R$ is one of the requirements necessary to assure metering accuracy.

Table 1. $NPSH_R$ values

$NPSH_R$	Pulsar	Pulsa
English (psi)	3	5
Metric (bar)	0.21	0.35

The net positive suction head available ($NPSH_A$) must be greater than the $NPSH_R$. The $NPSH_A$ of any given system is calculated as follows for comparison to the $NPSH_R$ as shown in Table 1.

Equation 1. For fluid viscosity below 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \left(\frac{L_S R G Q}{C_1 d^2}\right)$$

Equation 2. For fluid viscosity above 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \sqrt{\left(\frac{L_S R G Q}{C_1 d^2}\right)^2 + \left(\frac{L_S \mu Q}{C_2 d^4}\right)^2}$$

The variables used in Equations 1 through 4 must be in the units shown in Table 2 for the constants listed below to be used correctly.

Table 2. Unit sets and constant values for use in Equations 1 through 5.

Variable	Units Set	
	English	Metric
NPSH	psi	bar
P_A	psia	bar(a)
P_H	psi	bar
P_V	psia	bar(a)
L_S	feet	meters
R	strokes/min	strokes/min
G	no units	no units
Q	gallons/hr	liters/hr
d	inches	millimeters
μ	centipoise	centipoise
L_D	feet	meters
P_T	psi	bar
P_P	psi	bar
V_P	feet/sec	meters/sec
C_1	24,600	640
C_2	45,700	1.84
C_3	46.8	0.91

Note: If piping sizes vary throughout the suction line, different additive values may be used for the pressure losses attributed to the liquid's acceleration and deceleration. Use the last term of Equation 1 or 2 as many times as needed in the equation to adjust for different lengths of different pipe diameters in the suction line. (Everything but the pipe length and diameter will stay the same in the equation.)

All reciprocating metering pumps also require

that a minimum absolute pressure, minimum suction head (MSH), be maintained at the pump inlet throughout the pumping cycle to ensure a stable hydraulic system and proper pump operation. The sum of the $NPSH_A$ and the vapor pressure (P_V) must be greater than the values shown in Table 3.

Table 3. Minimum values for the sum of $NPSH_A$ and vapor pressure. (MSH)

MSH	Pulsar	Pulsar*	Pulsa
English, (psia)	5	7.5	9.5
Metric, (bar(a))	0.35	0.53	0.66

* Pulsar Pump with PULSAlarm leak detection diaphragm.

SYSTEM BACKPRESSURE

The system backpressure must exceed the suction pressure by at least 5 psi (0.35 bar) in order to prevent flowthrough, however it must not exceed the rated discharge pressure of the pump. Flowthrough can be defined as the process liquid flowing from a higher pressure to a lower pressure (downhill pumping), which attributes to pump failure and undesired flow at pump shutdown. If the system backpressure is not at least 5 psi (0.35 bar) greater than the suction pressure, a backpressure valve must be installed in the discharge piping. To calculate the system's total backpressure use Equation 3 or 4.

Equation 3. For fluid viscosity below 50 centipoise.

$$P_T = \left(\frac{L_D R G Q}{C_1 d^2}\right) + P_P \pm P_H$$

Equation 4. For fluid viscosity above 50 centipoise.

$$P_T = \sqrt{\left(\frac{L_D R G Q}{C_1 d^2}\right)^2 + \left(\frac{L_D \mu Q}{C_2 d^4}\right)^2} + P_P \pm P_H$$

APPENDIX II OIL SPECIFICATIONS

PULSAlube #1

For service 40°F to 280°F

Typical Characteristics:
API Gravity = 28-30
Viscosity SUS @ 100°F = 450
Viscosity SUS @ 210°F = 73-78
Viscosity Index = 95-160
Pour Point = 15° to -25°F
Four Ball Wear Test:
1800 RPM, 20 KG Load,130°F,1 Hr. =
0.30 MM Scar Diameter
OK Timken Load = 60-70 lbs
Rust Test (ASTM D-665) = Pass
Demulsibility Test (ASTM D-2711) = Pass
Oxidation Test (ASTM D-2893) = Pass
Nearest Commercial Equivalent:
Exxon Std. Oil - Nuto Series
Shell Oil - Tellus Series
Texaco - Rando Series (Suitable only

PULSAlube #5

For adverse temperature conditions
Service range 40 to 400°F

Typical Characteristics:
API Gravity = 34
Viscosity SUS @ 100°F = 150
Viscosity SUS @ 210°F = 46
Viscosity Index = 135
Pour Point = 65°F
Four Ball Wear Test:
1800 RPM, 40 KG Load, 200°F, 1 Hr =
0.40 MM Scar Diameter
OK Timken Load = 60 - 70 lbs
Rust Test (ASTM D-665) = Pass
Demulsibility Test (ASTM D-2711) = Pass
Oxidation Test (ASTM D-2893) = Pass
Nearest Commercial Equivalent:
Mobil Oil Corporation-Mobil SHC 624

APPENDIX III BOLT TORQUE RECOMMENDATIONS

FOR MODELS WITH METAL HEADS AND TFE DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W201544	8 * 5/16-18	5.8	7.9	2 * 1/4-20	12.2	1.4
W203344	12 * 1/2-13	21.7	29.4	2 * 5/16-18	50.7	5.7
W205343	12 * 5/8-11	41.4	56.1	2 * 5/16-18	81.0	9.2
W201983	8 * 3/8-16	11.3	15.3	2 * 5/16-18	29.7	3.4
W205699	8 * 1/2-13	21.0	28.5	3 * 3/8-16	49.7	5.6
W203017	10 * 3/4-10	100.8	136.7	2 * 1/2-13	265.0	30.0
W202420	6 * 1/2-13	23.7	32.1	2 * 1/2-13	49.0	5.5
W209786	6 * 1/2-13	23.7	32.1	2 * 1/2-13	140.3	15.9
W204938	12 * 5/8-11	50.8	68.9	2 * 1/2-13	168.0	19.0
W203806	6 * 3/4-10	89.7	121.6	2 * 1/2-13	180.4	20.4
W205341	6 * 3/4-10	38.2	51.8	2 * 1/2-13	48.1	5.4

1. Reagent heads in these categories can be referenced by the head # which is stamped or cast on the part.

2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

FOR MODELS WITH METAL HEADS AND METAL DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W204524	6 * 3/8-16	8.3	11.3	2* 1/4-20	12.2	1.4
W204335	12 * 1/2-13	18.4	25.0	2 * 5/16-18	50.7	5.7
W208287	12 * 5/8-11	34.4	46.1	2 * 5/16-18	76.0	8.6
W205117	8 * 7/8-9	120.4	163.2	2 * 3/8-16	152.2	17.2
W204537	6 * 1/2-13	17.2	23.3	2 * 1/4-20	7.1	0.8
W204331	8 * 3/4-10	49.8	67.5	3 * 3/8-16	27.4	3.1
W205505	8 * 1-1/8-7	249.0	337.6	2 * 1/2-13	121.8	13.8
W205011	10 * 1-1/4-7	369.0	500.3	2 * 1/2-13	203.0	22.9
W204241	8 * 1/2-13	27.7	37.6	2 * 1/2-13	26.9	3.0
W205799	12 * 3/4-10	68.1	92.3	2 * 1/2-13	66.3	7.5
W205533	10 * 1-1/8-7	217.6	295.0	2 * 1/2-13	117.6	13.3
W205144	10 * 1-1/2-6	653.9	886.6	2 * 1/2-13	265.0	29.9
W205631	8 * 3/4-10	73.8	100.0	2 * 1/2-13	49.0	5.5
W205137	12 * 1-1/4-7	281.0	381.0	2 * 3/4-10	252.0	28.5
W206986	8 * 3/4-10	77.4	104.9	2 * 1/2-13	80.2	9.1
W207481	8 * 1-1/4-7	290.1	393.3	2 * 1/2-13	180.4	20.4

1. Reagent heads in these categories can be referenced by the head # which is stamped or cast on the part.

2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

FOR MODELS WITH TFE/PVC HEADS AND TFE DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W204374	8 • 5/16-18	1.5	2.0	2 • 1/4-20	3.0	0.3
W203668	4 • 3/8-16	5.9	8.0	2 • 3/8-16	9.3	1.1
W204785	6 • 1/2-13	10.2	13.8	2 • 1/2-13	21.0	2.4
W209925	6 • 1/2-13	8.8	11.9	4 • 3/8-16	17.8	2.0
W204008	6 • 3/4-10	29.9	40.5	2 • 5/8-11	68.0	7.7
W204829	6 • 3/4-10	47.7	64.7	2 • 1/2-13	90.6	10.2

FOR MODELS WITH HYDRATUBE HEAD AND METAL VALVES (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W094147	8 • 5/16-18	5.8	7.9	2 • 5/16-18	15.2	1.7
W094544	4 • 3/8-16	9.8	13.3	2 • 3/8-16	15.5	1.8
W094689	4 • 1/2-13	22.9	31.0	2 • 1/2-13	52.1	5.9
W096319	4 • 3/4-10	67.3	91.2	2 • 1/2-13	90.2	10.2

FOR MODELS WITH HYDRATUBE HEAD AND TFE VALVES (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W094147	8 • 5/16-18	1.5	2.0	2 • 5/16-18	3.8	0.4
W094544	4 • 3/8-16	5.9	8.0	2 • 3/8-16	9.3	1.1
W094689	4 • 1/2-13	15.2	20.6	2 • 1/2-13	47.5	5.4
W094689	4 • 1/2-13	15.2	20.6	4 • 3/8-16	17.8	2.0
W096319	4 • 3/4-10	44.9	60.9	2 • 1/2-13	54.8	6.2

1. Reagent heads in these categories can be referenced by the # of bolts and thread size.
2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

APPENDIX IV PULSAFEEDER ACCESSORIES

I. PULSATROL INSTALLATION, OPERATION AND REMOVAL INSTRUCTIONS

The PULSAtrol is a pneumatically charged diaphragm type chamber that continuously stores energy. Used on the inlet it will improve $NPSH_a$ (Net Positive Suction Head available) characteristics of the suction piping system. On the discharge line it will reduce dangerous peak pressures, eliminate shock waves and if of sufficient volume will reduce pulsating flow to almost linear.

INSTALLATION

Figures 60 a and b

On both discharge and suction lines it is desirable to mount the PULSAtrol as close to the pump connection as possible. It can be mounted in any position, but vertical is preferred for ease of charging, draining and servicing. The air chamber is sealed and will not require replenishing regardless of position. A shut off valve should always be used between the piping system and PULSAtrol, also a drain valve should always be installed directly below the PULSAtrol. If the discharge line is open to atmospheric pressure then a back pressure valve should also be incorporated in the system near the PULSAtrol to assure proper operation.

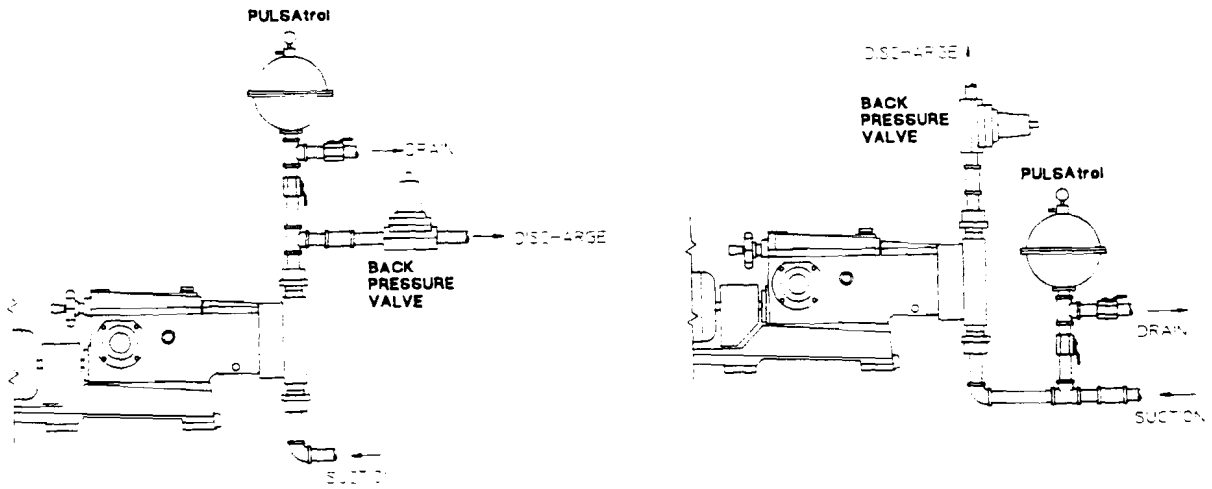


Fig. 60 a and b

OPERATION (Charging the PULSAtrol)

A Discharge Installation

The air side of the PULSAtrol must be precharged to approximately 50 percent of anticipated mean line pressure before placing on stream. This will permit the diaphragm to move to a neutral position between the chambers when operating.

PROCEDURE

Pre Charge Procedure for Discharge Installation

1. Calculate the precharge pressure

Mean Line Pressure (PSIG)
+ Atmospheric Pressure
Absolute Pressure (PSIA)
x Precharge Percentage (80% Max.)
Pressure Absolute
- Atmospheric Pressure
Precharge Pressure (PSIG)

= Precharge Pressure

2. Isolate PULSAtrol from line.

3. Carefully drain off process fluid by opening a drain valve (see recommend piping arrangement).

4. Apply precharge pressure (additional liquid may drain as diaphragm moves).

5. Close drain valve.

6. Place PULSAtrol in stream.

B. Suction Installation (Flooded Suction)

Charge the PULSAtrol with adequate pressure to overcome the static suction head. Start up the pump. Depress the stem on the charge valve, but only during discharge strokes of the pump, until the gauge indicates pressure pulses. The diaphragm has not centered allowing the PULSAtrol to accumulate liquid while the pump is discharging. If too much air becomes released and the gauge will not indicate pressure pulses then recharge the PULSAtrol and repeat the procedure.

PROCEDURE

Pre Charge Procedure for Suction Installation

1. Isolate accumulator from line.
2. Carefully drain off process fluid by opening a drain valve (see recommended piping arrangement, attached).
3. Apply 5-10 psi precharge pressure (additional liquid may drain as diaphragm moves).
4. Close drain valve.
5. Bleed off all pressure on the PULSAtrol.
6. Open the valve to put PULSAtrol in stream.
7. Push in on the stem of the charging valve during the discharge stroke of the pump and release during the suction stroke.
8. Continue this for about 10 times and observe the compound gauge. As accumulator functions, the needle will go from pressure to vacuum.

C. Suction Installation (Suction Lift)

Consult your PULSA Series representative or the factory for details.

II. DIAPHRAGM BACK PRESSURE VALVES

Figure 61

Pulsafeeder diaphragm back pressure valves create a constant back pressure without chatter or cycling. A TFE diaphragm, offering maximum chemical protection and service life, seals spring and bonnet from product. This diaphragm seals directly on a replaceable seat.

Be sure to install with fluid flow in direction of arrow on valve body. If arrow is missing from plastic valve body, install with flow exiting out center hole of valve body.

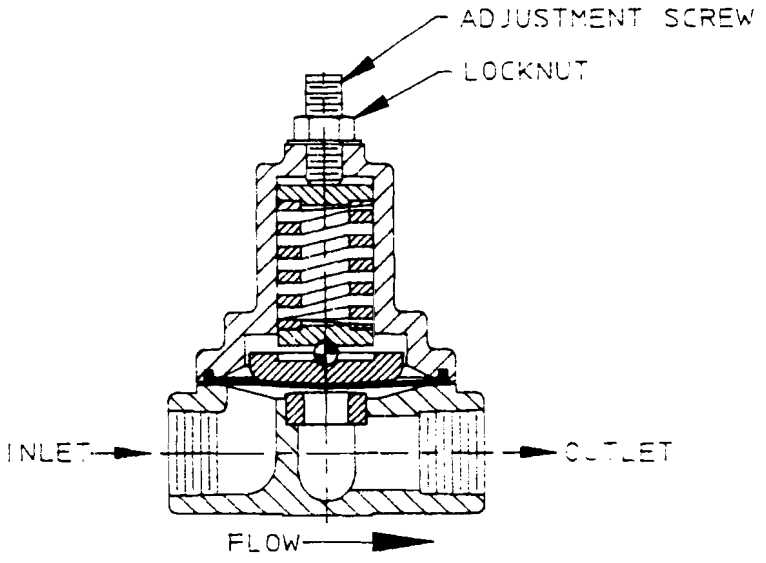


Fig. 61

MAINTENANCE LOG

Pump Model_____ Serial #_____

Gear Ratio_____ Maximum Flow_____

Piston Diameter_____ Maximum Pressure_____

KOPkit_____

All the above information can be obtained from the pump nameplate. Refer to the Pump Specification Data Sheet for additional information.

Date	Serviced By	Maintenance Performed

PULSA Series®
Diaghragm Metering Pumps

KOPkits®

Keep-On-Pumping kits save you money and time

Pulsafeeder has built a reputation for superior reliability by supplying carefully-designed, high-quality equipment. Even the best equipment, however, requires a minimal amount of preventative maintenance. KOPkits are designed to guard against unnecessary downtime and assure you the highest level of efficient and uninterrupted service from your PULSA Series pumps.

For each PULSA Series pump model you purchase, there is a unique KOPkit—a pre-packaged set of spare parts. A KOPkit contains all the parts which experience has shown require periodic replacement to assure reliable operation.

As an example, a KOPkit for a 680H Hydratube model will include a primary diaphragm (flat), a secondary diaphragm (tube), a set of check valves (balls & seats), o-rings, gaskets, oil seal and installation instructions.

Each KOPkit part is vacuum-sealed to keep it clean even when stored for long periods of time.

KOPkits save you maintenance costs 3 ways:

- When you need a part, you've got it! You can cut downtime and production loss from days to minutes.
- You save 5% on the price of a KOPkit compared to the total price of individual component parts.
- When you purchase it **with the pump**, you save an additional 5% on the KOPkit.

A KOPkit is a troubleshooter's best friend. In the event of a breakdown, it will put you back in business fast! Preventative maintenance will insure continuous high performance of you PULSA Series pump.

Keep on pumping! Get all the money-saving and security benefits of PULSA Series KOPkits immediately.

Ordering a KOPkit

Once the PULSA Series model is selected, its KOPkit can easily be quoted and ordered, since its price is automatically determined. Just consult your Representative for pricing.

Identifying a KOPkit

The KOPkit part number is stamped on the pump nameplate. The KOPkit number is also shown on the Specification Data Sheet and Pump Order Acknowledgment.

PULSA® 680
DIAPHRAGM METERING PUMP

MODEL SERIAL
GEAR RATIO : 1 MAX. FLOW
PISTON DIA. MAX. PRESS.
KOPKIT NO. KPC3AG1HACC

PULSAFEEDER
A Unit of IDEX Corporation

A
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PULSAFEEDER
A Unit of IDEX Corporation

Engineered Pump Operations
2883 Brighton-Henrietta Town Line Road, Rochester NY 14623
716-292-8000 • Fax 716-424-5619

Quality System ISO9001 Certified

Technical Sheet 180

IDEX CORPORATION

Printed in U.S.A.

PULSA® Series

DIAPHRAGM METERING PUMPS

S/N 9773133-1

Parts List

PULSAFEEDER

A unit of IDEX Corporation

** ORIGINAL **

716-292-8000 • Fax 716-424-5619

CUSTOMER	DATE	MODEL NO.	QUANTITY
KINEFLOW CORP	9/22/97	7440-S-E	1
CUSTOMER PURCHASE ORDER NO.		SERIAL NO.	ORDER NO.
K2237		9773133-1	C773133

IQUE	CUSTOMER ITEM NO.	QUOTATION REFERENCE NO.
PFBDBRAACCC0012	MCKESSON SITE	630-0059-97

JOB CONDITIONS

RODUCT	RAMM (Water/Fertilizer Mix	PUMPING TEMPERATURE	AMBIENT
SPECIFIC GRAVITY	1.00	VISCOSITY @ PUMPING TEMP	28.00 SSU
VAPOR PRESSURE @ PUMPING TEMPERATURE			
FLOW, MAX.	285.000	FLOW, MIN.	GPH
OPERATING PRESS. (1) (MAX)	80.000 PSIG	SUCTION PRESS. (2)	
SOLID CONCENTRATION	%		
SOLID SIZE			

(1) MUST BE AT LEAST 5 PSI ABOVE SUCTION PRESSURE (2) MUST BE AT LEAST 9.5 PSIA AND 5 PSI ABOVE VAPOR PRESSURE

COMMENTS: PUMP TEMP: AMB. (70) DEGREE F

SPECS

RATED CAPACITY	285.000 GPH			PUMP ASSEMBLY NO.	PFBDBRAACCC
RATED PRESSURE	80.000 PSIG			MULTIPLEX HEAD	
HYD. BY-PASS VALVE SETTING	80.000 PSIG			PISTON SIZE, DIAM.	3.000 INCHES
VALVE TYPE	BALL			STROKE LENGTH	1.450 INCHES
SUCTION VALVE QTY. 1	SIZE 1.500	INCHES		STROKE RATE	114.0 SPM
DISCHARGE VALVE QTY 1	SIZE 1.500	INCHES		GEAR RATIO	10.0 : 1

CONNECTION SIZE: SUCTION 2.500 INCH/NPT DISCHARGE 2.500 INCH/NPT

MATLS

VALVE	316	VALVE & CAP GASKETS	TEFLON (VIRGIN)	REAGENT HEAD	316
VALVE SEAT	316	DIAPHRAGM GASKETS	NONE REQUIRED	DIAPHRAGM	TEFLON (VIRGIN)
VALVE CAP & GUIDE	316	INTERMEDIATE FLUID	NONE REQUIRED		

HYDROSTATIC TEST	☐ YES	☒ NO	WITNESSED TEST	☐ YES	☒ NO	CALIBRATION TEST	☐ YES	☒ NO	INSPECTION	☐ YES	☒ NO
OTHER			REMOTE HEAD						LEAK DETECTION		

TAILS

All pumps receive a dynamic performance test for rated capacity/pressure test prior to shipment.

TAG PUMP: MCKESSON SITE - SYRACUSE NEW YORK SECO S/O 36908

For Standby Spares Kit, Order KOPKIT: KPFBDBRAACC

CONTROL DETAILS

EXTERNAL MANUAL STROKE ADJUSTMENT

DRIVER DETAILS

HP	.750	VOLTS	115/230	HZ	60	PHASE	1	AC	X DC
RPM	1140	FRAME	56	MFG	STK				
ENCLOSURE	XP								

MINIMUM SERVICE FACTOR IS EQUAL TO 1.0

DE-016 (9.95)

PUMP COPY

PULSAFEEDER DIVISION
2883 BRI-HEN TL RD
ROCHESTER, NY 14623
(716-292-8000)

OUR ORDER NUMBER - C773133
PUMP NUMBER - PFBDBRAACCC0012
SERIAL NUMBER 9773133-1
7440

CUSTOMER NAME KINEFLOW CORP REP: 63000

CUSTOMER P.O. K2237

PARTS LIST

QUANTITY	RELATIVE LEVEL	ITEM NUMBER	ITEM DESCRIPTION
1.000	1	PFBDBRAACCC	7440 EXT. *10:1FMMP 3.000 100
1.000	2	W209840-316	HEAD ASSY,REAGENT 6.00P 350A
2.000	3	W041472-316	VALVE,BALL 1.500 DIA
1.000	3	W094691-TFE	DIAPHRAGM,FLAT 6.00 DISH P
2.000	3	W096325-000	TIEBAR 1.00 2.94 4.62
2.000	3	W202944-316	SEAT,VALVE 1.50 B O H STD
2.000	3	W202946-316	GUIDE,VALVE 1.50 B O
1.000	4	W202946-X15	GUIDE CSTG,VALVE 1.50 B O
2.000	3	W202947-316	CAP,VALVE 2.50 NPT M
1.000	4	W089210-X15	CAP,VALVE 2.50 NPT M
6.000	3	W202966-TFE	GASKET,O RING 2.75 2.50 .125
1.000	3	W209786-316	HEAD,REAGENT 6.00 P S O 350
1.000	4	W209786-X15	HEAD CSTG,REAGENT 6.00 P 350
6.000	3	W770071-STA	.50-13X1.75 SCREW SKHD 8PSTA
4.000	3	W770158-STA	.50-13X4.25 SCREW SKHD 8PSTA
1.000	2	W209861-000	CONT ASSY,EXT 7440
2.000	3	W202398-000	HOUSING BOLT E,N,AP E
1.000	3	W208201-000	COVER ASSY,FRONT E,AP,N E
1.000	4	W202463-000	COVER,FRONT E,AE,AP,N E
1.000	4	W202505-000	DIAPHRAGM,COVER(FRONT) E
4.000	4	W771003-010	.25-20X1.00 SCREW FILHD 2PSTL
1.000	3	W209855-000	COVER ASSY,REAR (EXT) F
1.000	4	W049855-NTR	GASKET,O RING 2-010
1.000	4	W055785-000	BREATHER,FILTER
1.000	4	W092589-000	PIN,SHAFT ASSY 7120-E COVER
1.000	4	W092590-000	GEAR,REAR COVER(PINION) E,F,G,I
1.000	4	W092591-000	HANDWHEEL,EXT E,F,G,I
1.000	4	W092592-000	SLEEVE,REAR COVER
1.000	4	W092719-000	GEAR,REAR COVER E,F,G,I
1.000	4	W092720-000	SPUR GEAR,SHAFT ASSY 7120E COV
1.000	4	W092772-000	COUNTER,E & AE E,F,G,I
1.000	4	W094026-000	SHAFT,COVER EXT E,F,G,I
1.000	4	W096821-000	NAMEPLATE, STROKE SET 188SS
1.000	4	W202460-0AG	COVER,REAR EXT N
1.000	5	W202460-000	COVER,REAR EXT E
1.000	6	W202460-X01	COVER CSTG,REAR EXT E,F
1.000	6	W203185-000	BEARING,COVER EXT E,F,G,I
1.000	4	W202509-000	GASKET,COVER (REAR) E,F

PULSAFEEDER DIVISION
2883 BRI-HEN TL RD
ROCHESTER, NY 14623
(716-292-8000)

OUR ORDER NUMBER - C773133
PUMP NUMBER - PFBDBRAACCC0012
SERIAL NUMBER 9773133-1
7440

CUSTOMER NAME KINEFLOW CORP REP: 63000

CUSTOMER P.O. K2237

PARTS LIST

QUANTITY	RELATIVE LEVEL	ITEM NUMBER	ITEM DESCRIPTION
1.000	4	W202775-000	U-JOINT,ADJ L E,F
1.000	4	W203204-000	OIL LEVEL GAUGE ASSY E,F
1.000	5	W200781-NTR	GASKET,O RING 2-118
1.000	5	W203180-000	CAP,OIL FILL 20,60,80,R1
1.000	5	W203202-000	DIP STICK ALL-7120
1.000	4	W207459-000	GASKET,COUNTER E,F,G,I
1.000	4	W209821-000	ADJUSTMENT SHAFT SLEEVE 7440
1.000	4	W770007-STA	08-32X .88 SCREW SKHD 8PSTA
2.000	4	W771000-188	4-07X .18 SCREW DRIVE 0188
2.000	4	W771001-033	#05-40 X .38 SCREW RDHD 2PSTL
4.000	4	W771003-010	.25-20X1.00 SCREW FILHD 2PSTL
1.000	4	W771004-002	6-32X .12 SCREW SETSC 80STA
1.000	4	W771004-030	.25-20X .38 SCREW SETSC 80STA
1.000	4	W771005-STL	8 FLT WSHR, TYPE B REG PSTL
1.000	4	W771105-STL	8 REG LOCK WASHER PSTL
1.000	4	W771206-003	.094-S X .50 ROLL PIN 5STA
2.000	4	W771206-004	.094-S X .62 ROLL PIN 5STA
1.000	4	W771206-005	.094-S X .75 ROLL PIN 5STA
1.000	3	W209858-000	CONTROL COMMON PARTS 7440
1.000	4	W032971-000	CROSSHEAD E,F
1.000	4	W032974-000	PIN,CROSSHEAD E
2.000	4	W078200-001	GASKET,O RING (NITRILE) 2-018
1.000	4	W209799-000	PIN,CONNECTING ROD E,F
1.000	4	W209843-000	HAIRPIN COTTER CLIP
1.000	4	W771004-010	8-32X .25 SCREW SETSC 80STA
2.000	4	W771004-051	.38-16X .50 SSCR, FDP 80STA
1.000	3	W209860-000	HOUSING ASSY, (EXT) 7440
1.000	4	W032939-001	HOUSING,(EXT) E,F
1.000	4	W032961-000	PIN,HOUSING ADJ. E,F
1.000	4	W032968-000	ROD,CONNECTING (FRONT) E,F
1.000	5	W032968-X02	ROD,CONNECTING (FRONT)CSTG E,F
1.000	4	W033113-000	BLOCK,HOUSING E,F
1.000	5	W033113-X02	BLOCK,HOUSING CSTG E,F
1.000	4	W054520-000	.38-18 FLEXLOC NUT
1.000	4	W092583-000	ADAPTOR,HOUSING/GEAR E,F,G
1.000	4	W092584-000	BRACKET,ADJ.SHAFT 7120-HOUSING
1.000	4	W092585-000	SHAFT FOR TOP OF HOUSING 7120E
1.000	4	W092586-000	SHAFT,BLOCK ADJ E,F
1.000	4	W092714-000	GEAR ADJ-WORM FOR 7120 HOUSING

PULSAFEEDER DIVISION
2883 BRI-HEN TL RD
ROCHESTER, NY 14623
(716-292-8000)

OUR ORDER NUMBER - C773133
PUMP NUMBER - PFBDBRAACCC0012
SERIAL NUMBER 9773133-1
7440

CUSTOMER NAME KINEFLOW CORP REP: 63000

CUSTOMER P.O. K2237

PARTS LIST

QUANTITY	RELATIVE LEVEL	ITEM NUMBER	ITEM DESCRIPTION
1.000	4	W092715-000	GEAR,HOUSING ADJ E,F,G
1.000	4	W202774-000	U-JOINT,ADJ L E,F
1.000	4	W209820-000	ADJUSTMENT SLIP SHAFT 7440
1.000	4	W770007-STA	08-32X .88 SCREW SKHD 8PSTA
1.000	4	W771206-002	.094-S-X .31 ROLL PIN 5STA
2.000	4	W771206-004	.094-S X .62 ROLL PIN 5STA
1.000	4	W771206-009	.125-S-X .56 ROLL PIN 5STA
1.000	4	W771206-012	.125-S-X .87 ROLL PIN 5STA
1.000	4	W771206-036	.187-S-X 2.25 ROLL PIN 5STA
1.000	2	W209870-A24	HEAD ASSY,PUMP 100 P 3.00 G40
1.000	3	W209782-000	GEARBOX (1.50-3.00 PSTN) F
1.000	4	W202223-X07	GEARBOX,CSTG E,F
1.000	3	W209830-000	INSERT,DISH 6.00 DISH P
1.000	4	W094692-P00	INSERT,DISH 6.00 DISH P
1.000	3	W209846-000	PISTON ASSY,3.00 DIA 7440
2.000	4	W034859-000	SEAL,PISTON CUP 3.00 DIA E-I
1.000	4	W035172-000	SPACER,PISTON CUP 3.00
2.000	4	W035173-000	EXPANDER,PSTN CUP 3.00
1.000	4	W055147-000	.62-11 NUT FLEX LOCK
1.000	4	W209800-000	ROD,PISTON F
1.000	3	W209857-024	HEAD SUBASSY,PMP 6.00P 3.00 PF
1.000	4	W209809-000	CYLINDER,3.00 DIA. P F
1.000	4	W209832-000	HEAD,PUMP 6.00 P 1.50-3.00 PF
1.000	3	W209864-000	GASKET,HEAD (PUMP) 7440
1.000	3	W209865-A00	VALVE ASSY,HYDR BYP 0- 160
1.000	4	W038174-STL	BALL
1.000	4	W050359-000	SPRING,HBV F
1.000	4	W096477-000	GASKET,STAT-O-SEAL .38
1.000	4	W203378-000	GUIDE,SPRING (HBV)
1.000	4	W203379-000	SUPPORT,SPRING (HBV) C
1.000	4	W209835-000	GUIDE,HBV F
1.000	4	W209838-000	BODY,HBV .38-16 F
1.000	4	W209839-000	SEAT,VALVE .62 B O
1.000	4	W209841-000	GASKET,O RING (NITRILE) 2-023
1.000	4	W209842-000	GASKET,O RING (NITRILE) 2-019
1.000	4	W209862-000	CAP,HMV
1.000	4	W209863-CU0	GASKET,FLAT 1.375 1.130 .031
1.000	4	W209909-000	.38-16 X 1.75 TFL-HHCS HEXHD
1.000	4	W771261-STL	.38-16 NUT HEXJAM PSTL

PULSAFEEDER DIVISION
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7440

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CUSTOMER P.O. K2237

PARTS LIST

QUANTITY	RELATIVE LEVEL	ITEM NUMBER	ITEM DESCRIPTION
1.000	3	W209869-000	PUMP HD/PISTON COMM PARTS 7440
1.000	4	W053396-000	ADAPTOR,BLEEDER .38 NPT
1.000	5	W773965-212	.38 PIPE PLUG HEXHD SOLID STL
1.000	4	W200267-000	.12NPT CLOSE NIP SCH80 STL
1.000	4	W208070-000	VALVE ASSY,HYDR MAKE-UP CDEUV
1.000	5	W208070-001	VALVE ASSY,HYDR MAKE-UP CDEUV
1.000	5	W210432-000	SPRING, HMV 680
3.000	5	W210433-000	SPACER,HMV .297X.206X.031 STL
1.000	4	W208383-000	VALVE ASSY,AIR BLEEDER
1.000	5	W032575-CU0	GASKET,FLAT .312 .093 .016
1.000	5	W046646-STL	VALVE,BALL .250 DIA
1.000	5	W059657-000	SEAT,AUTO BLEED VALVE ALL
1.000	5	W059658-STL	VALVE,BALL .125 DIA
1.000	5	W092147-000	SCREW,AUTO BLEED BODY ALL
1.000	5	W771206-043	.062-S-X .75 ROLL PIN 5STA
1.000	5	W772602-001	04 OD X 02PT TUB FITG I
1.000	4	W209885-000	NAMEPLATE,PUMP F
2.000	4	W770029-STA	.25-20X2.25 SCREW SKHD 8PSTA
2.000	4	W770069-STA	.50-13X1.25 SCREW SKHD 8PSTA
4.000	4	W771000-188	4-07X .18 SCREW DRIVE 0188
1.000	4	W771543-MIR	.50X .38THD RED BUSHING 300LB
1.000	4	W772585-004	.50 PIPE PLUG SOCHD STA
1.000	4	W772602-001	04 OD X 02PT TUB FITG I
1.000	4	W772603-001	04 OD X 02PT TUB FITG I
1.000	4	W772603-003	04 OD X 02PT TUB FITG 270P I
2.000	4	W772618-001	08 OD X 06PT TUB FITG 169P I
3.000	4	W773963-005	.25ODX.040WALL TUBE POLYFLO
1.000	4	W773963-013	.50ODX.062WALL TUBE 88-P PPL
1.000	4	W773965-007	.50X .12THD R.BUSH. 150LB STL
1.000	2	W209874-010	GEAR ASSY,10.0:1 SPLX 7440
1.000	3	W209871-010	WORM SHAFT ASS'Y 10:1 7440
1.000	4	W209814-000	BEARING,WORM (TIMKEN) FRONT F
1.000	4	W209815-000	BEARING,WORM (TIMKEN) REAR F
1.000	4	W209828-010	WORM SHAFT 10:1 7440
1.000	3	W209872-010	SHAFT ASSY, ECC 10:1 7440
2.000	4	W209810-000	BEARING,ECC (TIMKEN) F
1.000	4	W209811-000	ECCENTRIC 7440
1.000	4	W209812-000	ECCENTRIC SHAFT 7440
1.000	4	W209822-000	SPACER,ECCENTRIC SHAFT 7440

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CUSTOMER P.O. K2237

PARTS LIST

QUANTITY	RELATIVE LEVEL	ITEM NUMBER	ITEM DESCRIPTION
1.000	4	W209827-010	WORM WHEEL 10:1 7440
1.000	5	W209827-F02	GEAR,FORGING G12-30
1.000	4	W209829-000	SPACER,WORM WHEEL 7440
1.000	4	W210029-000	.19 X 1.88 SQUARE KEY HT CRS
1.000	3	W209873-000	COM PARTS,GEAR ASSY SPLX 7440
2.000	4	W203216-000	SPACER,SHIM PACK CAM/ECC E,F
1.000	5	W203216-003	SPACER,SHIM .003 E,F
1.000	5	W203216-005	SPACER,SHIM .005 E,F
1.000	5	W203216-007	SPACER,SHIM .0075 E,F
1.000	5	W203216-020	SPACER,SHIM .020 E,F
1.000	4	W203239-000	SEAL,OIL (WORM SHAFT) E,F
2.000	4	W209813-000	ECCENTRIC BEARING BLOCK 7440
1.000	4	W209816-000	WORM SHAFT BEARING CAP 7440
1.000	4	W209818-000	SHIMS PACK-WORM SHAFT BRG CAP
1.000	5	W209818-003	WORM CAP SHIM .003 THK 7440
1.000	5	W209818-005	WORM CAP SHIM .005 THK 7440
1.000	5	W209818-007	WORM CAP SHIM .0075 THK 7440
1.000	5	W209818-020	WORM CAP SHIM .020 THK 7440
1.000	4	W209824-000	ROD,CONNECTING (REAR) 7440
1.000	5	W209824-X02	ROD,CONNECTING (REAR) 7440
12.000	4	W770401-STL	.25-20X .75 BOLT HEXHD 2PSTL
2.000	4	W771209-005	.25020DX .50 DOWEL PIN 0188
1.000	4	W773098-007	.19 X 1.00 SQUARE KEY STL
1.000	2	W209933-000	BASE ASSY, 56 C F
1.000	3	W042333-000	COUPLING, .62 .62 U L-070
1.000	3	W202900-000	BASE E,F,W
1.000	4	W202900-X07	BASE,CSTG E,F
1.000	3	W203223-000	GUARD,CPLG 3.62 4.25 R1.50
1.000	3	W203224-000	GUARD EXT,CPLG R1.72
2.000	3	W770400-STL	.25-20X .62 BOLT HEXHD 2PSTL
4.000	3	W770410-STL	.31-18X .75 BOLT HEXHD 2PSTL
3.000	3	W770412-STL	.31-18X1.00 BOLT HEXHD 2PSTL
1.000	3	W770459-STL	.25-20X .50 BOLT HEXHD 2PSTL
4.000	3	W771008-STL	.31 FLT WSHR, TYPE B REG PSTL
7.000	3	W771107-STL	.31 REG LOCK WASHER PSTL
1.000	1	W773118-016	3/4,115/230,1140,56XP ,1/60

**** FOR STANDBY SPARES KIT, ORDER KOPKIT KPFBDBRAACC ****

PULSAlube TECHNICAL DATA

PULSAlube #1

Service Range

For service 40°F to 280°F

Nearest Commercial Equivalent

Exxon - Nuto Series

Shell - Tellus Series

Texaco - Rando Series

Gulf - Harmony Series

Typical Characteristics

API Gravity	-	28 - 30
Viscosity SSU @ 100°F	-	450 - 700
Viscosity SSU @ 210°F	-	73 - 78
Viscosity Index	-	95 - 160
Pour Point	-	15° to -25°F
Four Ball Wear Test		
1800 RPM 20KG Load, 130°F, 1 Hr	-	.30MM Scar Diameter
Timken OK Load	-	60 - 70 lb.
Rust Test (ASTM D-665)	-	Pass
Demulsibility Test (ASTM D-2711)	-	Pass
Oxidation Test (ASTM D-2893)	-	Pass

PULSAlube TECHNICAL DATA

PULSAlube #5

Service Range
For adverse temperature conditions, service range -40°F to 400°F

Nearest Commercial Equivalent
Mobil - Mobil SHC 624

Typical Characteristics

API Gravity	-	34
Viscosity SSU @ 100°F	-	150
Viscosity SSU @ 210°F	-	46
Viscosity Index	-	135
Pour Point	-	-65°F
Four Ball Wear Test		
1800 RPM, 40 KG Load, 200°F, 1 Hr	-	.40 MM Scar Diameter
Timken OK Load	-	60 - 70 Lb.
Rust Test (ASTM D-665)	-	Pass
Demulsibility Test (ASTM D-2711)	-	Pass
Oxidation Test (ASTM D-2893)	-	Pass

MATERIAL SAFETY DATA SHEET

PULSAlube #1

I. IDENTIFICATION AND EMERGENCY INFORMATION

Product Name: PULSAlube #1
Supplier - Pulsafeeder Inc., 2883 Brighton-Hennetta Town Line Road, Rochester, NY 14623, (716)292-8000
Emergency Telephone - (800) 424-9300, Chemtrec (Inquines (716) 461-8310)
Chemical Name - Petroleum Lubricating Oil
CAS Number - Complex mixture, CAS not applicable
D.O.T. Hazard Class - N/A
D.O.T. I.D. Number - N/A
Labeling: NA
Miscellaneous: HMIS Code - Health - 1; Fire - 1; Reactivity - 0

II. PHYSICAL DATA

Boiling Point:	IBP > 200C
Odor:	Bland petroleum type
Appearance:	Light amber colored fluid
Specific Gravity:	(68° F) 0.86
Vapor Density (AIR=1):	Not Determined
Evaporation Rate:	Not Determined
apor Pressure:	Not Determined
lubility in Water:	Nil
our, Congealing or Melting Point:	Not Determined
ph:	Not determined
Percent Volatile by Vol.:	Ni1 from open container after 4 hrs. - @ 100° F

III. HAZARDOUS INGREDIENTS

This material is not known to contain greater than 0.1% of any carcinogen required to be listed under OSHA Hazard Communication Standard (29CFR 1910.1200)

From 0.02-0.10 percent Long Chain alkenylamine
From 0.002-0.02 percent Long Chain alkenylamine
From 0.002-0.02 percent Toluene (CAS 108-88-3)
From 0.002-0.02 percent Ester Copolymer
From 0.02-0.08 percent Acrylic Polymer
Greater than 80% Petroleum Lubrication Oil Base Stock (CAS 64741-88-4)

Please note that the chemical identity of some or all of the above hazardous ingredients is confidential business information and is being withheld as permitted by 29 CFR 1910.1200 and various State Right to Know Laws.

MATERIAL SAFETY DATA SHEET

PULSAlube #1

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (MINIMUM): >200 C (COC)
EXPLOSIVE LIMITS: (APPROX. % BY VOLUME IN AIR) Not determined
EXTINGUISHING MEDIA AND FIRE FIGHTING PROCEDURES: Foam, water spray (fog), dry chemical, carbon dioxide and vaporizing liquid type extinguishing agents may all be suitable depending on size or potential size of fire and circumstances related to the situation.

DECOMPOSITION PRODUCTS UNDER FIRE CONDITIONS: Fumes, smoke, carbon monoxide, sulfur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.

"EMPTY" CONTAINER WARNING:

"Empty" containers retain residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS OR OTHER SOURCES OF IGNITION: THEY MAY EXPLODE AND CAUSE INJURY OF DEATH. Do not attempt to clean since residue is difficult to remove. "Empty" drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All other containers should be disposed of in an environmentally safe manner in compliance with applicable government regulations.

V. HEALTH HAZARD DATA

Variability among individuals
Health studies have shown that many petroleum hydrocarbons and synthetic lubricants pose potential human health risks which may vary from person to person. As a precaution, exposure to liquids, vapors, mist or fumes should be minimized.

Effects of Overexposure (Signs and Symptoms of exposure): Prolonged or repeated skin contact may cause skin irritation.

Nature of Hazard: Prolonged or repeated skin contact with this product tends to remove skin oils possibly leading to irritation and dermatitis. Product contacting the eyes may cause irritation.

Toxicity Information: Product has a low order of acute oral and dermal toxicity, but minute amounts aspirated into the lungs during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death.

Pre-existing Medical Conditions Which May Be Aggravated By Exposure: None recognized.

VI. REACTIVITY DATA

This product is stable and will not react violently with water. Hazardous polymerization will not occur. Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite or calcium hypochlorite. Oxides of carbon, sulfur, phosphorous, calcium and zinc will occur on thermal decomposition.

MATERIAL SAFETY DATA SHEET

PULSAlube #1

VII. SPILL OR LEAK PROCEDURES

Steps To Be Taken In Case Material Is Released Or Spilled: Recover free product. Add sand, earth or other suitable absorbent to spill area. Minimize skin contact. Keep product out of sewers and watercourses by diking or impounding. Advise authorities if product has entered or may enter sewers, watercourses or extensive land areas. Assure conformity with applicable governmental regulations.

VIII. SPECIAL PROTECTION INFORMATION

VENTILATION

Use local exhaust to capture vapor, mist, or fumes, if necessary. Provide greater than 60 feet per minute hood face velocity for confined spaces. Provide ventilation sufficient to prevent exceeding recommended exposure limit or build-up of explosive concentrations of vapor in air. Use explosion-proof equipment. No smoking or open lights.

RESPIRATORY PROTECTION

Normally not needed at ambient temperatures. Use supplied-air respiratory protection in confined or enclosed spaces, if needed.

PROTECTIVE GLOVES

Use chemical-resistant gloves, if needed, to avoid prolonged or repeated skin contact.

EYE PROTECTION

Use splash goggles or face shield when eye contact may occur.

OTHER PROTECTIVE EQUIPMENT

Use chemical-resistant gloves, avoid contaminating regular clothing which could result in prolonged or repeated skin contact.

IX. SPECIAL PRECAUTIONS

WORK PRACTICES/ENGINEERING CONTROLS

Keep containers closed when not in use. Do not handle or store near heat, sparks, flame or strong oxidants.

MATERIAL SAFETY DATA SHEET

PULSAlube #1

IX. SPECIAL PRECAUTIONS (CONTINUED)

PERSONAL HYGIENE

Minimize breathing vapors, mist or fumes. Avoid prolonged or repeated contact with skin. Remove contaminated clothing. Cleanse skin thoroughly after contact, before breaks and meals and at end of work period. Product is readily removed from skin by waterless hand cleansers followed by washing thoroughly with soap and water.

X. EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT

If splashed into the eyes, flush with clear water for 15 minutes or until irritation subsides. If irritation persists, call a physician.

SKIN CONTACT

In case of skin contact, remove any contaminated clothing and wash skin with soap and water.

INHALATION

Vapor pressure is very low. Vapor inhalation under ambient conditions is normally not a problem. If overcome by vapor from product immediately remove from exposure and call a physician. If breathing is irregular or has topped, start resuscitation; administer oxygen if available. If overexposed to oil mist, remove from further exposure until excessive oil mist condition subsides.

INGESTION

If ingested, call a physician immediately.

XI. TRANSPORTATION INFORMATION

Transportation Incident Information

For further information relative to spills resulting from transportation incidents, refer to latest Department of Transportation regulations.

The information presented herein has been compiled from sources considered to be dependable and is accurate to the best of seller's knowledge. However, since the conditions of handling and use are beyond our control, seller makes no warranty whatsoever, expressed, implied or of merchantability regarding the accuracy or completeness of such data or the results to be obtained from use thereof. Further, seller assumes no responsibility for injury to buyer or to third persons, or for damage to any property. Buyer assumes all such risks, including but not limited to compliance of user with all applicable Federal, State and Local laws and regulations. Further, nothing contained herein is to be construed as a recommendation for use in violation of any patent or applicable laws and regulations.

MATERIAL SAFETY DATA SHEET

PULSAlube #5

I. Identification and Emergency Information

Product Name - PULSAlube #5
Supplier - Pulsafeeder Inc., P.O. Box 22909, 2883 Brighton-Hennetta TL Road, Rochester, New York 14692
Product Identification - Mobil SHC 624
24 Hour Emergency Telephone (call collect) - Mobil Oil Company (609)737-4411
Transport Emergency Telephone - (800) 424-9300 (CHEMTREC)
Chemical Names and Synonyms - Synthetic Hydrocarbons
Use or Description - Lubricant
Product and MSDS Information - (800) 662-4525

II. Chemical/Physical Data

Appearance - Lt. Amber Liquid	Odor - Mild	PH - N/A
Viscosity at 100 F, SUS: 155.0	At 40 C, CS: 30.0	
Viscosity at 210 F, SUS: 46.0	At 100 C, CS: 6.0	
Flash Point F(C): > 460 (238)	(ASTM D-92)	
Melting Point F(C): N/A	Pour Point F(C): -65 (-54)	
Boiling Point F(C): > 600 (316)		
Relative Density: 15/4 C: 0.852	Solubility in Water - Negligible	
Vapor Pressure: -mm Hg @ 20C: <.1		

NA = Not Applicable NE = Not Established D = Decomposes
For further information, contact your local marketing office.

III. Potentially Hazardous Ingredients

None

See sections XII and XIII for regulatory and further compositional data.

Sources A = ACGIH-TLV, A* = Suggested - TLV, M = Mobil, O = OSHA, S = Supplier
Note: Limits shown for guidance only. Follow applicable regulations.

IV. Health Hazard Data

- Includes aggravated medical conditions, if established. -

Threshold Limit Value - 5.00 mg/m3 Suggested for Oil Mist
Effects of Overexposure - Not expected to be a problem.

V. Emergency and First Aid Procedures - For Primary Routes of Entry

Eye Contact - Flush thoroughly with water. If irritation persists, call a physician.
Skin Contact - Wash contact areas with soap and water.
Inhalation - Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance and call a physician. If breathing has stopped, use mouth to mouth resuscitation.
Ingestion - Not expected to be a problem when ingested. If uncomfortable, seek medical assistance.

SHORT AND LONG TERM STORAGE PROCEDURES

Equipment Inspection

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage should be reported immediately to carrier and to your PULSA Series representative.

Storage Instructions

I. Short Term

Storage of PULSA Series pump for up to 12 months after shipment is considered short term. Under this condition the recommended storage procedure is as follows:

A. The pump should be stored indoors at room temperature in a dry environment.

B. Pumps with a HYDRATUBE reagent head assembly are shipped with the diaphragm in the neutral position. It must be kept in this position during storage.

C. The pump gearbox and hydraulic reservoir is to be completely filled with PULSAlube oil within two months after date of shipment.

D. The gearbox and hydraulic reservoir should be inspected every 3 to 6 months. Maintain the oil level and assure that no water or condensate builds up in the gearbox. If water or condensation is present, follow Procedure II, Step A below.

E. It is recommended that the stroke length of the pump be adjusted to its midpoint and that the piston be manually cycled through 3 to 6 cycles every 6 months.

F. Prior to startup, perform a complete inspection and then start up in accordance with instructions in this manual.

II. Long Term

For storage longer than 12 months in addition to the above, the following procedures should be followed.

A. Every twelve months PULSAlube oil should be drained from the gearbox and hydraulic reservoir. The gearbox and hydraulic reservoir should be flushed with kerosene or petroleum base solvent and then refilled with fresh PULSAlube oil.

B. Every 12 months the motor should be connected to a power source and the pump operated for a minimum of one hour. It is not necessary to have fluid in the reagent head during this operation.

After 12 months storage Pulsafeeder's warranty cannot cover such items as oil seals, gaskets, piston cups and other items which are subject to deterioration with age. If the pump has been in storage for longer than 12 months it is recommended that these items be replaced prior to going into service. Material and labor to recondition or replace this class of item is the purchaser's responsibility. For a one year service warranty after extended storage the refurbishment and equipment inspection must be done by a Pulsafeeder serviceman.

MATERIAL SAFETY DATA SHEET

PULSAlube #5

VI. Fire and Explosion Hazard Data

Flash Point F(C): > 450 (238) (ASTM D-92)
Flammable Limits. LEL: .6% UEL. 7.0%
Extinguishing Media - Carbon dioxide. foam. dry chemical and water fog.
Special Fire Fighting Procedures - Water or foam may cause frothing. Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure. For fires in enclosed areas. firefighters must use self-contained breathing apparatus. Prevent runoff from fire control or dilution from entering streams. sewers. or drinking water supply.
Unusual Fire and Explosion Hazards - None
NFPA Hazard ID: Health: 0, Flammability: 1. Reactivity: 0

VII. Reactivity Data

Stability (Thermal. light. etc.) - Stable
Conditions to Avoid - Extreme heat
Incompatibility (Materials to Avoid) - Strong oxidizers
Hazardous Decomposition Products - Carbon monoxide
Hazardous Polymerization - Will not occur

VIII. Spill or Leak Procedure

ENVIRONMENTAL IMPACT - Report spills as required to appropriate authorities. U. S. Coast Guard regulations require immediate reporting of spills that could reach any waterway including intermittent dry creeks. Report spill to Coast Guard, Toll Free Number 800-424-8802. In case of accident or road spill, notify CHEMTREC. (800) 424-9300.
Procedures if Material is Released or Spilled - Absorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up and dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulations. and product characteristics at time of disposal.
WASTE MANAGEMENT - Product is suitable for burning in an enclosed, controlled burner for fuel value or disposal by supervised incineration. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at any government approved waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

IX. Special Protection Information

Eye Protection: Normal industrial eye protection practices should be employed.
Skin Protection: No special equipment required. However, good personal hygiene practices should always be followed.
Respiratory Protection: No special requirements under ordinary conditions of use and with adequate ventilation.
Ventilation: Use in well ventilated area.

MATERIAL SAFETY DATA SHEET

PULSAlube #5

X. Special Precautions

No special precautions required.

XI. Toxicological Data

—Acute Toxicology—

Oral Toxicity (RATS): Nontoxic – Based on testing of similar products and/or the components.
Dermal Toxicity (RABBITS): Nontoxic – Based on testing of similar products and/or the components.
Inhalation Toxicity (RATS): Not established.
Eye Irritation (RABBITS): Expected to be non-irritating – Based on testing of similar products and/or the components.

Skin Irritation (RABBITS): Expected to be non-irritating – Based on testing of similar products and/or the components.

XII. Regulatory Information

Government Inventory Status: All components registered in accordance with TSCA.

DOT: Shipping Name: Not applicable
Hazard Class: Not applicable

US OSHA HAZARD COMMUNICATION STANDARD: Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined not to be hazardous.

RCRA INFORMATION: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D); does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity, and is not formulated with the contaminants listed in the Toxicity Characteristic (TC). Rule as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

FOLLOWING CATEGORY: H2 - Lubricants With No Food Contact

U.S. Superfund Amendments and Reauthorization Act (SARA) Title III: This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

SARA (311/312 - FORMERLY 302) REPORTABLE HAZARD CATEGORIES: None

This product contains no chemicals reportable under SARA (313) toxic release program.

The following product ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
NO REPORTABLE INGREDIENTS		

MATERIAL SAFETY DATA SHEET

PULSAlube #5

Key to List Citations

1	=	OSHA Z.	2	=	ACGIH.	3	=	IARC.
4	=	NTP.	5	=	NCI.	6	=	EPA CARC.
7	=	NFPA 49.	8	=	NFPA 325M.	9	=	DOT HMT.
10	=	CA RTK.	11	=	IL RTK.	12	=	MA RTK.
13	=	MN RTK.	14	=	NJ RTK.	15	=	MI 293.
16	=	FL RTK.	17	=	PA RTK	18	=	CA P65

NPT, IARC, AND OSHA INCLUDE CARCINOGENIC LISTINGS
Product is not formulated to contain PCBS.

XIII. Ingredients

INGREDIENT DESCRIPTION	PERCENT	CAS NUMBER
CONTAINS THE FOLLOWING BASE OILS:	> 95.00	
ALKENES, C>10 ALPHA, POLYMD.		68527-8-2
HEXANEDIOIC ACID, DITRIDECYL ESTER		16958-92-2
BENZENAMINE, N-PHENYL	0.05	122-39-4

APPENDIX

FOR MOBIL USE ONLY: MCN. MHC: 0* 0*. MPPEC: A. PPEC: A.
US91-450 APPROVE 07/19/91 REQ: US - MARKETING

INFORMATION GIVEN HEREIN IS OFFERED IN GOOD FAITH AS ACCURATE, BUT WITHOUT GUARANTEE. CONDITIONS OF USE AND SUITABILITY OF THE PRODUCT FOR PARTICULAR USES ARE BEYOND OUR CONTROL; ALL RISKS OF USE OF THE PRODUCT ARE THEREFORE ASSUMED BY THE USER AND WE EXPRESSLY DISCLAIM ALL WARRANTIES OF EVERY KIND AND NATURE, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE IN RESPECT TO THE USE OF SUITABILITY OF THE PRODUCT. NOTHING IS INTENDED AS A RECOMMENDATION FOR USES WHICH INFRINGE VALID PATENTS OR AS EXTENDING LICENSE UNDER VALID PATENTS. APPROPRIATE WARNINGS AND SAFE HANDLING PROCEDURES SHOULD BE PROVIDED TO HANDLERS AND USERS.

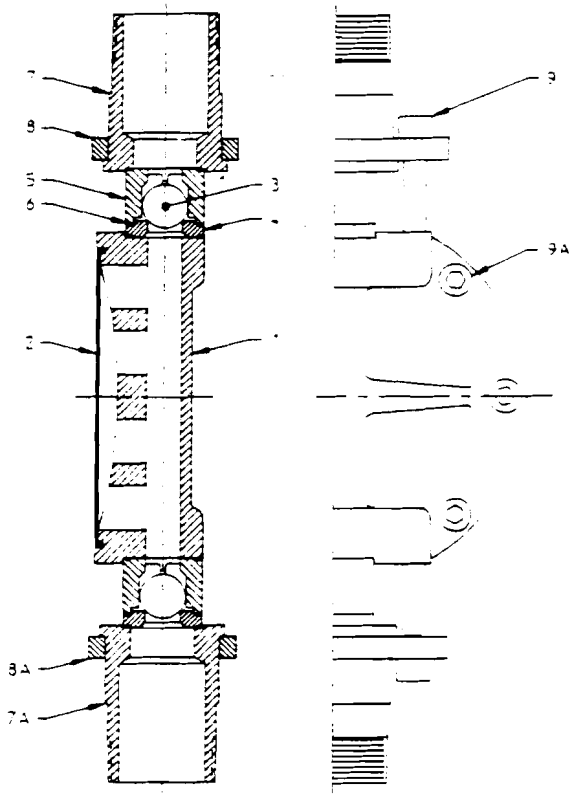
LUBRICATIONS INSTRUCTIONS

The recommended oil change interval is dependent upon the operating environment, two classifications are used.

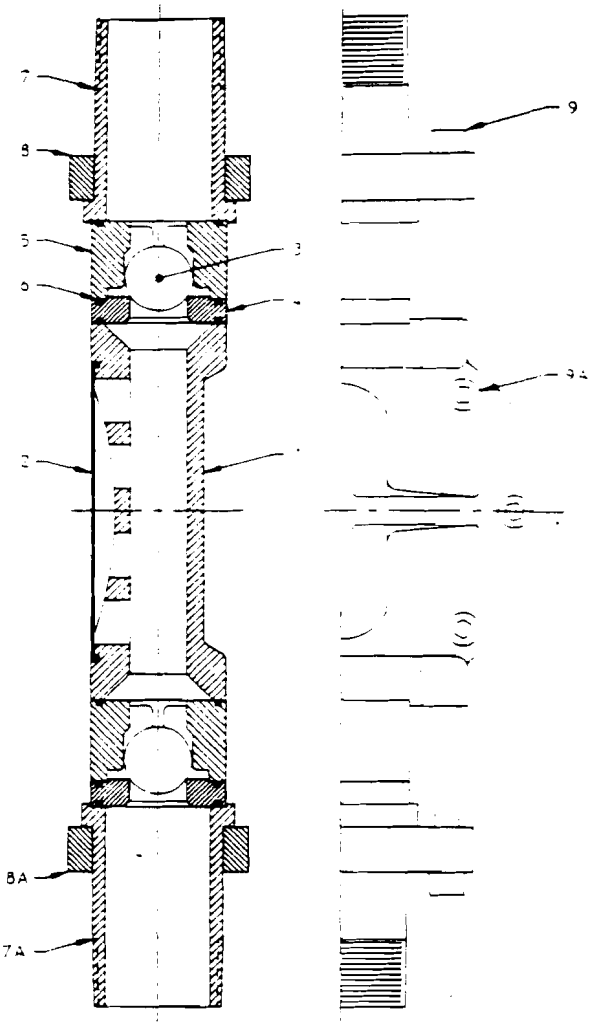
1. **Normal Service**: Clean/dry atmosphere and a gearbox operating temperature of 40°F to 100°F (4.4°C to 37.7°C).

2. **Severe Service**: Humid atmosphere and a gearbox operating temperature below 40°F or over 100°F.

The first oil change should be done after six (6) months of continuous operation (approximately 4500 hours) and thereafter every twelve (12) months, (9000 hours) for **normal** service and every six (6) months (4500 hours) for **severe** service.



SECTION "A"



SECTION "B"

ITEM	PART NAME	QTY	CROSS SECTION "A" SELECT PART NUMBER BY THE DIAMETER OF THE PISTON ASSEMBLY IN YOUR PUMP 2.12 2.38 2.62	CROSS SECTION "B" SELECT PART NUMBER BY THE DIAMETER OF THE PISTON ASSEMBLY IN YOUR PUMP 3.00	ADD PART NUMBER SUFFIX FROM THE COLUMN COVERING MATERIAL OR DESIGN OF PART IN CONTACT WITH PRODUCT 316SS	#20SS	H_2SO_4
1	REAGENT HEAD	1	W202420	W209786	-316	-020	-316
• 2	DIAPHRAGM	1	W09469*	W094691	-TFE	-TFE	-TFE
• 3	BALL VALVE	2	W034581	W041472	-316	-HCO	-HCO
• 4	VALVE SEAT	2	W202473	W202944	-316	-020	-020
5	VALVE GUIDE	2	W202472	W202946	-316	-020	-316
• 6	O RING	6	W078452	W202966	-TFE	-TFE	-TFE
7	VALVE CAP	1	W208396	W202947	-316	-020	-316
7A	VALVE CAP	1	W208396	W202947	-316	-020	-316
8	TIE BAR	1	W208405	W096325	-000	-000	-000
8A	TIE BAR	1	W208405	W096325	-000	-000	-000
9	CAP SCREW	4	W770075	W770158	-STA	-STA	-STA
9A	CAP SCREW	6	W770071	W770071	-STA	-STA	-STA
10	COMPLETE REAGENT HEAD ASSEMBLY CONSISTING OF ALL OF THE ABOVE COMPONENTS PREASSEMBLED	1	W208409 SEE NOTE 1	W209840 SEE NOTE 1	-316	-020	-HSO

• DENOTES DESIGNATED KOPKIT ITEMS

NOTES 1.) NOT FOR USE WITH 2.38.2.62 AND 3.00 PISTONS AT 175 SPM

ALL DIMENSIONS ARE IN INCHES

PULSA Series | PULSAFEEDER A Unit of IDEX Corporation

MODEL 7440 FL PLASTIC DIAPH
REAGENT HEAD ASSEMBLY
METAL HEAD AND VALVE

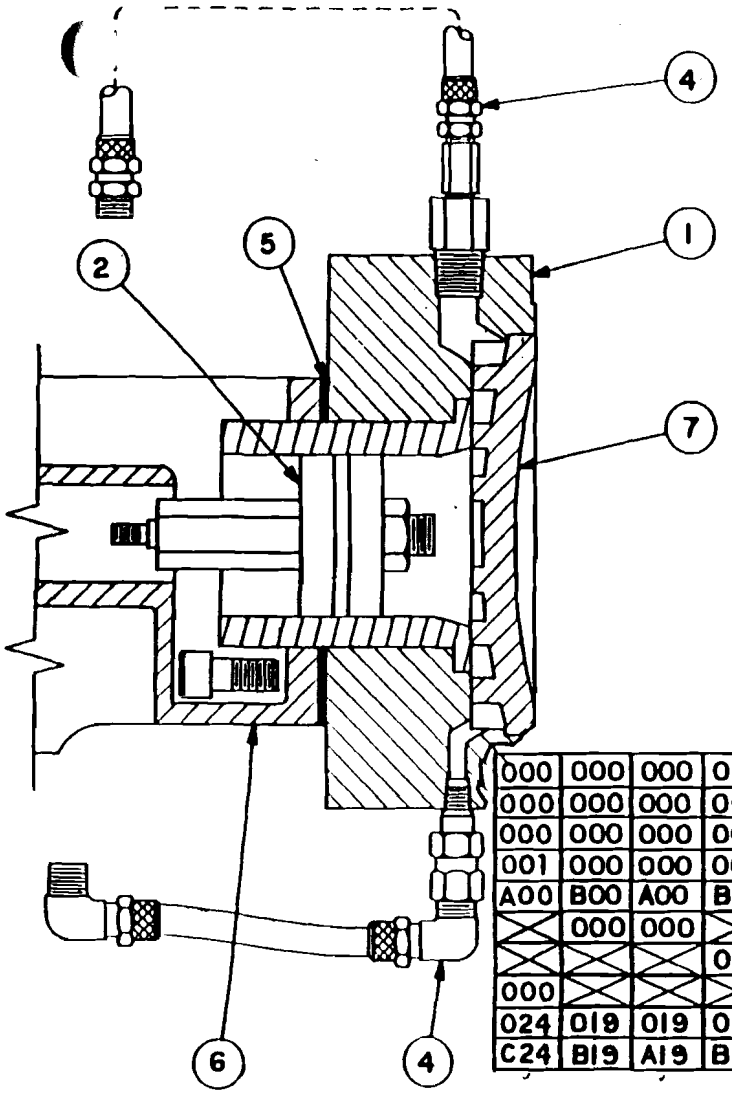
REF	REVISION UPDATE	DATE
6	REVISED FOR 1993 REISSUE	01/01/93

SECTION/PAGE	7440/103
EFFECTIVE	01/01/93
SUPERSEDES	01/11/91

DWN BY: MJP
DATE: 08/30/90

AP00214

DWG. NO. W209870 | SHEET 1 OF 3



USE -A : 60 PSI
-A : 0-130 PSI
-A24 : 0-100 PSI
-C24 : 0-100 PSI (HI TEMP) TO 212° F

REF	REVISION DESCRIPTION		DATE	APP
A	ADD SUFFIX A17 & B17 (SEE SH 2)		4-21-86	
B	ADD SUFFIX D17 SHEET 2		5-5-89	
C	ADD -C24 SUFFIX	ATB	6/3/89	
D	ADD -D24 SHEET 2 OF 2		10-25-90	
E	ADD -C19 SHT. 2 of 2	CLA	11-04-91	
F	SEE SHEET 2		12-05-91	TLM
G	ADD -C21 SHEET 3		4/21/92	KY
H	ADD SUFFIX D21 SHEET 3		5/11/92	TLM

SUFFIX							PART NUMBER LESS SUFFIX	QUAN	DESCRIPTION OR MATERIAL	ITEM
000	000	000	000	000	000	000	W209830	1	DISH PLATE INSERT 6.00 X 5.31	7
000	000	000	000	000	000	000	W209782	1	GEAR BOX	6
000	000	000	000	000	000	000	W209864	1	PUMP HEAD GASKET	5
001	000	000	000	000	000	000	W209869	1	PUMP HEAD/PISTON COMMON PARTS	4
A00	B00	A00	B00	A00	B00	A00	W209865	1	VALVE ASSY, HYDR BYP	3
X	000	000	X	X	X	X	W209844	1	PISTON ASSY 2.38"	2
X	X	X	000	000	X	X	W209845	1	PISTON ASSY 2.62"	2
000	X	X	X	X	000	000	W209846	1	PISTON ASSY 3.00"	2
024	019	019	021	021	024	024	W209857	1	PUMP HEAD SUB-ASSY	1
C24	B19	A19	B21	A21	B24	A24	W209870	X	PUMP HEAD / PISTON ASSY	X

MANUFACTURING STANDARDS UNLESS OTHERWISE SPECIFIED
TOLERANCES
MACHINED SURFACE ROUGHNESS 125
BREAK ALL SHARP EDGES .015 MAX
ALL DIMENSIONS IN INCHES

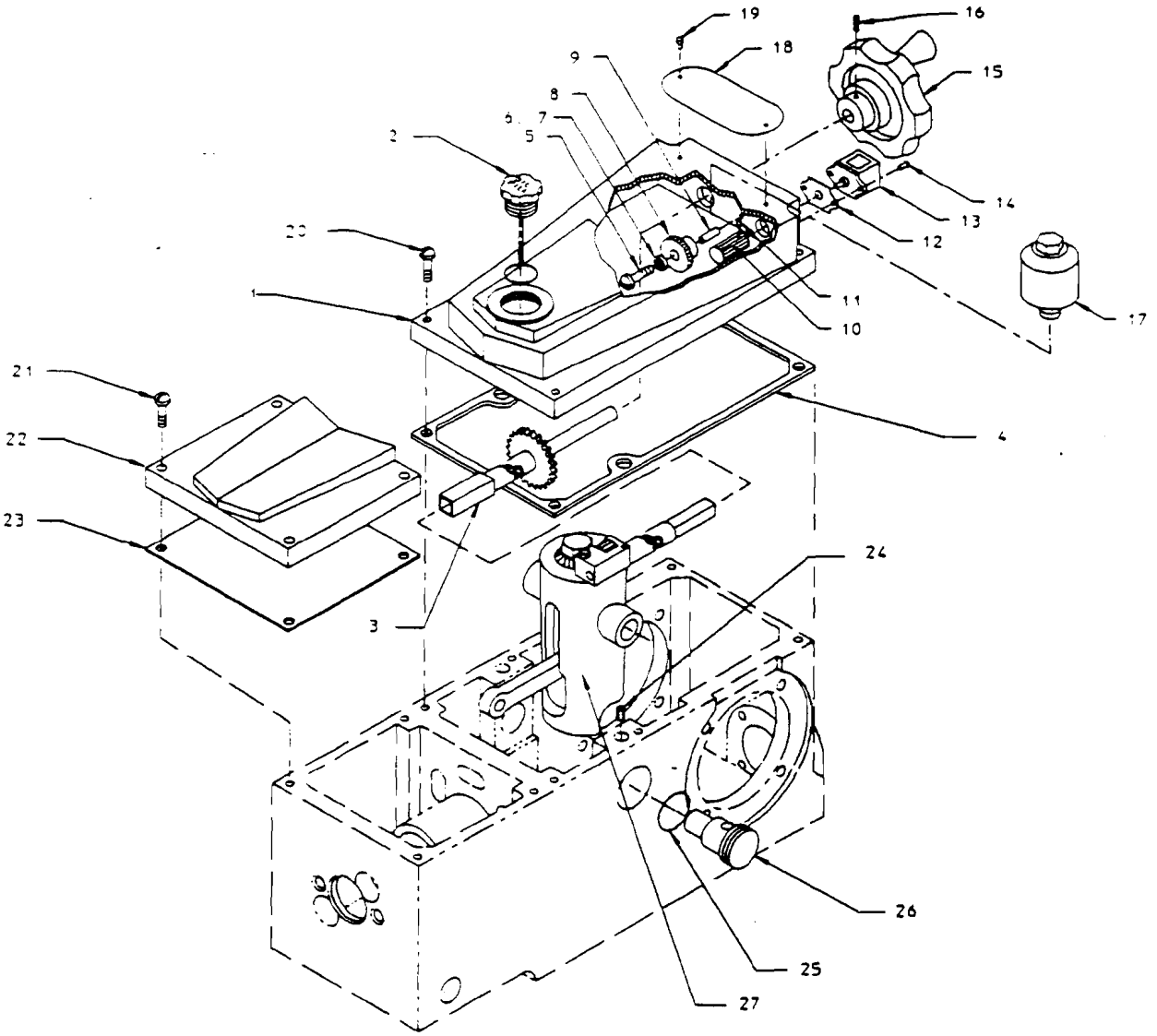
DWN	Mah	4-22-86
CHK		4-22-86
APP	RG	4-25-86

Pulsafeeder

TITLE: PUMP HEAD / PISTON ASSY

BOOKCASE: PH | SIZE: B | DWG NO: W209870

REF: 7440 A | SCALE | SHEET 1 OF 3



ITEM	PART NAME	QTY	PART NUMBER
1	REAR COVER	1	W202460-0AG
2	OIL LEVEL GAUGE ASSEMBLY	1	W203204-000
3	COVER SHAFT ASSEMBLY	1	W209856-000
4	COVER GASKET	1	W202509-000
5	CAP SCREW	1	W770007-STA
6	LOCK WASHER	1	W771105-STL
7	FLAT WASHER	1	W771005-STL
8	GEAR	1	W092719-000
9	SLEEVE	1	W092592-000
10	GEAR	1	W092590-000
11	SET SCREW	1	W771004-002
12	COUNTER GASKET	1	W207459-000
13	COUNTER	1	W092772-000
14	ROUND HEAD SCREW	2	W771001-033
15	HAND WHEEL	1	W092591-000
16	SET SCREW	1	W771004-030
17	BREATHER FILTER	1	W055785-000
18	STROKE NAMEPLATE	1	W096821-000
19	DRIVE SCREW	2	W771000-188
20	FILLISTER HEAD SCREW	4	W771003-010
21	FILLISTER HEAD SCREW	4	W771003-010
22	FRONT COVER	1	W202463-000
23	DIAPHRAGM	1	W202505-000
24	SET SCREW	2	W771004-051
25	O RING	2	W078200-001
26	HOUSING BOLT	2	W202398-000
27	HOUSING ASSEMBLY	1	W209860-000
28	COMPLETE REAR COVER ASSEMBLY CONSISTING OF ITEMS 1-20 PREASSEMBLED	1	W209855-000

ALL DIMENSIONS ARE IN INCHES

PULSA Series — PULSAFEEDER, A Unit of IDEX Corporation

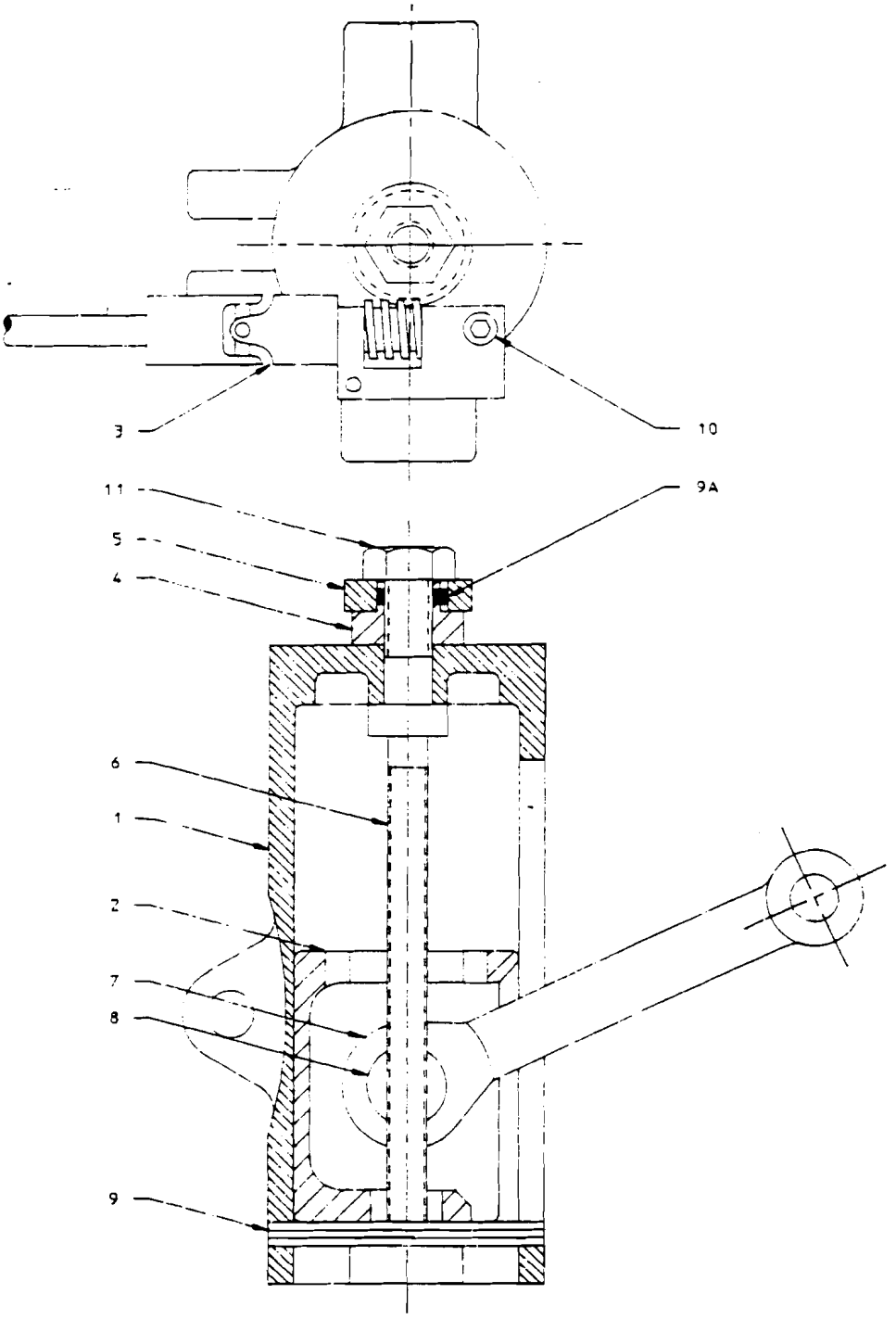
MODEL 7440-E
CONTROL ASSEMBLY
EXTERNAL MANUAL CONTROL

REF	REVISION UPDATE	DATE
A	UPDATE PARTS LIST	11/09/94

SECTION/PAGE	7440/400
EFFECTIVE	12/02/94
SUPERSEDES	10/01/93

DWN BY: MJP
DATE: 10/02/90

AP00230



ITEM	PART NAME	QTY	PART NUMBER
1	HOUSING	1	W032939-001
2	HOUSING BLOCK	1	W033113-000
3	ADJUSTMENT SHAFT ASSEMBLY	1	W209859-000
4	ADAPTOR	1	W092583-000
5	GEAR	1	W092715-000
6	ADJUSTMENT SCREW	1	W092586-000
7	CONNECTING ROD	1	W032968-000
8	PIN	1	W032961-000
9	ROLL PIN	1	W771206-036
9A	ROLL PIN	1	W771206-009
10	CAP SCREW	1	W770007-STA
11	LOCK NUT	1	W054520-000
12	COMPLETE HOUSING ASSEMBLY CONSISTING OF ALL THE ABOVE COMPONENTS PREASSEMBLED	1	W209860-000

ALL DIMENSIONS ARE IN INCHES

PULSA Series — PULSAFEEDER, A Unit of IDEX Corporation

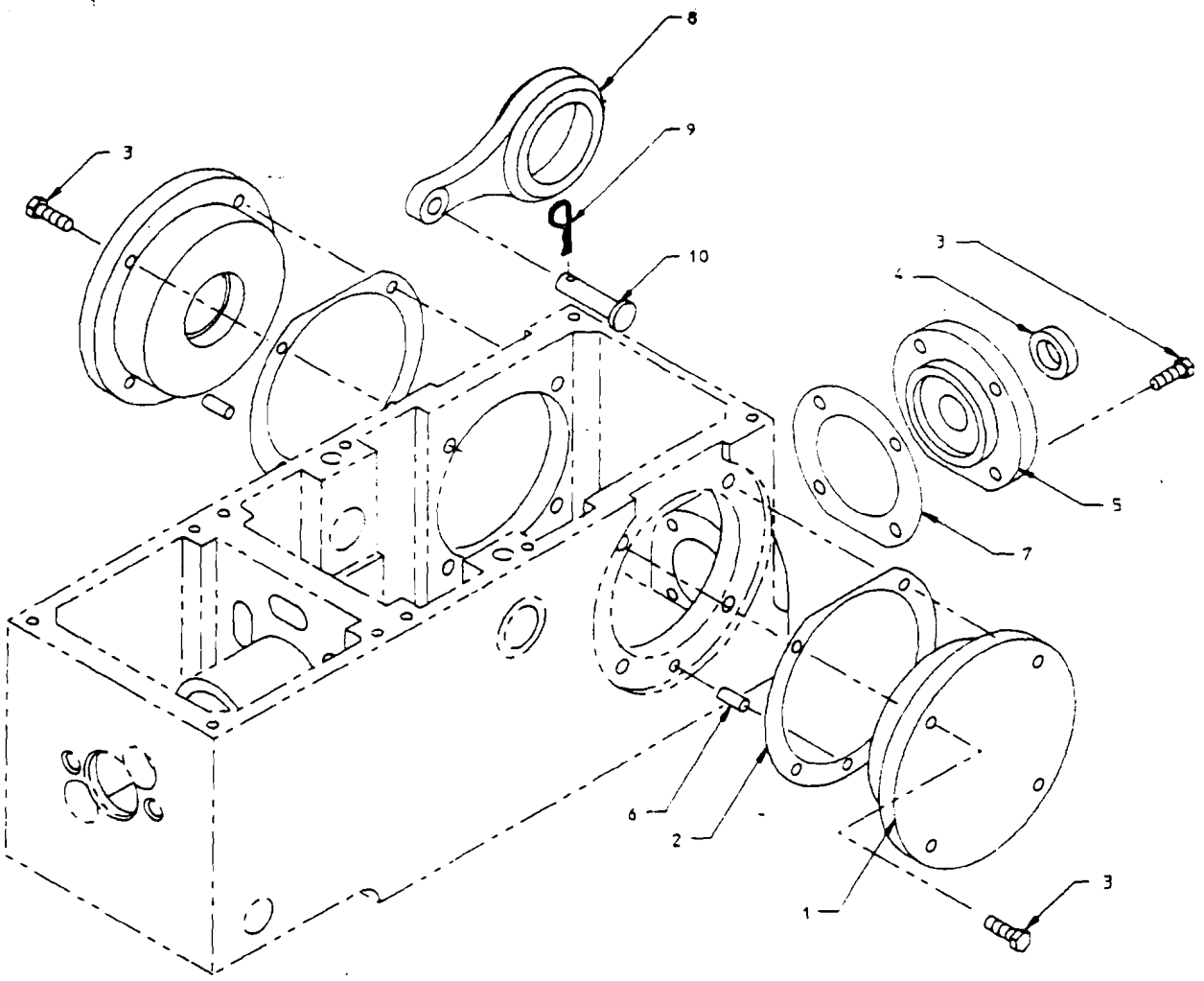
MODEL 7440
HOUSING ASSEMBLY
EXTERNAL MANUAL CONTROL

DWN BY: MJP
DATE: 10/02/90

AP00231

REF	REVISION UPDATE	DATE
A	REVISED FOR 1993 REISSUE	01/01/93

SECTION/PAGE	7440/411
EFFECTIVE	01/01/93
SUPERSEDES	07/18/86



ITEM	PART NAME	QTY	PART NUMBER
1	BEARING CAP - ECCENTRIC	2	W209813-000
2	SHIM PACK - ECCENTRIC	2	W203216-000
3	HEX HEAD BOLT	12	W770401-STL
* 4	OIL SEAL	1	W203239-000
5	BEARING CAP - WORM	1	W209816-000
6	DOWL PIN	2	W771209-005
7	SHIM PACK - WORM	1	W209818-000
8	CONNECTING ROD ASSEMBLY	1	W209824-000
9	COTTER CLIP	1	W209843-000
10	CONNECTING ROD PIN	1	W209799-000
11	COMPLETE GEAR RATIO COMMON PART ASSEMBLY CONSISTING OF ITEMS 1-8.	1	W209873-000

* DENOTES DESIGNATED KOPKIT ITEM.

NOTE: ITEMS 9 AND 10 ARE PART OF THE CONTROL COMMON PARTS ASSEMBLY BUT ARE SHOWN IN THIS ASSEMBLY FOR CLARITY

ALL DIMENSIONS ARE IN INCHES

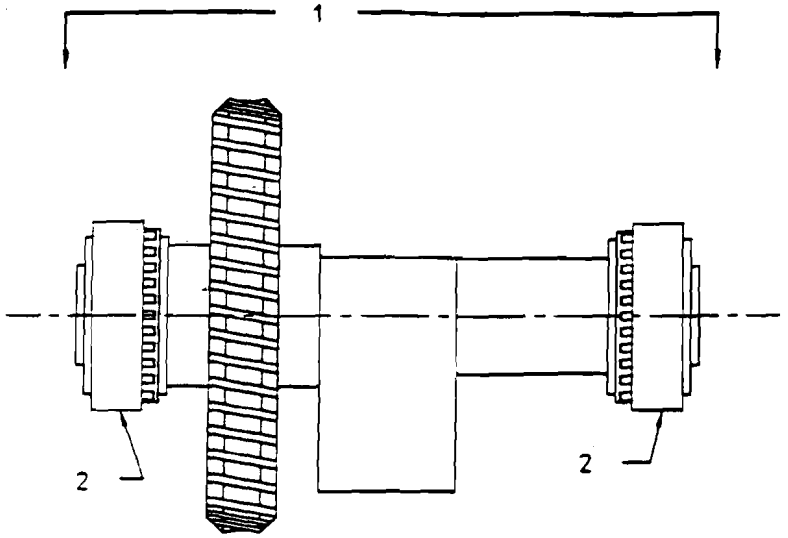
PULSA Series | PULSAFEEDER A Unit of IDEX Corporation

MODEL 7440 SIMPLEX GEAR RATIO ASSEMBLY COMMON PARTS

SECTION/PAGE	7440/500	
EFFECTIVE	01/01/93	DWN BY: MJP
SUPERSEDES	07/18/86	DATE: 10/02/90

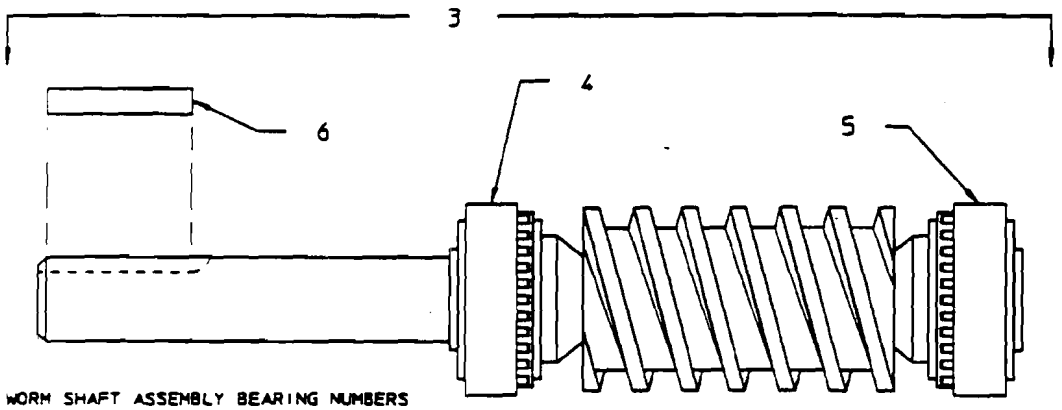
AP00232

REF	REVISION UPDATE	DATE
A	REVISED FOR 1993 REISSUE	01/01/93



ECCENTRIC SHAFT ASSEMBLY BEARING NUMBERS

PART	ITEM	CUP	CONE
PULSA SERIES	2	W209810-000	
TIMKEN		12520	12580



WORM SHAFT ASSEMBLY BEARING NUMBERS

PART	ITEM	CUP	CONE
PULSA SERIES	5	W209814-000	
TIMKEN		A6157	A6075
PULSA SERIES	4	W209815-000	
TIMKEN		21212	21075

PART NUMBER SUFFIX BASED ON RATIO OF GEARS

RATIO = MOTOR SPEED / YOUR PUMP PISTON STROKES PER MINUTE

GEAR RATIO IS INDICATED ON NAMEPLATE

ITEM	PART NAME	QTY	PART NUMBER	10:1	12:1	15:1	20:1	25:1	29:1	30:1
1	ECCENTRIC SHAFT ASSEMBLY	1	W209872	-010	-012	----	----	-025	----	----
3	WORM SHAFT ASSEMBLY	1	W209871	-010	-012	----	----	-025	----	----
6	KEY	1	W773098	-007	-007	----	----	-007	----	----
7	GEAR ASSEMBLY COMMON PARTS	1	W209873	-000	-000	----	----	-000	----	----
8	COMPLETE GEAR RATIO ASSEMBLY CONSISTING OF ALL OF THE ABOVE COMPONENTS PREASSEMBLED.	1	W209874	-010	-012	----	----	-025	----	----

NOTES:
1. ITEM 6 (KEY) IS A COMPONENT OF ITEM 7 (GEAR ASSEMBLY COMMON PARTS) AND IS SHOWN ON THIS PAGE FOR CLARITY.
2. REFER TO SECTION/PAGE 7440/500 FOR ADDITIONAL GEAR ASSEMBLY COMMON PARTS COMPONENTS.

ALL DIMENSIONS ARE IN INCHES

PULSA Series — PULSAFEEDER, A Unit of IDEX Corporation

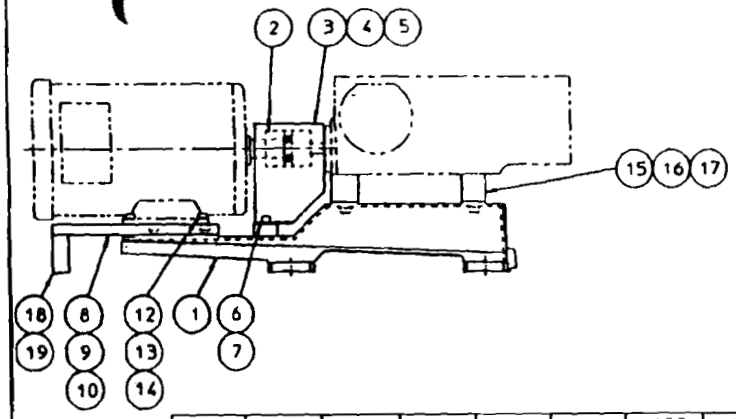
MODEL 7440 SIMPLEX GEAR RATIO ASSEMBLY

REF	REVISION UPDATE	DATE
A	UPDATE PARTS LIST	11/09/94

SECTION/PAGE	7440/501
EFFECTIVE	12/02/94
SUPERSEDES	01/01/93

DWN BY	MJP
DATE	10/03/90

AP00233



USE W209933 -000 56 FR
-001 48 FR
-002 143T,56HCZ FR
-003 145T FR
-006 56 FR *
-007 48 FR *
-008 143T,56HCZ FR *
-009 145T FR *
-016 56C FR W/RE-050 TACH
-030 143T FR W/-188 HARDWARE
-031 143-5TC FR
-032 148ATC
-039 56 FR W/ DBZ-A CPLG
-041 145BC FR

* LESS COUPLING & GUARD

DWG NO	W209933	SHEET 1 OF 6	
REV	REVISION DESCRIPTION	DATE	APP
A	CHA CPLG GD AND EXT SEE ECN	07/02/97	KY

PULSAFEEDER

JUL 02 1997

ENGINEERING

---	---	---	---	---	---	188	188	188	188	---	---	---	---	W771000	2	4-07X 18 SCREW DRIVE 0188 (NOT SHOWN)	21
---	---	---	---	---	---	000	000	000	000	---	---	---	---	W049791	1	ROTATION PLATE MISC (NOT SHOWN)	20
---	---	STA	---	---	---	---	---	---	---	---	---	---	---	W770037	2	.31-18X .88 SCREW SKHD	19
---	---	000	---	---	---	---	---	---	---	---	---	---	---	W210350	1	ADAPTOR PLATE SUPPORT	18
006	---	006	006	---	004	006	---	---	---	006	---	---	---	W203975	2	SPACER,GEARBOX 20	17
STL	STL	STL	STL	188	STL	STL	STL	STL	STL	STL	STL	STL	STL	W771107	3	.31 REG LOCK WASHER	16
STL	---	STL	STL	---	---	STL	---	---	---	STL	---	---	---	W770415	3	.31-18X1.75 BOLT HEXHD	15
---	---	---	---	---	STL	---	---	---	---	---	---	---	---	W770413	3	.31-18X1.25 BOLT HEXHD	15
---	STL	---	---	188	---	---	STL	STL	STL	---	STL	STL	STL	W770412	3	.31-18X1.00 BOLT HEXHD	15
STL	STL	STL	STL	188	STL	STL	STL	STL	STL	STL	STL	STL	STL	W771107	4	.31 REG LOCK WASHER	14
STL	STL	STL	STL	188	STL	STL	STL	STL	STL	STL	STL	STL	STL	W771008	4	.31 FLT WSHR,TYPE B REG	13
STL	STL	STL	STL	188	STL	STL	STL	STL	STL	STL	STL	STL	STL	W770410	4	.31-18X .75 BOLT HEXHD	12
STA	---	STA	STA	---	STA	STA	---	STA	---	STA	---	STA	---	W770037	4	.31-18X .88 SCREW SKHD	9
000	---	---	---	---	---	---	---	---	---	---	---	---	---	W212461	1	ADAPTOR,MOTOR 56BC,145BC	8
---	---	---	000	---	---	---	---	---	---	---	---	---	---	W211397	1	ADAPTOR,MOTOR 143-5TC	8
---	---	000	---	---	---	---	---	---	---	---	---	---	---	W211670	1	ADAPTOR,MOTOR 148ATC	8
---	---	---	---	---	000	---	---	---	---	---	---	---	---	W209438	1	ADAPTOR,MOTOR 56C/RE-050 TACH	8
---	---	---	---	---	---	---	---	000	---	---	---	000	---	W204314	1	ADAPTOR,MOTOR 48FR	8
---	---	---	---	---	---	000	---	---	---	000	---	---	---	W204104	1	ADAPTOR,MOTOR 145T	8
---	---	005	001	---	003	---	---	---	---	005	---	---	---	W208226	2	SPACER,CPLG GUARD	7
---	---	STL	STL	---	---	---	---	---	---	STL	---	---	---	W770405	2	.25-20X1.50 BOLT HEXHD	6
---	---	---	---	---	STL	---	---	---	---	---	---	---	---	W770403	2	.25-20X1.00 BOLT HEXHD	6
STL	STL	---	---	188	---	STL	STL	STL	STL	---	STL	STL	STL	W770400	2	.25-20X .62 BOLT HEXHD	6
---	STL	STL	STL	188	---	---	---	---	---	STL	STL	---	STL	W770459	1	.25-20X .50 BOLT HEXHD	5
---	000	000	000	000	---	---	---	---	---	000	000	---	000	W203224	1	GUARD EXT,CPLG R1.50 20	4
000	---	---	---	---	---	---	---	---	---	---	---	---	---	W212483	1	GUARD,TACH 4.62 3.25 R1.31	3
---	000	000	000	000	000	---	---	---	---	000	000	000	000	W203223	1	GUARD,CPLG 3.62 4.25 R1.50 20	3
---	000	---	---	---	---	---	---	---	---	---	---	---	---	W212096	1	COUPLING, 62 62 T DBZ-A ø50	2
000	---	000	000	---	---	---	---	---	---	000	---	---	---	W210062	1	COUPLING, 62 88 L L-090	2
---	---	---	---	000	---	---	---	---	---	---	000	---	---	W202519	1	COUPLING, 62 88 L L-075	2
---	---	---	---	---	---	---	---	---	---	---	---	000	---	W089032	1	COUPLING, 62 50 L L-070	2
---	---	---	---	---	000	---	---	---	---	---	---	---	000	WD42333	1	COUPLING, 62 62 L L-070	2
000	000	000	000	000	000	000	000	000	000	000	000	000	000	W202900	1	BASE, E,F	1
041	039	032	031	030	016	009	008	007	006	003	002	001	000	W209933	XX	BASE ASSY, F	XX
SUFFIX														PART NUMBER LESS SUFFIX	QTY	DESCRIPTION OR MATERIAL	ITEM

MANUFACTURING STANDARDS UNLESS OTHERWISE SPECIFIED
TOLERANCE
MACHINED SURFACES REQUIRED

PROPRIETARY DATA: THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH PULSAFEEDER HAS PROPRIETARY RIGHTS. THE RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION IS PROHIBITED.

DWN	PFM	09/09/91
CHK	PFM	09/09/91
APP	TLM	09/09/91

PULSA Series

PULSAFEEDER
A Unit of IDEX Corporation

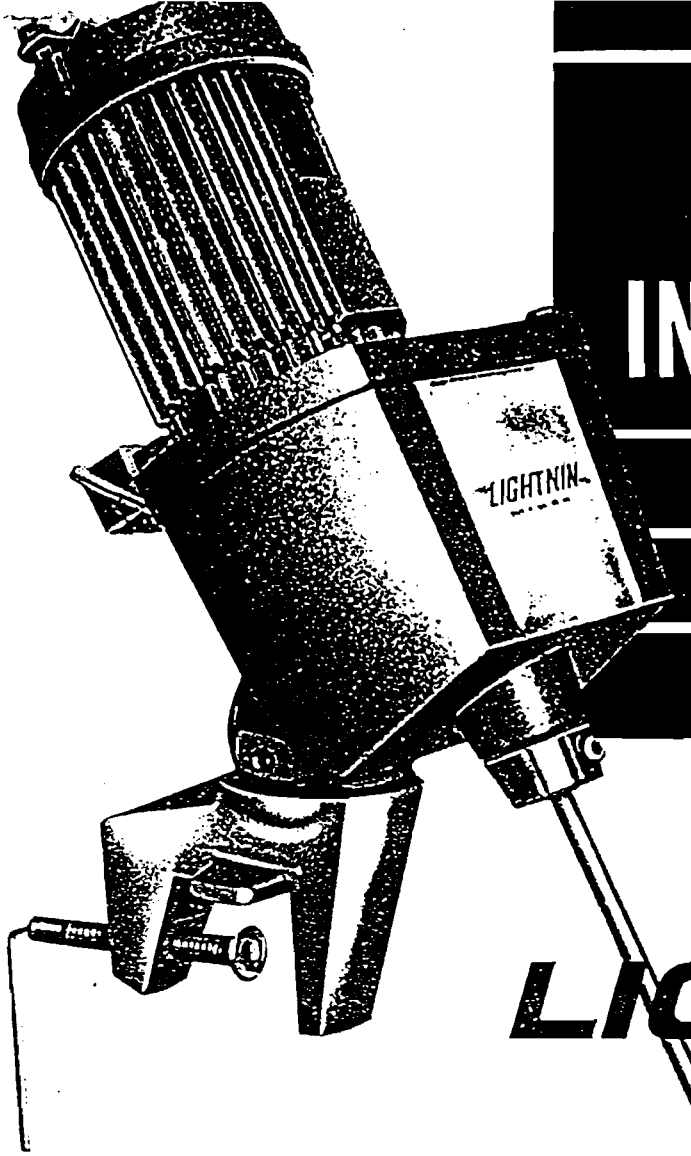
TITLE: BASE ASSY, F

DRW TYPE (BA) SIZE C DWG NO W209933

W209933.001 A SCALE 1:6 SHEET 1 OF 6

Agitator

OPERATING INSTRUCTIONS



LIGHTNIN®

XD AND XJ SERIES

PORTABLE MIXERS

FLUID MIXING SPECIALISTS

IT-1977F
6-15-94

A UNIT OF GENERAL SIGNAL
GS
LIGHTNIN

OPERATING INSTRUCTIONS

LIGHTNIN®

PORTABLE MIXERS

A LIGHTNIN Portable Mixer is a precision machine of the highest quality. They are designed to operate satisfactorily under all the conditions normally encountered.

This is a completely proven design — a product of LIGHTNIN Research and Development.

Among its features are:

MAXIMUM MIXING EFFICIENCY
ENERGY EFFICIENT DURA-MIX™ MOTORS
CONVENIENCE OF HANDLING
UNIQUE POSITIVE DRIVE CHUCK
POSITIVE CLAMPING AND POSITIONING
HIGH TECHNOLOGY IMPELLERS
MAINTENANCE FREE OPERATION
MODERN DESIGN STYLING

With proper care this LIGHTNIN Portable will give years of trouble-free service. If you should have any questions regarding its operation which are not answered in this manual, call your authorized LIGHTNIN Mixer Sales Engineer. Their telephone numbers are listed on the back cover.

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SAFETY CHECK LIST

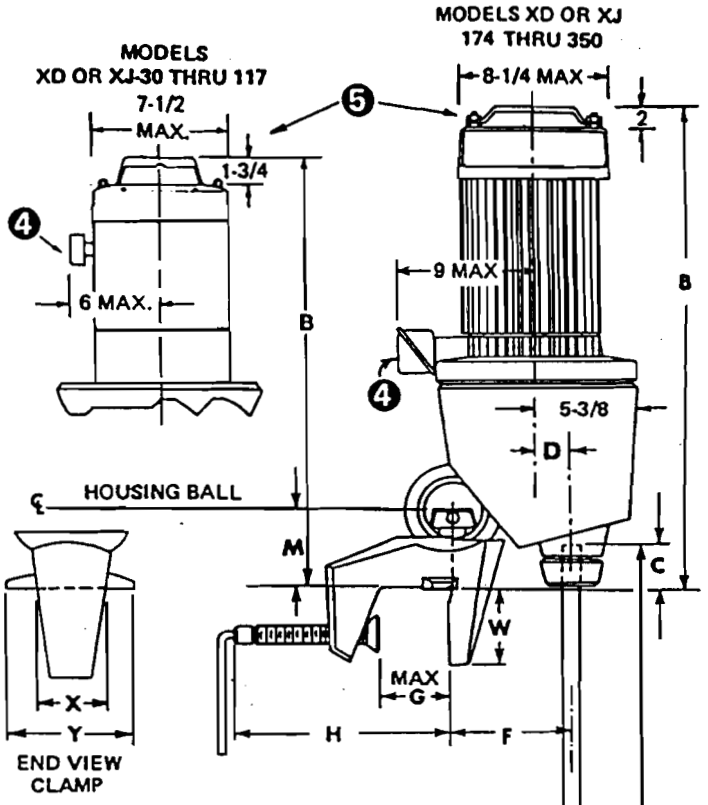
IMPORTANT

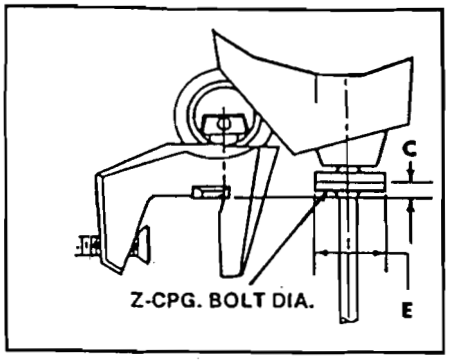
ALL *LIGHTNIN*® MIXERS AND AERATORS ARE PROVIDED WITH PROPERLY DESIGNED LIFTING DEVICES AND SAFETY COVERS TO AVOID POTENTIAL INJURY AND/OR EQUIPMENT DAMAGE. THE FOLLOWING SAFETY CHECK LIST SHOULD BE THOROUGHLY REVIEWED AND ADHERED TO BEFORE OPERATING OR PERFORMING MAINTENANCE ON THE MIXER.

1. USE ONLY THE LIFTING DEVICES PROVIDED ON YOUR UNIT TO INSTALL THE MIXER. USE SHOULDERED EYEBOLTS AND TIGHTEN SECURELY TO HANDLE COMPONENT PARTS. WE STRONGLY RECOMMEND THAT THE EYEBOLTS OR HOIST RINGS BE OF THE SAFETY SWIVEL TYPE WITH 360° ROTATIONAL CAPABILITY.
2. DO NOT CONNECT THE PRIME MOVER TO THE POWER SOURCE UNTIL ALL COMPONENTS ARE ASSEMBLED, THE MIXER IS INSTALLED AND ALL HARDWARE IS TIGHTENED TO THE PROPER TORQUE WHICH IS SPECIFIED IN THE OPERATION AND MAINTENANCE MANUALS SUPPLIED BY *LIGHTNIN*®.
3. DO NOT OPERATE SHAFT SEALING DEVICES AT TEMPERATURES OR PRESSURES HIGHER THAN THOSE SPECIFIED IN THE MANUAL OR ON NAMEPLATES.
4. PRIOR TO SERVICING MIXER, ELECTRICALLY DISCONNECT POWER.
5. DO NOT TOUCH ROTATING MIXER PARTS.
6. DO NOT OPERATE MIXER FOR SERVICE OTHER THAN ITS INTENDED USE.
7. DO NOT MAKE ANY FIELD CHANGES OR MODIFICATIONS (HORSEPOWER, OUTPUT SPEED, SHAFT LENGTHS, IMPELLERS, ETC.) WITHOUT REVIEWING THE CHANGE WITH YOUR *LIGHTNIN*® SALES REPRESENTATIVE OR THE *LIGHTNIN*® CUSTOMER SERVICE DEPARTMENT.
8. BEFORE OPERATING THE MIXER, IT IS VERY IMPORTANT TO CHECK THE FOLLOWING ITEMS:
   A. MAKE SURE MIXER IS PROPERLY GROUNDED.
   B. ENSURE ALL PROTECTIVE GUARDS AND COVERS ARE INSTALLED.
   C. ENSURE ALL DETACHABLE COMPONENTS ARE SECURELY COUPLED TO THE MIXER.
   D. THOROUGHLY REVIEW AND COMPREHEND THE MIXER OPERATION INSTRUCTIONS SUPPLIED BY *LIGHTNIN*®.
   E. ENSURE THE DRIVE OR SEAL SHAFT ROTATES FREELY BY HAND.
   F. ENSURE ALL PERSONNEL AND EQUIPMENT ARE CLEAR OF ROTATING PARTS.
   G. ENSURE ALL EXTERNAL CONNECTIONS (ELECTRICAL, HYDRAULIC, PNEUMATIC, ETC.) HAVE BEEN COMPLETED PER THE APPLICABLE CODES.
9. [illegible] ENTER TANK UNLESS [illegible]
   A. THE MIXER POWER SUPPLY IS LOCKED OUT.
   B. THE MIXER SHAFT IS FIRMLY ATTACHED TO THE MIXER DRIVE OR THE SHAFT IS SUPPORTED SECURELY FROM BELOW.

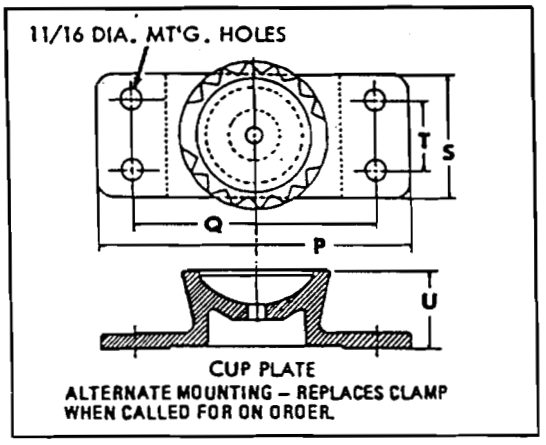
LIGHTNIN® PORTABLE MIXERS

ALL DIMENSIONS IN INCHES

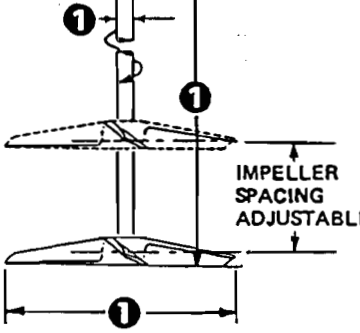




ALTERNATE COUPLING CONSTRUCTION DETAIL.



ALTERNATE MOUNTING – REPLACES CLAMP WHEN CALLED FOR ON ORDER.



DETAIL "A" STANDARD CHUCK CONSTRUCTION

NOTES:

1. REFER TO ORDER FOR:
   - A. MODEL NUMBER AND MOTOR HORSEPOWER.
   - B. SHAFT DIAMETER AND LENGTH.
   - C. QUANTITY AND SIZE OF IMPELLERS.
   - D. MOTOR SPECIFICATIONS.
   - E. SHAFT CONNECTION – STANDARD CHUCK OR ALTERNATE COUPLING CONSTRUCTION.
2. MIXER WEIGHT CAN VARY WITH MOTOR CHARACTERISTICS, SHAFT AND IMPELLER SELECTION. WEIGHTS SHOWN INCLUDE SHAFT AND STANDARD DUAL IMPELLERS.
3. DIMENSION "B" IS MAXIMUM. CAN VARY SLIGHTLY DEPENDING ON MOTOR ENCLOSURE.
4. CONDUIT BOX NOT INCLUDED WITH EXPLOSION PROOF MOTOR.
5. MOTOR HANDLES SHOWN 90° OUT OF POSITION.
6. "D" OFFSET DOES NOT APPLY TO XD SERIES.

XD SERIES – DIRECT DRIVE MODELS

MODEL	② APPROX. MIXER WT. LBS.	STANDARD IMPELLER DIA'S. ① SINGLE	DUAL	B ③	C WITH CHUCK	C WITH CPLG	E	F	G	H	P	Q	S	T	U	W	X	Y	Z
XD-30	64	3.8	3.4	19-3/8	4-3/4	7/8	3-7/8	4	3	9	9	7	3-1/2	2	2-1/4	3-1/8	2-3/8	5-3/16	3/8
XD-43	70	4.5	3.8																
XD-87	90	5.2	4.5	21	5-1/2	2	3-7/8	4	3-3/4	11	10	8-1/2	3-5/8	2	2-7/16	3-1/2	2-7/8	5-3/4	
XD-117	100	5.9	5.2	21-5/8															
XD-174	125	6.3	6.2	23-1/2	6	2-1/8	4-3/4	5	3-3/4	12	10	8-1/2	4	2-1/2	2-15/16	4-3/16	3-1/4	6-7/8	1/2
XD-230	130	6.8	5.9	26-1/4															

XJ SERIES – GEAR DRIVE MODELS

MODEL	② APPROX. MIXER WT. LBS.	STANDARD IMPELLER DIA'S. ① SINGLE	DUAL	B ③	C WITH CHUCK	C WITH CPLG	D	E	F	G	H	P	Q	S	T	U	W	X	Y	Z
XJ-30	66	11.2	10.0	21	3-7/8	3/8	1-3/8	3-7/8	5	3	9	8	7	3-1/2	2	2-1/4	3-1/8	2-3/8	5-3/16	3/8
XJ-43	70	11.8	10.0																	
XJ-65	86	13.6	11.8	22-7/8	4-7/8	0	1-5/8	3-7/8	5-1/2	3-3/4	11	10	6-1/2	3-5/8	2	2-7/16	3-1/2	2-7/8	5-3/4	3/8
XJ-87	95	15.1	12.8																	
XJ-117	100	15.6	13.6	23-1/8																
XJ-174	126	17.0	15.1	26-5/8	4-5/8	5/8	1-7/8	4-3/4	6-1/2	3-3/4	12	10	6-1/2	4	2-1/2	2-15/16	4-3/16	3-1/4	6-7/8	1/2
XJ-230	136	18.0	15.6	28-3/8																
XJ-350	140	19.0	17.0																	

INITIAL INSPECTION, SHIPPING ARRANGEMENTS AND STORAGE

1-1. As soon as you have uncrated your mixer, check it for shipping damage and report any damage immediately to the carrier and to our factory.

1-2. Mixer and impellers are packed together. The mixer shaft is packed in a separate container. Carbon steel mixer shafts and impellers are wrapped with Shell VPI-coated paper for domestic shipment. For foreign shippment these parts are coated with a rust inhibitor that is easily removed with kerosene, or similar solvents.

1-3. Do not remove wrappings or protective coating if the mixer is to be stored before it is placed in operation. Store the mixer in a clean, dry location, with circulating air, free from wide or rapid variations in temperature. When gear drive models have been stored for more than a year, the condition of the gear lubricant should be checked before the mixer is installed. (See lubrication instructions.)

SECTION 2 MOUNTING

2-1. Lift the mixer from its crate by the motor handle. Set the clamp squarely on the mounting surface so that both vertical and horizontal lines of clamp contact bare evenly. **Remove the hex key wrench stored in the clamp** and tighten the clamp screw securely. The wrench has been sized to properly tighten the clamp screw, 3/8-inch for XD or XJ 174 thru 350, 7/32-inch for XD or XJ-30 thru 117. DO NOT IMPACT THE WRENCH OR USE AN EXTENSION.

2-2. Impeller rotation must be according to the arrow on the mixer nameplate.

a. Single phase totally enclosed motors are wired at our factory for correct rotation.

b. All three phase and explosion proof motors must be field wired for proper rotation. If rotation does not agree with nameplate reverse any two line leads.

c. Dual voltage motors must be wired for the desired voltage. Refer to the connection diagrams provided on the motor nameplate or inside the conduit cover.

SECTION 3 MOTOR CONNECTIONS

3-1. LIGHTNIN Portables are equipped with ball bearing chemical plant motors specifically designed for mixer service in totally enclosed or explosion-proof construction.

a. Constant speed mixers are furnished with LIGHTNIN DURA-MIX™ energy efficient motors unless otherwise specified.

b. For variable speed mixers with electronic or air driven motors, refer to supplementary instructions for motor control data and connection requirements.

3-2. SINGLE PHASE MOTORS FOR XD/XJ30 THRU 87 (or motors nameplated 1/4 thru 1 Horsepower)

a. Totally enclosed motors are furnished with eight-foot cords fitted with UL approved three prong grounded plugs suitable for the correct voltage.

b. Explosion proof motors are furnished with a pipe tap connection and suitable leads. A conduit box with internal switch is available for explosion proof service.

c. All DURA-MIX™ single phase motors are equipped with an internal over-temperature device with manual reset. If the thermal trips, wait (15) fifteen minutes and depress the reset button on the motor body. A click indicates re-set.

3-3. THREE PHASE MOTORS

a. All totally enclosed motors are equipped with a conduit box and suitable leads.

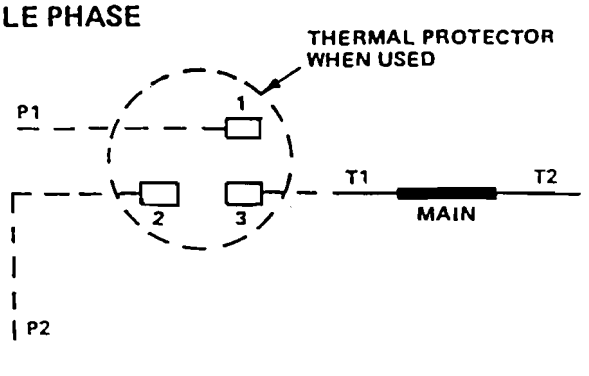
b. All explosion proof motors are furnished with a pipe tap connection and suitable leads.

IMPORTANT: ALL THREE PHASE MOTORS (Except explosion proof on XD/XJ 30 thru 65 or other XP motors nameplated 3/4 horsepower and below) are equipped with over-temperature thermostats which are designed to interrupt current in the holding coil of magnetic starters only. The motor thermostats will reset themselves, but the control panel "start" button must be depressed to start the motor.

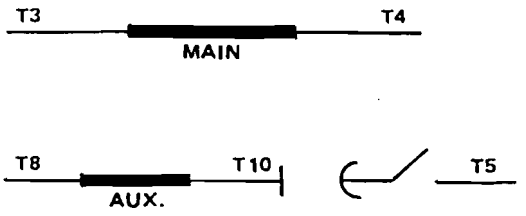
EXPLOSION PROOF MOTORS ON XD/XJ 30 THRU 65 or XP motors nameplated 3/4 horsepower and below are equipped with automatic over-temperature circuits which can trip and reset themselves after the motor cools TO AVOID INJURY DUE TO UNEXPECTED STARTUP, DISCONNECT FROM POWER UNTIL THE MOTOR COOLS.

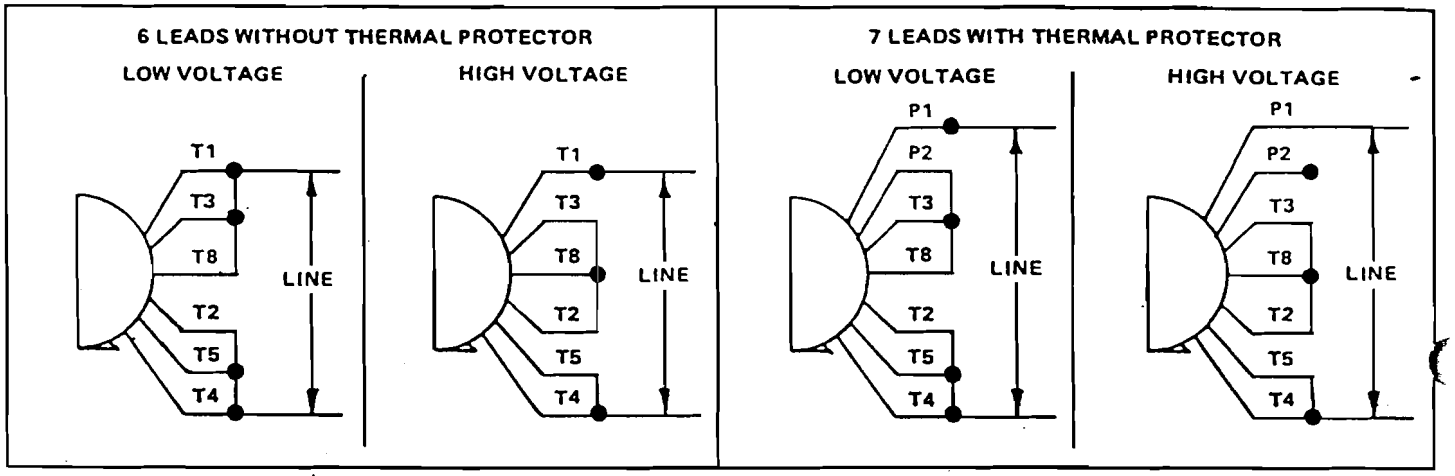
CONNECTION DIAGRAM FOR SINGLE PHASE MOTORS ON LIGHTNIN• PORTABLE AND FIXED MOUNTING MIXERS

SINGLE PHASE



DUAL VOLTAGE REVERSIBLE WITH OR WITHOUT THERMAL PROTECTOR





TO REVERSE ROTATION, INTERCHANGE LEADS T5 AND T8

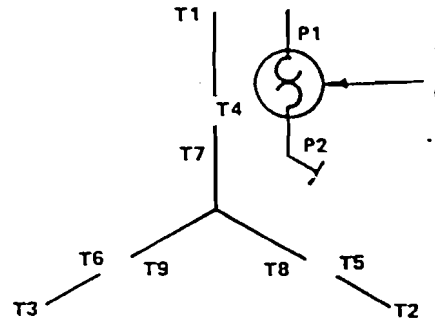
NOTE: All LIGHTNIN DURA-MIX™ totally enclosed or explosion proof single phase motors are equipped with an internal overtemperature device with manual reset. If the motor overheats and the thermal circuit trips, wait (15) fifteen minutes and depress the reset button on the motor body. An audible click indicates re-set.

NON DURA-MIX™ motors may or may not have internal thermal protection depending on construction.

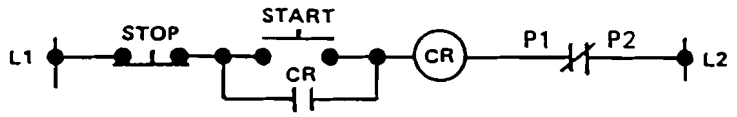
For three phase connections diagrams, see page 7.

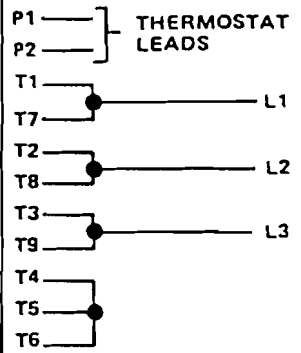
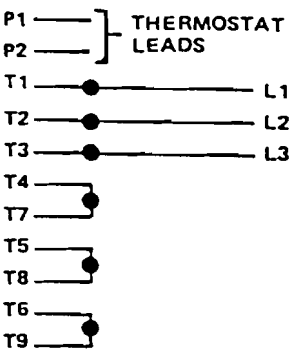
CONNECTION DIAGRAMS FOR THREE PHASE MOTORS ON LIGHTNIN. PORTABLE AND FIXED MOUNTING MIXERS

FIGURE 1A – CONNECTION DIAGRAM



TYPICAL THERMAL CONNECTION IN FULL VOLTAGE STARTERS



LOW VOLTAGE	HIGH VOLTAGE
	

TO REVERSE ROTATION, INTERCHANGE ANY TWO LINE LEADS

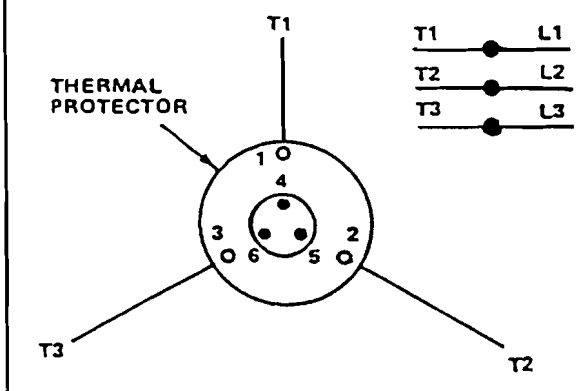
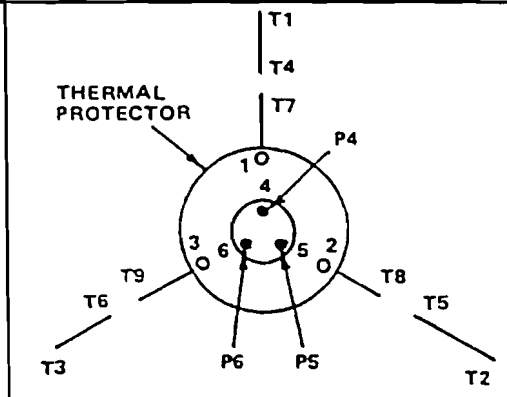
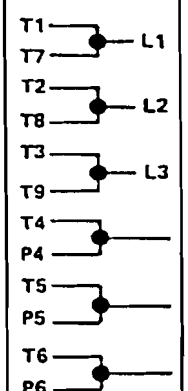
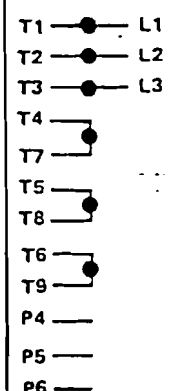
NOTES: (1) The diagram in Figure 1A pertains to:

a. TOTALLY ENCLOSED three phase motors used on XD/XJ Series 30 thru 350, XL 100 thru 500 & SXJ/SXJS 174 & 230 with DURA-MIX™ energy efficient motors or other totally enclosed motors nameplated 1/4 thru 5 horsepower.

b. EXPLOSION PROOF three phase motors used on XD/XJ Series 87 thru 350, XL 100 thru 500 & SX/SXJS 174 & 230 with DURA-MIX™ energy efficient motors or other explosion proof motors nameplated 1 thru 5 horsepower. For XP motors used on XD/XJ Series 30 thru 65 and XP motors nameplated 3/4 H.P. and less, see Figure 1B.

(2) The thermostats in above motors are designed to interrupt current only in the holding coil of magnetic starter and must be wired into the motor control circuit. The thermostats re-set themselves after the motor cools, bu the motor must be re-started by depressing the start button on the starter panel.

FIGURE 1B – CONNECTIONS FOR THREE PHASE EXP. PROOF MOTORS ON XD/XJ 30 THRU 65 OR MOTORS NAMEPLATED 3/4 HORSEPOWER OR LESS

SINGLE VOLTAGE WITH THERMAL PROTECTOR	DUAL VOLTAGE WITH THERMAL PROTECTOR	LOW VOLTAGE	HIGH VOLTAGE
			

TO REVERSE ROTATION, INTERCHANGE ANY TWO LINE LEADS

WARNING: THESE MOTOR THERMALS RE-SET AUTOMATICALLY. TO AVOID INJURY DUE TO UNEXPECTED STARTUP, DISCONNECT FROM POWER UNTIL MOTOR COOLS.

SECTION 4
MIXER SHAFT INSTALLATION

4-1. Position the impeller(s) on the mixer shaft. Refer to the specification sheet for recommended dual impeller spacing. The larger wedge shaped portion of the hub body must face up towards the mixer. The top of the hub is stamped "UP". Refer to Figure 2 for general orientation reference.

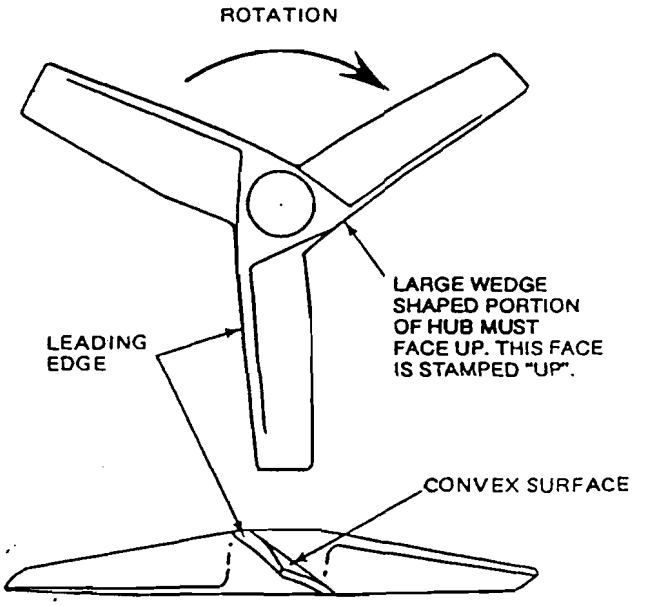


FIGURE 2. IMPELLER ORIENTATION

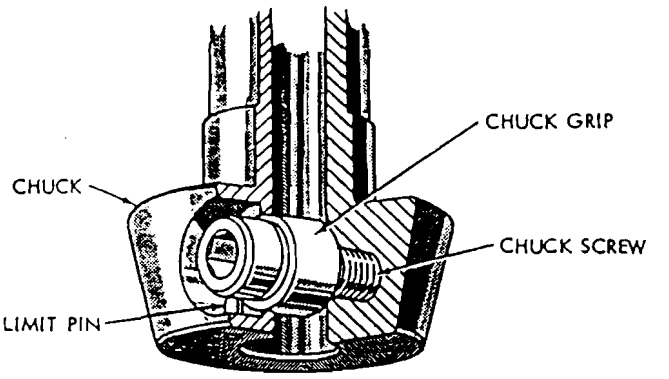


FIGURE 3. CHUCK DETAILS

4-2. To install the mixer shaft, back off the chuck screw (refer to Figure 3) as far as the limit pin will allow. DO NOT FORCE. Insert the mixer shaft into the chuck bore as far as it will go. For stepped shafts, make sure the shaft shoulder seats tightly against the chuck face. Draw up the chuck screw with the wrench provided, rotating the shaft slightly back and forth to make sure that the chuck grip seats against the flat of the shaft. Tighten the chuck screw with the wrench provided. The wrench has been properly sized to tighten the screw. DO NOT IMPACT THE WRENCH OR USE AN EXTENSION. NOTE: A safety feature is provided by a slight taper in the flat on the mixer shaft. The shaft cannot drop out unless the grip is intentionally released.

SECTION 5
POSITIONING

5-1. The positioning device of the mixer combines a vertical index on the ball of the housing and a horizontal index on the ram of the clamp socket. Mixing positions are established by referencing one index against the other. Figure 4 shows the indexes in D-5 position, a typical setting. To change the mixing position, loosen the wedge screw, adjust the mixer by its motor handle, and tighten the wedge screw. The wedge screw has a limited amount of travel before the wedge bottoms against the king bolt. If the wedge does eventually bottom, readjust the wedge assembly per 8-9, Step e.

5-2. The correct position for the mixer will vary in individual cases. Use Table I to position the mixer in relation to tank diameter and height for normal applications. In operation, some adjustment of position may be desirable for best results.

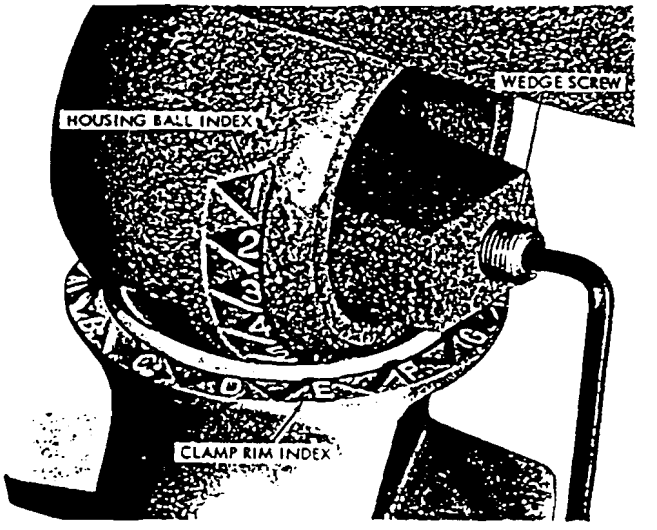


FIGURE 4. POSITIONING INDEXES

TABLE I

MIXING PATTERN	Batch Height (Z) / Tank Diameter (T)	CLAMP RIM INDEX (HORIZONTAL ANGLE)	HOUSING BALL INDEX (VERTICAL ANGLE)
NORMAL MIXING Off-center position Top to bottom turnover No swirling	Z/T less than 1 Z/T greater than 1	D D	5 6
VORTEXING On-center position	Z/T less than 1 Z/T greater than 1	E E	5 6
SWIRLING Off-center position Usually vortexing	Z/T less than 1 Z/T greater than 1	F F	6 7

Swirling and vortexing positions may be useful for surface introduction of solids, liquids, or gases.

SECTION 6
MIXER OPERATION

6-1. LIGHTNIN MIXERS are designed to operate continuously at normal and low liquid levels and in air. IMPORTANT: Variable speed drives sometimes have critical ranges where the unit should not be operated during drawoff or in air. These ranges will be indicated on a warning decal at the speed control. It is not good practice to operate any mixer continuously when extreme vortexing or surging occurs.

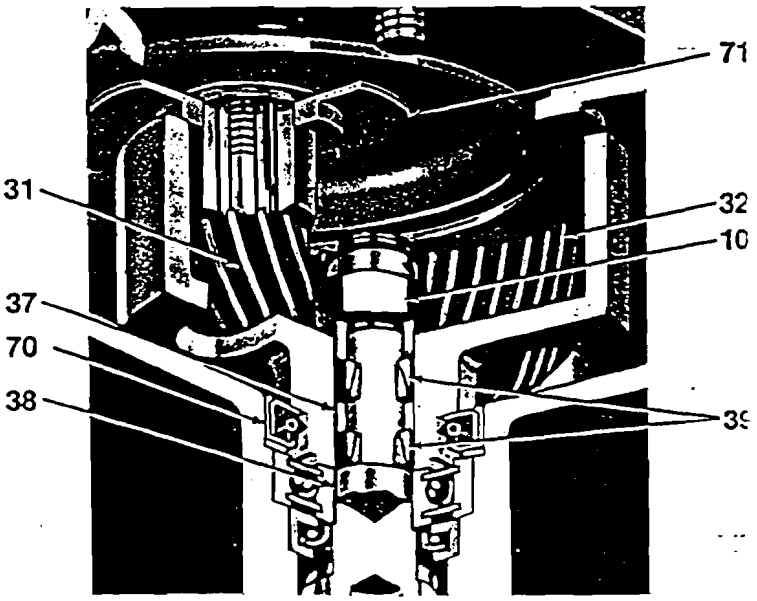
6-2. Turn on the mixer. Allow time enough for the mixing pattern to be established, then make any required adjustment of position.

6-3. At the end of two weeks service, check the housing cap screws, clamp screw, wedge screw, and chuck screw for tightness.

6-4. At the end of the mixing cycle, it is good practice to turn off the mixer before the tank has been drained to a level which will result in excessive splashing.

6-5. The gear drive models (XJ) include a built-in shock load feature. The grip springs (See Figure 5) provide a keyless friction drive between the gear and the drive shaft, and the springs will slip before the mixer is damaged. Therefore, if the mixer shaft does not rotate when the motor is on, remove the motor (41) from the housing (36), per Paragraph 9-1, and tighten the grip spring locknut (10) securely. (Table 4 on Page 18 lists the recommended tightening torques for this locknut. If a torque wrench is not available, be sure locknut is tightened sufficiently to prevent grip spring slippage.)

NOTE: Item 70, Oil Seal and Item 71, Slinger are furnished on XJ 174 thru 350 only.



31 — Pinion
37 — Grip Spring Spacer
38 — Drive Shaft
32 — Internal Gear
10 — Grip Spring Lock Nut
39 — Grip Spring Set
70 — Oil Seal
71 — Slinger

FIGURE 5. GRIP SPRING ASSEMBLY

SECTION 7
LUBRICATION

7-1. Your LIGHTNIN mixer has been lubricated at the factory with the correct type and amount of high quality lubricants. Lubricant cleanliness is protected by properly designed closures.

7-2. All mixer bearings are sealed type with contact rubbing seals and are pre-packed with lubricant. Relubrication of these bearings is not necessary.

7-3. The gear chamber in XJ series models has been factory filled with a grease suitable for an ambient temperature range of +50°F to +200°F. **Under normal operating conditions, this lubricant need not be changed until the unit has been dismantled for some reason.**

Under adverse operating conditions, periodic changes of lubricant may be necessary. Adverse conditions are defined as operating in very humid, dust laden or chemical atmospheres, or where wide variations in ambient temperature occurs. Such adverse conditions can lead to deterioration of lubricant compounds and additives and it is recommended that the condition of the grease be checked within six months after startup. Reputable lubricant suppliers can analyze the grease and recommend economical, safe change schedules.

7-4. CHANGING GEAR LUBRICANT

a. Make sure the mixer housing is vertical to prevent spillage.

b. Remove the housing to motor capscrews and lift off the motor by its handle.

c. Remove all old grease from the gear chamber and wipe clean.

d. Pack the chamber with fresh grease. (See notes① and ②). Paddle the grease to fill voids and remove air pockets, rotating the shaft and shaking the housing while paddling.

e. Check the "O" ring in the flange of the motor and replace if it is deformed, cut or deteriorated.

f. Carefully align the motor rabbet and guide into the housing bore. Guide the pinion into mesh with the gear and make sure the "O" ring is properly seated in the groove.

g. Check for free movement of all components by rotating the drive shaft.

h. If satisfactory, replace the housing to motor hardware and tighten securely.

7-5. GEAR LUBRICANT RECOMMENDATION

Use only a lubricant suitable for the temperature and operating conditions. See Table 2.

GREASE LUBRICANT

Ambient Temp. Range	NLGI#	Soap Base	Min. Oil Viscosity S.S.U.	Max. Operating Temp.
50°F to 200°F	0	Sodium or Lithium	4,000 @ 100°F 150 @ 210°F	200°F

TABLE 2

For operation in ambient temperatures below +50°F, we recommend use of a synthetic (Mobil SHC 32 or equal) compounded only with synthesized hydrocarbon fluids. This grease is suitable for a wide range of ambient temperatures between -30°F and +200°F and should be considered where seasonal lubricant changes are necessary.

GEAR CHAMBER CAPACITY	
MODEL	GREASE-LBS.
XJ 30 & 43	1.25 ①
XJ 65 THRU 117	2.5 ①
XJ 174 THRU 350	6.0 ②

TABLE 3

① PACK CHAMBER FLUSH WITH TOP OF THE INTERNAL GEAR.

② PACK CHAMBER TO WITHIN 3/4" OF TOP OF INTERNAL GEAR.

A UNIT OF GENERAL SIGNAL

MIXER PARTS • MODEL(S) XD-30, XD-43, XDA-33/ NC-4, NS-1, NAR-33

PARTS PRICING BOOK SEC. 2 PAGE 6.00 DATE 03/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16708, L-16710, L-15892, & L-15951							
1			Hex Head Cap Screw	2	100126	CPS	
1			Hex Head Cap Screw	2	100126	316	
2			Hex Head Cap Screw	2	100297	CPS	
2			Hex Head Cap Screw	2	100297	316	
3			King Bolt	1	100328	CPG	
3			King Bolt	1	100328	174	
4			Shaft Screw	1	102007	STL	
5			Clamp Screw (include 15 & 15A when ordering)	1	105413	CPR	
5			Clamp Screw (include 15 & 15A when ordering)	1	105413	174	
6			Wedge Screw	1	105414	CPR	
6			Wedge Screw	1	105414	174	
7		E	Hex Head Cap Screw (For Motor Handle)	2	100122	STL	
7		(1)	Hex Nut	2	107004	CPS	
8		C	Chuck Screw	1	105861	GR5	
8		C	Chuck Screw	1	105861	174	
11		C	Limit Pin	1	108504	PSP	
12			Plain Washer	1	112007	CPS	
12			Plain Washer	1	112007	316	
15			Cup Washer	1	112409	CPS	
15			Cup Washer	1	112409	316	
15A			Retaining Ring	1	205445	PSP	
16			Wedge Bottom	1	112531	BRZ	
16			Wedge Bottom	1	112531	316	
17			Wedge Top	1	112532	ALM	
17			Wedge Top	1	112532	316	
17			Wedge Top	1	112532	STL	
17		(2)	Wedge Top	1	112532	BRZ	
18		C	Chuck Washer	1	112756	S16	
18		C	Chuck Washer	1	112756	175	
20			Washer	1	112762	BRS	
20			Washer	1	112762	316	
21			Snap Ring	1	114276	302	
22		*	Retaining	1	114280	PSP	
24		*	Oil Seal	1	115382	PSP	
27		*	Ball Bearing	1	116223	PSP	
32			Hex Key Wrench	1	127210	BPF	
48			Lockwasher	1	115012	PSP	

PLATE 5109

○ Identity Code: *Recommended Spare Parts: (1) For New Style Motor Design
(2) Non Stock
C-Use with Chuck Drive Shaft (E) Use with Elec.Motor, (R) Use with Rigid Cp Drive Shaft

BLANK CODE DENOTES COMMON P/

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

PLATE ISSUE REVISED IT- 2038 SHEET 1of

MIXER PARTS • MODEL(S) XD-30, XD-43, XDA-33/NC-4, NS-1, NAR-33

PARTS PRICING BOOK SEC. 2 PAGE 6.01 DATE 03/12/84

NOTE: Reference Drawing No(s). L-16708, L-16710, L-15892 & L-15951

ITEM NO.		IDENT. CODE ○	DESCRIPTION			REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
33A			Tank Clamp Assy.	Includes	ALM	1	800057	PSP	
		(2)		Items	316	1	800058	PSP	
		(2)		3, 5, 6, 12	BRZ	1	800059	PSP	
		(2)		15, 15A, 16	STL	1	800060	PSP	
		(2)		17, 32, 33, 40	NAM	1	800061	PSP	
33			Clamp			1	129020	ALM	
33			Clamp			1	129020	316	
33			Clamp			1	129020	BRZ	
33			Clamp			1	129020	STL	
33			Clamp			1	129020	NAM	
33B			Cup Plate Assy.	Includes	ALM	1	801194	PSP	
		(2)		Items	316	1	801195	PSP	
		(2)		3, 6, 12	BRZ	1	801196	PSP	
		(2)		16, 17, 32	STL	1	801197	PSP	
		(2)		33, 40	NAM	1	801192	PSP	
33			Cup Plate			1	129208	ALM	
33			Cup Plate			1	129208	316	
33		(2)	Cup Plate			1	129208	BRZ	
33			Cup Plate			1	129208	STL	
33			Cup Plate			1	129208	NAM	
34		C	Chuck Grip			1	130013	316	
35		E	Handle Kit - Electric Motor				Consult Factory		
36			Housing			1	136144	ALF	
36		(2)	Housing			1	136157	316	
36			Housing			1	136144	NAL	
36			Housing			1	136157	CIR	
36		(2)	Housing			1	136144	BRZ	
38		C	Drive Shaft with Chuck			1	143788	NPS	
38		C	Drive Shaft with Chuck			1	143786	316	
38		R	Drive Shaft with Coupling			1	199338	41L	
38		R	Drive Shaft with Coupling			1	199338	316	
40			Vibration Pad			1	150332	DUK	
41		E	Electric Motor			1	See Sec.	1-C	
42			Mixer Shaft			1	See Sec.	1-D	
43		E	Plain Washer			2	112005	STL	
44/45			Impeller & Set Screw				See Sec.	1-D	
46			Motor Shaft Key			1	114196	STL	
47			Washer (for motor shaft screw)			1	112786	STL	

○ Identity Code: *RECOMMENDED SPARE PARTS/ (2) Non Stock
C - Use with Chuck Drive Shaft/ E- Use with Elec.Motor
R - Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PART

MIXER PARTS • MODEL(S) XD-65, XD-87, XD-117, XDA-100 NS-2, NS-3, NS-4A, NAR-100

PARTS PRICING BOOK SEC. 2 PAGE 7.00 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRIC (EAC
NOTE: Reference Drawing No(s). L-16708, L-16710, L-15892, & L-15951							
1			Hex Head Cap Screw	2	100325	CPS	
1			Hex Head Cap Screw	2	100297	316	
2			Hex Head Cap Screw	2	100324	CPS	
2			Hex Head Cap Screw	2	100324	316	
3			King Bolt	1	100329	CPG	
3			King Bolt	1	100329	174	
4			Shaft Screw	1	102009	CPS	
5			Clamp Screw (include 15 & 15A when ordering)	1	105412	CPR	
5			Clamp Screw (include 15 & 15A when ordering)	1	105412	174	
6			Wedge Screw	1	105414	CPR	
6			Wedge Screw	1	105414	174	
7		E	Hex Head Cap Screw (For motor handle)	2	100122	CPS	
7		(1)	Hex Nut	2	107004	CPS	
8		C	Chuck Screw	1	105861	CPG	
8		C	Chuck Screw	1	105861	174	
11		C	Limit Pin	1	108504	420	
12			Plain Washer	1	112013	STL	
12			Plain Washer	1	112013	316	
15			Cup Washer	1	112407	CPS	
15			Cup Washer	1	112407	316	
15A			Retaining Ring	1	205446	PSP	
16			Wedge Bottom	1	112529	BRZ	
16			Wedge Bottom	1	112529	316	
17			Wedge Top	1	112530	ALM	
17			Wedge Top	1	112530	316	
17			Wedge Top	1	112530	STL	
17		(2)	Wedge Top	1	112530	BRZ	
18		C	Chuck Washer	1	112756	S16	
18		C	Chuck Washer	1	112756	175	
20			Washer	4	112762	BRH	
20			Washer	4	112762	316	
21		C	Snap Ring	1	114276	302	
22		*	Retaining Ring	1	114280	PSP	
24		*	Oil Seal	1	115382	PSP	
27		*	Ball Bearing	1	116223	PSP	
32			Hex Key Wrench	1	127210	BPF	
48			Lockwasher	1	115013	PSP	

PLATE 5109

○ Identity Code: *Recommended Spare Parts : (1) For New Style Motor Design:
(2) Non Stock: E - With Elec.Motor
C - Use with Chuck Drive Shaft R - Use with Rigid Cplg.D

BLANK CODE DENOTES COMMON P/

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

PLATE ISSUE REVISED IT. 2039 SHEET 1 O:

MIXER PARTS • MODEL(S) XD-65, XD-87, XD-117, XDA-100 NS-2, NS-3, NS-4A, NAR-100

PARTS PRICING BOOK SEC. 2 PAGE 7.01 DATE 3/12/84

ITEM NO.	IDENT. CODE ○	DESCRIPTION			REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16708, L-16710, L-15892, & L-15951								
33A		Tank Clamp Assy.	Includes		1	800062	PSP	
	(2)		Items		1	800063	PSP	
	(2)		3, 5, 6, 12		1	800064	PSP	
	(2)		15, 15A, 16		1	800065	PSP	
	(2)		17, 32, 33, 40		1	800066	PSP	
33		Clamp			1	129019	ALM	
33		Clamp			1	129019	316	
33	(2)	Clamp			1	129019	BRZ	
33		Clamp			1	129019	CST	
33		Clamp			1	129019	NAL	
33B		Cup Plate Assy	Includes	ALM	1	801198	PSP	
			Items	316	1	801199	PSP	
			3, 6, 12	BRZ	1	801200	PSP	
			16, 17, 32	STL	1	801201	PSP	
	(2)		33, 40	NAM	1	801193	PSP	
33		Cup Plate			1	129207	ALM	
33		Cup Plate			1	129207	316	
33	(2)	Cup Plate			1	129207	BRZ	
33		Cup Plate			1	129207	CIR	
33		Cup Plate			1	129207	NAM	
34		Chuck Grip			1	130012	316	
35	E	Handle Kit - Electric Motor				Consult Factory		
36		Housing			1	136147	ALF	
36	(2)	Housing			1	136154	316	
36	(2)	Housing			1	136147	BRZ	
36	(2)	Housing			1	136154	CIR	
36		Housing			1	136147	NAL	
38	C	Drive Shaft with Chuck			1	143792	NPS	
38	C	Drive Shaft with Chuck			1	143790	316	
38	R	Drive Shaft with Coupling			1	143811	41L	
38	R	Drive Shaft with Coupling			1	143811	316	
40		Vibration Pad			1	150333	DUK	
41	E	Electric Motor			1	See Sec.	1-C	
42		Mixer Shaft			1	See Sec.	1-D	
43	E	Plain Washer			2	112005	STL	
44/45		Propeller & Set Screw			1	See Sec.	1-D	
46		Motor Shaft Key			1	114196	STL	
47		Washer (for Motor Shaft Screw)			1	112787	STL	

PLATE 5109

○ Identity Code: *Recommended Spare Parts: (2) Non Stock:
E - Use with Electric Motor
C - Use with Chuck Drive Shaft: R - Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PA

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

ISSUE IT. 2039

A UNIT OF GENERAL SIGNAL

MIXER PARTS • MODEL(S) XDA-150, XDA-300 NS-5, NS-6, NS-7 XD-174, XD-230, / NM-1, NM-3

PARTS PRICING BOOK SEC. 2 PAGE 8.00 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16708, L-16710, L-15878, & L-15921							
1			Hex Head Cap Screw	2	100147	CPS	
1			Hex Head Cap Screw	2	100147	316	
2			Hex Head Cap Screw	2	100200	CPS	
2			Hex Head Cap Screw	2	100200	316	
3			King Bolt	1	100318	CPG	
3			King Bolt	1	100318	174	
4			Shaft Screw	1	102561	GR5	
5			Clamp Screw (Include 15 & 15A when ordering)	1	105411	CPR	
5			Clamp Screw (Include 15 & 15A when ordering)	1	105411	174	
6			Wedge Screw	1	105410	CPR	
6			Wedge Screw	1	105410	174	
7			Hex Head Cap Screw (for motor handle)	2	100137	STL	
8		C	Chuck Screw	1	105860	CPG	
8		C	Chuck Screw	1	105860	174	
11		C	Limit Pin	1	108504	420	
12			Plain Washer	1	112017	STL	
12			Plain Washer	1	112017	316	
15			Cup Washer	1	112408	STL	
15			Cup Washer	1	112408	316	
15A			Retaining Ring	1	205447	PSP	
16			Wedge Bottom	1	112527	BRZ	
16			Wedge Bottom	1	112527	316	
17			Wedge Top	1	112528	ALM	
17			Wedge Top	1	112528	316	
17			Wedge Top	1	112528	STL	
17		(2)	Wedge Top	1	112528	BRZ	
18		C	Chuck Washer	1	112750	S16	
18		C	Chuck Washer	1	112750	175	
20			Washer	4	112761	BRS	
20			Washer	4	112761	316	
21		C	Snap Ring	1	114273	302	
22	*		Retaining Ring - Truarc 5100 - 137	1	114275	PSP	
24	*		Oil Seal - Nat. 50451-L	1	115381	PSP	
27	*		Ball Bearing - MRC-2075FF	1	116225	PSP	
32			Hex Key Wrench	1	127209	BPF	

PLATE 5109

○ Identity Code: *Recommended Spare Parts: (2) Non Stock:
E- Use with Electric Motor
C - Use With Chuck Drive Shaft: R- Use with Rigid Drive Shaft

BLANK CODE DENOTES COMMON P

MIXER PARTS • MODEL(S) XDA-150.XDA-300 NS-5,NS-6,NS-7 XD-174, XD-230 / NM-1,NM-3

PARTS PRICING BOOK SEC. 2 PAGE 8.01 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION			REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16708, L-16710, L-15878, & L-15921									
33A			Tank Clamp Assy.	Includes	ALM	1	800067	PSP	
		(2)		Items	316	1	800068	PSP	
		(2)		3, 5, 6, 12	BRZ	1	800069	PSP	
		(2)		15, 15A, 16, 17	STL	1	800070	PSP	
		(2)		32, 33, 40	NAM	1	800071	PSP	
33			Clamp			1	129408	ALM	
33			Clamp			1	129408	316	
33			Clamp			1	129408	BRZ	
33			Clamp			1	129408	CST	
33			Clamp			1	129408	NAL	
33B			Cup Plate Assy.	Includes	ALM	1	801202	PSP	
				Items	316	1	801203	PSP	
				3, 6, 12, 16	BRZ	1	801204	PSP	
				17, 32, 33, 40	STL	1	801205	PSP	
					NAM	1	801206	PSP	
33			Cup Plate			1	129206	ALM	
33			Cup Plate			1	129206	316	
33		(2)	Cup Plate			1	129206	BRZ	
33			Cup Plate			1	129206	CIR	
33			Cup Plate			1	129206	NAM	
34		C	Chuck Grip			1	130010	316	
36			Housing			1	136146	ALF	
36		(2)	Housing			1	136152	316	
36		(2)	Housing			1	136146	BRZ	
36		(2)	Housing			1	136152	CIR	
36			Housing			1	136146	NAL	
38		C	Drive Shaft with Chuck			1	143775	NPS	
38		C	Drive Shaft with Chuck			1	143778	316	
38		R	Drive Shaft with Coupling			1	143809	41L	
38		R	Drive Shaft with Coupling			1	143809	316	
40			Vibration Pad			1	150331	DUK	
41		E	Electric Motor			1	See Sec.	1-C	
43			Mixer Shaft			1	See Sec.	1-D	
44/45			Impeller & Set Screw			1	See Sec.	1-D	
46			Motor Shaft Key			1	190750	STL	

PLATE 5109

○ Identity Code: *Recommended Spare Parts:
(2) Non Stock:
C- Use with Chuck Drive Shaft
E- Use with Electric Motor
R- Use with rigid coupling dr.shaft.

BLANK CODE DENOTES COMMON PAR

MIXER PARTS • MODEL(S) XJ-30, XJ-43, XJA-33 ND-1, ND-1A, NAG-33

PARTS PRICING BOOK SEC. 2 PAGE 9.00 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s).			L-16709 & L-16711				
2			Hex Head Cap Screw	4	100326	CPS	
2			Hex Head Cap Screw	4	100326	316	
3			King Bolt	1	100328	CPG	
3			King Bolt	1	100328	174	
4			Shaft Screw	1	102007	CPS	
5			Clamp Screw	1	105413	CPR	
5			Clamp Screw	1	105413	174	
6			Wedge Screw	1	105414	CPR	
6			Wedge Screw	1	105414	174	
7		E	Hex Head Cap Screw (For Motor Handle)	2	100122	CPS	
8		C	Chuck Screw	1	105861	CPG	
8		C	Chuck Screw	1	105861	174	
10		*	Crip Spring Locknut	1	107717	STL	
11		C	Limit Pin	1	108504	420	
12			Plain Washer	1	112007	CPS	
12			Plain Washer	1	112007	316	
15			Cup Washer	1	112409	CPS	
15			Cup Washer	1	112409	316	
15A			Retaining Ring	1	205445	PSP	
16			Wedge Bottom	1	112531	BRZ	
16			Wedge Bottom	1	112531	316	
17			Wedge Top	1	112532	ALM	
17			Wedge Top	1	112532	316	
17			Wedge Top	1	112532	STL	
17		(2)	Wedge Top	1	112532	BRZ	
18		C	Chuck Washer	1	112756	S16	
18		C	Chuck Washer	1	112756	175	
20			Washer	4	112762	BRH	
20			Washer	4	112762	316	
21		C	Snap Ring	1	114276	302	
22		*	Retaining Ring	1	114278	PSP	
23		*	Retaining Ring	2	114282	PSP	
24		*	Oil Seal	1	115355	PSP	
25		*	Oil Seal	1	115358	PSP	
26		*	"O" Ring	1	115766	BUN	
27		*	Ball Bearing	1	116243	PSP	
28		*	Outer Ring And Roller Assy.	1	117027	PSP	
29			Inner Ring (sold as set with item 28)	1	117028	PSP	

PLATE 5109

○ Identity Code: *Recommended Spare Parts: (2) Non Stock - Consult Factory:
C- Use with Chuck Drive Shaft
E- Use with Electric Motor
R- Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PAI

MIXER PARTS • MODEL(S) XJ-30, XJ-43, XJA-33 ND-1, ND-1A, NAG-33

PARTS PRICING BOOK SEC. 2 PAGE 9.01 DATE 3/12/84

ITEM NO.	IDENT. CODE ○	DESCRIPTION			REQ'D PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s).		L-16709 & L-16711						
30/31		Gear and Pinion	(Set Only)		1	119869	PSP	
32		Hex Key Wrench			1	127210	BPF	
33A		Tank Clamp Assy.	Includes		1	800057	PSP	
	(2)		Items		1	800058	PSP	
	(2)		3, 5, 6, 12, 15		1	800059	PSP	
	(2)		15A, 16, 17,		1	800060	PSP	
	(2)		32, 33, 40		1	800061	PSP	
33		Clamp			1	129020	ALM	
33		Clamp			1	129020	316	
33	(2)	Clamp			1	129020	BRZ	
33		Clamp			1	129020	STL	
33		Clamp			1	129020	NAL	
33B		Cup Plate Assy.	Includes	ALM	1	801194	PSP	
	(2)		Items	316	1	801195	PSP	
	(2)		3, 6, 12, 16	BRZ	1	801196	PSP	
	(2)		17, 32, 33,	CIR	1	801197	PSP	
	(2)		40	NAM	1	801192	PSP	
33		Cup Plate			1	129208	ALM	
33		Cup Plate			1	129208	316	
33	(2)	Cup Plate			1	129208	BRZ	
33	(2)	Cup Plate			1	129208	CIR	
33		Cup Plate			1	129208	NAM	
34	C	Chuck Grip			1	130012	316	
35	E	Motor Handle Kit - Electric Motor			1	Consult Factory		
36		Housing			1	136142	ALF	
36		Housing			1	136156	316	
36		Housing			1	136142	BRZ	
36		Housing			1	136156	CIR	
36		Housing			1	136142	NAL	
37		Grip Spring Spacer			1	138808	STL	
38	C	Drive Shaft with Chuck			1	143796	NPS	
38	C	Drive Shaft with Chuck			1	143794	316	
38	R	Drive Shaft with Coupling			1	143851	41L	
38	R	Drive Shaft with Coupling			1	143851	316	
39	*	Grip Spring Set			2	147031	PSP	
40		Vibration Pad			1	150332	DUK	
41	E	Electric Motor			1	See Sec.	1-C	
42		Mixer Shaft			1	See Sec.	1-D	

PLATE 5109

○ Identity Code: * Recommended Spare Parts: (2) Non Stock Consult Factory
E - Use with Electric Motor
C - Usw with Chuck Drive Shaft R - Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PAF

MIXER PARTS • MODEL(S) XJ-30, XJ-43, XJA-33 ND-1, ND-1A, NAG-

PARTS PRICING BOOK SEC. 2 PAGE 9.02 DATE 3/12/8

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH
NOTE: Reference Drawing No(s).			L-16709 & L-16711				
43		E	Plain Washer	2	112005	STL	
44/45			Impeller & Set Screw	1	See Sec.	1-D	
46			Motor Shaft Key	1	114196	STL	
47			Washer (For Motor Shaft Screw)	1	112777	STL	
99			Gear Lubr. - 2 lb. Can. Temp 50° to 200°	1	123620	PSP	
48			Lockwasher	1	115012	PSP	

PLATE 5109

○ Identity Code: * Recommended Spare Parts:

E - Use with Electric Motor

BLANK CODE DENOTES COMMON P.

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

MIXER PARTS • MODEL(S) XJ-65/87/117 XJA-100

ND-2, ND-2A, ND-3
NAG-100

PARTS PRICING BOOK SEC. 2 PAGE 10.00 DATE 3/12/84

NOTE: Reference Drawing No(s). L-16709, L-16711, L-15893, L-15952, L-15920

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
2			Hex Head Cap Screw	4	100327	CPS	
2			Hex Head Cap Screw	4	100327	316	
3			King Bolt	1	100329	CPG	
3			King Bolt	1	100329	174	
4			Shaft Screw	1	102009	CPS	
5			Clamp Screw (Includes 15 & 15A)	1	105412	CPR	
5			Clamp Screw (Includes 15 & 15A)	1	105412	174	
6			Wedge Screw	1	105414	CPR	
6			Wedge Screw	1	105414	174	
7			Motor Eye Bolt	2	105620	PCS	
8		C	Chuck Screw	1	105861	GR5	
8		C	Chuck Screw	1	105861	174	
10		*	Grip Spring Locknut	1	107716	STL	
11		C	Limit Pin	1	108504	420	
12			Plain Washer	1	112013	STL	
12			Plain Washer	1	112013	316	
15			Cup Washer	1	112407	CPS	
15			Cup Washer	1	112407	316	
15A			Retaining Ring	1	205446	PSP	
16			Wedge Bottom	1	112529	BRZ	
16			Wedge Bottom	1	112529	316	
17			Wedge Top	1	112530	ALM	
17			Wedge Top	1	112530	316	
17			Wedge Top	1	112530	STL	
17		(2)	Wedge Top	1	112530	BRZ	
18		C	Chuck Washer	1	112756	S16	
18		C	Chuck Washer	1	112756	175	
20			Washer	4	112762	BRH	
20			Washer	4	112762	316	
21		C	Snap Ring	1	114276	302	
22		*	Retaining Ring	1	114279	PSP	
23		*	Retaining Ring	2	114283	PSP	
24		*	Oil Seal	1	115356	PSP	
25		*	Oil Seal	1	115357	PSP	
26		*	O Ring	1	115766	BUN	
27		*	Ball Bearing	1	116222	PSP	
28		*	Outer Ring And Roller Assy	1	117025	PSP	
29		*	Inner Ring (Set with 28)	1	117026	PSP	

PLATE 5109

○ Identity Code: * Recommended Spare Parts: (2) Non Stock - Consult Factory
E - Use with Electric Motor
C - Use with Chuck Drive Shaft R - Use with Rigid Coupling Drive Shaft

*Recommended Spare Parts
BLANK CODE DENOTES COMMON PAR

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

A UNIT OF GENERAL SIGNAL

MIXER PARTS • MODEL(S) XJ-65, XJ-87, XJ-117, XJA-100 ND-2, ND-2A, ND-3A, NAG-100

PARTS PRICING BOOK SEC. 2 PAGE 10.01 DATE 3/12/84

T.	IDENT. CODE ○		DESCRIPTION			REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16709, L-16711, L-15893, L-15952, L-15920									
30/31		*	Gear and Pinion	(set only)		1	119866	PSP	
32			Hex Key Wrench			1	127210	BPF	
33A			Tank Clamp Assy	Includes	ALM	1	800062	PSP	
		(2)		Items	316	1	800063	PSP	
		(2)		3, 5, 6, 12, 15	BRZ	1	800064	PSP	
		(2)		15A, 16, 17,	STL	1	800065	PSP	
		(2)		32, 33, 40	NAM	1	800066	PSP	
33			Clamp			1	129019	ALM	
33			Clamp			1	129019	316	
33		(2)	Clamp			1	129019	BRZ	
33			Clamp			1	129019	STL	
33			Clamp			1	129019	NAL	
33B			Cup Plate Assy.	Includes	ALM	1	801198	PSP	
		(2)		Items	316	1	801199	PSP	
		(2)		3, 6, 12	BRZ	1	801200	PSP	
		(2)		16, 17, 32,	STL	1	801201	PSP	
		(2)		33, 40	NAM	1	801193	PSP	
33			Cup Plate			1	129207	ALM	
			Cup Plate			1	129207	316	
		(2)	Cup Plate			1	129207	BRZ	
			Cup Plate			1	129207	STL	
33			Cup Plate			1	129207	NAL	
34		C	Chuck Grip			1	130011	316	
35			Motor Handle Kit - Electric Motor			1	consult factory		
36			Housing			1	136143	ALF	
36			Housing			1	136155	316	
36			Housing			1	136143	BRZ	
36			Housing			1	136155	CIR	
36			Housing			1	136143	NAL	
37			Grip Spring Spacer			1	138810	STL	
38		C	Drive Shaft with Chuck			1	143784	NPS	
38		C	Drive Shaft with Chuck			1	143782	316	
38		R	Drive Shaft with Coupling			1	143850	41L	
38		R	Drive Shaft with Coupling			1	143850	316	
39		*	Grip Spring Set			2	147030	PSP	
40			Vibration Pad			1	150333	DUK	
41		E	Electric Motor			1	See Sec.	1-C	
42			Mixer Shaft			1	See Sec.	1-D	

○ Identity Code: * Recommended Spare Parts: (2) Non Stock Consult Factory

C - Use with Chuck Drive Shaft E - Use with Electric Motor

R - Use with Rigid Coupling Drive Shaft

*Recommended Spare Parts

BLANK CODE DENOTES COMMON PARTS

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

MIXER PARTS • MODEL(S)

XJ-65, XJ-87 ND-2, ND-2A
XJ-117, XJA-100 ND-3A, NAG-100

PARTS PRICING BOOK SEC. 2 PAGE 10.03 DATE 3/12/84

ITEM NO.	IDENT. CODE ○	DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16709, L-16711 , L-15893, L-59952, L-15920						
44/45		Impeller & Set Screw	1	See Sec.	1-D	
46		Motor Shaft Key	1	114196	STL	
47		Washer (For Motor Shaft Screw)	1	112778	STL	
99		Gear Lubricant 2 lb. Can. (For Ambient Temp 50° to 200°F)	2	123620	PSP	
48		Lockwasher	1	115013	PSP	

PLATE 5109

○ Identity Code:

*Recommended Spare Parts
Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

BLANK CODE DENOTES COMMON PAR

A UNIT OF GENERAL SIGNAL

MIXER PARTS • MODEL(S) XJ-174, XJ-230, XJ-350

ND-3, ND-4
ND-4A, ND-4B

PARTS PRICING BOOK SEC. 2 PAGE 11.00 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s). L-16709, L-16711							
1			Hex Head Cap Screw	2	100306	CPS	
1			Hex Head Cap Screw	2	100306	316	
2			Hex Head Cap Screw	2	100506	CPS	
2			Hex Head Cap Screw	2	100506	316	
3			King Bolt	1	100318	CPG	
3			King Bolt	1	100318	174	
4			Pinion Cap Screw	1	102560	GR5	
5			Clamp Screw (Includes 15 & 15A)	1	105411	CPR	
5			Clamp Screw (Includes 15 & 15A)	1	105411	174	
6			Wedge Screw	1	105410	CPR	
6			Wedge Screw	1	105410	174	
7			Motor Eye Bolt - For 3hp.Motor	2	105619	CPS	
8		C	Chuck Screw	1	105860	CPG	
8		C	Chuck Screw	1	105860	174	
10		*	Grip Spring Locknut	1	107715	STL	
11		C	Limit Pin	1	108504	420	
12			Plain Washer	1	112017	STL	
12			Plain Washer	1	112017	316	
15			Cup Washer	1	112408	STL	
15			Cup Washer	1	112408	316	
15A			Retaining Ring	1	205447	PSP	
16			Wedge Bottom	1	112527	BRZ	
16			Wedge Bottom	1	112527	316	
17			Wedge Top	1	112528	ALM	
17			Wedge Top	1	112528	316	
17			Wedge Top	1	112528	STL	
17		(2)	Wedge Top	1	112528	BRZ	
18		C	Chuck Washer	1	112750	S16	
18		C	Chuck Washer	1	112750	175	
20			Washer	4	112761	BRS	
20			Washer	4	112761	316	
21		C	Snap Ring	1	114273	302	
22		*	Retaining Ring	1	114274	PSP	
23		*	Retaining Ring	2	114284	PSP	
24		*	Oil Seal	1	115349	PSP	
25		*	Oil Seal	1	115350	PSP	
26		*	"O" Ring	1	115763	BUN	
27		*	Ball Bearing	1	116677	PSP	
28		*	Outer Ring and Roller Assy.	1	117023	PSP	
29		*	Inner Ring	1	117024	PSP	

PLATE 5109

○ Identity Code: * Recommended Spare Parts: (2) Non Stock - Consult Factory
C - Use with Chuck Drive Shaft:
R - Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PAR

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

PLATE ISSUE REVISED

IT. 2043
SHEET 1

ND-3, ND-4

MIXER PARTS • MODEL(S) XJ-174, XJ-230, XJ-350 ND-4A, ND-4B

PARTS PRICING BOOK SEC. 2 PAGE 11.01 DATE 3/12/84

ITEM NO.	IDENT. CODE ○		DESCRIPTION			REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s).			L-16709 L-16711						
30/31		*	Gear and Pinion Set-Available in Set			1	119863	PSP	
			Form only includes items 30 & 31						
32			Hex Key Wrench			1	127209	BPF	
33A			Tank Clamp Assy	Includes		1	800067	PSP	
				Items		1	800068	PSP	
				3,5,6,15,15A		1	800069	PSP	
				16,17,32,		1	800070	PSP	
				33,40		1	800071	PSP	
33			Clamp			1	129408	ALM	
33			Clamp			1	129408	316	
33			Clamp			1	129408	BRZ	
33			Clamp			1	129408	CST	
33			Clamp			1	129408	NAL	
33B			Cup Plate Assy	Includes	ALM	1	801202	PSP	
		(2)		Items	316	1	801203	PSP	
		(2)		3,6,12,	BRZ	1	801204	PSP	
		(2)		16,17,32,	CIR	1	801205	PSP	
		(2)		33,40	NAM	1	801206	PSP	
33			Cup Plate			1	129206	ALM	
33			Cup Plate			1	129206	316	
33		(2)	Cup Plate			1	129206	BRZ	
33			Cup Plate			1	129206	CIR	
33		(2)	Cup Plate			1	129206	NAM	
34		C	Chuck Grip			1	130010	316	
35			Motor Handle			1	135213	STL	
36			Housing			1	136145	ALF	
36			Housing			1	136153	316	
36			Housing			1	136145	BRZ	
36			Housing			1	136153	CIR	
36			Housing			1	136145	NAL	
37			Grip Spring Spacer			1	138812	STL	
38		C	Drive Shaft with Chuck			1	143773	NSP	
38		C	Drive Shaft with Chuck			1	143777	316	
38		R	Drive Shaft with Rigid Coupling			1	143852	41L	
38		R	Drive Shaft with Rigid Coupling			1	143852	316	
39		*	Grip Spring Set			2	147029	PSP	
40			Vibration Pad			1	150331	DUK	
41			Motor			1	See Sec.	1-C	
42			Mixer Shaft			1	See Sec.	1-D	

PLATE 5109

○ Identity Code: * Recommended Spare Parts: (2) Non Stock -Consult Fact
C - Use with Chuck Drive Shaft
R - Use with Rigid Coupling Drive Shaft

BLANK CODE DENOTES COMMON PAF

ITEM NO.	IDENT. CODE ○		DESCRIPTION	REQ'D. PER UNIT	PART NO. DWG NO.	PART NO. MAT'L	PRICE (EACH)
NOTE: Reference Drawing No(s).			L-16709 L-16711				
44/45			Impeller & Set Screw	1	See Sec.	1-D	
46			Motor Shaft Key	1	190750	STL	
70			Oil Seal	1	115402	PSP	
71			Slinger	1	139054	PSP	
99			Gear Lubricant 2lb.Can (For Ambinet Temperatures 50° to 200°F)	3	123620	PSP	

PLATE 5109

○ Identity Code:

*Recommended Spare Parts

Consult your local LIGHTNIN Sales Office for terms of sale, ordering information and delivery.

BLANK CODE DENOTES COMMON PAR

SECTION 8

ASSEMBLY & DISASSEMBLY INSTRUCTIONS DIRECT DRIVE — XD SERIES

8-1. REMOVING THE MOTOR FROM THE HOUSING

a. Remove the mixer shaft from the chuck.

b. Remove housing cap screws and washers (1, 2, and 20).

c. Insert an Allen wrench in the chuck screw (8) to prevent the drive shaft from rotating.

d. Remove shaft screw (4) through the drive shaft bore in one of the following ways.

1. Fractional horsepower XD 30 thru 117: Use a Phillips screwdriver.

2. XD 174 thru 350: Use a 5/16-inch long-shank hex wrench.

e. The upper end of the drive shaft is closely fitted to the motor shaft. Use care in separating the motor (41) and housing (36) by one of the following methods.

1. Tap evenly around the upper edge of the housing with a mallet.

2. If the two assemblies do not readily separate, tighten the propeller on the mixer shaft and tighten the mixer shaft in the chuck. Separate motor and housing by tapping the top of the propeller hub with a mallet. Then remove the mixer shaft.

f. On XD 30 thru 117 models the motor shaft key (46) is lightly cemented in the motor shaft keyway.

8-2. REMOVING DRIVE SHAFT, BEARING, AND OIL SEAL FROM THE HOUSING

a. Follow the procedure of Paragraph 8-1.

b. Use Waldes Truarc No. 4 pliers to remove retaining ring (22).

c. Mount housing, large end upward, in an arbor press and press drive shaft (38) through the lower opening of the housing.

d. Turn the housing large end down and press ball bearing (27) and oil seal (24) downward out of the housing.

8-3. DISASSEMBLING THE CLAMP

a. Loosen the wedge screw (6).

b. Remove king bolt (3) and washer (12) to release wedge assembly and clamp assembly from the positioning ball of the housing.

c. Separate wedge top (17) and wedge bottom (16) and remove wedge screw (6).

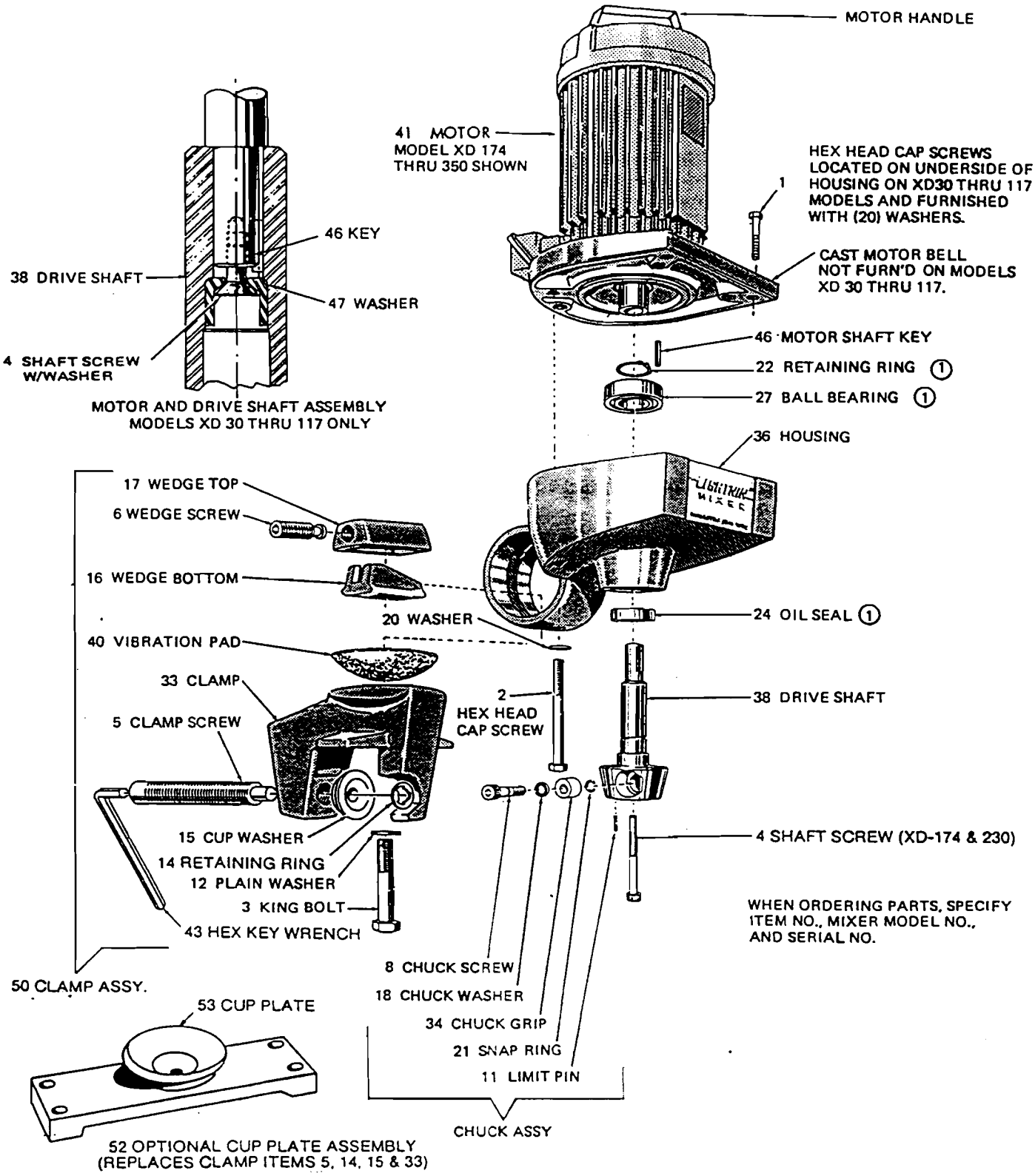
d. Remove vibration pad (40) from clamp (33).

8-4. DISASSEMBLING THE CHUCK

a. Remove the limit pin (11) by driving it into the counterbored hole.

b. Remove the chuck screw (8).

c. Remove snap ring (21), chuck grip (34) and chuck washer (18) from the chuck screw.



(1) RECOMMENDED SPARE PARTS

EXPLODED VIEW OF DIRECT DRIVE –
MODEL XD SERIES

8-5. PREPARING FOR ASSEMBLY

a. Clean all parts thoroughly.
b. Inspect for the following defects.
   1. Cracks or damage of the housing.
   2. Dents, gouges, or scoring of the drive shaft, housing bore, and particularly the mating faces of the motor and housing.
   3. Wear or deterioration of the vibration pad.
c. Repair or replace defective parts. It is good practice to replace an oil seal which has been removed from the housing. Apply a small quantity of bearing grease to the housing bore and around the oil seal lip to provide lubrication and to make the seal more effective.
d. Replace the ball bearing if it shows indications of wear.

8-6. ASSEMBLING THE DRIVE SHAFT IN THE HOUSING

a. Mount the housing (36) in an arbor press, large end up.
b. Press the ball bearing (27) on its outer race to the shoulder of the housing bore.
c. Turn the housing large end down and press the oil seal (24), sealing lip inward, flush with the lower end of the housing.
d. Support the housing, large end down, by resting the inner race of the ball bearing on a suitable sleeve.
e. Grease the lip of the oil seal and press the drive shaft (38) into the ball bearing until the shoulder of the shaft registers against the inner race of the bearing.
f. Use Waldes Truarc No. 4 pliers to install retaining ring (22) in the shaft groove.
g. Turn the housing large end down and press the drive shaft until the chuck head contacts the small end of the housing.

8-7. ASSEMBLING THE CHUCK

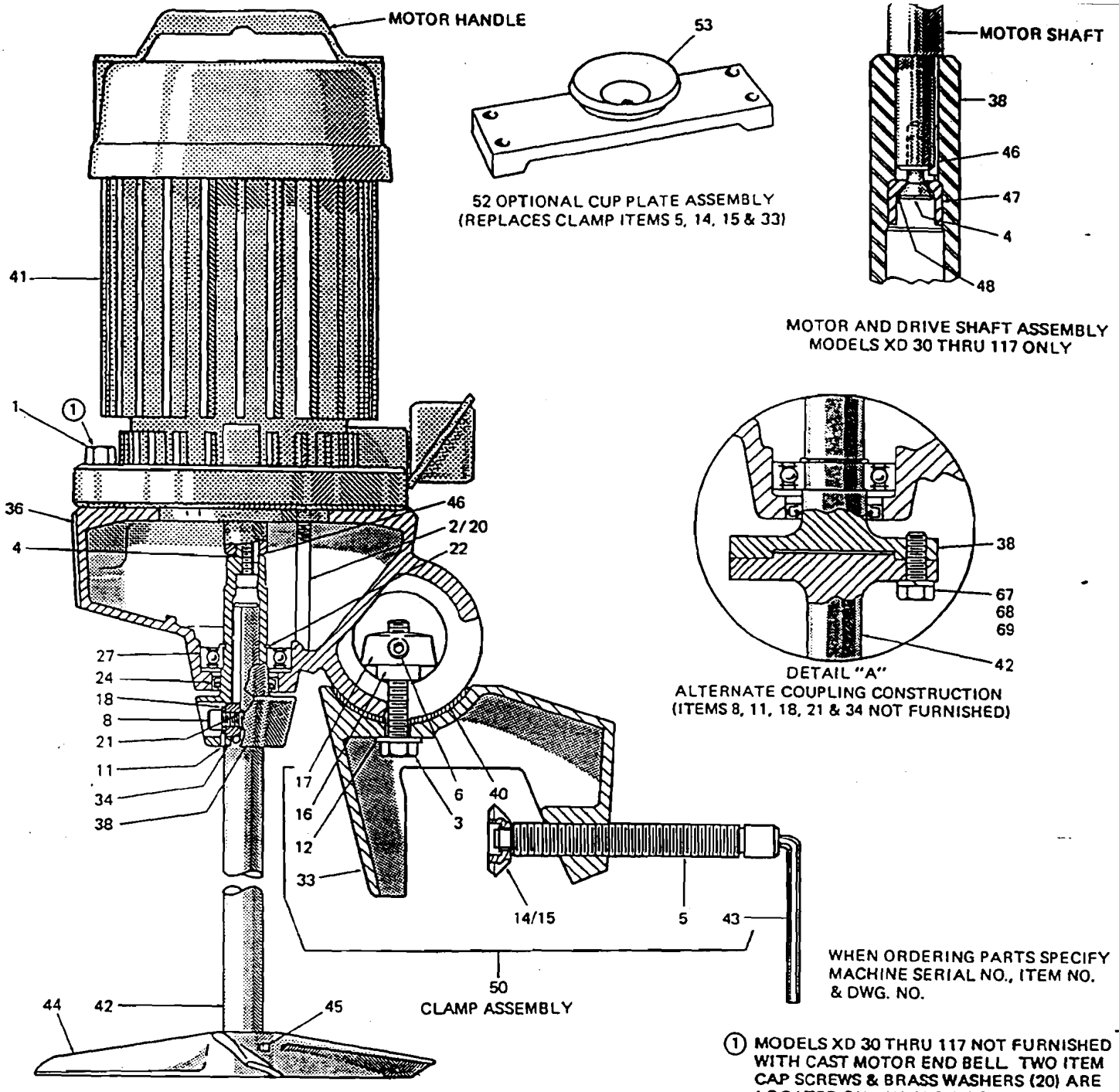
a. Assemble chuck washer (18), chuck grip (34), and snap ring (21) on chuck screw (8).
b. Thread the chuck screw into the chuck end of the drive shaft far enough to insert the limit pin (11) so that the end of the pin is 3/16 of an inch under flush.

8-8. ASSEMBLING THE MOTOR TO THE HOUSING

a. If the drive shaft has not been removed from the housing, repeat step g, Paragraph 8-6.
b. Install the motor shaft key (46).
   1. On Models XD 174 thru 350 — Install key in drive shaft keyway.
   2. On Models XD 30 thru 117 — If the key has been removed, clean key and motor shaft keyway and apply Loctite Sealant, Grade E. (American Sealants Co.) to both items before reassembling.
c. Apply a light film of oil to both shafts. Align the mating keyways and insert one shaft into the other, without forcing, until the shafts are securely butted. There will be a small gap between the motor face and housing face.
d. Align the motor and housing so that the switch conduit box, or junction box of the motor and the ball of the housing are on the same side.
e. Align the screw holes and install the housing cap screws and washers (1, 2 and 20).
f. Draw up the screws evenly until the housing face is just snug with the motor face, but do not completely tighten the screws.
g. Insert the Allen wrench in the chuck screw to keep the drive shaft from turning, then thread in and tighten the shaft screw (4).
h. Tighten the four housing cap screws evenly.

8-9. ASSEMBLING THE CLAMP

a. Thread the clamp screw (5) through the outer arm of the clamp (33). Slide the cup washer (15) over the end of the clamp screw. Slide the retaining ring (14) onto the clamp screw. Position the retaining ring approximately 3/16" from the end of the clamp screw to allow free movement of the cup washer.
b. Assemble wedge top (17), wedge screw (6), and wedge bottom (16) and set the assembly in place in the ball of the housing.
c. Assemble clamp, vibration pad (40), king bolt (3), and washer (12).
d. Pass king bolt through the slot in the ball of the housing and thread it loosely into the wedge top.
e. Back off the wedge screw all the way, then advance it two turns. With the wedge bottom in this position, tighten the king bolt until the clamp socket can just be moved on the housing ball.



52 OPTIONAL CUP PLATE ASSEMBLY
(REPLACES CLAMP ITEMS 5, 14, 15 & 33)

MOTOR AND DRIVE SHAFT ASSEMBLY
MODELS XD 30 THRU 117 ONLY

DETAIL "A"
ALTERNATE COUPLING CONSTRUCTION
(ITEMS 8, 11, 18, 21 & 34 NOT FURNISHED)

WHEN ORDERING PARTS SPECIFY MACHINE SERIAL NO., ITEM NO. & DWG. NO.

① MODELS XD 30 THRU 117 NOT FURNISHED WITH CAST MOTOR END BELL. TWO ITEM CAP SCREWS & BRASS WASHERS (20) ARE LOCATED ON UNDERSIDE OF HOUSING.

ITEM NO.	PART NAME	REQUIRED
1	HEX HEAD CAP SCREW } XD-174 &	2
2	HEX HEAD CAP SCREW } (350 Only)	2
2	HEX HEAD CAP SCREW XD 30-117 Only	4
3	KING BOLT	1
4	SHAFT SCREW (XD 174–350 only)	1
4	SHAFT SCREW & LOCKWASHER XD 30–117 only	1
5	CLAMP SCREW	1
6	WEDGE SCREW	1
8	CHUCK SCREW	1
11	LIMIT PIN	1
12	PLAIN WASHER	1
14	RETAINING RING	1
15	CUP WASHER	1
16	WEDGE BOTTOM	1
17	WEDGE TOP	1
18	CHUCK WASHER	1
20	WASHER (XD 30-117 Only)	4
20	WASHER (XD 174-350 Only)	2

ITEM NO.	PART NAME	REQUIRED
21	SNAP RING	1
22	RETAINING RING, EXTERNAL	1
24	OIL SEAL	1
27	BALL BEARING	1
33	CLAMP	1
34	CHUCK GRIP	1
35	MOTOR HANDLE	1
36	HOUSING	1
38	DRIVE SHAFT	1
40	VIBRATION PAD	1
41	MOTOR	1
42	MIXER SHAFT	1
43	HEX KEY WRENCH	1
44	IMPELLER	Per Order
45	SET SCREW	Per Order
46	MOTOR SHAFT KEY	1
47	WASHER (XD 30-117 Only)	1
48	LOCKWASHER (XD 30-117 Only)	1
67	HEX HEAD CAP SCREW	4
68	LOCKWASHER	4
69	HEX NUT (XD 30-43 Only)	4

When ordering parts, specify item number, machine model number and serial number.

9-1. REMOVING THE MOTOR FROM THE HOUSING

a. Set the mixer in a vertical position to prevent spilling the gear lubricant.

b. Remove four housing cap screws and washers (1, 2, and 20).

c. Raise motor (41) by its motor handle to separate motor and housing (36).

d. Remove "O" ring (26).

9-2. REMOVING THE PINION FROM THE MOTOR

a. Hold the pinion (31) from turning and remove the pinion cap screw (4) in one of the following ways.

1. XJ 30 thru 117 — Use a Phillips screwdriver.
2. XJ 174 thru 350 — Use a 5/16-inch Allen wrench.
3. For XJ 174 thru 350 — With nylon slinger, the slinger must be removed by breaking it. Place a wooden block under the slinger and strike the opposite side with a chisel.

b. Remove the pinion with a bearing puller.

9-3. REMOVING DRIVE SHAFT, BEARINGS, AND OIL SEALS FROM THE HOUSING

a. Remove the lubricant from the gear chamber.

b. Remove the grip spring locknut (10) from the upper end of the drive shaft. Use one of the following methods to hold the drive shaft from turning.

1. XJ 30 thru 117 — Insert an Allen wrench (43) in the chuck screw.
2. XJ 174 thru 350 — Remove the chuck assembly. (See paragraph 8-4). Insert a 1-foot length of 1-inch diameter bar in the chuck grip bore.

c. Thread a nut on the end of the drive shaft to protect the threads when pressing out the shaft.

d. Mount the housing in an arbor press, large end upward, and press the drive shaft clear of the internal gear bore.

e. Remove the internal gear (30), the two grip spring sets (39), and the grip spring spacer (37).

f. Remove the drive shaft, with the bearing inner ring (29) in place, through the lower opening of the housing.

g. If it is necessary to remove the bearing inner ring, start it from its seat with a thin screwdriver or wedge, then remove it from the drive shaft with a bearing puller.

h. XJ 174 thru 350 only — Pry the oil seal (70) from the housing bore as shown in Figure 6.

1. Insert a 7/8 bolt into the ball bearing (27) bore.
2. Use the bolt head as a fulcrum and pry out the oil seal (70) with pliers.

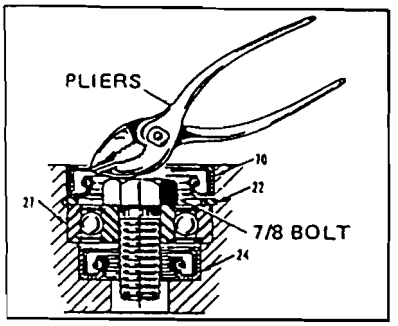


FIGURE 6

i. Use Waldes Truarc No. 4 pliers to remove internal retaining ring (22).

j. Remove ball bearing (27) and upper oil seal (24) through the upper opening of the housing.

k. Remove internal retaining rings (23).

l. Mount the housing, large end upward, in an arbor press and press out oil seal (25) and outer ring and roller assembly (28).

9-4. DISASSEMBLING THE CLAMP
(See Paragraph 8-3).

9-5. DISASSEMBLING THE CHUCK
(See Paragraph 8-4.)

9-6. PREPARATION FOR ASSEMBLY

a. Clean all parts thoroughly.

b. Inspect for the following defects.

1. Cracks or damage of the housing.
2. Dents, gouges, or scoring of the drive shaft, housing bore, and particularly the mating faces of the motor and housing.
3. Wear or deterioration of the vibration pad.

c. Repair or replace defective parts. It is good practice to replace an oil seal which has been removed from the housing. Apply a small quantity of bearing grease to the housing bore and around the oil seal lip to provide lubrication and to make the seal more effective.

d. Replace the "O" ring if it is cut, deformed, or deteriorated.

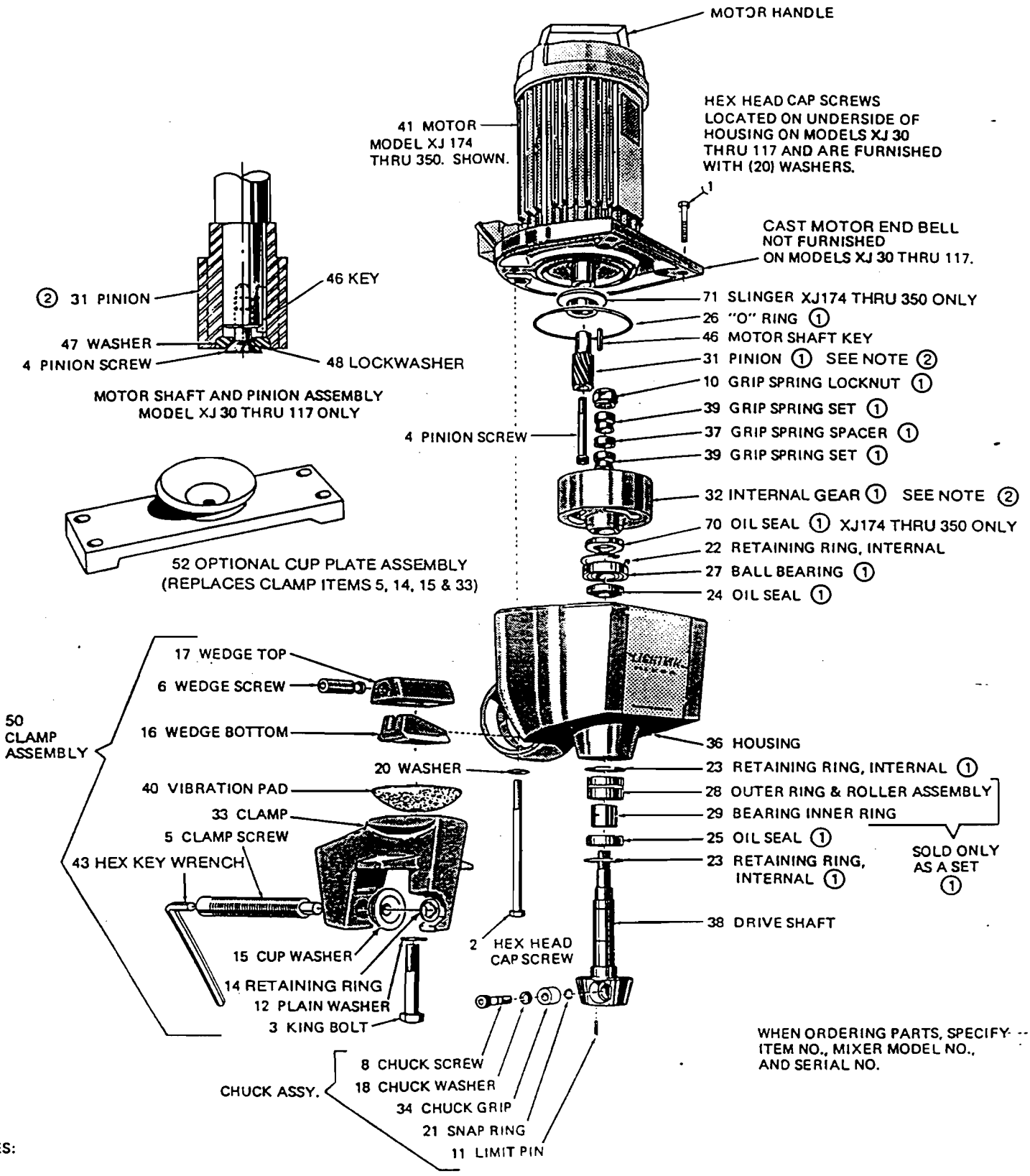
e. Replace the ball bearing and roller bearing (including the bearing inner ring) if they show indications of wear.

9-7. ASSEMBLING THE DRIVE SHAFT IN THE HOUSING

a. Mount the housing (36) in an arbor press, large end upward.

b. Press the upper oil seal (24), sealing lip upward, approximately 1/8-inch below the shoulder of the bore.

c. Press the ball bearing (27) on its outer race against the shoulder of the bore.



NOTES:

① RECOMMENDED SPARE PARTS

② GEAR & PINION SOLD IN SETS ONLY, HOWEVER PINION (31) IS AVAILABLE AS AN INDIVIDUAL ITEM WITHOUT MECHANICAL GUARANTEE. INTERNAL GEAR (32) NOT AVAILABLE AS INDIVIDUAL ITEM.

EXPLODED VIEW OF GEAR DRIVE MIXER XJ SERIES

d. Install retaining ring (22).

e. XJ 174 thru 350 Only

1. Apply a heavy coating of ball bearing grease to the top of the ball bearing (27).
2. Apply a coating of Loctite "Bearing Mount" grade to the outside of a new oil seal (70).
3. Press the oil seal (70), sealing lip up, into the housing until it seats on the retaining ring (22).

f. Turn the housing large end down in the press and install the inner of the two lower retaining rings (23).

g. Pack the outer ring and roller assembly (28) with a suitable bearing grease and press it into the housing bore until it registers against the retaining ring.

h. Press oil seal (25), with its sealing lip towards the large end of the housing, against the outer ring and roller assembly.

i. Install outer retaining ring.

j. If the bearing inner ring (29) has been removed from the drive shaft (38), press it in place.

k. Apply a thin film of light oil on the tapered surfaces *only* of each grip spring set. CAUTION: For proper operation of the grip springs, oil *must not* get between the grip spring driving surfaces and the drive shaft or gear bore.

l. Install the inner ring of the lower grip spring set (39) so that the thicker edge seats against the shaft shoulder.

m. Place the housing on its side and grease the lips of the oil seals.

n. Hold the internal gear (32) in place in the gear chamber and pass the drive shaft through its bearings as far as it will go into the hub of the gear.

o. With the gear on the end of the shaft, turn the housing large end down and press the shoulder of the drive shaft against the inner race of the ball bearing (27).

p. Turn the housing large end up. Center the internal gear on the drive shaft and install the external ring of the lower grip spring set (39), grip spring spacer (37), and upper grip spring set (39). Both grip spring sets should be installed with the thicker edge of the external ring upward. (See Figure 5 on page 9).

q. Apply a thin coating of light oil on the threads of the drive shaft and the bottom surface of the grip spring locknut.

r. Thread the grip spring locknut (10) onto the end of the drive shaft (finger tight). Rotate the internal gear (32) by hand and at the same time tighten down on the locknut until the internal gear can no longer be rotated. Tighten the locknut securely. (Table 4 lists the recommended tightening torques for this locknut. If a torque wrench is not available, be sure locknut is tightened sufficiently to prevent grip spring slippage.) Use one of the following methods to prevent the drive shaft from turning while performing this operation.

1. XJ 30 thru 117 — Reassemble the chuck assembly. (See Paragraph 8-7.) Insert an Allen wrench in the chuck screw.
2. XJ 174 thru 350 — With the chuck assembly removed from the drive shaft, insert a 1-foot length of 1-inch diameter bar in the chuck grip bore.

9-8. ASSEMBLING THE PINION ON THE MOTOR SHAFT

a. XJ 174 thru 350 only

If the slinger has been removed, reinstall on the motor shaft.

1. For units with aluminum slinger, allow 1/32 to 3/32 gap between the motor oil seal and top of slinger. Check shaft end play and rotate to make sure slinger rotates freely. Coat the set set screw threads with Loctite and tighten the set screw securely.
2. For units with nylon slinger, position on the motor shaft.

b. Apply a thin film of grease to the motor shaft or pinion shaft.

c. Make sure that the motor shaft key (46) is in place in the motor shaft keyway.

d. Assemble the pinion on the motor shaft by driving it into place with light strokes of a mallet. For units with nylon slinger, be sure the pinion teeth mesh with slinger teeth.

e. Make sure that pinion and motor shaft butt securely, then install and tighten the pinion screw (4) with lockwasher (48).

9-9. ASSEMBLING THE CHUCK (See Paragraph 8-7).

9-10. ASSEMBLING THE MOTOR TO THE HOUSING

a. Fill the gear chamber of the housing (36) level with a suitable lubricant. (See Section 7.) Make sure that grease is solidly packed without air pockets by paddling the grease, rotating the drive shaft by hand, tapping or shaking the housing.

b. Clean the mating surfaces of the motor (41) and housing.

c. Place the "O" ring (26) on the motor.

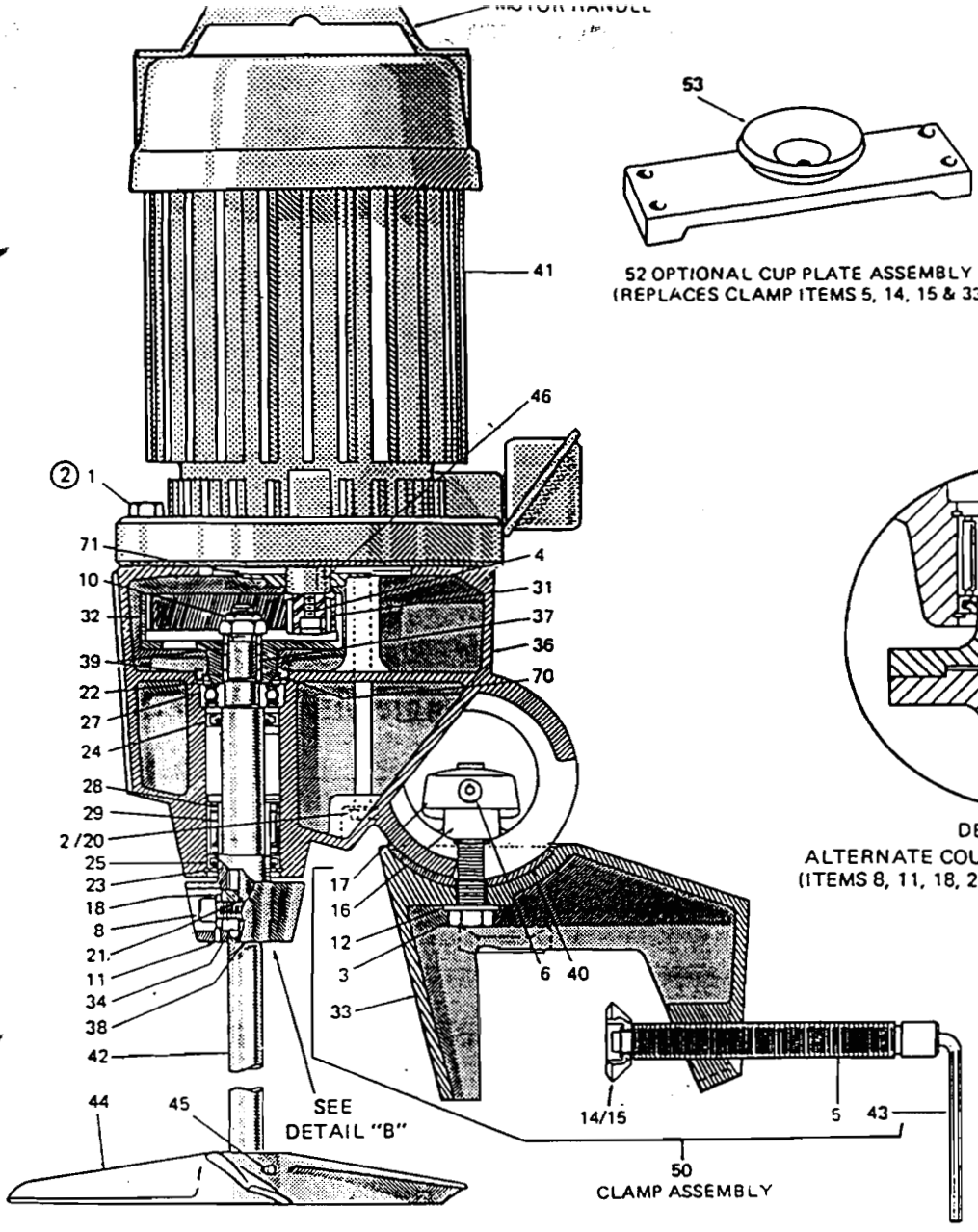
d. Align motor rabbet with the opening of the housing and lower motor into place using care so as not to damage the "O" ring.

e. Align the motor and housing so that the switch, conduit box, or junction box of the motor and the ball of the housing are on the same side.

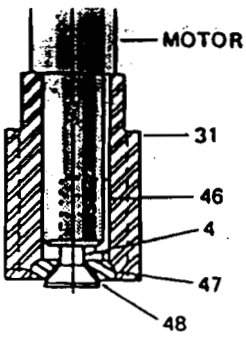
f. Align the screw holes and install the housing cap screws and washers (1, 2, and 20).

g. Rotate the drive shaft several revolutions by hand to make sure that all parts are running freely.

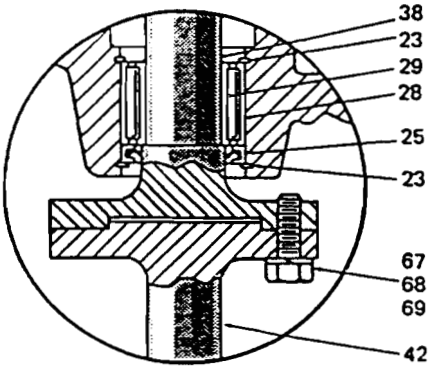
9-11. ASSEMBLING THE CLAMP. (See Paragraph 8-9.)



52 OPTIONAL CUP PLATE ASSEMBLY
(REPLACES CLAMP ITEMS 5, 14, 15 & 33)



MOTOR SHAFT AND PINION ASSEMBLY
MODEL XJ 30 THRU 117 ONLY



DETAIL "B"
ALTERNATE COUPLING CONSTRUCTION
(ITEMS 8, 11, 18, 21 & 34 NOT FURNISHED)

NOTE:

① SOLD IN SETS ONLY

② MODEL XJ 30 THRU 117 NOT FURNISHED WITH MOTOR END BELL (2) ITEM 2 CAP SCREWS AND BRASS WASHERS (20) LOCATED ON UNDERSIDE OF HOUSING.

WHEN ORDERING PARTS SPECIFY MACHINE SERIAL NO., ITEM NO., AND DRAWING NO.

ITEM NO.	PART NAME	REQUIRED
1	HEX HEAD CAP SCREW } XJ 174 thru	2
2	HEX HEAD CAP SCREW } 350 only	2
2	HEX HEAD CAP SCREW (XJ 30-117 only)	4
3	KING BOLT	1
4	PINION CAP SCREW (XJ 174-350)	1
4	PINION SCREW (XJ 30-117 only)	1
5	CLAMP SCREW	1
6	WEDGE SCREW	1
8	CHUCK SCREW	1
10	GRIP SPRING LOCKNUT	1
11	LIMIT PIN	1
12	PLAIN WASHER	1
14	RETAINING RING	1
15	CUP WASHER	1
16	WEDGE BOTTOM	1
17	WEDGE TOP	1
18	CHUCK WASHER	1
20	WASHER (XJ 30-117)	4
20	WASHER (XJ 174-350)	2
21	SNAP RING	1
22	RETAINING RING, INTERNAL	1
23	RETAINING RING, INTERNAL	2
24	OIL SEAL	1
25	OIL SEAL	1
26	"O" RING	1
27	BALL BEARING	1

ITEM NO.	PART NAME	REQUIRED
28	OUTER RING & ROLLER ASSEMBLY } SOLD ONLY AS A SET	1
29	BEARING INNER RING } SOLD ONLY AS A SET	1
30	GEAR/PINION SETS } SOLD IN SETS ONLY	1
31	PINION } SOLD IN SETS ONLY	1
32	INTERNAL GEAR } SOLD IN SETS ONLY	1
33	CLAMP	1
34	CHUCK GRIP	1
35	MOTOR HANDLE	1
36	HOUSING	1
37	GRIP SPRING SPACER	1
38	DRIVE SHAFT	1
39	GRIP SPRING SET	2
40	VIBRATION PAD	1
41	MOTOR	1
42	MIXER SHAFT	1
43	HEX KEY WRENCH	1
44	IMPELLER	Per Order
45	SET SCREW	Per Order
46	MOTOR SHAFT KEY	1
47	WASHER (XJ 30-117 only)	1
48	LOCKWASHER (XJ 130-117 Only)	1
67	HEX HEAD CAP SCREW	4
68	LOCKWASHER	4
69	HEX NUT (XJ 30-117 only)	4
70	OIL SEAL } XJ 174 thru	1
71	SLINGER } 350 only	1

TABLE 4 RECOMMENDED TIGHTENING TORQUES FOR GRIP SPRING LOCKNUT

MODEL	XJ 30	XJ 43	XJ 65	XJ 87 XJ 117	XJ 174	XJ 230 XJ 350
Tightening Torque in Foot-Pounds	20	20	50	50	125	125

SERVICE RECORD

DATE INSTALLED _____ BY _____

LOCATION (Tank no., Etc. _____

PROCESS _____

RELOCATED	DATE	LOCATION
2.	_____	_____
3.	_____	_____
4.	_____	_____

MAINTENANCE SCHEDULE

REPACK	(Motor) LUBRICATE (Mixer)
_____	_____
_____	_____
_____	_____

OVERHAUL _____

_____

_____

_____

REPAIRS _____

_____

_____

_____

_____

_____

REMARKS _____

_____

_____

The Lightnin Guarantee

LIGHTNIN guarantees that in the case of a failure of any mixer, which you feel is our responsibility, we will repair or replace it to your satisfaction or we will refund the purchase price. This guarantee applies for the first full year you use your mixer, or 18 months after we ship it, whichever comes first.

Portable mixers were the very first Lightnin products back in 1923. We still occasionally discover an original model going strong after 50 years' service or more.

Every day, we see Lightnin Mixers operating continuously around the clock after 20 years or more. But that's how we build them. For years and years of non-stop mixing.

for prompt service call your LIGHTNIN® sales engineers

They can save you time and money and provide you with mixers and aerators guaranteed to do the job.

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Charleston, WV	304-422-4755	Philadelphia, PA	609-386-5104
Charlotte, NC	704-334-3700	Phoenix, AZ	602-275-3185
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100 Gallon Mix Tank

DREW INDUSTRIAL DIVISION **CONTROL, FEED AND TEST**

Neptune[1] Polyethylene Tanks

Description

Neptune polyethylene tanks are package units utilized for the storage of chemicals used in water treatment and process applications. These tanks are made of polyethylene with steel support legs and a pump-mounting platform. The tanks are available in various sizes to suit many applications. The standard equipment furnished with the tank includes:

- hinged cover
- steel tank support frame
- agitator bracket
- 1/2" PVC suction ball valve
- 1/2" PVC drain connection
- 1/2" PVC fittings & suction tubing
- 1/2" PVC strainer

Features

- Easy installation
- Heavy-duty construction
- Equipped as a complete tank system
- Available with premounted and prepiped pumps

Selection Guide

Model	Gallon Capacity	Order Code
50 PT	50	7838-01-6
100 PT	100	7886-01-5
167 PT	167	7887-01-3
260 PT	260	7888-01-1
500 PT	500	1485-01-1

[1] *Neptune is a registered trademark of Neptune Chemical Pump Co.*

Drew Industrial Division • One Drew Plaza, Boonton, New Jersey 07005 • Phone: (201) 263-7800 • Fax: (201) 263-4483

Odor Control System

CALGON

CALGON CARBON CORPORATION

EQUIPMENT BULLETIN

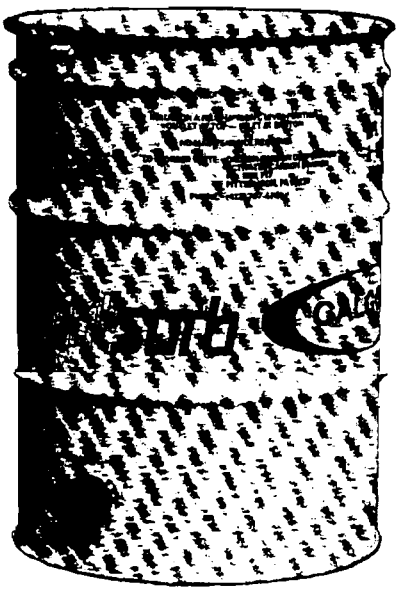
VENTSORB

GENERAL DESCRIPTION

VentSorb canisters – each containing 180 pounds of activated carbon – are ideal for low-flow air purification applications at industrial and municipal facilities. These economical adsorption systems control small volume organic contaminant and/or odorous gas emissions from:

- Storage tank vents
- Reactor vents
- API separator vents
- Sludge thickener tanks at waste treatment plants
- Sewer gas vents, wet stations and weir boxes at chemical and municipal waste treatment plants
- Chemical plant wastewater holding tanks
- Laboratory hood exhausts
- Landfills

The 55-gallon VentSorb canisters contain all the elements found in a full-scale adsorption system-vessel; activated carbon, inlet connection and distributor, and an outlet connection for the purified air stream. Air is distributed across the carbon bed with a corrosion-resistant stainless steel septum.



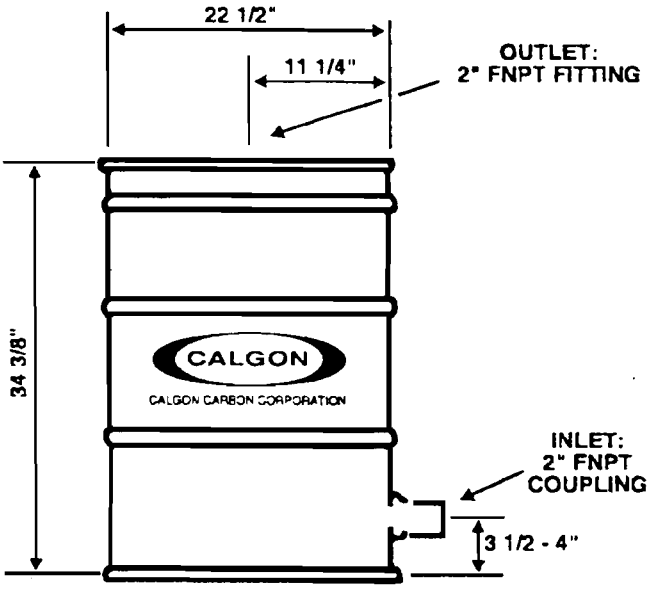
FEATURES AND BENEFITS

VentSorb canisters offer industrial and municipal users several important features and benefits, including:

- Effective treatment to remove a variety of vapor phase organic contaminants and odor-causing compounds.
- Continuous treatment at varying flow rates and concentrations.
- Simple installation and operation.
- Flexibility to be installed in series or multiple units in parallel.
- Supplied with the type of activated carbon selected specifically for the application.
- Practical disposal option, as pre-approved spent carbon canisters may be returned to Calgon Carbon for safe carbon reactivation.
- Low cost per unit makes carbon treatment economical.

VENTSORB SPECIFICATIONS

Vessel:	Open head 16 gauge steel canister
Max Operating Pressure:	4 psig
Cover:	Removable steel cover, 12 gauge bolt ring with polycord gasket
Internal Coating:	Heat cured 100% phenolic
External Coating:	High solids enamel
Temperature:	350°F (intermittent) (176.7°C)
Inlet:	2" FNPT: 304 stainless steel screen distributor
Outlet:	2" FNPT
Max Flow:	100 cfm (2.83 m³/min)
Carbon:	180 pounds Pellet BG or Type BPL 4x10 or Type IVP 4x6 (81.6kg)
Ship Weight:	240 pounds (108.8kg)



VENTSORB DIMENSIONS

LE-PGV-05/97

TYPICAL VENTSORB APPLICATIONS

Chemical, petrochemical, food, pulp and paper, and many other industrial plants – along with municipal sewage treatment facilities – are frequent users of VentSorbs for continuous control of vented emissions. Here are a few examples of user applications:

Storage Tank Vents – VentSorbs are widely used to control evaporative losses vented from storage tanks. Typically, these vapors are emitted during tank filling and emptying. In one application, a glycerin manufacturer is using the canisters to purify ambient air drawn into storage tanks during product transfer. The adsorption process helps prevent contamination of the company's glycerin product. The VentSorb units provide over six months of service for this application.

Reactor Vents – A pesticide manufacturer is using multiple VentSorbs on five reactor vessels to control trace amounts of odorous methylamine and diethylamine (which are by-products of a caustic scrubbing process). Each VentSorb unit handles a 30 cfm air stream containing 15 ppm of amine vapors. The units provide over three months of service for this application.

API Separator Vents – A major refinery is using VentSorb units to control odorous emissions from settling basins where oil is separated from wastewater that is discharged in condensate, blowdown or drain systems. For this application, air pollution control regulations. The air stream is pulled through two VentSorb units, operating in parallel configuration, at 100 cfm.

VENTSORB INSTALLATION

VentSorb canisters are shipped ready for installation. Each canister is self-supporting and should be placed on a level, accessible area as near as possible to the emission source. Installation is simple, requiring just a flexible hose or pipe to connect the vent to the 2-inch FNPT bottom inlet of the canister.

If the VentSorb will be vented directly to outside air, a U-shaped outlet pipe or rain hat – such as a pipe tee – is recommended to prevent precipitation from entering the unit.

VentSorb canisters operate from a continuous suction across the vent. The suction can be produced by a blower or by using the positive pressure inside the tank or process vessel. In many cases, the pressure or surge of pressure within the tank or vessel is sufficient to overcome the pressure drop across the canister – thus eliminating the need for a more information.

Maximum recommended air flow through a VentSorb is 100 cfm. If higher flows are encountered, plant operators should install two or more canisters in parallel configuration.

When VentSorb canisters are used to control vapors from organic solvent storage tanks, the following precautions are recommended:

- A safety relief valve must be provided. This protects the storage tank should the VentSorb become plugged or blocked in any fashion. Such a vent would open in this emergency situation, thereby relieving pressure.
- Under appropriate conditions, a flame arrestor and/or backflow preventer must be installed as shown in this bulletin's storage tank installation drawing. This prevents backflow of air through the VentSorb when the storage tank is empty.
- Pre-wetting the carbon helps dissipate excessive heat that may be caused by high organic compound concentration (>0.5 to 1.0 Vol. %).

Also, if VentSorb canisters are used to control organic emissions from airstrippers or other high moisture content air streams, Calgon Carbon recommends that humidity in the air stream be reduced to under 50 percent. Lower humidity optimizes adsorptive capacity of the carbon. In addition, for similar applications that generate a condensate, Calgon Carbon recommends installation of a drain on the inlet piping.

Four VentSorb units at a chemical plant are installed to operate in series and in parallel. More than 25 odorous and/or toxic vapors are controlled by 80 VentSorb units at this plant.

RETURN OF VENTSORBS

Arrangements should be made at the time of purchase regarding the future return of canisters containing spent carbon. Calgon Carbon will provide instructions on how to sample the spent carbon and arrange for carbon acceptance testing. The spent carbon is reactivated by Calgon Carbon and all of the contaminants are thermally destroyed. Calgon Carbon will not accept VentSorbs for landfill, incineration or other means of disposal.

No VentSorbs can be returned to Calgon Carbon unless the carbon acceptance procedure has been completed, an acceptance number provided, and the return labels (included with the units at the time of purchase) are attached.

VentSorbs must be drained – and inlet/outlet connections must be plugged – prior to return to Calgon Carbon.

THEORETICAL VENTSORB CAPACITIES

Theoretical Ventsorb Capacity Lb Adsorbed/VentSorb*

	BOILING POINT/°C	MOLECULAR WEIGHT	10 PPM	100 PPM	1,000 PPM
Acrylonitrile	77.3	53.1	6	12	24
Benzene	80.1	78.1	14	23	36
n-Butane	-0.5	58.1	4	8	13
Carbon Tetrachloride	76.8	153.8	40	56	76
Dichioroethylene	37.0	97.0	12	21	35
Methylene	40.2	84.9	3	7	18
Freon 114	3.8	170.9	11	19	33
n-Hexane	68.7	86.2	18	25	34
Styrene	145.2	104.1	45	57	71
Toluene	110.6	92.1	34	44	58
Trichloroethylene	87.2	131.4	33	50	73

* Theoretical capacity based on 70 degrees F., atmospheric pressure, less than 50 percent humidity and 180 pounds of carbon using isotherm data for Pellet BG carbon.

VENTSORB CARBON LIFE ESTIMATE

This table lists the theoretical adsorption capacities for several compounds. The adsorption capacity for nonpolar organics increases with the boiling point, molecular weight and concentration of the air contaminant. Estimate the life of a VentSorb canister for other organic compounds by matching them with compounds of similar boiling point and molecular weight in this table. Low molecular weight (less than 50) and/or highly polar compounds such as formaldehyde, methane, ethanol, etc., will not be readily adsorbed at low concentrations.

Note: The standard VentSorb canister contains 180 pounds of Pellet BG carbon. When removing hydrogen sulfide and mercaptans from moist air vented from sewage operations, greater efficiency will be achieved by using a VentSorb canister which contains specially impregnated Type IVP carbon. A VentSorb containing IVP carbon can remove up to 40 pounds of hydrogen sulfide and 15 pounds of methyl

VENTSORB SAFETY CONSIDERATIONS

While complying with recommended installation instructions, plant operators should also be aware of these additional heat-related safety considerations:

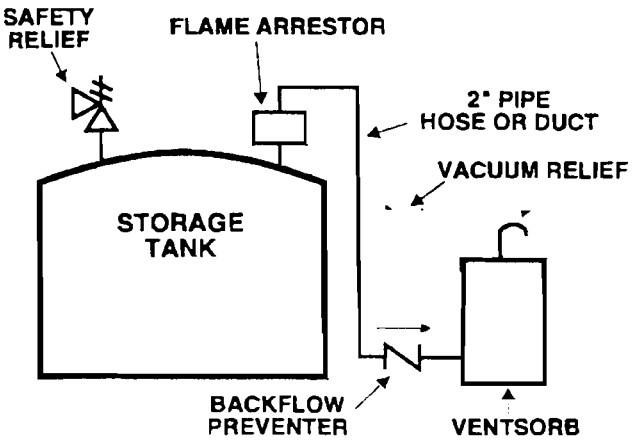
1. When contacting with activated carbon, some types of chemical compounds – such as those from the ketone and aldehyde families and some organic acids or organic sulfur compounds – may react on the carbon surface causing severe exotherms or temperature excursions. **If you are unaware or unsure of the reaction of an organic compound on activated carbon, appropriate tests should be performed before putting a VentSorb in service.**

2. Heat of adsorption can lead to severe temperature excursions at high concentrations of organic compounds. Heating may be controlled by diluting the inlet air, time weighting the inlet concentration to allow heat to dissipate, or pre-wetting the carbon.

3. **Do not use VentSorbs with Type IVP carbon in petrochemical or chemical industry applications.**

4. Type IVP carbon can liberate heat by reacting chemically with oxygen. To prevent heat within a vessel, the carbon must not be confined without adequate air flow to dissipate the heat. In situations where there is insufficient or disrupted air flow through the vessel, the chemical reaction can be prevented by sealing the inlet and outlet connections to the vessel.

NOTE: CONTACT YOUR LOCAL CALGON CARBON TECHNICAL SALES REPRESENTATIVE FOR CLARIFICATION OR TO ANSWER ANY QUESTIONS.



Typical VentSorb Installation at Storage Tank

CALGON CARBON AIR PURIFICATION SYSTEMS

VentSorb is a unit specifically designed for a variety of small applications. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a greater range of flow rates and carbon usages to meet specific applications.

WARRANTY

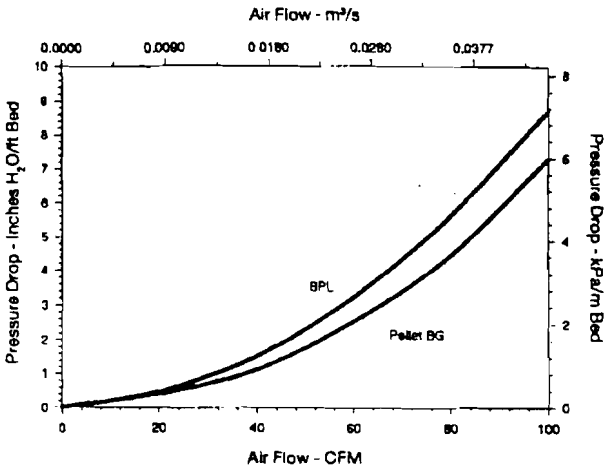
There are no expressed or implied warranties – or any warranty of merchantability or fitness – for a particular purpose associated with the sale of this product.

LIMITATION OF LIABILITY

The Purchaser's exclusive remedy for any cause of action arising out of purchase and use of the VentSorb, including but not limited to breach of warranty, negligence and/or indemnification, is expressly limited to a maximum of the purchase price of the VentSorb unit as sold. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall Calgon Carbon Corporation for any reason be liable for incidental or consequential damages, damages in excess of the purchase price of the VentSorb unit, loss of profits or fines imposed by Governmental agencies.

Application information provided in this bulletin is based upon theoretical data. Calgon Carbon Corporation assumes no responsibility for the use of the information in this product bulletin.

VENTSORB PRESSURE DROP

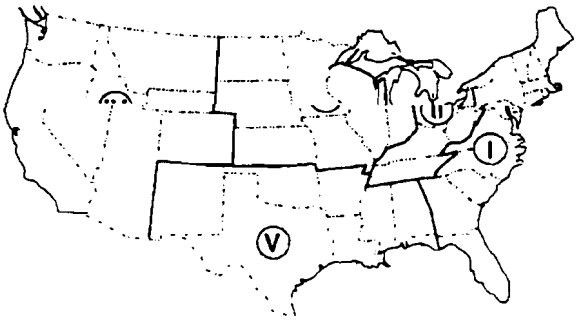


Pressure drop through a VentSorb unit is a function of the process air flow as shown in the graph. A VentSorb canister can handle up to 100 cfm at a pressure drop of less than 15 inches water column. If higher flows or lower pressure drop is needed, multiple canisters may be installed in parallel operation. The maximum canister pressure should not exceed 4 psig.

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999.

For detailed information on the products described in this bulletin, please contact one of our Regional Sales Offices located nearest to you:

1-800-4-CARBON



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Tel (412) 787-6700
1-800-4-CARBON
Fax (412) 787-6676

Region III
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Tel (630) 505-1933
Fax (630) 505-1936

Region IV
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Fax (510) 412-5660

Region V
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Fax (713) 690-7909

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Calgon Carbon Corp
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Fax (65) 221-3554

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Europe
Chemviron Carbon
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Tel (905) 857-9915
Fax (905) 857-9984

Latin America/Australasia/ Philippines
Pittsburgh, PA
Tel (412) 787-4519
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Calgon Carbon Corporation's activated carbon products are continuously being improved and changes may have taken place since this publication went to press.

CALGON
CALGON CARBON CORPORATION

CALGON

CALGON CARBON CORPORATION

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PO BOX 717-0717
PITTSBURGH PA 15230
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800-422-7266
Fax: 412-787-6324

PRICING
VENTSORB CANISTER
NON-RETURNABLE AND RETURNABLE

NON-RETURNABLE	1 to 3	4 to 9	10 to 29	30 or MORE
VENTSORB PELLETBG	$ 550	$ 520	$ 495	$ 485
VENTSORB VPR4X10	490	470	450	435
VENTSORB BPL4X10	679	640	600	585
VENTSORB IVP4X10	975	935	895	840
VENTSORB CENTAUR4X6	830	785	750	720
VENTSORB FCA4X10[1]	1,065	1,015	995	945

NOTE: [1]These goods cannot be exported without the permission of the United States Government.

RETURNABLE	1 to 3	4 to 9	10 to 29	30 or MORE
VENTSORB PELLETBG	$ 650	$ 620	$ 595	$ 585
VENTSORB VPR4X10	650	620	595	535
VENTSORB BPL4X10	779	740	700	685
VENTSORB CENTAUR4X6	930	885	850	820

Carbon Acceptance Fee

Prior to return of a unit for reactivation, we are required to sample the spent carbon to ensure a safe reactivation process. This is a one-time per site per application charge.

Non-RCRA Acceptance $400
RCRA Acceptance $1,000

Carbon Acceptance testing will take approximately 3-4 weeks once the sample and paperwork are received by Calgon Carbon Corporation.

The above prices are F.O.B. Pittsburgh, PA 15225.
Pricing excludes any applicable taxes.
Terms are net 30 days.

Effective 05-01-97

Blower

70-6100
F2-205 9/93
AK811 Rev.F

Post Office Box 97
Benton Harbor, MI. 49023-0097
Ph: 616/926-6171
Fax: 616/925-8288

INSTALLATION AND OPERATING INSTRUCTIONS FOR GAST HAZARDOUS DUTY REGENAIR BLOWERS

This instruction applies to the following models ONLY: R3105N-50, R4110N-50, R4310P-50, R4P115N-50, R5125Q-50, R5325R-50, R6130Q-50, R6P155Q-50, R6340R-50, R6P355R-50 and R7100R-50.

Gast Authorized Service Facilities are Located in the locations listed below

Gast Manufacturing Corporation
505 Washington Avenue
Carlstadt, N. J. 07072
Ph: 201/933-8484
Fax: 201/933-5545

Gast Manufacturing Corporation
2300 Highway M-139
Benton Harbor, MI. 49022
Ph: 616/926-6171
Fax: 616/925-8757

Brenner Fiedler & Associates
13824 Bentley Place
Cerritos, CA. 90701
Ph: 310/404-2721
Ph: 800/843-5558
Fax: 213/404-7975

Wainbee Limited
215 Brunswick Blvd.
Pointe Claire, Quebec
Canada H9R 4R7
Ph: 514/697-8810
Fax: 514/-697-3070

Wainbee Limited
5789 Coopers Ave.
Mississauga, Ontario
Canada L4Z 3S6
Ph: 416/213-7202
Fax: 416/213-7207

Japan Machinery
Central PO Box 1451
Toyko 100-91, Japan
Ph: 813 3573-5421
Fax: 813 3571-7896

Gast Manufacturing Co. Ltd.
Knaves Beech Business Centre
Loudwater, High Wycombe
Bucks, England HP10 9SD
England
Ph: 0628 532600
Fax: 0628 532470

OPERATING AND MAINTENANCE INSTRUCTIONS

SAFETY

This is the safety alert symbol. When you see this symbol personal injury is possible. The degree of injury is shown by the following signal words:

⚠ DANGER Severe injury or death will occur if hazard is ignored.

⚠ WARNING Severe injury or death can occur if hazard is ignored.

⚠ CAUTION Minor injury or property damage can occur if hazard is ignored.

Review the following information carefully before operating.

GENERAL INFORMATION

This instruction applies to the following models ONLY: R3105N-50, R4110N-50, R4310P-50, R4P115N-50, R5125Q-50, R5325R-50, R6130Q-50, R6P155Q-50, R6340R-50, R6P355R-50 and R7100R-50. These blowers are intended for use in Soil Vapor Extraction Systems. The blowers are sealed at the factory for very low leakage. They are powered with a U.L. listed electric motor Class 1 Div. 1 Group D motors for Hazardous Duty locations. Ambient temperature for normal full load operation should not exceed 40° C (105° F). For higher ambient operation, contact the factory.

Gast Manufacturing Corporation may offer general application guidance: however, suitability of the particular blower and/or accessories is ultimately the responsibility of the user, not the manufacturer of the blower.

INSTALLATION

⚠ *DANGER Models R5325R-50, R6130Q-50, R6340R-50, R5125Q-50, R6P155Q-50, R6P355R-50 AND R7100R-50 use Pilot Duty Thermal Overload Protection. Connecting this protection to the proper control circuitry is mandated by UL674 and NEC501. Failure to do so could/ may result in a EXPLOSION. See pages 3 and 4 for recommended wiring schematic for these models.*

⚠ *WARNING Electric shock can result from bad wiring. A qualified person must install all wiring, conforming to all required safety codes. Grounding is necessary.*

⚠ *WARNING This blower is intended for use on soil vapor extraction equipment. Any other use must be approved in writing by Gast Manufacturing. Corp.* Install this blower in any mounting position. Do not block the flow of cooling air over the blower and motor.

PLUMBING - Use the threaded pipe ports for connection only. They will not support the plumbing. Be sure to use the same or larger size pipe to prevent air flow restriction and overheating of the blower. When installing fittings, be sure to use pipe thread sealant. This protects the threads in the blower housing and prevents leakage. Dirt and chips are often found in new plumbing. Do not allow them to enter the blower.

NOISE - Mount the unit on a solid surface that will not increase the sound. This will reduce noise and vibration. We suggest the use of shock mounts or vibration isolation material for mounting.

ROTATION - The Gast Regenair Blower should only rotate clockwise as viewed from the electric motor side. The casting has an arrow showing the correct direction. Confirm the proper rotation by checking air flow at the IN and OUT ports. If needed reverse rotation of three phase motors by changing the position of any two of the power line wires.

OPERATION

⚠ *WARNING Solid or liquid material exiting the blower or piping can cause eye damage or skin cuts. Keep away from air stream.*

⚠ *WARNING - Gast Manufacturing Corporation will not knowingly specify, design or build any blower for installation in a hazardous, combustible or explosive location without a motor conforming to the proper NEMA or U. L. standards.* Blowers with standard TEFC motors should never be utilized for soil vapor extraction applications or where local state and/or Federal codes specify the use of explosion-proof motors (as defined by the National Electric Code, Articles 100,500 c1990).

⚠ *CAUTION Attach blower to solid surface before starting to prevent injury or damage from unit movement.* Air containing solid particles or liquid must pass through a filter before entering the blower. Blowers must have filters, other accessories and all piping attached before starting. Any foreign material passing through the blower may cause internal damage to the blower.

⚠ *CAUTION Outlet piping can burn skin. Guard or limit access.* Mark *"CAUTION Hot Surface. Can Cause Burns"* Air temperature increases when passing through the blower. When run at duties above 50 in. H_2O metal pipe may be required for hot exhaust air. The blower must not be operated above the limits for continuous duty. Only models R3105N-50, R4110N-50 and R4310P-50 can be operated continuously with no air flowing through the blower. Other units can only be run at the rating shown on the model number label. Do not Close off inlet (for vacuum) to reduce extra air flow. This will cause added heat and motor load. Blower exhaust air in excess of 230°F indicates operation in excess of rating which can cause the blower to fail.

ACCESSORIES ...Gast pressure gauge AJ496 and vacuum gauges AJ497 or AE134 show blower duty. The Gast pressure/vacuum relief valve, AG258, will limit the operating duty by admitting or relieving air. It also allows full flow through the blower when the relief valve closes

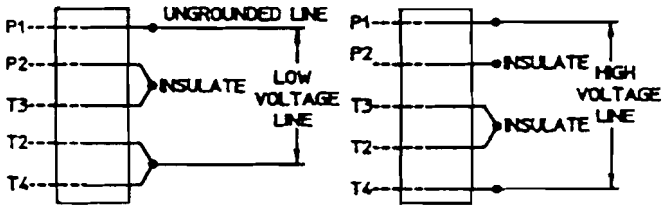
SERVICING

⚠ *WARNING* ***To retain their sealed construction they should be serviced by Gast authorized service centers ONLY.*** These models are sealed at the factory for very low leakage.

⚠ *WARNING* ***Turn off electric power before removing blower from service. Be sure rotating parts have stopped. Electric shock or severe cuts can result.*** Inlet and exhaust filters attached to the blower may need cleaning or replacement of the elements. Failure to do so will result in more pressure drop, reduced air flow and hotter operation of the blower. The outside of the unit requires cleaning of dust and dirt. The inside of the blower also may need cleaning to remove foreign material coating the impeller and housing. This should be done at a Gast Authorized Service Center. This buildup can cause vibration, failure of the motor to operate or reduced flow.

KEEP THIS INFORMATION WITH THIS BLOWER. REFER TO IT FOR SAFE INSTALLATION, OPERATION OR SERVICE.

MOTOR WIRING DIAGRAM FOR R4110N-50 & R3105N-50

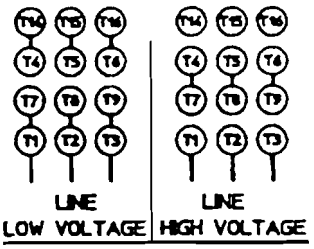


>>* WARNING

THIS MOTOR IS THERMALLY PROTECTED AND WILL AUTOMATICALLY RESTART WHEN PROTECTOR RESETS. ALWAYS DISCONNECT POWER SUPPLY BEFORE SERVICING.

MOTORS WIRING DIAGRAM FOR R4310P-50

TO REVERSE ROTATION. INTERCHANGE THE EXTERNAL CONNECTIONS TO ANY TWO LEADS.

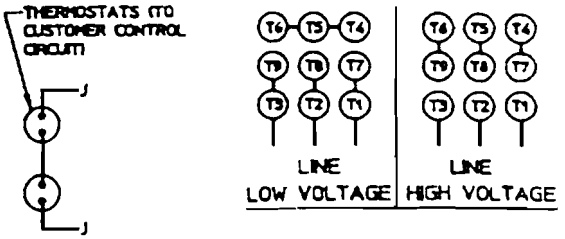


>>* WARNING

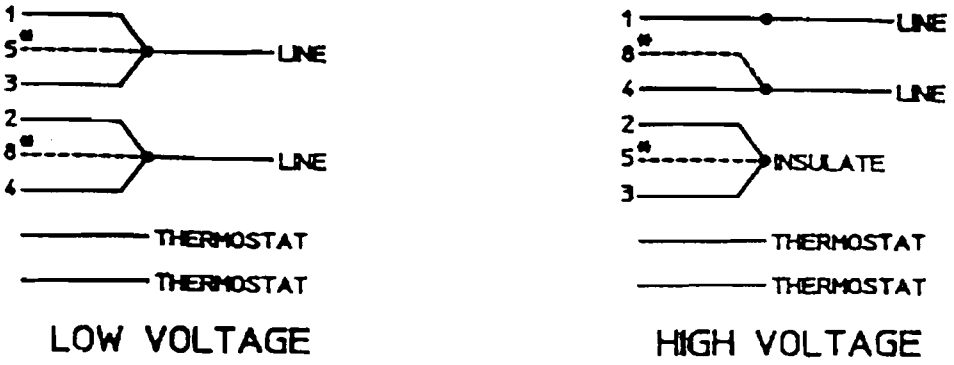
THIS MOTOR IS THERMALLY PROTECTED AND WILL AUTOMATICALLY RESTART WHEN PROTECTOR RESETS. ALWAYS DISCONNECT POWER SUPPLY BEFORE SERVICING.

MOTORS WIRING DIAGRAM FOR R5325R-50, R6340R-50, R6P355R-50, & R7100R-50

TO REVERSE ROTATION. INTERCHANGE THE EXTERNAL CONNECTIONS TO ANY TWO LEADS.



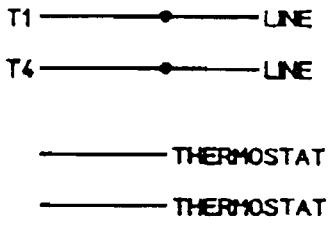
MOTOR WIRING DIAGRAM FOR RS125Q-50 & R4P115N-50



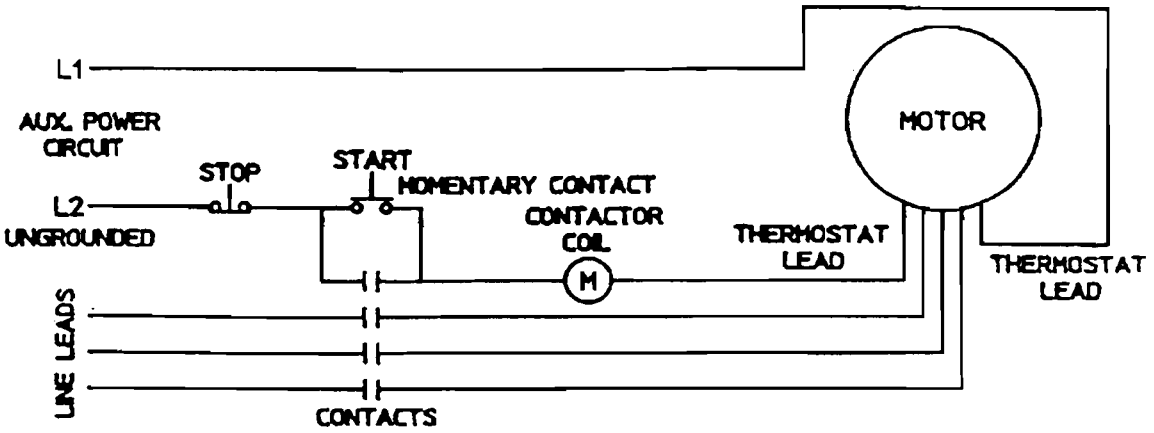
* RS125Q-50 BLOWERS PRODUCED AFTER SEPTEMBER 1992 (SER. NO. 0992) DO NOT HAVE MOTOR LEADS 5 & 8.

MOTOR WIRING DIAGRAM FOR R6130Q-50 & R6P155Q-50

CONNECT THERMOSTAT TO MOTOR PROTECTION CIRCUIT



CONNECTION FOR THERMOSTAT MOTOR PROTECTION



TERMOSTATS TO BE CONNECTED IN SERIES WITH CONTROL AS SHOWN. MOTOR FURNISHED WITH AUTOMATIC THERMOSTATS RATED A.C. 115-600V. 720VA CIRCUIT SHOWN IS FOR 3 PHASE MOTOR. SINGLE PHASE MOTOR HAS TWO LINE LEADS IN THE ABOVE CIRCUIT.

Autodialer

Verbatim™

Owner's Manual

SINCE 1948

RACO

REMOTE ALARMS AND CONTROLS

Warranty

RACO Manufacturing and Engineering Co. Inc., Emeryville, California warrants this product to be in good working order for a period of five years from date of purchase as a new product. In the event of failure of any part(s) due to defect in material or workmanship occurring within that five year period, RACO will, at it's option repair or replace the product at no charge for parts or labor.

Any alteration of the product without instruction from RACO's Engineering Department will automatically void this warranty. If alterations of the unit are authorized by RACO, please complete the authorization form in the Owners Manual and return the form to RACO to ensure the warranty. Under no circumstances will RACO be responsible for consequential or secondary damages.

The defective product should be returned, insured and freight prepaid, securely packaged to the address listed below. Please include a copy of your sales receipt, the dialers serial number, and a detailed description of the problem you are experiencing.

RACO Manufacturing and Engineering Co. Inc.
Service Department
1400 62nd Street
Emeryville, CA 94608

Copyright

Disclaimer

Every effort has been made to ensure the accuracy of this document. However, RACO Manufacturing and Engineering Co. assumes no responsibility for its use or any third party action as that may result from its use.

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RACO is a registered trademark of RACO Manufacturing & Engineering, Co.

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1400 62nd Street, Emeryville, CA 94608
(510) 658-6713
1-800-722-6999
FAX # 1-510-658-3153

1 Overview

1.1 Product Description

The Verbatim™ autodialer functions as a remote alarm monitor, typically monitoring critical facilities which are not staffed 24 hours a day.

The Verbatim autodialer may be factory configured for different input and output configurations. Your Verbatim may have as many as 32 discrete inputs, 16 analog inputs, 8 digital outputs and 96 Remote Channels. The minimum configuration of the Verbatim autodialer monitors 4 internal input channels.

The internal inputs are sometimes called Physical Channels (PCs). PCs monitor user-supplied external sensors such as float switches, limit switches, etc. Sensors connected to discrete inputs are usually dry (non-powered), isolated contacts which close or open to indicate the sensed condition. In most cases, the outputs of logic controllers may be connected directly to Physical Channel inputs without the need for interfacing relays or other signal conditioning.

Remote Channels (RCs) do not directly connect to sensors. RCs monitor PLC I/O and data table locations as defined by the user. RC data is kept current by the Verbatim constantly making queries to PLC data registers over the industrial network connection.

An alarm condition can be indicated by change at a sensor, by new data from a Remote Channel (RC), or by loss of AC power. When an alarm occurs, the Verbatim accesses the standard phone line to which it is connected, dials the appropriate phone numbers and delivers the user's own pre-recorded voice message corresponding to those particular alarm conditions that are currently active.

Dialing continues repeatedly through the entire list of up to 16 programmed phone numbers, until the alarm is acknowledged by touch tone command or by calling the Verbatim autodialer back.

The Verbatim autodialer incorporates many flexible, voice-supported programming and message recording options, to meet a wide range of user requirements. Yet, in most cases, the user may rely on pre-existing default programmed parameters, greatly simplifying programming. Even default voice alarm messages are provided.

Note:

All user programming except access code and voice message recording may be entered, reviewed or changed either from the front panel or from a remote telephone at any time. Thus, installation and programming may easily be done by separate personnel at separate times.

Most programming is entered in the form of 3-digit codes as described in this manual. All user programming, including recorded messages, is maintained in permanent non-volatile memory.

The Verbatim autodialer incorporates extremely thorough and effective electrical surge protection and overall rugged construction, to deliver reliable operation under real-world conditions.

1.2 Manual Description

This manual guides you through the following procedures:

- Location and mounting
- Initial programming
- Configuring Remote Channels to monitor PLCs
- Voice message recording
- Using Your Verbatim autodialer
- Advanced programming

A glossary explaining the terms used in this manual is included the end of the manual, along with a troubleshooting guide, an index, a return authorization form, and FCC notice to users.

Worksheets are provided to document and clarify your programming and message recording steps.

Please take a moment to read, complete, and mail the warranty registration card at the back of this manual.

1.2.2 Conventions

Throughout this manual various icons are used to visually identify information. They are as follows:

- ◆ The solid diamond symbol shows a list of procedures, decisions, or single step tasks.
- The bullet symbol shows a list of items.

The bomb indicates a warning message. The information concerns process that may result in damage to equipment or harm to a person.

The hand indicates a caution message. The information concerns a process that may result in equipment failure.

The pencil indicates general information.

The open diamond pattern indicates one or more exceptions or special considerations for a process.

The phone indicates that you can access the Verbatim autodialer through your phone.

Other icons include button or keys on the Verbatim autodialer front panel.

"items in quotes"	Quotation marks indicate titles of sections and messages.
italic	Italic text indicates items for emphasis, message text, and sample text.
ALL CAPITALS	Capital letters reference the names of keys, lights, and LEDs.
Initial Capital Letters	Capitalization of the first letter of a set of words indicates mode and function types.

2 Installation

This section describes how to install the Verbatim autodialer and how to install a parallel printer to use the Parallel Printer Local Data Logging feature.

2.1 Location and Mounting

Choose a mounting location which is not exposed to condensing humidity or temperatures beyond the limits of 20°-130°F. This location should ideally be within 5 feet of a standard RJ-11 phone jack and a *grounded* 120 VAC power outlet.

1. Mount the Verbatim autodialer on centers of 6" x 11 3/8" using the external mounting ears on the enclosure. #10 or 3/16" bolt sizes are best.
2. Install the NEMA 4X weatherproof outer enclosure, (optional purchase).

   This allows the Verbatim autodialer to be mounted outdoors as long as temperature limits are not violated. It is best to provide at least an overhead shelter to minimize direct precipitation and solar heating effects.
3. Install the heater/thermostat for cold or humid environments, (optional purchase).

   The 120 VAC heater dissipates 75 watts, providing a temperature rise of approximately 30 degrees, or 60 degrees when enclosed in the optional NEMA 4X enclosure.

2.2 Wiring

Refer to the diagram on page 2-3 for an example of the wiring connections.

1. Inspect and remove any foreign materials which might create short circuits.
2. Connect the red (positive) battery lead to the positive terminal on the gel-cell battery.
3. Plug the power cord into a *grounded* 120 VAC *outlet.*

   Or, remove the power cord from the Verbatim autodialer and install well-grounded 120 VAC power to terminal strip TS3, located on the lower right of the main circuit board.

If there are any green grounding wires in place on TS3 originating from plug-in expansion cards, leave those green grounding wires in place on the terminal marked GRN (Green). If the Verbatim autodialer turns on when power is applied, turn it off with the red POWER ON/OFF key.

4. Connect dry (unpowered) contacts to the terminal strip connection points.

   The connection point for basic four-channel units is terminal strip TS1, located on the lower left of the main circuit board. Note that there are four common return terminals marked "C"; any combination of these internally grounded terminals may be used. Terminal strip TS1 may be unplugged for convenience. All terminal points are screw clamp type, eliminating the need for wire termination lugs.

   The contact input wires should ideally be light (18 to 24 gauge) signal wire rather than heavy power wire. This reduces problems of bulk and stiffness.

5. If your unit has 8 or more inputs, the VX32 Channel Expansion Card should be plugged into connector J4.

   If your unit has this card installed, then use TS1 for common return connections only, and connect one side of each contact to the appropriately marked channel input number on the VX32 card. Leave TS1 terminals 1,2,3 and 4 disconnected.

Notes:

- The common *return* side of the contacts will need to be consolidated into not more than four wires coming into the TS1 terminals marked "C".
- Route the wires to the VX32 card so that they do not protrude above the top of the card, other wise they will interfere with the front panel board when the door is closed.
- Terminal strip TS1, and the terminal strips on the VX32 card if any, are not removable terminal blocks. Be sure that the terminal strips do not become unplugged due to wires being stressed when the door is closed.

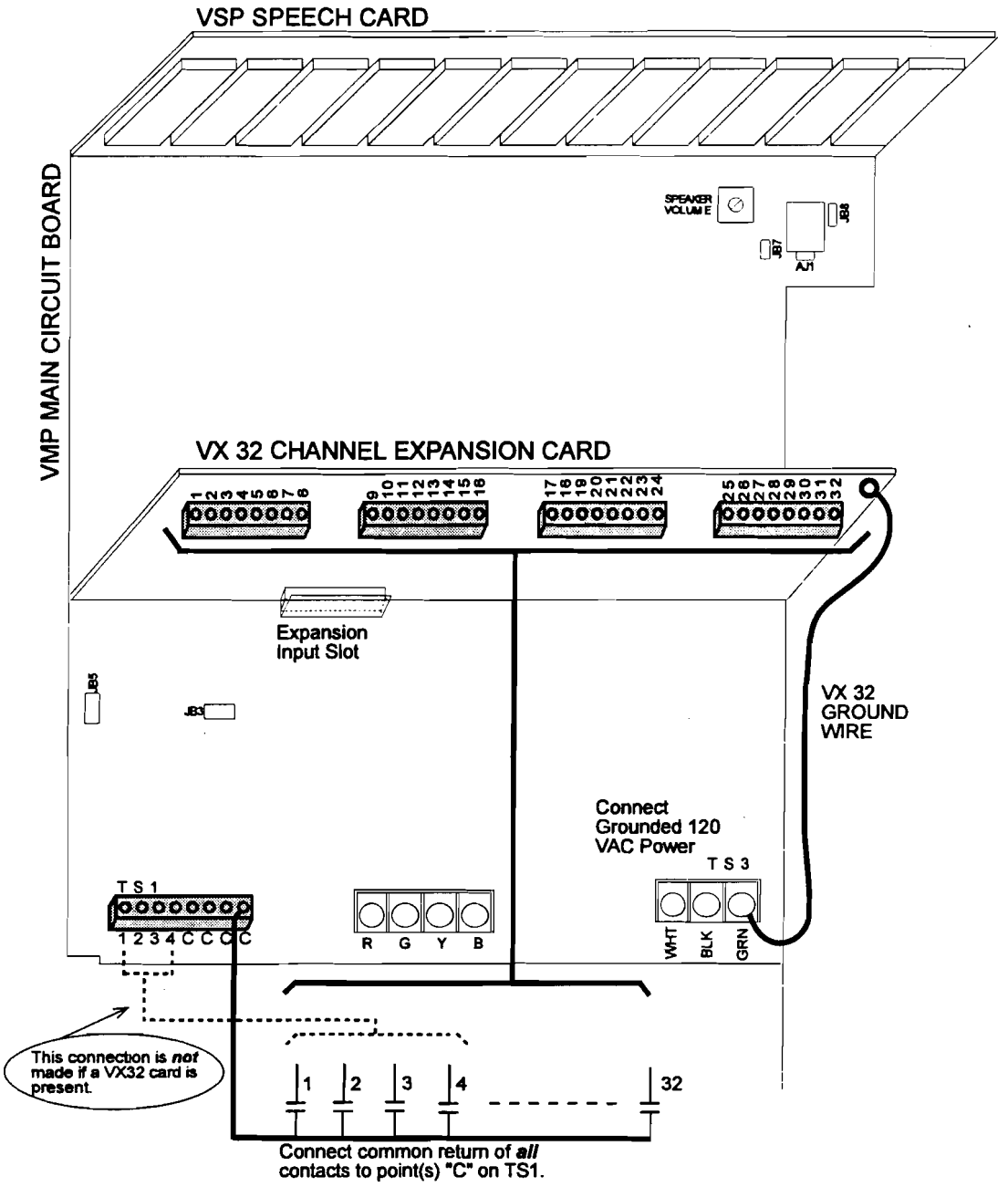
Caution:

NO 120 VAC INPUT CIRCUITS! Please verify that the circuits you connect to these inputs are "dry" (unpowered) and are ***not*** directly connected to 120 VAC power. Connecting such circuits will damage the unit.

Exception:

If your inputs are coming from a logic controller with TTL, CMOS or 5-volt DC logic outputs, direct connection may be made as long as the controller has the same electrical ground as the Verbatim autodialer.

Electrical Connection Diagram For Dry Contact Inputs



The common returns for all inputs are connected to TS1 terminals marked "C". These four "C" terminals are connected together and to electrical ground.

4 Channel Verbatim: Connect one side of each contact to the corresponding numbered terminals on TS1. The other side of each contact connects to the common return (the "C" terminals on TS1).

8 Or More Channel Verbatim: Connect one side of each contact to the corresponding numbered terminals on the VX32 expansion card. Connect the other side of each contact to the common return (the "C" terminals on TS1 of the main board). Note that TS1 terminals 1 through 4 are not used in this case.

2.3 Installing the Parallel Printer

The Verbatim Parallel Printer Local Data Logger feature will print reports on a local printer which is connected via a standard parallel interface. The local printer will automatically print out each action that occurs; e.g., alarms, acknowledgments, programming entries, inquiry calls, etc. You can cause a printout, upon command, at any time. Also, you may program the Verbatim for automatic printout of all input conditions at regular intervals. A time/date stamp will be included with each printed item.

You will need to:

- Connect the parallel printer to the Verbatim front panel using the RACO PPC-1 cable (or equivalent).
- Set the time and date so that each printout will be accompanied by the proper time and date stamp.

2.3.1 Installing the Printer Cable

Note:

If you ordered the Verbatim Parallel Printer Port Adapter Cable from RACO at the time you ordered your Verbatim autodialer it should already be properly installed. (The cable may be ordered from RACO using the part # VPPC-1.) You may also use an identically wired cable from a separate source. If you wish to acquire or fabricate the cable yourself, please refer to the, *"VPPC-1 Serial Cable Connection Diagram,"* in Appendix G.

The front panel circuit board must show a designation of VFP4 or higher. Also, the firmware version for the program chips U3 and U4 (on the main circuit board) must be V2.01 or higher. If your hardware does not conform to these revision levels contact your RACO Sales Representative about getting the proper upgrade modules.

The VPPC-1 cable attaches to the front panel circuit board where the mating pins protrude, just inside the front door of the Verbatim . Orient the connector so the cable's Pin 1 index (a red stripe on the cable or an arrow on the connector) is near the corner of the front panel board. The cable extends out of the Verbatim chassis and overlaps the lower chassis wall at the bottom of the chassis. When the front door of the Verbatim is closed the flat ribbon cable will be safely folded around the lower wall of the Verbatim chassis.

At the other end of the VPPC-1 cable is a standard "Centronics" style 36 pin connector. This 36 pin connector is the proper gender to mate with the data connector on the back of your parallel printer. However, if the printer cannot be located within the three-foot length of the VPPC-1 cable, install a standard

"Centronics" parallel printer extension cable (male on one end, female on the other). The extension cable extends from the end of the VPPC-1 cable to the printer.

Note:

The maximum length of the printer extension cable should be no greater than 10 feet. If you need to extend the printer greater than 10 feet from the Verbatim please consider ordering the RACO Serial Local Data Logger Option. Serial interfaces may be extended to a few hundred feet if necessary. Furthermore, if a serial interface is used together with special "line driver" devices, the printer cable may be extended for thousands of feet.

2.3.2 Load Paper and Place Printer On line

The printer must be properly loaded with paper and be on line in order for the Verbatim to print reports. (Some printers have a button labeled "select" rather than "on line.") If the printer runs out of paper or is taken off line, printing will cease immediately. A limited amount of printout data can be saved in the Verbatim internal print buffer while the printer is off line or out of paper. The size of the Verbatim printer buffer depends on several factors such as which Verbatim options are configured (i.e., analog, RSC, PLC interface, etc.). If the printer is off line or out of paper, printout data is sent to the Verbatim buffer each time it would otherwise be printed on the printer. Once the amount of data sent to the buffer exceeds the size of the buffer, printout items will continue to be copied to the buffer but will begin to overwrite buffered data. The printer buffer "wraps" around and new printout data is copied over the oldest printout data.

It is possible that no data will be lost while your printer is out of paper or off-line if you manage to restore the printer to operation before the Verbatim buffer "wraps." Then as soon as the printer is restored to operation, the Verbatim sends the buffered reports to the printer. (Note that the date/time stamp eventually printed will show the time and date of the event; not the time and date of the printing activity.)

2.3.3 Programming Time and Date

Time and date may be entered or changed with the following programming code entries:

- To check the date:

  9 4 1 ENTER

- To set the date:

  9 4 1 MM DD YY DW ENTER

MM is the month (01 for January, etc.), DD is the day of the month (07 for the 7th day of the month, YY is year (93 for 1993) and DW is the day of the week (1 for Sunday, 2 for Monday, etc.) Entry of the DW is optional.

- To check the time:

  9 4 2 ENTER

- To set the time:

  9 4 2 HH MM SS ENTER

HH are the hours in 24 hour format (13 for 1 PM), MM for minutes (don't forget the leading zeros) and SS is the seconds. Entry of SS is optional.

- To clear the time and date back to a default time and re-initializes the real-time clock chip:

  935 7 ENTER

Note:

The preceding operation should only be necessary if the real-time clock chip has been added or replaced in the field.

2.3.4 Printout at Regular Intervals

The Verbatim autodialer may be programmed to automatically log (print on the printer) all input conditions at regular intervals, by entering the following code:

943 XXX.X ENTER

where XXX.X is the desired printing interval in hours, from 0.1 to 999.9 The first such printout will occur when the period elapses, rather than immediately upon programming.

- To check the presently programmed printing interval enter the following code:

  943 ENTER

- To turn off the regular interval printing function enter the following code:

  943 0 ENTER

- To immediately print a record of all current user programming enter the following code:

  944 ENTER

2.3.5 Turning Off the System With a Printer

Some parallel printers tend to "leak" electrical current through the parallel interface into the Verbatim when it is powered off, resulting in the Verbatim not remaining turned off. It is possible that a few seconds after powering off the Verbatim it will turn itself back on again. To remedy this condition simply turn off the printer whenever turning off the Verbatim .

3 Programming and Testing

3.1 Starting Up and Clearing the Unit

Basic set-up and testing of the Verbatim involves:

- Program at least one phone number.
- Program the input channels to reflect alarm conditions.
- Test the alarm conditions to be sure witing and programming are correct.
- Record voice messages, trip delays and other programming as desired.

All programming operations must be done with the unit in the Program mode.

1. To put the Verbatim autodialer in the Program mode, press PROGRAM.

   Program mode is indicated by the lighted PROGRAM LED.

Note:

Before you begin programming the Verbatim for your monitoring application it is best to first clear the unit's memory of any old programming. This step also ensures that memory corruption, which might have occurred during shipment or due to anomalous power distrubances, will be wiped away. See Step 2 below.

Caution:

The following step erases all user programming including recorded messages so normally it is done only at initial start-up.

2. To clear the system memory, press:

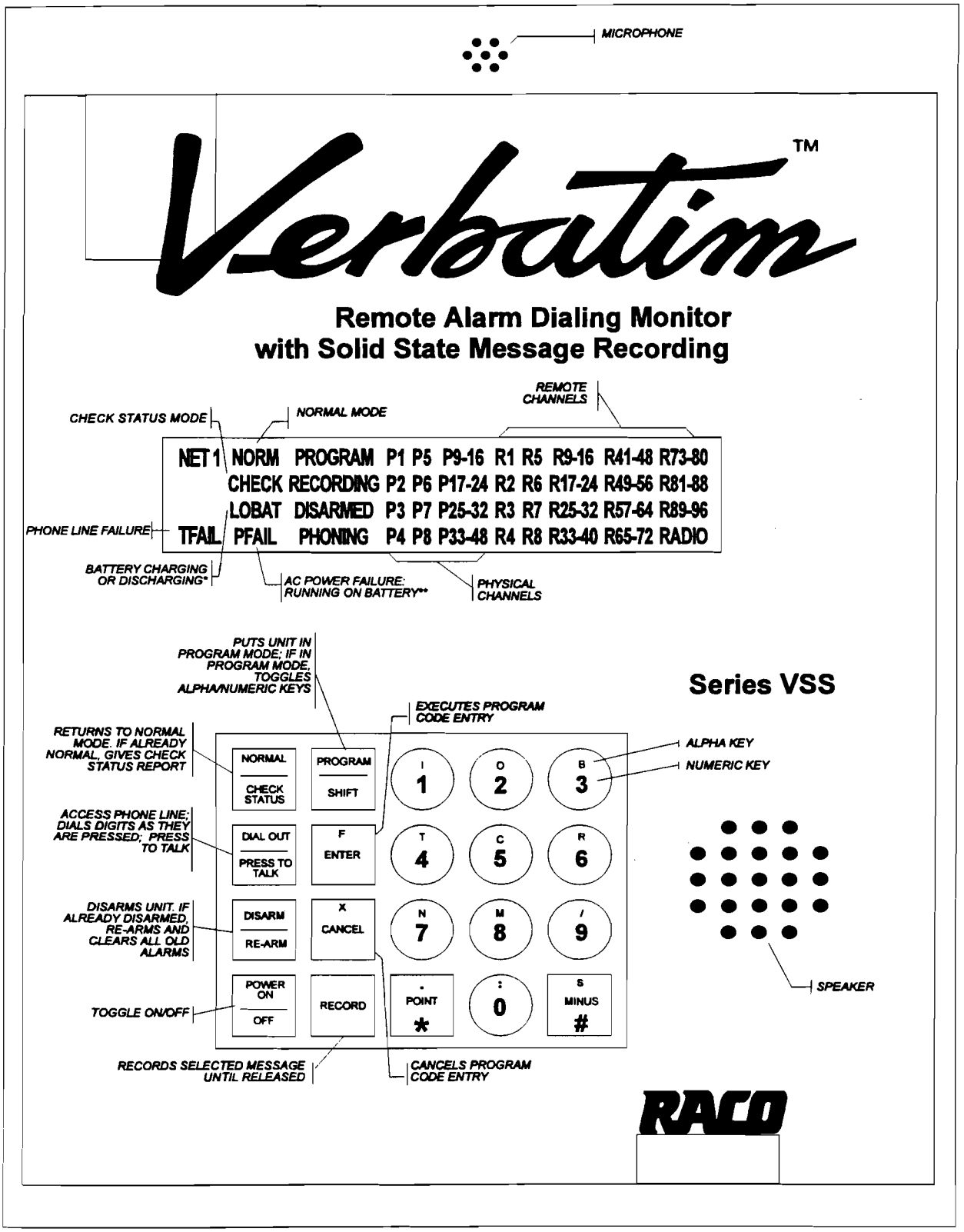
   `9 35 9 ENTER`

   If you make an error in code entry, press CANCEL and start again.

Exceptions:

If you have powered up your Verbatim without connecting a live telephone line to the unit you may observe that the TFAIL indicator is on. This indicates that the unit is checking for the presence of a telephone connection and attempting to determine the line configuration. If you are planning to program your unit without a live telephone connection you may wish to disable the Telephone Line Fault Detection (Phone Fault) feature by pressing `9 17 0 ENTER`
See Section 6.2.6 for information on temporarily disabling this feature.

Front Panel Keys and Indicators Diagram



*** A discharged battery may take up to a day to fully charge. Meanwhile, light may remain on.**

**** During AC power failure, all illuminated LED's will flash to conserve battery power.**

3.2 Programming Phone Numbers

Refer to Programming Worksheet A (See Appendix J). You are encouraged to write down the phone numbers you want to program, along with a person's name for each phone number.

- To program the first dial-out phone number, press:

  `7 01 (then the complete phone number) ENTER`

  For example, to program 1 (510) 658-6713 as the first phone number, press:

  `7 01 1 5 1 0 6 5 8 6 7 1 3 ENTER`

- To program a second phone number:

  Use code 7 02 instead of 7 01, progressing to a maximum of code 7 16 for the 16th phone number.

Each number may be up to 60 digits in length. Be sure to include any necessary area codes or "1" prefixes.

Exceptions:

- To use touch tone dialing, press:

  `9 01 1 ENTER`

- To go back to standard pulse dialing, press:

  `9 01 0 ENTER`

- To insert delays between dialed digits.

  Press the MINUS key once for each additional delay desired in the phone number programming process. Default delay is one second.

- Refer to Section 6. "Advanced Programming," for specialized programming such as *grouping* phone numbers with input channels, *Call Progress Monitoring* phone fault detection, etc., or to establish and use a *call forward* phone number, etc.

3.3 Programming Input Channels

Your Verbatim autodialer needs to know whether its input channels are to be *normally closed* (alarm on Open Circuit), or *normally open* (alarm on Closed Circuit).

All contact inputs are initially set normally closed (i.e. they will alarm on Open Circuit). This is the default setting and, therefore, any open circuits, including any inputs left disconnected during installation, will appear as alarms until the inputs are programmed.

- To automatically program the inputs:

  Make sure all inputs are in their normal (non-alarm) state. Then press:

  ```
  5 0 0 ENTER
  ```

The Verbatim autodialer automatically examines all inputs and programs them to alarm on the opposite input state from their present status. This code 500 does not affect any channels that have been programmed for Disabled Channels, Status Only, Run Time Meter, or Pulse Totalizer function.

Exceptions

In most cases, no further programming of contact inputs is necessary. However, the following configuration options are available:

- To set any input to be disabled and never be annunciated, press:

  ```
  5 ZZ 0 ENTER
  ```

  where ZZ is the 2 digit channel number you are programming. Be sure to always use a leading 0 for channels 1 through 9 to keep the channel number a two-digit entry.

- To set an individual contact input for normally closed operation (i.e. to alarm on Open Circuit), press:

  ```
  5 ZZ 1 ENTER
  ```

- To set an individual contact input channel for normally open operation (i.e. to alarm on Closed Circuit), press:

  ```
  5 ZZ 2 ENTER
  ```

- To set inputs to report status only, program each individual channel as follows:

  ```
  5 ZZ 3 ENTER
  ```

  This setup never causes an alarm to dial out.

- To set contact inputs for the run-time meter function, program each channel as follows:

  ```
  5 ZZ 4 ENTER
  ```

See Section 6.2.3, "Channel Programming (Configuring)." This setup never causes an alarm to dial out but reports the total accumulated hours that the input contact is closed.

- To set any of your contact inputs for the Pulse Totalizer function, see Section 6.2.3, "Channel Programming (Configuring)."

3.4 Initial Testing

Perform the following steps to ensure that your Verbatim autodialer is properly installed.

1. First, temporarily disarm the unit by pressing:

   DISARM/RE-ARM until the DISARM LED is flashing. This prevents the unit from dialing out.

2. Next, physically trip each sensing device in turn (manipulate float switches, relays, etc.).

   Verify that the corresponding input channel LED lights at the front panel, and then restore all sensors to their normal state.

3. Now press DISARM/RE-ARM. This will clear out the channel input LEDs and restore the unit to a ready condition.

4. To test the phone line connection, with the unit's phone cord plugged into its phone jack, temporarily remove the AC power cord to the unit.

   The PFAIL LED will illuminate. At this point all illuminated LEDs will flash on and off in order to conserve battery power. Since the unit is not disarmed this time, after a 0.1 minute Alarm Trip Delay the PHONING light will illuminate and the unit will access the phone line and will begin dialing the first phone number.

   The unit will recite its station ID and power failure messages. You may converse with the person answering by pressing and releasing DIALOUT/PRESS TO TALK. Press this key again when you wish to speak, and release this key to listen. This action will suspend message recital. In this case, when the conversation is done, you should end the call by pressing NORMAL. Ordinarily the alarm call would end automatically.

5. Now press DISARM/RE-ARM twice.

   This step disarms and then rearms the unit clearing all acknowledged alarms. This clearing also occurs automatically after the Alarm Reset Time has elapsed (default value 1 hour). See Section 5.6, "Alarm Reset Time-out After Acknowledgment."

6. Your Verbatim autodialer is now able to operate, having at least one dialout phone number programmed and having its input channels configured.

   However, you may wish to record your own voice messages (see the next section) or perform special advanced programming items (see Section 6, "Advanced Programming") before referring to Section 5, "Using Your Verbatim autodialer."

4 Recording Voice Messages

This chapter describes how to record your own voice messages. Messages may be recorded for the Station ID and for the Alarm and Normal condition for every channel in your Verbatim autodialer.

Note:

Be sure to complete the programming of the input channels as described in the previous chapter before recording any messages.

Using Default Messages Instead of Recording Your Own.

Recording messages is an optional step. Your Verbatim autodialer comes with built-in default normal and alarm messages for all channels. Recording voice messages can be postponed until you have become more familiar with your unit. You may even choose to record or re-record your own messages from a remote telephone at any time.

Using default messages for selected channels or for the Normal condition of channels is an excellent way to conserve speech memory for certain important and lengthy alarm messages.

Types of Default Messages

- Discrete (i.e. digital, contact) physical channel inputs:

  "Channel N Normal" and "Channel N Alarm."

- Discrete remote channel inputs:

  "Remote Channel N Normal" and "Remote Channel N Alarm."

- Discrete Status-only or Run-time meter physical channel inputs:

  "Channel N is ON" when input circuit is closed, and "Channel N is OFF" when input circuit is open.

- Discrete Status-only remote channel inputs:

  "Remote Channel N is ONE" or "Remote Channel N is ZERO."

- Analog (integer) physical or remote channel inputs:

  ["Channel N, present reading is ..."] followed by the recited analog value.

- Station ID message:

  "ID Number N."

There is also a default Network ID message. See Appendix F for details.

4.1 Planning Messages

Worksheet C in Appendix J is provided to assist you with this. Please use the Worksheet! Not only will you then have a written record of your messages for future reference, you will also then be prepared to record your messages with the greatest ease and efficiency.

In general, two different messages are used for each input channel:
One message for the Normal Condition, and another for the Alarm (fault) Condition.

When you have written down the messages that you want to record, you are ready to verify/extend your recording time.

❖ ***Exceptions:***

- Status-only or Run-time Metering Channels. See Section 6.2.3, "Channel Programming (Configuring)."

  To record your own messages for these specially configured channels rather than relying on the default "Channel N is ON" or "Channel N is OFF" messages:

  - Plan a message for the Closed Circuit condition and another message for the Open Circuit condition for each channel.

  For Run-time channels, the unit will add a report of the run-time in hours, using built-in speech, after the Closed or Open Circuit message.

- Pulse Totalizer Channels

  See Section 6.2.3, "Channel Programming (Configuring)," for special guidance in planning Pulse Totalizer messages.

4.2 Managing Available Speech Memory

The table below shows the total available message recording time for units with differing total number of channels. The available message recording time may be extended in two ways. First, you may explicitly change the recording rate from the default Rate 1 to Rates 2, 3, or 4 (See Section 6). Secondly, you may automatically extend the message recording time by using the Autoextend™ feature described in this section.

Unit type	Initial recording time (at Rate 1):	Extendable to: (Rate 2, 3 or 4)
4-8	26 sec	40, 54 or 79 sec
16-32	104 sec	160, 216 or 318 sec
33-40 chan. unit	130 sec	200, 270 or 399 sec
41-48 chan. unit	156 sec	240, 324 or 476 sec
49-56 chan. unit	182 sec	280, 378 or 555 sec
57 or more	208 sec	320, 432 or 624 sec

4.2.1 Verifying/Extending Recording Time

Initially, the unit is set for the fastest memory use rate ("Rate 1"), giving the highest fidelity sound recording. If you are sure that your messages take less than the "initial" time shown above for your unit (14 seconds total for a 4-channel unit), go to Section 4.3, "Record Your Messages." You may also verify your unit's current rate setting and corresponding total message recording time by pressing:

```
9 1 1 ENTER.
```

If, after performing this step, you think you may need more recording time perform the Autoextend™ step described next. The Autoextend™ feature will automatically extend the available recording time, selecting the optimum recording rate (speech memory rate) to give you the highest possible recording sound quality for your length of recording.

Warning:

The following step will erase any existing recorded messages.

To use the Autoextend™ feature to extend recording time, have your message Worksheet handy as you press:

```
9 1 2 ENTER
```

The Verbatim autodialer will prompt you to immediately begin reciting your entire list of messages at the sound of the beep, one after another, at the same speed that you will want to later record them.

During this time, the Verbatim autodialer will *not* be recording your spoken messages. Instead, it will be timing you.

When you have finished reciting (not recording) the last message, immediately press ENTER.

Over the phone, press ZERO to start the timing, and ZERO again to end the timing. See Section 5.7, "Programming by Phone."

Based on how long your message recital took, the Autoextend feature will automatically calculate which recording rate is optimum for your length of recording time, and will then automatically select that rate. It will tell you how many seconds your message took, and how much total recording time it has now given you.

4.3 Record Your Messages

First, minimize any background sounds. Then proceed as follows:

- Have your message Worksheet in front of you and be prepared to recite the first Alarm (fault) Condition message in a loud clear voice within about 6 to 12 inches of the microphone located at the top of the front panel. Press:

  `1 ZZ ENTER`

  where ZZ is the appropriate 2-digit channel number, such as 01 for channel 1. Be sure to use leading zeroes, in order to keep ZZ a 2-digit entry. Use 00 for the Station ID message.

The voice specifically identifies the message you are about to record, and then prompts you to press the RECORD key and hold it just for the duration of your spoken message. Note that the RECORDING light comes on during recording.

Over the phone, since there is no RECORD key, the voice will prompt you to press ZERO to begin recording, and press ZERO again to stop recording. See Section 5.7, "Programming by Phone."

The Verbatim autodialer will immediately play back the message you have just recorded, allowing you to determine if you need to re-record it louder, softer or more clearly, etc.

Experiment with different volume levels to get the best message clarity. If there is too much background noise at the Verbatim autodialer site, record your messages over the phone.

Always stop the recording promptly to avoid wasting recording time.

- To record an alternate "Normal Condition" message for channel ZZ, press:

  `2 ZZ ENTER`

  and follow the same procedure as above.

- To review both existing messages for channel ZZ, press:

  `3 ZZ ENTER`

  The Verbatim autodialer will replay both existing messages for channel ZZ. This will include any default messages remaining in use.

Exceptions:

- For any channels programmed for "Status Only" or for Run Time Meter function, use code 1 ZZ for the Open Circuit message, and 2 ZZ for the Closed Circuit message.
- If you run out of recording time, you will hear the message "No more message time." See Section 4.2 above to re-establish total available recording time. You may elect to shorten some messages, or rely more on selected default messages, or you may Autoextend the available recording time. Then, re-record all messages.
- If you wish to extend the available time for a specific message while leaving the other messages unaffected, enter the code for recording that message, but add an extra digit 1 through 4, before pressing ENTER.

  The digit 1 (Rate 1) gives the shortest time and the best sound quality, while 4 (Rate 4) gives the longest time with poorest sound quality.

- If you wish to reinstate a default message, enter the code for recording that message, and an extra POINT before pressing ENTER. For example:

  `1 ZZ POINT ENTER`

- If you wish to use the default Station ID message but with a different ID number in place of the "one", press:

  `9 1 4 N ENTER`

  where N is the desired ID number which may be up to 16 digits long. Some users program the Verbatim autodialer's own phone number as its ID number.

- If you want to set a specific recording rate rather than letting Autoextend do it, press:

  `9 1 3 N ENTER`

  where N is the desired recording rate 1, 2, 3 or 4.

- You will then need to re-record any messages that were previously recorded at a different rate.

5 Using Your Verbatim Autodialer

5.1 Placing Inquiry Calls to the Verbatim Autodialer

You may call the Verbatim autodialer at any time from any phone. The unit will wait the programmed number of rings before answering and then will begin a full status report. The status report starts with the Station ID Message, followed by any special warning messages (e.g.: no phone numbers programmed, or the unit is disarmed, etc.), and concludes with the listing of the status of each channel input.

If there are no alarm conditions on any channel, then the Verbatim autodialer will say "All channels normal" just prior to beginning the complete channel status report.

If there are channels with unacknowledged alarms conditions prior to the call, placing a call to the unit will result in the acknowledgement of these alarms. The Verbatim autodialer will say "Alarm is acknowledged" immediately after reciting the Station ID message.

Exception:

The Call in Acknowledge Mode command (Code 925) may be used to set the Verbatim so that calls *to* the unit will not automatically acknowledge alarms.

The channel status report will be recited the programmed number of message repeats (default is 3 times). Between each recital the Verbatim autodialer will issue a prompting beep and then wait a few seconds for you to optionally enter a special Command Tone. See Section 5.7, "Programming by Phone." After all message repeats, if you have not entered a tone, the unit will say "Goodbye" and terminate the call.

See Section 6.2, "Programming Operations."

5.2 CHECK STATUS Inquiry at Panel

When the NORM LED is lit, you may hear a report of current conditions by pressing the NORMAL/CHECK STATUS key. You may cut this report short by again pressing the NORMAL/CHECK STATUS key.

5.3 Receiving Alarm Calls

When any input condition violates the programmed alarm criteria for an interval longer than the Alarm Trip Delay for that input (See Section 6.2.6), the unit goes into an Unacknowledged Alarm state. The unit begins dialing the first of up to 16 programmed phone numbers. See Section 6.1, "Program Codes," about optional Alarm Call Grouping if you want the numbers dialed to depend on which channel is in alarm. Whenever there is an Unacknowledged Alarm the corresponding channel alarm LED begins flashing.

The voice messages follow the same format as an inquiry call, including the prompting beep, except the channels having no alarm activity are not included in the alarm report. If there is no acknowledgment, the Verbatim autodialer will replay the message for the programmed number of repeats (default is 3) and then will say, "Goodbye," before terminating the call.

See Appendix I for information on alternate annunciator state models. Annunciator state models support various Return To Normal (RTN) calling sequences.

Phrases Appended to Alarm Messages

(user recorded or default)

These appending phrases will continue to be included in any status reports until the Alarm Reset time expires for that channel.

ALERT
Any channel with an input violation which has not been present longer than the Alarm Trip Delay for that channel will have its status message appended with the word "Alert."

NOW NORMAL
If the violation which originally caused the alarm has gone away the phrase "Now Normal" will be appeneded to the alarm status message.

ACKNOWLEDGED
Any channel which was in an unacknowledged alarm state but became acknowledged will have its status message appended with the word "Acknowledged."

NOW NORMAL, ACKNOWLEDGED
Any channel which is both acknowledged and whose input voilation has gone away will have its status messages appended with the phrase "Now Normal, Acknowledged."

Note:

When the autodialer goes into alarm, it dials each phone number in sequence until it receives an acknowledgement. The alarm may be acknowledged after the warble tone by pressing a touch tone "9"; by calling the unit back after it says, "goodbye," or by pressing NORMAL on the front panel. After acknowledgement, the dialer will not call out again on that channel until it is reset. This is usually done automatically after a set period of time called the *Alarm Reset Time*, which allows the person who acknowledged the alarm time to go fix the source of the problem without further callouts from the dialer. After the reset time, the unit is automatically reset, and any alarms present at that time will cause a dial out.

Exception:

Power Failure alarms only cause two spoken messages: *1)* When power has been off for longer than the Power Failure Trip Delay, "Power is Off" is reported. *2)* When power has been off and is later restored the message "Power is On" is reported.

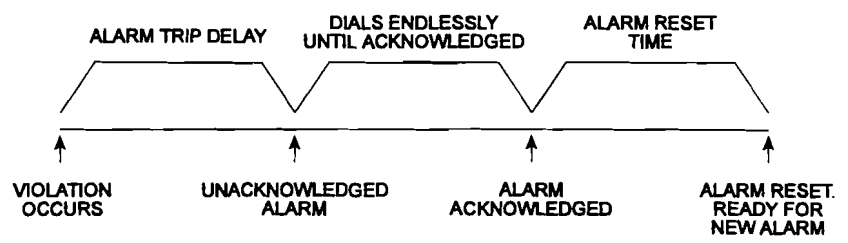
5.4 Continued Dialing in the Absence of Acknowledgment

The Verbatim autodialer will then wait for the programmed Time Between Alarm Calls (default 2 minutes; See Section 6.2.12, "Miscellaneous Programming Tips," to change default time), during which you may call the Verbatim autodialer back to acknowledge the alarm. If no acknowledgment is received at the end of this period, the next phone number will be dialed. The process will be repeated indefinitely, repeatedly going through all the designated phone numbers, until acknowledgment is received.

Exception:

If you want further calling terminated when channels return to normal you may so program the unit by using the "Set Return to Normal" command (Code 923). See Appendix K.

ANATOMY OF AN ALARM



5.5 Acknowledging the Alarm Call

To acknowledge the alarm during the alarm call wait to hear the prompting "warble" tone then enter a touch tone '9' (Also 1, 2, 4, or 0 will acknowledge in this situation). The Verbatim autodialer will say "Alarm is acknowledged, Goodbye" and terminate the call. See Section 5.7, "Programming by Phone," for additional ways of acknowledging an alarm without ending the call.

Alternative methods of Acknowledging:

Wait for the alarm call to end then place a call to unit.

At the front panel press NORMAL, PROGRAM, DISARM, or DIALOUT .

Upon acknowledgment, the channel LED changes from flashing to steady illumination.

At the end of the Alarm Reset period the channel alarm LED turns off, the Acknowledged Alarm status is cleared for that particular channel input, and it is again ready to go into Unacknowledged Alarm whenever a violation occurs at that input. In particular, if a violation has not been removed (prior to timeout), dialing begins immediately upon the Alarm Reset period timeout. To reactivate the alarm before the alarm reset timeout period is over, re-arm the alarm.

5.6 Alarm Reset Timeout After Acknowledgment

As shown in the figure, "Anatomy of an Alarm," p. 5-3, when an acknowledgment is received, the Verbatim autodialer begins timing out the Alarm Reset Time, (default 1 hour).

Further calling on behalf of that channel is suspended, regardless of further activity at that particular input during this period. If new alarms occur on other channels during this period, the unit will go back into the Unacknowledged Alarm state and dial the first appropriate phone number, with dialing continuing until a new acknowledgment is received.

5.7 Programming by Phone

During any phone call (inquiry call or alarm call), at the end of each round of messages, the prompting warble tone is issued. If you press a Command Tone "1" at the sound of the warble tone, the Verbatim autodialer will prompt you to enter a program code. (Or, if you have established a Security Access Code, you will first be prompted for this code).

To enter programming codes over the phone:

- Enter a touch tone "1" after the warble tone.
- Enter the program code followed by # #.
- Enter an additional # # when you are ready to hang up.

You may enter codes for most of the programming operations described in this manual except reading or changing the optional security access code. See Section 6 for more information about the 910 Security Access feature.

Since some of the front panel keys are not found on a touch tone keypad, some special conventions apply for over-the-phone programming:

In Place Of:	Enter:
CANCEL	* *
ENTER	# #
POINT	*
MINUS	#

- ◆ To enter the Program Mode press "1" after the warble tone.
- ◆ To end a phone call after programming:

  Press # # without a prior digit entry.

  The Verbatim autodialer will then issue a prompting beep which is another opportunity to enter a "1" if you didn't want to end the call. It will then say "Goodbye" and end the call.

Exception:

Over the phone, you may not program more than one consecutive dialing delay, because # # (two in a row) is interpreted as ENTER when programming. However, you may extend this delay using code 928. See *Program Code Table* p. 6-9.

- ◆ If you initially enter a Command Tone "2" in place of the "1", you will be in a special Program Review Mode, which allows you the safety of checking any of the programming items or messages, without the possibility of altering any of them.
- ◆ If you initially enter a Command Tone "3" in place of the "1", you will hear a report of each channel that has any acknowledged or unacknowledged alarm condition.
- ◆ If you initially enter a Command Tone "4" in place of the "1", you will hear a listing of all programmed phone numbers, plus any other basic programming items that you have altered from their default values. This is particularly useful in diagnosing operating problems.

- If you initially enter a Command Tone "8" in place of the "1", the unit will not be acknowledged and will immediately say "goodbye" and end the phone call.
- If you initially enter a Command Tone of "0, 5, 6, 7, or 9," in place of the "1", the alarms will acknowledge an alarm and the unit will immediately say "goodbye" and end the phone call.

Note:

Command tones "1, 2, 3, and 4" will acknowledge all alarms, even those not in their Alarm Call Group (ACG). See Section 6.2.13. Command tones "0, 5, 6, 7, and 9" will acknowledge only alarms in their ACG. Command tone "8" will not acknowledge any alarms, but will give the status of all alarms.

5.8 Dialing Out and Conversing Through the Verbatim Autodialer

DIAL OUT / PRESS TO TALK

At the panel, starting in the Normal Mode, press the DIALOUT/PRESS TO TALK key. Next press the digits of the phone number you want to dial. Each digit you press will be dialed as you press it. You will then hear the sound of the ringing.

When you hear the phone answered, press and hold the same DIALOUT/ PRESS TO TALK key as you speak to the person on the line, and release the key to listen. Continue the conversation in this manner.

- To end the call press NORMAL. If the DIALOUT/PRESS TO TALK key is not pressed for more than 2 minutes (or as previously set), the Verbatim autodialer will automatically end the call.
- To automatically re-dial a number that was previously manually entered by this method, press DIALOUT/ PRESS TO TALK as before, then press ENTER rather than entering digits manually.

If you are at the panel when a phone call is in progress, you may suspend the message report and converse with the person on the other end by pressing the DIALOUT/PRESS TO TALK key as described above. There will be no additional dialing, since connection has already been established. To end the call, press NORMAL.

NORMAL / CHECK STATUS

6 Advanced Programming

6.1 Program Codes

This chapter provides the Program Codes table which summarizes the wide variety of available programming operations, along with a description and comments. Additional information may be found in referenced notes below as well as in the referenced sections elsewhere in the manual.

When the overall programming is cleared out at initial start-up, all programming is automatically set to factory default values as shown in the table. Most of these default values are quite suitable for most users and only selected items may need to be programmed to different values.

ENTER

- To read the existing programmed settings:

  Enter a code and then ENTER without any intervening value. This reads the existing programmed setting without changing it.

POINT
*

- To clear a program:

  Enter POINT ***after the code*** and before ENTER. This clears the program item, or returns it to its default value.

In the Program Codes table, several forms of numeric value entries are shown:

Value	Definition
V	A value of one or more digits which may include a decimal point or minus. Examples: .5, 2.8, 300.6, 60.
N	One or more digits giving a whole number; no decimal points allowed. Examples: 1, 5, 20.
DN	A two-digit Designation Number for phone numbers (01 for first number, 02 for second, etc.).
1/0	Used to turn a function ON (1) or OFF (0).
ZZ	2-digit channel number (use ZZ=00 for ID message).

6.1.1 Notes for Programming Code Table:

Refer to these numbered items under the "Notes" column in the following *Programming Code Table.*

1. ZZ = 2 digit channel number. Use ZZ=00 for Station ID message.
2. For any channels you have programmed as "Status Only" or "Run Time Meter", use code 1 ZZ for the Open Circuit message, use code 2 ZZ for the Closed Circuit Message. See Section 6.2, "Programming Operations," for message information for any Pulse Totalizer channels.
3. DN (Designation Number) is 01 for first dialout phone number, 02 for second number, etc. DN = 00 for special "callback" phone number. Use MINUS to insert any needed delays between digits. Each such delay is 1 second unless extended using code 928.
4. Actual power failure trip delay may be a fraction of a second longer than programmed value, due to power supply discharge time which varies with the number of option boards.

Caution:

5. If Alarm Reset Function is turned OFF, acknowledged alarms will NEVER RE-ARM, preventing further alarm calls after acknowledgment for each channel.
6. Speaker always operates during front panel programming, even if programmed to be off.
7. Cannot be read or changed over the phone.
8. Does not change channels that have been configured for "Status Only," "Run Time Meter," or "Pulse Totalizer."

Caution:

9. High Speed Dialing setting may not work reliably with some telephone company exchanges.
10. Add POINT to restore default message.
11. To pre-set a Run Time value, include the value before ENTER.
12. Maximum value that can be entered is 4,294,967,294.
13. Omits all mention of disabled channel. Restore by setting for Normally Closed, Normally Open, etc.

Programming Code Table (Page 1 of 8)

Code	Description & Comments	Default	Range/Values	Notes *See p. 6-2*	Section
Channel Status Reading					
0ZZ	Reads status of channel ZZ				6.2.1
0ZZ0	Reads actual open/closed circuit status directly				6.2.1
Message Recording and Reviewing					
100	Records Station ID message			1, 2, 10	4.3, 6.2.2
1ZZ	Records channel ZZ alarm message			1, 2, 10	4.3, 6.2.2
2ZZ	Records channel ZZ normal message			1, 2, 10	4.3, 6.2.2
3ZZ	Reviews channel ZZ both messages ZZ=00 for Station ID msg			1	4, 4.3, 6.2.2
911	Reads current record rate and available record time				4.2
912	Autoextend: sets optimum record rate for recited msg				4.2
913 N	Sets recording rate	Rate 1	Rate 1-4		4.3
914 N	Inserts N in place of 1 in canned station ID message	Station 1	1-16 digits		4.3
Channel Programming (Configuration)					
500	Sets current status as normal for all channels				3.3, 6.2.3
500 N	Sets all inputs to config parameter N	normally closed	0/1/2/3 0 = disarmed 1 = normally closed (default) 2 = normally open 3 = no alarm		3.3, 6.2.3
5ZZ	Reads alarm criteria for channel ZZ	1			6.2.3
5ZZ 0	Disables channel ZZ			13	3.3, 6.2.3
5ZZ 1	Sets chan ZZ normally closed			1	3.3, 6.2.3
5ZZ 2	Sets chan ZZ normally open			1	3.3, 6.2.3
5ZZ 3	Sets chan ZZ for no alarm (status report only)			1	3.3, 6.2.3
5ZZ 4	Sets chan ZZ for run time meter operation			1	3.3, 6.2.4
5ZZ 4 V	Preset starting value	0.0 hrs	0.0-99,999.9 hrs	1	6.2.4
5ZZ 7 N	Pulse totalizer: ACTIVATES with starting value N			12, 2	6.2.5
5ZZ 8 N	Pulse totalizer: sets scale factor N			12	6.2.5
5ZZ 6 N	Pulse totalizer: sets alarm setpoint N with starting value N			12	6.2.5

Programming Code (Page 2 of 8)

Code	Description & Comments	Default	Range/Values	Notes *See p. 6-2*	Section
Alarm Trip Delays					
600	Reads power failure alarm trip delay				6.2.6
600 V	Sets power failure alarm trip delay to V	0.1 min	0.1-999.9 min		6.2.6
6ZZ	Reads chan ZZ alarm trip delay				6.2.6
6ZZ V	Sets chan ZZ individual alarm trip delay to V	2 sec	0.1-9999.9 sec	1	6.2.6
6ZZ POINT	Returns chan ZZ individual alarm trip delay to default	2 sec		1	6.2.6
902 V	Sets global (all channels) alarm trip delay to V seconds	2 sec	0.1-9999.9 sec		6.2.6
902 POINT	Returns global (all channels) alarm trip delay to default	2 sec			6.2.6
Phone Numbers and Pulse/Tone Dialing					
700	Reads special "callback" phone number			See Code 924	6.2.18
700 N	Sets special "callback" phone # to N		1 - 60 digits		6.2.18
7DN	Reads phone number DN		01 - 16 DN = 01-16		3.2, 6.2.7
7DN N	Sets phone number DN to N phone #		1 - 60 digits N can = up to 60 digits	3	3.2, 6.2.7
7DN POINT	Clears out phone number DN				3.2, 6.2.7
900 0/1	Read/Set Call Progress Monitoring	0 (OFF)	0/1 0 = OFF 1 = ON		6.2.12
901 0/1/2	Sets dialing mode	Pulse mode	0/1/2 0 = pulse 1 = tone 2 = high speed	9	6.2.7
903 V	Sets time between callouts to V	2 min	0.1-99.9 min		6.2.18
906 N	Sets ring answer delay to N N = whole number	1 ring	1 - 20 rings		6.2.18
908 0/1	Sets Autocall ON/OFF	OFF	0/1 0 = OFF 1 = ON		6.2.18
909 V	Sets Autocall interval to V	24 hrs	0.1-99.9 hrs		6.2.18
916 N	Set Automatic Phone Fault Detect frequency	24 hrs	0.1 - 24 hrs	916 POINT resets to default	6.2.10
917 0/1/2/3	Set Phone Fault and Auto Tone-Pulse	3	0/1/2/3 0 = Phone Fault OFF/Auto Tone-Pulse OFF 1 = Phone Fault ON/Auto Tone-Pulse OFF 2 = Phone Fault OFF/Auto Tone-Pulse ON 3 = Phone Fault ON/Auto Tone-Pulse ON		6.2.10
918	CPM Ring Count	10 rings	5 - 20 rings		6.2.12
928 N	Extends length of inserted dialing delays to N sec	1 sec	1 - 10 sec		6.2.7

Programming Code (Page 3 of 8)

Code	Description & Comments	Default	Range/Values	Notes *See p. 6-2*	Section
Alarm Call Grouping					
5ZZ 9	Reads channel ZZ alarm call grouping linkage			1	6.2.13
5ZZ 9 DN	Links channel ZZ to phone numbers DN.	Calls all phone #s	01 - 16 DN = 01-16	1	6.2.13
5ZZ 9 POINT	Clears channel ZZ alarm call grouping linkage.			1	6.2.13
Alarm Ready Scheduling					
935 7	Initializes real-time clock chip on install to 1/6/92 2				2.3, 6.2.19, 7.9
941 MMDDYYD	Sets date	01/06/92 2	01/01/94 - 12/13/20 D *(Day Code)* is optional: 1 = Sunday 2 = Monday 3 = Tuesday 4 = Wednesday 5 = Thursday 6 = Friday 7 = Saturday		2.3, 7.9
942 HHMMSS	Sets time	08:00:00	00:00-23:59:59 (military-24-hour-clock)		2.3, 7.9
961	Read weekday rearm/disarm times				7.9
961 RRRR DDDD	Sets weekday rearm/disarm times	1700, 0800		RRRR=rearm time, DDDD=disarm time (military-24-hour-clock)	7.9
962	Reads weekend rearm/disarm times				7.9
962 RRRR DDDD	Sets weekend rearm/disarm times	1700, 0800		RRRR=rearm time, DDDD=disarm time (military-24-hour clock)	7.9
963	Reads weekend rearm/disarm day of week				7.9
963 R D	Sets weekend rearm/disarm day of week	Friday, Monday	R = rearm day D = disarm day		7.9
964	Reads holiday rearm date				7.9
964 MMDDYY	Sets holiday rearm date	12/24/90	Today - 12/31/20 MM = month DD = day YY = year		7.9
965	Reads holiday disarm date				7.9
965 MMDDYY	Sets holiday disarm date	12/24/90	The day after the holiday rearm date (see Code 964) - 12/31/20		7.9

Programming Code (Page 4 of 8)

Code	Description & Comments	Default	Range/Values	Notes	Section
				See p. 6-2	
Alarm Ready Scheduling . . . *Continued from p. 6-5*					
966	Reads alarm ready schedule control number				7.9
966 N	Sets alarm ready schedule control number	0	N control 0-7 0 = OFF 1 = Weekday 2 = Weekend 3 = Weekday and Weekend 4 = Holiday 5 = Weekday and Holiday 6 = Weekend and Holiday 7 = Weekday, Weekend and Holiday		7.9
Local Data Logging Programming Codes					
935 7	Initialize real-time clock chip on install to 1/6/92 2				2.3, 6.2.19, 7.9
941 MMDDYYD	Sets date.	01/06/92 2	01/01/94-12/31/20 D *(Day Code)* is optional: 1 = Sunday 2 = Monday 3 = Tuesday 4 = Wednesday 5 = Thursday 6 = Friday 7 = Saturday		2.3, 7.9
942 HHMMSS	Sets time	08:00:00	00:00-23:59:59 (military-24-hour clock)		2.3, 7.9
943 V	Sets regular interval local printing	OFF	0 = OFF .1 - 999.9 hrs		2.3, 7.9
944	Prints all current programming immediately				2.3, 7.9
Analog Input Programming					
5 ZZ 1 X.XX	Sets low signal input value				B.1.5
5 XX 1 POINT	Sets low signal input value to real world point				B.1.5
5 ZZ 2 X.XX	Sets low signal input spoken value				B.1.5
5 ZZ 3 X.XX	Sets high signal input value				B.1.5
5 ZZ 3 POINT	Sets high signal input value to real world point				B.1.5
5 ZZ 4 X.XX	Sets high signal input spoken value				B.1.5

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Code	Description & Comments	Default	Range/Values	Notes	Section
				See p. 6-2	
Analog Input Programming . . . *Continued from p. 6-6*					
5 ZZ 5 X.XX	Sets low setpoint alarm value				B.1.5
5 ZZ 6 X.XX	Sets high setpoint alarm value				B.1.5
5 ZZ 7	Sets analog input signal type	0	0/1/2 0 = 4-20 ma signal 1 = 0-1 VDC signal 2 = RACO TS-705A		B.1.3
Remote Supervisory Control					
For all items in this section: N = output number, Range = 01, 02, 03, 04, 05, 06, 07, 08					
95 N	Reads RSC output #N ON/OFF condition			14	C.1.3
95 N 0	Turns RSC output #N OFF				C.1.3
95 N 1	Turns RSC output #N OFF				C.1.3
95 N 2 V	Turns RSC output #N ON for V seconds only	1 sec	1 - 99,999 sec		C.1.3
95 N 3 V	Turns RSC output #N OFF for V seconds only	1 sec	1 - 99,999 sec		C.1.3
9500	Reports ON/OFF status of all outputs				C.1.3
9500 0	Turns OFF all outputs				C.1.3
9500 1	Turns ON all outputs				C.1.3
9500 8 V	Establish default pulse duration in minutes (When using 95 N 2 or 95 N 3)				C.1.3
9500 9 V	Establish default pulse duration in seconds (When using 95 N 2 or 95 N 3)				H.2.3
Data Acquisition/Central Data Logging					
919 V	Sets quick intercall time	60 sec	35-999 sec		E.2
981 V	Return To Normal (RTN) calling	0	0/1/2/3/4/5	See Code 923	E.1, K.4
982 0/1/2	Acknowledgment calls to central station	0	0/1/2 0 = 1 1 = ON 2 = resets all alarm acknowledgment call status		E.3
983 0/1	Modem Automatic Speed Select	1	0/1 0 = OFF 1 = ON		E.4

Programming Code (Page 6 of 8)

Code	Description & Comments	Default	Range/Values	Notes	Section
				See p. 6-2	
Data Acquisition/Central Data Logging . . . *Continued from p. 6-7*					
984 0/1	Modem High/Low speed selection	1	0/1 0 = 300 1 = 1200		E.5
985 N	Data call attempts	3	1 - 10		E.6
986 0/1	Sets answer mode	0	0/1 0 = Data-to-Voice 1 = Voice Only		E.7
987 N	Data/Voice autocall calls	0	0/1/2 0 = Autocalls to Central Station only 1 = Autocalls to personnel numbers only 2 = Autocalls to all numbers		E.8
Miscellaneous Programming Items					
902 V	Sets global (all channels) alarm trip delay to V	2 sec	0.1-9999.9 sec		6.2.6
904 V	Sets alarm reset time to V	1 hour	0.1-99.9 hr		5.6, 6.2.18
905	Clears all acknowledged alarms and clears reset timers				6.2.18
907 N	Sets number of alarm message repeats to N N = whole number	3 repeats	1-20 repeats		5.3, 6.2.18
910 N	Establishes a security access code N	None	0-8 digits	7	6.2.18
920 V	Power failure trip delay (duplicates function of code 600)	0.1 min	0.1-999.9 min	4	6.2.6
921 0/1	Sets power failure alarm	ON	0/1 0 = off 1 = on		6.2.6
922 0/1	Sets alarm reset timers	ON	0/1 0 = off 1 = on	5	6.2.18
923	Annunciator Sequence	1	1-4 Values: 1 = M-1designations 2 = A-1-4 designations 3 = A-1 designations 4 = A-1-4 variant	See also Code 981	K.4
924	Initiates test callback to phone # 00			unit must be ARMED	6.2.18
925 0/1	Turns on/off alarm acknowledgment on call-in to dialer.	ON	0/1 0 = OFF 1 = ON		
926 V	Sets delay before return to normal (Exit Delay) to V	2 min	1-99.9 min	Nonrecurring Function	6.2.18

Programming Code (Page 7 of 8)

Code	Description & Comments	Default	Range/Values	Notes	Section
				See p. 6-2	
Miscellaneous Programming Items . . . *Continued from p. 6-8*					
927 0/1	Sets intercall delay parameter	0	0/1 Values: 0 = Normal operation of intercall delay. 1 = If new Unacknowledged alarms occur during the intercall delay period, the unit will begin a new dialout immediately. The unit will dial the next phone number in the dialing sequence. It will not start over at the top of the list.	** Firmware version 2.01+ only**	
928 N	Extends length of inserted dialing delays to N sec	1 sec	1-10 sec		5.7, 6.2.7
930 0/1	Sets arm or disarm unit for alarm callouts	armed	0/1 0 = disarms 1 = arms unit		6.2.18
932	Invokes one-time 15-second listening period	OFF			6.2.18
933 0/1	Sets local microphone ON or OFF	OFF	0/1 0 = OFF 1 = ON		6.2.18
934 0/1	Sets speaker ON or OFF	ON	0/1 1 = ON 0 = OFF	6	6.2.18
Clear Out Operations					
935 0	Clears out phone numbers; sets all delays to defaults				6.2.19
935 1	Clears out phone numbers only				6.2.19
935 2	Clears out all alarm call grouping linkage				6.2.19
935 3	Sets the following delays to their factory default values: 902, 903, 904, 920, 921, 926, 928			921 sets power failure alarm ON	6.2.19
935 4	Clears all user recorded messages				6.2.19
935 5	Clears all programming except messages			does not clear 913, 930, 941, 942	6.2.19
935 6	Clears all totalizers to 0 (not to preset) reading				6.2.19
935 7	Clears real-time clock chip (reinitialize)				2.3, 6.2.19, 8.9
935 9	Total clearout: Erases all programming & messages			does not clear 941, 942	3.1, 6.2.19
Diagnostic Readouts					
940	Reads all 4 diagnostic counts (add 0 to clear all 4)				6.2.20
940 1	Reads call in count (add 0 to clear)				6.2.20
940 2	Reads dial out count (add 0 to clear)				6.2.20
940 3	Reads acknowledged alarm count (add 0 to clear)				6.2.20
940 4	Reads power failure alarm count (add 0 to clear)				6.2.20

Programming Code (Page 8 of 8)

Code	*Description & Comments*	*Default*	*Range/Values*	*Notes* *See p. 6-2*	*Section*
Local Alarm/Line Seizure					
960 0	Read local alarm relay/line seizure				H.8
960 00/01	Set local alarm relay/line seizure 00 = local alarm relay 01 = line seizure	00	00/01		H.8

6.2 Programming Operations

The following descriptions show the relevant program codes in parenthesis, and are organized according to their appearance in the preceding Program Codes table located in Section 6.1, "Program Codes."

Refer also to Section 5, "Using Your Verbatim Autodialer," for a description of over-the-phone programming.

6.2.1 Channel Status Reading

Code	Function	Description
0 ZZ	Read Status of Channel ZZ	Plays the message that corresponds to the present input condition of Channel ZZ.
0 ZZ 0	Read Open/Closed Circuit Status Directly	Says "Channel ZZ is closed" if channel ZZ input is presently Closed Circuit, or "Channel ZZ is open" if the input is Open Circuit. Useful in troubleshooting, especially at setup time.

Note:

If a channel is disabled, its status will never be mentioned.

6.2.2 Message Recording and Reviewing

Be sure to refer to Section 4, "Record Voice Messages," for important details on message recording, including codes 911, 912, 913, and 914.

Code	Function	Description
100	Record Station Message	
1 ZZ	Record Channel ZZ Alarm Message	Used for Open Circuit message for channels programmed for NO ALARM (status only), or for Run Time Meter operation. Also used for a preamble message for channels programmed for Totalizer or Analog function.

2 ZZ	Record Channel ZZ Normal Message	Used for Closed Circuit message for channels programmed for NO ALARM (Status Only) or for Run Time Meter operation. Also used for "units of measure" portion of a message following preamble and digit readings, for channels programmed for Totalizer or Analog function.
3 ZZ	Review Channel ZZ Messages	Use 3 00 to review Station ID message

6.2.3 Channel Programming (Configuring)

Also see Section 3.3, "Programming Input Channels."

Code	Function	Description
500	Set Present Input Status as Normal Condition for All Contact Input Channels	Used at setup time as the most expedient way of programming the Normally Open/Normally Closed configurations ("Alarm Criteria") of contact input channels. Special configurations such as Status Only, Run Time Meter or Totalizer may then be programmed for specific individual channels. This code does not affect channels already programmed for Status Only, Run Time Meter, or Pulse Totalizer. **APPLIES ONLY TO CONTACT INPUTS.**
500 0	Sets the Alarm Criteria for all contact channels to DISABLED	Used at setup time as the most expedient way of programming all channels to the same alarm criteria. **APPLIES ONLY TO CONTACT INPUTS.**
500 1	Sets the Alarm Criteria for all contact channels to NORMALLY CLOSED	Same as above
500 2	Sets the Alarm Criteria for all contact channels to NORMALLY OPEN	Same as above
500 3	Sets the Alarm Criteria for all contact channels to STATUS ONLY	Same as above
5 ZZ	Read Channel ZZ Programming ("Alarm Criteria")	
5 ZZ 0	Disables Channel from Being Monitored and Reported	
5 ZZ 1	Set Channel ZZ for Normally Closed Operation	An Open Circuit condition will cause an alarm. **APPLIES ONLY TO CONTACT INPUTS.**
5 ZZ 2	Set Channel ZZ for Normally Open Operation	A Closed Circuit condition will cause an alarm. **APPLIES ONLY TO CONTACT INPUTS.**
5 ZZ 3	Set Channel ZZ for No Alarm (Status Only)	**APPLIES ONLY TO CONTACT INPUTS.**

6.2.4 Run Time Meter Programming

You may program any of the ordinary contact (digital or discrete) input channels to accumulate and report the number of hours that their respective input circuits have been closed. Any such channels will never cause an alarm, but on inquiry will recite the channel's Closed Circuit message or the Open Circuit message according to the status of the input, and will then report the accumulated Closed Circuit time (run time) to the tenth of an hour.

- To program channel ZZ for Run Time Meter operation, press:

  `5 ZZ 4 ENTER`

- To preset a starting value, press:

  `5 ZZ 4 V ENTER`

  where V may be any value from 0 to 99,999.9.

- To delete the Run Time Meter programming, you must reprogram the channel for any other type of alarm criteria.

As with channels programmed for NO ALARM (Status Only) operation, the default Open Circuit message is "Channel N is off." To record your own Open Circuit message for channel ZZ, use program code 1 ZZ. The default Closed Circuit message is "Channel N is on." To record your own Closed Circuit message for channel ZZ, use program code 2 ZZ.

6.2.5 Pulse Totalizer Function Programming

The Totalizer function counts the accumulated number of pulses (momentary contact closures) occurring at the contact input for a channel which you have programmed for Totalizer operation. This function is typically used to accumulate the pulse output of rotary flow meters.

An alarm set-point may be programmed to create an alarm call upon reaching a particular total value. Scale and offset factors are programmable, and user-recorded messages may be used.

Any contact input channel may be programmed for the Totalizer function, up to a total of 8 Totalizers. The input pulse rate must not exceed 100 pulses per second, and if the rate is over 50 pulses per second, the pulses must have a 50% duty cycle.

- To program channel ZZ for Totalizer operation, press:

  `5 ZZ 7 ENTER.`

Note:
This function must be done to Activate the Totalizer. It is only possible to program up to 8 contact input channels for Pulse Totalizer. However, any 8 inputs may be used from the full set of contact inputs in your unit.

- To establish a non-zero starting value for the spoken reading, add the desired starting spoken value after the 7 and before ENTER.
- To establish a scale factor (so that a number of pulses will be translated into a single spoken unit count), press:

  5 ZZ 8 N ENTER

  where N is the number of pulses corresponding to a single spoken unit count. For example, if a pulse from a flow meter occurs for each 1/10 gallon of water flow, but the desired report is needs to be in thousands of gallons, a value of 10,000 would be used for N. The unit uses the word "percent" in speaking of the scale factor.

The spoken scaled value will "roll over" to zero upon reaching 4,294,967,294 (2^{32}). Values above this should not be entered at the keyboard.

The default message for Totalizer channels is "Channel N Totalizer count is N." User-recorded messages are normally done in two segments. Use program code 1 ZZ to record a preamble message such as "The total water flow reading is". Use program code 2 ZZ to record an ending units-of-measure message such as "thousand gallons". During the report, the unit will insert the digits comprising the actual scaled value. In this example, the resulting complete report would be "The total water flow reading is (spoken value) thousand gallons".

- To establish a Totalizer alarm set-point, press:

  5 ZZ 6 N ENTER.

When the scaled value reaches N, the unit will go into Unacknowledged Alarm and begin dialing. After the initial alarm has occured, a new alarm will not occur until the user has reset the criteria. You may program a value of zero for N to cancel any previously programmed Totalizer alarm set-point for channel ZZ.

- To clear out all Totalizer readings to zero in one step, press:

  9 3 5 6 ENTER.

6.2.6 Alarm Trip Delays

The Alarm Trip Delay is the length of time after a violation occurs before the unit goes into Unacknowledged Alarm and begins dialing. The default value is 2 seconds for all inputs and 0.1 minute (6 seconds) for power failure. During this time, if a status is read, the message will be the ALARM message, with the extra word "alert" appended. If the violation is corrected before the Alarm Trip Delay times out, no alarm or dialout will occur.

There are two ways to change this Alarm Trip Delay: global (common for all channels except power failure) programming, and individual programming for each channel and power failure.

- To program a new global Alarm Trip Delay, press:

  9 0 2 V ENTER

  where V is a value consisting of 1 to 4 digits, between .1 and 9999.9 seconds. For example, possible entries include .1, 5, 5.1, and 600.1 (seconds).

- If you wish to program a new Alarm Trip Delay for an individual ZZ channel, press:

  6 ZZ V ENTER

- To set a different Power Failure Trip Delay, press:

  6 00 V ENTER (code 920 does the same thing)

- To turn off the Power Failure Alarm function, press:

  9 2 1 0 ENTER

- To turn on the Power Failure Alarm function, press:

  9 2 1 1 ENTER

Note:

The global code 902 overrides any previously set individual channel Alarm Trip Delays. Therefore, if you wish to establish a different global Alarm Delay and also program selected inputs for still different individual trip delays, perform the global programming first, and then any individual trip delay programming.

The default trip delay is 2 seconds for the contact channels and 6 seconds (.1 hour) for power failure. If you are getting a lot of "nuisance" alarms, with a call saying, "alarm now normal," you might think about setting the alarm trip delay up a bit. A good example of this would be the power fail trip delay. In some areas of the country, it is very common to have short periods of power failure -- ten seconds or less. These may not be of particular concern, so setting the power fail trip delay to .2 or .3 hours could save unnecessary phone calls.

Caution:

When leaving program mode all timers for unacknowledged alarms and violations will be reset.

6.2.7 Phone Numbers and Pulse/Tone Dialing

Also see the section 6.2.13, "Alarm Call Grouping," and Section 3.1, "Starting Up and Clearing the Unit."

Note:

DN is the 2-digit Designation Number: 01 for the first phone number, 02 for the second number, up to 16 for the 16th phone number.

Refer to Programming Worksheet A. Write down each phone number you wish to program, along with a person's name, for future reference.

- To program the first phone number to be dialed on alarm, press:

  `7 01 (then the complete phone number) ENTER.`

- To program the second phone number to be dialed on alarm:

  Use code 7 02 in place of 7 01, progressing to a maximum of code 7 16 for a 16th phone number.

Each phone number may be up to 60 digits in length. Be sure to include any necessary area codes or "1" prefixes.

- To erase phone number DN, press:

  `7 DN POINT ENTER.`

- If you need Touch Tone dialing, press:

  `9 01 1 ENTER.`

- For high speed dialing, press:

  `9 01 2 ENTER.`

Caution:

"High speed dialing" may not work reliably with some older telephone company exchanges.

- To switch back to pulse dialing, press:

  `9 01 0 ENTER`

- To insert delays between dialed digits (e.g. after a leading "9" in PBX systems), in the programming process, press the MINUS key once for each one-second delay desired. To extend the length of each delay beyond 1 second, press:

  `9 28 N ENTER`

  where N is the number of seconds of delay desired for each delay invoked with the MINUS key.

6.2.8 Enhanced Telephone Interface Features

The Enhanced Telephone Interface features give the user additional power to solve unusual telephone system interface problems and to provide more reliable and efficient notification of alarms.

The Enhanced Telephone Interface Features include the following functions:

- 60 Digit Phone Numbers
  - For all 16 telephone numbers and the call-back number.
- Telephone Line Fault Detection (Phone Fault)
  - Tests phone line at regular programmed interval
  - Flashes TFAIL LED on dialer front panel upon failure
  - Logs Phone Faults and phone line restoration to Local Printer
- Automatic Selection of Tone versus Pulse Dialing
  - Tests for tone capability upon first power up without user intervention
  - May be overridden for PBXs with "non-standard" dialtones
- Call Progress Monitoring (CPM)
  - Detects busy and ringing signals
  - Waits until phone is answered to annunciate voice reports
  - Abandons call if busy or no answer and quickly tries next number
- Numeric Pager Support
  - Designate Pager only numbers - no voice annunciation
  - Insert pager system terminator characters such as '#' or '*'
  - Insert DTMF A, B, C & D tones in phone number strings for unique IDs
- PBX Support
  - Ignore "non-standard" PBX dialtones
  - Insert "wait for outside line" dialtone into phone number strings

The Enhanced Telephone Interface Features are included on Verbatims with a mainboard Revision of VMP-5a and above and firmware revisions 2.09 and above ONLY.

Contact your RACO Representative about upgrading if the Enchanced Telephone Interface is required.

6.2.9 60 Digit Phone Numbers

Telephone numbers may be as long as 60 digits. This allows, for instance, the Verbatim autodialer to make calls using long distance companies which require entry of access codes. Even with many digits occupied by long distance numbers and access codes there will still be sufficient digits remaining for calls to pager systems requiring complex sequences of terminators, ID numbers, time delays, tone detects, etc.

6.2.10 Telephone Line Fault Detection (Phone Fault)

The Phone Fault Detection feature tests the telephone line whenever the unit needs to make a phone call and at a regular programmable time interval (as long as there are phone numbers programmed).

Phone Fault is turned ON by default but may be disabled if so desired. Also, the Phone Fault Detection interval is user programmable.

Phone Fault shares a user code with the Automatic Tone/Pulse Selection capability. The basic user command is code 917. Entering code 917 with no parameter will cause a recitation of the current settings for Phone Fault and Automatic Tone/Pulse Selection.

The following parameters may be entered:

- Turns OFF BOTH Phone Fault Detect and Auto. Tone/Pulse Select

  `9 1 7 0`

- Turns ON Phone Fault Detect, turns OFF Auto. Tone/Pulse Select

  `9 1 7 1`

- Turns OFF phone fault detect, turns ON Auto. Tone/Pulse Select

  `9 1 7 2`

- Turns ON BOTH Phone Fault Detect and Auto. Tone/Pulse Select (default)

  `9 1 7 3`

Note:

The factory default setting for code 917 is parameter 3, BOTH Phone Fault Detect and Auto. Tone/Pulse Select ON.

The command code 916 is used to set the Automatic Phone Fault Detection interval. This time interval can range from 0.1 hour to 24 hours. The factory default setting is 24 hours. Enter the command 916 followed by a value from 0.1 to 24.0 to program the Phone Fault Detection interval.

- For example, to set the Phone Fault Detection interval to 0.3 hour., enter:
  916 0.3

Whenever a Phone Fault is first detected, a Local Data Logger (LDL) message will be sent to the printer with date and time stamp. Additionally, the Phone Fault LED, labeled TFAIL, will begin to blink.

If a Phone Fault is detected at the beginning of an outgoing phone call the TFAIL LED will flash and the unit will return to the NORMAL state. Then, while still in the NORMAL state, the unit will continually check the telephone line every 30 seconds for restoration of the telephone service.

When telephone service is restored, a message will be sent to the Local Data Logger's printer and the TFAIL LED will go from flashing to solid ON. The Verbatim autodialer will then resume making any pending phone calls. The TFAIL LED will remain ON until a voice message about the Phone Fault is communicated via the phone or to an operator at the front panel by pressing the CHECK STATUS button. The TFAIL LED and pending voice annunciation of the Phone Fault condition may also be cleared at the front panel by pressing the DISARM/RE-ARM button twice.

No Phone Fault Detection will be performed if there are no phone numbers programmed. If the unit needs to make an alarm call when there is a Phone Fault the numbered channel LEDs will blink continuously even though the unit is in the NORMAL state. This unusual condition will only be seen while there is a Phone Fault and the unit is constantly testing for the return of telephone service.

6.2.11 Automatic Tone/Pulse Selection

When Automatic Tone/Pulse Selection is ON the Verbatim autodialer will test for the ability to use tone dialing. This test will be performed only once, one minute after the unit is powered on or is reset. Automatic Tone/Pulse Selection enables the installer to not be concerned about whether the telephone line supports tone dialing.

Automatic Tone/Pulse Selection shares a user code with Phone Fault Detection. The basic user command is code 917. Entering code 917 with no parameter will cause a recitation of the current settings for Phone Fault and Automatic Tone/ Pulse Selection. The following parameters may be entered:

- Turns OFF BOTH Phone Fault Detect and Auto. Tone/Pulse Select
  9 1 7 0
- Turns ON Phone Fault Detect, turns OFF Auto. Tone/Pulse Select
  9 1 7 1

- Turns OFF phone fault detect, turns ON Auto. Tone/Pulse Select

  9 1 7 2

- Turns ON BOTH Phone Fault Detect and Auto. Tone/Pulse Select (default)

  9 1 7 3

Note:

The factory default setting for code 917 is parameter 3, BOTH Phone Fault Detect and Auto. Tone/Pulse Select ON.

Setting Automatic Tone/Pulse Selection ON when it was previously OFF will cause the Verbatim autodialer to perform the test for Tone/Pulse Selection even though it has been longer than one minute since the unit was last powered on or reset.

After powering the unit on, Automatic Tone/Pulse Selection may be temporarily suspended by any front panel activity. Automatic Tone/Pulse Selection will then be resumed one minute after the front panel activity has ceased.

No Tone/Pulse Selection will be done while the unit is being programmed over the phone or if there are not phone numbers programmed.

6.2.12 Call Progress Monitoring (CPM)

Call Progress Monitoring (CPM) operates by listening for the presence or absence of busy and ringing signals. These are the same signals you hear after you dial a phone number. Proper operation of CPM requires that the busy and ringing signals are composed of standard Call Progress frequencies.

The possibility exists that CPM may not function properly because the CPM tones on a particular phone system are not standard.

Unlike other equipment with Call Progress Monitoring, CPM on the Verbatim autodialer does not include detection for the dial tone at the beginning of the dialout session. However, dialtone detection is an integral part of Phone Fault Detection. This allows CPM to be operational even when the Verbatim autodialer is installed inside of a PBX phone system which has a non-standard dialtone.

CPM is intended to detect the following phone line states:

- phone line is busy - both subscriber and trunk busy signals are detected
- non-existent phone number
- phone unanswered - still ringing
- phone answered - ringing stopped

When CPM determines that a call is not complete, an appropriate report will be sent to the local printer.

Reasons for a non-completed call:

- CPM determines the line is busy
- CPM does not detect cessation of ringing before end of programmed CPM ring count
- CPM does not detect either busy signal or valid ring signals

Reason for a completed Call:

- CPM detects at least one ring followed by cessation of ringing

If a call is not completed, the Verbatim autodialer will disconnect the call and enter the intercall delay state. At the end of the intercall delay, the next programmed telephone number will be dialed.

When a call is not completed, the intercall delay will always be shortened to 30 seconds. This CPM altered intercall delay is fixed at 30 seconds and is not affected by the user-programmed intercall delay. The normal programmable intercall delay will apply only to the delay between completed calls.

Call Progress Monitoring for firmaware version 2.09 is set to ON by factory default. If CPM is OFF the Verbatim will deliver voice messages without regard to any ringing or busy signals. This unit will simply dial the number, then after a short delay, start annunciating voice reports.

As noted above, dialtone detection is actually a part of the Phone Fault Detection feature. It is possible to have CPM turned OFF and Phone Fault Detect turned ON. In this case, the unit will test for a dialtone but not for busy or ringing signals.

Use code 900 to read or set CPM programming. Use code 900 followed by a 1 or 0 parameter to program CPM ON (1) or OFF (0).

The CPM ring count is the number of rings Verbatim autodialer will wait for an answer before considering the call to be incomplete. Use code 918 to read or set the number of CPM rings. The factory default is 10 rings and the user may program any number of rings from 5 to 20.

- For example, to program the CPM ring count to 10 rings, enter:

  `918 10 then ENTER`

6.2.13 Alarm Call Grouping

This is a programming step that "links" selected channels to selected dialout phone numbers, so that when a given channel goes into alarm, only the phone numbers "linked" to that channel will be dialed. Ordinarily, an alarm on any channel will cause dialing of the entire list of phone numbers.

Alarm Call Grouping is typically done when certain channels are associated with a specific category of personnel, such as electrical, plumbing, security, etc. However, Power Failure to the Verbatim autodialer causes dialing of all phone numbers. If you need to limit Power Failure alarm calls to selected numbers:

1. Turn off the regular Power Failure alarm function using code 9 2 1 0, (described below)
2. Then connect an unused input channel for power failure monitoring, using the contacts of a relay.

To program for Alarm Call Grouping:

1. Enter your phone number. It is important to first write in your entire list of phone numbers on Programming Worksheet A in Appendix J.

Note:

There is a 2-digit "Designation Number" on the Worksheet associated with each phone number (01 for the first number, etc.). This number corresponds with the 3-digit program code for entering phone numbers (701 for the first number, etc.).

2. Group them by using code `5 ZZ 9 DN`. Begin by filling in Programming Worksheet B in Appendix J.

   Refer to the filled-in examples for guidance. The right-hand column will now contain the actual program code strings which you should now enter, terminating each string entry with the ENTER key.

   For example, to link channel 1 to the second and fifth phone numbers, following the filled-in example, you would press:

   ```
   5 01 9 02 05 ENTER
   ```

3. Phone numbers will always be dialed in ascending order of the 2-digit Designation Numbers, regardless of their order in your program code entry. Note that an alarm on any channel that is not "linked" with a program code entry will cause dialing of the entire list of phone numbers.

   - To read the linkage programming on channel ZZ, press:

     ```
     5 ZZ 9 ENTER
     ```

- To "un-link" channel ZZ so that it again calls all phone numbers, press:

  5 ZZ 9 POINT ENTER

- To undo all existing linkage on all channels, press:

  9 35 2 ENTER

6.2.14 Alarm Ready Scheduling

Refer to Section 7, "Using the Alarm Ready Schedule Feature," for use and application information. See also Appendix E , "Data Acquisition/Central Data Logging."

6.2.15 Local Data Logging Programming Codes

Refer to Chapter 2, "Installation," for use and application information.

6.2.16 Analog Input Programming

Refer to Appendices B, C and D, "Analog Signal Input," "Remote Supervisory Control Output," and "Printer Options," for use and application information.

6.2.17 Remote Supervisory Control

Refer to Appendices B, C and D, "Analog Signal Input," "Remote Supervisory Control Output," and "Printer Options," for use and application information. See also Appendix E, "Data Acquisition/Central Data Logging."

6.2.18 Data Acquisition/Central Data Logging

Refer to Appendix E, "Data Acquisition/Central Data Logging."

6.2.19 Miscellaneous Programming Tips

(903) Time Between Alarm Call Outs

This is the length of time after ending one alarm call-out and before beginning the next call-out. Default value is 2 minutes; range is 0.1 to 99.9 minutes.

- To program a different number of minutes V, press:

  9 03 V ENTER

(904, 922) Alarm Reset Time

This is the length of time after acknowledgment before a given channel (or Power Failure) is automatically reset to a clear condition, ready to act on a new alarm condition. Refer to the diagram "Anatomy of an Alarm" in Section 5, "Using Your Verbatim Autodialer," for a depiction of the various events involved in association with the Alarm Reset Time. Default value is 1 hour; range is 0.1 to 99.9 hours.

- To program a different number of hours V, press:

  `9 04 V ENTER`

- To turn the Alarm Reset Timer function off, press:

  `9 22 0 ENTER`

Caution:

You should not turn the alarm reset timer function off under normal circumstances because once a given channel's alarm has been acknowledged, it would never again cause an alarm call out.

- To turn the Alarm Reset Timer function on again, press:

  `9 22 1 ENTER`

(905) Clear All Acknowledged Alarms and Alarm Reset Timers

Especially during setup and testing, it is useful to be able to re-trip an alarm after it has previously been tripped and acknowledged, without having to wait for the Alarm Reset Time to expire.

- To perform this clear out, press:

  `9 0 5 ENTER`

At the panel, the same result may be more easily obtained by pressing DISARM/RE-ARM to disarm the unit, then pressing it again to rearm the unit.

(906) Ring Answer Delay

Represents the number of rings required when calling the Verbatim unit, before the unit will answer. A long ring delay might be programmed if you wish personnel to have the opportunity to answer a regular telephone on the same line, before the Verbatim autodialer would answer. Default value is 1 ring; range is 1 to 20 rings.

- To program a different number of rings N, press:

  `9 06 N ENTER`

(907) Number of Alarm Message Repeats

Represents the total number of times each message or set of messages is spoken during each alarm call out. Normally a value of 3 repeats (strictly speaking, the alarm message plus 2 repeats) should be programmed. The reason for this is that there needs to be adequate message recital time to allow adequate time to answer the phone call and hear at least one complete set of messages. Default value is 3 repeats; range is 1 to 20 repeats.

- To program a different number of repeats N, press:

  `9 07 N ENTER`

(908) Autocall Test Function

The Autocall Test Function causes the unit to place test calls at regular intervals for the purpose of ongoing verification of Verbatim autodialer and phone line functioning. Calls are placed only once for each interval, to each regular phone number programmed (7 01 through 7 16). The exception being the acknowledgement of a test call, where additional calls will not be placed for that time interval. Each call gives the station ID message and a statement that this is a test call, plus a report of all inputs.

- To turn this function on, press:

  `9 08 1 ENTER`

- To turn it off, press:

  `9 08 0 ENTER`

The first series of calls begins as soon as the Autocall Test Function is turned on. Therefore, if you want the unit to call at 5 PM each day, you will need to turn this function on at that time. The default interval is 24 hours; range is 0.1 to 99.9 hours.

- To program a different interval V, press:

  `9 09 V ENTER`

Note:

If the Verbatim autodialer is in the disarmed mode, call-outs/autocalls will not be made.

(910) Security Access Code

Once you establish a Security Access Code, unauthorized personnel are prevented from altering your programming or messages over the phone without first entering the Access Code. This does not affect programming access at the panel.

- To establish an Access Code N of up to 8 digits, press:

  `9 10 N ENTER (at the panel)`

Once established, whenever you press a Command Tone 1 at the prompting beep, the unit first prompts you to enter the Access Code before allowing you to perform programming or message recording operations. You may still read existing programming without using the Access Code by pressing a Command Tone 2 at the prompting beep. However, the Access Code itself cannot be read over the phone.

- To delete the Security Access Code so that no code is required in order to perform over the phone programming, press:

  `9 1 0 POINT ENTER (at the panel)` **ONLY**

(921, 930) Power Failure Alarm Function ON/OFF; DISARM/RE-ARM All Alarms

- To turn off the Power Failure Alarm function, press:

  `9 21 0 ENTER`

- To turn the Power Failure Alarm function on again, press:

  `9 21 1 ENTER`

- To disarm the unit, preventing any alarm call outs, press:

  `9 30 0 ENTER`

- To rearm the unit, press:

  `9 30 1 ENTER`

At the front panel, the same result is more easily obtained by using the DISARM/RE-ARM key.

(700, 924) Callback/Callforward

This feature causes the unit to dial a special "zeroth" phone number on command. This is typically initiated over the phone, causing the unit to call back to the person who invoked the command, in order to verify the ability of the unit to successfully dial out. The unit gives a status report of all channels as part of this call.

- To program this special callback number, press:

  `7 00 (then the complete phone number) ENTER`

- To initiate the actual dialing, press:

  `9 2 4 ENTER`

If you have executed this command over the phone, the unit will advise you that it will be calling the callback number in 15 seconds. Then it will end the current call in preparation for placing the callback call. If you have executed this command at the front panel, the dialing will occur immediately.

Note:

If the Verbatim autodialer is in the disarmed mode, call-outs/autocalls will not be made.

(926) Delay Before Return to Normal (Exit Delay)

Sometimes it is desirable to prepare the unit for the ability to detect violations and dial out, but with an "exit delay" that allows the user time to exit or remove temporarily existing alarm violations before the unit becomes active.

To set delay before Return to Normal:

1. Press:

   `9 26 V ENTER`

   where V is the desired delay in minutes (range 1.0 to 99.9 minutes).

2. Then press DISARM/RE-ARM if necessary to extinguish the flashing DISARMED legend light. However, do not press NORMAL, but instead leave the unit in PROGRAM mode, with the PROGRAM light illuminated. The unit cannot go into alarm while in PROGRAM mode.

When the delay period times out, the unit will automatically return to NORMAL mode and will then be ready to act on any alarm violations that occur after that time. This code must be re-entered each time you wish an exit delay, since the delay value automatically returns to the default value of 2 minutes upon timeout.

The 2 minute default value provides protection against the possibility that someone might walk away leaving the unit in PROGRAM mode, or perhaps hang up the phone after performing over-the-phone programming without properly ending the call.

(932, 933, 934) Microphone and Speaker Operation

If you enable the front panel microphone using program code 933 as described below, the microphone will be automatically activated for a 15 second listening period at the end of each alarm or inquiry call, allowing you to hear the sounds near the unit from a remote telephone.

An additional warble tone is issued at the end of this listening period, allowing you to postpone tone acknowledgment until after the listening period.

- To turn this function on, press:

  `9 33 1 ENTER`

- To turn this function off, press:

  `9 33 0 ENTER`

If you have turned the microphone on, as above, then during any phone call, you may also invoke a one-time listening period by entering Remote Program Mode (press 1 at the warble tone) and then entering 9 3 2 # #.

- To turn off the speaker so that neither alarm call or inquiry call activity is heard at the unit, press:

  9 34 0 ENTER

The speaker will still be heard when operating keys at the front panel.

- To turn the speaker on again, press:

  9 34 1 ENTER

Note:

The speaker volume may be adjusted via the trimpot marked SPKR VOL shown on the Electrical Connection Diagram. See Section A.1, "Adjusting Internal Speaker Volume.

6.2.20 Program Clear Out Operations

The following list of program codes provides a flexible variety of operations to conveniently clear selected programming items in order to allow for a fresh start.

Code	Function
935 0	Clears out phone numbers; sets all delays to default.
935 1	Clears out phone numbers only.
935 2	Clears out all alarm call grouping linkage.
935 3	Sets the following delays to their factory default values: 902, 903, 904, 920, 921, 926, 928 (921 sets power failure alarm ON)
935 4	Clears all user recorded messages.
935 5	Clears all programming except messages. (Does not clear 913, 930, 941, and 942)
935 6	Clears all Totalizer counts to zero.
935 7	Clears and initializes clock.
935 9	Total clear out (Does not clear 941 and 942).

Caution:

Code 9 35 9 erases all programming and messages.

6.2.21 (940) Diagnostic Readouts

To assist in analyzing the way the unit is operating, the following list of diagnostic count codes is provided.

Code	Function
940	Reads all 4 diagnostic counts (add 0 to clear all 4)
940 1	Reads Call In Count (add 0 to clear)
940 2	Reads Dial Out Count (add 0 to clear)
940 3	Reads Acknowledged Alarm Count (add 0 to clear)
940 4	Reads Power Failure Alarm Count (add 0 to clear)
940 0	To Clear all Counts

7 Using the Alarm Ready Schedule Feature

7.1 Definition

An Alarm Ready Schedule is defined as an interval of time during which the Verbatim autodialer is ARMED and "Ready" to respond to alarm conditions. Alarm Ready Schedules can be automatically started according to times and dates entered by the operator. An Alarm Ready Schedule commences with the Verbatim autodialer becoming REARMED. (If the Verbatim autodialer was previously not DISARMED then the schedule will still be commenced at that time.) Once the Alarm Ready Schedule has commenced the Verbatim autodialer will continue in an ARMED state until the end of the Alarm Ready Schedule, at which time the Verbatim autodialer will be automatically DISARMED. Once an Alarm Ready Schedule has commenced it is said to be "active."

There are three steps to programming for Alarm Ready Scheduling:

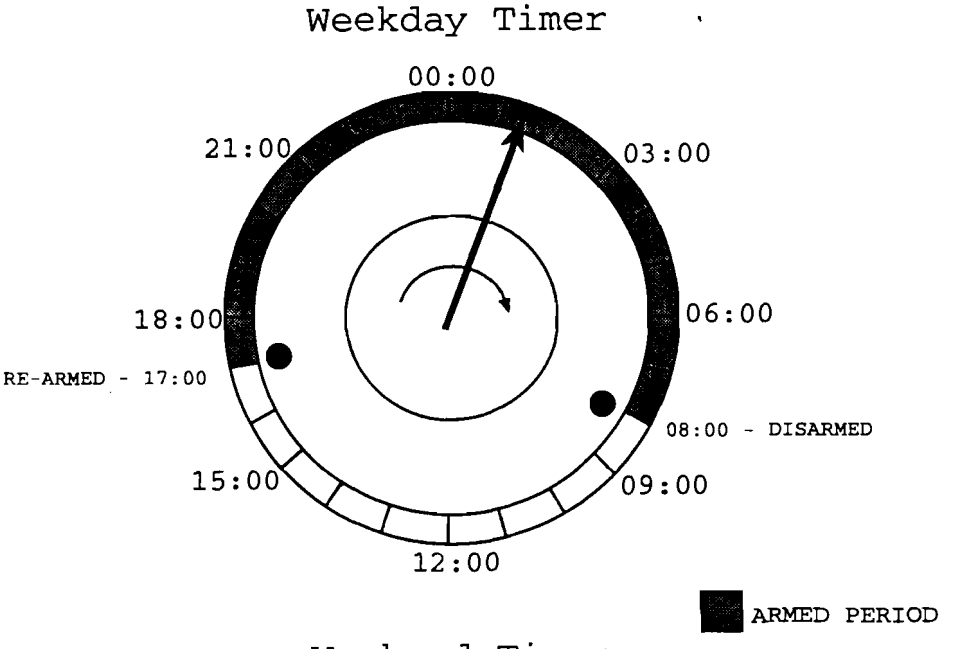
- Date and time setting
- Enter alarm start and stop times
- Enable the Alarm Ready Scheduling feature using code `966 N`.

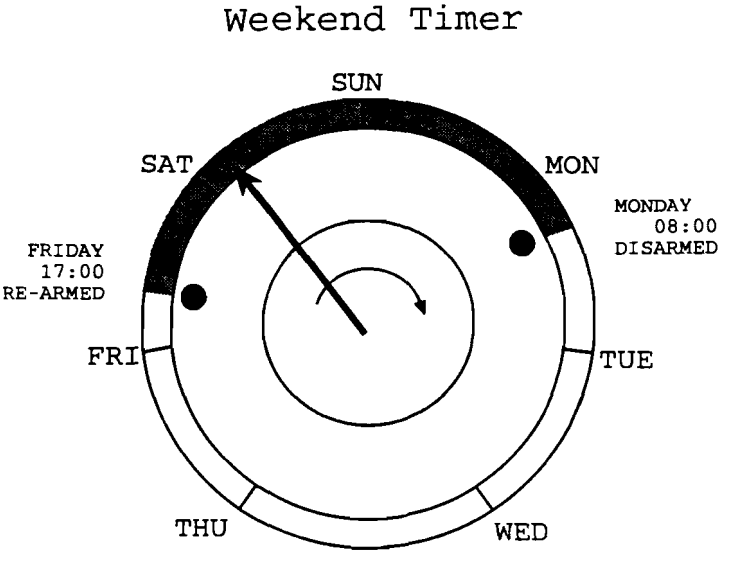
7.2 General Descriptions

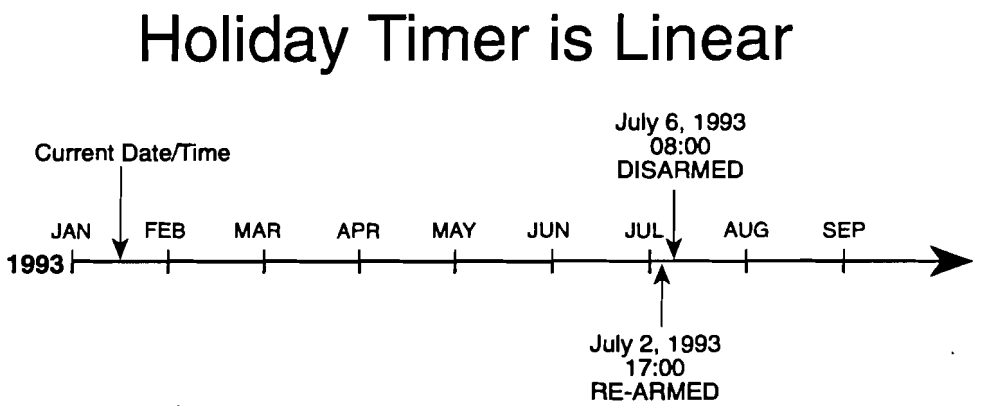
Alarm Ready Schedules can be viewed as really nothing more than an automated way of pressing the REARM/DISARM button. Therefore, if an alarm occurs while the Verbatim autodialer is DISARMED, no dial-outs will be made and the alarm will be automatically acknowledged. Correspondingly, if there is an acknowledged alarm when the Verbatim autodialer becomes REARMED and the input violation is still present then the Verbatim autodialer will begin calling after the trip delay has elapsed.

If the Verbatim autodialer is doing a sequence of alarm calls or Autocall calls at the time when an Alarm Ready Schedule should change the Verbatim autodialer's REARM/DISARM state the change will be delayed until after the end of the calling sequence.

Alarm Ready Schedules can be temporarily overridden by the operator pressing the REARM/DISARM button. However, if the REARM/DISARM button is pressed during an active Alarm Ready Schedule the schedule still remains active. If the operator DISARMs the Verbatim autodialer in the middle of an Alarm Ready Schedule the schedule will actually continue to it's ending time. It will then deactivate itself and attempt to DISARM the Verbatim autodialer just as if the Verbatim autodialer was still ARMED. If the operator DISARMs the Verbatim autodialer in the middle of an active Alarm Ready Schedule, then REARMs the Verbatim autodialer once again before the end of the Alarm Ready Schedule the schedule will remain active until its ending time. The schedule will then be deactivated and the Verbatim autodialer will be DISARMED.







7.3 Alarm Ready Schedule Modes

There are three possible Alarm Ready Schedules modes: Weekday, Weekend & Holiday. Any combination of these three possible schedules may be enabled at one time, however, the Verbatim may only become REARMED or DISARMED by one mode at a time. See Section 7.7, "Alarm Ready Schedule Priorities." For example, you may have both weekday & weekend schedules enabled at the same time or you may have all three enabled at the same time. When the Verbatim becomes DISARMED or REARMED by an Alarm Ready Schedule it will verbally announce which mode caused the REARM/DISARM action. The Alarm Ready Schedule modes are as follows:

Mode	Schedule
Mode 1	Weekday Schedule
Mode 2	Weekend Schedule
Mode 3	Holiday Schedule

For example, if there was a weekday schedule enabled to REARM the Verbatim at 1700 daily, when the weekday schedule became active the Verbatim would say, "REARMED for mode 1". Also, when there is a local printer connected to the Verbatim , the mode of the Alarm Ready Schedule causing the REARM/DISARM (WEEKDAY, WEEKEND, or HOLIDAY) will be printed along with the current time.

7.4 Weekday Schedule Mode 1

The weekday schedule will REARM the Verbatim autodialer daily at the programmed weekday REARM time and DISARM the Verbatim autodialer daily at the programmed DISARM time. If no weekend schedule is enabled (via the Alarm Ready Control Number settings) then the weekday schedule applies everyday, Monday through Sunday. As noted below, the weekend schedule is overridden by the weekend and holiday schedules.

7.5 Weekend Schedule Mode 2

If programmed, the weekend schedule operates once a week. The weekend schedule is set by factory default to be Friday through Monday. If the defaults are used the Verbatim autodialer could be REARMED every Friday afternoon at 1700 and DISARMED again every Monday morning at 0800. The weekend schedule could be changed from the defaults, for example, so that the Verbatim autodialer would be REARMED on Saturday and DISARMED on Monday (for organizations with 6 day work-weeks).

When the weekend schedule is enabled the weekday schedule will be overridden. In other words, there would be no DISARMING of the unit at 0800 Saturday morning.

By default, the weekend REARM/DISARM times are set to be the same as the weekday REARM/DISARM times. However, non-default weekend REARM/DISARM times may be entered if the operator so chooses.

Therefore, if personnel regularly leave early on Fridays then the REARM time could be set to 1500 instead of the usual 1700.

7.6 Holiday Schedule Mode 3

The Holiday schedule is a one-shot, non-recurring schedule which overrides all of the other schedules.

The Holiday schedule will be set by factory default to some Holiday period in the past (such as last Christmas).

Note:

For the Holiday schedule only, the exact date is entered including the year. Once, the Holiday schedule has been run it is complete and finished until a new schedule, for some date in the future, is entered.

To use the Holiday Alarm Ready Schedule, the operator must enter the REARM date (month/date/year) and DISARM date (month/date/year).

For the time-of-day, the Holiday Alarm Ready Schedule always uses the Weekend REARM/DISARM times.

7.7 Alarm Ready Schedule Priorities

There is a priority among the Alarm Ready Schedules. The Holiday Alarm Ready Schedule has the highest priority, then comes the weekend schedule and finally the weekday schedule.

If all three Alarm Ready Schedules are to be active, a Holiday schedule will always start at it's scheduled time & date regardless of the state of the other schedules. When the Holiday schedule is over then the other schedules will resume.

Likewise, the Weekend Alarm Ready Schedule has priority over the Weekday Alarm Ready Schedule. The weekend schedule will always start at its programmed day-of-week and time regardless of the state of the weekday schedule. When the weekend schedule is over then the weekday schedule will resume.

7.8 Programming Alarm Ready Schedule Parameters

The following section explains the Verbatim autodialer codes to be used for programming Alarm Ready Schedules and the Alarm Ready Schedule Control Numbers. Alarm Ready Schedule parameters may be entered either at the front panel or over the phone.

There are some restrictions which must be remembered when entering DISARM/REARM times and ALARM READY SCHEDULE CONTROL NUMBERS.

1. When entering new schedule times, the REARM time must be later than the time the operator is programming the schedule. However, it may not be possible to "jump" into a schedule when exiting the programming mode. For example, if the current time is 1700 hours and the operator enters a weekday schedule to REARM daily at 1630 and DISARM daily at 0730, this new schedule would not start until the following day at 1630 hours.

   Conversely, assume that the current time is 1700 hours and that the operator goes into PROGRAM mode and enters a new weekday schedule to REARM at 1705 and DISARM at 0800. At this time, the operator can either return to NORMAL mode or continue in PROGRAM mode and do other programming. Even though it may be after 1705 when finally returning to the NORMAL mode, the weekday schedule will still begin (or have begun) at 1705 hours.

2. You cannot enter any holiday date values which will cause the holiday REARM or DISARM date and time to be earlier than the current date and time. As explained below, the holiday schedule uses the weekend times for the time-of-day of the holiday REARM and DISARM.
3. It's useful to understand that the Verbatim autodialer's internal count-down timers used for REARM/DISARM times are re-calculated as a result of the operator making certain Alarm Ready Schedule programming changes. Anytime a new REARM or DISARM date/time is entered, a calculation is made to determine the next REARM and DISARM for that particular schedule.

   Also, when the ALARM READY SCHEDULE CONTROL NUMBER is changed all REARM and DISARM date/times are re-calculated. Further, whenever the current date or time is set or changed by the operator, all REARM and DISARM date/times will be re-calculated.

7.9 Starting the Real-Time Clock Chip, Time and Date Setting

Use Program Code 935 7 ENTER to start the real time clock chip. This needs to be done only once at the time of the installation of the chip.

Time and date may be set or corrected with the following programming code entries:

- To check the date:

  ```
  941 ENTER
  ```

- To set the date:

  ```
  941 MM DD YY D ENTER
  ```

MM is the month (03 for March); DD is the date (07 for the 7th day of the month); YY is the year (89 for 1989); and D is the day of the week (1 for Sunday; 2 for Monday, etc.). Entry of D is optional.

- To check the time:

  ```
  942 ENTER
  ```

- To set the time:

  ```
  942 HH MM SS ENTER
  ```

HH are the hours in military time (13 for 1 PM); MM are the MM (09 for 9 minutes); and SS are the seconds. Entry of SS is optional.

- To clear the time and date back to 00:00:00 on 01/01/89:

  ```
  935 7 ENTER
  ```

7.10 Setting Alarm Start & Stop Times

CODE 961

READ WEEKDAY REARM & DISARM TIME (defaults: 1700 & 0800) Press 9 6 1 then ENTER to hear the Weekday REARM & DISARM times recited. Times will not be altered and new REARM & DISARM values will not be calculated.

SET WEEKDAY REARM & DISARM TIME Press 9 6 1 plus REARM & DISARM time. For example, 961 1600 0700 then ENTER to set REARM time to 1600 (4:00 P.M.) & DISARM time to 0700 (7:00 A.M.) The user is allowed to enter just the REARM time, i.e.; 961 1600 (enter). But, if the user wants to change the DISARM time then both the REARM & DISARM times must be entered.

CODE 962

READ WEEKEND REARM & DISARM TIME (defaults: 1700 & 0800) Press 9 6 2 then (enter) to hear the Weekend REARM & DISARM times recited. Times will not be altered and new REARM & DISARM values will not be calculated.

SET WEEKEND REARM & DISARM TIME Press 9 6 2 plus REARM & DISARM time then ENTER, for example, 962 1500 0700 then ENTER to set REARM time to 3:00 P.M. & DISARM time to 7:00 A.M. The user is allowed to enter just the REARM time, i.e.; 962 1500 ENTER. But, if the user wants to change the DISARM time, then both the REARM & DISARM times must be entered.

CODE 963:

READ WEEKEND REARM & DISARM DAY-OF-WEEK (defaults: Fri. & Mon.) - Press 9 6 3 then ENTER to hear the Weekend REARM & DISARM day-of-week (d-o-w) recited as a number from 1 to 7. Note: Sunday = 1, Monday = 2, etc. Day-of-week will not be altered and new REARM & DISARM values will not be calculated.

SET WEEKEND REARM & DISARM DAY-OF-WEEK Press 9 6 3 plus REARM & DISARM d-o-w then ENTER. For example, 963 6 1 then ENTER to set the weekend REARM day-of-week to Friday & REARM day-of-week to Sunday. The user is allowed to change only the REARM d-o-w if so desired, e.g.; 963 7 ENTER to set the REARM d-o-w to Saturday. But, if the user wants to change the DISARM d-o-w then both the REARM d-o-w & DISARM d-o-w must be entered.

CODE 964:

READ HOLIDAY REARM DATE (default: 12/24/95) Press 9 6 4 then ENTER to hear the Holiday REARM date recited. The Holiday REARM will not be altered.

SET HOLIDAY REARM DATE Press 9 6 4 plus REARM date. For example, enter 964 12 24 95 ENTER to set holiday REARM date to December 24, 1995. The new REARM date can not be before today's date.

Note:

The day-of-week date cannot be entered for a Holiday schedule.

CODE 965:

READ HOLIDAY DISARM DATE (default: 12/26/95) Press 9 6 5 then ENTER to hear the Holiday DISARM date recited. The Holiday DISARM will not be altered.

SET HOLIDAY DISARM DATE Press 9 6 5 plus REARM date. For Example, enter 965 12 26 95 ENTER to set holiday DISARM date to December 26, 1995. The new DISARM date can not be before today's date.

Note:

The day-of-week date cannot be entered for a Holiday schedule.

7.11 Enabling the Alarm Ready Schedule Feature

CODE 966

READ ALARM READY SCHEDULE CONTROL NUMBER (default: 0) Press 9 6 6 then (enter) to hear the Alarm Ready Schedule Control Number recited. The Control number will not be altered and new REARM & DISARM values will not be calculated.

ALARM READY SCHEDULE CONTROL NUMBER HAS THE FOLLOWING MEANING:

0 OFF No Alarm Ready Schedules executed. Also used to reset all active Alarm Ready Schedules.

1 Only the Weekday Alarm Ready Schedule will be active. (Daily: Monday-Sunday) Default: REARMED everyday 1700 & DISARMED everyday 0800.

2 Only Weekend Alarm Ready Schedule will be active. Default: REARM every Friday 1700 & DISARM every Monday 0800.

3 Both Weekday & Weekend Alarm Ready Schedules will be active. Default: REARM daily at 1700 Monday-Thursday & DISARM daily at 0800 Tuesday-Friday. REARM Friday at 1700 & DISARM Monday at 0800.

4 Only Holiday Alarm Ready Schedule will be activated. Default: REARM at 1700 December 24, 1990 then DISARM at 0800 December 26, 1990

5 Both Holiday & Weekday Alarm Ready Schedules will be activated. Default: REARM daily at 1700 & DISARM daily at 0800. REARM at 1700 December 24, 1990 then DISARM at 0800 December 26, 1990.

6 Both Holiday & Weekend Alarm Ready Schedules will be activated. Default: REARM every Friday at 1700 then DISARM every Monday at 0800. REARM at 1700 December 24, 1990 then DISARM at 0800 December 26, 1990.

7 Holiday, Weekend & Weekday Alarm Ready Schedules will be activated. Default: REARM daily at 1700 Monday-Thursday then DISARM daily at 0800 Tuesday-Fri. REARM every Friday at 1700 then DISARM every Monday at 0800. REARM at 1700 December 24, 1990 then DISARM at 0800 December 26, 1990.

Note:

Whenever a new Alarm Ready Schedule Control Number is entered all REARM & DISARM values will be recalculated. Any active Alarm Ready Schedules will be halted and the Verbatim autodialer will be left in which ever REARM/DISARM state it was last in.

7.12 Factory Defaults

Activity	Schedule
Weekday REARM time	1700
Weekday DISARM time	0800
Weekend REARM day-of-week	Friday
Weekend DISARM day-of-week	Monday
Weekend REARM time	1700
Weekend DISARM time	0800
Holiday REARM date	12/24/90
Holiday DISARM date	12/26/90
Holiday REARM time	always same as Weekend REARM time
Holiday DISARM time	always same as Weekend DISARMtime
Alarm Ready Control Number	0 (all schedules disabled)

Note:

Both Weekend times are initially the same as their respective Weekday times, but can be reprogrammed.

7.13 Weekday and Weekend Alarm Ready Schedule Programming Example

For the following example assume that personnel are present at a plant being monitored by the Verbatim autodialer during normal business hours, Monday through Friday, 7 A.M. to 4 P.M. Assume further that there is someone at the plant every Saturday from 7 A.M. until 12 Noon and that the personnel would be aware of any alarm conditions at the plant and would not want the Verbatim autodialer to be making calls to phone numbers in its phone number list.

In this example, the Verbatim autodialer should be:

- REARMED every weekday evening at 1600
- DISARMED every weekday morning at 0700
- REARMED every Saturday at 1200 noon
- Stay in the ARMED state until it is DISARMED every Monday at 0700

For the example, use the following steps:

1. Verify that the current time is one of the times when the Verbatim autodialer is DISARMED, i.e.; during normal workday hours. It is important that the time be the current time, since any Alarm Ready Schedule begins with the Verbatim autodialer becoming REARMED and ends with the Verbatim autodialer becoming DISARMED.

   If a user were to set up a repeating Alarm Ready Schedule (weekday or weekend) during the time the Verbatim autodialer was to be ARMED, the programmed schedule would not actually begin until the next time that schedule was to take effect. For example, if the current time was 1630 and a weekday schedule was being programmed, that weekday schedule would not actually start until the next day at 1600.
2. Press the PROGRAM key to put the Verbatim autodialer into the program mode.
3. Set the current date and time: (if not already set)
   a. Enter CODE "941 MM DD YY d" followed by ENTER

      Where:

      MM = 2 digits for month, DD = 2 digits for date,

      YY = 2 digits for year, and d = 1 digit for day-of-week.

b. Enter CODE "942 HH MM SS" followed by ENTER

Where:

HH = 2 digits for hours, MM = 2 digits for minutes,

SS = 2 digits for seconds.

4. Set the Weekday REARM/DISARM times:

   Enter CODE "961 1600 0700" followed by ENTER to set the REARM time to 1600 and the DISARM time to 0700.

5. Set the Weekend REARM/DISARM times:

   Enter CODE "962 1200 0700" followed by ENTER to set the weekend REARM time to 1200 and the weekend DISARM time to 0700.

6. Set the Weekend REARM/DISARM day-of-week:

   Enter CODE "963 7 2" followed by ENTER to set the weekend REARM day-of-week to Saturday and the Weekend DISARM day-of-week to Monday.

7. Enable both the Weekday and Weekend Alarm Ready Schedules:

   Enter CODE "966 3" followed by ENTER to set the Alarm Ready Schedule Control Number to 3 to enable both the Weekday and the Weekend Alarm Ready Schedules.

Note:

If the Verbatim autodialer is configured with a local printer, a summary of all of the REARM and DISARM times will be printed.

8. Return to the Normal mode and make sure the Verbatim autodialer is DISARMED.

8 Maintenance, Testing, and Battery Replacement

Regular testing is the main element of a maintenance program for ongoing Verbatim autodialer reliability. The test should include interrupting AC power to the Verbatim autodialer for at least 4 hours to verify the gel cell battery maintains Verbatim autodialer operation for that time. You may wish to disconnect the phone cord to avoid nuisance calls during the test period.

Note:

The LOBAT light on the Verbatim activates whenever the charge or discharge current for the rechargeable battery exceeds a certain level. If the battery is not fully charged (as following installation or following a power failure) then the charging current will activate the light. If the battery is currently being discharged (as during a power failure) the light will be activated. The LOBAT light does not necessarily warn of a battery wearing out. It should be considered a secondary indication of battery and charger activity.

The gel cell battery is much like a car battery. That is, at the end of its life when called on to deliver power, it discharges very quickly without prior warning. The best protection is to replace the battery every 3 years regardless of any test results.

The battery is a *Power Sonic PS 640, 4 AH 6 volts*

You may order a replacement battery from RACO at the address below:

RACO Manufacturing and Engineering Co.
1400 62nd Street
Emeryville, CA 94608

Or from:

Power Sonic, Redwood City, CA; (415) 364-5001

See Section 9.2, "Phone Support Procedures," and Section 9.3, "Returning Parts to the Factory," for more information.

Verbatim™

Addendum to Owner's Manual

SINCE 1948

RACO

REMOTE ALARMS AND CONTROLS

Addendum to Verbatim Owner's Manual

Changes in Verbatim Firmware Revision 2.12

Raco Manufacturing and Engineering continually makes improvements in the operation and functionality of its products. This addendum describes Verbatim firmware revision 2.12 and its differences to the previous firmware revisions.

Are You Familiar with the Operation of the Verbatim Autodialer Yet?

Changes to a few, very specific features of the Verbatim are described in this addendum. It is assumed that the reader of this addendum is already familiar with the basic operation and programming method of the Verbatim. If this is not the case, please take the time necessary to familiarize yourself with the Verbatim autodialer by reading the Verbatim Owner's Manual.

Addendum Table of Contents

App. 1 Use New Programming Code for Total Clear-down

Section 3.1 of the Verbatim User's Manual (Starting Up and Clearing the Unit) advises that it's a good procedure to completely clear down the unit back to factory defaults. This step clears out all programming and should be performed prior to installation and before programming the unit for the application.

The User's Manual says to use programming code 9359 for the total clear-down operation. In firmware revision 2.12 programming code 9359 still operates identically to the way it did in previous firmware revisions. However, a new programming code, 935911, performs a more thorough clear-down, including a hardware reset.

For total clear-down press:

9 3 5 9 1 1 ENTER

This operation will perform a special type of hardware reset which clears all memory including user speech messages and resets all user programming back to factory defaults.

Note: If you perform this operation while programming the Verbatim over-the-phone the unit will hang up the phone without even saying "good-bye". However, the Verbatim will be ready to receive another a call from you immediately.

App. 2 Modbus Protocol & Local Data Logger (LDL) Now User Settable

In previous Verbatim firmware revisions, network protocols were always "hardcoded" at the factory and could not be altered. With firmware revision 2.12 and above the user may reconfigure networks and protocols as desired (within the basic capabilities of the unit as specified at time of purchase).

In fact, units are now shipped with ***NO*** protocols enabled. The user ***must*** enable the desired protocol at the time of installation according to the intended application of the product.

App. 2.1 Determining Network Port Number & Protocol Identifier

The Verbatim supports four device ports, named NET1-4. Connections to any of these ports are completely separate from each other. Each will need to be configured independently. The table below describes how they may be used. NET3, usable only for the Modbus Plus protocol, is only available in the Verbatim Gateway product. Consult the factory for details.

Port Name	NET1	NET2	NET4
Location:	J307 on expansion card (diagram in chapter 2)	J303 on expansion card (diagram in chapter 2)	inside door front panel card (see section 2.3)
Connector Type:	RJ-45	RJ-45	VPPC-1
Interface Specification:	RS-232C	RS-232C	Centronics
Supported Protocols:	Modbus, LDL	Modbus, LDL	LDL only

Network Device Ports

The general steps for connecting the Verbatim to a Modbus network or to a Local Data Logger printer are as follows:

- Determine which network interfaces are needed for the application. This step is beyond the scope of this manual. Consult the equipment vendors, or contact RACO Customer Service for advice.

- Prepare the external network connection. The following subsections describe usage and configuration for many interfacing devices. Follow the vendor's procedures for installation and configuration.

- Connect the correct cable between the autodialer and the network. Section 2 provides a diagram. Appendix F contains wiring diagrams for all cables. It now ought to be safe to power up all equipment.

- Use code 4906 to configure the desired protocol driver on the autodialer port.

- Use the other 490 codes to alter default settings for the autodialer's baud rate, data bits, stop bits, parity, node number, and communications timers as appropriate. If necessary, use the 495 codes to further optimize performance.

App. 2.1.1 User Codes for Enabling a Protocol on a Port

To enable a protocol on a particular port enter:

4906 net * N

Function:	Sets protocol for network. Omit *N to just read the value
Range:	See Table below
Default:	NONE. **All protocols must be explicitly configured by the user.**
Response:	*<net ID> protocol is <current protocol>*

N	Protocol	Description	Nets
0	NONE	device disabled	All nets
5	MODBUSM	Modbus Master	Net 1 or Net 2 on VCP card
128	LDL	Local Data Logging May only be used on one device	Net 2 only on VCP Otherwise - Net 4

Protocol Identifiers

If there is any error setting a protocol then the error response is made, and the prior protocol and operations are restored. If the configuration is successful the following things happen:

- All network parameters are set to their default values, and all diagnostics are cleared. These default values depend on the protocol.

- If the new protocol is different than the old, all RCs using that device are completely cleared down. If the old and new protocols are identical, then only the diagnostic information is cleared.

- If the new protocol is Modbus, RC scanning on the net is enabled.

- If the new protocol is LDL then the prior LDL device (if any) is closed and output will resume on the new device with no data loss.

- If the old protocol is LDL and the new one is not, then all unprinted data will be lost.

App. 2.2 Local Data Logger Specifics

The Local Data Logger (LDL) interface (either serial or parallel) may now be turned ON/OFF or reconfigured by the operator. If your LDL printer is interfaced via the Asynchronous Communications option (VCP Card), you may now set serial interface parameters to match the settings of your serial printer. The serial parameters of baud rate, data bits, stop bits and parity may be read and changed by programming codes.

NOTE: The Local Data Logger now must be turned ON by the operator before any LDL output will be sent to the printer. LDL is set to OFF by factory default.

App. 2.2.1 Determining Your Local Data Logger Method of Interface

There are two possible ways to interface a printer to the Verbatim for Local Data Logging — parallel or serial. The remainder of this section describes these two methods and the steps necessary to connect and configure LDL.

Parallel interfaced printers are the most common type of printers and are usually the least expensive. Raco Verbatim autodialers always include a parallel interface for Local Data Logging at no extra cost. However, there is one disadvantage of parallel interfaced printers. The parallel interface requires that the cable between the Verbatim and the printer be short — about 15 feet maximum.

Serial interfaced printers can have comparatively long cables — up to several thousand feet if the baud rate is derated with the increase in cable length. The major disadvantage of serial printers is that the serial interface usually increases the cost of the printer.

Is Serial Local Data Logging a Possibility?

Your Verbatim autodialer may have been configured at the factory with the Verbatim Asynchronous Communications Option. This Verbatim expansion card is sometime also called the Async. Com. Card and is label on the expansion circuit card as VCP.

You may not have specifically requested this option. However, you may have received it as a result of ordering the Modbus PLC interface option. If your Verbatim unit *does* have the Async. Com. Card then it is possible to interface a serial printer for Local Data Logging. That is, if you are using the Async. Com. Card for just one Modbus (PLC) network connection then you may use the remaining network port to interface a serial printer for Local Data Logging.

Required Cables

Serial printers are interfaced via Raco cable VSER-01 (cable drawing is Owner's Manual Appendix G-2) connected to the modular jack J303 on the VCP card. (Refer to Owner's Manual Appendix F-4)

The parallel interface for Local Data Logging uses Raco cable VPPC-1 (cable drawing is Appendix G-3) connected as per the instructions in section 2.3 of the Verbatim Owner's Manual.

App. 2.2.2 Turning ON LDL

To turn ON the Local Data Logger interface press:

4 9 0 6 Net * 128 enter

Where Net is:
2 for the Serial Interfaced LDL (Modular Connector J303 on VCP Card)
4 for the Parallel Interfaced LDL (Dual-row Connector on Front Door)

Note: * is the key labeled 'POINT' on the top portion of the key and '*' on the lower portion..

App 2.3 Setting Serial LDL Parameters

Note: The following is not applicable to parallel interfaced LDL.

To read the serial communication parameters for serial interfaced LDL press:

4 9 0 0 2 enter

To reset all serial communications parameters for serial LDL to factory defaults press:

4 9 0 0 2 * enter

To set the baud rate for serial interfaced LDL press:

4 9 0 1 2 * N enter

Where N, if present, is 50, 75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, or 57600. All other values are ignored.

To set the data bits for serial interfaced LDL press:

4 9 0 2 2 * N enter

Where N, if present, is 5, 6, 7 or 8. All other values will be ignored.

To set the stop bits for serial interfaced LDL press:

4 9 0 3 2 * N enter

Where N, if present, is 0 for NO parity, 1 for ODD parity, 2 for EVEN parity, 3 for SPACE parity, or 4 for MARK parity. All other values will be ignored.

App 2.4 LDL Notes and Exceptions

NOTES:
1) Factory defaults for serial interfaced LDL are: 9600 baud, 8 data bits, 1 stop bit, NO parity.
2) Setting serial communications parameters applies only to printers interfaced via the Asynchronous Communications Option (NET 2). When a Local Data Logger printer is interfaced via the parallel printer interface (NET 4) there are no communications parameters to be set.
3) Only one interface method, either serial or parallel, may be used at a time. Turning ON the serial interfaced LDL turns OFF the parallel interfaced LDL and vise versa.

App. 3 Programming Code 917 Removed But Features Still Exist

The combined programming code for *Phone Fault Detection & Automatic Tone/Pulse Selection* has been removed.

App. 3.1 Automatic Tone/Pulse Selection

Automatic tone/pulse selection can no longer be configured by the operator. However, the Verbatim still performs automatic selection of tone or pulse dialing.

The unit performs automatic tone/pulse selection only after the following events occur:
1) power is applied to the unit *and* dialing mode had not been altered from default tone mode.
2) the operator performs programming code 9 3 5 9 1 1 to set all programming to factory defaults.
3) jumper blocks JB-3 or JB-5 shorted together for hardware reset.

Notes:
1) performing programming codes 9 3 5 9 or 9 3 5 9 1 1 or shorting jumper block JB-3 will erase all programming.
2) If the operator has explicitly programmed the dialing mode (using code 901) cycling power or shorting jumper block JB-5 will ***not*** change the dialing mode programming.

If the Verbatim has automatically selected the dialing mode the resulting setting may be read by using programming code 901. And, as in all versions of Verbatim firmware, the operator may also use code 901 to manually select tone or pulse dialing mode. Refer to the Verbatim Owner's Manual section 3.2

App. 3.2 Phone Fault Detection

Use programming code 916 to turn ON/OFF Phone Fault Detection. In prior firmware revisions programming code 916 was only used to set the Phone Fault Detection Interval. Now, also use code 916 to turn ON/OFF the Phone Fault Detection feature as follows:

Turn Phone Fault Detection OFF by setting the Phone Fault Detection Interval to a value of 0.
Turn Phone Fault Detection ON by setting any valid Phone Fault Detection Interval.

To turn OFF Phone Fault Detection press:

9 1 6 0 enter

To turn ON Phone Fault Detection press:

9 1 6 V enter

Where: V a valid Phone Fault Detection interval of 0.1 hours to 24.0 hours.

App. 4 Personal Identification Numbers

The personal identification number (PIN) feature is provided as a way both to limit telephone access to the Verbatim autodialer and to provide an audit trail of acknowledgments. The use of PINs is always optional, and the default configuration omits them. PINs do not alter operations of the programming mode security feature (code 910) in any way.

Each authorized operator is assigned a unique PIN to identify them. This PIN will appear in the printed Local Data Logger reports of telephone sessions and alarm acknowledgments. The remainder of this section describes operations in more detail.

App. 4.1 PIN Operations

A PIN consists of 1-5 digits. It is not possible to use any letters or other symbols. Up to 32 distinct PINs may be configured.

Once any PIN has been configured, thereafter all over-the-phone sessions will require entry of a valid PIN. The session begins with the station ID message followed by a prompt to enter a PIN. The entry is made by pressing the DTMF keys, followed by the double pound-key termination.

This prompt is given a maximum of three times at 10 second intervals. If no valid PIN is entered, the Verbatim says *good-bye* and then hangs up. The calling sequence then proceeds as if the call had not been answered at all.

If a valid PIN is entered, that event is logged and the session continues as standard. Entry of the PIN does not automatically acknowledge anything. Use of the usual DTMF tones is still required. Any acknowledgments during the session will cause that operator's PIN to become associated with the acknowledgment status of the channel. That PIN will then be printed as part of any subsequent LDL status reports. Voice status reports omit this PIN information.

Only the most recent PIN to have acknowledged a channel (either ALARM or RTN) will be logged. Any operator working from the front panel is always given the PIN of 00000. Standard operations may be restored at any time by clearing all PINs (code 48*).

App. 4.1.1 PIN Local Data Logger Output Examples

The following text provides a sample of the LDL output when PINs are active. All PIN-specific entries are shown in boldface italics. The first segment shows a sample alarm session:

```
ALARM  MODE 13:39:10 Mon.  8/14/95
Alarm session with phone #1. # is 1.    13:39:16 Mon.  8/14/95
Valid PIN 50000 entered 13:39:39 Mon.  8/14/95
Channel                          Status
-------------------------------------------------
   1                             ALARM
   2                             ALARM
   3                             ALARM
Acknowledgment for linked alarms via phone #1 (1) PIN was 50000.
13:39:46 Mon.  8/14/95
HUNG-UP at  13:39:47 Mon.  8/14/95
NORMAL MODE  at 13:39:47 Mon.  8/14/95
```

This next segment shows a sample phone-in session. Note that the PIN '00000' indicates operator acknowledgment from the front panel.

```
CALL-IN MODE 13:41:52 Mon.  8/14/95
```

```
Valid PIN 50000 entered 13:42:02 Mon.  8/14/95

Channel                          Status
-------------------------------------------------------
   1                             ALARM, Acknowledged by PIN 50000
   2                             ALARM, Acknowledged by PIN 00000
   3                             ALARM, Acknowledged by PIN 40032
   4                             NORMAL

HUNG-UP at  13:42:19 Mon.  8/14/95
```

App. 4.2 Programming Personal Identification Numbers

The following programming codes are provided for configuring and controlling the PIN functionality. For security reasons, all commands in this group are available only from the front panel. If entered over the telephone, the *error, enter program code* response is made.

48 ddddd
Function Establishes 'ddddd' as a valid PIN.
'ddddd' must consist of 1 to 5 numeric digits.
Response *P-I-N is ddddd* (success)
P-I-N exceeded (32 PINs already configured, invalid characters, too long, or '00000' is specified.
Note The sequence '00000' is reserved to indicate any front panel operator.

48 ddddd *
Function Deletes 'ddddd' as a valid PIN.
Response *P-I-N ddddd is cleared* (success)
P-I-N error (failure)
Note Any channels currently acknowledged by PIN 'ddddd' will thereafter appear acknowledged "by PIN 00000".

48
Function Lists all PINs currently configured
Response *All P-I-Ns programmed are ...list...* (PINs currently configured)
No P-I-N is programmed (No PINs currently configured)

48 *
Function Erases all PINs currently configured
Response *All P-I-Ns programmed are cleared*

Note: This effectively turns off all PIN functionality. No more "acknowledged by PIN ....." messages will be logged.

App. 5 Totalizer Alarm Reset Timers Now Affected by Programming Codes 904 and 922

In prior firmware revisions changing the setting of either code 904 (Read/Set Alarm Reset Time) or code 922 (Alarm Reset Timer On/Off) had no effect on the alarm reset timers for totalizer alarm channels. Now,

with Version 2.11, changing the setting of code 904 or 922 will clear the alarm reset timers for totalizer channels in exactly the same manner as for discrete and analog alarm channels.

App. 6 Feature Codes 923 and 981 Now Mutually Exclusive

Programming code 923 is used to program the Verbatim to cease the alarm calling sequence when all inputs have returned-to-normal status. Programming code 981 is used to program the Verbatim to make calls to personnel when the inputs to channels with acknowledged status return-to-normal (no violation) These two features have now been made mutually exclusive. That is, setting one feature ON sets the other OFF. Refer to page K-5 for details on code 923. Refer to section E.1 for details on code 981.

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K Annunciator Sequences and Options

9 Troubleshooting Tips

9.1 What's The Problem?

Unit is dead: no lights or voice.

If the unit will not respond to the ON/OFF key, verify that the battery is connected. Verify that there is 120 volts AC between the WHITE and BLACK wire terminals on TS3. Verify that the fuse (1/4 amp slow blow) is not blown.

Unit seems OK but will neither answer nor dial out on phone line.

This assumes that you hear a voice report at the panel when you press CHECK STATUS. With the NORMAL light lit, test the phone line by pressing DIAL-OUT. The PHONING light should light and you should hear a dial tone.

If you do not hear a dial tone, open the door of the unit and verify that relay K1 is correctly seated in its socket, with its indentation mark facing downward. Check the phone line and its connection with a DC voltmeter and/or a separate telephone handset. Verify the presence of about 50 volts DC between the RED and GREEN conductors on phone line terminal strip TS2. This voltage will drop to just a few volts when the Verbatim autodialer or other connected phone device goes off hook (PHONING light lit).

If you do hear the dial tone after pressing DIALOUT, press the digits of a valid phone number. You should hear the loud clicks of relay K1 (for pulse dialing) or else the tones of tone dialing, as you press each digit. The dial tone should cease after you have entered the first digit. Continue until you have dialed the complete phone number. You should now hear the sound of ringing and someone answering at the other end. End the call by pressing NORMAL.

Unit answers incoming calls, and also goes into alarm when it should and attempts to dial out, but does not reach dialed number.

First, verify whether the unit is actually attempting to dial out, as evidenced by pulse dialing clicks or tone dialing sounds followed by message recital. If not, then see the separate problem below, "Unit does not go into alarm when it should".

If your unit has previously been programmed for Automatic Tone/Pulse select (via code 917 2 or 917 3) and has been left connected to a phone line for several minutes, then you can assume that the correct dialing mode for your phone line has already been selected. Again, refer below to "Unit does not go into alarm when it should."

If Automatic Tone/Pulse select is programmed OFF (via code 917 0 or 917 1) and you hear the clicks or tone dialing sounds, but the dial tone does not cease, perhaps your phone system requires the opposite mode of dialing (pulse vs tone) from its presently set mode. Read the present mode by pressing PROGRAM 9 0 1 ENTER. Then set the opposite by entering 9 0 1 1 (to change to tone dialing), or 9 0 1 0 (to change to pulse dialing). Then press NORMAL and repeat the manual DIALOUT procedure as described above.

Verify that you have programmed complete phone numbers including any area codes or "1" prefixes that might be required to complete the call.

Consider whether your phone system requires a prefix such as 9 to be dialed, followed by a delay period (to access an outside phone line) before dialing out. If so, see Section 3.2, "Programming Phone Numbers."

Unit dials out, but will not answer incoming calls.

Check programmed ring delay by pressing PROGRAM 9 0 6 ENTER. If it is set for a number larger than one, the Verbatim autodialer is not supposed to answer until the corresponding number of rings has been received. Try setting it back to 1 using code 9 0 6 1 ENTER. If the unit still will not answer incoming calls but is able to dial out, try plugging a regular telephone into the same phone jack in place of the Verbatim autodialer and see if it rings. If the problem is not the phone line, try temporarily connecting test point C to test point D on the main circuit board, for a period of about 5 seconds and see if it "answers" with the PHONING light and a voice report, then call the factory for advice.

Unit will not go into alarm when it should.

This is usually the result of incomplete understanding of how the Verbatim autodialer manages alarms.

For the Verbatim autodialer to go into Unacknowledged Alarm and Dial Out, a violation must be continuously present for the Alarm Trip Delay time. At least one phone number must be programmed. The unit must not be in the DISARMED state. And, the channel that has the violation must not already be in an acknowledged alarm state, since acknowledged alarm status for a given channel (including power failure) precludes further activity on that channel until that status is cleared. Refer to Section 5, "Using Your Verbatim autodialer," for a discussion of how the unit manages alarms.

To clear the acknowledged alarm status of all channels including power failure, starting with the NORMAL light lit, press DISARM/RE-ARM to get the flashing DISARMED indication, then press it again to re-arm the unit with all acknowledged alarm statuses cleared. Now any violations lasting longer than the Alarm Trip Delay will cause unacknowledged alarms and dialing.

Unacknowledged alarm status is indicated by the corresponding channel number flashing. Acknowledged alarm status is indicated by the same light remaining on continuously without flashing.

If you don't observe this, press PROGRAM and then press 7 0 1 ENTER to check your first phone number. Press 9 0 2 to check the Global (overall) Alarm Trip Delay. For the specific channel ZZ (2 digits) that you are attempting to create an alarm on, also press 6 ZZ to check for any longer Individual Alarm Trip Delay setting.

Check the Normally Open/Normally Closed alarm criteria programming for this channel by pressing 5 ZZ. Make sure it is not set for No Alarm or for Run Time Meter, since these settings would not allow an alarm. Now, for example, if the channel is configured Normally Open, you will want to temporarily provide a Closed Circuit at its input to trip the alarm. You can directly read and verify the Open/Closed status you are applying by pressing 0 ZZ 0. You may also use a DC voltmeter to trace your circuit connections. With the Verbatim autodialer turned on, an Open Circuit to a channel contact input reads 5 volts DC with respect to the "C" terminals or electrical ground. A Closed Circuit reads zero volts.

Unit keeps calling when it should not.

Be sure that the initial alarm call is in fact being acknowledged. The unit will specifically state "alarm is acknowledged" at the moment you successfully acknowledge the call. The unit will accept a tone acknowledge only following the prompting warble beep.

Also, be sure that the alarm violation has been corrected. Otherwise, even if the alarm is acknowledged, when the Alarm Reset period times out, dialing will begin again.

Write down exactly what the unit recites when it gives the unwanted call. This provides valuable guidance as to the cause and correction of the problem. You may need to lengthen the Alarm Trip Delay in order to minimize nuisance alarms, particularly the power failure Alarm Trip Delay (code 920). If you hear an alarm message with the phrase "now normal" added at the end, it means that the violation occurred long enough to trip the alarm but has returned to normal by the time you are hearing the report. In the case of power failure, if the power has been restored by the time the message is being heard, the message will be "Power is on". The fact that power is mentioned at all lets you know that there has been a power failure lasting longer than the power failure Alarm Trip Delay. Power will continue to be mentioned in any phone call or front panel status check, until the Alarm Reset time expires.

Unit is continuously "locked" in on state, or is behaving erratically.

Environmental factors such as lightning or power surges may have caused program lockup. With the unit turned on, use a screwdriver blade to momentarily connect the two pins on Jumper Block JB5 (see diagram Appendix H, p. H-26).

If this does not return the unit to normal operation, next try jumping the 2 pins on JB3. This latter step will erase all user programming and recorded messages, so all user programming and messages will need to be re-entered.

9.2 Phone Support Procedures

Make sure you have the following before you call:

- Serial #: Found inside front panel. If you are not at the unit, call the unit up and enter program code 968. This will give you a number that our Customer Support Department can reference.
- Note the unit's symptoms: Exact speech pattern, what it is saying, if it is calling or not. The more specific and accurate you are in describing the symptoms, the quicker the Customer Support Department will be able to diagnose and troubleshoot the problem. In many cases, it may save a return to the factory.

THEN call 1-800-449-4539 for Customer Support.

If the Customer Support determines that the unit needs to be sent to the factory for repair, you will be given a Return Materials Authorization (RMA) number.

9.3 Returning Parts to Factory

Pack all parts well! To avoid extra charges, return any removed chips card guides or daughter boards to the factory at the address below:

RACO Manufacturing and Engineering Co.
1400 62nd Street
Emeryville, CA 94608

Remember to:

- Put return address on package.
- Include a packing slip.
- Have serial # and RMA # handy when you call in for tracking.

A Verbatim Series DFP Autodialer

The following is an instruction supplement for the Verbatim Series DFP autodialer. This supplement describes differences between the Verbatim Series DFP, and the Series VSS.

The Series DFP is a modified Verbatim autodialer which omits the front panel keypad and some of the front panel LED indicators. The primary practical difference between the two models is that the programming for the Series DFP must be done over the phone, whereas programming for the Series VSS may be done over the phone or at the front panel.

The enclosed diagram of the front panel of the Series DFP (p. A-2) replaces the Series VSS diagram on page 2-5 of this manual. A supplemental diagram of the inside view of the front door panel (p. A-3) is also enclosed, showing the location of the ON/OFF switch.

The practical differences to consider in programming and using the Series DFP are explained below.

A.1 Programming the Series DFP from a Remote Telephone

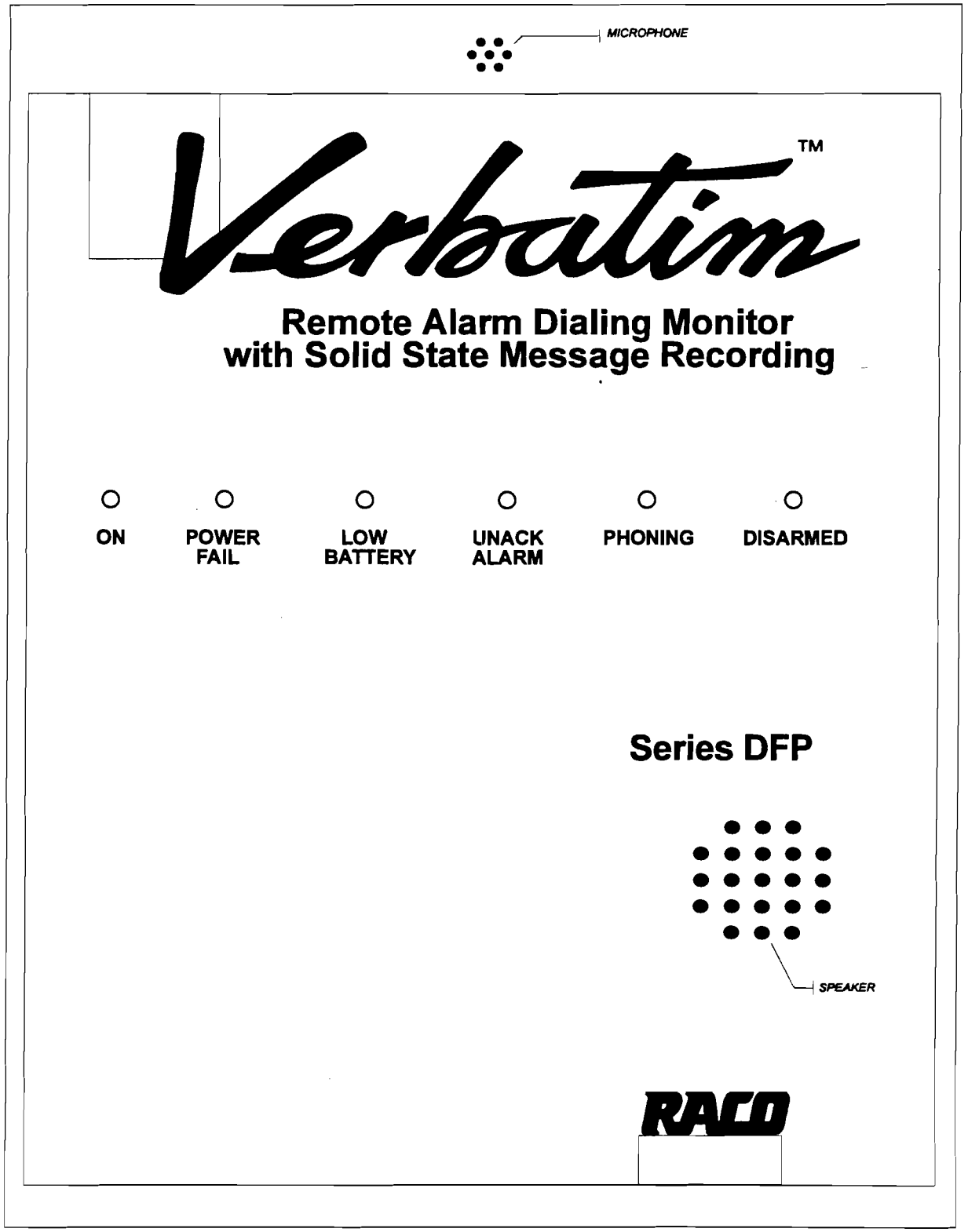
All programming of the Series DFP Verbatim autodialer is done from a remote Touch Tone telephone. This method of programming the product is described in Section 5.7 of this manual, and it is also more briefly referred to at other places in the manual such as Sections 4.2 and 4.3. With the Series DFP, this is the sole applicable means of programming. Therefore an "advance" description of over-the-phone programming follows.

When you call the Verbatim from any Touch Tone telephone, it will answer and begin reciting its message. At the end of each round of messages, you will hear a warble tone. If you press a command tone "1" immediately following this tone, you will the Verbatim autodialer will then be in Program Mode, and you will be prompted to enter a program code.

A chart listing the program codes is located in Section 6.1 of this manual. This section also includes some guidelines for using the program codes, and a more complete description of the programmable items is located in Section 6.2.

Program code entries generally consist of three digits, which may or may not be followed by additional followup values, before you complete the entry by pressing the # key twice. You will hear a spoken confirmation of each numerical tone digit as you issue it. There is no spoken response to the # or * key.

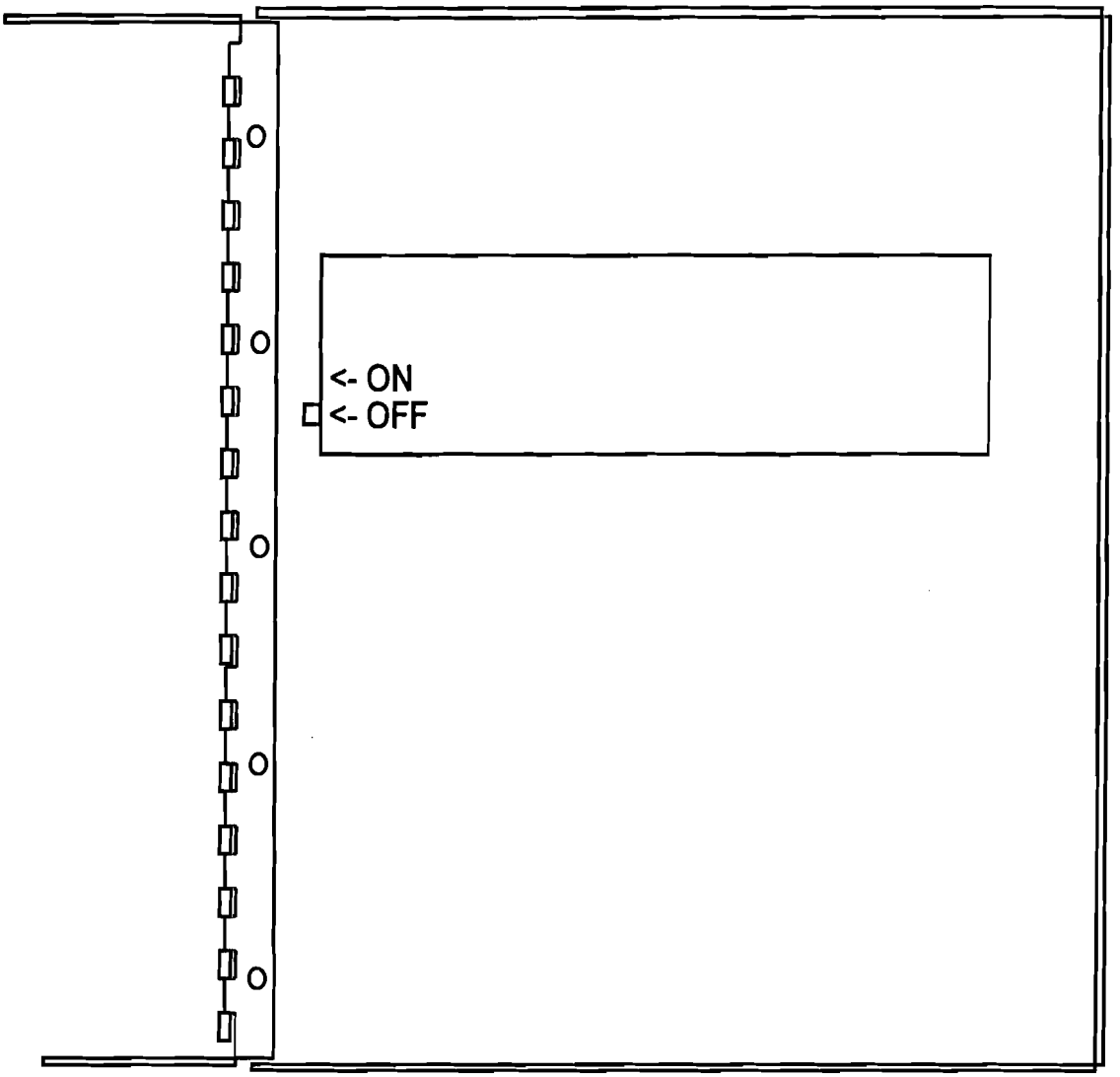
Verbatim Series DFP Front Panel Diagram



*** A discharged battery may take up to a day to fully charge. Meanwhile, light may remain on.**

**** During AC power failure, all illuminated LED's will flash to conserve battery power.**

Verbatim Series DFP Inside Front Panel ON/OFF Switch



Inside view of front panel, showing ON/OFF switch

Note:

The procedure of pressing the # key twice, is to be used in relation to all references throughout this manual to the term, "ENTER."

In general, if you enter just the three tone digits followed by # #, you will hear the present setting or value for that program item. If you include additional values before the # #, the new value will replace the existing setting or value. In either case, the voice report will provide confirmation of the updated program setting or value.

Sometimes there is need to include a decimal point or a minus as part of a value entry. Also, if you make a mistake as you are issuing tone digits, you will want to cancel the entry. The conventions for these functions are as follows:

CANCEL	* *
ENTER	# #
POINT	*
MINUS	#

To end a phone call after programming, press # # without any prior tone digit. The Verbatim autodialer will then issue a prompting warble tone which is an opportunity to re-enter a "1" if you did not really want to end the call. It will then say, "Goodbye," and end the call.

Refer to Section 5.7 for a description of the other command tones that may be used in place of the "1" for special purposes.

A.2 Programming and Testing

The following sections provide a sequential reference to this manual regarding the relevant differences and similarities in instructions for the Verbatim Series DFP.

A.2.1 Resetting (Clearing) the Unit

Caution:

The following step erases all user programming including recorded messages so normally it is done only at initial setup.

Turn the unit on if it is not already on, via the switch at the rear of the front panel door. From a touch tone telephone, place a call to the phone number of the unit, and at the sound of the warble tone, issue a command tone "1" as described above.

To clear the system of all programming, in program mode as described above, issue:

9 3 5 9 # #

As always, if you make an error in issuing tone digits, press * CANCEL and start again.

A.2.2 Programming Phone Numbers

Essentially the same as Section 3.2 in this manual.

A.2.3 Programming Input Channels

Essentially the same as Section 3.3 in this manual.

A.2.4 Initial Testing

Temporarily place all input signal sources into their alarm state, long enough to satisfy the alarm trip delay. The unit will begin dialing the first phone number, perhaps before you have managed to get all the inputs into an alarm indication state. You should hear the a dial tone and then the sound of ringing, and then the sound of someone answering the call. Testing consists in verifying that the call is actually received at the first phone number, and that all the alarm messages are recited.

Your Verbatim Series DFP autodialer is now able to operate, having at least one dialout phone number programmed, and having its input channels configured. However, you may wish to record your own voice messages (Section 4) or perform special advanced programming items (Section 6) before referring to Section 5 on using your programmed Verbatim Autodialer.

A.3 Recording Messages In Your Own Voice

Essentially the same as Section 4 in the Owner's Manual, but following the guidelines for over-the-phone programming and recording.

A.4 Using Your Programmed Verbatim Autodialer

Section 5.7 is largely replaced by the discussion in Section 4 regarding over-the-phone programming, except for discussion of the alternative command codes "2," "3," "4," and "0."

Disregard Section 5.8.

A.5 Remainder of the Manual

All other descriptions in this manual may be followed and applied to the DFP with no practical limitiations.

Note:

The lack of front panel programming has specific impact on some minor aspects of specific programming items, as follows:

- **CODE 910:**

  SECURITY ACCESS CODE No Security Access Code may be programmed since this could only be programmed from the front panel keyboard.

- When a delay between dialing digits is needed (as for pager applications), it will only be possible to insert one delay period, since this is done over the phone by pressing the # key, and if this were pressed more than once in succession it would be interpreted as a Cancel Entry command. Therefore to get the length of delay desired, use 928 to extend the duration of the single delay from its default value of one second, to whatever value is needed.

- **CODE 926:**

  EXIT DELAY FUNCTION The Exit Delay function is not applicable in the absence of the front panel keyboard.

- The Speakerphone/Dialout function is not applicable in the absence of the front panel keyboard.

- There is no Parallel Printer Output.

- The speaker and microphone are present. However the microphone is limited to the function of optionally "listening in" since voice recording must be done via remote telephone.
- The On/Off function is controlled via the slide switch inside the front panel door. See diagram on page A-3 .

A.6 Enhanced Telephone Interface Features

The manual Section entitled, "Enhanced Telephone Interface Features," is generally applicable except that there is no front panel indication for telephone line failure.

B Analog Signal Input

B.1 Analog Connections

Refer to the diagram (page B-10) showing the VAN analog boards for connection of analog inputs. Be sure you follow the indicated positive and negative polarity indications, except in the case of TS705 temperature sensor inputs, for which positive and negative polarity does not matter. Two signal wires are required for each input. The terminal blocks can be unplugged for convenience. Because of the space constraints, it is best to use small gauge wire like telephone wire. If bulkier wire is needed outside the dialer, it is best to install a terminal strip outside the dialer to make the transition from the bulkier wire to the more compact wiring going into the analog input connection points.

Note:

Take care to route the incoming signal wires to one side of the enclosure or the other so that they do not interfere with the front panel circuit board when the unit's door is closed. Also, try to route the analog signal wires away from power wiring to minimize noise pickup.

B.1.1 Programming for Analog Channels

Each analog input will need to be programmed to specify:

1. The analog Input Signal Type (if other than standard 4-20 ma input).
2. The numerical value to be spoken at a corresponding minimum signal level.
3. The numerical value to be spoken at a corresponding maximum signal level. Items 2 and 3 amount to programming the translating scaling factors for each analog input.
4. In many cases you will also want to program high and low setpoint limits for each analog input.
5. You may also elect to replace the generic default voice message with your own recorded messages for any analog channel, as described in section 4.

B.1.2 Assignment of Input Channel Numbers

The unit automatically assigns the lowest channel numbers to whatever number of contact input channels exist on the unit (whether or not you are using them) and the analog channels are assigned channel numbers beginning with the next available number.

For example, the first analog input on a unit with 24 contact inputs and 16 analog inputs would be "channel 25" and the last analog input would be "channel 40". Note that since the unit's maximum LED display capacity is a total of 32 channels, on such a unit the final 8 analog channels would not have corresponding LED status indicators on the front panel. Further, note that on units with remote channels, the LED display may group inputs into a single indicator.

It is important that you have correctly determined the channel number assigned for each analog input channel before performing the following programming steps.

B.1.3 Programming the Input Signal Type

(You may skip this step if you are using 4-20 ma inputs).

The analog inputs are very flexible and can accommodate a variety of Input Signal Types, but the unit needs to know which type each input is being used for a given analog input. Note that in addition to programming the Input Signal Type, the physical component configurations on the VAN plug-in circuit card must match the Signal Type used. Normally this will have been handled in the process of ordering the unit and will not require additional user attention. If there is any doubt about this, refer to the markings on the rear of the VAN circuit board. If there is still any question, refer to the markings you find and also your unit's serial number, when contacting the factory.

- To program the Input Signal Type for input channel ZZ:

  `5 ZZ 7 N ENTER`

  where ZZ is the two-digit channel number, and N is a single digit as follows:

  0 for a 4-to-20 milliamp current loop input. This is the default setting, so if your inputs are 4-20 milliamp current loops, you may skip this step.

  1 for 0 to 1 volt DC signal input. In the case of larger signal levels, such as 0 to 10 volts DC, the hardware input circuitry on the VAN card will have been factory configured to pre-scale the signal to a range within 0 to 1 volt DC, and corresponding special scaling information will be provided to fit the particular application.

2 for a Raco Temperature Sensor input (sensor model TS705A), used to measure temperatures from -20 to +120 degrees F.

3 for additional types of special custom-specified signals.

Summary of Codes for Input Signal Type	
0 (default)	4-20 ma current loop
1	0-1 volt DC
2	Raco temperature sensor
3	Other special inputs

B.1.4 Programming the Scaling and Offset Factors

This set of steps is not necessary for inputs using a Raco Temperature Sensor, since these values will be automatically inserted if the parameter 2 is selected in the above step.

In the above step, accepting the default parameter of 0 for 4-20 milliamp inputs automatically provides for a spoken reading of 0.0 percent for the minimum (4 ma) signal input value, and 100.0 percent for the maximum (20 ma) signal, until you enter different factors.

In most cases, you will want to program the unit to give spoken reports in terms of the actual physical variables being monitored, such as water level in feet, etc. In general, you will need to determine the desired spoken numerical values corresponding to two widely separated (low end and high end) signal input values. Often this will be available from the overall system specifications. In other cases, this will be determined (or revised) based on actual on-the-spot observations. The Verbatim Autodialer offers the unique option of entering this scaling information based either on your particular system specifications (the System Specification method) or else on your real world observations (the Real World Method). Also, scaling information which you may have originally entered based on your system specifications may later be easily "fine tuned" based on real world observation.

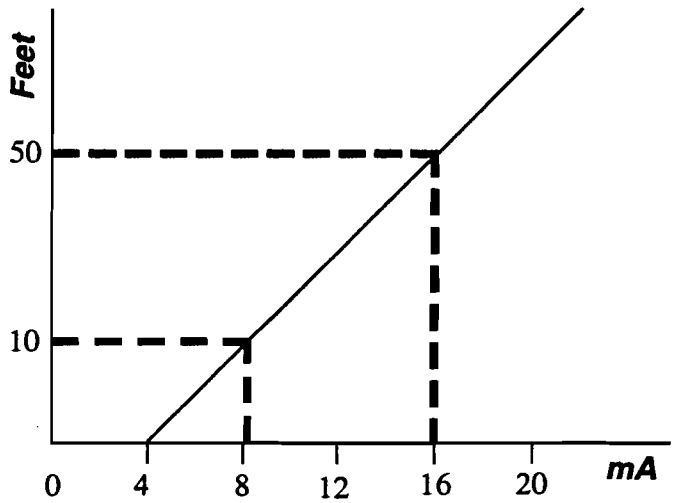
In addition, you may wish to record your own identifying message to replace the default message, as described in the message recording section of the manual.

B.1.5 Additional Perspective on Scaling Factors

Analog Math

It may be useful, in comprehending the process of establishing the scaling factors, to visualize a graph which relates the water level in a tank to the input from a 4-20 ma transducer. To establish the relationship on such a graph, it is necessary to define two separate points, or coordinate pairs ideally at two widely separated points on the graph. For such a linear relationship any point on the "reading" (Y) may be calculated from the formula:

```
y = mx + b
```



where m is the gain and b is the zero crossing point or Input (ma -> offset. The gain may be calculated from: m=(y2-y1)/x2-x1)

where x1, y1 is one coordinate pair on the graph and x2, y2 is the other.

Therefore, when you have chosen to enter non-default coordinates you are in fact setting the gain factor. This gain factor is taken along with the input signal type you have chosen which will define both the gain and offset.

Notice that each of the two points requires two separate coordinate pieces of information to define: the signal level and the corresponding water level. With two such points defined, an entire line or linear equation is defined, so that given any new signal level, we could use the graph to "look up" the corresponding water level. In operation, the Verbatim autodialer measures the signal level presented to it, and then calculates the corresponding physical value, all based on the line or linear equation defined by your entry of the high end and low end scaling information whether done by the System Specification Method or the Real World Method.

Be sure that the correct Input Signal Type setting is entered as described above, because changing the Signal Type setting will overwrite the programming described next.

System Specification Method of Programming Scaling Factors

The following four codes must be entered to invoke scaling:

- For the low-end portion of the data for channel ZZ, enter the following pair of codes:

  ```
  5 ZZ 1 X.XXXX ENTER
  ```

  where X.XXXX is the low input signal value chosen, within the bounds of input signal type.

  ```
  5 ZZ 2 YYYY.YYYY ENTER
  ```

  where YYYY.YYYY is the desired spoken numerical value

- Then to complete the scaling factors for this channel, enter the following pair of codes for the high-end portion of the data:

  ```
  5 ZZ 3 X.XXXX ENTER
  ```

  or

  ```
  5 ZZ 3 POINT ENTER
  ```

  for the high-end signal value

  ```
  5 ZZ 4 YYYY.YYYY
  ```

  for the high-end corresponding spoken value

Note:

For all analog value entries you may enter up to four digits before an optional decimal point, and up to four digits after, but simple entries (such as -20, 3.45, 500, 4, etc.) work as well.

Alternative Real World Method of Programming Scaling Factors

If the system specifications for the scaling factors are not known, or if you wish to adjust a previous entry to reflect real-world as opposed to system specification conditions, wait until the input signal or the physical variable happens to be near the low end of the scale. Enter the following pair of codes:

```
5 ZZ 1 POINT ENTER
```

which will automatically accept the present moment signal value as the low input signal value, rather than having to enter the value shown as X.XXXX above. Then, enter:

```
5 ZZ 2 YYYY.YYYY ENTER
```

where YYYY.YYYY is the corresponding low-end physical value which you observe in real-world terms.

At another time, when the signal or physical variable is toward the high end of the scale, enter the following pair of codes:

```
5 ZZ 3 POINT ENTER
```

which accepts the present signal level as corresponding to the high-end physical value which you enter as:

```
5 ZZ 4 YYYY.YYYY ENTER
```

Example:

It may already be known from your system's specification that for channel 6, a low-end signal of 4 milliamps corresponds to a desired spoken value of 34.5 feet of tank water level. In such a case, you would use the System Specifications Method to enter:

- for 4 milliamps

  ```
  5 06 1 4 ENTER
  ```

- for a spoken reading of 20.5

  ```
  5 06 2 20.5 ENTER
  ```

- for 20 milliamps

  ```
  5 06 3 20 ENTER
  ```

- for a spoken reading of 34.6

  ```
  5 06 4 34.6 ENTER
  ```

Then, suppose with the system in operation, you observe that the tank level is 31.7 feet, but the Verbatim reports a value of 31.45 feet. The discrepancy will most likely be due to a discrepancy of the sensor's actual output versus the theoretical system specification. Regardless, to correct for it, keeping in mind that the signal is presently near the high end of the scale, you would use the Real-World Method, entering:

- To reference the present signal level

  ```
  5 06 3 POINT ENTER
  ```

- To recalibrate 31.7 as the corresponding spoken value

  ```
  5 06 4 31.7 ENTER
  ```

Continue the example, there might also be a discrepancy toward the low end of the scale. Suppose on another day you observe a tank level of 22.5 feet but the Verbatim report 2293 feet. Since this signal is at the low end of the range, you would enter:

```
5 06 1 POINT ENTER
```

and

```
5 06 2 22.5 ENTER
```

Note:

These Real-World Method adjustments did not require you to measure any actual signal levels!

From that time on, assuming that the sensor maintains its calibration and has a linear output, the spoken value should track the actual value very closely. The Verbatim itself is much more accurate and consistent than almost any sensor available to connect to it. Note that the signal does not need to be exactly at the end of its range (e.g. 4 ma or 20 ma) for these programming steps. However, in general the wider the spread between the signal levels used, the better informed the Verbatim will be to reflect the actual relationship between the sensor's output and the real value being measured.

Note:

While the unit reports with very high accuracy and resolution, you do not need to enter your programming value to the same high degree of accuracy unless you choose to.

For TS705 Temperature Sensor Inputs

Selecting signal type "2" (TS705 sensor) will automatically load scaling factors as describe earlier. However, these automatically loaded scaling factors are not adjustable. If you want to be able to do Real World calibration adjustments for temperature sensor inputs, then instead of selecting sensor type "2", select sensor type "1" (0-1 VDC input) and enter scaling factors as follows:

```
5 ZZ 7 1 ENTER (Selects signal type 1)

5 ZZ 1 .843 ENTER

5 ZZ 2 -19.8 ENTER

5 ZZ 3 .316 ENTER

5 ZZ 4 120.1 ENTER
```

This gives the same scaling factors as would otherwise automatically result from selecting signal type 2, but it allows for subsequent adjustments using the Real-World adjustment method.

B.1.6 Programming High and Low Analog Setpoints

You should first enter the gain, offset and scaling factor programming described above before entering setpoints. Later, if you adjust the factors as described above, you may also need to adjust the setpoints correspondingly. Changing setpoint values after scaling is set could cause changes in the scaling values.

- To program a low limit setpoint for channel ZZ, use code:

  `5 ZZ 5 X.XX ENTER`

Note:

X.XX is the desired setpoint in terms of spoken units, rather than in terms of the signal value. You do not need to enter all four possible leading and trailing digits. Simple entries like 7 and 3.68 work as well.

- To program a high limit setpoint for channel ZZ, use code:

  `5 ZZ 6 X.XX ENTER`

Thereafter, whenever the measured value exceeds the setpoint for a continuous period exceeding the alarm trip delay, the unit will go into unacknowledged alarm and begin dialing to report the specific violation, also reporting the current measured value. As with contact inputs, if the input is no longer in violation at the moment of the report, the phrase "Now Normal" will be appended to that channel's report.

- To check an existing setpoint value, use the above codes but omit the value (X.XX).
- To turn off (completely disable) an unused analog channel so that it will not be included in status report, enter code:

  `5 ZZ 0 ENTER`

  where ZZ is the 2-digit channel number.

- To turn the channel on again, you must enter some high or low setpoint value for that channel.
- To turn off (disable) a high or low analog setpoint, while still leaving the channel able to report readings, enter a setpoint value of -0 for that particular setpoint. If you try to enter a setpoint value outside a wide signal range, the Verbatim will say "Error in number."

Note

The scanning time required by the unit to check all analog readings against established setpoints increases with the number analog channels. With 16 channels, the time can total on the order of one second, and this imposes a limit on how fast the unit can detect analog setpoint violations. Normally, this will not be noticed unless you set Alarm Trip Delays of less than two seconds, and there is no effect on the trip delay for contact channels in any case.

Refer to the following section for recording the corresponding voice messages other than the spoken numerical values.

B.1.7 Summary of Analog Programming Codes

Code	Description
Signal Type:	
5 ZZ 7 N	Select input signal type. 0 is default for 4-20 ma
Scaling:	
5 ZZ 1 X.XX or POINT	Low end signal value
5 ZZ 2 YYYY.YYYY	Corresponding low end spoken value
5 ZZ 3 X.XX or POINT	High end signal value
5 ZZ 4 YYYY.YYYY	Corresponding high end spoken value
Setpoints:	
5 ZZ 5 X.XX	Low alarm limit setpoint
5 ZZ 6 X.XX	High alarm limit setpoint
5 ZZ 5(6) -0	Disable low (high) setpoint
Disable Channel:	
5 ZZ 0	Turn off (disable) channel ZZ

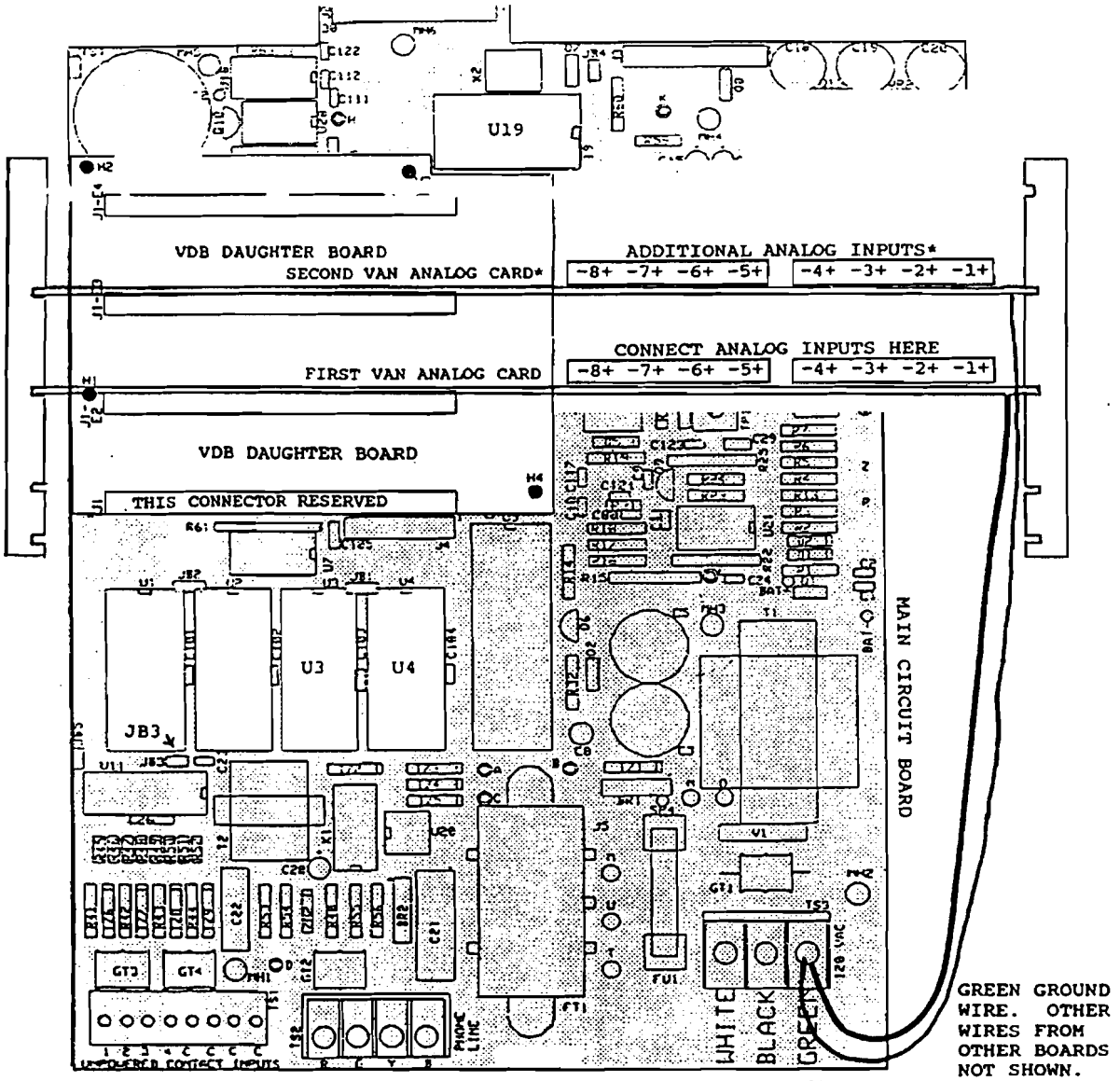
B.1.8 Recording Speech Messages for Analog Channels

This information supplements the basic information in the manual on recording speech messages. Refer to that information before attempting to record any speech messages.

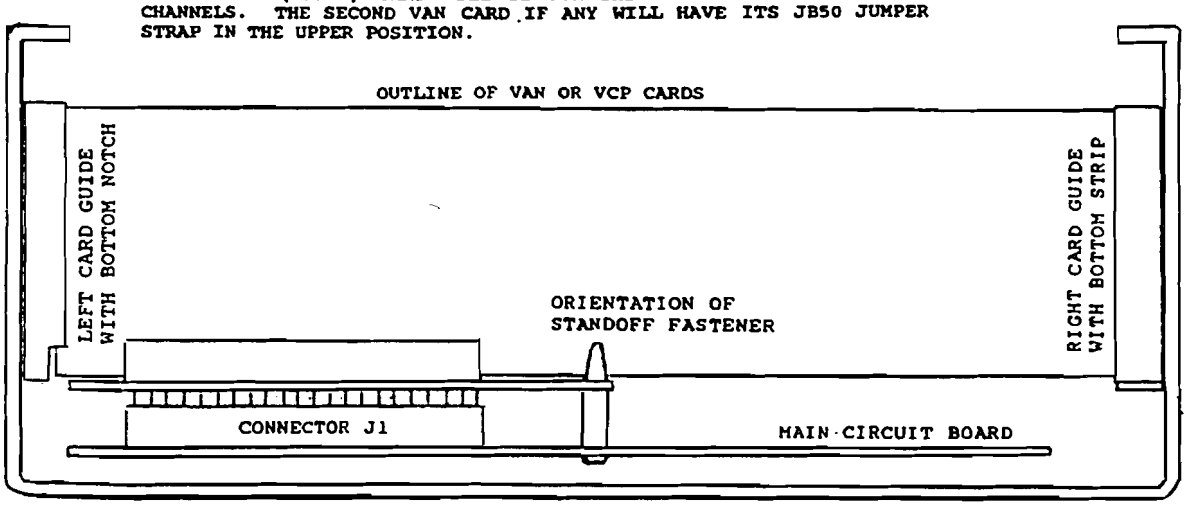
For analog input channels, the default message is "The present channel N reading is ..."

For any analog inputs, in place of the default messages you may plan to record a preamble message of the general form "The total water flow in gallons is" or "the main tank water level in feet is."

Use program code 1 ZZ to record the analog preamble message.



*UNITS EQUIPPED FOR 16 ANALOG CHANNELS WILL REQUIRE 2 VAN CARDS. THE SECOND (UPPER) CARD WILL BE FOR THE HIGHER NUMBERED ANALOG CHANNELS. THE SECOND VAN CARD IF ANY WILL HAVE ITS JB50 JUMPER STRAP IN THE UPPER POSITION.



B.1.9 If Analog Inputs Do Not Work Correctly

Recheck programming settings, especially the Input Signal Type setting. Verify that the polarity of your input connections is correct.

In the case of 4-20 ma input, does the spoken value always reflect a 0 ma signal level? If so, the problem is presumably with the connection or the signal source. Use a DC meter to verify that both sides of the offending input are within 10 VDC of ground. A 4-20 ma current loop input should give a meter reading of about .07 volt per milliamp of current as measured across the two signal input terminals.

Are other instruments included in the same current loop? If they read correctly, temporarily disconnect the input to the Verbatim Autodialer. This should throw the readings of the instruments off scale. If there is no such effect, your wiring is not including the Verbatim autodialer in the loop. Verify that the type of signal source agrees with the physical configuration on the VAN card according to the marking on the back of the card.

B.1.10 Troubleshooting Analog Grounding Problems for Verbatim Analog

The most common analog signal type in use in the Verbatim marketplace is current loops, wherein the signal is a controlled DC current ranging from 4 to 20 milliamperes.

The loop consists of a current transmitter (consisting of a transducer and a supporting power supply which may or may not be packaged into one unit), and one or more receiving devices which measure and respond to the current signal they detect on the loop. The power supply voltage is typically 24 volts DC.

The terms "transducer" and "transmitter" are used interchangeably. The transmitter's job is to ensure that the current level accurately reflects the physical parameter which the transducer is measuring (typically a pressure or liquid level), regardless of what impedance it sees in the loop.

In order to do this, it presents whatever voltage across its terminals is needed to achieve the correct current flow. This voltage must be great enough to accommodate the total resistance in the loop. The typical resistance contribution presented by each receiving device is 250 ohms. However, the DC resistance presented by the Verbatim analog inputs is around 70 ohms (49.9 ohm precision resistor plus two 10 ohm surge standoff resistors).

In theory, all elements in the loop are isolated from any connection to electrical ground. This is intended to eliminate concerns about errors in the signal caused by conflicting ground or other conflicting connections.

In practice it is not unusual to have some element of the loop in fact tied to ground or to some other voltage source away from ground -- or if not directly tied, at least limited in its ability to depart from the ground or other voltage. As long as only one element in the loop is so committed, there is no problem since the other elements can freely accommodate as needed.

The Verbatim has its own limitations in this respect. It can only accommodate a departure from ground voltage potential, of 8 volts nominal, before its protective tranzorbs begin to conduct and clamp the signal. Such clamping when in direct conflict with some other voltage commitment in the loop, will not only cause incorrect readings by the Verbatim, but also cause the other elements in the loop to read and respond incorrectly.

This ability to accommodate departures of both sides (positive and negative) or the analog signal input, is called the common mode input voltage range. A truly isolated input would have as much common mode input voltage range as the voltage limitation of the isolation, typically over 1,000 volts.

The reason we do not provide isolated inputs is because it is bulky, and expensive to achieve accurate translation across the isolation barrier. Also, these days there has been a large shift to transformer and capacitive coupling schemes to achieve DC isolation, but these provide almost zero protection against the fast rise time transients induced by lightning. So, we need to be able to troubleshoot when a customer places one of our analog inputs into a current loop where there is another conflicting voltage commitment.

When this problem occurs, the customer will typically report that his loop works but is thrown off when our analog input is placed in the loop. Sometimes the disturbance takes the form of not just altering the DC current but causing parasitic oscillations in the loop. It may not be easily discernible whether the disturbance is or is not taking the form of a parasitic oscillation. Regardless, temporarily ungrounding the dialer or unplugging the analog card, will usually eliminate the disturbance.

The procedure for troubleshooting and correction of this problem is generally as follows: First we need to find out as much as we can about any preexisting, conflicting voltage commitments. To do this, have the customer unplug the card or unground the dialer so that the loop is not disturbed, and then use a voltmeter to check both the AC and the DC voltage readings at each node around the loop, with respect to electrical ground.

We hope there is not much AC signal present. If there is a strong enough AC component on top of the DC voltages, there will be disturbance to the extent that the peak level in the AC waveform exceeds the common mode input limitation of our analog input. In such a case the cause of the AC component of the signal needs to be found and eliminated, if the following procedure does not lead to a good result.

However, it is possible and even likely, that an observed AC signal is merely a "softly" induced hum that holds no sway when it meets any clamping introduced by our analog input. With this in mind, it may be best to defer even taking AC reading until after the DC oriented methods have proven unsuccessful.

With the main focus being the DC voltage readings, we are looking at some point on the loop that is much less than eight volts DC away from ground, and that is where the Verbatim input should be relocated in the loop. Chances are good that the Verbatim had previously been placed at a point on the loop well away from ground potential and that the relocation will end the problem.

An added step that may be useful in addition to the two sets of voltage readings (AC and DC), especially if the voltage readings seem to be erratic, is to have the customer use a jumper wire to temporarily connect some candidate point in the loop to electrical ground, and observe whether the loop is disturbed by this temporary grounding. If it is not, that is a good place to locate our input in the loop. In fact, this approach can be used without taking voltage readings at all. But if it does not work, then we do want the voltage readings in order to best understand what is going on.

Occasionally, something in the loop will cause there to be no available point in the loop that is close to ground potential. In such cases, if this cannot be changed, then the customer will need to install an optical isolator between the loop and our inputs. The customer may be referred to: Action Instruments, San Diego, CA, (619) 279-5726. Isolators cost $300 per loop.

C Remote Supervisory Control Output

C.1 Remote Supervisory Control (VRSC) Output Installation and Operation Instructions

This option allows you to turn connected equipment on and off from any remote Touch Tone telephone, or from an non-Touch Tone telephone with the use of a portable tone generator. Option VRSC-4 provides 4 outputs, VRSC-8 provides 8 outputs. The unit's voice guides and confirms your operations. Advanced features such as programmable length momentary activations are included. Control operations may also be performed from the unit's keyboard.

Connections are normally made by means of optically isolated solid state relays housed in a separate Output Relay Enclosure which requires its own 120 VAC power connection. In some situations, the user may choose to make connections directly to the transition outputs within the main unit.

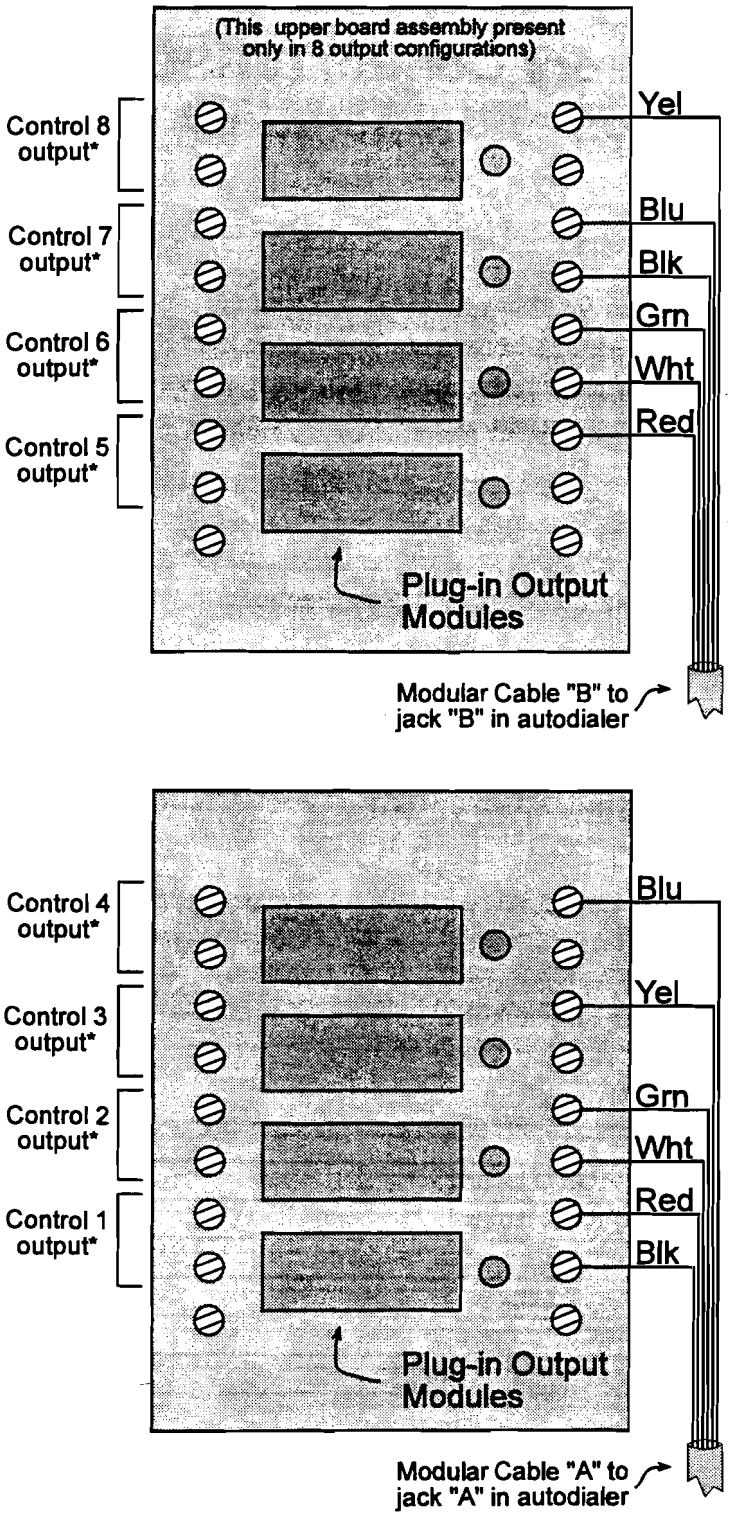
If your unit was not originally equipped with this option, refer to the separate instructions for adding this option.

C.1.1 Mounting and Wiring Connections for Remote Supervisor Control

If you are using the separate Output Relay Enclosure normally supplied with this option, mount the enclosure within 3 feet of the Verbatim Autodialer, and make your output connections to the left hand row of terminal strip points within the separate enclosure, as shown in the diagram of the VRSC Output Relay Enclosure. Be sure that the correct type of plug-in Opto 22 relays are in place. The available types are:

Type	Value
OAC5	12 to 140 VAC, 2 amps
OAC5A	24 to 280 VAC, 2 amps
OAC5A5	120/240 volt AC, Normally Closed
ODC5	5 to 60 VDC, 2 amps
ODC5A	5 to 200 VDC, 2 amps
ORR 5	Reed relay dry contact output

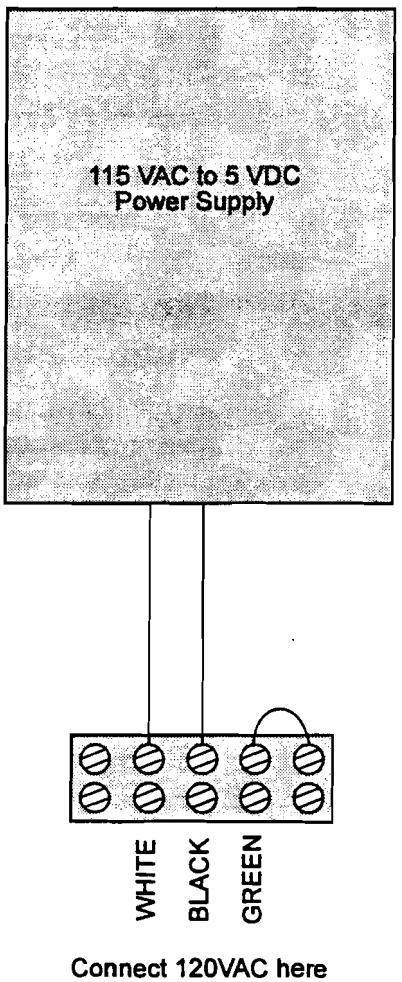
RSC Supervisory Remote Control Output Box Diagram



OUTPUT MODULE TYPES:

OAC5	12 to 140 VAC, 2 amps
OAC5A	24 to 280 VAC, 2 amps
ODC5	5 to 60 VDC, 2 amps
ODC5A	5 to 200 VDC, 0.67 amps
ORR5	Reed Relay Output

* If DC output modules are used, the lower terminal is the positive terminal, for each control output.



Unless ordered otherwise, type OAC5 is normally provided from the factory. Connect 120 VAC power as shown on this same diagram. Route modular "Cable A" through one of the entrance holes on the bottom of the Verbatim Autodialer, and plug it into J301 (the right-hand jack on the VCP circuit card, see diagram). The 8-output VRSC-8 option also includes a second modular "Cable B", connect this to the adjacent jack J302 on the VCP circuit card. Avoid routing these cables alongside power wiring and route them so that the front panel circuit board does not pinch them when the door is closed.

C.1.2 Optional Direct Connection Without Use of Output Relay Enclosure

The outputs on the VCP circuit card are NPN transistor open collectors capable of switching up to 12 volts DC at up to 500 ma, and thus these outputs may in some cases be connected directly to logic inputs of logic controllers, etc, although external pullup resistors may be required. Consult Raco for details. The color codes for VRSC cables "A" and "B" are:

Cable	Color Code
Cable A	
Common Return	Black
Output # 1	Red
Output # 2	Green
Output # 3	Yellow
Output # 4	Blue
Cable B	
Output # 5	Red
Output # 6	Green
Output # 7	Blue
Output # 8	Yellow

C.1.3 Remote Supervisory Control Operation

- To check the on/off status of output # N, use program code

  `9 5 N ENTER`

  where N is a 2 DIGIT output number (e.g. 01 for output # 1).

- To turn output # N ON, use program code

  `9 5 N 1 ENTER`

- To turn output # N OFF, use program code

  `9 5 N 0 ENTER`

- To turn output # N on for a specific number of seconds, use code

  9 5 N 2 XXXXX ENTER

  where XXXXX is the desired number of seconds, from 1 to 99999.

- To turn output # N off for a specific number of seconds, use code

  9 5 N 3 XXXXX ENTER

  where XXXXX is the desired number of seconds, from 1 to 99999.

- To establish a default pulse time duration in seconds for a given output N (2 digits), use code

  9 5 N 9 XXXXX ENTER

  where XXXXX is 1 to 99999 seconds.

- Alternatively, to establish a default pulse time duration in minutes, for individual output N (2 digits), use code

  9 5 N 8 XXXX ENTER

  where XXXX is 1 to 1666 minutes.

  Then you may use code 9 5 N 2 (or 3) without need to enter the digits. The unit will use the pre-stored value for that output's pulse length.

- To hear a report of the on/off status of ALL outputs in one operation, use program code

  9 5 0 0 ENTER

- To turn ALL outputs OFF in one operation, use code

  9 5 0 0 0 ENTER

- To turn ALL outputs ON in one operation, use code

  9 5 0 0 1 ENTER

- To establish a default pulse time duration for ALL outputs in one operation, use code

  9 5 0 0 8 XXXX (XXXX = 1 to 1666 minutes)

or

  9 5 0 0 9 XXXXX (XXXXX = 1 to 99999 seconds)

Warning:

Because the devices under control would not normally be operational during AC power failures, the Output Relay Enclosure does not include battery backup for the output relays during AC power failures. Upon restoration of AC power, the outputs will return to the state dictated by the Verbatim Autodialer.

When the Verbatim Autodialer itself is first turned on, and at certain other times when a microprocessor reset occurs, all the outputs will be turned ON for a fraction of a second, before assuming the state dictated by the Verbatim Autodialer. In some installations this could cause problems, and in such cases external time delay relays or other measures may be required to prevent unwanted momentary activation of controlled devices.

MM are the minutes (09 for 9 minutes)

SS are the seconds. Entry of SS is optional.

- To clear the time and date back to 00:00:00 on 01/01/89.

```
935 7 ENTER
```

D Printer Options

D.1 Local Data Logger (Local Printer) Option

If your unit was not originally equipped with this option, refer to the separate instructions for installing this option. (See Section 2.3 for LDL parrallel). The local printer will automatically print out each activity that occurs: alarms, acknowledgments, programming entries, inquiry calls, etc.. A time and date stamp will be included with each report. The local printer may be either serial or parallel as discussed below.

D.1.1 Serial Printer Interface

- If your printer was obtained through Raco, it will have been properly configured and tested at the factory...
- If it was purchased independently, refer to the printer's instruction manual to configure it for 9600 baud, 8 data bits, 1 stop bit, and no parity.
- Improper configuration settings will result in "garbage" being printed, or possibly no printing at all.
- The printer must have a "serial" input.
- Printers not specified by or purchased through Raco are not guaranteed to be compatible for this application.
- Connect the DB-25 connector end of a Raco SER-01 cable (the specific type required will depend upon the printer type) to the input connector on the back of the printer.
- Route the small "modular" plug end of this same cable through one of the holes at the bottom of the Verbatim Autodialer, and plug it into modular jack J303 located near the left side of the Verbatim Autodialer, on the vertical VCP circuit card.
- Avoid routing this cable alongside power wiring, and route it so that the front panel circuit board does not pinch it when the door is closed.

D.1.2 Parallel Printer Interface

Some newer models of the VSS Series autodialer have a standard Parallel Printer Interface. This interface is accessed via the parallel printer port located on the inside of the unit front panel door. This printer port is already activated. (See Section F.3)

- To activate this port, attach a RACO VPPC-1 Parallel Printer Cable (or equivalent) to the front panel port and to the parallel port on your printer.

Caution:

Attach the parallel printer cable to the VSS front panel port with the "red striped edge" on the right side. If you connect any other way, you may damage the parallel connection on your printer.

D.1.3 Time and Date Setting

Time and date may be set or corrected with the following programming code entries:

- To check the date

  `941 ENTER`

- To set the date

  `941 MM DD YY D ENTER`

  where:

  MM is the month (03 for March)
  DD is the date (07 for the 7th day of the month)
  YY is the year (89 for 1989)
  D is the day of the week (1 for Sunday, 2 for Monday, etc.). Entry of D is optional.

- To check the time

  `942 ENTER`

- To set the time

  `942 HH MM SS ENTER`

  where:

  HH are the hours in military time (13 for 1 PM)
  MM are the minutes (09 for 9 minutes)
  SS are the seconds. Entry of SS is optional.

- To clear the time and date back to 00:00:00 on 01/01/89.

  `935 7 ENTER`

D.1.4 Printout at Regular Intervals

The unit may also be programmed to automatically log (printout) all input conditions at regular intervals, by entering code:

```
943 XXX.X ENTER
```

XXX.X is the desired printing interval in hours, from 0.1 to 999.9.

The first such printout will occur when the period elapses, rather than immediately upon programming.

- To check programmed printing interval

  ```
  943 ENTER
  ```

- To turn off regular interval printing function

  ```
  943 0 ENTER
  ```

- To printout All User-Entered Programming

  ```
  944 ENTER
  ```

E Data Acquisition/Central Data Logging

The following section describes commands used to configure features of the Data Acquisition/Central Data Logging options. The software is called SCADA.

E.1 Return To Normal (RTN) Calling

You may program the unit to place calls upon an input returning to its normal state. This applies only to channels which have become acknowledged alarms. Return to Normal (RTN) calls may be placed to people, to a SCADA Central Station or to a Central Data Logger (CDL) printer.

- There are three modes of calling for RTN calls:
  Mode 0 = Data only
  Mode 1 = Voice only
  Mode 2 = Data and Voice

Return-to-normal (RTN) calls on units NOT configured for SCADA or CDL will always be mode 1, Voice only. RTN calls on SCADA or CDL configured units may be mode 0, mode 1 or mode 2. If mode 1 is set on SCADA/CDL units then data calls to the SCADA Central Computer or CDL printer will be skipped. (See Appendix K for a discussion of the Return-to-Normal modes of operation.)

- To program Return to Normal Calls, press:

  `981 V`

  Where V is one of the following:

  - 0 = OFF - No return-to-normal calls will be made (Default is OFF)
  - 1 = ON - Return-to-normal calls will be made for channels in the ALARM, ACKNOWLEDGED state whose input returns to normal (non-violation).
  - 2 = used to manually reset all return to normal channel status - does not affect the return-to-normal calling ON/OFF state above or the calling modes below.
  - 3 = Sets return-to-normal mode to mode 0 - makes return to normal calls only in data mode to the SCADA Central Computer or to Central Data Logger Printer Entering this parameter does not affect the RTN ON/OFF state.

- 4 = Sets return-to-normal mode to mode 1 - makes return to normal calls only in voice mode (NO data calls to the SCADA Central Computer or Central Data Logger Printer. Entering this parameter does not affect the RTN ON/OFF state.
- 5 = Sets return-to-normal mode to mode 2 - makes both data and voice calls upon return to normal. Entering this parameter does not affect the RTN ON/OFF state.

E.2 Quick Intercall Delay & SCADA Units Connected to Cellular Phones

This section discusses two different but sometimes interrelating topics regarding SCADA configured autodialer/RTU units. One topic is the different ways in which the intercall delay operates in SCADA units. The other is the ability to interface SCADA units over cellular phones.

Units configured for SCADA operation may place and receive calls via cellular telephones instead of standard dial-up telephone lines. If purchased from RACO, the combination of autodialer/RTU, dial-up adaptor and cellular transceiver is called the CELLULARM™ package.

CELLULARM™ autodialers/RTUs may be used in cases where land lines are not available but cellular service is available in a particular area. CELLULARM™ units function nearly identically to land line based dial-up interfaced units.

Exceptions

The *intercall delay* (time between calls) functions somewhat differently on SCADA units than on non-SCADA units. On SCADA units a shortened intercall delay takes effect under certain circumstances. These circumstances are:

1) There is a fixed, non-adjustable intercall delay of 35 seconds between:
   a) multiple attempts at data calls to the SCADA Central Computer.
   b) the last personnel (voice) number and "wrapping around" to the data number again.
2) The is also a special adjustable quick intercall delay taken only between the progression from data calls to the first personnel (voice) call.

The quick intercall delay is set to 35 seconds by default. The usual intercall delay taken between between one personnel number and the next personnel number is 2.0 minutes by default.

The purpose of the quick intercall delay is for more expedient in transitioning from data calls to voice calls. However, in certain cases the quick intercall delay may actually interfere with attempts to call the autodialer/RTU for acknowledgement. This is especially true for cellular interfaced units.

Cellular phone calls often take substantially more time to connect to the called party. Therefore, on cellular interfaced units you may need to lengthen the quick intercall delay to allow a longer time "window" for acknowledgement calls from the SCADA Central Computer.

- To set the quick intercall time, press:

  `919 V`

  Where V is 35 to 999 secs.
  Default is 60 secs.

Note:

Available ONLY on units with firmware revision between V1.36 to V1.99. Applies only when the autodialer/RTU is advancing to the first voice number. Does NOT apply to data call retries, calls between successive voice numbers or wrap-around from last voice number to data calls again.

E.3 Acknowledgment Calls To The SCADA Central Station

Units configured for SCADA operation may be programmed to make calls to the SCADA Central Computer to report alarms which were acknowledged by personnel. Alarm Acknowledgement which occurs during calls to personnel or when personnel call the unit will prompt a sequence of Acknowledgement calls made to the SCADA Central Computer. The purpose of Acknowledement calls is simply to log the event of alarms being acknowledged by personnel.

- To program the unit for Acknowledgement Calls, press:

  `982 V`

  Where V is one of the following:

  - 0= OFF - (Default)
  - 1= ON - Make Acknowledgment calls
  - 2= resets all alarm acknowledgement call status - inhibits all further attempts for this alarm acknowledgement occurence.

E.4 Modem Automatic Speed Select for SCADA units

Automatic speed selection of 1200 baud or 300 baud may be programmed ON or OFF. When programmed ON, the unit will attempt to make data calls at 1200 baud first. If 1200 baud cannot be automatically negotiated with the SCADA Central Computer's modem, fallback to 300 baud will occur. When programmed OFF, the modem speed will be determined by the 984 command (below).

Exception

In some cases, 1200 baud may not provide reliable data communications due to phone line noise, etc. If necessary, use this command to force the unit's modem to use one specific speed only.

- To program the Automatic Speed Selection, press:

  `983 N`

  Where N is 1 (ON) or 0 (OFF)
  Default is 1

Note:

This command is not applicable to Central Data Logger units.

E.5 Modem High Speed or Low Speed Selection

When the unit is programmed with Automatic Speed Select OFF use this command to fix the modem speed at either 1200 or 300 baud.

- To program the (non-Automatically selected) Modem Speed, press:

  `984 N`

  Where N is 1 (1200) or 0 (300)

Note:

When Automatic Speed Select is set to ON (command 983) this command has no effect on modem speed.

E.6 Number of Data Call Attempts Before Tripping a Communications Alarm

The autodialer can make multiple attempts to communicate in data mode to the SCADA Central Computer or to the Central Data Logger (CDL) printer. When all attempts to establish data communications have failed a Communications Failure Alarm will be tripped. If the unit is able to make voice calls (i.e. more than just the 1st phone number programmed) the Communications Alarm will be announced to personnel along with the usual alarm and status report messages. When a calling sequence is ended, for example by alarms getting acknowledged, the Communications Alarm is cleared.

If the Communications Alarm persists and successful data communications to the SCADA Computer or CDL printer is eventually established a Communications Alarm message will be logged and/or printed. After a Communications Alarm is logged and/or printed it will be cleared.

- To set the number of attempts before tripping a Communications Failure Alarm, press:

  `985 N`

  Where N is 1 to 10
  Default is 3

Note:

If Automatic Speed Select is set ON the unit will actually make twice the programmed number of attempts before tripping a Communications Alarm; N attempts at 1200 baud and N attempts at 300 baud.

E.7 Answer Mode - VOICE ONLY or DATA-TO-VOICE

Most calls made to an autodialer/RTU will be polling calls from the SCADA Central Computer. By default the autodialer/RTU will be expecting a data call and answer with a modem answer tone. This is called DATA-to-VOICE answer mode. Personnel wishing to call an autodialer/RTU to get voice reports can just wait through the modem answer tone for a few seconds for the unit to fall back to voice mode and begin speaking.

The autodialer/RTU may also be programmed for VOICE ONLY answer mode. In VOICE ONLY mode the unit will never answer with a modem answer tone and voice annunciation will begin immediately upon answering.

Programming an autodialer/RTU for VOICE ONLY defeats polling calls from the SCADA Central Computer since the unit will only answer by voice and not assert a modem answer tone. However, VOICE ONLY answer mode does not affect data calls made FROM the RTU to the SCADA Central Computer or CDL Printer.

If your SCADA Central Computer is not operational you may wish to program the answer mode to VOICE ONLY. Customers who purchase the SCADA option for their autodialer/RTUs in advance of installing their SCADA Central Computer should use this programming command to make the unit function as a non-SCADA networked autodialer. In addition to programming the answer mode to VOICE ONLY make sure there is no 1st phone number programmed. (The 1st phone number does data only calls to the SCADA Computer.)

- To program the Answer Mode, press:

  `986 N`

  Where N is 0 (default) for DATA-to-VOICE or 1 for VOICE ONLY

Note:

Does not apply to Central Data Logger (CDL) units. CDL units never receive polling calls and always answer in VOICE ONLY mode. The 1st phone number must be programmed to call the CDL printer.

E.8 DATA/VOICE Autocall Calls for SCADA & Central Data Logger

Autocall calls may function substantially the same in SCADA and Central Data Logger (CDL) units as in standard, non-SCADA units. However, different operating modes of Autocall may be programmed in addition to the usual Autocall functionality.

Exceptions:

- Autocall calls may be restricted to only calling the SCADA Central Computer or CDL printer. Also, Autocall calls may be restricted to calling just the personnel numbers programmed into the unit (i.e. no calls to SCADA Computer of CDL printer). And finally, Autocalls may call both personnel numbers and SCADA Computer or CDL printer numbers.
- Autocall calls made to the SCADA Central Computer or CDL printer result in logging and printing of the Autocall session. No acknowledgement is required or is possible.
- Autocalls calls made to personnel numbers will be standard voice annunciation sessions.

- To program the DATA/VOICE Autocall mode, press:

  `987 N`

  Where N is 0 to 2

  - 0 = (default) Autocall Calls made to SCADA Central Station only
  - 1 = Autocall Calls made to personnel numbers only
  - 2 = autocall Calls made to all numbers

F MODBUS Interface

This section covers the PLC specific functions of the Verbatim autodialer. It is assumed the reader is already familiar with the basic operation of the Verbatim autodialer. If this is not the case, please take the time now to review the previous sections of this manual.

In the discussion that follows, there are many technical terms specific to PLC operation which may be unfamiliar to those not experienced with PLCs. Please refer to the Glossary section for definition of these terms.

F.1 Overview

The Verbatim autodialer allows direct connection to Programmable Logic Controllers (PLCs) via a serial interface or other network connection. No direct connections from PLC output points to the Verbatim input points are required in order to monitor or annunciate for the PLC. Also, in most cases, no changes in the PLC's ladder logic program are required.

In addition, the autodialer allows connection to any non-PLC equipment compatible with supported PLC network protocols. An example of this application is a SCADA or DCS system running software configured with a PLC network protocol driver module. The autodialer does not care if the devices are a real PLC network or a computer mimicking a PLC network. However, master/slave protocols will require the autodialer to assume the role of master.

The Verbatim autodialer may read or write any data register within the PLC network. The data registers accessed by the autodialer may be in a single PLC or may be arbitrarily spread over a number of PLCs on the network.

Obviously, the number of data table locations in even a single PLC may number into the thousands. To relieve the user of having to deal with a huge number of precisely notated data table addresses, the autodialer uses the artifice of Remote Channels (RCs). Simply stated, RCs are nothing more than a kind of speed-dial number like you might set up on your telephone. Once the full number sequence has been entered into memory, a shorter sequence of numbers may be used as an abbreviation for the long sequence stored in memory.

Through the Verbatim autodialer, the user associates the address of a PLC data register to a RC. Thereafter, the RC becomes a shorthand designation for that data register's address. Any register, whether digital, analog, or other miscellaneous type, may be associated with an RC.

Data registers may actually be spread over a network of PLCs. The autodialer does not care if RC #2 is associated with a data register in a different PLC from the data register associated with RC #1. Therefore, when programming the autodialer to associate a PLC data register with a RC, the node number of the PLC may be included in the description for the location of the data register.

Additionally, the amount of User Recorded Speech Memory is increased appropriately for each Remote Channel configuration. These different quantities of memory yield total message recording times consistent with each of the available RC configuration options.

F.2 General Operation

This section describes configuring the Verbatim autodialer to continuously monitor any data register on the PLC network. Additionally, under user command, the autodialer may read and write to any PLC data register. The autodialer will only perform these functions after it has been properly installed, connected to the PLC network, and programmed.

F.2.1 Associating a Remote Channel with a PLC Data Register

In order for the Verbatim autodialer to read, write or continuously monitor a PLC data register the address of the data register must be associated with a Remote Channel (RC). After a data register address has been associated with a RC the Verbatim autodialer then knows where to direct queries for the contents of a data register on the PLC network.

The data register's complete address description is called the ***net address***. See section F.4.2 for information about net address formats.

Once a data register's net address has been associated with a RC, the alarm criteria may then be programmed. Only after an alarm criteria is entered will the PLC data register be scanned continuously by the Verbatim autodialer. When the content of the data register changes to match the alarm criteria, the RC associated with the data register goes into the alarm state.

RCs in the alarm state behave in exactly the same way as Verbatim autodialer internal or "physical" channels.

The Verbatim autodialer may be called at any time to receive an annunciation of the status of channels monitored. PLC registers associated to RCs may be read and written over-the-phone. Additionally, programming activities may be performed via the buttons on the user's phone.

When an operator calls the autodialer, the status of RCs will be reported and the user may reprogram parameters of RCs over-the-phone. When accessing the autodialer over-the-phone, all user functions that could result in the alteration of ANY data register can be made subject to correct entry of an access code.

Alarm criteria, trip delays and alarm call groupings are established in a fashion similar to normal physical channels. RCs associated with PLC discrete data registers support the normally open or closed criteria. RCs associated with PLC analog or integer data registers support high and low set points.

Associating a net address to a RC implicitly establishes the channel as digital or analog. For RCs, the default alarm criteria for both digital and analog channels is 'disarmed'. Attempts to set analog criteria on digital channels, and vice versa will cause an error announcement. If the net address for an RC already configured is re-programmed so that the type (analog or discrete) of data changes, the criteria will automatically be set to 'no alarm'. There is no run-time or totalizer capability for any of the RCs.

At the front panel, the LED channel status display shows all Remote and Physical Channels. Since the count of total Physical and Remote channels is greater than the usual 32 status LEDs, channels are combined into groups so that the status of all channels may be observed.

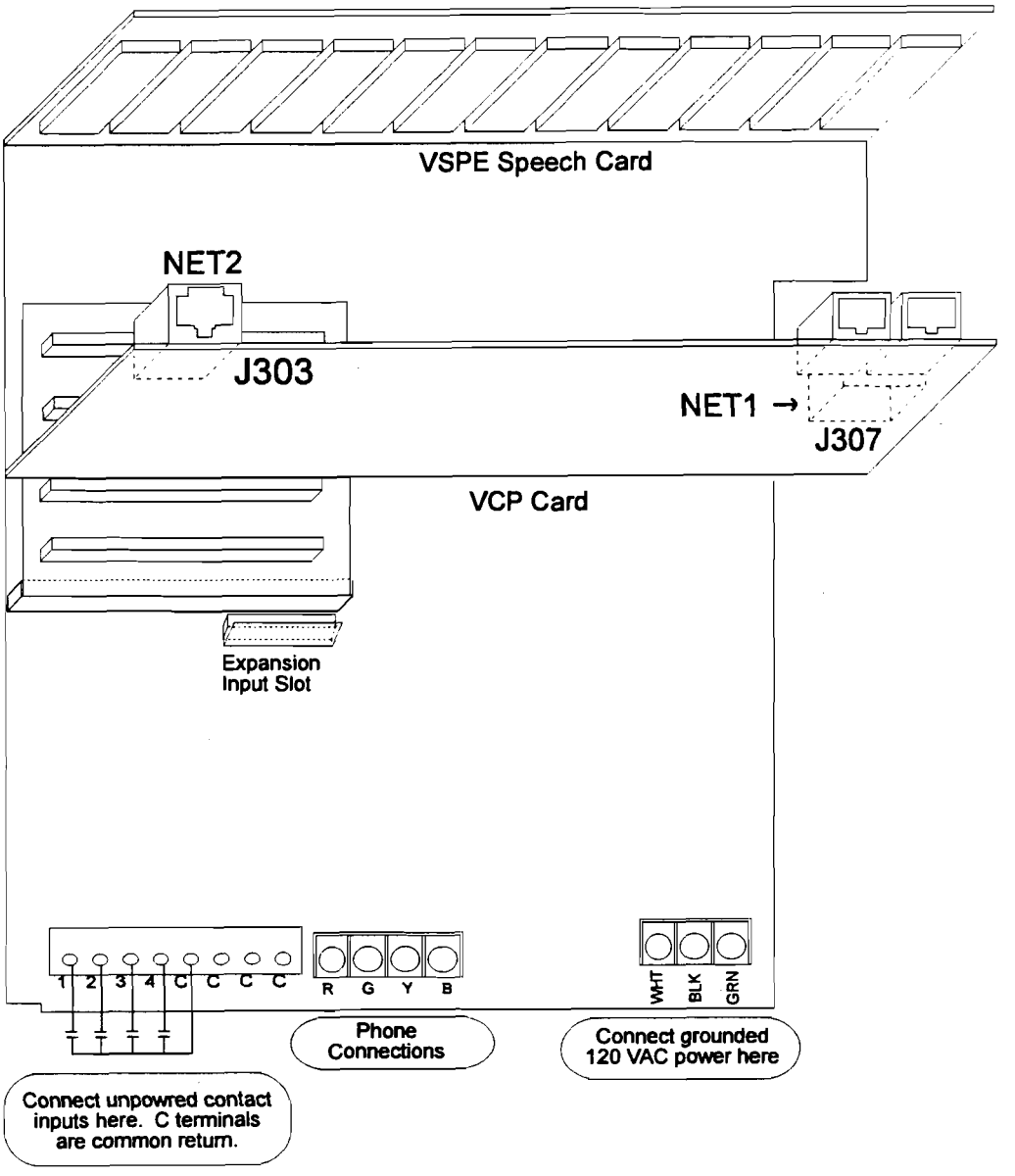
F.3 Connecting to the PLC Network

In most cases, the cable supplied by RACO will already be connected at the Verbatim autodialer end to a modular jack inside the unit. If this is not the case, please refer to the drawings in appendix H.

Note:

Refer to the cable drawings in the appendices to identify your type of PLC network connection.

Electrical Connection Diagram for PLC Network Connection



Cable connections for various PLC network protocols	
NET1	NET2
Modbus	NONE
Modbus	Serial LDL

F.3.1 Before Calling Technical Service Assistance

Programmable Logic Controllers have been used for several decades for process control applications. There is a large body of knowledge germane to using PLCs. RACO assumes that the user needing to monitor a PLC network with the Verbatim autodialer is already familiar with the PLCs being used for the application. It may also be assumed that the user has access to a PLC expert to help accurately identify the addresses of a PLC data register.

Before consulting the RACO Customer Service Department or your local RACO Representative for assistance in installation and configuration, please insure that the PLC details described in the next paragraph are readily available.

The user must have access to the PLC ladder logic program listing and know the location and properties of all data table locations which will be monitored by the Verbatim autodialer. Also the user must be able to determine the basic operating parameters of the PLC communications channel. This means being able to configure the PLC's parameters such as the node address, baud rate, data bits, parity and stop bits. Setting these parameters at the PLC may require the use of a PLC Hand Held Terminal, or a Personal Computer running PLC programming software available from the PLC's manufacturer.

The MODBUS communications protocol is a Verbatim autodialer firmware option and must have been properly configured at the factory. Parameters concerning link, frame and packet-level interfaces are configurable in the field.

F.4 Programming for Remote Channels

F.4.1 Remote Channel Programming Overview

The Remote Channels (RCs) behave fundamentally the same as their physical channel (PC) counterparts. Procedures for programming and recording messages for remote channels are very similar to the procedures described in the previous sections of this manual. There are some differences, however. These differences will be discussed in this section.

In general, all Verbatim autodialer commands that operate on remote channels will begin with the digit '4'. Commands that perform functions similar to non-Remote Channel specific commands use the same key sequence, preceded by the digit '4'.

- For example: to interrogate the alarm status for Physical Channel number 1 1, enter the command:

  `0 1 1 then <ENTER>`

- To interrogate the alarm status for Remote Channel number 1 1 enter the command:

  4 0 1 1 <ENTER>

The existing commands that apply globally to all channels will apply uniformly to the RCs as well. Specifically, these codes are: 900, 902, 904, 917N, 923N, 927N, 930, 935N, 966N, 9403, 9404. The 'CHECK STATUS' function, either from the front panel or over-the-phone, reports channel status for all channels both physical or remote.

The sub-sections that follow itemize all programming key sequences available to the user. A short description of each function is provided, together with longer notes when necessary. If a programming key sequence is not recognized by the Verbatim autodialer, or any parameter is invalid, the Verbatim autodialer simply says "Enter program code".

All commands that use a full network address may omit the network ID and/or the node address, in which case the default values (codes 4910, 4911) will be used. The user should then also omit the '*' delimiter associated with the omitted component. If the user does omit a field then all preceding fields must also be omitted. (See Section F.4.2 for more information on net address formats.)

The RCs on any specific network may be globally inactivated without erasing any of their configuration. An individual RC may be inactivated without erasing the network address by setting the no alarm or disarmed criterion. In this case, it will be necessary to reprogram the criterion in order to re-activate the channel.

F.4.2 Associating a Net Address with a Remote Channel

Note:

Remember that * = POINT when referenced in this manual.

The most important operation in configuring your Verbatim autodialer is associating a data register's net address to a RC. The net address is actually part of the complete command sequence entered by the user when programming the association of a RC and a data register. Consider the following example. Suppose the Verbatim's NET 1 is configured for the Modbus protocol and node 2 on that net is a PLC. To associate RC #01 with the16 bit data register whose address is 40001 you would enter the following command sequence:

4 5 0 1 * 1 * 2 * 40001 * then ENTER.

The first 4 digits from the above example are the programming command for RC association or RC alarm criteria. Thus, the sequence 4 5 0 1 refers to programming for RC #01. The net address portion of this command sequence is the remaining digits plus the '*' used for delimiting. The 16 bit data register has the address of 40001. The PLC's node number is 2 and the Verbatim's NET is 1.

The general net address syntax has the following form:

```
* NET * node * address *
```

where:

NET is NET Number - 0, 1, or 2

Net 0 is Physical Channels

Net 1 is Modbus

Net 2 is serial printer

node is PLC's Node Number

Modbus - 1 to 256

address is Data Register Address - may be numbers. Syntax for the register address is very specific to the PLC brand.

In the previous example, certain simplifications were made. Simplifications in the net address may be made by using programmed defaults. The usual default for the Verbatim's NET number is 1. The default node number may be set to any value allowed by protocol. Therefore, in the previous example, the entry may be simplified further to the following:

```
4 5 0 1 * 40001 * <ENTER>
```

F.5 General MODBUS Requirements

This appendix provides information specific to Modicon's Modbus network. There are sections on PLC data table addressing, net address format, and global data. The paragraphs here describe general requirements and hints.

Modicon PLCs: Be sure that the DEF/MEM switch on compact 984 PLCs is set to 'MEM'. Otherwise, it will be impossible to change network communications parameters from the defaults.

Modbus Networks: All nodes on a Modbus network must use RTU protocol. There can be only one master on the network. The master must be the Verbatim Autodialer.

Use the link-level timer (command 4908) to insert a delay between query/response cycles. This will only be necessary if talking to a slow device.

F.6 PLC Address Format

The table below shows how to address specific objects in Modicon PLCs. 'x' represents a digit in the range 0-9. The Verbatim autodialer User Interface will accept any values for 'xxxx'. If a value is out of range for a particular PLC, that PLC will issue an error diagnostic, which will be passed on to the user. This is to say, the remote PLCs enforce the validity of PLC addresses on their own.

Notes:

- Extended memory access is not currently implemented.
- Inputs may be written by the Verbatim autodialer, but will most likely be overwritten immediately by the PLC when it does its next scan of the ladder logic.
- The PLC memory protect switch will prevent a coil or register from being written.

Addressing Modicon PLC Objects

Address	*Description*
0xxxx	Coil (1-bit Output) number xxxx
1xxxx	Input point (1-bit) number xxxx
3xxxx	Input register (16-bit) number xxxx
4xxxx	Output (holding) register (16-bit) number xxxx

F.7 Potential Effects of Network Communications Failures

Physical channels only go into alarm state when their input matches programmed alarm criteria. Remote channels also support these criteria-based alarms.

It must be remembered however, that the channel data compared against the criteria must first be received from the network being monitored. Since the remote channel's data is being transferred over a network, alarming may be affected by various network failures.

If such a failure occurs, and the data cannot be received, it is no longer possible to reliably compare the channel against the alarm criteria. As a result, the remote channels will enter the alarm state even though their channel data may not have changed. The term "COMALARM" is used to distinguish this sort of alarm scenario from the criteria based alarms.

More precisely, an RC will register a COMALARM whenever the following two conditions are met:

1. The RC is configured with alarmable criteria.
2. All attempts to poll the RC have failed for the COMALARM trip delay period (code 4907).

For status reports, alarm calls, LED indicators and acknowledgments, the COMALARMs are treated in the same way as criteria alarms. They are annunciated in the following manner:

1. The COMALARM message will override any criteria alarm message.
2. The COMALARM message is not user recordable. It always consists of "Remote Channel Number ZZ Communication Failure Code XXX."

The failure code annunciated by the Verbatim autodialer serves as an aid in troubleshooting the network problem causing the failure. They are listed in section F.17.

To further assist in network troubleshooting several diagnostic commands are provided. It is possible to:

1. Perform a complete network self-test.
2. Read the communications status for any RC.
3. Read and reset the COMALARM count for any RC.
4. Read a list of the last 10 COMALARM codes on the network.
5. List all RCs currently in the COMALARM state.
6. List the nodes (PLCs) on the net that have all of their RCs in the COMALARM state.

The Verbatim autodialer provides several other features to help the user with the inevitable complexities of a networked environment. One is the ability to suspend/resume all queries initiated by the Verbatim autodialer without altering any RC programming. The status reports will inform the user when a network is globally disabled in this fashion.

Another diagnostic tool is the front panel Network Status Indicator LED for each network. Each LED is like a channel which monitors the overall health of each network. This is accomplished by accumulating all the COMALARM codes into a single value. The value is compared against a threshold. See code 492 in Section F.16 for details.

If the threshold is exceeded, then the LED will blink and status reports will annunciate the current value of the network status code. If the network has been globally disabled the LED is off. Otherwise the LED is steadily ON, indicating the network is operating within programmed parameters. See Section F.17.

The Verbatim autodialer keeps a count of the threshold violations. Programming commands are available to announce and reset these counts. It is also possible to announce the current value of the status code and set the threshold to any severity level. See section F.16 for details.

F.7.1 Abbreviations and Typographic Conventions

In the following sub-sections, the verbal response expected from the Verbatim autodialer will be given following the program code that the user is to enter for each programmable function. This verbal response will be differentiated by being in italics in the following way: *Remote Channel Number TEN, Alarm, Acknowledged.* The following table describes the abbreviations used in the code listings and elsewhere in this document:

Code Listing Abbreviations

Code	*Description*
ZZ	Any two-digit remote channel number, from 01 to 96, depending on the hardware configuration.
yy	Same as above
N	An integer from 0 to 65535, or as specifically noted.
net	The network ID: 1 to 5
node	The node address, as appropriate for a given network.
addr	The PLC address, as appropriate for the given PLC. (Details on specific PLCs and protocols are found in the appendices.)
DN	A two-digit code indicating a specific phone number.
V	An arbitrary floating point number of the form: 1.23. If 3 or more digits to the right of the decimal point, V is truncated to the nearest .005.
*	Same as 'point' key
#	Same as 'minus' key

F.8 Remote Channel Status, Reading, and Writing

4 0 ZZ

Function — Read alarm status of Remote Channel ZZ. (See code 49402 for Network Alarm Status)

Response — *remote channel <ZZ> <alarm status>*

If ZZ=00 in the following two commands, then the command applies to the net address specified by the most recent 4500* command. In that case, the "remote channel ZZ" responses are replaced with the explicit net address.

*4 0 ZZ **

Function — directly read PLC address associated with Channel ZZ

Response *remote channel <ZZ> is <N>* or
remote channel <ZZ> communications error <code>

*4 0 ZZ * N*

Function write value N to PLC address associated with channel ZZ
Response *remote channel <ZZ> set to <N>* or
remote channel <ZZ>communications error <code>

Notes:

- This command will execute without any "are you sure?" checking. Users must make sure the address and value being written will not create an unsafe condition.
- Writing a value greater than 1 to a digital or net address will result in the value 1 being written.

F.9 Remote Channel Message Recording and Reviewing

4 1 00 net

Function Record network ID message for specified net. Append a '*' to the command to return to default network ID message.
Response whatever was recorded or the default message: *NET <net>*

Notes:

- For the following 2 commands, N is optional. If present, it must be in range 1-4 and sets the recording rate for that particular message. User Messages for the remote channels are used in the same way as user messages for the physical channels.
- For analog channels, the alarm message is always the default: "<high> <low> set-point exceeded". The user messages form a preamble and epilogue for the data value recitation during alarm messages. The default epilogue for remote channels is null.

4 1 ZZ N

Function Record channel ZZ alarm/preamble message. *N*, if present, specifies the recording rate to use. If *N* is not present, the default recording rate is used. Append command with a '*' or '0' to return to default alarm message
Response whatever was recorded or the default message: *remote channel <ZZ> alarm*

4 2 ZZ N

Function Record channel ZZ normal/epilogue message. *N*, if present, specifies the recording rate to use. If *N* is not present, the default recording rate is used. Append command with a '*' or '0' to return to default normal message.

	Response	whatever was recorded. The default message for discrete channels is: *remote channel <ZZ> normal* . The default message for analog channels is silence (no epilogue).
4 3 ZZ		
	Function	Review both messages for channel ZZ. If ZZ is 00 then all network ID messages are reviewed.
	Response	whatever was recorded or the default messages.

F.10 Remote Channel Configuration

Commands in the series "4 5 ZZ," are used for Remote Channels as follows:

- Associate a PLC net address to a Verbatim Remote Channel. This step tells the Verbatim autodialer where on the PLC network to look for the point to be monitored.
- Establish the alarm criteria for a Remote Channel. This step tells the Verbatim autodialer what constitutes an alarm condition in the monitored PLC point.
- Link a Remote Channel to a phone number or group of phone numbers. When an alarm occurs in the monitored PLC point only the phone numbers linked to the Remote Channel will be called. (By default, all phone numbers will be called.)

Note that you must first assign a net address to a Remote Channel before any alarm criteria may be configured.

F.10.1 Assigning PLC Net Addresses to Remote Channels

Command "45ZZ" associates a remote channel with a network address and, as such, is essential for activating an RC. When issued, this command will cause the Verbatim autodialer to immediately access the specified network address. Any communications errors at this point will generate the message: *communication error code <diagnostic>*. Any command in this section will support ZZ=00.

If the data type (analog, discrete) of the new address is incompatible with the existing alarm criteria, then the NOALARM criteria will replace them. Otherwise, the existing criteria are untouched. The Verbatim will announce this action. Any links to other RCs are always preserved.

Notes:

See section F.4.2 for an overview of net addresses.

*4 5 ZZ **

Function — Read the network address which is currently associated with RC number ZZ.

Response — *remote channel <ZZ> NET <net> NODE <node> ADDRESS <addr>* or *communication error code <diagnostic>*

*4 5 ZZ * net *node *addr **

Function — Associate RC <ZZ> with specified network address. Does not alter any other parameters.

Response — *remote channel <ZZ> NET <net> NODE <node> ADDRESS <addr>* or *communication error code <diagnostic>*

F.10.2 Remote Channel Alarm Criteria

4 5 00

Function — The criteria for all "eligible" RCs are set so that the channel is normal in its current state. An RC is NOT eligible if any of the following conditions apply:

- Channel's net address type is analog or floating point
- Channel has NOALARM criteria already configured
- Channel is already the destination channel in a linked pair

Response — *present input condition is programmed to be normal for all remote channels*

4 5 ZZ

Function — Read alarm criteria for channel ZZ

Response — *remote channel <ZZ> <criteria> or remote channel <ZZ> no net address programmed*

4 5 ZZ 0

Function — Disarms <ZZ> (i.e. eliminates all status reporting for the channel). All other configuration information is preserved.

Response — *remote channel <ZZ> disarmed*

4 5 ZZ 1

Function — Set channel number ZZ alarm criteria to normally 1.

Response — *remote channel <ZZ> normally 1*

4 5 ZZ 2

Function — Set channel number ZZ alarm criteria to normally 0.

Response — *remote channel <ZZ> normally 0*

4 5 ZZ 3

Function — Set channel number ZZ alarm criteria to no alarm. The channel is still listed in all status reports.

Response — *no alarm condition for remote channel <ZZ>*

4 5 ZZ 4

Function — Set channel number ZZ to NETERR mode — alarm if and only if a communications alarm occurs.

Response — *remote channel <ZZ> alarm on communication failurec.*

4 5 ZZ 5 N

Function — Set channel number ZZ analog low alarm set point to N. Use N = -0 to clear. Omit N to read current set point value.

Response — *remote channel <ZZ> low set point is <N>*

4 5 ZZ 6 N

Function — Set channel number ZZ analog high alarm set point to N. Use N = -0 to clear. Omit N to read current set point value.

Response — *remote channel <ZZ> high set point is <N>*

F.10.3 Linking Remote Channels to Phone Numbers

4 5 ZZ 9

Function — Read RC number ZZ alarm call grouping linkage.

Response — *remote channel <ZZ> calls <list>*

4 5 ZZ 9 DN

Function — Link RC number ZZ to phone number list DN

Response — *remote channel <ZZ> calls <list>*

*4 5 ZZ 9 **

Function — Clear all RC number ZZ phone number linkages

Response — *remote channel <ZZ> calls all phone numbers*

Note:

Linking Remote Channels to phone numbers is different than linking one Remote Channel to another Remote Channel. The latter is discussed in section F.12.

F.11 Alarm Trip Delays

The alarm trip delay commands here apply only to criteria violations. See code 4907 for the COMALARM trip delay. See codes 4921 and 4922 for network alarming.

4 6 ZZ

Function — Reads channel number ZZ alarm trip delay.

Response — *remote channel <ZZ> alarm trip delay is <v> seconds*

*4 6 ZZ **

Function — Sets channel number ZZ alarm trip delay to 2.0 seconds.

Response — *remote channel <ZZ> alarm trip delay is 2.0 seconds*

4 6 ZZ V

Function — Sets RCZZ individual alarm trip delay to V.

Response — *remote channel <ZZ> alarm trip delay is <V> seconds*

F.12 RC Linking/Network Bridging

The commands detailed in this section allow data to be passed between any two remote channels. Applications include passing data between nodes on compatible and incompatible networks, updating status registers in DCS systems, or exporting the Verbatim physical I/O to remote nodes. One channel acts as a data "source" and the second as a data "destination". Data is read from the source channel's net address and then written to the destination channel's net address once per scan loop. The destination and source are said to be "linked".

F.12.1 Linking Modes

The linking functions can work in one of two modes. In Data Link mode, the data read from the source is written directly to the destination. In the absence of communication problems, each destination channel is updated with a frequency equal to the Verbatim scan time. If there is a communications problem reading data from the source, then nothing is written to the destination.

In Alarm Link mode, the source channel data is first interpreted against the configured alarm criteria. If any alarm condition exists at the SRC channel, then a 1 is written to the DST. Otherwise, 0 is written. Any communications problem reading from the source will be reflected.

For both modes, the reads and writes are attempted once per scan loop. Any required protocol conversions are handled automatically. Any problems getting data for or writing data to the destination will appear as communications errors on the source or destination RCs. The data read or written is subject to RC initialization and the worst-case scan loop latencies. See Section F.7 for details.

F.12.2 Commands & Limitations

The commands below establish the channel linkage configurations. There are several rules and restrictions as follows:

1. Both the source and destination RCs must already be configured with net addresses. If this is not the case, then an error message is given. The net address for either channel in a linked pair may be reconfigured at any time, without altering the link.
2. If the RC specified as source is already configured as destination for any other linked pair, then an error message is given. Similarly, if the RC specified as destination is already configured as source for any other linked pair, an error message is given. This prevents "chaining" of linked pairs.

3. If the RC specified as destination is already configured as the destination for another source, then the new configuration supersedes the old one. No error message is given. This prevents the configuration of multiple sources for a single destination. The user must take care that distinct destination channels do not have identical net addresses. Multiple destinations for a single source are allowed.
4. If either the source or destination RC are "DISARMED", then its criteria will be reset to "NETERR". This alteration will be announced. All other existing criteria are accepted without alteration. Once a link is configured, any attempt to DISARM either the source or destination results in an error message. All other criteria modifications are allowed. Note however that it rarely makes sense to have destination criteria of anything other than "NETERR" or "NOALARM".
5. The linking of channels with different data types is allowed. For example, it is OK to have a discrete source linked to an analog destination. Special data conversion rules apply and are presented in the table below.

Conversion Rules

Source	*Dest.*	*Destination Value*
16 or 32 bit	1 bit	0 if source is 0, otherwise 1
1 bit	16 bit	0 if source is 0, otherwise 1
1 bit	32 bit	0.0 if source is 0, otherwise 1.0
16 bit	32 bit	floating point number with integer value equal to the source value
32 bit	16 bit	garbage: least significant 16 bits of the source value, however encoded

6. If the destination channel is read-only (i.e. a PLC input register) then a COMALARM will result.

*4 7 ZZ * YY*

Function — Establishes an alarm mode link with RC ZZ as the source channel and YY as the destination channel. Channel ZZ's alarm status will be written to YY's net address once per scan loop. A 1 is written if any alarm exists, otherwise zero.

Response — *remote channel ZZ alarm link to remote channel YY* or, *remote channel (ZZ,YY) not programmed*, if no net address, or, *remote channel (ZZ,YY) already linked*, if multiple sources, or link chain would result.

*4 7 ZZ * YY **

Function — Establishes a data mode link with RC ZZ as the source channel and YY as the destination. The value from ZZ's net address is written to YY's net address once per scan loop.

Response — *remote channel ZZ data link to remote channel YY* or, *remote channel (ZZ,YY) not programmed*, if no net address, or, *remote channel (ZZ,YY) already linked*, if a link chain would result.

The commands listed below report or clear existing link configurations. When a link is cleared, the net address and criteria for both channels are untouched. Operation of the source channel is unchanged. In fact, the only change is that the destination channel will no longer write any data to the remote address. Rather, it begins to read the remote address and will alarm according to the existing criteria, just like the source or any other remote channel.

4 7 ZZ

Function — Reports all linked channel pairs using ZZ as either source or destination channel. If ZZ is 00, then the set of all linked channel pairs is listed.

Response — *remote channel <ZZ,XX> <data,alarm> link to remote channel <YY,ZZ>*

4 7 ZZ-0

Function — Clears all linked channel pairs using ZZ as either source or destination channel. If ZZ is 00, then the set of all linked channel pairs is cleared.

Response — *remote channel ZZ link to remote channel YY is cleared* or, *remote channel ZZ is not linked*, if no such link existed, or, *all remote channel links cleared*, if ZZ is 00.

*4 7 ZZ * YY-0*

Function — Clear specific link using ZZ as source and YY as destination.

Response — *remote channel ZZ <data,alarm> link to remote channel YY is cleared.* or, *no link*, if such a link does not exist.

F.13 Communications Parameters

All commands in this section allow the 'net' parameter to be omitted, in which case the default network is used. If either 'net' or the default net (see code 4910) is 0, the command has no effect. If the '*' is omitted, then the current setting is spoken. If '*' is present and 'N' omitted, then the parameter is set to it's default. If 'N' is present, then '*' must precede it.

If the protocol currently configured on any specific net forbids alteration of a parameter, then the command is ignored and the "Enter program code" message is announced. The defaults for each parameter are also network dependent.

4 9 00 net

Function — Announces the current setting of all applicable parameters.

Response — See all codes below

*4 9 00 net **

Function Resets all applicable parameters to their factory default.
Response See all codes below

F.13.1 Serial Port Parameters

*4 9 01 net * N*

Function Read/set baud rate for net to N. If present, N must be: 50, 75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, 57600. Any other values are ignored.
Response *<net ID message> baud rate is <N>* .

*4 9 02 net * N*

Function Read/set data bits for net to N. If present, N must be one of: 5, 6, 7, or 8. Any other values will be ignored.
Response *<net ID message> data bits are <N>*

*4 9 03 net * N*

Function Read/set stop bits for net to N. N must be 1 or 2. Any other values will be ignored.
Response *<net ID message> stop bit is <N>*

*4 9 04 net * N*

Function Read/set parity for net. If present, N=0 is NO parity, N=1 sets ODD parity and N=2 sets EVEN parity for net, N=3 for SPACE parity, N=4 for MARK parity. Any other values will be ignored.
Response *<net ID message> parity is <even, odd, space, mark>*

F.13.2 Network Parameters

*4 9 05 net * N*

Function Read/set local node address for net to N. The allowable range for N is protocol dependent. Illegal values are ignored.
Response *<net ID message> node number is <N>*

4 9 06 net

Function Read protocol for network.
Response *<net ID> protocol is <current protocol>*

F.13.3 Timing Parameters

*4 9 07 net * V*

Function Reads/sets communications alarm trip delay. Communications errors for all RCs on net must persist continuously for V seconds before a COMALARM violation is registered.
Response *<net ID> communication alarm trip delay is <V> seconds*

*4 9 08 net * N*

Function — Reads/sets link-level timer. Units are milliseconds. Usage of this timer is protocol dependent and described in the appendices. In general, this parameter is the maximum time the Verbatim will wait for the response from a communications co-processor or interface module.

Response — *<net ID> link limit time is <N> mseconds*

*4 9 09 net * N*

Function — Reads/sets application-level timer. Units are milliseconds. This value is the maximum amount of time the Verbatim will wait for another node to respond to any command.

Response — *<net ID> message limit time is <N> mseconds*

F.14 Miscellaneous

*4 9 **

Function — Repeats the previous command which began with a '4'. It is possible to add key strokes after the * and before enter, subject to limit of 65 total keystrokes. The added key strokes are not concatenated for subsequent 49* commands.

Response — appropriate to actual command resulting

In the following, N may be omitted, in which case the current value is only announced, not altered. The values apply to all commands expecting a net or node value to be specified. They allow fewer keystrokes to be used when programming net addresses and other commands.

4 9 10 N

Function — Read/set default net number to N. N must be 0-5, consistent with the hardware options.

Response — *Default net address network is N*

4 9 11 N

Function — Read/set default node number to N. Allowable values for N are protocol dependent.

Response — *Default net address node is <N>*

F.15 Clear-Out Operations

*4 9 3 * net*

Function — Globally disables/enables RC polling on the specified network. Acts as a toggle, so two consecutive entries cancel each other out. No RC programming is erased.

Response — *<net ID> communication is (off, on)*

4 9 35 4

Function — Clears all RC user recorded messages.

Response *All remote Channel messages cleared*

4 9 35 5

Function Clears all RC configuration data: network addresses, criteria, links.

Response *All remote channels reset*

4 9 35 8

Function Clears out all communications failure codes and counts.

Response *Communication error count overall reset*

4 9 35 9

Function Does all the 4935 functions. NOTE, ONLY the RC configuration is affected.

Response *Verbatim RC programming requires Firmware Revision*

F.16 Diagnostic Readouts

In the following, N may be omitted, in which case the current value is only announced, not altered.

4 9 2 <net>

Function Reads current value for Network Failure threshold. The LED indicator will blink and a Network Failure Alarm will register when this value is exceeded.

Response *<net ID> network status alert setpoint is <N>*

4 9 2 <net> <<N>>*

Function Sets current value for Network Failure threshold. Use N=200 to disable the network failure indicator.

Range for N 0-200

Default 0

Response *<net ID> network status alert setpoint is <N>*

*4 9 30 * net*

Function Perform a diagnostic self-test on specified network. Depending on protocol and LDL configuration, diagnostic counters may be printed and/or reset.

Response *<net ID> communication test is <normal, errcode>*

4 9 40

Function Read all 4940x diagnostic info for all networks.

Response See error/diagnostic code list in section F.17.

Note:

In the following, 'net' may be omitted, in which case the information for the default network is annunciated.

*4 9 40 * net*

Function Read all 4940 diagnostic info for <net>

Response see commands below

4 9 40 1

Function — Read time to complete RC table scan
Response — *scan time is <time> seconds*

4 9 40 2 net

Function — Read network status code for specified network
Response — *<net ID > network status code is <code>*

4 9 40 3 net

Function — Read network alert count.
Response — *<net ID > network alert count is <count>*

4 9 40 4 net

Function — List all the node addresses whose RCs are currently experiencing communication failure.
Response — *<net ID > communication failure at node(s) <list>*

4 9 40 5 net

Function — List all RCs on net currently having communications failure.
Response — *<net ID > remote channel(s) now in communication alarm are <list>*

Note:

49405 does not report criteria-tripped alarms. The check status command (4 0 ZZ) checks all alarm conditions, communication or otherwise.

4 9 40 6 net

Function — Read diagnostic codes for last 10 network problems. Append -0 to clear the history stack.
Response — *recorded error numbers are code <n>...*

4 9 41 ZZ

Function — Read current communications status for channel number ZZ. Status reported is result of latest scan loop poll, not the communications alarm status (see 40zz)..
Response — *remote channel <ZZ> communication alarm code is <diag code>*

*4 9 41 ZZ **

Function — Read count of communication alarms for RC ZZ (add -0 to clear)
Response — *remote channel <ZZ> communication alarm count is <count>*

4 9 42 net

Function — Read list of disarmed (see code 45ZZ0) RCs
Response — *<net ID> remote channels now disarmed are <list>*

4 9 43

Function — Read list of uninitialized RCs.
Response — *remote channel(s) not programmed are <list>*

Continued on next page . . .

4 9 44

Function — Read list of all RCs not using the default criterion.
Response — *remote channels armed are <list>*

4 9 45 ZZ

Function — Reports net address, criterion, setpoints, links, and alarm status for channel number ZZ.
Response — See commands 45zz*, 45zz, 47zz*, 4941zz

F.17 Status, Diagnostic & Error Code Listing

This section lists all network status, diagnostic and communications error codes likely to be of use for customer troubleshooting. Other codes may be reported in rare instances, and information about their interpretation may be obtained from RACO customer support.

F.17.1 Network Status Codes

The Network Status code reflects the overall health of all devices connected to a specific net. The values for these codes are used both for programming the alert threshold and in reporting the current status. Whenever a specific network's status code exceeds the alert threshold the network status LED will blink and an alert message is included in all reports. There is a distinct LED and status code and threshold for each net.

The table below lists the values and interpretation for the Network Status codes and thresholds.

0	No error. All RCs and scanned nodes are operating within scan timing parameters.
1-96	Some RCs are in communications failure and have not been successfully scanned for the COMALARM trip delay period. The number of such failed RCs is equal to the code value.
101-196	Some nodes on the net have quit responding to scanning. The number of such failed nodes is computed by subtracting 100 from the code. All RCs on those nodes are in COMALARM.
200	The scan of all nodes on the network is failing.

F.17.2 Diagnostic & Communications Error Codes

The diagnostic and communications error codes are registered whenever the scan for a particular RC fails. When such an event occurs, the code is pushed onto the diagnostic history stack (see code 49406) and copied into the RC status word (see code 4941zz). These may be interrogated at any time.

If the problem occurs during selftesting or configuration, the code is reported immediately. During normal scanning, the problem must continue for the COMALARM trip delay period before a communications alarm for that RC is triggered. The report for that alarm will then mention the code. The network status code is then updated appropriately. See table on next page.

The table below lists the values and interpretations for the most common error situations. Note that some codes are derived directly from standard error codes supported by specific protocols. The documentation for those products is then necessary for interpretation.

0	no error condition detected
352	specified net is invalid
354	protocol doesn't support the net address format
356	request timed out with no feedback
357	node address is invalid for selected protocol
359	node/driver incompatible with address mode
360	miscellaneous error parsing address string
361	some field was duplicated in address string
362	file type specifier in address string not supported
363	couldn't parse file number field in address string
364	couldn't map the I/O slot specified in address string
365	couldn't parse element field in address string
366	couldn't parse subelement field in address string
367	couldn't parse bit field in address string
368	too many routing nodes specified in address string
369	some routing node has illegal syntax
370	transaction aborted at user request
390	source channel data not available for RC link
410	no traffic received from the net
430	timeout with no recognizable response
431	timeout with no response at all
501	transaction took too long to transmit
601- 608	AEG/MODICON exception codes. That code can be determined by subtracting 600 from this code.

Refer to F.5, "General Modbus Reauirements," for details.

Continued on next page . . .

700	device has not been opened
705	DUART not present
710	net not configured with PLC-type protocol
715	bad serial io configuration parameter
725	background noise on network substrate
730	another modbus master already active
731	mbplus peer in monitor-on-line state
732	mbplus peer never getting token
735	diagnostic loopback test failed
750	a remote node has same node address
755	could not find any nodes on network
1540	NAK count limit exceeded for transmit msg
1541	ENQ count limit exceeded for transmit msg
1561	timeout waiting for response to command
2278	RAM allocation failed
2279	hardware failed self-test at warmstart
2280	cannot access net hardware

PLC Programming Code Table (Page 1 of 4)

Code	Description	Default	Range	Section
Remote Channel Status, Reading and Writing to PLC Data Register				
40ZZ	Read alarm status of Remote Channel ZZ		ZZ=0 to 96	F.8
40ZZ*	Read data register associated with RC ZZ		ZZ=0 to 96	F.8
40ZZ*N	Write value N to data register associated with RC ZZ		ZZ=0 to 96, N=0 to 65535	F.8
Remote Channel Message Recording and Reviewing				
4100 net	Record network ID message		net=1 to 5	F.9
41ZZ N	Record Remote Channel ZZ ALARM/PREAMBLE message at recording rate N (N is optional)	See Code 913	ZZ=1 to 96, N=1 to 4	F.9
42ZZ N	Record Remote Channel ZZ NORMAL/EPILOGUE message at recording rate N (N is optional)	See Code 913	ZZ=1 to 96, N=1 to 4	F.9
43ZZ	Review both Remote Channel ZZ messages (ZZ=0 for network ID messages)		ZZ=1 to 96	F.9
Remote Channel Programming (Configuration)				
4500	Sets current status as NORMAL for all RCs			F.10.2
45ZZ	Reads alarm criteria for RC ZZ		ZZ=1 to 96	F.10.2
45ZZ * net *node *addr *	Associate RC ZZ with specified network address		ZZ=1 to 96	F.10.1
45ZZ *	Read back the net address (net/node/addr) assoc. with RC ZZ		ZZ=1 to 96	F.10.1
45ZZ0	Disables Remote Channel ZZ		ZZ=1 to 96	F.10.2
45ZZ1	Sets alarm criteria to NORMALLY 1		ZZ=1 to 96	F.10.2
45ZZ2	Sets alarm criteria to NORMALLY 0		ZZ=1 to 96	F.10.2
45ZZ3	Sets alarm criteria to NO ALARM Status reporting only		ZZ=1 to 96	F.10.2
45ZZ4	Sets alarm criteria to NETERR mode		ZZ=1 to 96	F.10.2
45ZZ5 N	Sets analog low setpoint to N		ZZ=1 to 96, N=0 to 65535	F.10.2
45ZZ6 N	Sets analog high setpoint to N		ZZ=1 to 96, N=0 to 65535	F.10.2

PLC Programming Code Table (Page 2 of 4)

Code	Description	Default	Range	Section
Alarm Call Grouping				
45ZZ 9	Reads RC ZZ alarm call grouping linkage			F.10.3
45ZZ 9 DN	Links RC ZZ to phone numbers DN			F.10.3
45ZZ 9 *	Clears all RC ZZ alarm call linkages.			F.10.3
Alarm Trip Delays				
46ZZ	Reads Remote Channel ZZ alarm trip delay			F.11
46ZZ V	Set RC ZZ individual alarm trip delay to V	none	.1 - 9999.9 sec	F.11
46ZZ *	Resets RC ZZ individual alarm trip delay back to default of 2.0 sec.			
Remote Channel Linking/Network Bridging				
47ZZ * YY	Establish Alarm Link. ZZ source, YYdestination			F.12
47ZZ * YY *	Establish Data Link. ZZ source, YYdestination			F.12
47ZZ	Report all linked channel pairs using ZZ as source or destination. If ZZ=0 reports all linked channel pairs.			F.12
47ZZ -0	Clears all linked pairs using ZZ as source ordestination If ZZ=0 clears all linked channel pairs.			F.12
47ZZ * YY -0	Clear Specific Link using ZZ as source and YY as dest.			F.12
Serial Communications Parameters				
Note: See Code 4910 for default value for "net" in all of the following				
4900 net	Announces the current settings of all serial parameters for "net"			F.13
4900 net *	Resets all serial parameters for "net" to their factory defaults		See Below	F.13
4901 net *N	Read/Set baud rate for net to N	9600	50-57600	F.13.1
4902 net *N	Read/Set data bits for net to N	8	7 or 8	F.13.1
4903 net *N	Read/Set stop bits for net to N	1	1 or 2	F.13.1

PLC Programming Code Table (Page 3 of 4)

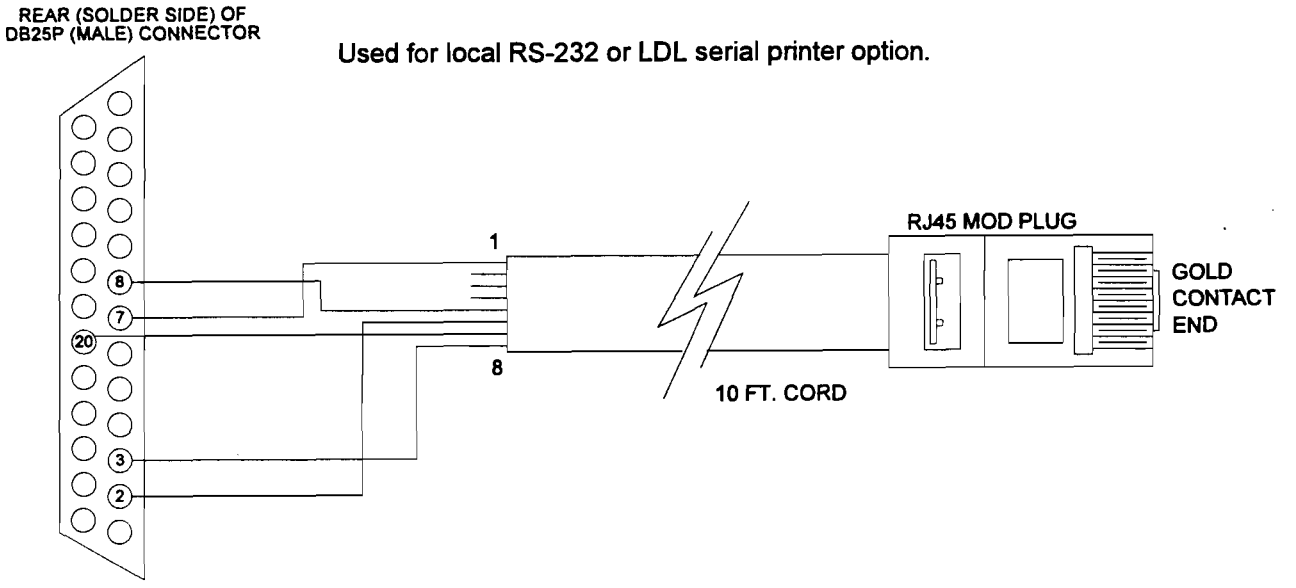
Code	Description	Default	Range	Section
Serial Communications Parameters . . . *Continued from p. F-26*				
Note: See Code 4910 for default value for "net" in all of the following				
4904 net *N	Read/Set parity for net	protocol dependent	odd, even, none	F.13.1
4905 net *N	Read/Set local node address for net to N	1	1-256	F.13.2
4906 net	Read protocol type for net N	Factory Configured	Not user settable	F.13.2
4907 net *N	Read/Set COMALARM Trip Delay	30 sec.	N=0.1-999.9 sec.	F.13.3
4908 net * V	Read/Set link-level timer.	Protocol Specific	V is in msec.	F.13.3
4909 net * V	Read/Set applications-level Timer	Protocol Specific	V is in msec.	F.13.3
49 50	Reads/Sets all protocol	varies	See applicable notes	F.13.4,
Miscellaneous				
49 *	Repeat the previous command which began with a '4'			F.14
4910 N	Read/Set default net to N	1	1 to 5	F.14
4911 N	Read/Set default node to N	1	protocol dependent	F.14
Clearout Operations				
493 *net	Globally disables/enables network communications		Acts as toggle	F.15
4935 4	Clears all RC user recorded speed messages			F.15
4935 5	Clears all RC net addresses and criteria			F.15
4935 8	Clears out all communications failure codes and counts			F.15
Diagnostic Readouts				
Note: See Code 4910 for default value for "net" in all of the following				
49 2 net	Reads current Network Failure threshold for net			F.16
49 2 net *N	Set Network Failure threshold to N		0 - 200	F.16
49 30 *net	Perform diagnostic self-test on specified net			F.16
49 40	Reads all 4940 X diagnostic for all networks			F.16
49 40 *net	Reads all diagnostic information for net			F.16

PLC Programming Code Table (Page 4 of 4)

Code	Description	Default	Range	Section
Diagnostic Readouts . . . *Continued from p. F-27*				
Note: See Code 4910 for default value for "net" in all of the following				
49 40 1	Reads time to complete RC table scan			F.16
49 40 2 net	Reads communications alert status for net			F.16
49 40 3 net	Reads communications alert count for net (Append with 0 to clear count)			F.16
49 40 4 net	Reads all node address whose RCs have current communications failure			F.16
49 40 5 net	Reads all RCs on net currently having communications failure			F.16
49 40 6 net	Reads diagnostic codes for last 10 network problems			F.16
49 41 ZZ	Reads communicatons status for RC ZZ			F.16
49 41 ZZ*	Reads count of COMALARMS for RC ZZ			F.16
49 42 net	Reads list of disarmed (code 45ZZ0) RCs			F.16
49 43	Reads list of uninitialized RCs			F.16
49 44	Reads list of all RCs not using the default alarm criteria			F.16
49 45 ZZ	Reports net address, alarm criteria, setpoints, links and alarm status for RC ZZ			F.16

G Cabling Diagrams

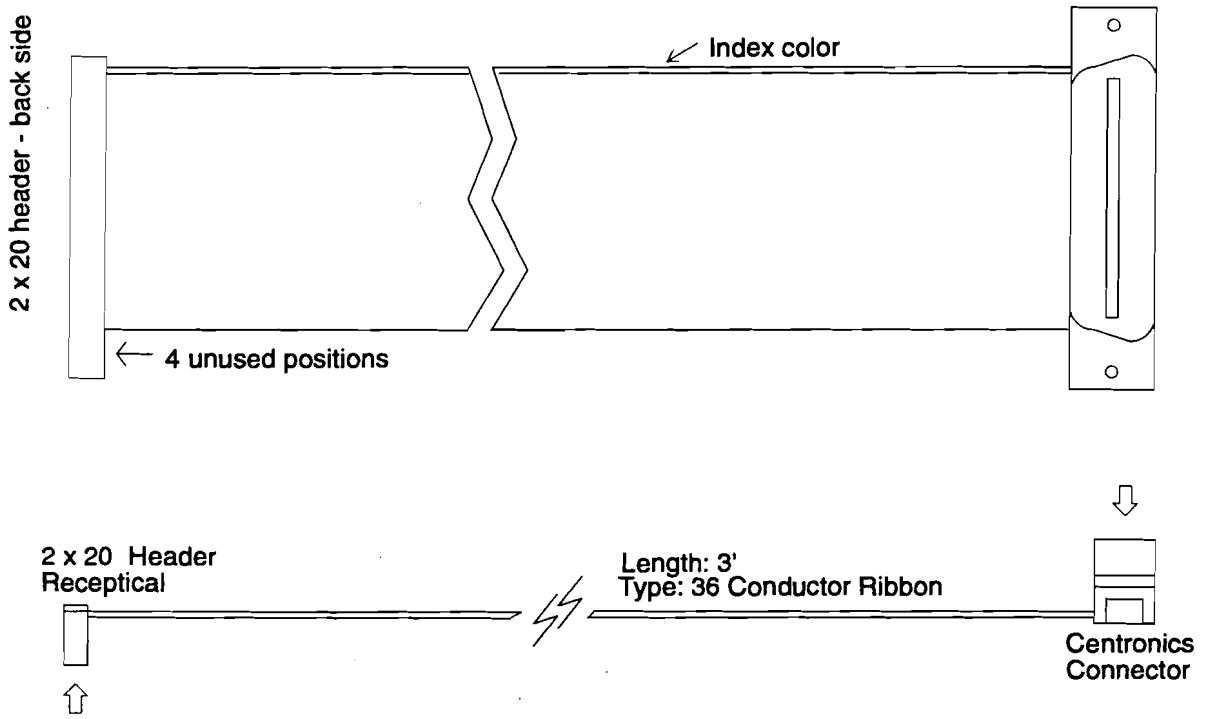
G.1 RACO VSER-01 Serial Cable Connection Diagram



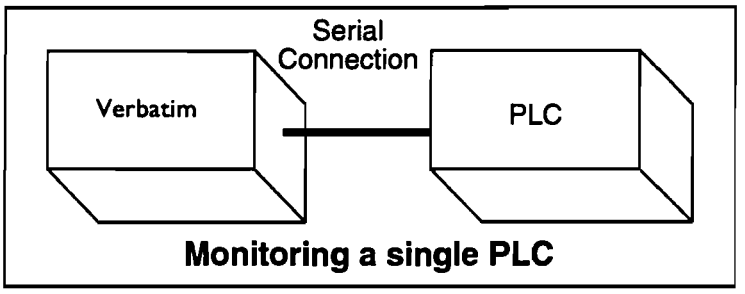
25 Pin Connector Pin-Out		
2	RXD	Data to VB
3	TXD	Data from VB
7	SGND	Signal Ground
8	DCD	Carrier Detect - Handshake Out (not used)
20	DTR	Data Terminal Ready - Handshake In (not used)

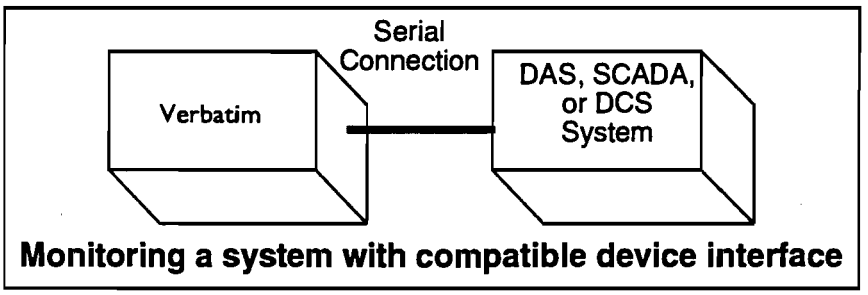
G.2 RACO VPPC-1 Parallel Cable Connection Diagram

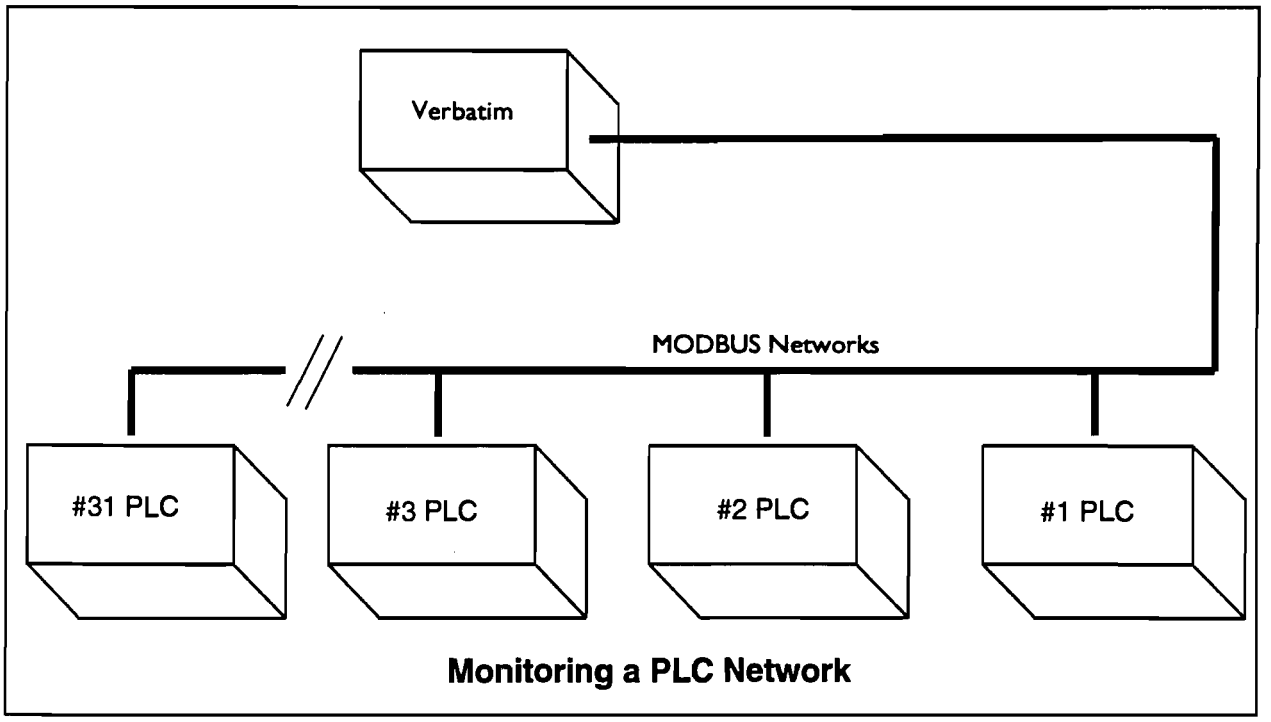
Used for LDL parallel printer option



G.3 Verbatim PLC Network Connections Diagram

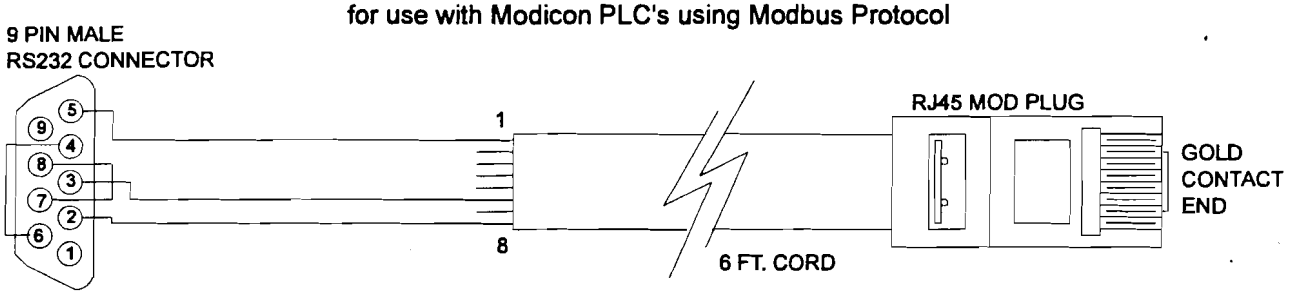






G.4 RACO VMB-2 Serial Cable Connection Diagram

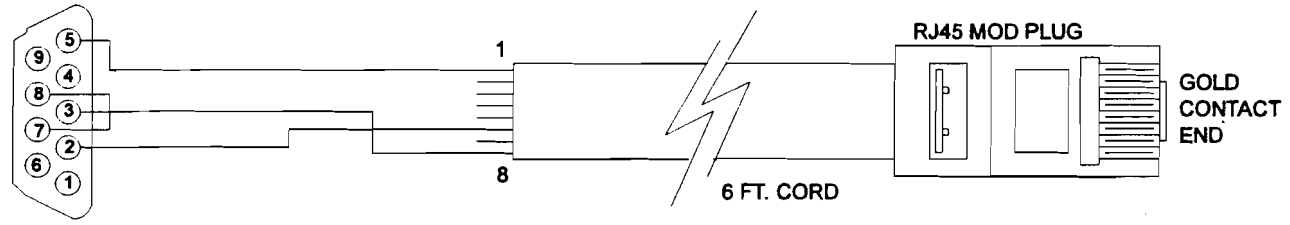
for use with Modicon PLC's using Modbus Protocol



9 Pin Connector Pin-Out		
2	TXD	Data from Verbatim
3	RXD	Data to Verbatim
4	DSR	Data Set Ready - Jumpered to DTR at 9 pin conn. only
5	SGND	Signal Ground
6	DTR	Data Terminal Ready - Jumpered to DSR at 9 pin conn. only
7	RTS	Request to Send - Jumpered to CTS at 9 pin conn. only
8	CTS	Clear To Send - Jumpered to RTS at 9 pin conn. only

G.5 RACO VMBM-1 Serial Cable Connection Diagram

for use with Modicon Micro PLC's using Modbus Protocol



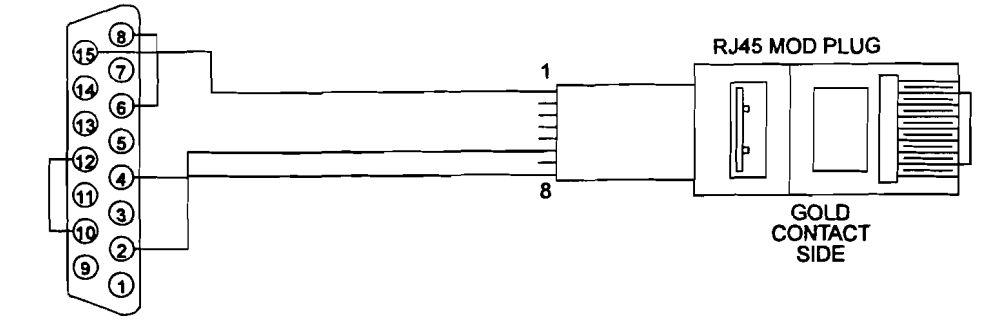
9 Pin Connector Pin-Out		
2	RXD	Data to Verbatim
3	TXD	Data from Verbatim
5	SGND	Signal Ground
7	RTS	Request to Send - Jumpered to CTS at 9 pin conn. only
8	CTS	Clear To Send - Jumpered to RTS at 9 pin conn. only

Note:

Connection to Modicon Micro PLC requires use of Modicon Cable Part Number 110XCA28201, 110XCA28202, or 110XCA28203 plus adaptor 110XCA20300. This combination of cable plus adaptor mates with above RACO cable. The Modicon cable is a flat, eight wire cable with RJ-45 male connectors on each end. The Modicon adaptor is an RJ-45 female to D-sub 9 Pin female adaptor.

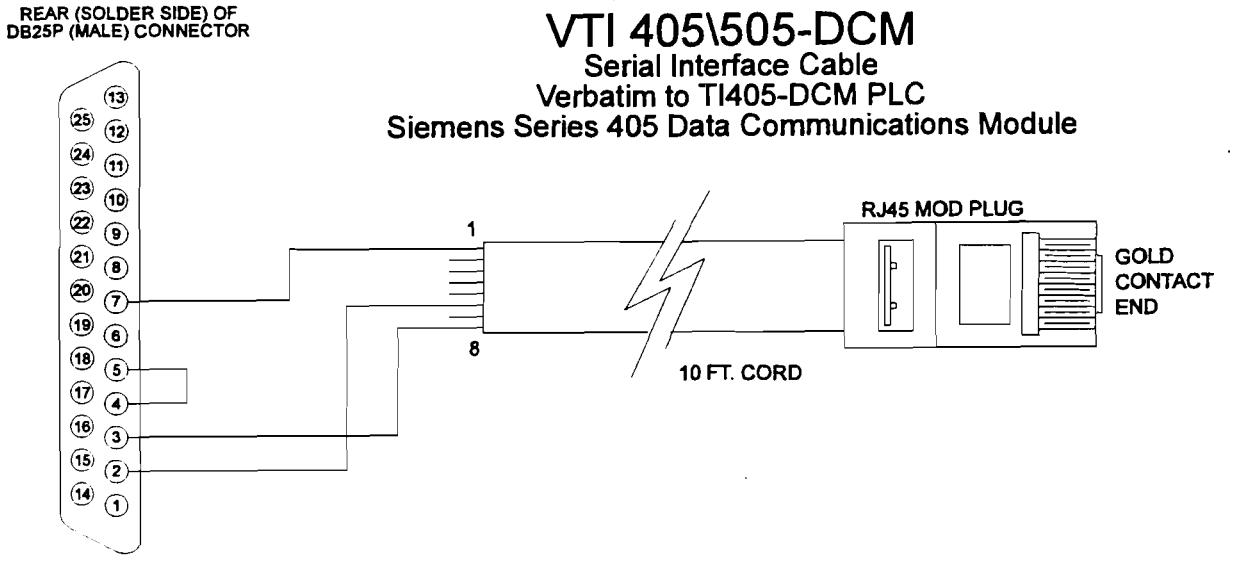
G.6 RACO VBB-1 Serial Cable Connection Diagram

for use with Bristol Babcock DPC 3330 or 3335



15 Pin Connector Pin-Out		
2	RXD	Data to Verbatim
4	TXD	Data from Verbatim
6	JUMP	Jumpered to pin 8
8	JUMP	Jumpered to pin 6
10	JUMP	Jumpered to pin 12
12	JUMP	Jumpered to pin 10
15	SGND	Signal Ground

G.7 VTI 405/505-DCM Serial Cable Connection Diagram



25 Pin Connector Pin-Out		
2	RXD	Data to VB
3	TXD	Data from VB
7	SGND	Signal Ground

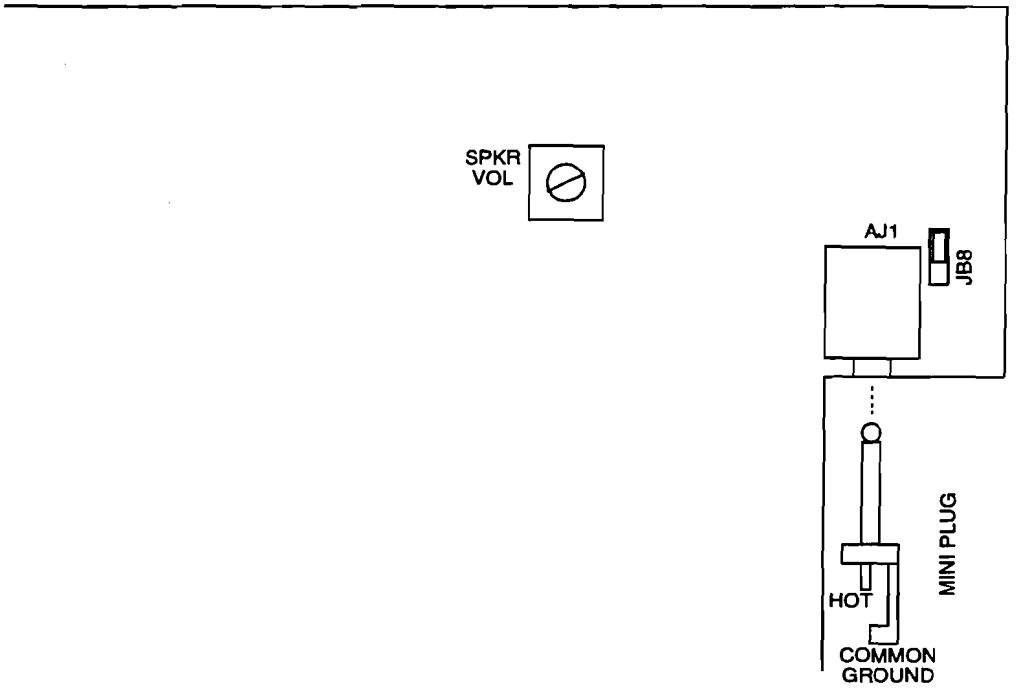
H

Verbatim Floobydust

H.1 Adjusting Internal Speaker Volume

Speaker volume may be adjusted via the trimpot marked SPKR VOL located in the upper right hand area of the main circuit board.

This trimpot also adjusts the level of the audio signal that can be obtained via jack AJ1. However, sensitive audio systems may require an additional signal level attenuator in order to prevent overloading.



H.2 External Speaker Connections

An audio output suitable for driving an external speaker of 4 to 16 ohms impedance, headphones, or other audio system, is available via jack AJ1, located in the upper right hand area of the main circuit board. This jack must be configured to deliver audio signal output by placing a jumper shunt across the upper pair of pins on the three-pin header JB8, located next to AJ1.

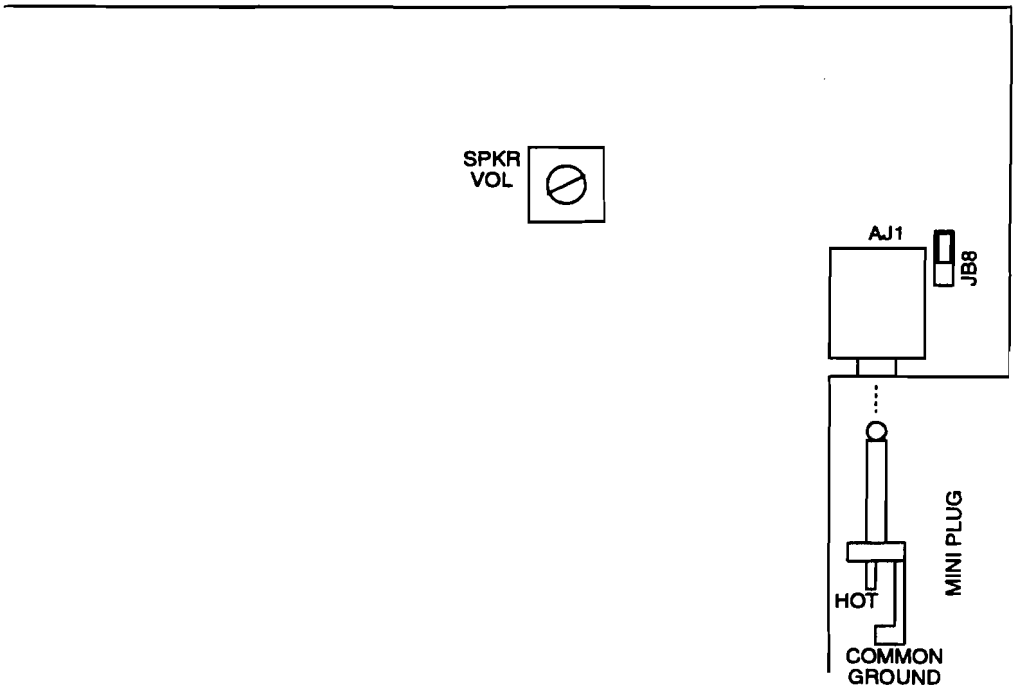
Note that AJ1 is a dual purpose jack which may be used either for audio output or DC power input, but not for both simultaneously.

To make connection with AJ1, use a standard single-circuit "MINI" plug. The tip end will be the audio signal; the shell will be ground.

The output signal has a nominal impedance of 8 ohms and a nominal average amplitude of 1 volt RMS, when the audio level trimpot, described below, is set to full clockwise position.

H.2.1 Specifications for Audio Output from Jack AJ1

Nominal output impedance	8 ohms
Nominal average output amplitude with 8 ohm load	1 VRMS



H.3 Alternative Power Sources

As an alternative to the 120 VAC input, an external DC power source can be used. The DC power source should have a current capacity of at least 500 ma DC and a voltage from 8 to 14 VDC. Actual current consumption will be approximately 250 ma standby and 375 ma while phoning and speaking, plus whatever current is required to charge the internal 6 volt, 4 AH gel-cell battery. This supplemental charging current will be roughly 25 ma when the battery is already fully charged, and up to 200 ma if the battery is being recharged after a discharge. Option cards such as analog, remote supervisory control etc. will also moderately increase the current being drawn.

DC power should be connected via a standard single-circuit "MINI" plug, inserted into jack AJ1 located in the upper right hand corner of the main circuit board. This jack must be configured to accept DC power input by placing a jumper shunt across the lower pair of pins on the three-pin header JB8, located next to AJ1. **The positive (plus) side of the power source must go to the end "tip" of the plug; reversing this polarity can damage the product.**

Note:

Note that AJ1 is a dual purpose jack which may be used either for audio output or DC power input, but not for both simultaneously. Note also that the AC power fuse FU1 is bypassed with this configuration. It should be removed to avoid confusion.

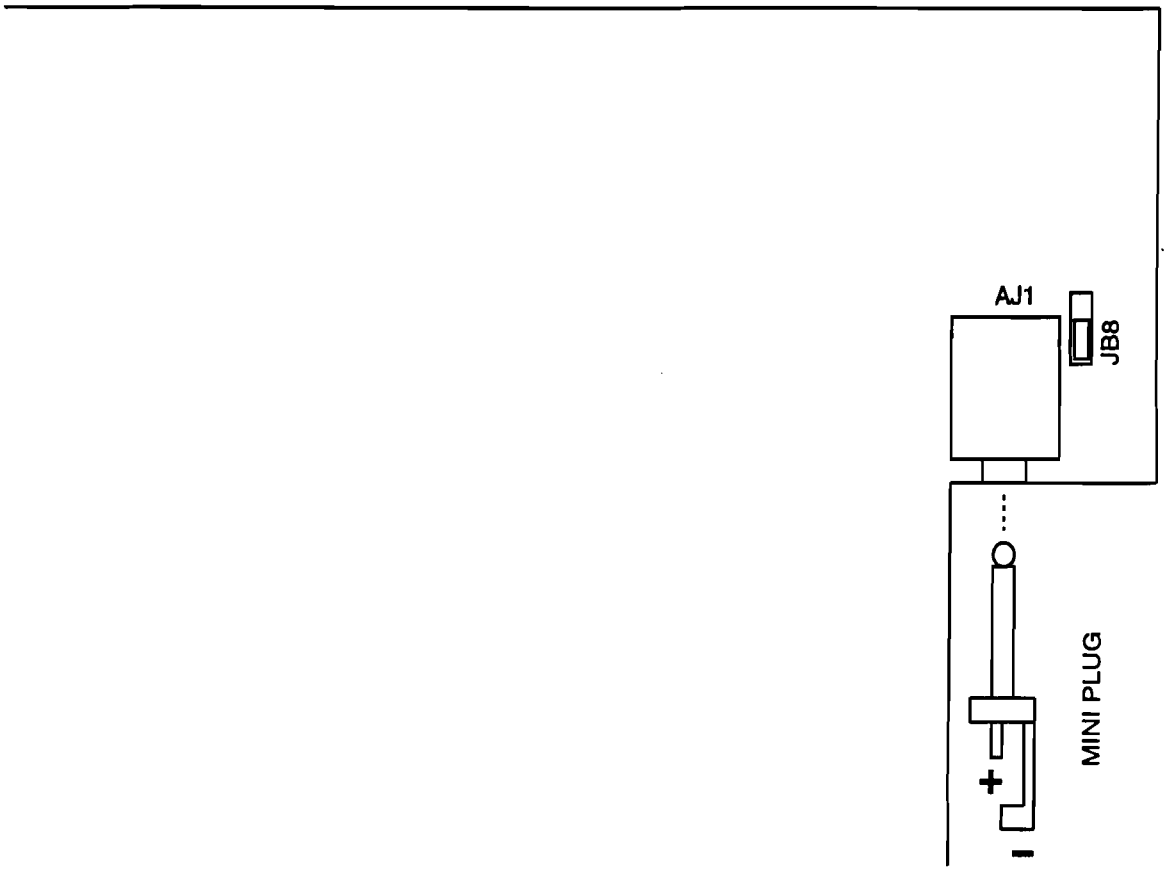
The front panel ON/OFF control will operate as with standard 120 VAC power input. If the external power source is interrupted, the unit will switch to gel cell battery power and go into power failure alarm.

The Verbatim autodialer is capable of being powered by other types of power source, including 240 VAC, on special order. Contact factory for details.

H.3.1 Standard DC Power Power Specifications

Input voltage range	8-14 VDC
Recommended minimum current capacity	500 ma DC
VSS-4C-32 current drawn, less battery, standby	275 ma
VSS-4C-32, less battery, phoning/talking	400 ma
Added current to maintain charged battery	25 ma
Added current to charge discharged battery	200 ma

DC Power Connection Diagram



H.4 Speech Recording Times

The following is a table of available speech recording times on Verbatim autodialer.

To find the available amount of speech recording time, first determine the total number of channels on the unit, then find the corresponding row indicating the number of seconds of speech recording time at the various recording rates.

Example: A VSS-4C-32, has a total of 36 channels (4 contact and 32 plc channels). Therefore the available recording times are 130, 200, 270 or 399 seconds, depending upon which recording rate is selected by the user.

Total# OF Channels	# OF RAM CHIPS	# OF Seconds @ Rate1	# OF Seconds @ Rate2	# OF Seconds @ Rate3	# OF Seconds @ Rate4
1-8	1	26	40	54	79
9-16	2	52	80	108	159
17-24	3	78	120	162	237
25-32	4	104	160	216	318
33-40	5	130	200	270	399
41-48	6	156	240	324	476
49-56	7	182	280	378	555
57 UP	8	208	320	432	624

The above table indicates the recording times that are shipped standard. However on special order, the available recording time can be increased to correspond with any row in the table.

H.5 PBX Support

Interfacing the Verbatim to PBX or PABX phone systems can occasionally present problems. Some PBXs have a non-standard dialtone. Additionally, in many PBXs, you must first press a special key, like a '9' to get an outside line. After pressing the '9' there may be a short delay followed by the dialtone for the outside line.

By turning OFF Phone Fault Detection you can avoid problems with non-standard dialtones from your PBX system. Then Phone Fault Detect will not falsely indicate a telephone line interruption.

Even with Phone Fault Detect OFF you can still accomplish dialtone detection on outside lines. Simply add the Tone Detect key sequence to the phone number string after the '9' or other digit to request an outside line.

H.5.1 Cautionary Notes About Interfacing to PBXs

Must Be an Analog Line

Some PBX systems are either partially or entirely digital. That is, voice and signaling information is converted to a digital representation. Voice information arriving at the PBX from the outside is converted from analog to digital. Voice information leaving the PBX to the outside is converted from digital to analog. Phone sets within a digital system may be interfaced by digital signals only. In such systems it may be difficult, but usually not impossible, to obtain a "standard" analog phone line to use in interfacing devices such as a Verbatim . It may be necessary to contact the vendor of your PBX system for information on addition of analog lines.

Lines Can Cause Damage

Caution is advised. Some telephone lines within digital PBXs present voltages which can be dangerous to RACO's equipment. If you are attempting to interface a Verbatim inside of a PBX it would be a good practice to have the phone line you intend to use checked for "unusual" voltages and signals.

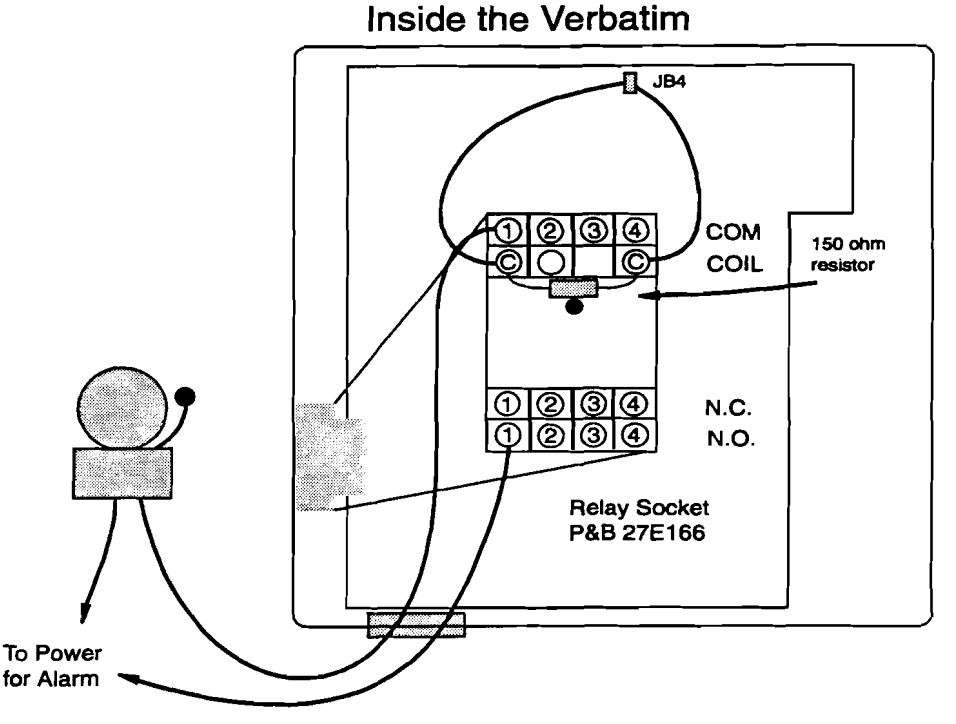
With few exceptions, if you can get a standard telephone set to word on a PBX line then you will be able to make the Verbatim work as well.

H.6 Local Alarm Relay Option

The Verbatim provides a 5 volt output that is turned on whenever the unit goes into alarm. This is available at JB4, located at the top center of the main board. Use a molex style 2 pin connector to plug onto the JB4 pins. This output can activate a sensitive (500 ohm +) relay such as a Potter & Brumfield KHU-17D11-6). Connect a 150 ohm,1/4 watt resistor across the relay coil. The Potter & Brumfield relay plugs into a socket (#27E166) which is shown in the accompanying figures. Note that it has four separate circuits in SPDT form. This relay may be used for local alarm, line seizure, or both.

H.6.1 Local Alarm Relay Configuration

1. Wire the relay coil as described in the introduction.
2. Wire the local alarm to one of the four circuits of the relay. In the illustration, the numbers refer to the four separate circuits, and C refers to the coil terminals.
3. Note that the Verbatim does not provide the power for the alarm, it functions only as a switch.
4. The program code for Local Alarm Relay configuration is
   960 00 ENTER
   which is the factory default.



H.7 Line Seizure Option

Line Seizure is a feature that ensures that the dialer will seize the phone line when it goes into alarm, cutting off any phones, FAX, or answering machines that may be on line at the time (these are called the *downstream* phones, as they are *downstream* from the Verbatim). The unit waits two seconds to allow a dial tone to come up, then dials out. These phones will remain cut off until the alarm is acknowledged.

The Verbatim provides a 5 volt output that is turned on whenever the unit goes into alarm. This is available at JB4, located at the top center of the main board. Use a molex style 2 pin connector to plug onto the JB4 pins. This output can activate a sensitive (500 ohm +) relay such as a Potter & Brumfield KHU-17D11-6. Connect a 150 ohm, 1/4 watt resistor across the relay coil. The Potter & Brumfield relay plugs into a socket (#27E166) which is shown in the accompanying figures. Note that it has four separate circuits in SPDT form. This relay may be used for local alarm, line seizure, or both.

The phone jack must be an RJ-31X, which is available from the phone company or a phone supply outlet. In operation, the Verbatim plugs into the RJ-31X jack and makes contact with the middle four pins, which are the standard red, green, yellow and black wires.

Note that you may combine the Local Alarm Relay with Line Seizure feature simply by using one of the spare circuits (3 or 4) for the local alarm. It breaks the downstream connections, thereby seizing the line, then waits two seconds to allow a dial tone to come up, then dials out.

H.7.1 Line Seizure Installation

1. Wire the relay coil as described in the introduction.
2. Wire the four terminals of the telephone input terminal strip to the relay a follows (please refer to accompanying figures):

Terminal Strip	Relay
R	COM circuit #2
G	COM circuit #1
Y	N.C. circuit #1
B	N.C. circuit #2

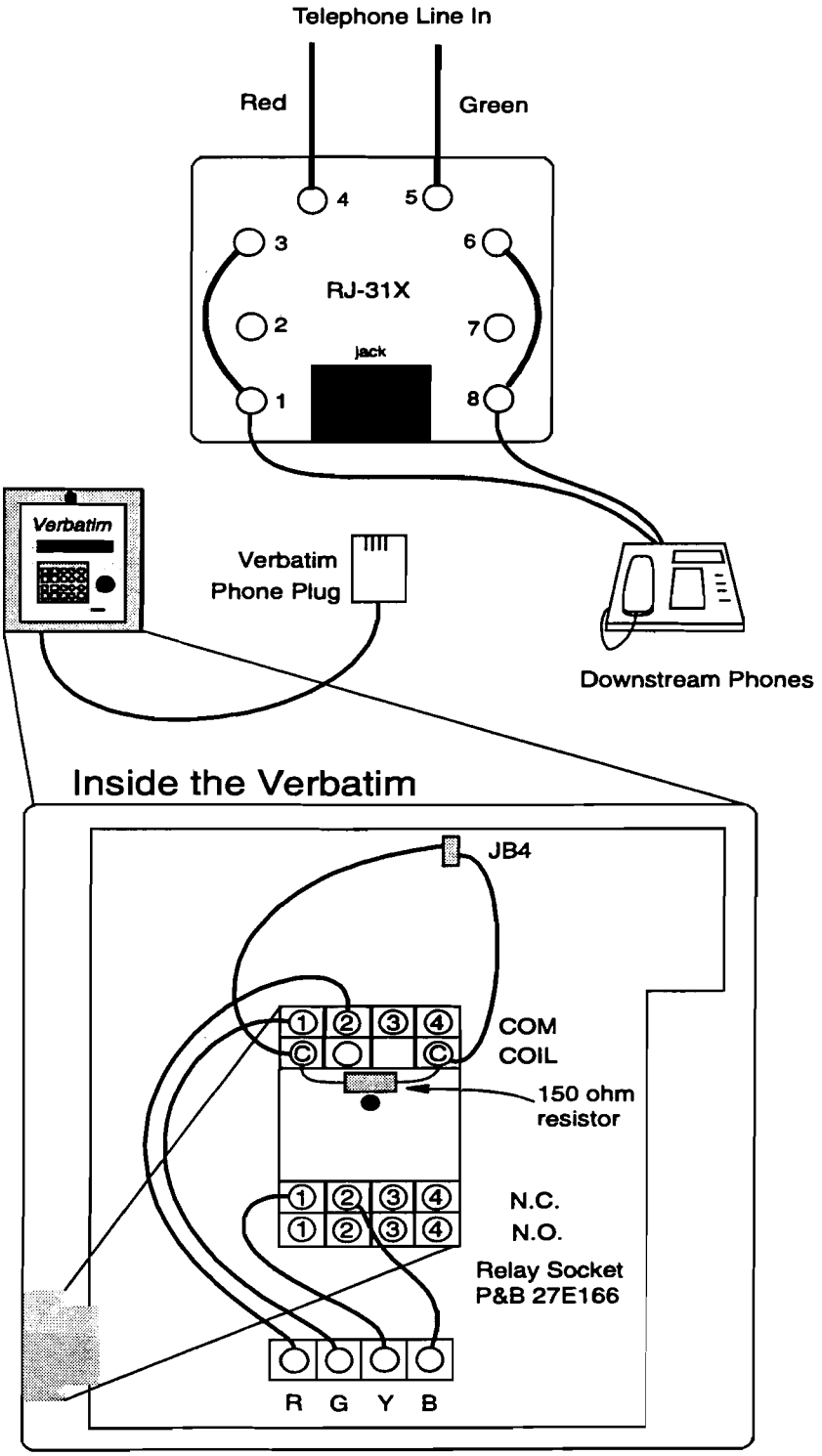
3. Wire the special RJ-31X line seizure jack as follows (refer to the accompanying figures):

   Connect a jumper wire from terminals 1 to 3 and a second jumper wire from terminals 6 to 8.

   Connect the incoming telephone line red wire to terminal 4 and the green wire to terminal 5.

   Connect the downstream extension phones to terminals 1 and 8.
4. Plug the Verbatim into the RJ-31X socket.
5. Program the Verbatim with code:
   `960 01 ENTER`
   This is the code for Line Seizure configuration of the Local Alarm Relay.

Wiring the RJ-31X Line Seizure Jack Diagram



H.8 Heater / Thermostat Option

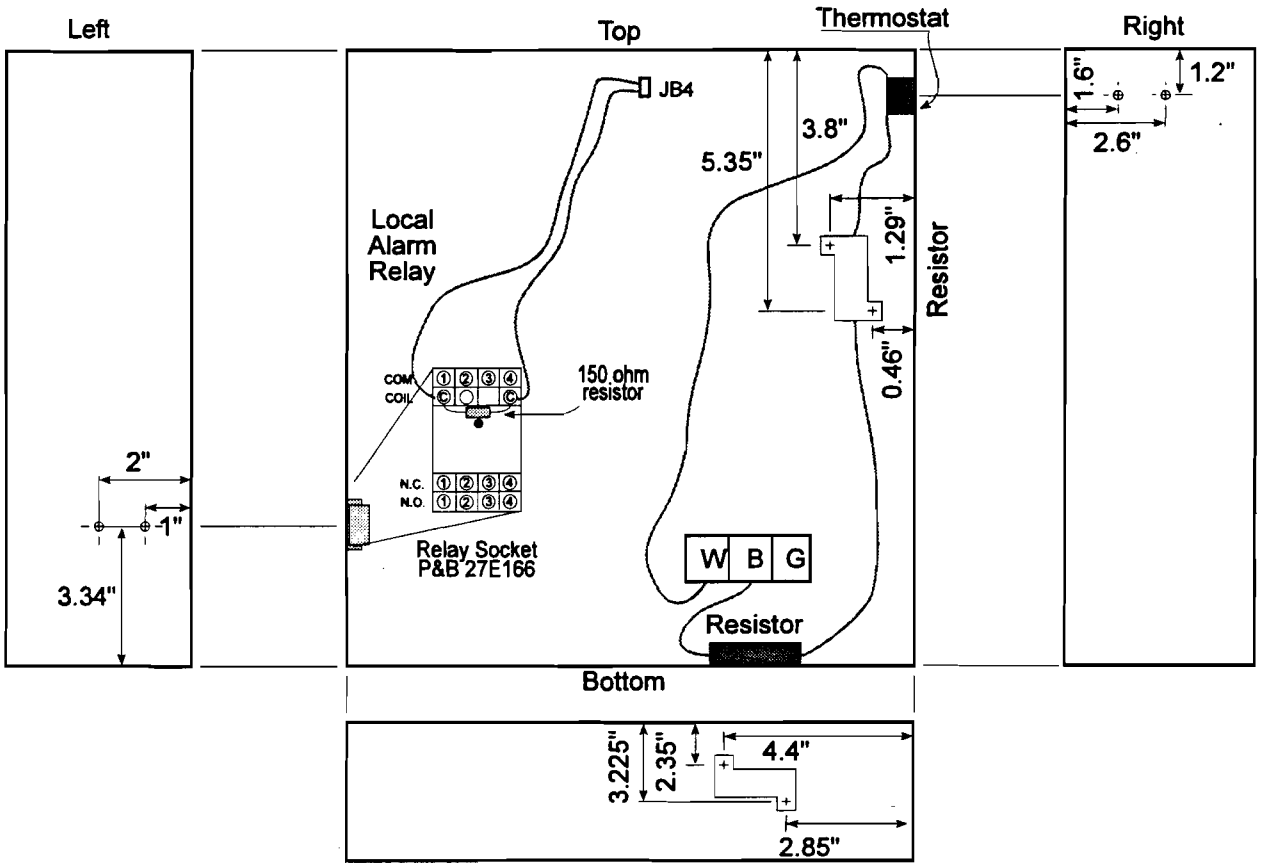
The heater/thermostat option is intended to provide warming of the product when it is exposed to particularly cold ambient temperatures.

The thermostat applies 120 VAC power to two chassis-mounted resistors, when it senses temperatures below approximately 40 degrees F. The resistors dissipate a combined 75 watts of power. The amount of temperature elevation above ambient temperature that this provides depends on the thermal insulation of the enclosure and "heat sinking" into the surface which the unit is mounted to. The unit's aluminum enclosure provides relatively little thermal insulation by itself. However if RACO's fiberglass NEMA 4X enclosure option is used, a temperature elevation of about 75 degrees is provided.

If the unit is to be powered by something other than 120 VAC and you need a heater/thermostat, consult factory.

Heater/Thermostat Option	
Power source required	120 VAC
Power dissipated when activated	75 watts
Nominal activation temperature	40 deg F
Nominal heat rise in fiberglass NEMA 4X enclosure	75 deg F

Heater/Thermostat Mounting and Wiring Diagram



H.9 Connecting to a Radio Transmitter

If you have a radio transmitter that can provides for external connection of an audio signal input and also for connection of an external contact closure to key on the transmitter, you may connect it to the Verbatim autodialer. However you should also consider the alternative of using RACO's CELLULARM cellular phone system, which provides a superior means of signalling where regular land line phone service is not available.

Note that the radio operation described below is not compatible with installation of the Telephone Line Seizure option.

To obtain the contact closure used to key on the transmitter, it is necessary to solder some special connections on the back of the main circuit board. **This step is not necessary if your unit has been supplied from the factory with the RF Interface option.**

First, disconnect the gel cell battery and remove all AC power connections. Remove any option cards. Then carefully remove the speech card located at the top of the unit, via its two mounting screws. Be careful to retain the plastic spacers located behind these screws, for use when replacing this speech card. Flex the card slightly to clear the two mounting pegs and pull the card straight outward.

Remove the main circuit board by removing the six 6-32 mounting screws. You may also wish to unplug the contact input terminal strips and the ribbon cable which leads to the front panel. Solder a pair of jumper wires to the back of the board as indicated in the Jumper Wires for RF Link Diagram. This step connects the auxiliary contacts of off-hook relay K1, to the Y and B terminals of telephone terminal strip TS2.

Re-assemble the unit and restore any connections which were removed. Be sure that the ribbon cable's connector is accurately and firmly seated.

Connect the Y and B terminals on TS2, to the external keying input of your transmitter. The transmitter will now be keyed on whenever the off-hook relay is activated.

The method of audio connection depends on whether the product is to be connected to a regular phone line in addition to the radio transmitter. If a sensitive microphone input is used, additional attenuation may be required to avoid overloading the audio input.

If phone line operation is required in addition to radio operation, establish the audio connection into the transmitter via jack AJ1, as described in the section on EXTERNAL SPEAKER CONNECTIONS.

If no phone line operation is required, you may instead remove the phone cord and obtain an isolated 600 ohm, line-level audio signal at the TIP and RING terminals of TS2.

In operation, the transmitter will be keyed on whenever the off-hook relay is activated -- i.e. whenever the product is attempting to place or answer a phone call. Thus, if an ordinary phone line is also used, all phone activity will also be transmitted.

If no phone line is used, it will still be necessary to program a "dummy" phone number consisting of a single digit "1", using program code 7 0 1 1. Also, program for touch tone dialing using program code 9 0 1 1. When the unit goes into alarm, it will activate the off-hook relay and therefore the transmitter. Then it will issue the single digit tone, and a few seconds later it will begin the speech message, continuing as it would for a regular phone call. The number of message repeats may be altered if desired, using program code 907.

If a phone line is also used, program the appropriate phone numbers as you would ordinarily do. All phone calls will also be transmitted by radio. If you desire to have selected "calls" go out only over the air and not to any real phone number, program the single "dummy" phone number as described above. This single digit will silence the dial tone which would otherwise be broadcast along with the speech message.

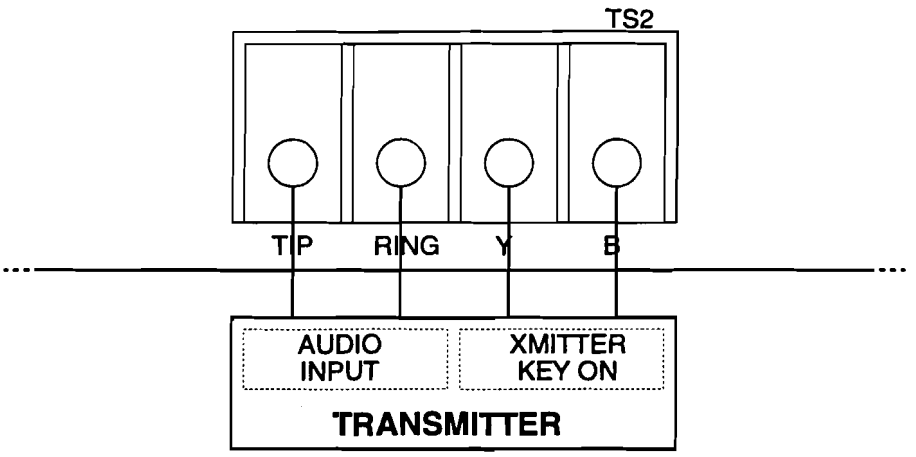
Alarm calls will continue until acknowledged, unless the unit is programmed to cease calling when the alarm violation ceases, using program code 9 2 3 2.

In order to acknowledge alarms, it will be necessary to phone the unit back (if a phone line connection is also being used), or else press one of the keys on the front panel.

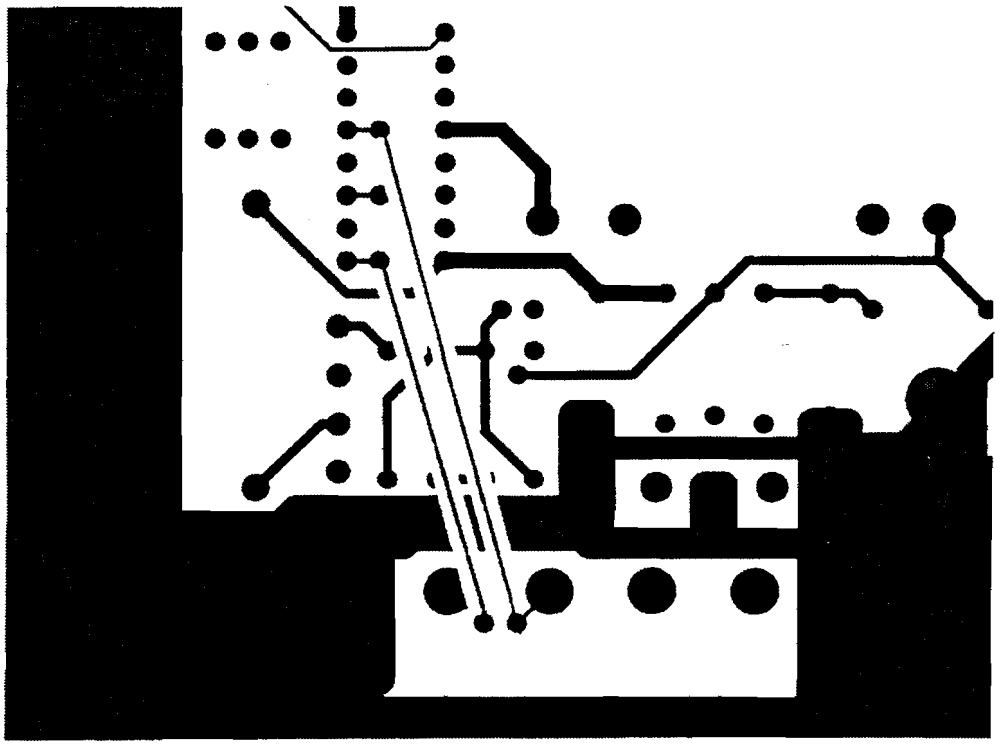
If a two-way transceiver is available which includes some kind of tone signalling and detection feature that results in momentary closure of a local relay contact at the autodialer locations, this contact may be used to place inquiry calls to the unit and also to acknowledge alarms, by radio. Contact factory for details.

Note that it will not be possible to perform remote programming of the unit with these radio connections.
A CELLULARM cellular system eliminates all such contraints.

TS2 Connection Diagram



Jumper Wires For RF Link Diagram



H.10 Calling a Pager

H.10.1 Introduction

It has become fairly common to have the autodialer call a pager system with an alarm call. The dialer is well equipped to handle many of the current pager protocols, and an overall understanding of the sequence of events will make the required programming go smoother.

Typically, a call to the pager is placed. After a short period (usually 5-12 seconds), the pager answers then gives a beep or a short burst of beeps. This is the signal to begin entering the number you want to be received and displayed by the beeper. When the information is complete, the pager terminal will hang up.

Note:

RACO strongly recommends that you program other personnel phone numbers at the appropriate place in the dialing list. This is to insure that if for some reason the pager system cannot be activated, you will get a timely warning from your autodialer.

H.10.2 General Programming Considerations

In most cases, the entire pager calling sequence is handled within the dialing string of the Verbatim. That is, it is all part of the phone number. The unit will handle up to 60 digits, including any timing delays you insert. The dialer must be programmed for touch tone dialing (program code 9011), as a pager terminal will not recognize pulse dialing.

Numeric Pager Support

Support for Numeric Pagers is comprised of a number of Verbatim autodialer features:

- Ability to add delays into a phone number string

  Often needed to pause after dialing the pager system's digits and emitting the caller's ID digits in the phone string.

- Ability to add DTMF # (or DTMF*) into a phone number string

  Often needed as a terminator character to inform the paging system that the last digit has been entered.

- Ability to add a pause for tone detect anywhere in the phone number string

  Sometimes used to detect the paging system's beep(s) heard after it answers.

- Ability to defeat voice annunciation for a specific phone number

  Often just dialing the pager system and emitting a DTMF ID sequence is sufficient for that phone call. Voice reports only delay the calling of subsequent numbers.

- Ability to add DTMF A, B, C, and D tones to phone number string

  These DTMF characters don't appear on standard telephones and may be used to differentiate automation equipment from humans calling the paging system.

Except for simple delays, entry of these additional digits into a phone number string requires a two key sequence. For example, to enter a '#' character into a phone number string, either at the front panel or over the phone, press the '*' key followed by the 8 key. This two key sequence will enter the single '#' character into phone number string.

The complete list of special digits is as follows:

Desired Result	User Enters	Voice Speaks
DTMF 'A' in phone string	*1	A
DTMF 'B' in phone string	*2	B
DTMF 'C' in phone string	*3	C
DTMF 'D' in phone string	*4	D
No voice annunciation for this number	*5	PHONE
Pause for tone detect	*6	TONE
DTMF '*' in phone string	*7	STAR
DTMF '#' in phone string	*8	POUND

Case 1: Simplest Case Pager

The simplest case is when you only have to call the pager and can hang up as soon as it answers, with no information being passed to the pager except that someone called. If you have only one dialer (and no one else uses the number!) you assume that any call from the pager is a Verbatim alarm call, and proceed from there. Of course, if you had two possible callers, you wouldn't know which one had called.

Example:

Set the first phone number to call the pager, the second phone number to call the plant foreman. Program 701 9 *6 1 713 235 3456 ENTER. (here, 701 signifies the first phone number, 9 to get an outside line, *6 to get an outside line dial tone, 1 713 235 3456 our hypothetical long distance call to a pager, and ENTER to complete the phone number). Program 702 9 *6 548 7632 ENTER (this is the second phone number, to call the foreman in case the pager call doesn't get through).

Case 2: Passing a Phone Number to a Pager

Some pager systems will allow the caller to enter a phone number (or other ID number), which is then relayed on to the beeper. When the person with the beeper gets the call, he will know immediately from the number which dialer has called. This is a good system if you are using multiple dialers, or have other pager calls in addition to autodialers.

Example:

Consider the following example of initiating a call to a paging system. We will assume here we don't have to dial 9 to get an outside line for this example. The paging terminal phone number is entered, followed by a CPM wait *6 to wait for the pager to beep. After that, an ID number is entered. Often the ID number is simply the phone number at the Verbatim autodialer site.
A # terminator *8 is inserted. Finally, the characters *5 are added to designate this phone session as a pager call and not a voice annunciation. Entry of additional delay digits may be required for proper timing of the pager call session.

The phone number string for this example with the first phone number calling a pager, is:

```
701 2352456 *6 5481234 *8 *5
```

Program 702 548 7632 ENTER (this is the second phone number, to call the foreman in case the pager call doesn't get through).

❖

Exception:

With some pager systems, Call Progress Monitoring (CPM) on may cause a delay that will not allow the pager message to be transmitted in the time allowed. If this is the case with your paging system, either have CPM in the default off state or, if you want CPM on, time delays can be used in the place of *6 pause for tone detect. The critical task here is to time the delay from the last digit dialed until the pager beeps. The delay time needed can be determined by using a stopwatch or a clock with a second hand. You want to time this delay to the nearest second, then add 1 second to be sure. Consult the diagram on page H-20 to see the time line of events, then program the dialer.

Example 1:

Delays are added by pressing the MINUS # key on the front panel. Each delay is normally 1 second, but can be programmed (using 928 N) to be any length from 1 to 10 seconds.

We made each delay 2 seconds long by programming code 928 to be 2 seconds for each delay used: program 928 2 ENTER. We then called the pager, and determined timed the delay between the last digit dialed and the pager beep was 6 seconds.

We programmed our pager phone number: 701 6586713 ### 18007226999 *8 *5, where # are delays inserted.

Example 2:

In this example we will enter an ID number before entering a phone number into the pager. The pager phone number is 1 713 2352456. The ID number is 7711. The dialer is at 5481234. Calling the pager by hand from the dialer site, we find the following:

- dial pager
- wait for pager to answer (6 seconds)
- pager beep
- enter ID (7711)
- wait for new pager prompt (2 seconds)
- enter dialer phone number (5481234)
- hang up

  The phone number to enter will look something like:

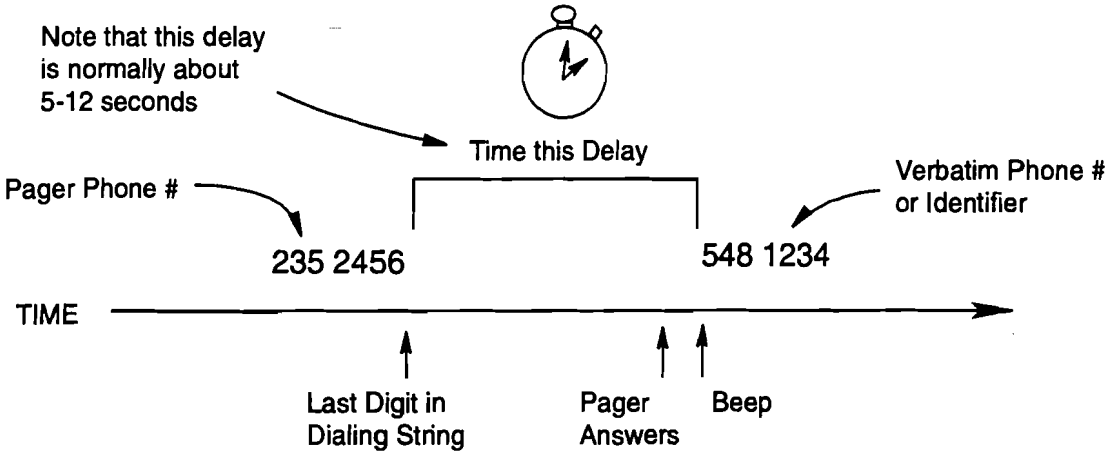
  1 713 235 2456 (delay 1) 7711 (delay 2) 548 1234
- In our example we programmed Phone #1:

  701 1 713 235 2456 ### 7711 # 548 1234 ENTER

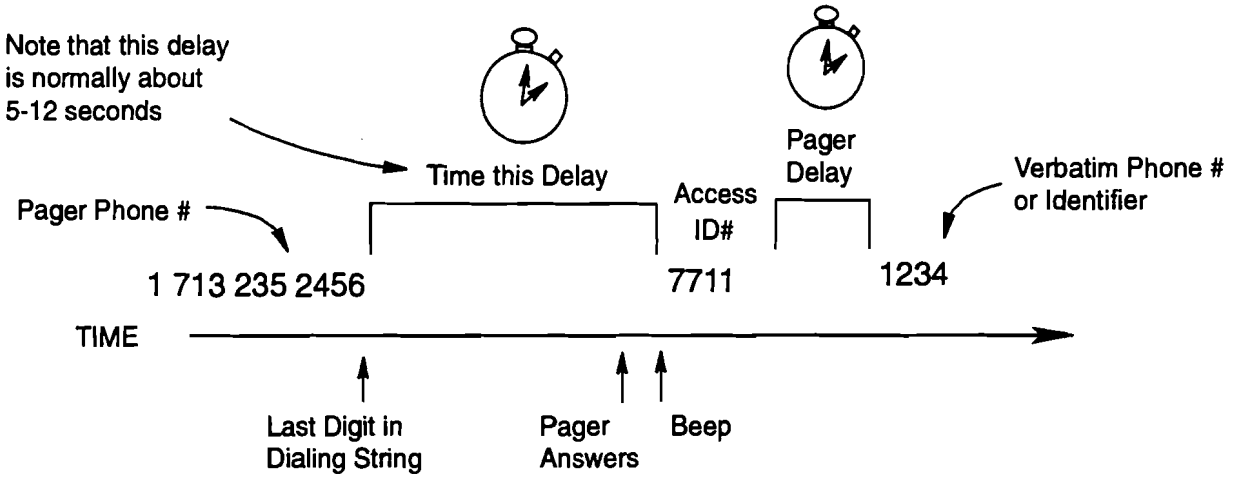
  (Remember that each # represents a 3 second delay).
- and Phone #2:

  702 548 7632 ENTER (our foreman again)

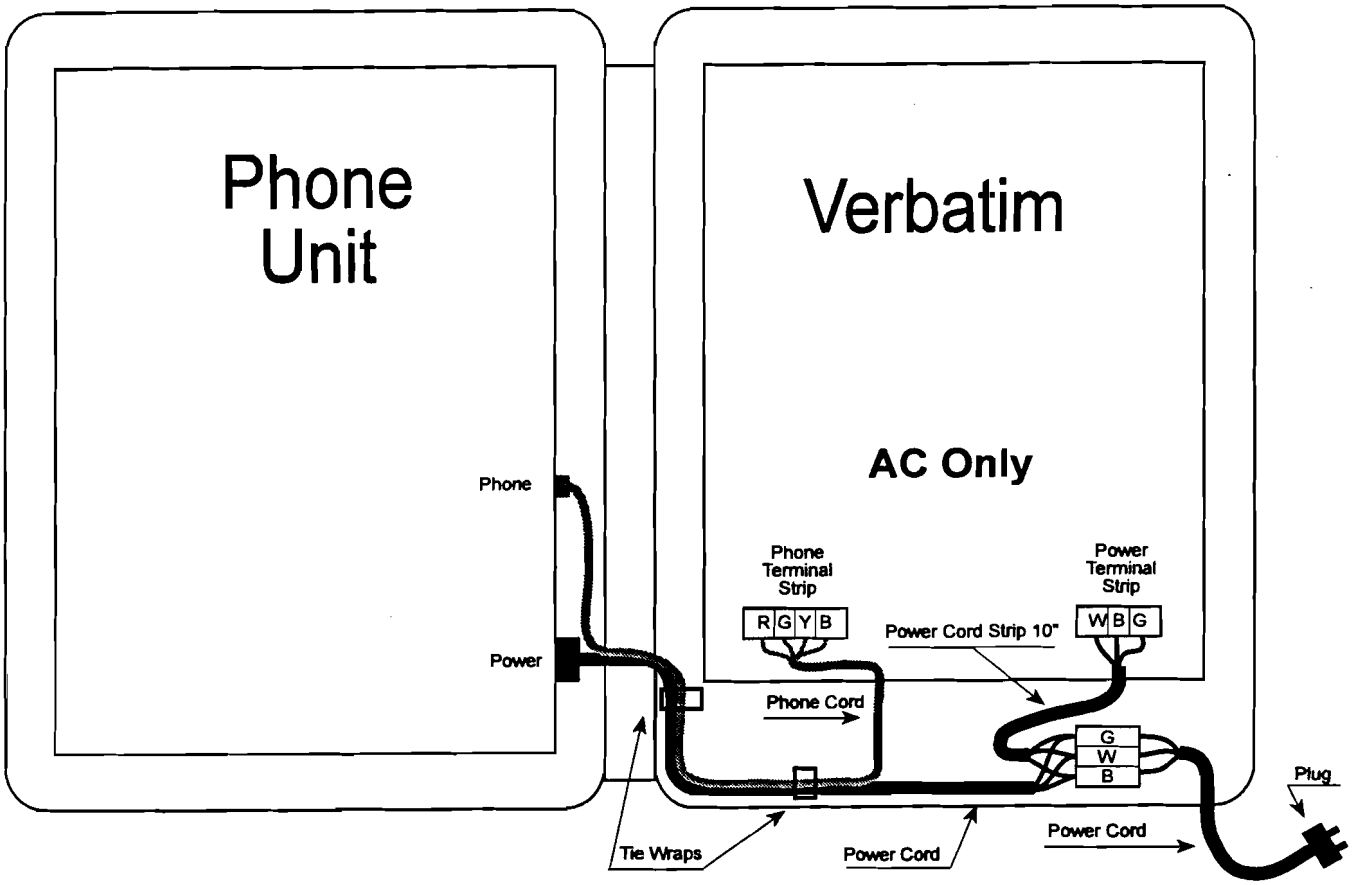
Case 2: Pager Calling Sequence Using Delays (Example 1)



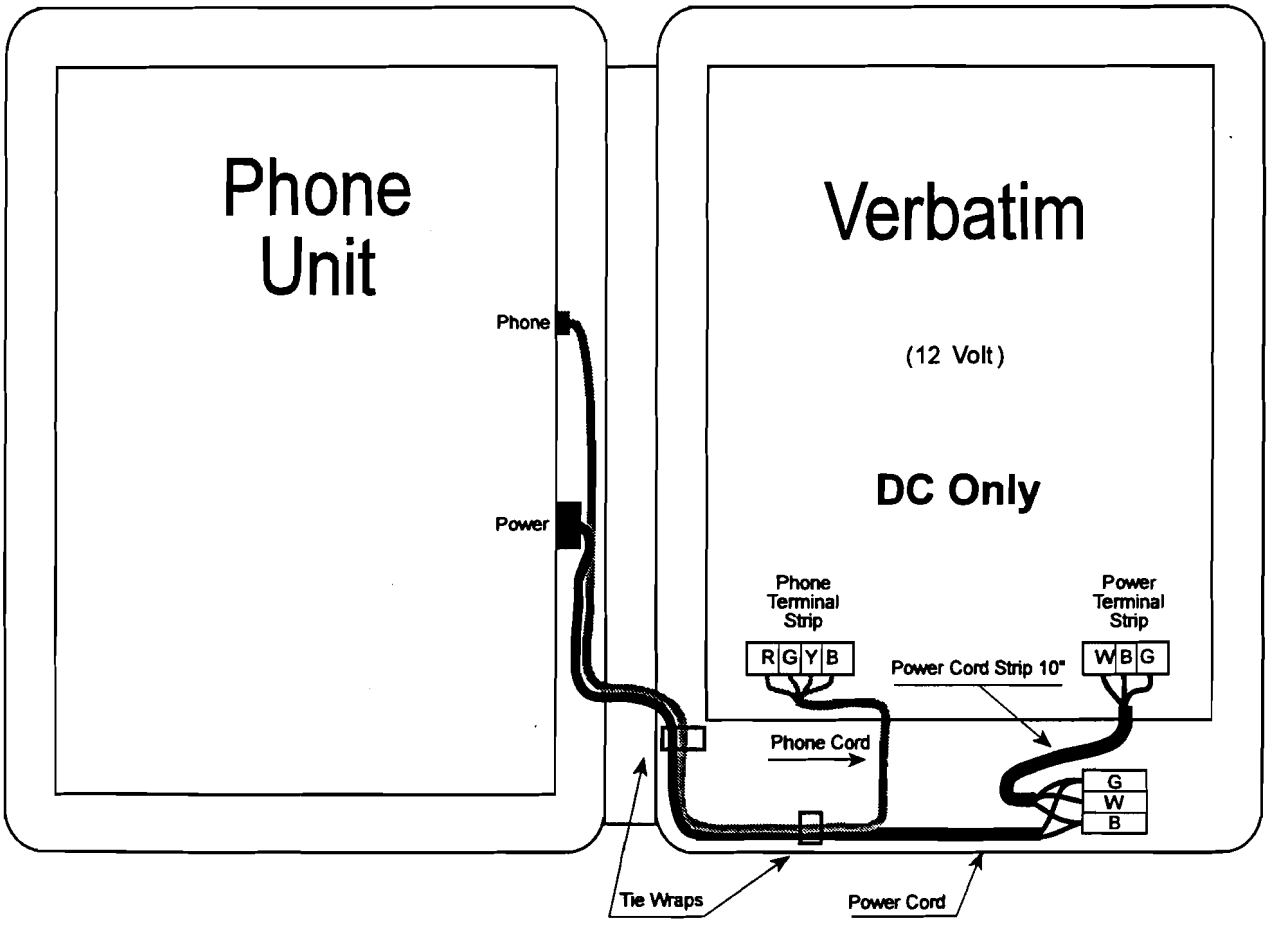
Case 2: Pager Calling Sequence Using Delays (Example 2)



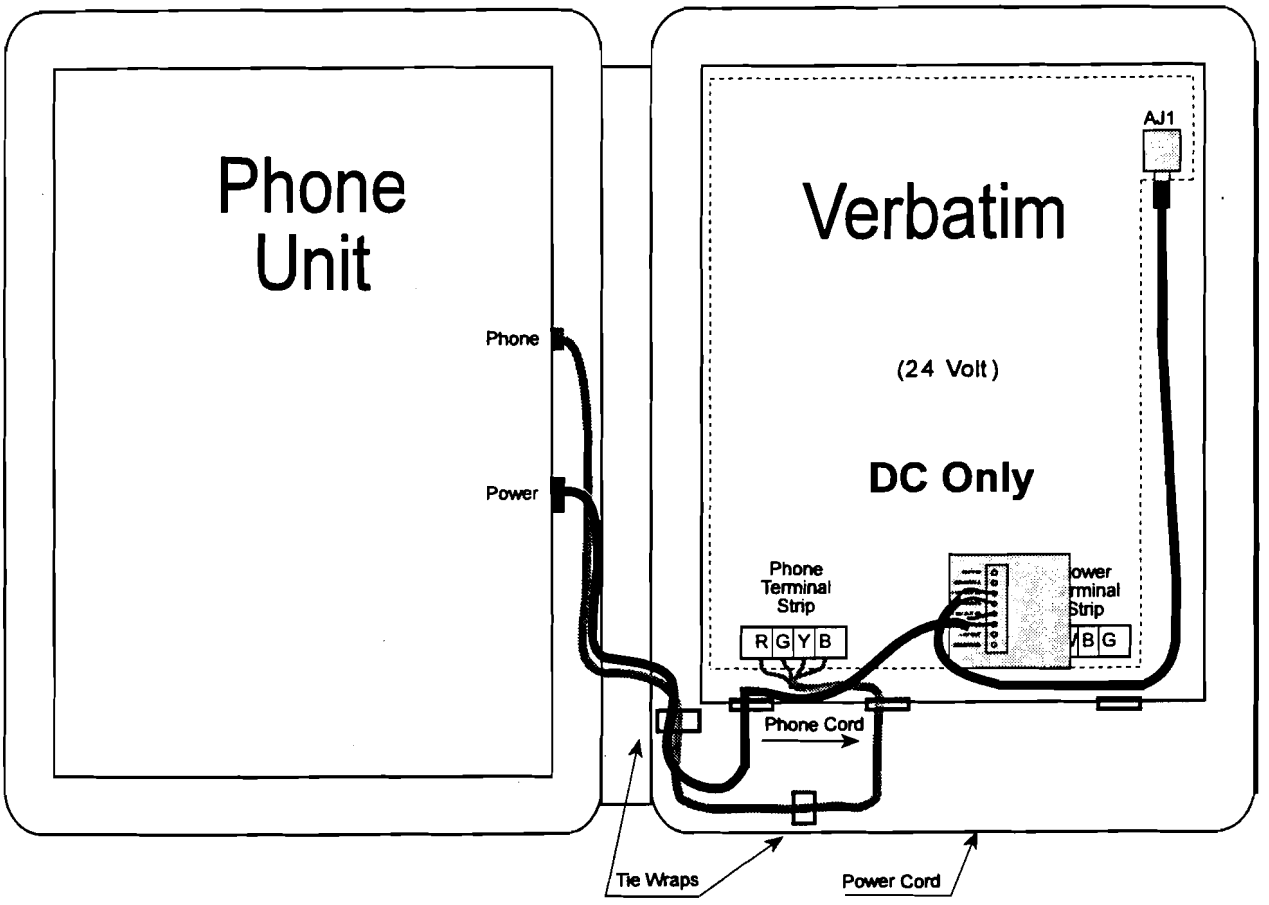
Cellularm Cellular Communications Diagram (AC Only)



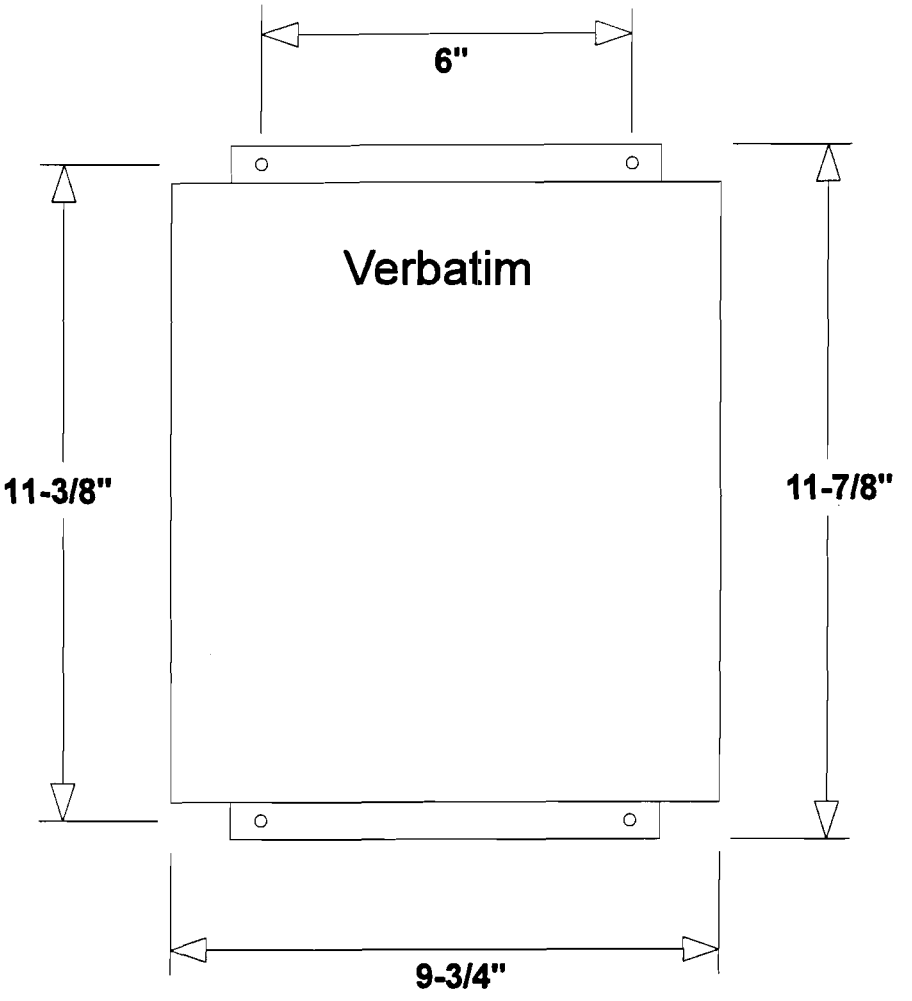
!ularm Cellular Communications Diagram (12V DC Only)



'ellularm Cellular Communications Diagram (24V DC Only)

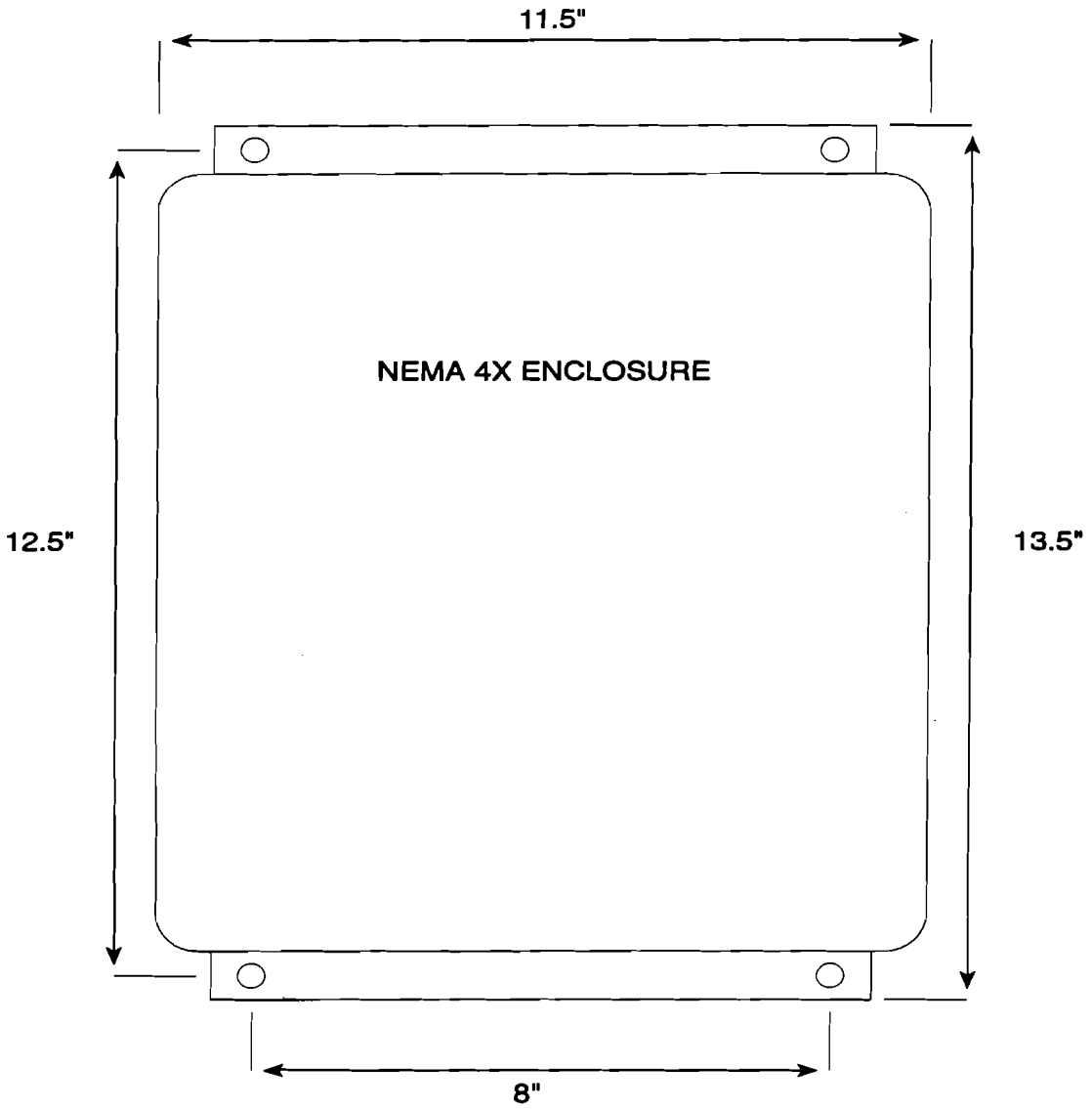


Verbatim Enclosure Diagram



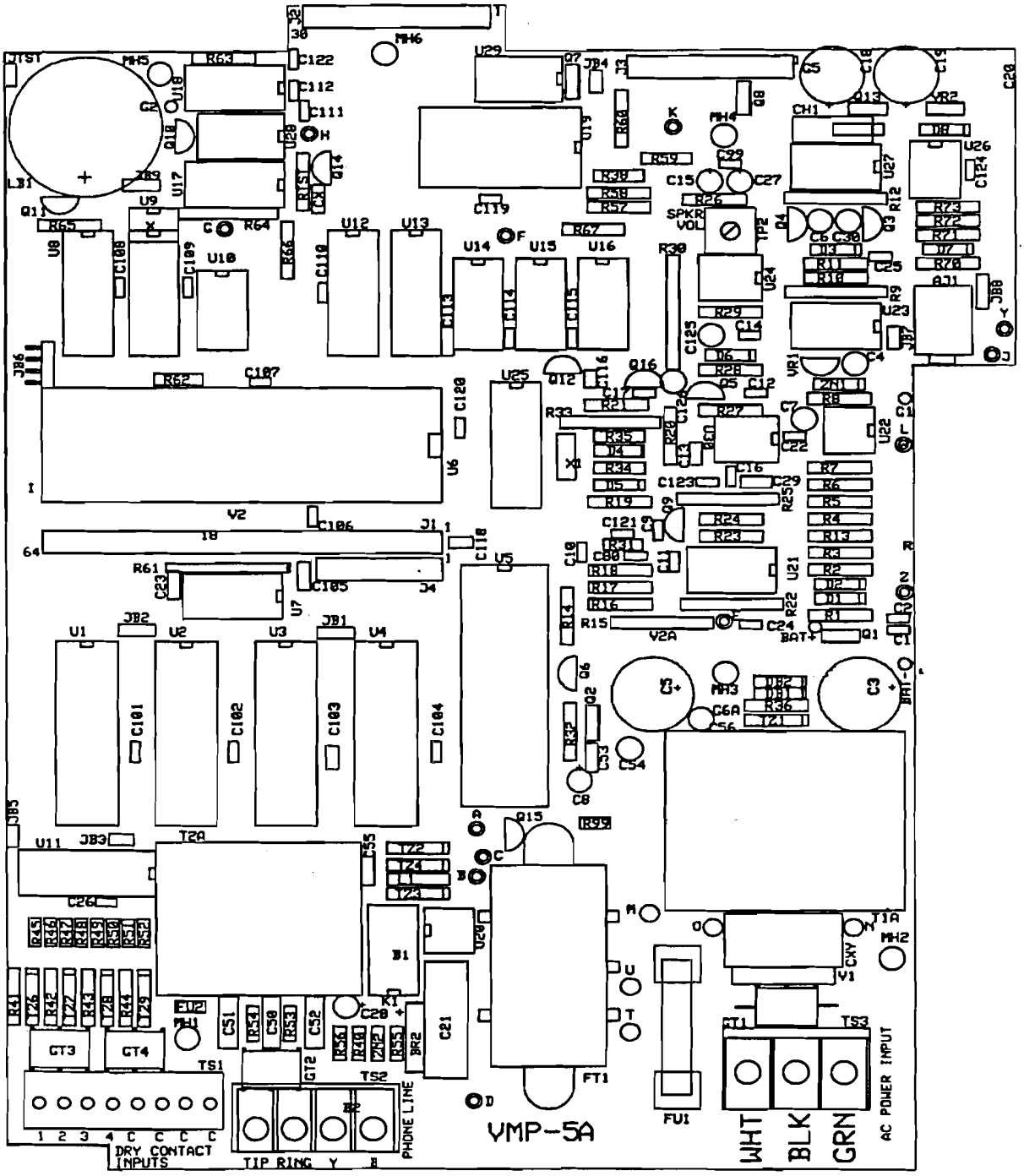
RECTANGULAR MOUNTING CENTERS: 6" W x 11-3/8" H
OVERALL DIMENSIONS: 9-3/4" W x 11 7/8" H x 5" D

NEMA 4X Enclosure Diagram

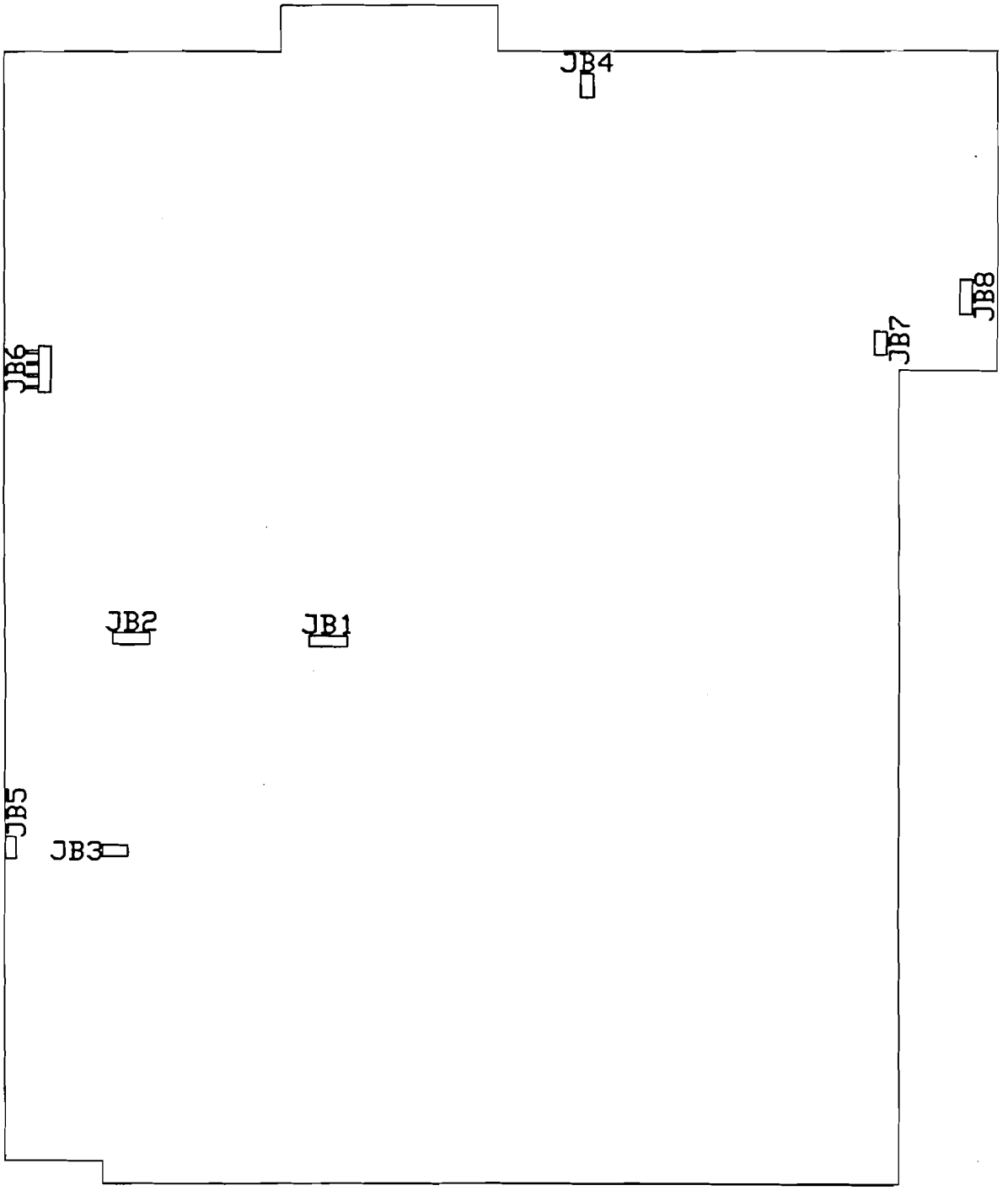


RECTANGULAR MOUNTING CENTERS: 8" W x 12.5" H
OVERALL DIMENSIONS 11.5" W x 13.5" H x 5.5" D

Motherboard Component Diagram



Jumper Block Diagram



H.11 Jumper Configurations

Main Board VMP-5A

- JB1 - configures sockets U3 and U4 for the size of EPROM chip used.
  Placement of shorting block:
  - left hand two pins- 2 meg EPROMs (for future use)
  - right hand two pins- 1meg and 512k EPROMs (factory default)

- JB2 - configures sockets U1 and U2 for the size of RAM chip used.
  Placement of shorting block:
  - left hand two pins- 1 meg or 256k RAMs (factory default)
  - right hand two pins- 2 meg RAMs (for future use)

- JB3 - RESET. Short these two pins together for about 2 seconds (a screwdriver works fine) to clear the programming back to factory defaults.

- JB4 - Local Alarm Relay/ Line Seizure Relay output. Upper pin is ground, lower pin supplies 5vdc on alarm to activate the relay.

- JB5 - SYSTEM RESET. Short these two pins together for about two seconds to reset the system hardware.

- JB6 - factory use only

- JB7 - factory use only

- JB8 - configures jack AJ-1 to be either an audio output jack or a 12vdc power input jack.
  Placement of shorting block:
  - upper two pins makes AJ-1 an audio output jack, for using an external speaker or connecting to another audio system.
  - lower two pins makes AJ-1 a 12vdc power input jack for powering the unit from an external source.

- JB9 - factory use only

Speech Board VSPE-2

- JB101 - position of jumper varies with the firmware version
  Placement of shorting block:
  - left hand two pins if the firmware version is 2.00 or higher. Speech RAM is to be placed in the board beginning with U103 then U104 and so on up to 8 RAM chips.
  - right hand two pins if the firmware version is 1.36 or below. A maximum of two speech RAM may be used. If using just one RAM chip, it goes in socket U104. A second one if used can go in U105 (U103 is skipped).

I Verbatim™ Series VSS Autodialer Specification

I.1 Description & Phone Number Dialing

The autodialer shall be a solid state component capable of dialing up to 16 phone numbers, each up to 60 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system's keyboard or Touch Tone phone. Further, the autodialer shall be capable of connecting, via a single serial interface cable, to a variety of Programmable Logic Controllers (PLCs), Distributed Control Systems (DCSs) & SCADA systems. Serial interfacing methods shall incorporate commonly used standard industrial network protocols such as Modicon, Inc. Modbus RTU

I.2 Solid State Voice Message Recording and Playback

The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical tape mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

I.2.1 User Field Recorded Messages

The user may record and re-record his own voice messages, for each input channel and for the Station ID.

1. *There shall be no limit on the length of any particular message*, within the overall available message recording time, which shall be 409 seconds for 36 total channel units and 624 seconds for 57 total or more channel units.
2. The unit shall allow selective recording of *both Normal and Alarm advisory messages* for each input channel.
3. The unit shall provide for *automatic setting of the optimum speech memory usage rate* for the total set of messages recorded, in order to achieve optimum recording sound quality.
4. Circuit board switches or jumper straps shall not be acceptable means of manipulating message length or recording rates.

I.2.2 Permanent Resident Non-Recorded Messages

Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

I.3 Local & Remote Programming Capabilities

The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone phone.

Capability	Setting/Description
Alarm Call Grouping	On alarm, system shall selectively call the correct phone numbers according to the current alarm(s).
Alarm response delay	.1 to 9999.9 seconds.
Delay between alarm call outs	.1 to 99.9 minutes.
Alarm reset time:	0.1 to 99 hours or "NO RESET".
Incoming ring response (answer) delay	1 to 20 rings.
Input alarm criteria	Each channel shall be independently configured for "Normally Closed," "Normally Open," "No Alarm," or "Disabled."
Autocall Test	When enabled, the unit shall place a single round of test calls, both at the time this function is enabled and also at regular subsequent intervals until this function is disabled at the keyboard.
Run Time Meter	Selected physical channel inputs shall accumulate and report the number of hours that its input contacts have been closed.
Remote system microphone activation.	
Remote and local arming and disarming of system.	
Pulse Totalizer Function.	Selected physical input channels shall be capable of counting pulses of up to 100Hz. at 50% duty cycle.

I.4 Nonvolatile Program Memory Retention

User-entered programming and voice messages shall be kept intact even during power failures or when all power is removed for up to ten years.

I.5 Acknowledgment

Acknowledgment of an alarm phone call is to be accomplished by pressing a Touch Tone® "9" as the alarm call is being received, and/or by returning a phone call to the unit after having received an alarm call.

I.6 Remote (PLC) Channel Monitoring Function

The unit shall continuously scan all properly configured Remote Channels. The unit shall monitor remote channels which physically reside in other industrial equipment interfaced to the Verbatim via the serial interface. The unit shall be capable of interfacing to at least two PLC networks simultaneously. The unit shall be capable of monitoring any PLC data register regardless of register type, whether digital, analog, input, output or status point. Alarm criteria shall be settable according data register type. For digital remote channels, alarm criteria shall be settable for normally '0' or normally '1'. For analog remote channels, both a high setpoint and a low setpoint alarm criteria shall be settable. Violation of alarm criteria at any remote channel shall cause the unit to go into alarm state and begin dial-outs. All remote channel alarm criteria shall be settable either at the front panel of the unit of over the telephone using touch-tone commands. The unit shall be capable of writing data to any PLC data register to which writing data is a legal operation. The unit shall monitor any failure of the active serial communications channels. Upon failure of any communications channel the unit shall enter the alarm state and begin dial-outs. The unit shall be capable of transferring data between one remote channel on one serial communications network and another remote channel on a second serial communications network. The unit shall also be capable of transferring data between remote channels on a serial communications network and physical channels within the unit. The unit shall be optionally upgradable to incorporate provision for 32, 64 or 96 total remote channels.

I.7 Input Monitoring Function

The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. Unit shall optionally be field upgradeable to incorporate a total of 8, 16, 24, or 32 dry contact inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs. Unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normally Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Open Circuit" or "Closed Circuit," without disturbing any message programming. Each input channel shall also be independently programmable, *without need to manipulate circuit board switches or jumpers*, as Normally Open or Normally Closed, or for No Alarm (Status Only), or for Pulse Totalizing, or for Run Time Metering.

I.8 Run Time Meter Inputs

Any dry contact input can be programmed to accumulate and report the number of hours their respective input circuits have been closed. Any such channels will never cause an alarm, but on inquiry will recite the channel's message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electromechanical Run Time Meters. Up to a total of 8 Run Time Meters may be programmed.

I.9 Pulse Totalizer Inputs

Any dry contact input can be programmed to accumulate the number of pulses (momentary contact closures) occurring at the input. The maximum input pulse rate must not exceed 100 pulses per second, and if the rate is over 50 pulses per second, the pulses must have a 50% duty cycle. The user shall be able to program an initial starting value and a scale factor for each pulse totalizer input. The pulse totalizer input shall cause an alarm call upon reaching a user defined alarm setpoint.

I.10 Alarm Message

Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status".

I.11 Communications Protocol

The unit shall interface to standard networks commonly used in industrial installations. The unit shall be capable of network communications using the Modbus RTU protocol.

I.12 Diagnostics

The unit shall include user commands to execute diagnostics of the PLC network to determine the health of the network. The unit shall inform the user of the length of scan time for the set of all configured remote channels. The unit shall provide a complete verbal report of all programmable functions and their programmed values on command form any remote Touch Tone phone.

I.13 Speakerphone

The unit shall be capable of dialing any phone number on command and function as a speakerphone.

I.14 Inquiry Message and Function

Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.

I.15 Power Battery Backup

Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of 13 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger," in order to minimize recharge time and maximize battery life available.

I.16 Phone Line

The autodialer is to use a standard rotary pulse or Touch Tone "dial-up" phone line (direct leased line not to be required) and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ-11).

the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

I.17 Local Data Logging

The system shall include a parallel printer interface for local data logging. The local printer will automatically print out, with date and time stamp, each activity that occurs; alarms, acknowledgements, programming entries, inquiry calls, etc.. For the purpose of easy program review the user shall be able to printout on demand all user entered programming.

I.18 Public Address Broadcast

The standard dialer shall provide a mini phone jack for optional connection to a local public address system. If connected to the PA system the dialer shall broadcast all alarm messages over the PA system and the telephone simultaneously.

I.19 Integral Surge Protection

All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit/ 3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each such line. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

I.20 Warranty

The dialer shall be covered by a five (5) year warranty covering parts and labor performed at the Factory.

I.21 Modular Upgrades

The system shall include expansion connectors to accommodate field upgrades for additional internal dry contact inputs, remote supervisory control outputs, and internal analog inputs, CDL, SCADA.

I.22 Additional Features: Sealed Switches, LED Indicators, Alarm Disable Warning, TalkThrough

All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Phone Call in Progress, Status for each channel, AC Power Present, AC Power Failure, and Low, Discharging or Recharging Battery. On any Inquiry telephone call or On Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the unit is in the "alarm disable" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and have a two-way conversation with personnel at the dialer.

I.23 Special Order Items

The following options shall be available on specific order:

a) 4, 12, 20, or 28 extra contact channels (8,16,24, or 32 respectively, total.)

b) 32, 64, 96 remote channels

c) 1, 4, 8, or 16 analog channels.

d) Remote supervisory control (4 or 8 outputs).

e) Cellular telephone communications.

f) Radio communications interface.

g) NEMA 4X (sealed) enclosure.

h) Thermostatically controlled heater.

Specifications subject to change without notice.

J

Worksheets

Worksheet A Programming

Part 1: Phone Number Programming

2-Digit Phone Number Designation	Use Program Code	Phone Number (Including any necessary prefixes or area codes)	Person
01 (First)	701		
02 (Second)	702		
03 (Third)	703		
04 (Fourth)	704		
05 (Fifth)	705		
06 (Sixth)	706		
07 (Seventh)	707		
08 (Eighth)	708		
09 (Ninth)	709		
10 (Tenth)	710		
11 (Eleventh)	711		
12 (Twelfth)	712		
13 (Thirteenth)	713		
14 (Fourteenth)	714		
15 (Fifteenth)	715		
16 (Sixteenth)	716		

Part 2: Optional Programing

Record of any optional programming to alter selected parameters from their normal default values. *(Sample highlighted)*

Program Code	Parameter Description	Default Value	Write In Any Altered Values YouProgram
902	***Alarm Trip Delay***	***2 seconds***	***40 seconds***

Worksheet B Alarm Call Grouping Programming

Purpose: To "link" certain input channels to call only selected phone numbers.
See Section 6.2.13

Part 1: Group Description Naming

As an organizational step, write in a Group Description Name (Electrical, Security, etc.) for each of your phone number groups, and the two-digit designation number of the phone numbers you want included in each group. Refer to the filled-in example below. This should be done only after you have already entered your entire list of up to 16 phone numbers on Worksheet A. (*Sample highlighted*)

Group Description (Electrical, etc.)	2-Digit Phone # Designation (Taken from Worksheet A)
Maintenance	***01, 04, 05, 06***
Electrical	***03, 04***
Security	***02, 05***

Worksheet B Alarm Call Grouping Programming Cont. . .

Part 2: Linking Channels To Groups

For each input channel that you wish to have "linked" to one of your groups, write in your chosen Group Description Name (Electrical, etc.), and the corresponding set of 2-digit Phone Number Designations which you established above. Finally, write in these same sets of 2-digit codes, without the separating commas, to the right of the printed program code (501, etc.). This establishes the complete program code to enter for each channel that you want "linked" to call only a selected group of phone numbers. (*Sample highlighted*)

The filled-in sample, below, is for an 8-channel unit. Three groups were established, and 5 of the channels were linked to a group. The remaining 3 channels were not linked to any group, and therefore, those 3 "unlinked" channels would dial the entire list of phone numbers in regular order.

Note:

Any channels that you do not enter such a program code for, will cause dialing of the entire list of phone numbers, when that channel goes into alarm.

Channel	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
01	*Security*	*02, 05*	*501 9 02 05*
02	*Security*	*02, 05*	*502 9 02 05*
03	*Electrical*	*03, 04*	*503 9 03 04*
04	*Maintenance*	*01, 04, 05, 06*	*504 9 01 04 05 06*
05	____	____	*~~505 9~~*
06	*Electrical*	*03, 04*	*506 9 03 04*
07	____	____	*~~507 9~~*
08	____	____	*~~508 9~~*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 1 of 6)

Internal Input Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
01			*501 9*
02			*502 9*
03			*503 9*
04			*504 9*
05			*505 9*
06			*506 9*
07			*507 9*
08			*508 9*
09			*509 9*
10			*510 9*
11			*511 9*
12			*512 9*
13			*513 9*
14			*514 9*
15			*515 9*
16			*516 9*
17			*517 9*
18			*518 9*
19			*519 9*
20			*520 9*
21			*521 9*
22			*522 9*
23			*523 9*
24			*524 9*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 2 of 6)

Internal Input Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
25			*525 9*
26			*526 9*
27			*527 9*
28			*528 9*
29			*529 9*
30			*530 9*
31			*531 9*
32			*532 9*
33			*533 9*
34			*534 9*
35			*535 9*
36			*536 9*
37			*537 9*
38			*538 9*
39			*539 9*
40			*540 9*
41			*541 9*
42			*542 9*
43			*543 9*
44			*544 9*
45			*545 9*
46			*546 9*
47			*547 9*
48			*548 9*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 3 of 6)

Remote Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
01			*4501 9*
02			*4502 9*
03			*4503 9*
04			*4504 9*
05			*4505 9*
06			*4506 9*
07			*4507 9*
08			*4508 9*
09			*4509 9*
10			*4510 9*
11			*4511 9*
12			*4512 9*
13			*4513 9*
14			*4514 9*
15			*4515 9*
16			*4516 9*
17			*4517 9*
18			*4518 9*
19			*4519 9*
20			*4520 9*
21			*4521 9*
22			*4522 9*
23			*4523 9*
24			*4524 9*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 4 of 6)

Remote Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
25			*4525 9*
26			*4526 9*
27			*4527 9*
28			*4528 9*
29			*4529 9*
30			*4530 9*
31			*4531 9*
32			*4532 9*
33			*4533 9*
34			*4534 9*
35			*4535 9*
36			*4536 9*
37			*4537 9*
38			*4538 9*
39			*4539 9*
40			*4540 9*
41			*4541 9*
42			*4542 9*
43			*4543 9*
44			*4544 9*
45			*4545 9*
46			*4546 9*
47			*4547 9*
48			*4548 9*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 5 of 6)

Remote Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
49			*4549 9*
50			*4550 9*
51			*4551 9*
52			*4552 9*
53			*4553 9*
54			*4554 9*
55			*4555 9*
56			*4556 9*
57			*4557 9*
58			*4558 9*
59			*4559 9*
60			*4560 9*
61			*4561 9*
62			*4562 9*
63			*4563 9*
64			*4564 9*
65			*4565 9*
66			*4566 9*
67			*4567 9*
68			*4568 9*
69			*4569 9*
70			*4570 9*
71			*4571 9*
72			*4572 9*

Worksheet B Alarm Call Grouping Programming Cont. . .

(Page 6 of 6)

Remote Channels	Linked to Group	Corresp. Phone # Desig's Est. Above	Program Code to Enter
73			*4573 9*
74			*4574 9*
75			*4575 9*
76			*4576 9*
77			*4577 9*
78			*4578 9*
79			*4579 9*
80			*4580 9*
81			*4581 9*
82			*4582 9*
83			*4583 9*
84			*4584 9*
85			*4585 9*
86			*4586 9*
87			*4587 9*
88			*4588 9*
89			*4589 9*
90			*4590 9*
91			*4591 9*
92			*4592 9*
93			*4593 9*
94			*4594 9*
95			*4595 9*
96			*4596 9*

Worksheet C Message Planning & Recording *(Page 1 of 11)*

Input Channel Message Designation	Program Code	Message Content	Approx. Length
Station ID	*100*		
Ch 01 Alarm	*101*		
Ch 01 Normal	*201*		
Ch 02 Alarm	*102*		
Ch 02 Normal	*202*		
Ch 03 Alarm	*103*		
Ch 03 Normal	*203*		
Ch 04 Alarm	*104*		
Ch 04 Normal	*204*		
Ch 05 Alarm	*105*		
Ch 05 Normal	*205*		
Ch 06 Alarm	*106*		
Ch 06 Normal	*206*		
Ch 07 Alarm	*107*		
Ch 07 Normal	*207*		
Ch 08 Alarm	*108*		
Ch 08 Normal	*208*		
Ch 09 Alarm	*109*		
Ch 09 Normal	*209*		
Ch 10 Alarm	*110*		
Ch 10 Normal	*210*		
Ch 11 Alarm	*111*		
Ch 11 Normal	*211*		
Ch 12 Alarm	*112*		
Ch 12 Normal	*212*		
Ch 13 Alarm	*113*		
Ch 13 Normal	*213*		
Ch 14 Alarm	*114*		
Ch 14 Normal	*214*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording (Page 2 of 11)

Input Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 15 Alarm	*115*		
Ch 15 Normal	*215*		
Ch 16 Alarm	*116*		
Ch 16 Normal	*216*		
Ch 17 Alarm	*117*		
Ch 17 Normal	*217*		
Ch 18 Alarm	*118*		
Ch 18 Normal	*218*		
Ch 19 Alarm	*119*		
Ch 19 Normal	*219*		
Ch 20 Alarm	*120*		
Ch 20 Normal	*220*		
Ch 21 Alarm	*121*		
Ch 21 Normal	*221*		
Ch 22 Alarm	*122*		
Ch 22 Normal	*222*		
Ch 23 Alarm	*123*		
Ch 23 Normal	*223*		
Ch 24 Alarm	*124*		
Ch 24 Normal	*224*		
Ch 25 Alarm	*125*		
Ch 25 Normal	*225*		
Ch 26 Alarm	*126*		
Ch 26 Normal	*226*		
Ch 27 Alarm	*127*		
Ch 27 Normal	*227*		
Ch 28 Alarm	*128*		
Ch 28 Normal	*228*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 3 of 11)*

Input Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 29 Alarm	*129*		
Ch 29 Normal	*229*		
Ch 30 Alarm	*130*		
Ch 30 Normal	*230*		
Ch 31 Alarm	*131*		
Ch 31 Normal	*231*		
Ch 32 Alarm	*132*		
Ch 32 Normal	*232*		
Ch 33 Alarm	*133*		
Ch 33 Normal	*233*		
Ch 34 Alarm	*134*		
Ch 34 Normal	*234*		
Ch 35 Alarm	*135*		
Ch 35 Normal	*235*		
Ch 36 Alarm	*136*		
Ch 36 Normal	*236*		
Ch 37 Alarm	*137*		
Ch 37 Normal	*237*		
Ch 38 Alarm	*138*		
Ch 38 Normal	*238*		
Ch 39 Alarm	*139*		
Ch 39 Normal	*239*		
Ch 40 Alarm	*140*		
Ch 40 Normal	*240*		
Ch 41 Alarm	*141*		
Ch 41 Normal	*241*		
Ch 42 Alarm	*142*		
Ch 42 Normal	*242*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 4 of 11)*

Input Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 43 Alarm	*143*		
Ch 43 Normal	*243*		
Ch 44 Alarm	*144*		
Ch 44 Normal	*244*		
Ch 45 Alarm	*145*		
Ch 45 Normal	*245*		
Ch 46 Alarm	*146*		
Ch 46 Normal	*246*		
Ch 47 Alarm	*147*		
Ch 47 Normal	*247*		
Ch 48 Alarm	*148*		
Ch 48 Normal	*248*		
Remote Channel Message Designation	**Program Code**	**Message Content**	**Approx. Length**
NET 1 ID	*41001*		
Ch 01 Alarm	*4101*		
Ch 01 Normal	*4201*		
Ch 02 Alarm	*4102*		
Ch 02 Normal	*4202*		
Ch 03 Alarm	*4103*		
Ch 03 Normal	*4203*		
Ch 04 Alarm	*4104*		
Ch 04 Normal	*4204*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 5 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 05 Alarm	*4105*		
Ch 05 Normal	*4205*		
Ch 06 Alarm	*4106*		
Ch 06 Normal	*4206*		
Ch 07 Alarm	*4107*		
Ch 07 Normal	*4207*		
Ch 08 Alarm	*4108*		
Ch 08 Normal	*4208*		
Ch 09 Alarm	*4109*		
Ch 09 Normal	*4209*		
Ch 10 Alarm	*4110*		
Ch 10 Normal	*4210*		
Ch 11 Alarm	*4111*		
Ch 11 Normal	*4211*		
Ch 12 Alarm	*4112*		
Ch 12 Normal	*4212*		
Ch 13 Alarm	*4113*		
Ch 13 Normal	*4213*		
Ch 14 Alarm	*4114*		
Ch 14 Normal	*4214*		
Ch 15 Alarm	*4115*		
Ch 15 Normal	*4215*		
Ch 16 Alarm	*4116*		
Ch 16 Normal	*4216*		
Ch 17 Alarm	*4117*		
Ch 17 Normal	*4217*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 6 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 18 Alarm	*4118*		
Ch 18 Normal	*4218*		
Ch 19 Alarm	*4119*		
Ch 19 Normal	*4219*		
Ch 20 Alarm	*4120*		
Ch 20 Normal	*4220*		
Ch 21 Alarm	*4121*		
Ch 21 Normal	*4221*		
Ch 22 Alarm	*4122*		
Ch 22 Normal	*4222*		
Ch 23 Alarm	*4123*		
Ch 23 Normal	*4223*		
Ch 24 Alarm	*4124*		
Ch 24 Normal	*4224*		
Ch 25 Alarm	*4125*		
Ch 25 Normal	*4225*		
Ch 26 Alarm	*4126*		
Ch 26 Normal	*4226*		
Ch 27 Alarm	*4127*		
Ch 27 Normal	*4227*		
Ch 28 Alarm	*4128*		
Ch 28 Normal	*4228*		
Ch 29 Alarm	*4129*		
Ch 29 Normal	*4229*		
Ch 30 Alarm	*4130*		
Ch 30 Normal	*4230*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 7 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 31 Alarm	*4131*		
Ch 31 Normal	*4231*		
Ch 32 Alarm	*4132*		
Ch 32 Normal	*4232*		
Ch 33 Alarm	*4133*		
Ch 33 Normal	*4233*		
Ch 34 Alarm	*4134*		
Ch 34 Normal	*4234*		
Ch 35 Alarm	*4135*		
Ch 35 Normal	*4235*		
Ch 36 Alarm	*4136*		
Ch 36 Normal	*4236*		
Ch 37 Alarm	*4137*		
Ch 37 Normal	*4237*		
Ch 38 Alarm	*4138*		
Ch 38 Normal	*4238*		
Ch 39 Alarm	*4139*		
Ch 39 Normal	*4239*		
Ch 40 Alarm	*4140*		
Ch 40 Normal	*4240*		
Ch 41 Alarm	*4141*		
Ch 41 Normal	*4241*		
Ch 42 Alarm	*4142*		
Ch 42 Normal	*4242*		
Ch 43 Alarm	*4143*		
Ch 43 Normal	*4243*		
Ch 44 Alarm	*4144*		
Ch 44 Normal	*4244*		
Ch 45 Alarm	*4145*		
Ch 45 Normal	*4245*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 8 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 46 Alarm	*4146*		
Ch 46 Normal	*4246*		
Ch 47 Alarm	*4147*		
Ch 47 Normal	*4247*		
Ch 48 Alarm	*4148*		
Ch 48 Normal	*4248*		
Ch 49 Alarm	*4149*		
Ch 49 Normal	*4249*		
Ch 50 Alarm	*4150*		
Ch 50 Normal	*4250*		
Ch 51 Alarm	*4151*		
Ch 51 Normal	*4251*		
Ch 52 Alarm	*4152*		
Ch 52 Normal	*4252*		
Ch 53 Alarm	*4153*		
Ch 53 Normal	*4253*		
Ch 54 Alarm	*4154*		
Ch 54 Normal	*4254*		
Ch 55 Alarm	*4155*		
Ch 55 Normal	*4255*		
Ch 56 Alarm	*4156*		
Ch 56 Normal	*4256*		
Ch 57 Alarm	*4157*		
Ch 57 Normal	*4257*		
Ch 58 Alarm	*4158*		
Ch 58 Normal	*4258*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 9 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 59 Alarm	*4159*		
Ch 59 Normal	*4259*		
Ch 60 Alarm	*4160*		
Ch 60 Normal	*4260*		
Ch 61 Alarm	*4161*		
Ch 61 Normal	*4261*		
Ch 62 Alarm	*4162*		
Ch 62 Normal	*4262*		
Ch 63 Alarm	*4163*		
Ch 63 Normal	*4263*		
Ch 64 Alarm	*4164*		
Ch 64 Normal	*4264*		
Ch 65 Alarm	*4165*		
Ch 65 Normal	*4265*		
Ch 66 Alarm	*4166*		
Ch 66 Normal	*4266*		
Ch 67 Alarm	*4167*		
Ch 67 Normal	*4267*		
Ch 68 Alarm	*4168*		
Ch 68 Normal	*4268*		
Ch 69 Alarm	*4169*		
Ch 69 Normal	*4269*		
Ch 70 Alarm	*4170*		
Ch 70 Normal	*4270*		
Ch 71 Alarm	*4171*		
Ch 71 Normal	*4271*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 10 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 72 Alarm	*4172*		
Ch 72 Normal	*4272*		
Ch 73 Alarm	*4173*		
Ch 73 Normal	*4273*		
Ch 74 Alarm	*4174*		
Ch 74 Normal	*4274*		
Ch 75 Alarm	*4175*		
Ch 75 Normal	*4275*		
Ch 76 Alarm	*4176*		
Ch 76 Normal	*4276*		
Ch 77 Alarm	*4177*		
Ch 77 Normal	*4277*		
Ch 78 Alarm	*4178*		
Ch 78 Normal	*4278*		
Ch 79 Alarm	*4179*		
Ch 79 Normal	*4279*		
Ch 80 Alarm	*4180*		
Ch 80 Normal	*4280*		
Ch 81 Alarm	*4181*		
Ch 81 Normal	*4281*		
Ch 82 Alarm	*4182*		
Ch 82 Normal	*4282*		
Ch 83 Alarm	*4183*		
Ch 83 Normal	*4283*		
Ch 84 Alarm	*4184*		
Ch 84 Normal	*4284*		

Total estimated recorded message length in seconds, this page _____

Worksheet C Message Planning & Recording *(Page 11 of 11)*

Remote Channel Message Designation	Program Code	Message Content	Approx. Length
Ch 85 Alarm	*4185*		
Ch 85 Normal	*4285*		
Ch 86Alarm	*4186*		
Ch 86 Normal	*4286*		
Ch 87 Alarm	*4187*		
Ch 87 Normal	*4287*		
Ch 88 Alarm	*4188*		
Ch 88 Normal	*4288*		
Ch 89 Alarm	*4189*		
Ch 89 Normal	*4289*		
Ch 90 Alarm	*4190*		
Ch 90 Normal	*4290*		
Ch 91 Alarm	*4191*		
Ch 91 Normal	*4291*		
Ch 92 Alarm	*4192*		
Ch 92 Normal	*4292*		
Ch 93 Alarm	*4193*		
Ch 93 Normal	*4293*		
Ch 94 Alarm	*4194*		
Ch 94 Normal	*4294*		
Ch 95 Alarm	*4195*		
Ch 95 Normal	*4295*		
Ch 96 Alarm	*4196*		
Ch 96 Normal	*4296*		

Total estimated recorded message length in seconds, this page _____

See next page to complete calculations

Worksheet C Message Planning & Recording Calculations:

Total estimated recorded message length in seconds, page 11 of 11 _____
Total estimated recorded message length in seconds, page 10 of 11 _____
Total estimated recorded message length in seconds, page 9 of 11 _____
Total estimated recorded message length in seconds, page 8 of 11 _____
Total estimated recorded message length in seconds, page 7 of 11 _____
Total estimated recorded message length in seconds, page 6 of 11 _____
Total estimated recorded message length in seconds, page 5 of 11 _____
Total estimated recorded message length in seconds, page 4 of 11 _____
Total estimated recorded message length in seconds, page 3 of 11 _____
Total estimated recorded message length in seconds, page 2 of 11 _____
Total estimated recorded message length in seconds, page 1 of 11 _____

Total estimated recorded message length in seconds, **all** pages _____
See Code 912 for alternate method of timing spoken messages.

Note:

For any channels that you have programmed for Status Report Only or for Run Time Metering, the message to be spoken on Open Circuit input is recorded with the Program Code ordinarily used for the Alarm Message; the message to be spoken on Closed Circuit input is recorded with the program code ordinarily used for the Normal Message.

K

Annunciator Sequences and Options

This appendix discusses Verbatim operations in the context of the *ANSI/ISA-S18.1 Annunciator Sequences and Specifications* standard. It also describes the options available for configuring the Verbatim to support a variety of sequence models. This information will be useful for users needing calling sequences different from the one discussed in Section 5.

Note that the ANSI specification uses slightly different terminology from that used here and elsewhere in this manual. Hopefully, this won't cause much confusion.

One concept central to this discussion is that of *channel state*. At any given time every armed channel is in one of the following 5 states: *normal, alarm, acknowledged alarm, return to normal (RTN), acknowledged RTN*. The precise meaning of these terms will be clarified later on.

The term *annunciator state* is used here to describe the actions and indications of the Verbatim . These include LED illumination,voice reporting and status logging.

An *annunciator sequence* consists of specifying how transitions between the channel states occur and how they impact the annunciator state. The Verbatim supports three distinct types of annunciator sequences. These are each discussed in the subsections below. The next several paragraphs discuss the properties they all share in common.

The normal, alarm and RTN states are determined by comparing the channel's value with the criteria settings. A transition into these states requires that the condition persist for a time period referred to as the *alarm trip delay*. This provides hysteresis, or debouncing between the real-world signals and the channel state.

The two acknowledged states are determined by operator actions. Unacknowledged alarms and RTNs transit to the acknowledged states by pressing keys on the front panel or entering DTMF tones over the phone.

The Verbatim gives visual indications for the state of each channel or group of channels. If normal, the LED is OFF. When alarmed, the LED is blinking. When acknowledged the LED is steady ON. The visual indications for the RTN states are sequence dependent, and described later.

Audible indications for the channel states are also given. These take the form of voice reports either from the speaker or over the phone. These reports may be requested at any time by pressing the CHECK STATUS key, or phoning the unit.

Whenever any channel is in the unacknowledged alarm or RTN state, the Verbatim will solicit acknowledgment by phoning personel. The calling sequence itself is determined by the alarm call grouping and alarm ready scheduling configuration.

All audible indications can be silenced by pressing the ARM/DISARM key on the front panel. This action will also always acknowledge all unacknowledged conditions. Also, all annunciator state transitions and actions are suspended whenever the box is in program mode. Channel state transitions will still occur.

The annunciator state may at any time be completely reset by pressing the ARM/DISARM key twice. This action will also reset the state of each channel.

In terms of *ANSI/ISA-S18.1*, there is one more property that all Verbatim annunciator sequences share: there is no support for the *first out* sequence designations (**F1, F2, F3**). Groups of alarms and RTNs are always registered, reported and reset without regard to which one tripped out first.

K.1 Standard Annunciator Sequence (Manual Reset)

This section describes the default annunciator sequence used by the Verbatim . It is a minor variant of the *ANSI/ISA-S18.1* designation **M-1** (Manual Reset with silence pushbutton). It may be configured by entering code **923 1** in program mode.

Operations in this sequence are detailed in Section 5. Briefly, channel states transit from normal to alarm when criteria violations persist for the trip delay. The alarm state is then locked in until acknowledgment is made. The transition from acknowledged back to normal happens upon manual reset or expiration of the alarm reset timer. The RTN states are omitted from the sequence.

The annunciator states include only those visual and audible indications described above. Also, the annunciator sequence follows the transitions described there too.

This sequence differs from the vanilla **M-1** designation in two ways. The first involves the operation of the automatic reset timer. The true **M-1** sequence is obtained by turning the alarm reset timers off (code **922**). The second distinction involves configurations where no phone numbers are programmed. Here the transition from alarm to acknowledged happens automatically and immediately. There are never any audible or visual indications of the unacknowledged state. This sequence has ANSI designation **M-1-5-6**.

K.2 Clear On Return To Normal (Automatic Reset)

This section describes annunciator sequence options that are variants of the ANSI designation **A-1** (automatic reset with silence pushbutton). The main distinction of these from the **M-1** sequence is that the alarm state is automatically reset when the channel enters the RTN state. The Verbatim sequences in this category differ amongst themselves mainly in when this RTN transition is allowed to occur.

The basic **A-1** sequence is obtained by executing code **923 3**. Channel states transit from normal to alarm when criteria violations persist for the trip delay. The alarm state is then locked in until acknowledgment is made. If no phone numbers are configured, then this transition happens automatically and immediately (**A-1-5-6**). Otherwise, operator action is required. The transition from acknowledged back to normal happens via manual reset or expiration of the alarm reset timer. It also happens whenever the criteria violation for an acknowledged alarm returns to normal.

Designation **A-1-4** is obtained by code **923 2**. This sequence differs from **A-1** only in that the unacknowledged alarms are not locked in. All visual and audible indications are automatically reset whenever the criteria violations return to normal for the trip delay period.

A minor variant of **A-1-4** is obtained by code **923 4**. Here, the indications for an acknowledged alarm will not be reset until it has been reported once, regardless of RTN status. Unacknowledged alarms will be reset completely without any lock-in whatsoever.

The implementation of these **A**-designates involves one wrinkle. The check for RTN condition is not performed continuously, but rather only at specific times. Hence, changes that happen in the midst of a report may not be reflected in the annunciator state until some time later.

K.3 Report Return To Normal (Ringback)

This section describes the annunciator sequence option that provides explicit indications of RTN conditions. This is a variant of the **R-1-8** designation (ringback with silence pushbutton and common ringback audible). There are two differences between **R** and **M** or **A** designations. First is that the RTN state can be entered only from the acknowledged alarm state. **M** has no notion of RTN at all, and **A** allows the transition at any time. Second is that **R** locks in RTN states until acknowledged, whereas **A** immediately resets.

A variant of the **R-1-8** sequence is obtained by executing code **981 1**. Channel states transit from normal to alarm when criteria violations persist for the trip delay. The alarm state is then locked in until acknowledgment is made. If no phone numbers are configured, then this transition happens automatically and immediately (**R-1-5-6**). Otherwise, operator action is required.

The transition from acknowledged alarm to unacknowledged RTN is made whenever the criteria violation goes away for the trip delay period. The RTN state is then locked in until acknowledged. RTN acknowledgment is made in the same fashion as alarm acknowledgments. The channel states are reset either manually or by expiration of the reset timer. The reset timer begins running when the original alarm condition is acknowledged. This means that if a sufficiently long interval exists between acknowledgment of the alarm and the RTN, then the reset will happen immediately.

The main differences between this variant and the standard **R-1-8** sequence are as follows. First, there is no registration of momentary alarms once the RTN state is entered. Once the RTN state is acknowledged, no further calls will be triggered until the channel is reset. This is to say transitions in the channel state may continue, but will not be reflected in the annunciator state. Still, all reports will reflect the current state of the channels. Second, there is no visual indication for the RTN states. The LEDs will continue to reflect the acknowledged alarm status. Third, the silence pushbutton stops all flashing LED indications. Fourth, there is the automatic reset timer.

Unlike the implementation for the **A** designations, RTN conditions are checked continuously for all channels. So long as any unacknowledged alarm or RTN condition exists, the Verbatim will be making calls. Alarm conditions have priority. Hence, if an alarm is one call group and an RTN is in another, no calls will be placed to the RTN group until the alarm is acknowledged.

If the trigger for a call is an RTN, then the report will explicitly mention this before reporting the status of all channels in the group. An RTN report mentions RTN conditions only. Any acknowledgment while in RTN calling state acknowledges RTN conditions only. In contrast, any operator acknowledgment during an alarm call will also acknowledge all RTNs. But, the alarm reports do mention all unacknowledged RTN conditions.

If a new alarm occurs on any channel while in the RTN calling state, a change from RTN to alarm calling will occur as soon as possible. This can happen no sooner than the completion of any report in progress. Such reports may or may not include mention of the new condition depending on whether that channel has already been announced.

K.4 Annunciator Sequence Option Summary

The following paragraphs provide a concise summary of the available annunciator sequence options. The ANSI designator is given, along with the Verbatim configuration code, followed by a short functional description.

M-1: Manual Reset with Silence Pushbutton.
Code (923 1)

Alarm states are registered directly from configured criteria without regard for return to normal conditions. Alarm states are locked in and dialer will continue to call until acknowledged. Acknowledged alarms are reset via automatic timer. Total dialer reset andsilence via arm/disarm key.

M-1-5-6: Manual Reset with Silence Pushbutton, No Flashing, and No Audible.
Code (923 1) - with no phone numbers programmed

Same as **M-1**, except the alarm state is immediately converted to acknowledged state.

A-1: Automatic Reset with Silence Pushbutton.
Code (923 3)

Same as **M-1** except the acknowledged alarm state will be cleared if the channel returns to normal. The check for this transition occurs only when all alarms have been acknowledged.

A-1-5-6: Automatic Reset with Silence Pushbutton, No Flashing, and No Audible.
Code (923 3) - with no phone numbers programmed.

Same as **A-1**, except the alarm state is immediately converted to the acknowledged state.

A-1-4: Automatic Reset with Silence Pushbutton and No Lock-in.
Code (923 2)

Same as **M-1** except BOTH the acknowledged and unacknowledged alarm states will be cleared if the channel returns to normal. The check for this transition occurs only in between alarm calls.

A-1-4 variant: Automatic Reset with Silence Pushbutton, No Lock-in, and Single Acknowledge Report.
Code (923 4)

Same as **A-1-4** except the clearing for the acknowledged alarm can't happen until after a single report has been made.

R-1-8: Ringback with Silence Pushbutton and Common Ringback Audible. *Code (981 1)*

Alarm and Return to normal states are registered from criteria and locked-in. Dialer will continue to call until all alarm and RTN states are acknowledged. Acknowledged alarms and RTNS are reset via automatic timer. Total dialer reset and silence via arm/disarm key.

R-1-5-6: Ringback with Silence Pushbutton, No Flashing, and No Audible. *Code (981 1) - with no phone numbers programmed.*

Same as **R-1-8** except all unacknowledged alarm and RTN states are immediately converted to the acknowledged state.

Glossary

ACCESS CODE See Security Access Code.

ACKNOWLEDGMENT The act of advising the Verbatim autodialer that its alarm message has been heard. This is done either by pressing a touch tone 9 at the prompting beep, or by calling the unit back after the alarm call has ended. Once acknowledged, further activity on that particular channel will not cause further dialing until the expiration of the Alarm Reset Time. See Section 5.1, "Placing Inquiry Calls to the Verbatim autodialer," and Section 5.5, "Acknowledging the Alarm Call."

ALARM CALL GROUPING Special programming established to cause specific input channels to cause dialing of only selected phone numbers. Used to provide separate alarm functions according to category of personnel, such as maintenance, security, plumbing, etc. See Section 6.1, "Program Codes."

ALARM CONDITION For contact input channels, the Alarm Condition is the Open or Closed circuit condition opposite to that which was established as the Normal Condition for that channel. For example, for a channel programmed as Normally Open, the Alarm Condition would be Closed Circuit. Also see Violation. See Sections 3.3, "Programming Input Channels" and 5.3, "Receiving Alarm Calls."

ALARM CRITERIA The chosen determination of what will constitute an alarm condition (violation) for a given channel. See Normally Closed.

ALARM READY SCHEDULING A program setting which causes the Verbatim autodialer automatically disarm for certain time periods. This function prevents the product from sending alarm telephone calls during periods when personnel are stationed at the site and are able to deal with the problem directly.

ALARM RESET TIME The period of time, beginning at the moment an alarm is acknowledged, during which alarm dialing on behalf of that specific channel is suspended regardless of further activity of its input circuit. At the end of this period, the Acknowledged Alarm status is cleared for that channel. See Section 5.6, "Alarm Reset Timeout After Acknowledgment" and Section 6, "Advanced Programming."

ALARM TRIP DELAY The time required for an input violation to remain in violation before the unit trips into the Unacknowledged Alarm state. See Section 6, "Advanced Programming."

ANALOG Analog signals have variable values of current or voltage, with the specific value generally representing some physical parameter such as water level or pressure. The most common type of analog signal is a 4-20 milliampere current loop, with a transmitter (transducer and associated power supply) governing the current in a loop. This current is detected by one or more receiving devices in the loop, such as an optional analog input channel on a Verbatim autodialer.

AUTOCALL A special test calling function. When Autocall is turned on, the unit places test calls at regular intervals to provide ongoing assurance of Verbatim autodialer and phone line operation. See Section 6, "Advanced Programming."

AUTODIALER A device which constantly monitors a set of inputs from various external sensors, and places outgoing alarm calls when there is an alarm condition. It also allows inquiry calls.

AUTOEXTEND A unique feature on the Verbatim autodialer which automatically extends the available message recording time as required, selecting the optimum speech memory rate for the user's voice message recording. See Section 4.2.1, "Verifying/Extending Recording Time."

CALL BACK See Call Forward.

CALL FORWARD The unit may be commanded from the panel or over the phone, to place a call to a specific phone number. This is called Call Forwarding. If the number called is that of the person commanding the call from a remote telephone, then it is termed Call Back. This is typically done for test purposes. See Section 5.8, "Dialing Out and Conversing Through the Verbatim autodialer," and Section 6, "Advanced Programming."

CALL OUT The action of the Verbatim autodialer placing calls to outside personnel or facilities.

CDL (Central Data Logger) The combination of a modem, a serial interfaced printer and a special Raco-built interface box is called a Central Data Logger (CDL). A Raco autodialer/RTU may be configured to call and log data to the CDL printer. CDL RTUs first call the CDL printer to log alarm and status information then proceed on to calling personnel by voice.

CLOSED CIRCUIT CONDITION One of two possible states of a contact closure input circuit. Closed Circuit is the condition in which the contacts complete the electrical circuit connection. Open Circuit is the opposite condition, in which the contacts do not complete the electrical circuit connection. The Open Circuit condition is electrically equivalent to having no connection to the input circuit. A Closed Circuit input will measure zero volts DC from the input connection to the common connection point. An Open Circuit input will measure 5 volts DC. The Open or Closed Circuit status may

also be read without a voltmeter, by use of Program Code 0 ZZ 0, where ZZ is the 2-digit channel number. See Section 3.3, "Programming Input Channels" and 5.3, "Receiving Alarm Calls".

COMMON The combined electrical return connection point for all contact closure inputs. One side of all contact inputs are connected to Common. Physically, this Common connection point is any of the 4 terminals marked C on terminal strip TS1. The circuit board internally connects Common to the AC ground (GREEN) terminal on terminal strip TS3. See Section 2, "Installation."

DEFAULT Programming values which are built into the unit and remain in effect until the user alters them. Also, permanently available speech messages which are utilized when the user has not recorded his own messages.

DELAY BETWEEN DIGITS In some applications, an extra waiting time is needed between dialed digits. For example in some PBX systems, a 9 must be dialed, followed by a waiting time of several seconds before the main phone number may be dialed. See Section 3.2, "Programming Phone Numbers," Appendix F, "MODBUS Interface," and Section 6, "Advanced Programming."

DESIGNATION NUMBER The two-digit "order number" of a phone number in the overall set of phone numbers programmed. For example, the designation number for the third phone number is 03. See Programming Worksheet A. See Section 3.2, "Programming Phone Numbers," 6.1, "Program Codes," and 6.2, "Programming Operations."

DIALER See autodialer.

DRY Description of a sensor contact circuit that is not connected to any power source.

EXIT DELAY A delay period after a user arms the unit, before the unit will actually accept new alarms. Used to allow user to exit a protected entrance without tripping the unit into alarm. See Section 6, "Advanced Programming."

GLOBAL Essentially "over all" or "universal". Programming that simultaneously sets the same value for all channels, but excluding the Power Failure Alarm function.

GROUPING See Alarm Call Grouping.

ID MESSAGE See Station ID Message.

INQUIRY CALL A call placed by personnel to the Verbatim autodialer. See Section 5.1, "Placing Inquiry Calls to the Verbatim autodialer."

LED A lighted legend indicator on the front panel.

LINK See Alarm Call Grouping.

MEMORY USE RATE See Speech Memory Rate.

MODEM A device which allows digital data (as opposed to voice) to be transmitted between two sites, usually via public telephone lines. In the case of a Verbatim autodialer equipped with the CDL or SCADA option, a modem is built into the option card so that no external modem is required.

NETWORK The physical and higher level protocols for a specific vendor's PLC data communications. The Verbatim can support a maximum of 3 networks simultaneously. The actual number of networks and type of protocol are hardware options.

NETWORK ADDRESS The concatenation of the network ID, node, and PLC address. It is sometimes symbolized by '/net/node/addr' where net is the network ID, node is the node address, and addr is the PLC address. The network address suffices to uniquely identify any data object which the Verbatim can access.

NETWORK ID A voice message identifying a specific network. By default, the message is "Verbatim Net X", where 'X' is a number from 0 to 5. Custom messages, such as "Building 320 LAN" may be recorded. See 'NETWORK' entries below for more details.

NETWORK 0 Refers to the discrete, analog, and RSC points internal to the VSS.

NETWORK 1 Refers to devices connected to the 'NET1' port on the serial communications card. Protocols may vary.

NETWORK 2 Refers to devices connected to the 'NET2' port on the serial communications card. Protocols may vary.

NETWORK 3 Refers to devices connected to the MBPLUS port on the MBPLUS communications coprocessing card.

NETWORK 4 Refers to devices connected to the Parallel port.

NETWORK 5 Refers to devices connected to the Modem port on the serial communications card.

NODE The address of a specific PLC on the network. Each PLC is already configured with a unique integer as its node address. The Verbatim must also be given a unique number as its node address on each network to which it interfaces. The network ID and node together suffice to uniquely identify any PLC.

NORMAL CONDITION For contact closure inputs, the Normal Condition is that condition (open or Closed Circuit) which normally exists. The opposite condition would create an alarm. See Section 3.3, "Programming Input Channels" and 5.3, "Receiving Alarm Calls."

NORMALLY CLOSED Describes a monitored "contact type" input signal circuit, for which the normal, non-alarm state is associated with the circuit being closed (i.e. a completed connection being established between the two conductors of the input circuit). An alarm condition causes the circuit to be opened (broken), which the Verbatim autodialer would detect and begin placing alarm calls. This requires that this input be programmed as Normally Closed on the Verbatim autodialer.

NORMALLY OPEN Opposite of a Normally Closed circuit. The input signal is open in the normal, non-alarm state and closes when an alarm occurs. This requires that this input be programmed as Normally Open on the Verbatim autodialer, which is the default setting for a contact type input.

NON-VOLATILE MEMORY When AC power fails, the unit continues to operate for several hours on its internal Gel Cell battery. When this battery is near discharge, the unit automatically turns itself off. However all the user's programming and all user recorded messages are kept intact by Non-volatile Memory for up to ten years, so when power is later restored, no reprogramming or message recording will be required.

OPEN CIRCUIT CONDITION See Closed Circuit Condition.

PHYSICAL CHANNEL OR PC Internal inputs are sometimes call Physical Channels (PCs). PCs monitor user-supplied external sensors such as float switches, limit switches, etc. In most cases, the outputs of logic controllers may be connected directly to Physical Channel inputs without the need for interfacing relays or other signal conditioning. The normal Verbatim inputs, as distinguished from the RCs when necessary. The semantics are such that all RCs on network 0 are PCs.

PLC ADDRESS The data table location of an object within a specific PLC's internal memory. The format of the PLC address is vendor dependent. For network 0, the PLC address is the physical channel number.

POWER FAILURE The disappearance of 120 VAC power to the unit. The unit will continue to operate under power failure until its internal Gel Cell battery is discharged.

PULSE TOTALIZER The totalizer function accumulates a continuing count of the number of cycles of a train of pulses presented to the input. The pulses may be in the form of an open and closed circuit, or they may be in the form of a 5-volt logic signal.

RECORDING RATE In the process of digitally recording the user's voice messages into speech memory, the message is recorded into memory at one of four possible rates. The faster this rate of memory usage, the higher the recording fidelity. However, this results in less total available recording time than at slower rates. Rate 1 is the fastest rate giving the best sound quality. The Auto-

extend feature automatically selects the optimum rate to allow adequate recording time for the user's own set of messages at the best possible sound fidelity. See Section 4.2.1, "Verifying/Extending Recording Time," and Section 4.3, "Record Your Messages."

REMOTE CHANNEL OR RC A Verbatim I/O point whose value mirrors the value at some network address. Each active RC is associated with one and only one network address. The RC number can be viewed both as a 'speed dial' abbreviation for the lengthy network address and as a 'virtual' I/O point that supports alarm criteria. Different RCs can refer to the same network address. All data objects referenced by any RC are either 1 or 16 bits in length. 1-bit objects are termed "discrete" or "digital" points. 16-bit objects are sometimes termed "analog" points even though the data may actually be a discrete counter or timer. The type of object is implicit in the RC's network address. This is to say, any RC can be either discrete or analog.

Analog RCs are NEVER scaled to engineering units within the Verbatim Gateway. They can only have decimal integer values in the range 0 to 65535. Any desired must be done within the PLCs program. Floating point, hexa-decimal, and octal data formats are not supported.

REPEATS The number of times a series of messages (including Station ID message) is spoken when an alarm call is placed. As used here, this number includes the first recital of the messages. For example, 3 repeats means 3 times total, not 4. See Section 5.3, "Receiving Alarm Calls" and Section 6.1, "Program Codes."

RING ANSWER DELAY The number of rings required before the Verbatim autodialer will answer an inquiry call. See Section 5.3, "Receiving Alarm Calls," and 6.1, "Program Codes."

RTU (Remote Telemetry Unit) A monitoring device, interfaced to a communications medium, whose mission is to communicate conditions at a remote or inaccessible site. RTUs are usually polled by a central computer on some schedule or interval. Additionally, RTUs may request polling to report any exceptions such as alarms or other events which require the attention of the central computer or its operators. When a Raco Verbatim autodialer is configured with the asynchronous communications module it is known as an RTU. The Verbatim RTU does not loose any of the basic features of the Verbatim autodialer. In addition, the Verbatim RTU is capable of receiving polling calls from the Raco SCADA Central Computer. Furthermore, alarms may be communicated to the Raco SCADA Central Computer or to a Raco Central Data Logger (CDL) printer.

RUN TIME METER A feature which, when turned on, accumulates the total number of hours that an input channel is in the Closed Circuit condition. Typically used to monitor equipment operation time, particularly alternating pump systems. See Section 3.3, "Programming Input Channels," and Section 6, "Advanced Programming."

SCALE FACTOR A translation factor which may optionally be entered in conjunction with the Pulse Totalizer function. The spoken Totalizer reading will be the actual number of pulses accumulated, divided the programmed scale factor. See Section 6, "Advanced Programming."

SECURITY ACCESS CODE A code optionally programmed by the user at the front panel. Once programmed, this code is required in order to perform any program operations over the phone. See Section 5.7, "Programming by Phone," and Section 6, "Advanced Programming."

SPEECH MEMORY RATE See Recording Rate.

STATION ID MESSAGE A message which is always included in all phone calls to or from the unit, intended to identify the unit. The default Station ID Message is "ID number is 1". See Section 4.1, "Planning Messages" and 4.3, "Record Your Messages."

TIME BETWEEN ALARM CALLS With the unit in Unacknowledged Alarm status, the waiting time from the time the unit terminates a given alarm call, until the time when the unit again accesses the phone line to place the next call. During this interval (default 2 minutes), personnel may call the unit back, which will acknowledge the alarm and suspend further calling. See Section 5.4, "Continued Dialing in the Absence of Acknowledgment," and Section 6, "Advanced Programming."

VIOLATION For contact closure inputs, a violation (also called Alarm Condition) is the Open or Closed Circuit condition which is opposite the condition which has been programmed as Normal for that channel. For example, if a given input channel is programmed for Normally Open operation, then a Closed Circuit is a violation for that input. If the violation persists for the Alarm Trip Delay time, the unit will go into Unacknowledged Alarm state and begin placing alarm calls. See Section 3.3, "Programming Input Channels, " 5.3, "Receiving Alarm Calls," and 5.6, "Alarm Rest Timeout After Acknowledgment."

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FCC Notice to Users

1. You must notify your telephone utility as follows:
    a. Intention to install an FCC Part 68-registered device.
    b. The FCC registration number: HKS-23J06304-AL-R
    c. The ringer equivalence number: 0.3A
    d. When the device is disconnected from the telco network and will not be reconnected.
2. These units may not be used on party lines.
3. The telco has the right to make changes in their network which may affect the operation of your unit, provided adequate notice is given to you in advance to permit continued correct operation.
4. In the event of operational problems, disconnect your unit by removing the modular plug from the modular telephone jack. To test the phone line, temporarily plug a working rotary-dial telephone into the jack normally used by the Verbatim. If the substitute telephone works correctly, your Verbatim has a problem and should be returned for repairs (in or out of warranty). If the substitute telephone does not work correctly, notify the telco that they have a problem and request prompt repair service (at no cost to the user).
5. The user may not under any circumstances (in or out of warranty) attempt any service or repairs on the Verbatim. It must be returned to RACO for all repairs.

Control Devices

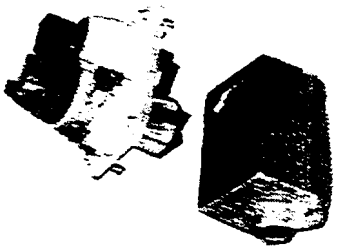
CONTROL DEVICES EFS/EFD AND EDS SERIES

SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE

IF89

Installation & Maintenance Instructions

Typical EFS Series
(not Factory Sealed)



Typical EFD Series
(w/integral Sealing Chamber)

Typical EDS Series
(uses factory sealed contact block pictured)

APPLICATION

EFS/EFD and EDS Series control devices are used in conjunction with magnetic starters or contactors for remote control of motors and to visually indicate that the desired function is being performed.

EFS (dead end) and EFSC (through feed) Series pushbutton stations, selector switches and factory sealed pilot lights are used separately or in combinations with a variety of standard features and special options available.

EFD (dead end) and EFDC (through feed) Series factory sealed pushbutton stations and factory sealed pilot lights do not need external sealing.

[redacted] and EDSC (through feed) Series factory sealed pushbutton stations, selector switches, and snap switches do not need external sealing.

EFS/EFD and EDS Series control devices are suitable for use in Class I, Groups C and D (Division 1), Class II, Groups E, F, G and Class III hazardous (classified) locations, as defined by the National Electrical Code® (NEC). Certain units are suitable for Class I, Group B (Division 1) usage, they are identified by the suffix GB added to the Catalog Number and must have seals installed within 1-1/2" of each conduit opening. Standard EDS Series pushbutton and selector switch controls with the factory sealed contact blocks (shown Figure 2) are suitable for Class I, Group B, Division 2.

INSTALLATION

WARNING

Electrical power must be **OFF** before and during installation and maintenance.

1. Select a mounting location that will provide suitable strength and rigidity for supporting all contained wiring and control devices. Figure 3 shows the mounting dimensions of all EFS/EFD and EDS device bodies. Drill and tap mounting holes for 5/16 — 18 bolts.
2. Securely fasten the device body to the mounting surface, then attach the body into the conduit system.

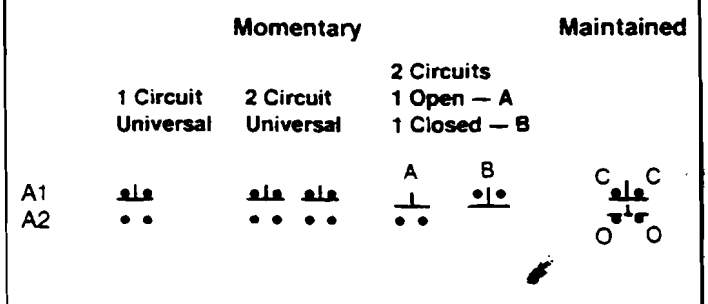
CAUTION

Hazardous location information indicating the class and group the product is approved for is marked on the nameplate of each device. Conduit sealing fittings may be required to be installed to comply with the requirements of the latest edition of the NEC, Section 501-5 and/or 502-5 plus any other applicable standards.

For Class I, Group B, hazardous locations: Units with suffix GB in the catalog number on the nameplate, may be installed in Class I, Division 1, Group B locations. Seals must be installed within 1-1/2" of all conduit openings.

3. Remove the cover screws and then lift the cover assembly from the device body taking care not to damage either ground joint surface.
4. Pull supply wires into the enclosure, making them just long enough to make the required connections.
5. Make the electrical connections utilizing the wiring scheme established for your system. See Figures 1A and 1B for the contact diagrams of EFS/EFD and EDS pushbutton stations and selector switches.

Pushbutton Stations:



NOTE: A1, B1 and C Contacts are "Normally Closed" and A2, B2 and O Contacts are "Normally Open"

Figure 1A

®National Electrical Code is a registered trademark of NFPA.

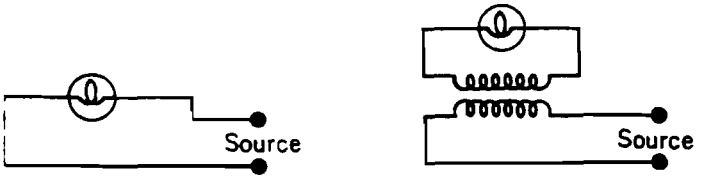
Selector Switches:

Style	Position 1	Position 2	Position 3
·o Position) Circuit	A1 A2		
Two Position Four Circuit	A1 A2 B1 B2		
Three Position Two Circuit	A1 A2		
Three Position Four Circuit	A1 A2 B1 B2		
	A1 A2 B1 B2		

NOTE: A1, B1 and C Contacts are "Normally Closed" and A2, B2 and O Contacts are "Normally Open"

Figure 1B

Pi ghts:



Nominal 120V

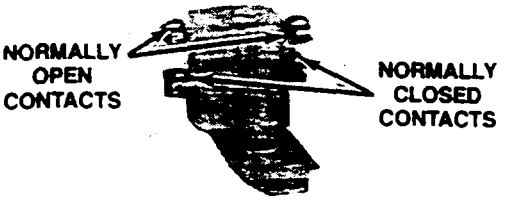
Nominal 220, 440, 550V

Pilot Light Transformer
Voltages above 125 Volts

Nominal Volts 50/60 Hertz Transformer	Primary Voltage Range
220-110	220-240
440-110	440-480
550-110	550-600

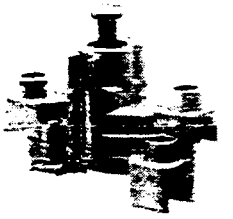
Figure 1C

The field wiring terminals on the switch units used for pushbutton or selector switch stations are marked, (see Figure 2). The ⊣⊢, and "O" indicates normally open contacts; and ⊣/⊢, and "C" indicates normally closed contacts of the switch. These switches are provided with binding screw terminals. For EDS/E Series toggle switches; splice factory sealed wires to / wires using suitable connectors. Factory sealed wires entified in accordance with the wiring diagram located on the side of the sealing chamber. (See Figure 2).

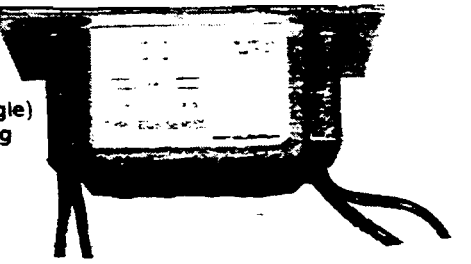


EDS/EFS Pushbutton Stations Screw Terminals

EFD Pushbutton Station Screw Terminals



EDS Factory Sealed contact block for pushbuttons and selector switches



EDS snap switch (toggle) sealing well with wiring diagram.

Figure 2

Strip the insulation on each conductor wire back 3/8".

Use a slotted or Phillips head screwdriver to loosen the field wiring terminal screws the required 3 or 4 turns.

Insert the bare wire conductor(s) on either side of the terminal screw(s), under the terminal wire clamp(s) and securely tighten the screw(s).

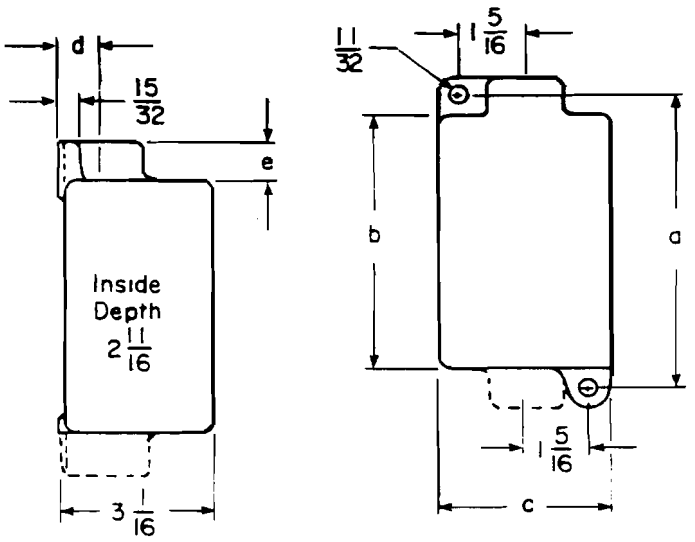
NOTE: Do Not exceed 15 in. lbs. of torque.

Pilot lights and sealing wells are furnished with pigtail leads for field connection by use of wire nuts.

6. Test wiring for correctness with continuity checks and also for unwanted grounds with an insulation resistance tester.
7. Carefully assemble cover assembly to the device body with the cover screws. Check the tightness of the cover screws to ensure that the cover assembly is securely fastened.

WARNING

Check for dirt, grit or other foreign material on the mating surfaces of the cover and the device body. Be certain that each surface is wiped completely clean before assembling. Surfaces must seat fully against each other to provide a proper explosionproof seal.



SIZE	Dimensions (in.)		
	a	b	c
Single Gang Tandem	5-7/8	5-3/32	3-1/2
Two Gang	5-7/8	5-3/32	7-3/16
Three Device	8-1/8	7-1/4	3-1/2
Two Gang Tandem	11-1/4	10-7/16	3-1/2

HUB (in.)	d	e
1/2	3/4	13/16
3/4	7/8	13/16
1	1	15/16

Figure 3

PILOT LAMP REPLACEMENT

110-125 Volt Circuit: 6 watt, type S6, candelabra base
220-250 Volt Circuit: 10 watt, type S6, intermediate base

REPLACEMENT PARTS

For a complete listing of replacement parts for EFS/EFD and EDS control devices, refer to the Crouse-Hinds Catalog.

MAINTENANCE

WARNING

Always disconnect primary power source before opening the enclosure for inspection or service.

1. Frequent inspection should be made. A schedule for maintenance checks should be determined by the environment and frequency of use. It is recommended that it should be at least once a year.
2. Perform visual, electrical and mechanical checks on all components on a regular basis.

   Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.

   Electrically check to make sure that all connections are clean and tight, and that contacts in the components make or break as required.

   Mechanically check that all parts are properly assembled, and that operating mechanisms move freely.

All statements, technical information and recommendations contained herein are based on information and tests we believe to be reliable. The accuracy or completeness thereof are not guaranteed. In accordance with Crouse-Hinds "Terms and Conditions of Sale", and since conditions of use are outside our control, the purchaser should determine the suitability of the product for his intended use and assumes all risk and liability whatsoever in connection therewith.

COOPER

Crouse-Hinds

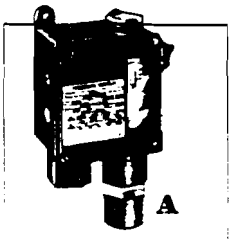
Quality from
Cooper Industries

Cooper Industries Inc.
Crouse-Hinds Division
PO Box 4999
Syracuse, New York 13221 • U.S.A.

IF899
Revision 03/92

PRESSURE SWITCHES

Piston Pressure Switches

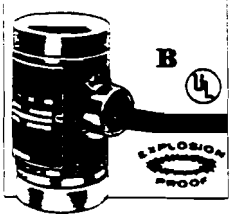


A • Temperature Range: −40° to 165° F

SINGLE ACTION—A single piston opens or closes switch when pressure rises above or falls below any point set within the adjustable range. Great for air, oil, and water service. Switches have a stainless steel piston and fitting with a Buna-N O-ring.

Snap-action switch is single pole, double throw (SPDT) with automatic reset. Rated 10 amps at 120/240/480 VAC. NEMA 13 indoor enclosure is oil and dust tight. Pressure connection is ¼" FPT. Electrical conduit connection to switch screw terminals is ½" NPT. External adjustment screw is tamper resistant.

Adjustable Range, PSI Decreasing Min.	Max.	Increasing Min.	Max.	Approx. Minimum Diff. PSI	No.	NET EACH
20	180	25	200	5	4735K43	$196.71
75	505	85	540	10	4735K45	196.71
100	1400	130	1500	30	4735K46	188.21
235	3200	295	3400	60	4735K48	188.21
425	5640	545	6000	120	4735K49	188.21



B • Temperature Range: 32° to 275° F

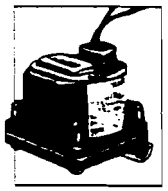
EXPLOSIONPROOF DUAL ACTION—Switches have two pistons, each controlling a separate switch. Set them to operate together or at any two points within the high and low ranges. Use for two actions in response to pressure rise and fall.

Switches work with liquid, air, and gas. Ideal for protecting motors, pumps, compressors, generators, engines, and presses. Switch differential is approximately 10% of range.

UL listed for Class I, Groups A, B, C, and D; Class II, Groups E, F, and G. Snap-action, single-pole, double-throw (SPDT) switches are rated 10 amps at 125/250 VAC, 60 Hz. Conduit connections are ½" FPT for pressure and ¾" NPT for electrical. Aluminum housing has Mylar diaphragm and Buna-N O-ring; stainless steel housing has Teflon diaphragm and viton O-rings.

Adjustable Range, PSI Low	High	Aluminum Housing No.	NET EACH	Type 316 Stainless Steel Housing No.	NET EACH
3 to 40	5 to 75	4836K31	$228.33	4636K41	$251.12
25 to 250	30 to 400	4636K33	228.33	4636K43	251.12
100 to 1000	150 to 1500	4636K35	228.33	4636K45	251.12

Diaphragm Pressure Switches



Set any point within the adjustable range—an increase or decrease in pressure will open or close the circuit. Switches have NEMA 4 watertight enclosures and tamper-resistant, external adjustment screws. Pressure (vacuum) connection is ¼" FPT. Electrical connection is ½" NPS conduit.

Snap action, single-pole, double-throw (SPDT) switches automatically reset. Rating is 10 amps at 125/250 VAC; 3 amps at 480 VAC.

Nos. 5004K11, 13, 15, 22, and 24 have stainless steel internal parts; 5004K12, 14, 16, 21, and 23 have copper internal parts.

DISCONTINUED

Adjustable Range Decreasing Min.	Max.	Increasing Min.	Max.	Approx. Minimum Diff.	No.	NET EACH
PRESSURE SERVICE SWITCHES—All values in PSI						
.018	1.654	0.064	1.7	0.018	5004K21	$105.77
.018	1.65	0.068	1.7	0.02	5004K22	110.50
.03	2.89	0.14	3	0.05	5004K23	105.77
.03	2.85	0.18	3	0.07	5004K11	110.50
4	17.8	0.60	18	0.10	5004K12	105.05
4	17.74	0.66	18	0.12	5004K13	110.50
5	77.2	3.3	80	1.4	5004K14	105.05
5	76.6	3.9	80	1.6	5004K15	110.50
1.5	144.8	6.7	150	2.2	5004K18	105.05
1.5	144.0	7.5	150	2.3	5004K24	110.50
VACUUM SERVICE SWITCHES—All values in inches of mercury						
06	5.80	0.26	6	0.09	5004K23	$105.77
06	5.72	0.34	6	0.14	5004K11	110.50
8	29.34	1.46	30	0.4	5004K12	105.05
8	29.2	1.6	30	0.4	5004K13	110.50

ITEM # 5004K22
DECREASING
0.068 psi → 1.7 psi.
INCREASING
0.018 – 1.65 psi

Bourdon-Tube Pressure Switches

Two separate adjustments let you set exact high and low pressure points. Differential (the difference between high and low points) adjusts over the full scale. Switch operates with a brass Bourdon tube in a NEMA 1, general-purpose steel enclosure. Excellent for gases, steam, and liquids not corrosive to brass. Steam more than 35 psi and media more than 180°F require a siphon or remote connection. **See page 1364 for siphons.**

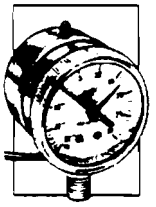
Steel housing with transparent cover lets you view calibrated dial for set points and on/off indicator.

UL listed and CSA certified. Single-pole, single-throw (SPST) mercury switch is rated 10 amps at 120 VAC, 5 amps at 240 VAC, 3 amps at 440 VAC. Bottom connection is ¼" MPT.

Adjust. Oper. Range PSI	Min. Diff. Pres. PSI	Opens Circuit on Pressure Rise No.	NET EACH	Closes Circuit on Pressure Rise No.	NET EACH
⅞ to 15	1	4941K21	$109.39	4941K31	$109.39
0 to 30 ◆	2 ◆	4941K22	109.39	4941K32	109.39
1 to 35	1.75	4941K24	109.39	4941K34	109.39
2 to 60	3	4941K25	109.39	4941K35	109.39
5 to 100	3.75	4941K26	109.39	4941K36	109.39
5 to 150	6	4941K27	109.39	4941K37	109.39
10 to 200	8	4941K28	120.35	4941K38	120.35
10 to 300	14	4941K29	120.35	4941K39	120.35

◆ Vacuum in inches of mercury.

Stainless Steel Indicating Pressure Switches



• Temperature Range: −20° to 135° F

A handy pressure gauge and alarm all in one. If set point you have entered is exceeded, a built-in solid state switch activates an external alarm, light, or relay. An LED on top of case lights as an indicator. Choose a set point anywhere on indicator as long as switching differential is 3% of range. Accuracy is ±2% of full scale with ¼% repeatability. Switches are furnished normally open but can be adjusted in the field to normally closed.

Leads are 12" long. The 2" diameter case and movement are corrosion-resistant, 300 series stainless steel. Socket and bourdon tube are Type 316 stainless steel. White dial has black markings and screw-on polycarbonate bezel. Bottom connection is ¼" MPT. Switch power input is 8-30 VDC; power rating is 12 watts. **Unit is cleaned to ANSI B40.1 level IV and compatible with oxygen service.**

Range	Figure Intervals	No.	NET EACH
30" vacuum, 30 psi	10" vacuum, 5 psi	38825K71	$201.72
0 to 15 psi	3 psi	38825K72	201.72
0 to 30 psi	5 psi	38825K73	201.72
0 to 60 psi	10 psi	38825K74	201.72
0 to 100 psi	20 psi	38825K75	201.72
0 to 160 psi	40 psi	38825K76	201.72
0 to 200 psi	40 psi	38825K77	201.72
0 to 300 psi	50 psi	38825K78	201.72
0 to 400 psi	100 psi	38825K79	201.72
0 to 600 psi	100 psi	38825K81	201.72
0 to 1000 psi	200 psi	38825K82	201.72
0 to 1500 psi	250 psi	38825K83	201.72
0 to 2000 psi	400 psi	38825K84	201.72
0 to 3000 psi	500 psi	38825K85	201.72
0 to 4000 psi	1000 psi	38825K86	201.72
0 to 5000 psi	1000 psi	38825K87	201.72
0 to 6000 psi	1000 psi	38825K88	201.72

OPERATING INSTRUCTIONS AND PARTS LIST

PHOTOHELIC® PRESSURE SWITCH/GAGE*

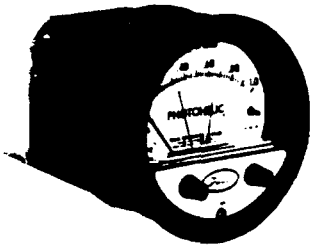
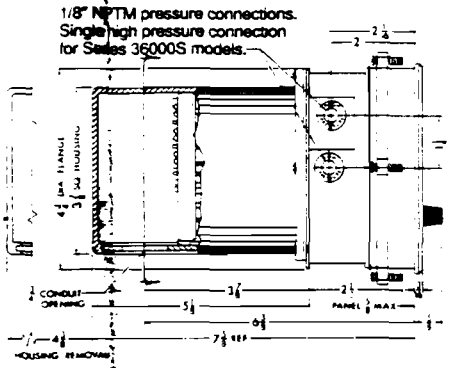
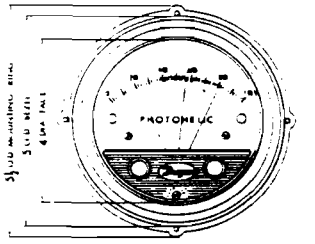


Figure 1 Series 3000 Photohelic® Switch/Gage.





4-13/16" (122 mm) dia. hole required for panel mounting.

NOTE: Detailed dimension drawings are available from our Customer Service Dept. for PHOTOHELIC® switch/gages as installed in two optional enclosures. For weatherproof housing, request no. 13-700132-00. For explosion-proof housing, request no. 13-700113-01.

The Photohelic® Switch/Gage is a very versatile, precise pressure switch combined with the time-proven Magnehelic® pressure gauge. Models are available with one or two phototransistor actuated relays. Gage reading is unaffected by switch operation. Easy to adjust set points have knob controls. Applied pressure and switch set points are fully visible at all times. Deadband is one pointer width — less than 1% of full scale. Double-pole double-throw relays can be easily interlocked to provide variable deadband control. For positive, negative or differential pressures; single positive pressure only on 36000S models. Full scale ranges available from 0-.25 in W.C. to 0-6000 psig.

PHOTOHELIC SENSING — HOW IT WORKS

In a typical control application, the Photohelic switch/gage controls between high and low pressure set points. When pressure changes, reaching either set point pressure, the beam from an LED to the limiting phototransistor will be cut off by the helix-driven light shield. The resulting signal change is electronically amplified to actuate its DPDT slave relay and switching occurs. Dead band between make and break is 1% of full scale or less — just enough to assure positive, chatter-free operation.

*Patent No. 3,862,416

SPECIFICATIONS

1. Dimensions: 5" Diameter × 8¼" Length.
2. Weight: 4 Lbs. 12 oz.
3. Gage Bezel: 5" O.D. × 4" I.D. across gage face. Fits panels up to 5/8" thick. 4 13/16" diameter hole required. Optional, 122 mm.
4. Gage Connections: 1/8" N.P.T.
5. Finish: Baked Dark Gray Epoxy Enamel.
6. Pressure Rating: –20" Hg. to 25 psig (–.67 to 1.7 bar). MP option; 35 psig (2.4 bar), HP option; 80 psig (5.5 bar). 36003S-36010S; 150 psig (10.3 bar). 36020S and higher; 1.5 × full scale pressure.
7. Ambient Temperature Range: 20 Deg. to 120 Deg. F standard. Low temperature model available.
8. Standard Accessories: Two (2) brass 1/8" N.P.T. to rubber tubing adapters, two (2) 1/8" N.P.T. pipe plugs, mounting ring, snap ring and screws for flush panel mounting. Instructions.
9. Contact Rating: 10A @ 24 VDC / 120VAC; 6A @ 240VAC.
10. Power Required: 117 V., 50, 60 Hz. A.C., 5 watts average (220V. and 240V. units also available).
11. Conduit Opening: 3/4" Conduit.
12. Accuracy: 2 percent of full scale (3% on -0 and 4% on -00 Ranges) at 70 Deg. F.
13. Series 3000 models are for use with air or compatible gases. Series 36000S models are for use with compatible gases and liquids.

For repeated over-ranging or high cycle rates, refer to factory.

DWYER INSTRUMENTS, INC.
P. O. BOX 373 · MICHIGAN CITY, INDIANA 46361 U.S.A.
Telephone 219/872-9141
Fax 219/872-9057

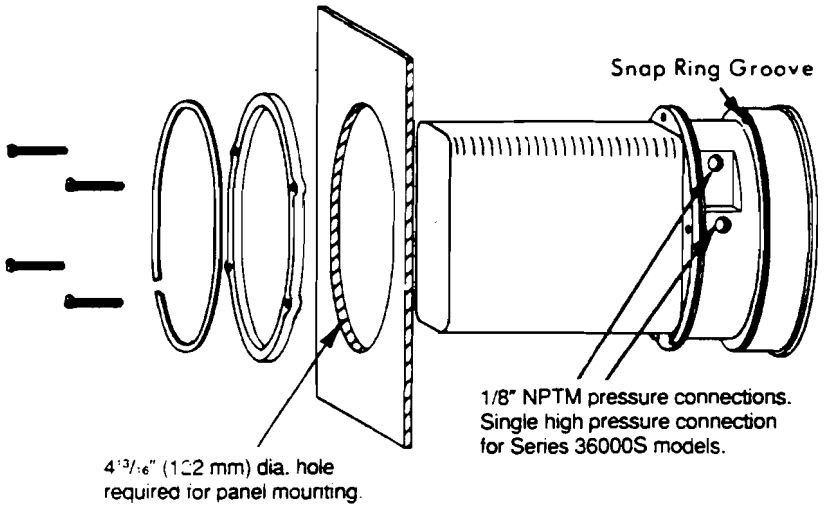


Figure 2
Through Panel Mounting

INSTALLATION

1. **Location:** All parts of the Dwyer PHOTOHELIC* pressure switch/gage are ruggedly constructed and will stand a moderate amount of vibration, physical shock, and handling. Normal care in handling and installation is all that is required. In cases where instrument panel vibration is severe, the panel should be spring mounted or the amplifier-relay unit mounted remotely on a more stable surface.

   Select a location where the ambient temperature will not exceed 120°F. Pneumatic pressure sensing lines may be run any necessary distance. For example. 250 foot sensing lines will not affect accuracy but will damp the reading slightly. Do not restrict lines. If pulsating pressure or vibration causes excessive pointer oscillation or relay chatter, consult factory for additional damping means. See accessory Bulletin S-101 for fittings.

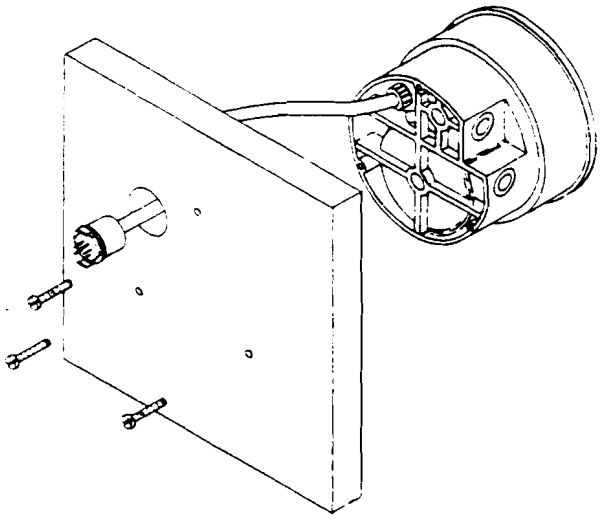
2. **Position:** The PHOTOHELIC* may be mounted as an integral package or the amplifier-load relay assembly and housing may be mounted remotely from the indicating gage-phototransistor unit. Extention cords with 7 pin plugs and receptacles are available from Dwyer for interconnection of the two units.

   The unit may be mounted in any desired position, scale vertical or horizontal, without affecting its accuracy, but must be rezeroed if position is changed from horizontal to vertical or vice versa. The -0 and -00 models must be mounted with the scale vertical.

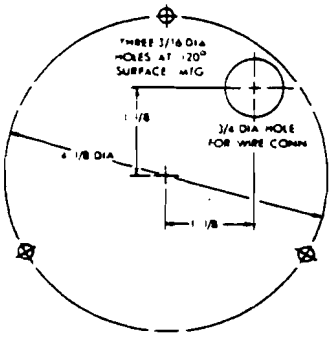
3. **Mounting:** The PHOTOHELIC* is normally mounted before making electrical connections, as the electrical enclosure is independent of the mounting means and may be removed at any time.

   A. **Panel Mounting:** Normal mounting is flush or through panel as shown in Fig. 2. Be sure to allow 4-3/8" extra space behind the unit for electrical enclosure removal. Make a single 4 13/16" diameter hole in the panel. Insert the entire PHOTOHELIC* unit from the front, then slip on the mounting ring and snap ring from the rear. Seat the snap ring in its groove, back up the mounting ring against snap ring and tighten the four (4) 2" No. 6-32 clamp screws provided. If behind panel space is critical, the amplifier-relay unit can be mounted remotely. See the Remote-Relay Mounting Instructions for details.

B. Gage Mountings with Relays Remote: Where it is desirable to mount the amplifier-relay unit separate from the gage-phototransistor unit, the gage may be mounted either as shown in Fig. 2 (except less amplifier-relay portion) or surface mounted as shown in Fig. 3A. Use the layout shown in Fig. 3B to locate holes. The complete package cannot be surface mounted.

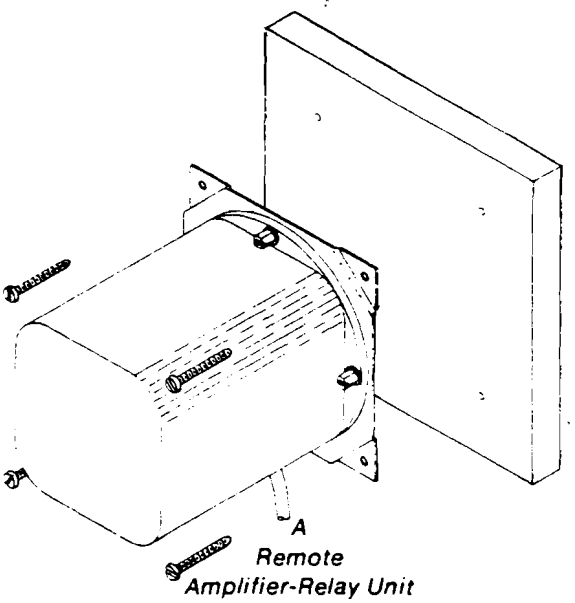


A
Surface Mounting

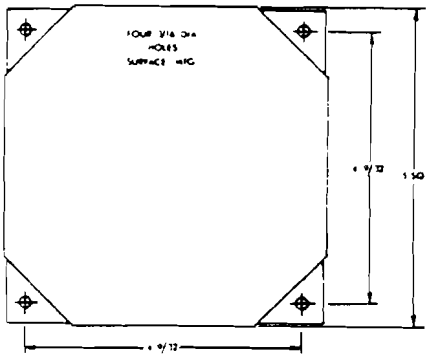


B
Hole Layout (Front)

Figure 3



A
Remote
Amplifier-Relay Unit



B
Hole Layout

Figure 4

4. Pneumatic Connections & Zeroing: After installation but before making pressure connections, set the indicating pointer exactly on the zero mark, using the zero adjust screw located at the bottom of the front cover. Note that this adjustment can only be made with the high and low pressure taps both open to atmosphere.

Connect the high and low pressure taps to positive, negative, or differential pressure sensing points. Use ¼" diameter metal or other instrument tubing and ⅛" N.P.T. adaptors at the Dwyer PHOTOHELIC® pressure switch gage. Adaptors for rubber or soft plastic tubing are furnished with the instrument for use where this type of connection is preferred.

If the PHOTOHELIC® is not used to sense differential pressure, one of the pressure taps must be left open to atmosphere. This will allow the reference pressure to enter. In this case, installation of a Dwyer No. A-331 Filter Plug or similar fitting in the reference pressure tap is recommended to reduce the possibility of dust entering the instrument.

NOTE: If the Photohelic switch/gage is over pressured, pointer may "jump" from full scale back to zero and remain there until the excess pressure condition is relieved. Users should be aware of possible false zero pressure indications under this condition.

C. Remote Relays Mounting: The amplifier — relay unit may be mounted remotely as shown in Fig. 4A. Use the hole layout as shown in Fig. 4B for this option.
Additional mounting information for special requirements is available from the factory.

ELECTRICAL CONNECTIONS

1. **Cover:** The amplifier-relay unit has an easy to remove housing. Remove the three (3) screws as shown in Fig. 5 and slide the housing off. Make all the electrical connections before reinstalling and refastening the housing.

2. **Conduit:** Electrical access to the connection box portion of the relay housing is by bottom opening for ¾" conduit. Use of flexible conduit is recommended. It should be supported from the panel or other suitable surface to prevent the wiring system from exerting undue strain on the instrument. See Fig. 5.

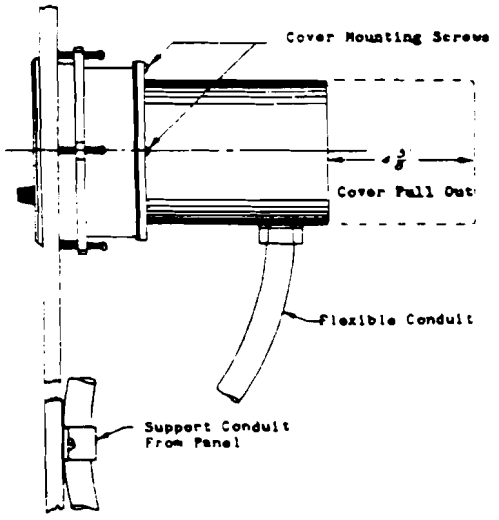
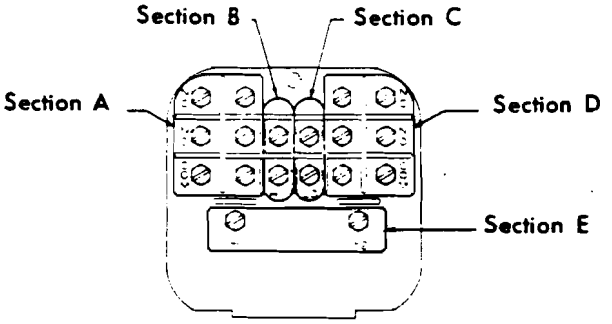


Figure 5
Mounting Details

3. **Terminal or Connection Board Layout:** In Fig. 6, "Terminal Board," **Section A** contains the connections for the load or slave relay actuated by the high or right set-point. This relay is a double pole, double throw type. The two top connections are normally closed, the two middle connections are normally open, and the bottom connections are the common pair. The relay is in its normal or De-Energized position when pressure is below the right hand set-point.

Section D is exactly the same as **Section A** except that its load or slave relay is controlled by the low or left set-point. The De-Energized position is below the left hand pointer set-point.

Section B contains the external connections to the holding coil circuit for the high or right set-point relay and **Section C** contains similiar connections for the low or left set-point relay. The function and use of these connections varies somewhat depending on the circuit style of the instrument. See paragraphs 5 and 6 for details.



CAUTION: Do not apply electrical current to terminals in sections B and C.

Figure 6
Terminal Board

Section E contains the power connections for the control unit transformer primary. The transformer in turn supplies reduced voltage power for the LED, phototransistor, amplifier unit, and load relay pull in and holding coils. Connections must always be made to this section in order to put the unit in operation. Standard units are designed for 117 V.A.C. input to the transformer. Special units are also available for other voltages.

Separate Ground Wire attachment is provided for by a No. 6-32 screw on the mounting bracket near the conduit opening. An additional ground wire connection is located on the side of the gage body for use when the amplifier-relay unit is mounted remotely.

Single Set-Point instruments are furnished with the right or high set-point components and circuitry in place. These are connected to Sections A and B of the terminal board. The left or low set-point components are omitted.

4. **Circuit Style:** The PHOTOHELIC® is available with several factory installed optional internal circuits. They are identified as to style by a label shown in Fig. 7. This label is mounted prominently on the terminal board of each instrument. The letter H denotes a circuit in which the relay can be made to latch or remain energized after pressure increase to its set-point.

PHOTOHELIC®
CIRCUIT:
POWER SUPPLY: VAC 50/60 HZ 5W
CONTACT RATING: 10A @ 24 VDC/120 VAC
6A @ 240 VAC

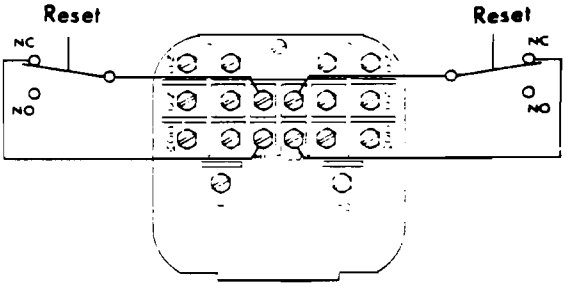
Figure 7
Circuit Label

The letter L denotes a circuit in which the relay can be made to latch or remain de-energized after pressure decrease to its set-point. Two letters are required to fully identify a dual set-point unit. Thus, circuit style HH, which is standard, is a dual set-point circuit which has provisions for latching on pressure increase to either set-point. Single relay units are identified by the letters SR followed by H for the standard unit or L for the special low latch unit. Units for use with other than standard 117 VAC will be so indicated on the label.

5. **Dual Set Point Automatic Reset:** Circuit Style HH is used for simple on-off switching applications. To place in service, connect load circuits to the appropriate terminals in Section A (Fig. 6) for the right set-point and Section D for the left set-point. Note that the N.O. contacts are open when the gage pressure pointer is to the left of the set-point pointers. No connections are necessary in Sections B and C. Make external ground connections as required and connect power to Section E for the control unit. To use circuit style LL for automatic reset, a jumper wire must be installed between the upper and lower terminals in sections B and/or C.

6. **Dual Set Point Manual Reset:** Circuit Style HH may also be used for manual reset applications where it is desired to have maintained contact on either relay following pressure increase above its set-point. Load or signal connections are made to the appropriate terminals in Sections A and D (as in paragraph 5 above). Connect terminals in Sections B and C through normally closed switches or push buttons as shown in Fig. 8. Use of "dry-circuit" type switches such as Dwyer Part No. A-601 with paladium, gold, etc. or rotary wiping action type contacts is recommended. Make external ground connections as required and connect power to Section E for the control unit.

Circuit style LL is used for manual reset applications which require that contact be maintained following pressure decrease below the set-point. Load connections are made to the appropriate terminals in Sections A and D. A normally open type manual reset switch such as Dwyer Part No. A-601 is connected to the terminals in sections B and C. The circuit must be "armed" by momentarily closing the switch while the black pointer is to the right of the set-point. From that point on, the circuit will latch on pressure decrease below the set-point and remain latched on pressure increase until manually reset with the optional switch.



CAUTION: Do not apply electrical current to terminals in sections B and C.

Figure 8
Manual Reset with Circuit HH

7. **Dual Set Point Automatic and Manual Reset Combinations:** Circuit style HH may be used with either set-point wired and operating as in paragraph 5 above and other set-point wired and operating as in paragraph 6.

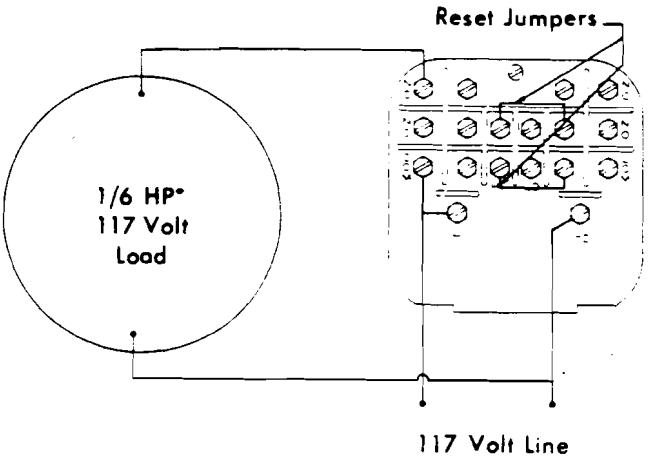
8. **High Low Limit Control — Dual Set-Point:** Circuit Style HH may be used to control fans, dampers, pumps, etc., between the set-points of a PHOTOHELIC.® To accomplish this, use one set-point relay to reset the other as shown in the wiring diagram Fig. 9. In this typical application, the load (for instance a fan) would be connected to the N.C. contacts of the right set-point relay. Section A (Fig. 6). On pressure rise to the right set-point, its relay would pull in and hold even though pressure might then fall below that set-point. If the pressure continued to fall to the left set-point, its relay would automatically be DE-ENERGIZED, return to its normal position and in so doing, open the holding coil circuit from Section B (Fig. 6). The right set-point relay would thus be reset and the cycle could repeat.

9. **Dual Set-Point Special Purpose Circuits:** Circuit Style LL may be used where manual reset following maintained contact on pressure decrease to either set-point is desired. Circuit Styles HL and LH are combination units. For special combinations of features, special units, and detailed instructions regarding their use, consult the factory.

10. **Single Set-Point PHOTOHELIC:®** The single set-point PHOTOHELIC® is furnished with the right set-point only. Terminals in Section A and B (Fig. 6) are connected to this relay. Circuit Style SRH is wired for automatic reset as in paragraph 5 above. Manual reset is accomplished by adding a normally closed reset switch or push button to the circuit as described in paragraph 6 above.

11. **Single Set-Point Special:** Manual reset after actuation on falling pressure can be obtained by using Circuit Style SRL. Consult the factory for special units and detailed instructions regarding their use.

12. **Placing in Service:** In normal operation each relay is de-energized when the pressure applied to the instrument is below its set-point. Special low-latching units will ordinarily have to be reset before placing on the line in normal operation.



*Note: For larger motors, use the Photohelic® in a maintained contact, 117 Volt Control or Push Button Circuit of the motor starter.

Figure 9
High-Low Limit Control
(Circuit HH)

13. **Failure Mode:** The PHOTOHELIC® circuit design provides certain protection in the event of a loss of pressure or electrical power. In either case, both relays will de-energize, returning to their normal "zero pressure" state. The exceptions to this are models with center zero ranges. Because the relays on all standard models are always energized when the indicating (black) pointer is to the right of their respective set points, the relay action on loss of pressure will depend on set-point position, since either of them could be located to the left of zero. As an example; if the left pointer were set at -2 in. w.c. and negative pressure was -3 in. w.c., a loss of that pressure would allow the black pointer to return to the center and thus cause the low set-point relay to energize.

If the LED should burn out, only the left-low relay will de-energize. The right-high relay will react as if pressure were above its set-point and will remain energized even though pressure might be below that setting. In this situation, only termination of electrical power will allow the right-high relay to de-energize.

MAINTENANCE AND SERVICE

Dwyer PHOTOHELIC® Switch/Gages are precision instruments, expertly assembled and calibrated at the factory. They require no lubrication or periodic servicing. If the interior is protected from dust, dirt, corrosive gases and fluids, years of trouble-free service may be expected. Zero adjustment should be checked and reset occasionally to maintain accuracy. Any repairs necessary to either the Dwyer Magnehelic® pressure gage or the electronic components should be performed by a trained instrument mechanic. In most cases, this is best accomplished by returning the complete PHOTOHELIC® Switch/Gage to the Dwyer factory.

PHOTOHELIC®
PRESSURE SWITCH/GAGE

MODELS AND RANGES

Model Number	Range, Inches of Water	Minor Div.
3000-00	0- 25	005
3000-0	0- 50	01
3001	0-1 0	02
3002	0-2 0	05
	0-3 0	10
3004	0-4 0	10
3005	0-5 0	10
3006	0-6 0	20
3008	0-8 0	20
3010	0-10	20
3015	0-15	50
3020	0-20	50
3025	0-25	50
3030	0-30	1 0
3040	0-40	1 0
3050	0-50	1 0
3060	0-60	2 0
3080	0-80	2 0
3100	0-100	2 0
3150	0-150	5 0

Model Number	Range, Zero Center Inches of Water	Minor Div.
3300-0	.25-0-.25	.01
3301	.5-0-.5	.02
3302	1-0-1	05
3304	2-0-2	10
3310	5-0-5	20
3320	10-0-10	50
3330	15-0-15	1.0

Model Number	Range PSIG	Minor Div. PSIG
3201	0-1	.02
3202	0-2	.05
3203	0-3	.10
3204	0-4	.10
3205	0-5	.10
3210	0-10	.20
3215	0-15	.50
3220	0-20	.50
3230	0-30	1.0
36003S	0-30	1.0
36006S	0-60	2.0
36010S	0-100	2.0
36020S	0-200	5.0
36030S	0-300	10
36060S	0-600	20
36100S	0-1000	20
36300S	0-3000	100
36600S	0-6000	200

Dual Scale Air Velocity Units*

Model Number	Range, Inches of Water	Range, Air Velocity FPM
3000-00AV	0- 25	300- 2000
3000-0AV	0- 50	500- 2800
3001-AV	0-1 0	500- 4000
3002-AV	0-2 0	1000- 5600
3010-AV	0-10	2000-12500

*For use with Pitot tube

Model Number	Range, MM of Water	Minor Div. MM
3000-6MM	0-6	20
3000-10MM	0-10	50
3000-25MM	0-25	.50
3000-50MM	0-50	1.0
3000-80MM	0-80	2.0
3000-100MM	0-100	2.0

Model Number	Range, Zero Center MM of Water	Minor Div. MM
3300-20MM	10-0-10	.50

Model Number	Range, CM of Water	Minor Div. CM
3000-15CM	0-15	50
3000-20CM	0-20	50
3000-25CM	0-25	.50
3000-50CM	0-50	1.0
3000-80CM	0-80	2.0
3000-100CM	0-100	2.0
3000-150CM	0-150	5.0
3000-200CM	0-200	5.0
3000-250CM	0-250	5.0
3000-300CM	0-300	10.0

Model Number	Range, Zero Center CM of Water	Minor Div. CM
3300-4CM	2-0-2	10
3300-10CM	5-0-5	20
3300-30CM	15-0-15	1.0

Model Number	Range, Pascals	Minor Div. Pascals
3000-60Pa	0-60	2.0
3000-125Pa	0-125	5.0
3000-250Pa	0-250	5.0
3000-500Pa	0-500	10.0
3000-750Pa	0-750	25.0

Model Number	Range, Zero Center Pascals	Minor Div. Pascals
3300-250Pa	125-0-125	5.0
3300-500Pa	250-0-250	10.0

Model Number	Range Kilo-pascals	Minor Div. Kilo-pascals
3000-1kPa	0-1.0	.02
3000-1.5kPa	0-1.5	.05
3000-2kPa	0-2 0	05
3000-3kPa	0-3 0	10
3000-4kPa	0-4 0	10
3000-5kPa	0-5 0	10
3000-8kPa	0-8 0	20
3000-10kPa	0-10	20
3000-15kPa	0-15	.50
3000-20kPa	0-20	50
3000-25kPa	0-25	.50
3000-30kPa	0-30	1 0

Model Number	Range, Zero Center Kilo-pascals	Minor Div. Kilo-pascals
3300-1kPa	.5-0-.5	.02
3300-3kPa	1.5-0-1.5	10

Note: The Photohelic® pressure switch/gage may be used in an Underwriters Laboratories approved industrial control panel if the usage conforms to U/L specifications for the acceptance of unlisted components.

PHOTOHELIC® PRESSURE-SWITCH/GAGE

EXPLODED VIEW

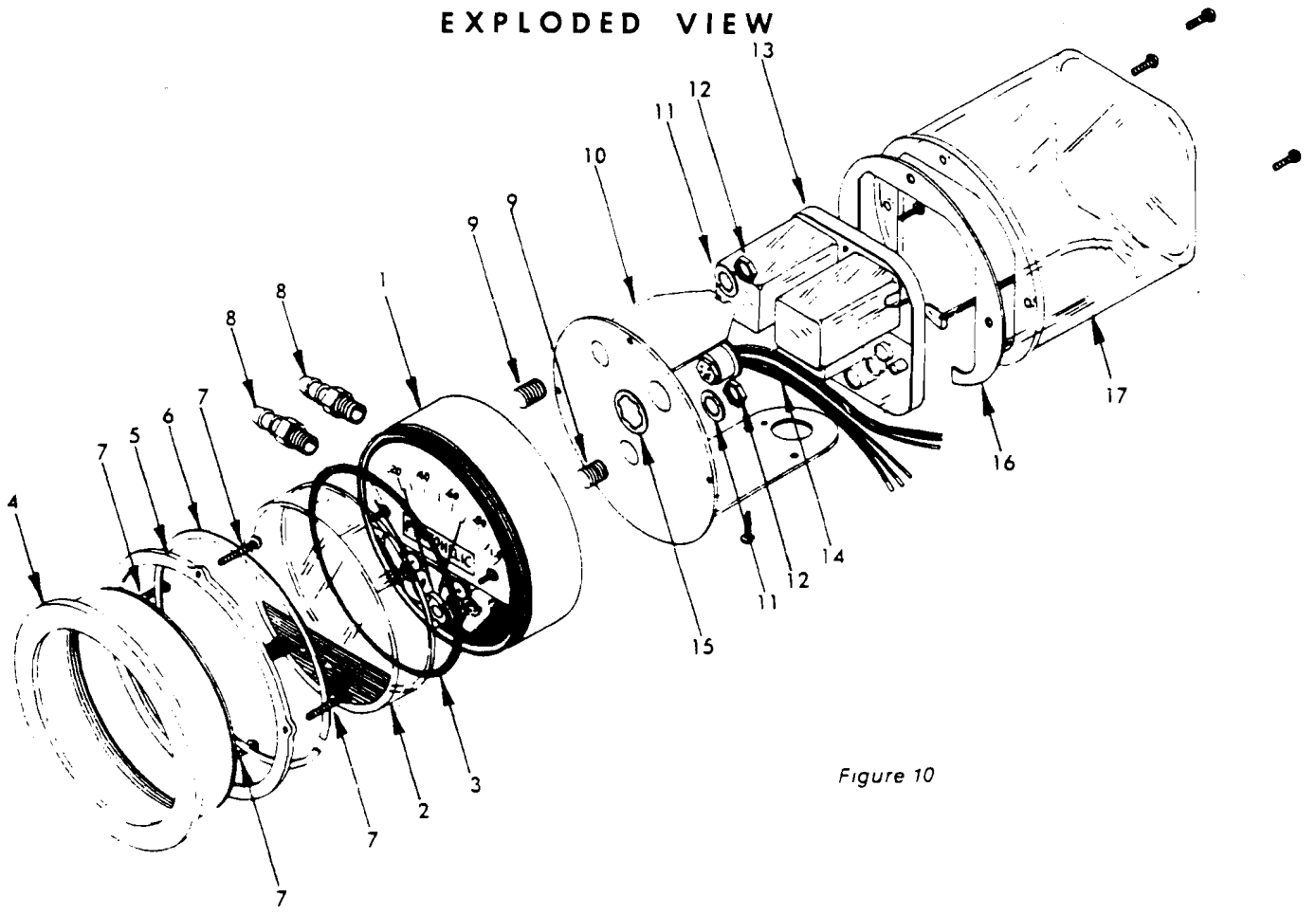


Figure 10

1. Photohelic® Gage Body & Sensor Assembly.
2. Cover, Knob and Zero Adjust Assembly.
3. Cover "O" Ring Seal.
4. Bezel.
5. Mounting Ring.
6. Snap Ring (Mounting).
7. Clamp Screws (Mounting).
8. 1/8 N.P.T. to Rubber Tubing Adapter (No. A-339).
9. 1/8 N.P.T. Mounting Studs.
10. Flange Plate and Bracket Assembly with Circuit Board Mounting Screws.
11. Lock Washer.
12. 1/8 N.P.T. Mounting Nut.
13. Amplifier-Relay Circuit Assembly.
14. Wiring Harness and Receptacle.
15. Retainer.
16. Gasket, Flange Plate to Amplifier-Relay Unit Housing.
17. Amplifier-Relay Unit Housing with Mounting Screws.

When corresponding with the factory regarding Photohelic® switch/gage problems, refer to the call-out numbers in this view. Be sure to include range, single or double circuit and circuit style letters where required. Field repair is not recommended; contact the factory for service information.

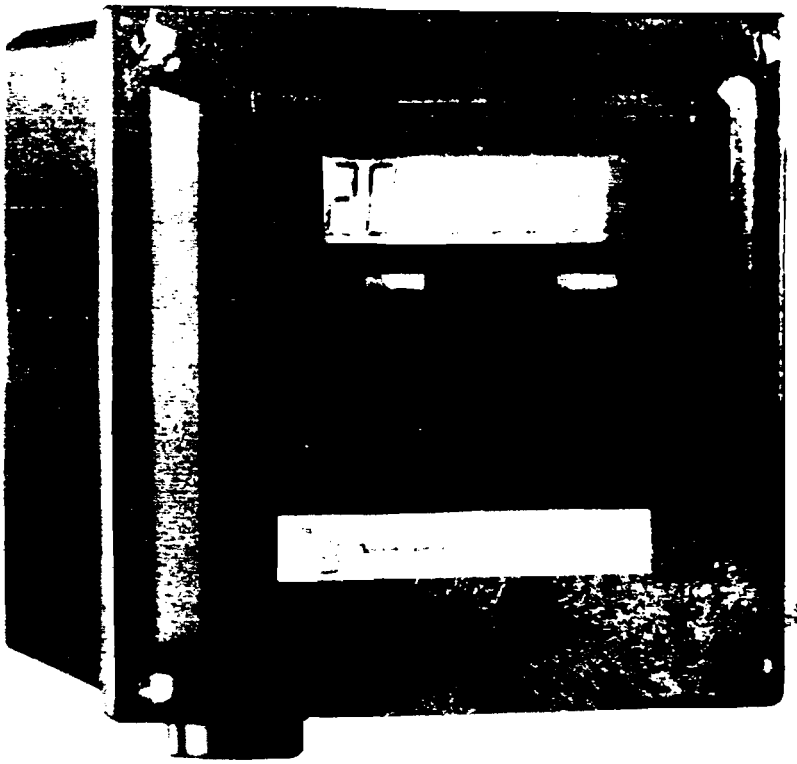
Printed in U.S.A. 5/94 FR 13-440202-02

Flow Meter

Model ER-8

Digital Resettable Totalizer and
Digital Rate of Flow Indicator

Installation & Operation Manual



This Product Contains Lithium ***Batteries.***

Read *This Manual Before Attempting Any* ***Installation,*** *Wiring Or Operation.*

BadgerMeter, Inc.
Industrial Division

Bulletin No. IOM-068-04
Part No. 53400-068
September 1996

ER8 Programming Calculations

TOTALIZER PROGRAMMING

Totalizer values can be expressed in any engineering unit of measure such as gallons, quarts, liters, etc. For each unit a unique scale factor must be programmed.

To determine the **Totalizer Scale Factor** (Program Mode #1), use the following formula:

Totalizer Scale Factor =
1/(Transmitter pulses per unit X Decimal Factor)

where:

Transmitter Pulses per Unit is the number from the chart at the right, or the Tech Brief (ITB) for your particular transmitter meter combination. The chart is expressed in gallons and liters. If you wish to read in other units, use the appropriate conversion factor.

Decimal Factor (from 1.0 to .001) determines the resolution of the reading. If you wish to read to the nearest 1/10 unit, the Decimal Factor would be 0.1.

Example: You have a model 35 RCDL meter with a PFT2 transmitter that has a pulse output of 126.7 pulses per gallon. You wish to read the totalizer to the nearest tenth gallon.

1/(126.7 X 0.1) = **0.0789** (scale factor)

Step #1: Set The Totalizer Scale Factor to 0.0789. (Program Mode #1)

Step #2: Set the totalizer Decimal Point to "0.0" (one decimal place) (Program Mode #2).

RATE OF FLOW PROGRAMMING

Rate of flow can be expressed in any engineering unit of measure for any time base such as gallons/minute, liters/second, barrels/hour, etc.

To determine the Rate Scale Factor (Program Mode #4), use the following formula:

Rate Scale Factor =
(Seconds X Decimal Factor) / Transmitter Pulses per Unit

where:

Seconds is the number of seconds in the rate time unit. If you wish to read flow in units per minute, seconds would equal 60. If you wish to read flow in units per hour, seconds would equal 3600.

Decimal Factor determines the resolution of the reading. If you wish to read to the nearest 1/10 unit, the Decimal Factor would be 0.1.

Transmitter Pulses per Unit is the number from the chart below or the Tech Brief (ITB) for your particular transmitter meter combination. The chart is expressed in gallons and liters. If you wish to read in other units, use the appropriate conversion factor.

Before you program the Rate Scale Factor, you must set the Rate Decimal Point position (Program Mode #3). This decimal point will correspond to the decimal in the Rate Scale Factor number.

Example: You have a model 35 RCDL meter with a PFT2 transmitter that has a pulse output of 126.7 pulses per gallon. You wish to read rate of flow in gallons per minute.

(60 seconds X 1) / 126.7 pulses per gallon
= 60/126.7 = **0.473**(rate scale factor)

Step #1: Set the rate scale factor decimal point to X.XXX (Program mode #3)

Step #2: Set the rate scale factor to 0.473 (Program mode #4)

Step #3: Since we are reading in whole gallons, set program mode #5 (Rate Decimal Point) to "off".

		Transmitter Pulses per Unit chart			
		FT1 PFT2 PFT2E	FT2 PFT3 FT1E	FT420 PFT420	
Size (Inches)	Meter Model	Gallons	Liters	Gallons	Liters
5/8	SC-ER	160.0	42.3	320.0	84.5
3/4	SC-ER	132.9	35.1	265.8	70.2
1	SC-ER	43.4	11.5	86.9	23.0
1 1/2	SC-ER	19.1	5.0	38.2	10.1
2	SC-ER	10.0	2.6	20.1	5.3
1/2	OP	223.0	58.9	445.9	117.8
1/2	OP(FT1 only)	111.5	29.4	–	–
1	OP	76.6	20.2	153.3	40.5
2	OP	20.6	5.4	41.1	10.9
2	TURBO	*17.36	*4.6	34.8	9.2
3	TURBO	*12.4	*3.3	24.8	6.6
4	TURBO	*2.56	*0.7	5.2	1.4
6	TURBO	*1.08	*0.3	2.2	0.6
5/8	25 IND RCDL	198.4	52.4	396.8	104.8
3/4	35 IND RCDL	126.7	33.5	253.3	66.9
1	40 IND RCDL	89.8	23.7	179.6	47.4
1	70 IND RCDL	46.8	12.4	93.6	24.7
1 1/2	120 IND RCDL	23.8	6.3	47.6	12.6
2	170 IND RCDL	14.6	3.9	29.1	7.7

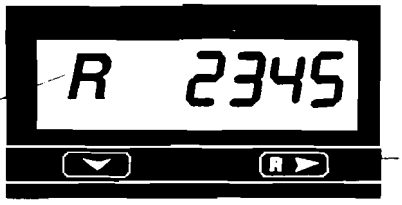
*If using a PFT3E transmitter, multiply number by 2.

Operation

By pressing the DOWN ▼ key during normal operation, the ER-8 will alternatively display the Flow Total or the Flow Rate. The Letter "R" on the left indicates that the Flow Rate is being displayed.

Total Display: Indicates the present count value, which is equal to the number of pulses received (since the last reset) multiplied by the Totalizer Scaler Value in Program mode #1.

Rate Display: Indicates the rate value, which is equal to the input frequency multiplied by the Rate Scaler Value in Program Mode #3. (If no pulses are received for 2 seconds, the rate value goes to zero.)



Reset Key: R▶

If the total value is being displayed, depressing this key will cause the value to be reset to 0 as long as program mode #6 is preset accordingly.

or

When the program input is active (see wiring) this key is used to select a menu item for editing.

▼ Down Key: Toggles the unit between the total and rate display. When the program input is active this key is used to scroll through the menu items. After a menu item has been chosen for editing, the down key is used to set the value for the currently selected (flashing) digit.

Programming

Note: Programming can be done only if terminals 1 and 5 are connected (together)

• **Step 1**- Toggle the ▼ key until the desired program appears on the screen (1 through 6).

• **Step 2**- Once the desired program is selected, pressing the R▶ key will either cause the left most digit of that value to flash (scale factors modes 1 & 4), or it will change the parameters for the other programming modes (decimal point position and totalizer reset)

• **Step 3**-On program modes 1 & 4 use the R▶ and ▼ keys in combination to choose individual digits and change their value.

Note that on program modes #1, #4 & #6 you can advance to the next program mode only if a digit is not flashing. Use the R▶ key until the display is not flashing.

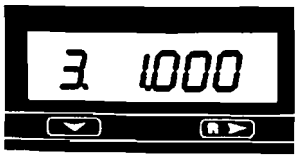
After all programming is complete, remove the connection between terminals 1 and 5 in order to insure that the unit is not reprogrammed by mistake.

Mode #1: Totalizer Scaler: Multiplies the input pulses by this number (Programmable from 0.0001 to 99.9999) and displays the results as the totalizer value.

Mode #4: Rate Scale Factor: Multiplies the input pulses by this number, which can be programmed in conjunction with the Rate Decimal Point for a number from 0.001 to 9999.

Mode #2:Totalizer Decimal Point: Sets the decimal point on the totalizer display from no decimal (off) to 0.00000

Mode #5: Rate Decimal Point: Sets the decimal point on the Rate of Flow display from no decimal (off) to 0.000. You can also program the display to have a dead zero (----0), for a 5 digit display with the least significant digit always being "0".



Mode #3: Rate Scale Factor Decimal Point: Sets the decimal point in the Rate Scale Factor number from no decimal to 0.000.

Mode #6: Front Panel Reset Enable: When programmed "on" the R▶ key will reset the totalizer to zero when depressed. When programmed "off" the totalizer can only be reset through the remote reset input (see wiring)

PROBLEM	POSSIBLE CAUSES	REMEDIES
Screen is blank	1. Battery is dead.	1. Replace battery.
Will not count in totalizer mode	1. Improperly programmed. 2. Broken or defective wiring. 3. Improperly connected. 4. Transmitter defective.	1. Check programming. 2. Check wiring. 3. Check connections. 4. Repair or replace transmitter.
Will not indicate rate of flow	1. Improperly programmed. 2. Improperly connected. 3. Transmitter defective.	1. Check programming. 2. Check connections. 3. Repair or replace transmitter.
Cannot program	1. Program enable jumper is not installed or installed improperly.	1. Install jumper.
Cannot reset from front panel	1. Reset enable is not programmed.	1. Reprogram mode #6 to ON.
Erroneous readings	1. Improperly programmed. 2. Defective transmitter.	1. Check programming. 2. Repair or replace transmitter.

For further assistance, call our Technical Support Staff at 414-355-0400.

Field Calibration

Field calibration consists of determining the exact transmitter pulse output per unit of measure for your particular meter/transmitter combination and then using this value as the transmitter pulse output value when calculating the counter and time base values on page 4.

The procedure is as follows:

1. Set the totalizer scale factor to "1".
2. Set the totalizer Decimal Point to "off".
3. Reset the counter to "zero".
4. Run fluid into a weigh tank or calibrated vessel.
5. Determine number of pulses per gallon by dividing indicator reading by number of gallons of fluid in the vessel. Use this value for your calculations.

Example:
You programmed the indicator for calibration and connected the outlet of a 1" OP meter to a calibrated vessel. You opened the valve and allowed fluid to flow into the vessel. You determined that there was 22.35 gallons of fluid in the vessel. The reading on the indicator is 1720.

1720 / 22.35 = 76.95

The transmitter output is 76.95 pulses per gallon. Use 76.95 when calculating the Totalizer Scale Factor on page 5.

Scope of this manual

This manual contains information concerning the installation, operation and maintenance of the Badger ER-8 indicator. To ensure proper performance, the instructions given in this manual should be thoroughly understood. Retain the manual in a readily accessible location for future reference.

Installation, wiring and programming of the ER-8 is simple and straight forward. This manual is designed so as to provide you with a step by step guide for this purpose.

Examples are provided only to facilitate programming. Your specific application will most likely require a different set of numbers for proper programming.

The troubleshooting section attempts to illustrate the most common problems that can be encountered, their most likely cause and the recommended solution. If a problem persists, please contact our technical support group at:

Badger Meter, Inc.
Industrial Division
1-414-355-0400

General Information

The ER-8 is an external or battery powered indicator that displays rate of flow and total flow. It has independent programmable scale factors for rate and totalization, allowing you to program these displayed values in different but meaningful engineering units, such as gallons per minute and total gallons.

The supertwist LCD display with 8 digits for total, and 4 digit plus legend for rate, provides easy viewing at a glance. For conditions where ambient light is poor, the display can be backlit by connecting an external DC (10-28 VDC) power supply. A single unit can accept NPN or dry contact inputs for low or high speed applications.

Powered by either one or two replaceable 3V Lithium batteries, this unique design allows for a new battery to be installed before removing the old one, thereby retaining count total and program data. A low battery indicator appears on the screen to provide a warning a couple of weeks before the end of battery life. If two batteries are used simultaneously, the individual expected life doubles to 10 years.

Setup is quick and easy as the two front panel keys are used to scroll through and preset values in all program mode choices.

Specifications

Count Input (Terminal 2):
Type: NPN Signal, or Contact Closure
Count Speed: NPN-280Hz max., Contact-95Hz max.
Logic: Low < 1.0 VDC. High > 2.0 VDC.
Minimum Pulse Width: NPN-1.78 micro seconds, Contact-5ms
Maximum Input: 28VDC
Impedance: 1 M to battery

Front Panel Enable Input (Terminal 5)
Type: NPN Signal, or Contact Closure: level sensitive
Maximum Input: 28 VDC

Remote Reset Input (Terminal 4)
Type: NPN Signal, or Contact Closure: edge sensitive
Frequency Response: 30 Hz (50% duty cycle)
Maximum input: 28 VDC

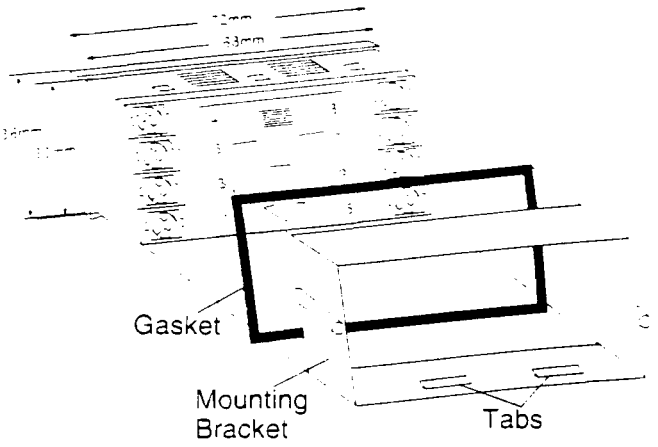
Power Source:
Type: Single 3V Lithium battery with dual optional (Battery P/N 62576-001)
Expected Life: 1 battery-5 years, 2 batteries-10 years
Low Power Indicator: "Low Bat" flashes on display approx. 2 weeks prior to end of battery life

Display:
Type: Supertwist LCD for use with or without backlighting
Number: 8 digits count value, 4 digits (plus dead zero) for rate value
Height: 12mm (.472")
Backlighting: Green Illumination over viewable area with a 10 to 28 VDC supply (Terminal 8)

Physical:
Dimensions: 36mm x 72mm, 38mm deep
1.417in x 2.835in. 1.496 in. deep
Mounting: Panel Mount (mounting bracket supplied)
33mm x 68mm (+ 0.3mm) panel cutout
1.299in x 2.677in. (+ 0.012in) panel cutout
Connections: Screw terminals
Weight: Approximately 13 ounces

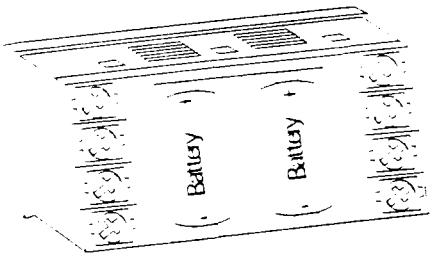
Operating Temperature:
Indicator: 32° F (0° C) to 140° F (60° C)

Installation



Panel Installation

Place the unit in the panel through a 33mm x 68mm cutout. Slide the included gasket over the rear of the unit, then slide the panel mount bracket into place so that the 4 tabs catch in the grooves on the top and the bottom of the unit (the bracket should be oriented so that the tabs are on the side nearest the panel). Use the provided panel mount screws to tighten the bracket until there is a secure seal against the gasket. Do not over tighten.

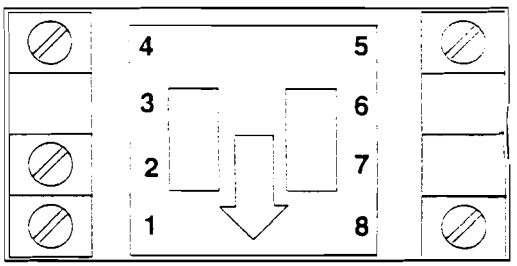


Battery Installation

The unit is shipped with one battery, which is not installed. Remove the battery cover by pushing inward and down. Install the battery in either of two slots. The unit runs on a single battery, and the second slot is provided to allow for installing a new battery before removing the old one, retaining count total and program data. The unit can also be run on two batteries to extend the battery life to 10 years. Once the battery is in place the unit will go into a self test mode, and all the segments on the LCD display will be illuminated. The self test mode is exited by depressing the R key, which will then display the model number (5). Depress R again to ready the unit for operation.

Wiring Instructions

1. DC Common
2. Count Input - NPN Signal 280 Hz max. or Dry Contact 95 Hz max.
3. Not used.
4. Remote Reset - Resets count value when switched to common.
5. Front Panel Program Enable - allows access to program mode when connected to common.
6. Not used.
7. Not used.
8. DC Supply Input - 10 to 28 VDC for backlighting.



TRANSMITTER CONNECTIONS

For connecting to Badger Meter transmitters, refer to the Technical Brief (ITB) for your specific transmitter, and the chart to the right. "Connections" refers to the wires or the terminal numbers depending on the transmitter model. The numbers in parenthesis refer to the terminal numbers on the ER-8. Connect the wire or terminal coming from the transmitter to the corresponding terminal number on the ER-8.

To connect a generic reed switch to the ER-8, connect one of the wires to terminal 1 on the ER-8. Connect the remaining wire to terminal 2.

To connect a generic NPN transmitter to the ER-8, connect the emitter to terminal 1 on the ER-8. Connect the collector to terminal 2.

Transmitter	Connections	
EPT1	Black (1)	Red (2)
FT1 (1/2" OP)	Black (1)	Black (2)
FT1	White (1)	White (2)
FT1E	Black (1)	Green (2)
FT2	White (1)	White (2)
FT420	Black (1)	White (2)
MSE1	Black (1)	Red (2)
MSE5	Black (1)	Red (2)
PEPT1	Black (1)	Red (2)
PFT1E	Term. #6(1)	Term. #5 (2)
PFT2	White (1)	White (2)
PFT2E	Black (1)	Green (2)
PFT3E	Black (1)	Green (2)
PFT3	White (1)	White (2)
PFT420	Black (1)	White (2)
PFT420/2	Black (1)	White (2)
PFT4E	Term. #6(1)	Term. #5 (2)
PM5	Black (1)	Red (2)

Pipes

ZDS

ZILOG DEVELOPMENT SYSTEMS, INC.

ADS N-

Corrugated exterior for superior strength

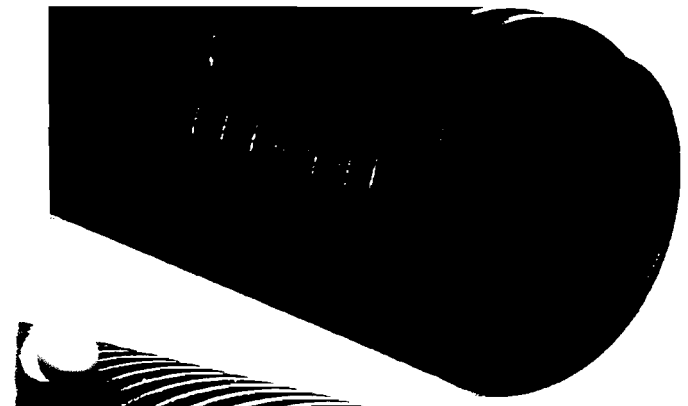
N-12 pipe is formed with a corrugated exterior for added strength. In each of its diameters, from 4" to 36", N-12 is a drainage pipe specifically designed to give excellent long-term performance.

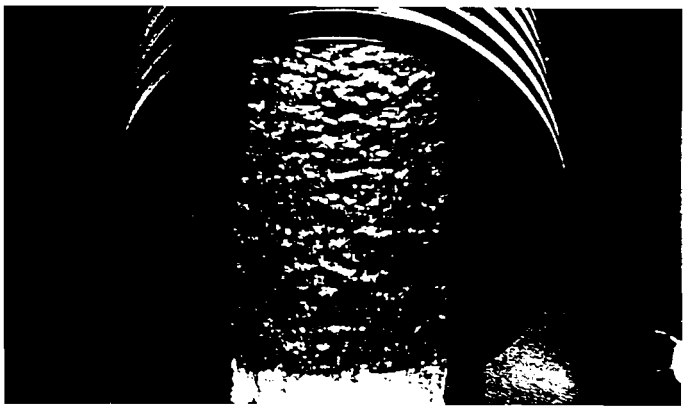
N-12 is suitable for use under both H20 and E80 live loads with fill heights in excess of 50 feet. In field research, tests show the pipe performing well at fill heights of more than 100 feet.

Smooth interior for superior flow

N-12 is the large-diameter, corrugated polyethylene pipe that meets the most demanding hydraulic requirements.

N-12 is available in diameters of 4" to 36" and is manufactured with a smooth interior to provide maximum flow capacity. So it's ideal for storm sewers and other applications where optimum hydraulics are essential.

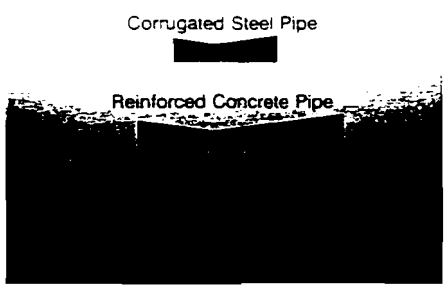




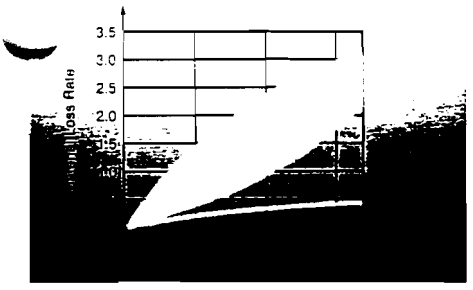
N-12™ pipe

The unmatched properties of polyethylene pipe

ADS N-12 possesses durability that is unique to ADS large-diameter polyethylene pipe. Manufactured with High Density Polyethylene (HDPE) resins, N-12 is highly resistant to chemical attack and corrosion. An inert material, polyethylene is immune to galvanic and electrochemical effects, and is unaffected by soils or effluents with a ph range from 1.5 to 14.



Durability studies have shown N-12 to be significantly more resistant to abrasion than traditional materials. In fact, ADS pipe has often successfully replaced conventional materials which had failed due to extreme abrasion. This has made ADS pipe popular as a liner to restore deteriorated metal culverts.

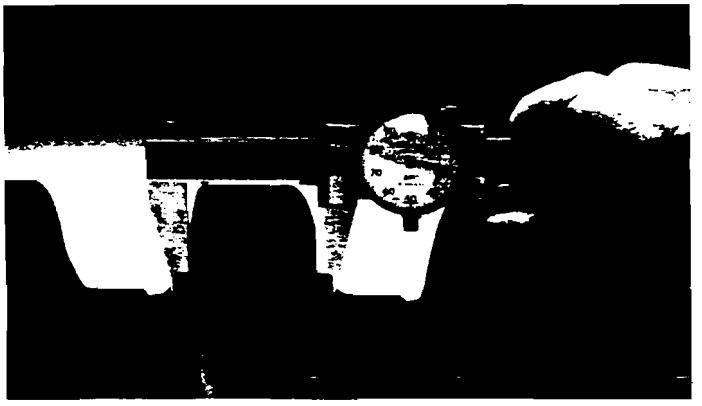


The highest standards of quality and performance

Advanced Drainage Systems is the nation's oldest and most experienced maker of polyethylene drainage products. Over the years. ADS has pioneered many of the advances that have become industry standards. At its more than 22 plants across the country, ADS maintains a comprehensive quality control program that extends through every stage of production to ensure that its polyethylene products meet applicable ASTM and AASHTO standards.

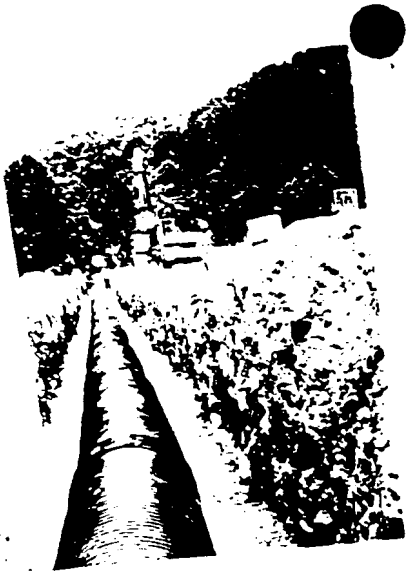
Today, Advanced Drainage Systems is America's leading manufacturer of quality corrugated polyethylene pipe and related products. Ever-increasing numbers of engineers and contractors are choosing ADS pipe for use in industrial, mining and public works projects — the toughest of applications.

N-12 delivers all the quality and performance the industry has come to expect from ADS, and puts it to work in storm sewer and other applications where hydraulics are important and durability is critical.



N-12 is chosen for the toughest applications

Calibrating the test devices



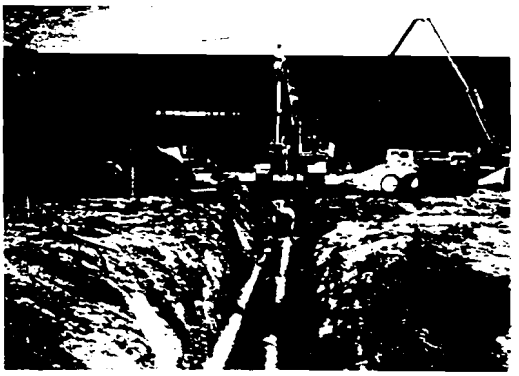
Ready for backfill and cover

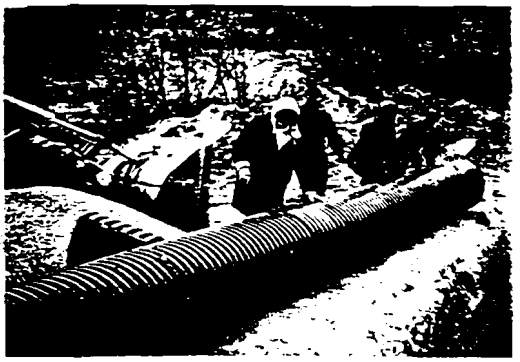
A site that provides 104' of cover

Deep burial project

In conjunction with the University of Massachusetts, the Pennsylvania Department of Transportation, the Federal Highway Administration and Mashuda Construction, Advanced Drainage Systems buried 24-inch polyethylene pipe under 104 feet of total cover on a highway site near Pittsburgh, Pennsylvania in 1987. Electronic and hydraulic systems are monitoring pipe performance, including pipe wall strain and compression, pipe deflection and shape, plus soil pressure and strain, all over a 5-year period.

Results to date indicate that, under the tremendous soil pressure, the pipe is deflecting at the same percentage of strain as the surrounding soil. This means the pipe is transferring the load to the surrounding soil. The Federal Highway Administration has become involved in the sponsorship of the test and will be publishing subsequent results.





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HDPE N- in its ease design fle site adapt dard 20' le posi cut c ditions. Pl accommo ect desigr its diamet 10, 12, 15, 36 inches

The new storm drain will sit at the base of a landscaped median

N-12 will withstand the corrosive environment

N-12 won't misalign in sandy soil

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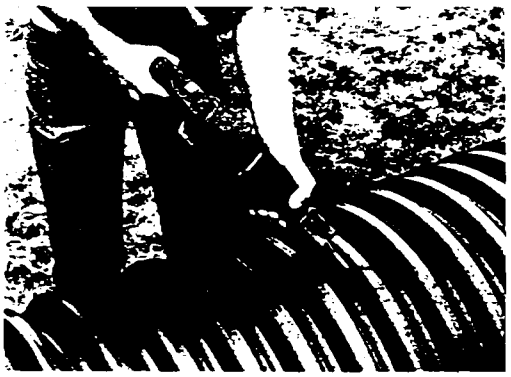


Ocean City, Maryland Highway Project

A project by the Maryland Department of Transportation involved construction on a 17,500-foot-long median strip to divide the six lanes of State Route 528. A significant problem to overcome was the east/west flow of storm-water over the road's surface, causing occasional traffic hazards. Designing a quality storm sewer system was vital to ensure that water would drain quickly from the highway to Assawoman Bay.

A high-density polyethylene pipe was chosen as the only material that would withstand the elements in this oceanside site. Past experience demonstrated that concrete pipe laid in the area's sandy soil misaligned, which eventually caused collapsed overburden and erosion of beaches. Engineers also decided against specifying steel pipe because the center line of the pipe is set at the low mean tide of the surrounding bay, so saltwater would stand in the storm sewer for at least half of every day. This would cause steel pipe to corrode.

Hydraulics were also an important consideration. ADS N-12 was specified for the sewer pipe, because of its smooth hydraulic interior and polyethylene properties. More than 16,500 feet of N-12 was ordered for the project in diameters of 12, 15, 18 and 24 inches and lengths of 20 feet. The pipe was manufactured in ADS's plant in Montezuma, Georgia.

Specifications an

Applicable Specifications and Installation Guidelines

1. ASTM F 405, Standard Specification for Corrugated Polyethylene Pipe and Fittings.
2. ASTM F 667, Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
3. AASHTO M 252, Standard Specification for Polyethylene Corrugated Drainage Pipe.
4. AASHTO M 294, Standard Specification for Corrugated Polyethylene Pipe, 12" to 36" diameter.
5. ADS Installation Guidelines for Culvert and Other Heavy-Duty Drainage Applications.

ADS corrugated polyethylene pipe is a semi-rigid conduit. When properly installed, ADS pipe has excellent compressive load bearing strength. It is suitable for use under H20 and E80 live loads, or with fill heights in excess of 50 feet. (For fill heights greater than 60 feet, ADS regional engineers are available for technical assistance.) To ensure maximum performance, ADS pipe should be installed in accordance with the following recommendations:

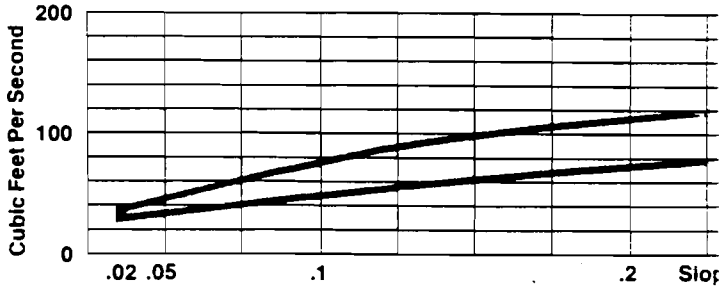
stallation Recommendations

1. Crushed stone, gravel or compacted soil backfill material should be used as the bedding and envelope material.
2. The corrugated pipe should be laid on grade, on a layer of bedding material. If native soil is used as the bedding and backfill material, it should be well compacted in six inch layers under the haunches, around the sides and above the pipe to the recommended minimum height of cover.
3. Either flexible (asphalt) or rigid (concrete) pavements may be laid as part of the minimum cover requirements.
4. Site conditions and availability of bedding materials often dictate the type of installation method used.
5. The load bearing capability of flexible conduits is dependent on the type of backfill material used and the degree of compaction achieved. Crushed stone and gravel backfill materials typically reach a compaction level of 90-95% AASHTO standard density without compaction. When native soils are used as backfill material, a compaction level of 85% is required. This is the same minimum compaction that is recommended by all drainage pipe manufacturers and can be achieved by either hand or mechanical tamping.

Two types of installations are recommended for H-20 live loads — the heaviest legal highway loads. These are the trench and open ditch installations. The minimum height of cover recommendations are the same for both conditions.

ADS Pipe Hydraulics

24" Diameter



ADS Recommended Manning's "n" For Desigr

Pipe Diameter	ADS Corrugated Polyethylene	*ADS-N-12 Polyethylene*
4-6-8-10-12"	.018	*.010*
15"	.018	*.010*
18"	.020	*.010*
24"	.020	*.010*
30"	.020	*.010*
36"	.020	*.010*

*ASCE Manual and Report on Engineering Practice #37

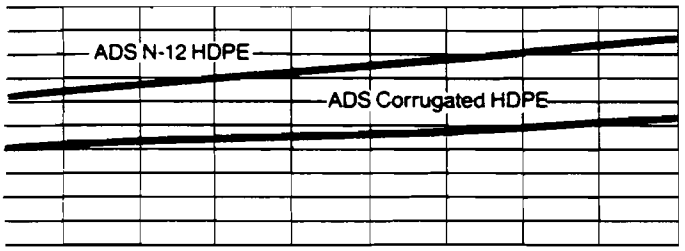
ADS N-12 Pipe Stiffness

Pipe Diameter	Minimum Pipe Stiffness Pounds/Inch/Inch
4-6-8 Inches	60
10 Inches	56
12 Inches	45
15 Inches	42
18 Inches	40
24 Inches	34
30 Inches	28
36 Inches	22

Weight Comparison Pounds/Linear Foot

Inside Diameter (inches)	ADS Corrugated HDPE Pipe	Clay or Concrete	Corrugated Metal
10"	2.0	50	9.0
12"	2.5	79	10.5
15"	3.1	103	12.9
18"	6.6	131	15.8
24"	13.8	217	19.4
30"	18.0	384	30.0
36"	22.0	524	36.0

Technical Data



	Concrete Pipe*	Corrugated Steel Pipe*
	.011-.015	.022-.026
	.011-.015	.022-.026
	.011-.015	.022-.026
	.011-015	.022-.026
	.011-.015	.022-.026
	.011-.015	.022-.026

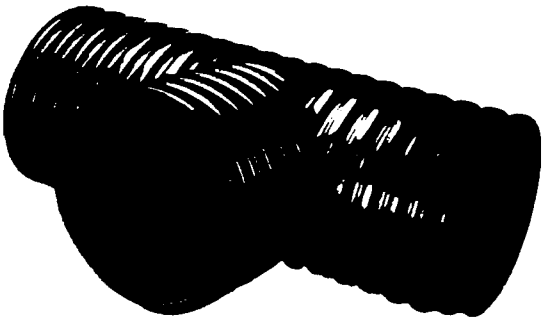
Height of Cover Table for ADS Culvert Pipe

– Depth of Cover for Corrugated Polyethylene Pipe
– H20 or E80 Live Load
– Pipe Manufactured to AASHTO M-294

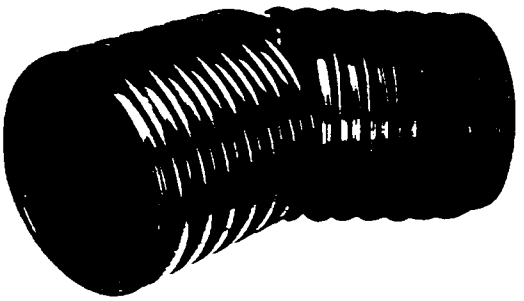
Diameter (inches)	Minimum Cover H20 (inches)	E80 (inches)	Maximum Cover (feet)
4-6-8-10-12"	12	24	58
15"	12	24	59
18"	12	24	62
24"	12	24	61
30"	12	24	61
36"	12	24	61

Notes:
1. Cover limitations calculated using load factor design per AASHTO procedures.
2. Soil density of 100#/cu. ft. is assumed. Backfill around the pipe must be compacted to a density of 90% per AASHTO T-99.
3. Use reasonable care in handling and installation.
4. Cover limitations are measured from the top of the pipe.

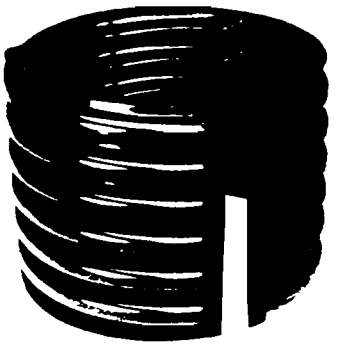
N-12 Fabricated Tee Fitting



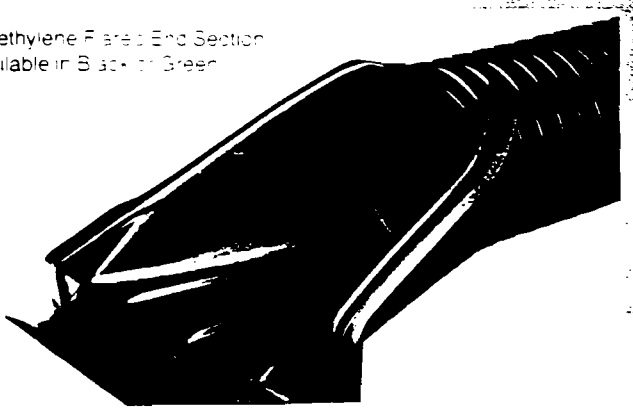
N-12 Fabricated Elbow Fitting



N-12 Coupler



Polyethylene Flared End Section
(Available in Black or Green



Backing top quality products with top quality service

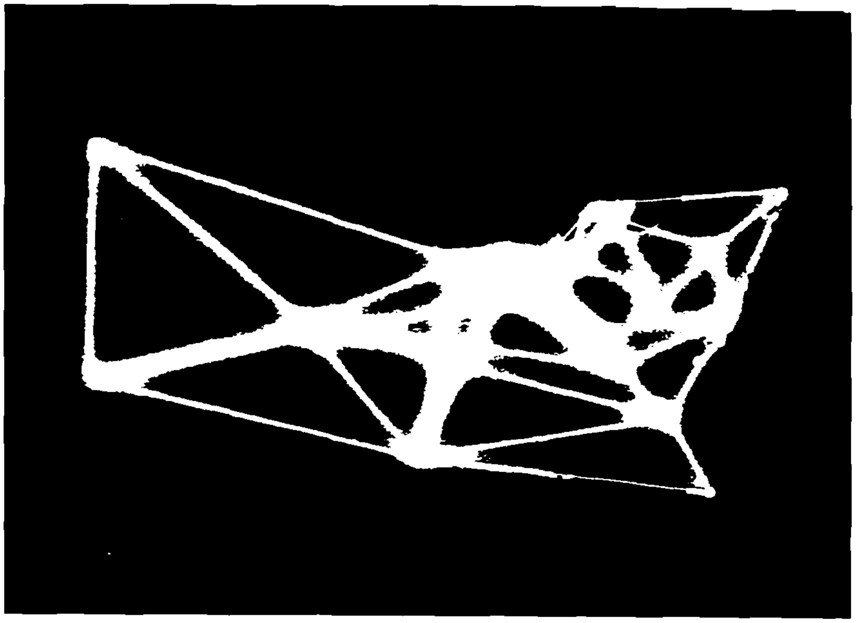
Advanced Drainage Systems manufactures the highest quality polyethylene pipe products, plus a complete line of fittings and couplings that simplify installations for even the most complex projects.

In addition, ADS backs its products with a service network designed to meet customer needs. The ADS network includes a nationwide sales force, 11 regional sales offices, a large field engineer group and dealers and distributors nationwide.

Over the years, ADS has built a tradition of customer satisfaction by providing specialized services to meet the needs of American agriculture, road building, mining and construction.

ADS commitment to service includes providing fast, reliable delivery. ADS operates a large fleet of trucks that are driven by ADS employees who are dedicated to delivering products on time, every time.

Through its manufacturing, sales and distribution network—the most extensive in the industry—ADS is never out of reach.



Custom trailers featuring ADS's unique remote control unloading system make on-site delivery easy and safer than conventional methods.

Engineers and contractors across the nation rely on Advanced Drainage Systems for the combination of products and service that has made ADS America's leading producer of corrugated polyethylene pipe.

ADS Nationwide Sales and Manufacturing Network

CALIFORNIA	
Madera	209-674-0903*
Madera	209-674-0054
COLORADO	
Fort Collins	303-493-7234*
FLORIDA	
Longwood	407-788-1974*
Lakeland	813-665-8668
GEORGIA	
Montezuma	912-472-7556
ILLINOIS	
Monticello	217-762-9448*
Harvard	815-943-5477
IOWA	
Iowa City	319-338-3689*
Creston	515-782-8565
Eagle Grove	515-448-5101
Iowa City	319-338-9448
KENTUCKY	
Livermore	502-733-4324
Versailles	606-873-8046
MASSACHUSETTS	
Ludlow	413-589-0515*
MICHIGAN	
Owosso	517-725-789[illegible]
Owosso	517-723-520[illegible]
NORTH CAROLINA	
Charlotte	704-527-0137*
Rowland	919-422-3303
OHIO	
London	614-852-4067*
London	614-852-9554
Napoleon	419-599-9565
Wooster	216-264-4949
PENNSYLVANIA	
Muncy	717-546-7686
TENNESSEE	
Brentwood	615-373-9964*
TEXAS	
Ennis	214-875-6591
VIRGINIA	
Buena Vista	703-261-6131
WASHINGTON	
Washougal	206-835-8522*

*Regional Sales Office

J.C. Smith Co.
Syracuse NY.
428-9903

ADVANCED DRAINAGE SYSTEMS, INC.

Corporate Office/3300 Riverside Drive, Columbus, Ohio 43221 (614) 457-3051

Chevron Plexco

Application Note No. 8

System Testing

Pressure Testing Considerations

Guidelines for All Test Methods

Leak testing may be conducted if specified by the responsible Project Engineer or Owner.

Joints may be exposed to inspect for leakage.

Testing may be conducted on the full system, or in sections. The test section size is determined by test equipment capability. If the pressurizing or pumping equipment is too small, it may not be possible to complete the test within allowable testing time limits. If so, higher capacity test equipment, or a smaller test section may be necessary.

Expansion joints and expansion compensators should be temporarily restrained, or isolated, or removed during the pressure test.

The temperature of the test medium and the pipe test section should be the same, and if possible, should be less than 100°F, (38°C). Before applying test pressure, allow time for the test medium and the pipe test section to equalize. At temperatures above 100°F (38°C), test pressure must be reduced. Contact Plexco/Spirolite for technical assistance with elevated temperature pressure testing.

Heat fusion joints must be completely cooled before pressure testing. See Plexco Bulletins 101 and 108 for fusion joining procedures.

CAUTION: Pipe system pressure testing is performed to discover unacceptable faults in a piping system. Pressure testing may cause such faults to fail by leaking or rupturing. This may result in catastrophic failure. Piping system rupture may result in the sudden, forcible, uncontrolled movement of system piping, or components, or parts of components.

WARNING: Pipe Restraint. The pipe system section under test and any closures in the test section should be restrained against sudden uncontrolled movement from catastrophic failure. Test equipment should be examined before pressure is applied to insure that it is tightly connected. All low pressure filling lines and other items not subject to the test pressure should be disconnected or isolated.

WARNING: Personal Protection. Take suitable precautions to eliminate hazards to personnel near lines being tested. Keep personnel a safe distance away from the test section during testing.

WARNING: Test Equipment should be examined before pressure is applied to insure that it is tightly connected. All low pressure filling lines and other items not subject to the test pressure should be disconnected or isolated.

References

The following reference publications provide pressure testing information: *ASME B31.1* Power Piping, Section 137, Pressure Tests, and *PPI TR-31* Underground Installation of Polyolefin Piping, Section 7, System Testing. Plexco/Spirolite Technical Personnel should be consulted before using pressure testing procedures other than those presented here. Other pressure testing procedures may or may not be applicable depending upon piping products and/or piping applications.

Test Pressure

Test pressure may be limited by valves, or other lower pressure rated components. Such components may not withstand the required test pressure. They should be either removed, or isolated from the test section to avoid possible damage, or failure of these devices. Isolated equipment should be vented.

- For pressure piping systems the maximum allowable test pressure is 1-1/2 times the system design operating pressure at the lowest point in the section under test, provided that test pressure limiting components or devices have been isolated, or removed from the test section.
- If a lower pressure rated device or component cannot be removed or isolated, then the test pressure is limited to the pressure rating of that device.
- For non-pressure, low pressure, or gravity flow (intermittent pressure) systems, consult Plexco/Spirolite Technical Personnel to determine maximum allowable test pressure.

Test Duration

For any test pressure from 1 to 1-1/2 times the system operating design pressure, the total test time including initial pressurization, initial expansion, and time at test pressure, must not exceed eight (8) hours. **If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, then allow it to "relax" for at least eight (8) hours before bringing the test section up to test pressure again.**

Table 1 Test Phase Make-up Amount

Nominal Pipe Size (in.)	Gallons/100 ft. of Pipe		
	1 Hour Test	2 Hour Test	3 Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.5
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	8.0	16.2	24.3
36	9.0	18.0	27.0

HYDROSTATIC TESTING

General

PIPING SYSTEM PRESSURE TESTING USING HYDROSTATIC PROCEDURES IS RECOMMENDED. The preferred testing medium is clean water, but other liquids may be suitable. The test section should be completely filled with liquid. Take care to bleed off any trapped air. While the test section is filling, venting at high points may be necessary to purge air pockets. Venting may be provided by loosening flanges, or by using equipment vents. Retighten any loosened flanges before applying test pressure.

Monitored Make-up Water Test

The test procedure consists of initial expansion, and test phases. During the initial expansion phase, the test section is pressurized to the test pressure, and enough make-up liquid is added each hour for three (3) hours to return to test pressure.

The test phase follows immediately, and may be one (1), two (2), or three (3) hours. At the end of the test time, the test section is returned to test pressure by adding a measured amount of liquid. If the amount of make-up liquid added does not exceed Table 1 values, leakage is not indicated.

Non-monitored Make-Up Water Test

The test procedure consists of initial expansion, and test phases. For the initial expansion phase, makeup water is added as required to maintain the test pressure for three (3) hours. For the test phase, the test pressure is reduced by 10 psi. If the pressure remains steady (within 5% of the target value) for an hour, no leakage is indicated.

PNEUMATIC TESTING

Guidelines

CAUTION: Pneumatic testing should not be used unless the Owner and the responsible Project Engineer specify pneumatic testing or approve its use as an alternative to hydrostatic testing.

PIPING SYSTEM PRESSURE TESTING USING PNEUMATIC TESTING IS NOT RECOMMENDED.

WARNING: Compressed air or any pressurized gas used as a test medium may present severe hazards to personnel near lines being tested. take extra personnel protection precautions when a gas under pressure is used as the test medium.

*WARNING: Explosive Failure. **Piping system rupture during pneumatic pressure testing may result in the explosive, uncontrolled movement of system piping, or components, or parts of components. Keep personnel a safe distance away from the test section during testing.***

Pneumatic testing (testing with a gas under pressure) should not be considered unless one of the following conditions exist:

- when the piping system is so designed that is cannot be filled with liquid; or
- where the piping system service cannot tolerate traces of a liquid testing medium.

The testing medium should be non-flammable and non-toxic. The test pressure should not exceed the maximum allowable test pressure for any non-isolated component in the test section.

Leaks may be detected using mild soap and water solutions (detergents should be avoided), or other acceptable leak detecting fluids, applied to the joint. Bubbles indicate leakage. After leak testing, all soap solutions or leak detecting fluids should be rinsed off the system with clean water.

High Pressure Procedure

For continuous pressure rated pipe systems, the pressure in the test section should be gradually increased to not more than one-half the test pressure, then increased in small increments until the required test pressure is reached. Test pressure should be maintained for ten (10) to sixty (60) minutes, then reduced to the design pressure rating, and held for such time as required to examine the system for leaks.

Low Pressure Procedure

For pipe and components rated for gravity flow, intermittent low pressure, or low pressure service, the required test pressure should be maintained for ten (10) minutes to one (1) hour, but not more than one (1) hour.

Leakage inspections may be performed during this time. If the test pressure remains steady (within 5% of the target value) for the test time, no leakage is indicated.

TEST PRESSURE RATINGS MUST NOT BE EXCEEDED.

INITIAL SERVICE TESTING

Guidelines

An initial service test may be acceptable when other types of tests are not practical, or when leak tightness can be demonstrated by normal service, or when performing initial service tests of other equipment. An initial service test may apply to systems where isolation or temporary closures are impractical, or where checking out pumps and other equipment affords the opportunity to examine the system for leakage prior to full scale operations.

Procedure

The piping system should be gradually brought up to normal operating pressure, and held at operating pressure for at least ten (10) minutes. During this time, joints and connections should be examined for visual evidence of leakage.

NON-TESTABLE SYSTEMS

Guidelines

Some systems may not be suitable for pressure testing. These systems may contain non-isolatable components, or temporary closures may not be practical. Such systems should be carefully inspected during and after installation. Inspections such as visual examination of joint appearance, mechanical checks of bolt for joint tightness, and other relevant examinations should be performed.

Plexco/Spirolite™
1050 Busse Highway, Suite 200
Bensenville, IL 60106
(708) 350-3700

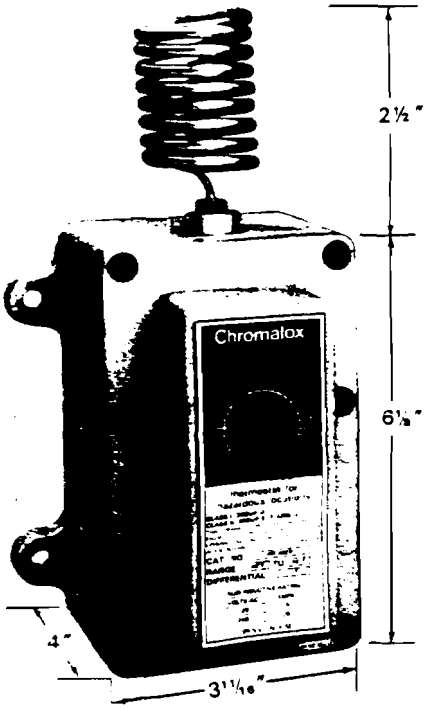
Thermostat

Chromalox®

Installation and Operating Instructions

SERVICE REFERENCE			
DIV. 4	SEC. WR	NUMBER	3013E
SALES REFERENCE	(Supersedes PK435-4)		PK435-5
			161-048630-001
DATE	JUNE, 1994		

Chromalox Explosion Proof Room Thermostat Type WR-80EP



WR-80EP
40 to 90°F.
UL Listed

Specifications — Table A

Catalog No.	Temp. Range °F.	Maximum Rating					
		120-v a-c	†115-v d-c	240-v a-c	†230-v d-c	277-v a-c	480-v a-c
WR-80EP	40-90	25 amps or 3000 total watts	125va pilot duty (use with d-c contactor)	22 amps or 5280 total watts	125va pilot duty (use with d-c contactor)	18 amps or 5000 total watts	125va pilot duty (use with a-c contactor)

†d-c ratings not UL listed

GENERAL

Positive accuracy, long and reliable service, 3° differential. Heavy-duty, single stage, SPST line voltage snap-acting switch. Patented hydraulic element. WR-80EP has external, coiled sensing element and a low position which drops control point to keep heater off.

Uses — Automatically controls room temperature by turning electric air heaters on and off. Can be used to control the air heaters directly, within thermostat rating. For higher ratings use thermostat with magnetic contactor. Place thermostat on inside wall, away from undue heating or cooling influences, about 4 feet above the floor. The explosion proof WR-80EP is suitable for Class I, Group D and Class II, Groups E, F, and G locations.

NOTICE: Type WR thermostats are designed for temperature control service only. Because they do not fail safe, they should not be used for temperature limiting duty.

WARNING: *Users should install adequate back-up controls and safety devices with their electric heating equipment. Where the consequences of failure may be severe, back-up controls are essential. Although the safety of the installation is the responsibility of the user, Chromalox will be glad to assist in making equipment recommendations.*

Principle of Operation — Control action of these thermostats is provided through the principle of liquid volume change. With a variation in temperature, the liquid in the sensing element expands or contracts, causing a bellows to actuate the switching mechanism.

Housing — The control housing and cover assembly is of heavy-duty cast aluminum.

MOUNTING

Note: Do not mount control where it will be subject to vibration, shock, grease, dust, lint or corrosive vapors. Do not mount adjacent to a large magnetic contactor, as vibration and shock will cause thermostat to interact erratically — resulting in chattering of the contactor.

W' NG: *Do not twist or uncoil the coiled element on top of the .*

The proper location of a heavy duty room thermostat is important to assure good performance.

1. Locate where air circulates freely.
2. Never install on or near outside wall.
3. Keep away from windows or doors.
4. Do not locate too close to strong light or other false source of heat, such as sunlight, steam lines, etc.
5. If electrical conduit leads into cooler or warmer room, plug up space around wires in the conduit with rock wool.

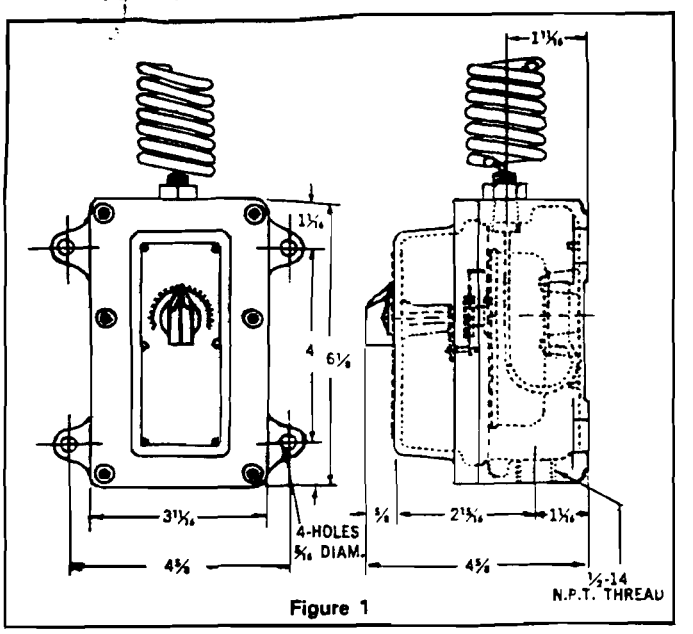


Figure 1

WIRING

WARNING: ***Hazard of electric shock. Disconnect all power before wiring or servicing this control.***

1. After a suitable location has been chosen for the control, remove the front cover by using a 3/16" Allen Head Wrench, (furnished with control) in the 6 cover screws.
2. Electric wiring to heater must be installed in accordance with National Electrical Code and with local codes. **WARNING:** *Use copper conductors only.*
3. Entrance for wiring is provided by one ½-14 NPT hole in the bot' of the housing. Wiring to control housing must be in rigid co also in accordance with National Electrical Codes (NEC) for hazardous locations. (See Figure 2)
4. Connect wires according to wiring diagrams (Figures 3 and 4).

Note: Electrical connections should be made with generous loops of wire — approximately 6" per lead.

Note: If load amperage or voltage rating exceeds switch rating, a contactor must be used. Contactor and wiring to be supplied by customer. (See Figure 4)

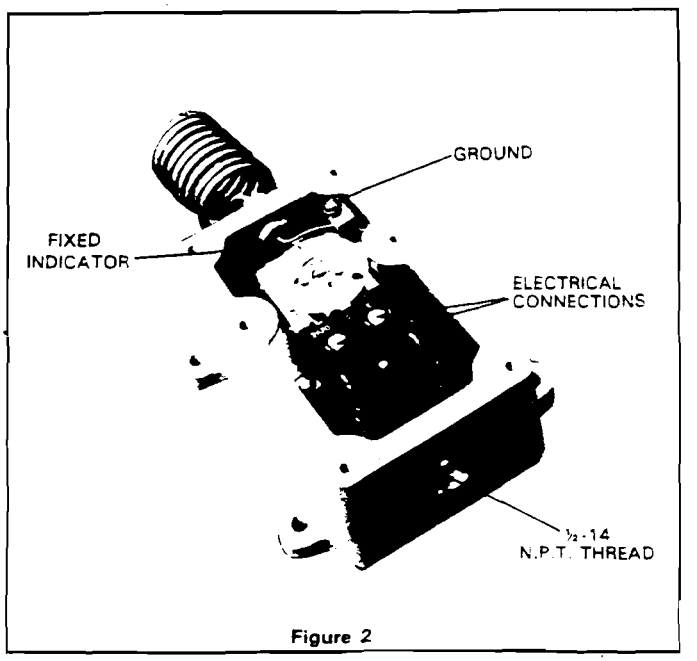


Figure 2

Replacing Cover

1. Set the internal dial and the external dial to the same setting so that the hole in the dial lines up with pin on the arm that is operated by the knob. (See Figure 2)
2. Replace 6 cover screws and tighten with Allen Wrench provided.

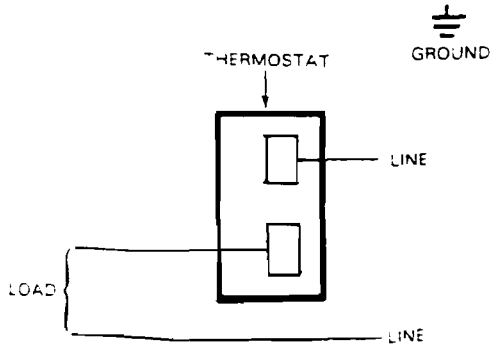


Figure 3 — Single phase loads when load does not exceed rating of thermostat.

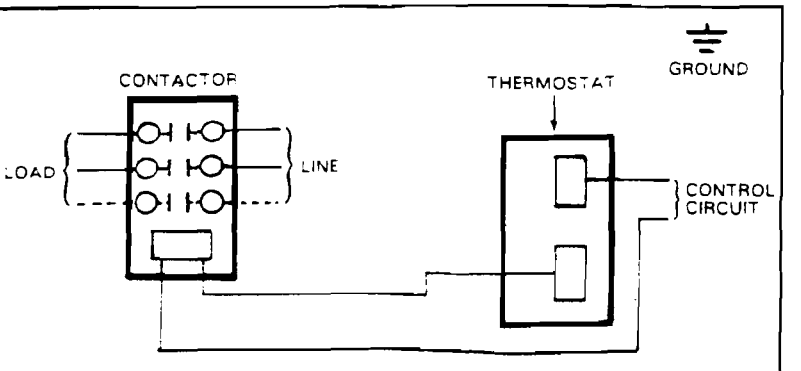


Figure 4 — Single phase loads when load exceeds rating of thermostat and three phase loads.

CALIBRATION

WARNING: ***Hazard of electric shock. Extreme care should be exercised during calibration adjustments because of shock hazard due to exposed electrical terminals.***

DANGER: ***Calibration will involve exposure of internal control terminals to ambient conditions during some part of the recalibration procedure. Combustible materials which cause hazardous conditions must not be present during recalibration process — otherwise explosion may result.***

WR-30EP thermostats are accurately calibrated at the factory so the dial setting correctly indicates the temperature at which the contacts open on temperature rise. If, as a result of damage in transit or for other reasons the room temperature differs appreciably from the dial setting, the calibration may be adjusted as follows:

1. Note temperature on a thermometer.
2. Set dial at highest temperature.
3. Turn dial slowly to lower temperature and stop when thermostat contacts open.
4. Remove cover using the 3/16" Allen Head Wrench as in #1 wiring.
5. Loosen two dial screws (Figure 2). Carefully turn the dial only to correct temperature setting as indicated by thermometer. Be sure the thermostat shaft is not moved during this operation.
6. Tighten the dial screws and replace thermostat cover. (See "Replacing Cover")

Dual-Seal Units

Two (2) Mechanical Shaft Seals are separated by an oil-filled seal chamber. If Lower seal begins to leak, Upper seal will still be lubricated by oil in the motor cover and is protecting the motor. Normal operation can continue until prompt replacement of Lower seal. Motor is now being temporarily lubricated by the water emulsion in the seal chamber.

Lubrication

Caution: Disconnect all electrical power when handling pump or controls.

Important: Submersible pump/motor units are oil-filled. On a regular schedule, depending on usage, check oil quantity and condition as follows:

Caution: If there has been leakage, the motor cover may be under pressure. Hold a rag over inspection plug to prevent splatter when loosening it. Take a sample of the oil with a plastic tube. If oil is emulsified (cream-like) or watery, it indicates a leak.

For Dual-Seal unit, lay unit on side and also make same checks of oil in lower seal chamber through its inspection plug.

Possible causes of leakage: loose inspection plug, loose cable entry, leak at O-ring joint(s), worn shaft seal(s).

Have problem corrected and motor cover cavity refilled to 90% full (1/2" minimum above motor).

For Dual-Seal Unit, the lower seal cavity must also be refilled to 90% full.

Limited Warranty

This warranty applies to all pumps and related accessories manufactured and/or supplied by Goulds.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the buyer or any subsequent owner during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A user who believes that a warranty claim exists must contact the authorized Goulds dealer from whom the equipment was originally purchased and furnish complete details regarding the claim. The dealer is authorized to adjust any warranty claims utilizing Goulds Customer Relations Department and its distributor organization.

This warranty excludes:

(a) Labor, transportation and related costs incurred by the consumer to make the allegedly defective equipment available to the dealer for inspection.

(b) Re-installation costs of repaired equipment.

(c) Re-installation costs of replacement parts.

(d) Consequential damages of any kind.

(e) Reimbursement for loss caused by interruption of service.

Problem Tracing Guide

PROBLEM	PROBABLE CAUSES	CORRECTIVE ACTION
Pump Will Not Shut Off **Note:** Before trouble shooting automatic control, check to see that pump operates on manual control. If it does, automatic controls are at fault. If not, fault is in pump or power supply.	Diaphragm Switch Weak rubber diaphragm Plugged vent tube Dirt or sediment lodged between retainer ring and rubber diaphragm causing contacts to remain closed	Replace switch Clear vent tube of any obstruction Clean area around rubber diaphragm
	Pump is air locked	Shut power off for approximately 1 minute, then restart. Repeat several times to clear air from pump. If system includes a check valve, a vent hole should be drilled in discharge pipe approximately 2' above discharge flange connection.
	Liquid inflow matches pump capacity.	Larger pump required.
Pump Runs But Does Not Discharge Liquid	Check valves installed backwards.	Check flow indicating arrow on check valve body to insure it is installed properly.
	Check valve stuck or plugged.	Remove check valve and inspect for proper operation.
	Lift too high for pump.	Check rating table.
	Inlet to impeller plugged.	Pull pump and clean.
	Wrong rotation.	Change rotation.
	Pump is air locked.	(See corrective action above)
Pump Does Not Deliver Rated Capacity	Lift too high for pump.	Check rating table.
	Low voltage, speed too low.	Check for proper supply voltage to make certain it corresponds to nameplate voltage.
	Impeller or discharge pipe is clogged.	Pull pump and clean. Check pipe for scale or corrosion.
	Impeller may be rotating in the wrong direction.	**Single Phase Units** — Shut off power and allow impeller to stop rotating. Turn pump on again, and pump should self-correct rotation. Long discharge pipe without check valve allows liquid to drain back to sewage basin, rotating impeller backwards. If pump starts while impeller is rotating in the wrong direction, it will continue to operate in that direction. **Three Phase Units** — Interchange any two (2) power lead connections.
	Impeller wear due to abrasives or corrosion.	Replace worn impeller.
Pump Cycles Continually	No check valve in long discharge pipe allowing liquid to drain back into basin.	Install a check valve in discharge line.
	Check valve leaking.	Inspect check valve for correct operation.
	Sewage basin too small for inflow.	Install larger size sewage basin.

GOULDS PUMPS
SENECA FALLS, NEW YORK 13148
Form No. 486.2S, Litho in U.S.A.

Ceiling Ventilator

CARNES®
CEILING VENTILATOR

MODELS
VCDB10 & VCDB15

READ AND SAVE THESE INSTRUCTIONS

WARNING

TO REDUCE THE RISK OF FIRE, ELECTRICAL SHOCK, OR INJURY TO PERSONS, OBSERVE THE FOLLOWING:

1. Use this unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.
2. Before servicing or cleaning unit, switch power off at service panel and lock service panel to prevent power from being switched on accidentally.
3. Installation work and electrical wiring must be done by a qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction codes and standards.
4. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent backdrafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and the local code authorities.

WARNING

5. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
6. Ducted fans must always be vented to the outdoors.
7. If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application.
8. Never place a switch where it can be reached from a tub or shower.
9. This unit must be grounded.

CAUTION

1. For general ventilating use only. Do not use to exhaust hazardous or explosive materials and vapors.
2. To avoid motor bearing damage and noisy and/or unbalanced impellers, keep drywall spray, construction dust, etc. off power unit.
3. Please read specification label on product for further information and requirements.

TYPICAL MOUNTING

1. **Provide Frame** - Provide a solid frame to assure lowest sound levels. See Figure 1 for typical installation.

Brackets are factory set for 1/2" ceiling thickness. Make sure that housing will be flush with finished ceiling.

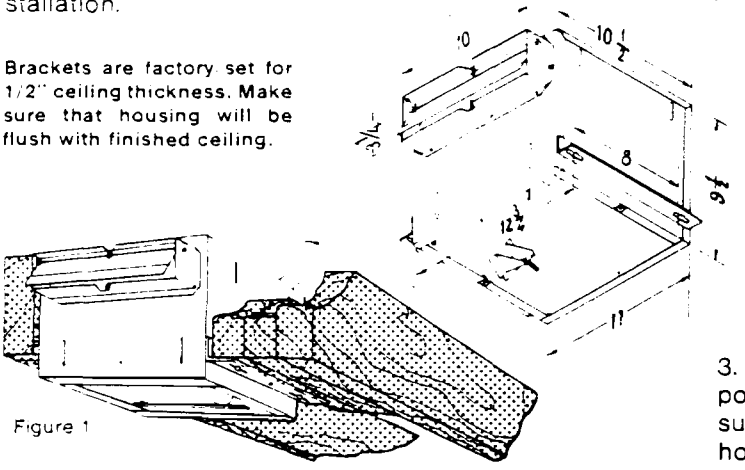


Figure 1

2. **Trace Keyhole Slots** - Hold unit against frame and trace keyhole slots in mounting brackets onto frame. Start screws provided in same end of all traced keyhole openings. Leave about 3/8" of screws projecting from frame. (Fig. 2)

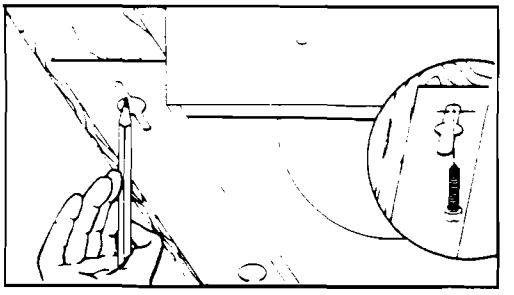


Figure 2

3. **Hang Unit** - Tighten mounting screws as firmly as possible to assure lowest sound levels. For additional support, fasten unit to frame with nail of screw through hole in center of each mounting bracket.

TYPICAL WIRING

SAFETY WARNING
TURN OFF PROPER 120 VOLT CIRCUIT AT THE SERVICE ENTRANCE BEFORE WIRING THE VENTILATOR.
ALL ELECTRICAL CONNECTIONS MUST BE MADE IN ACCORDANCE WITH LOCAL CODES, ORDINANCES, AND NATIONAL ELECTRICAL CODE. IF YOU ARE UNFAMILIAR WITH METHODS OF INSTALLING ELECTRICAL WIRING, SECURE THE SERVICES OF A QUALIFIED ELECTRICIAN.

4. **Wire Unit** - Remove wiring adapter plate, which is located on top of housing (See Fig. 9), and attach electrical cable with appropriate electrical connector. Fasten incoming ground wire (bare or green wire) to adapter plate with green ground screw provided. Connect white wire to white, black wire to black. (Fig. 3) Replace wiring adapter plate so that tab on housing slides through slot on plate. (See Fig. 9)

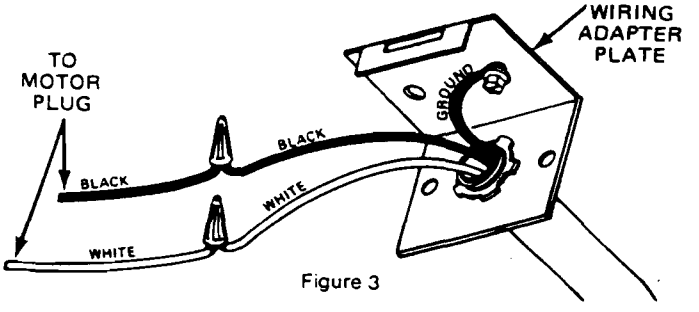


Figure 3

TYPICAL DUCTING

5. **Connect Ductwork** - Connect ductwork to damper/duct connector. (Fig. 4) Tape all joints with duct tape.

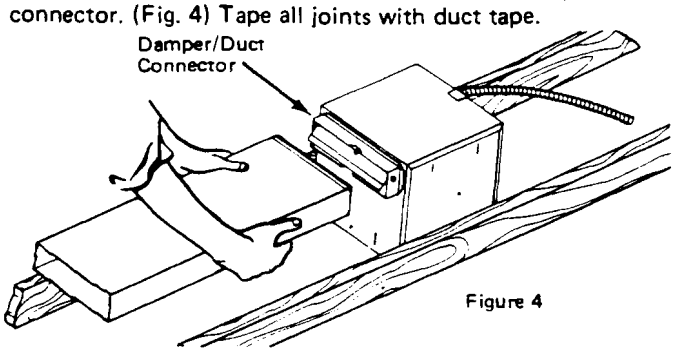


Figure 4

NOTE

MAKE SURE THAT BLOWER OUTLET MATCHES DAMPER POSITION ON VENTILATOR HOUSING.

HOUSING SHOULD BE FLUSH WITH FINISHED CEILING. SEE " To adjust brackets" IN "INSTALLATION OPTIONS" SECTION.

WHEN USING A TRANSITION TO CONNECT THE 3¼" x 10" DISCHARGE TO 6" ROUND DUCTWORK: MAKE SURE DAMPER FLAP OPENS FREELY INSIDE THE TRANSITION.

GRILLE MOUNTING

6. Install grille using screws provided. Do not over-tighten.

INSTALLATION OPTIONS

Mounting brackets may be adjusted and/or moved for various types of installations shown below.

To adjust bracket position, loosen 7/16" hex nuts and move brackets up or down. Re-tighten hex nuts securely. (Fig. 5)

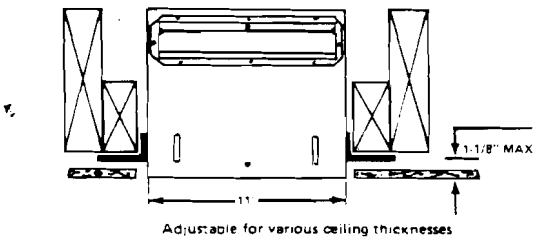


Figure 5

To move brackets, remove 7/16" hex nuts. Re-position brackets on different set of slots. Replace hex nuts and tighten securely. (Fig. 6)

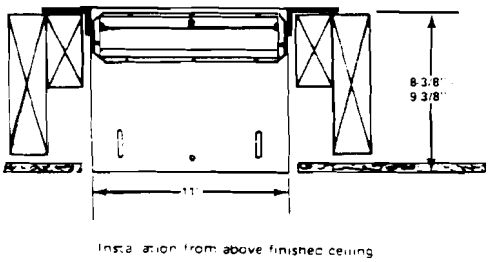


Figure 6A

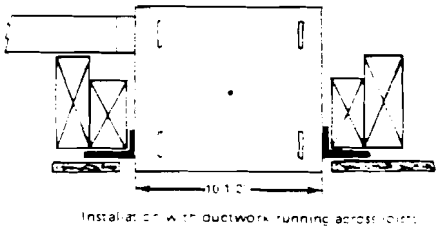


Figure 6B

Reverse brackets to give approximately 1" more clearance. Remove hex nuts, flip brackets over, and replace hex nuts. Tighten nuts securely. (Fig. 7)

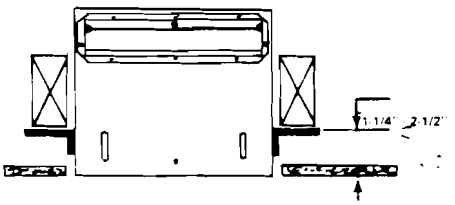


Figure 7A

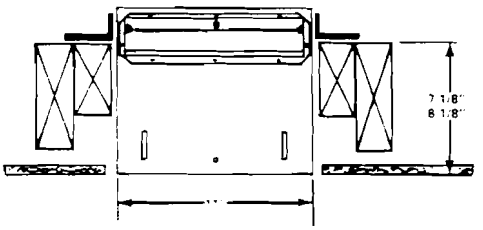


Figure 7B

For in-line installations, remove 7/16" hex nuts. Reposition brackets so that housing opening is at the side instead of the bottom. (Fig. 8)

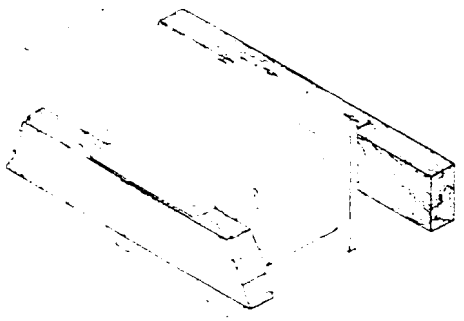


Figure 8

WIRING OPTIONS

If you do not have adequate access to wiring compartment from outside housing, wire unit from inside. Remove blower (described in "Vertical Ducting" section below.) Wiring compartment cover is fastened with two sheet metal screws.

Wiring may enter unit from top or side. To change wiring adapter plate position, remove sheet metal screws, flip plate over, and replace screws, Make sure that tab on housing slides through slot on plate. (Fig. 9)

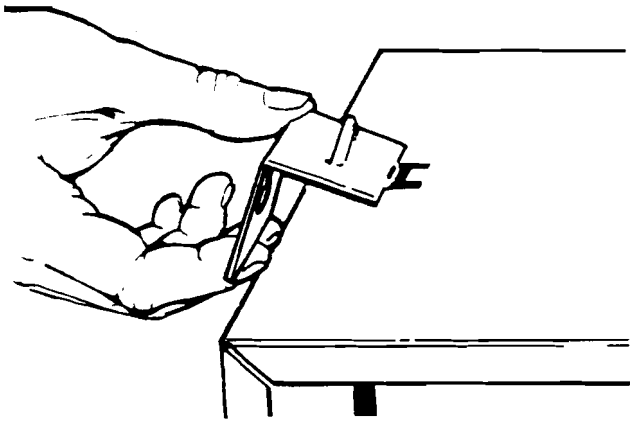


Figure 9

Unit may be installed with a variable speed switch to control fan speed and noise levels. Wire unit as shown in Figure 10.

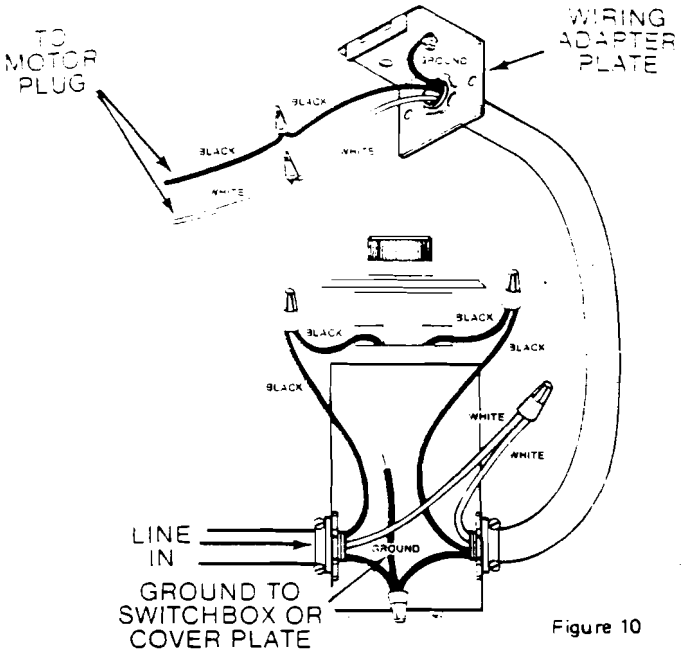
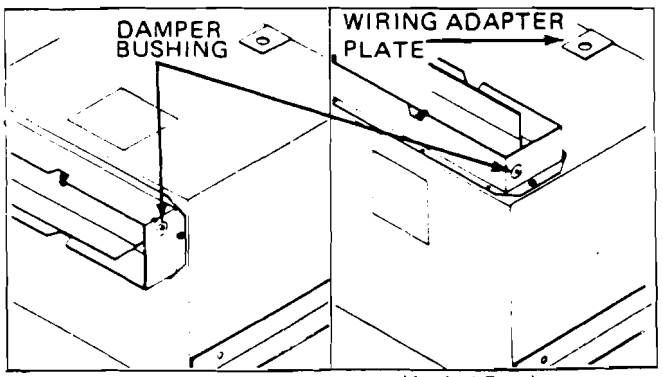


Figure 10

DUCTING OPTIONS

To duct ventilator vertically, change blower as follows:

a.) Remove and install damper on top of unit with damper bushings as shown. (Fig.11)



Horizontal Ducting (Unit is shipped in this position)

Vertical Ducting

Figure 11

b.) Unplug electrical connector from blower. Do not pull on plug wires. (Fig. 12)

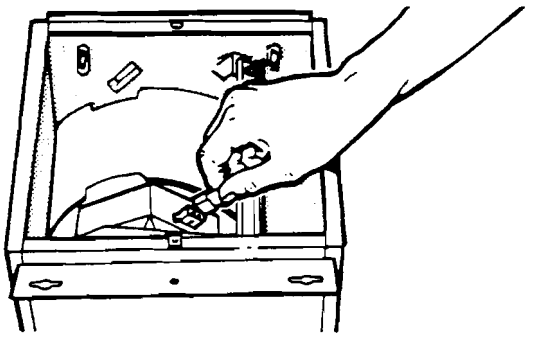


Figure 12

c.) Remove 7/16" hex nuts holding blower in place.

d.) Lift out blower and line up blower dishcarge with vertical opening. See Figure13. Do not grasp blower by blower wheel, as wheel may be damaged.

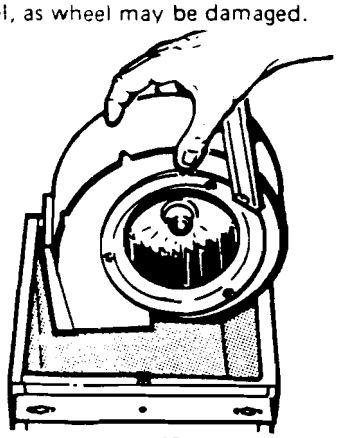


Figure 13

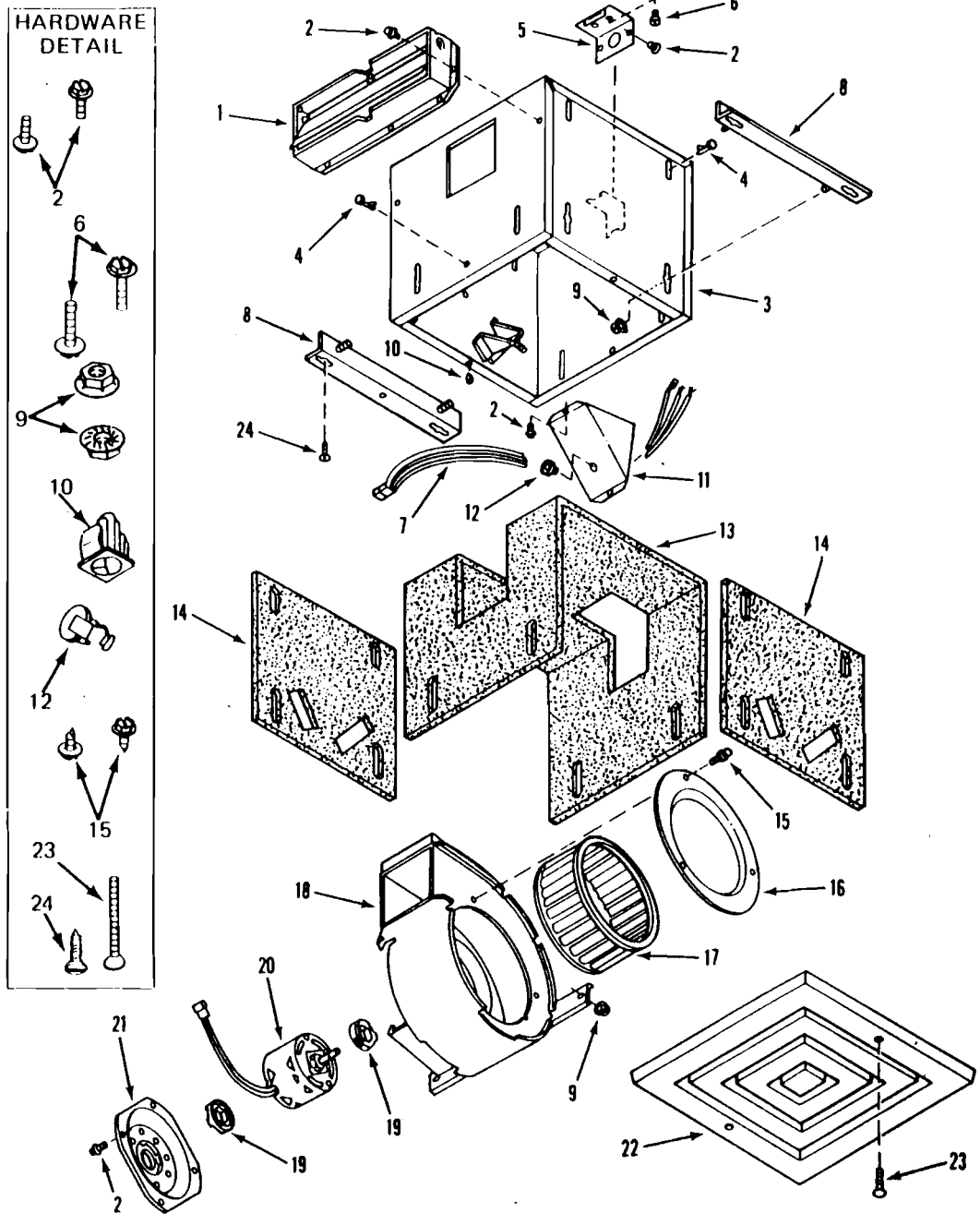
e.) Replace hex nuts and tighten securely.

f.) Plug in blower.

PARTS LIST - VCDB10 & VCDB15

KEY NO.	PART NUMBER	DESCRIPTION	QTY.
1	97005544	Damper Assembly	1
2	99170245	#8B x 3/8" Screw	10
3	97006017	Housing Assembly	1
4	99420466	Insulation Mounting Clip	4
5	98005512	Wiring Adapter Plate	1
6	99150471	#10-32 x 1/2" Ground Screw (Green)	1
7	97006039	Wiring Harness	1
8	97006061	Mounting Bracket Assembly	2
9	99260477	1/4-20 Whiz Nut	6
10	99420470	Grille Nut	2
11	98005513	Outlet Box Cover	1
12	99400035	Strain Relief Bushing	1
13	99500315	Wrapper Insulation	1
14	99500316	Side Insulation	2
15	99150417	#8A x 1/4" Screw	3
16	98001187	Venturi Ring	1
17	99020014	Blower Wheel, Clockwise	1
18	97011269	Blower Assembly	1
19	99100412	Motor Mounting Rubber	2
20	97008583	Motor (VCDB10)	1
	97008584	Motor (VCDB15)	1
21	98005533	Motor Cup	1
22	97006322	Grille Assembly	1
23	99150472	#8-18 x 1-1/4" Screw	2
24	99150480	#10 x .875 Screw*	4

*Standard Hardware, may be purchased locally.



CARNES® Company, Inc.
448 S. Main Street
Verona, Wisconsin
53593

99041204G

Forced Air Heater

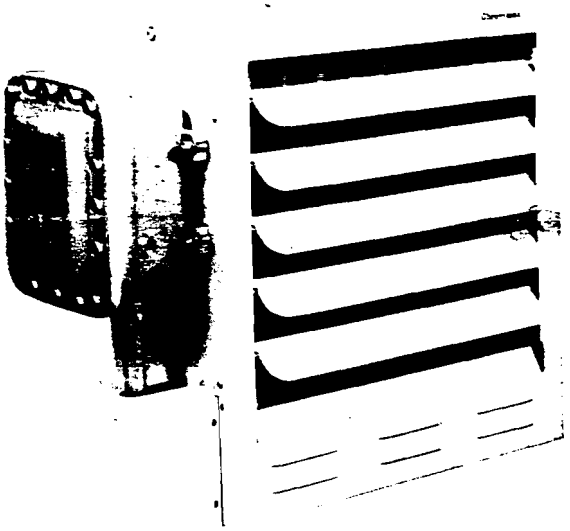
Chromalox®

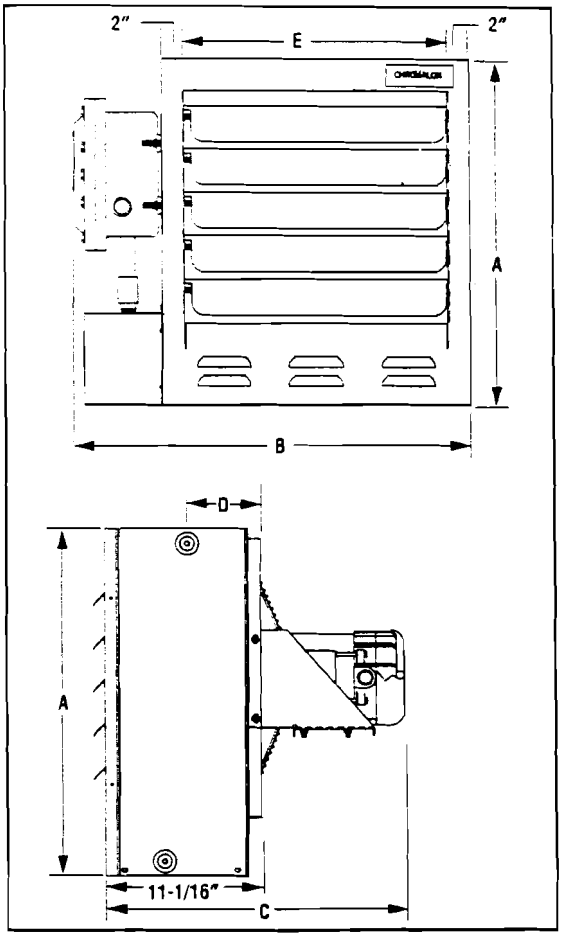
Installation Instructions
and
RENEWAL PARTS IDENTIFICATION

SERVICE REFERENCE	
DIVISION 4	SECTION CXH-A
SALES REFERENCE	PF490
	161-302421-004
DATE JUNE, 1997	

Chromalox Forced Air Heater for Hazardous Locations

Type CXH-A-03 EP to CXH-A-35 EP
Class I - Group D, Div. 1 & 2
Class II - Groups E, F & G
T3B - 165°C (329°F)





Specifications Table A

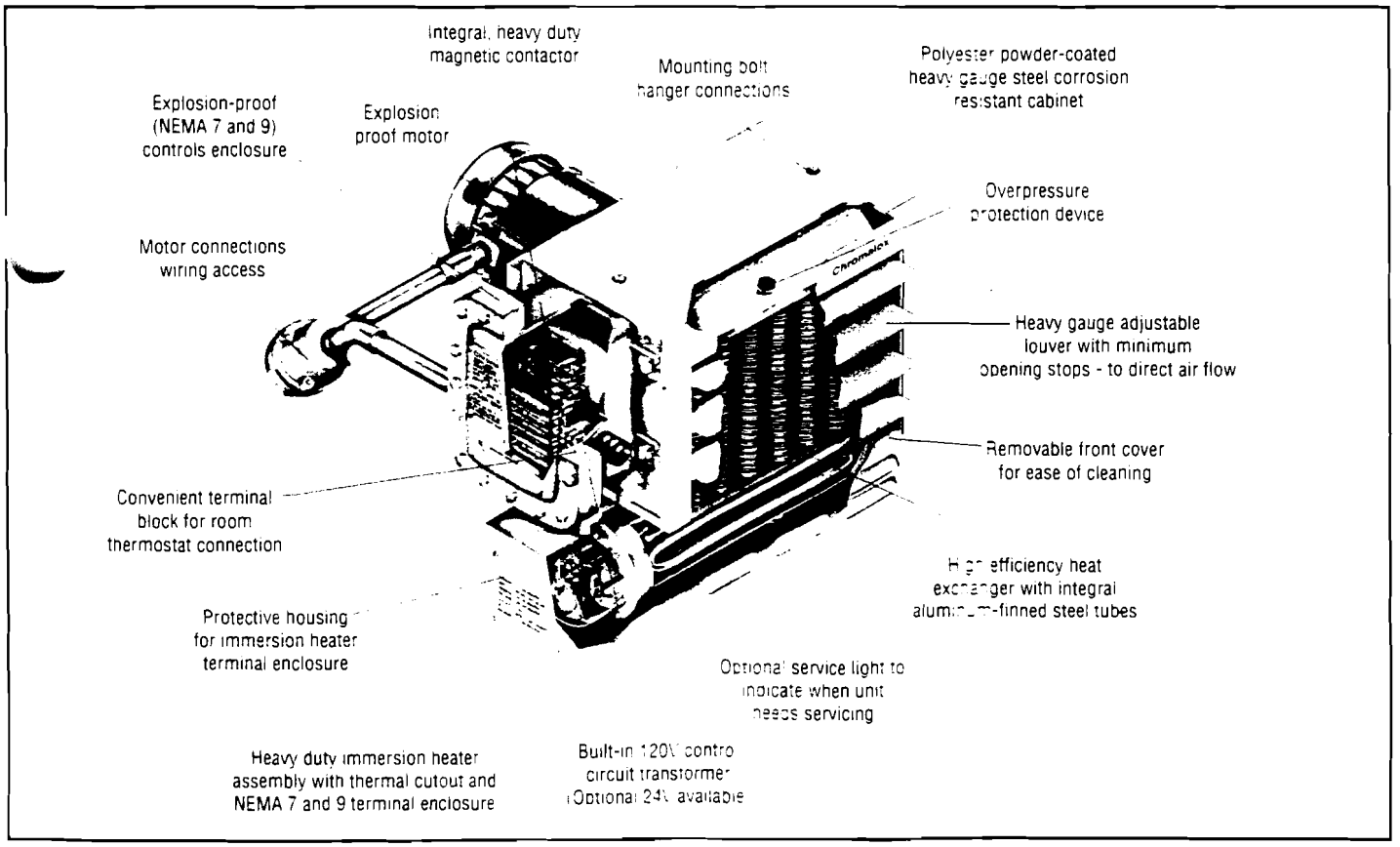
Catalog Number	kW	Voltage and Phase	Horiz. Air Discharge (ft.)	BTUH	CFM	Unit Wt. (lbs.)	Overall Dimensions (inches)			5/8" UNC Tapped Mounting Hole Locations	
							A	B	C	D	E
CXH-A-03	3	208/240V-1 or 3Ø 480/575V-3Ø	28	10,236	700	127	19-1/8	23-7/8	21	3-1/2	13-5/8
CXH-A-05	5	208/240V-1 or 3Ø 480/575V-3Ø	28	17,060	700	127	19-1/8	23-7/8	21	3-1/2	13-5/8
CXH-A-07	7.5	208/240V-1 or 3Ø 480/575V-3Ø	32	25,590	840	133	19-1/8	23-7/8	21	3-1/2	13-5/8
CXH-A-10	10	240V-1 or 3Ø 208/480/575V-3Ø	32	34,120	840	138	19-1/8	23-7/8	21	3-1/2	13-5/8
CXH-A-15	15	208/240/480V 575V-3Ø	47	51,180	1450	150	25	27-7/8	21	4-13/32	17-5/8
CXH-A-18	18	240V-3Ø	43	61,420	1400	165	25	27-7/8	21	4-13/32	17-5/8
CXH-A-20	20	480/575V-3Ø	43	68,240	1400	165	25	27-7/8	21	4-13/32	17-5/8
CXH-A-25	25	480/575V-3Ø	54	85,300	2330	200	32-1/8	31-7/8	21-3/4	5-1/2	21-5/8
CXH-A-30	30	480/575V-3Ø	54	102,360	2330	200	32-1/8	31-7/8	21-3/4	5-1/2	21-5/8
CXH-A-35	35	480/575V-3Ø	54	119,420	2330	200	32-1/8	31-7/8	21-3/4	5-1/2	21-5/8

WARNING

Failure to understand and follow these installation instructions and the **WARNING** notes contained therein may result in severe personal injury, death or substantial property damage.

reduce the risk of ignition of hazardous atmospheres:

1. In accordance with the National Electrical Code, do not install where operating temperature code exceeds the ignition temperature of the hazardous atmosphere. Use only in atmospheres having an ignition temperature higher than 165° C (329° F).
2. Disconnect from supply circuit before opening enclosures.
3. ***Hazard of electric shock. Heater must be grounded to earth to eliminate shock hazard.***
4. Heat exchanger contains Propylene Glycol under pressure at operating temperature. A material safety data sheet is available from Chromalox upon request. Should leakage occur, remove unit from service and investigate cause.
5. Keep all electrical enclosure covers tightly closed and secured with all bolts and threads. Cover joints must be clean before replacing covers.
6. Install and operate in upright position only. Refer to Figure 3 for level requirements. Failure to comply will cause overheating of the element and shutting down the unit by tripping the high temperature cutout.
7. All unused threaded openings not used for supply wiring must be fitted with threaded plugs approved for use in hazardous locations.
8. All unit electrical installation fittings, conduit, wiring and seals must meet NEC and local codes for hazardous locations. External line fusing or circuit breaker protection is required.
9. Hi limit cutouts must never be bypassed in the control circuit.
10. Alarm pilot lamp, if supplied, will turn on if the high limit control actuates. Steady on lamp indicates manual reset protector has tripped. This could result if the heat exchanger is obstructed (dirty), inlet air restricted or fan not turning. Shut off power to unit and refer to repair procedures section of instruction sheet.
11. Mounting clearances on nameplate must be observed.
12. Use copper wire for supply connections according to size and rating on nameplate.
13. Do not install any type of gasket material on any of the electrical junction box cover surfaces.
14. Do not attempt to override louver stops or operate unit with louvers fully closed.



GENERAL

The CXH-A series units rated 3 through 35kW are designed for operation in Class I, Div. 1, Group D and Class II, Div. 1, Groups E, F and G hazardous atmospheres having an ignition temperature of 165°C (329°F) or higher. They are designed for comfort heating and should not be operated in ambient temperatures exceeding 40°C (104°F). All units in Table A are UL listed. The units are easily adapted for wall, ceiling or pole mounting. Refer to Figure 4 on Page 3 for mounting information. They are supplied with either 24 or 120V internal control circuit voltage. The heater is designed for use with an external hazardous location thermostat or optional built-in thermostat.

The standard heater is designed to operate up to 7500 altitude. Consult factory for specific recommendations when using the units at higher altitudes.

Chromalox®

MATERIAL SAFETY DATA SHEET

SERVICE REFERENCE	
DIVISION 4	SECTION CXH-A
SALES REFERENCE	PF462
	161-302441-002
DATE JANUARY, 1997	

DATE	
MANUFACTURER'S NAME Emerson Electric, Wiegand Industrial Company	EMERGENCY TELEPHONE NO. 1-800-UCC-HELP
ADDRESS 701 Alpha Drive, Pittsburgh, PA 15238	

Chromalox urges each customer or recipient of this MSDS to study it carefully to become aware of and understand the hazards associated with the product. The reader should consider consulting reference works or individuals who are experts in ventilation, toxicology and fire prevention, as necessary or appropriate to the use and understand the data contained in this MSDS.

To promote safe handling, each customer or recipient should: (1) notify its employees, agents, contractors and others whom it knows or believes will use this material of the information in this MSDS and any other information regarding hazards or safety; (2) furnish this same information to each of its customers for the product; and (3) request its customers to notify their employees, customers and other users of the product of this information.

I. IDENTIFICATION

PRODUCT NAME:	UCAR FOODFREEZE 35
CHEMICAL NAME:	Propylene Glycol (Phosphate Inhibited)
CHEMICAL FAMILY:	Glycols
FORMULA:	CH3 CH (OH) CH2 OH
MOLECULAR WEIGHT:	76.1
SYNONYMS:	PM-6552
CAS # AND NAME:	Not Applicable (mixture)

II. PHYSICAL DATA (Determined on Typical Material)

BOILING POINT, 760 mm Hg:	161°C (323°F)	**SOLUBILITY IN WATER by wt:**	100 AT 20°C
SPECIFIC GRAVITY (H2O = 1):	1.05 AT 20/20°C	**APPEARANCE:**	Transparent colorless
FREEZING POINT:	Pour Point -51°C (-59°F)	**ODOR:**	Odorless
VAPOR PRESSURE AT 20°C:	0.66 mmHg	**PHYSICAL STATE:**	Liquid
EVAPORATION RATE (Butyl Acetate = 1):	0.07	**PERCENT VOLATILES (by weight):**	98.0
VAPOR DENSITY (AIR = 1):	2.4		

III. INGREDIENTS

%	MATERIAL	CAS#	EXPOSURE LIMIT
95.5	Propylene Glycol	57-55-6	None established
-2	Dipotassium Hydrogen Phosphate	7758-11-4	None established
-2.5	Demineralized Water	7732-18-5	Not Applicable

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method(s)):	210°F Cleveland Open Cup ASTM D 92 240°F Tag Closed Cup ASTM D 56
FLAMMABLE LIMITS IN AIR % by volume:	LOWER: 2.6 (Propylene glycol) UPPER: 12.5 (Propylene glycol)
SPECIAL FIRE FIGHTING PROCEDURES:	Use self-contained breathing apparatus and protective clothing.
EXTINGUISHING MEDIA:	Apply alcohol-type or all-purpose-type foam by manufacturer's recommended techniques for large fires. Use carbon dioxide or dry chemical media for small fires.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	None

V. HEALTH HAZARD DATA

EXPOSURE LIMIT(S):	None established by ACGIH or OSHA.
EFFECTS OF SINGLE OVEREXPOSURE:	
SWALLOWING:	No evidence of harmful effects from available information.
SKIN ABSORPTION:	No evidence of harmful effects from available information.
INHALATION:	Short-term harmful health effects are not expected from vapor generated at ambient temperature.
SKIN CONTACT:	May cause minor irritation with itching and possible slight local redness.
EYE CONTACT:	May cause mild discomfort. Excess redness of the conjunctiva may occur.
EFFECTS OF REPEATED OVEREXPOSURE:	No adverse effects anticipated from available information.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:	A knowledge of the available toxicology information and of the physical and chemical properties of the material suggests that overexposure is unlikely to aggravate existing medical conditions.
SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:	In a developmental toxicity study, mice were given dosages of 0 (water control), 0.5, 5.0, 10.0 ml/kg/day of undiluted propylene glycol by gavage over the period of organogenesis. The only material effect was an increase in water consumption at 5.0 and 10.0 ml/kg/day. There was no evidence of teratogenic or embryotoxic effects. The only skeletal variant apparently increased was poorly ossified unossified cervical centra #1-#4. This however fell within the historical control values.
OTHER EFFECTS OF OVEREXPOSURE:	Skin contact may cause sensitization and an allergic skin reaction in a small proportion of individuals.
EMERGENCY AND FIRST AID PROCEDURES:	
SWALLOWING:	If patient is fully conscious, give two glasses of water. Induce vomiting. Obtain medical attention without delay.
SKIN:	Wash skin with soap and water.
INHALATION:	Remove to fresh air.
EYES:	Immediately flush eyes with water and continue washing for several minutes. Obtain medical attention if discomfort persists.
NOTES TO PHYSICIAN:	There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

VI. REACTIVITY DATA

STABILITY: Stable

CONDITIONS TO AVOID: None known.

INCOMPATIBILITY (materials to avoid):
None known.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS:
Burning can produce oxides of carbon, and trace amounts of oxides of potassium and phosphates.
Carbon monoxide is highly toxic if inhaled; carbon dioxide in sufficient concentrations can act as an asphyxiant.
Acute overexposure to the products of combustion may result in irritation of the respiratory tract.

HAZARDOUS POLYMERIZATION:
Will Not Occur

CONDITIONS TO AVOID: None Known.

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Small spills can be flushed with large amounts of water; larger spills should be collected for disposal.

WASTE DISPOSAL METHOD: Incinerate in a furnace where permitted under Federal, State, and local regulations.

VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type):
None expected to be needed.

VENTILATION: General mechanical room ventilation is satisfactory for normal handling and storage operations.

PROTECTIVE GLOVES: PVC-coated

EYE PROTECTION: Safety glasses or Monogoggles

OTHER PROTECTIVE EQUIPMENT:
Eye Bath, Safety Shower

IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
WARNING! Causes eye and skin irritation.
May cause allergic skin reaction.
Avoid contact with eyes, skin, and clothing.
Wash thoroughly after handling.
FOR INDUSTRIAL USE ONLY

OTHER PRECAUTIONS: DISPOSAL: At very low concentrations in water, this product is readily biodegradable in a biological wastewater treatment system.

WARNING: Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without the presence of obvious ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions.

Any use of this product in elevated-temperature processes should be thoroughly evaluated to establish and maintain safe operating conditions. Further information is available in a technical bulletin entitled "Ignition Hazards of Organic Chemical Vapors."

X. REGULATORY INFORMATION

STATUS OF SUBSTANCE LISTS:

The concentrations shown are maximum or ceiling levels (weight %) to be used for calculations for regulations. Trade Secrets are indicated by "TS".

FEDERAL EPA

Comprehensive Environmental Response Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center of release of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQs) in 40 CFR 302.4.

Components present in this product at a level which could require reporting under the statute are: "NONE"

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQs) in 40 CFR 355 (used for SARA 302, 304, 311 and 312).

Components present in this product at a level which could require reporting under the statute are: "NONE"

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all MSDSs that are copied and distributed for this material.

Components present in this product at a level which could require reporting under the statute are: "NONE"

Toxic Substances Control Act (TSCA) STATUS:

The ingredients of this product are the TSCA inventory.

STATE RIGHT-TO-KNOW

CALIFORNIA Proposition 65: This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm

MASSACHUSETTS Right-To-Know. Substances Lists (MSL) Hazardous Substances and Extraordinarily Hazardous Substances on the MSL must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are: "NONE"

PENNSYLVANIA Right-To-Know. Hazardous Substance List Hazardous Substances and Special Hazardous Substances on the list must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are:

HAZARDOUS SUBSTANCES (= > 1%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Propylene Glycol	57-55-6	95.5

CALIFORNIA SCAQMD RULE 443.1 VOC'S:

Voc. 1004.18 G/L: Vapor Pressure 0.66 mmHg at 20°C.

OTHER REGULATORY INFORMATION:

None Known

NOTE: The opinions expressed herein are those of qualified experts with Union Carbide. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of the use of the product are not under the control of Union Carbide, it is the user's obligation to determine conditions of safe use of the product.

REVISED SECTIONS: This MSDS has been revised to update the information in Section V (HEALTH HAZARD DATA).

Chromalox®
INDUSTRIAL HEATING PRODUCTS
701 ALPHA DRIVE, PITTSBURGH, PA 15238
PHONE: (412) 967-3800 FAX: (412) 967-5146

WIEGAND INDUSTRIAL DIVISION
EMERSON ELECTRIC CO
EMERSON.

INSTALLATION

WARNING: *Mount only in upright position and observe nameplate mounting clearances.*

Heater Location instructions:

Arrange units so their discharge air streams:

a. are subjected to a minimum of interference from columns, machinery and partitions.
b. wipe exposed walls without blowing directly at them.
c. are directed away from room occupants in comfort heating.
d. are directed along the windward side when installed in a building exposed to a prevailing wind.

Locate thermostat on interior partition walls or posts away from cold drafts, internal heat sources and away from heater discharge air streams.

Small rooms can be heated by one unit heater. Where two walls are exposed, the heater should be mounted as shown in Figure 2. Large rooms require multi-unit installations. Number and capacity of units will be determined by volume of building and square feet of floor area to be heated. Arrange units to provide perimeter air circulation where each unit supports the air stream from another.

The CXH-A hazardous location heaters are designed for use only in a permanently mounted upright position. We recommend the use of a mounting kit (ceiling, wall or pole) available from Chromalox. (Figures 5, 6 and 7)

The ceiling or wall mounting surface and the anchoring provision must be sufficient to support the combined weights of the unit and mounting hardware.

If using mounting hardware or a supporting structure not supplied by Chromalox, the unit should be suspended from the supporting structure thru the two mounting points on top of the unit with 5/8 NC bolts and lockwashers. If single point mounting is desired, order the correct size Chromalox adapter bracket (P/N 027-302361-001 for 12" fan units, P/N 027-302361-002 for 16" fan units) and P/N 027-302361-003 for 20" fan units. This bracket is designed to hold the unit over its center of gravity with a 1 dia. bolt. The maximum tilt angles as shown in Figure 3 must not be exceeded in either direction during operation and installation. Failure to comply will cause high limit shut down.

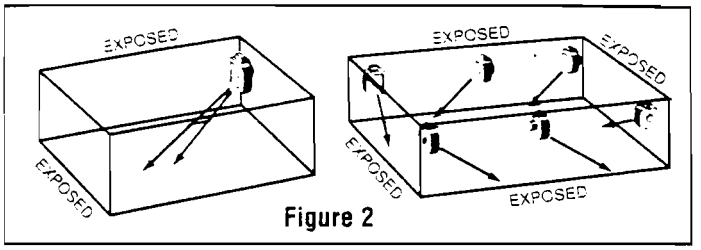


Figure 2

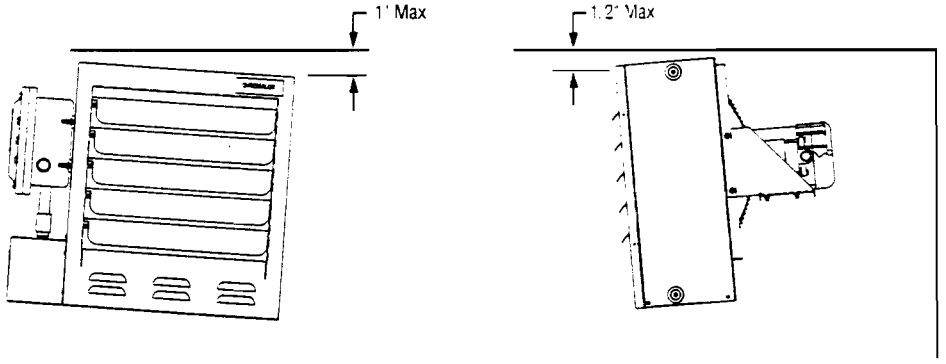


Figure 3

The heaters may be mounted at any convenient height above floor. The minimum spacings shown in Figure 4 should be maintained to adjacent walls and ceiling. If floor heat is desired, do not mount higher than 8 to 10 feet above floor.

Controlling thermostats to individual heaters should be mounted at shoulder height on inside walls or columns and clear of the discharge air stream of the unit. Allow at least 4 in front of heater for air stream to discharge freely.

Do not mount mercury type thermostat directly on unit, vibration could cause malfunction.

Heater may be mounted on a shelf or stand from the bottom. Be sure that mounting clearances are maintained and that bottom of unit has at least 1 clearance underneath it. This is necessary for good air circulation and servicing of heat exchanger. All mounting methods must allow for removal of front cover.

The mounting and anchoring provisions must take into account the unit vibration and cantilevered loading when wall or pole mounted. One of the Chromalox mounting kits shown in Figures 5, 6 and 7 must be used whenever possible.

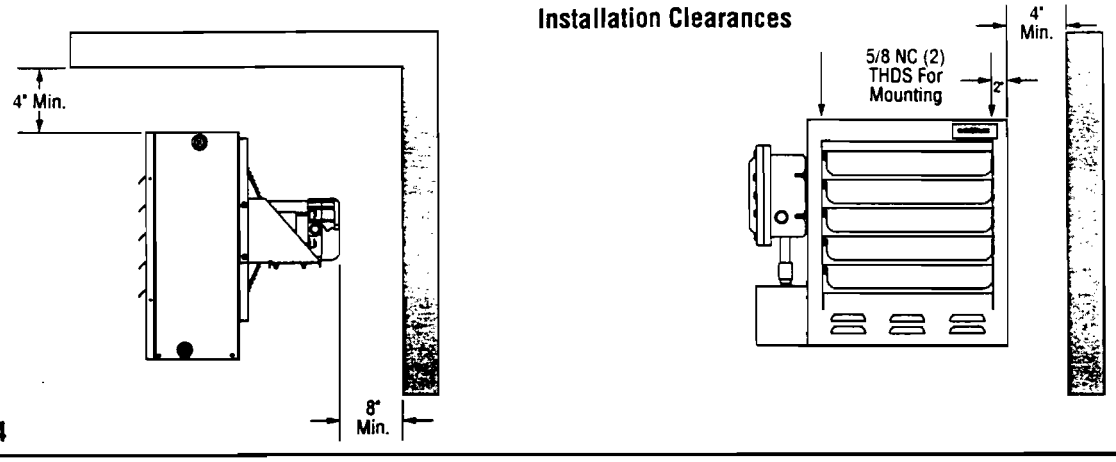
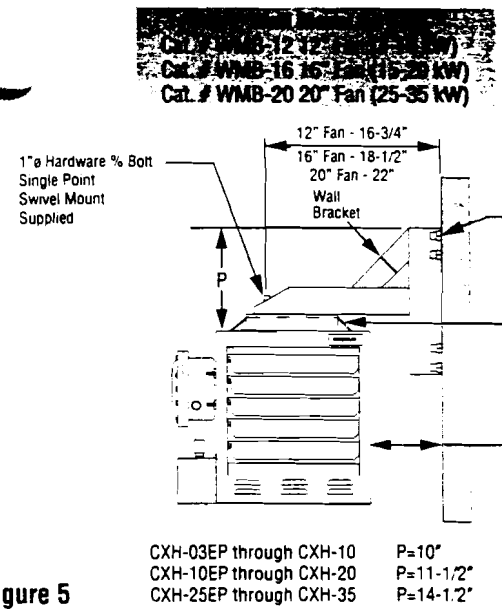
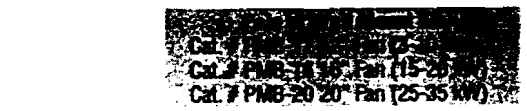


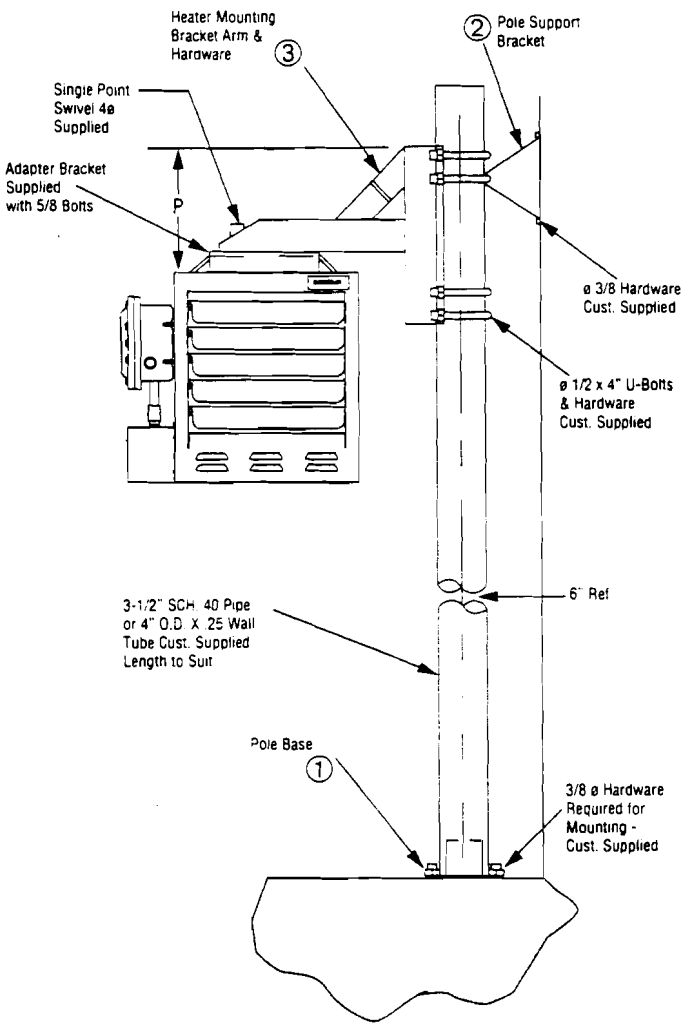
Figure 4



CXH-03EP through CXH-10 P=10"
CXH-10EP through CXH-20 P=11-1/2"
CXH-25EP through CXH-35 P=14-1/2"

Figure 5





CXH-03 through CXH-10 P=10"
CXH-10 through CXH-20 P=11-1/2"
CXH-25 through CXH-35 P=14-1/2"

Figure 6

Ceiling Mounting Kit
Cat. # HMK-00

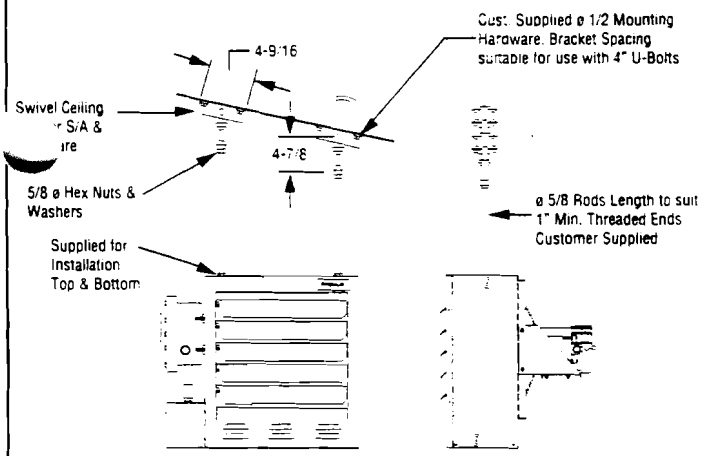


Figure 7

Electrical Components

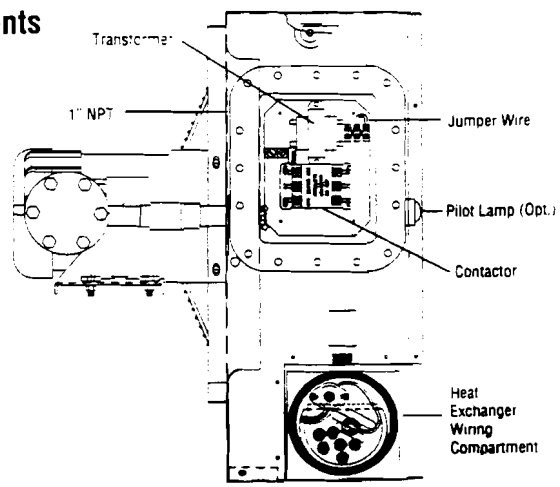


Figure 9

Unit Top View

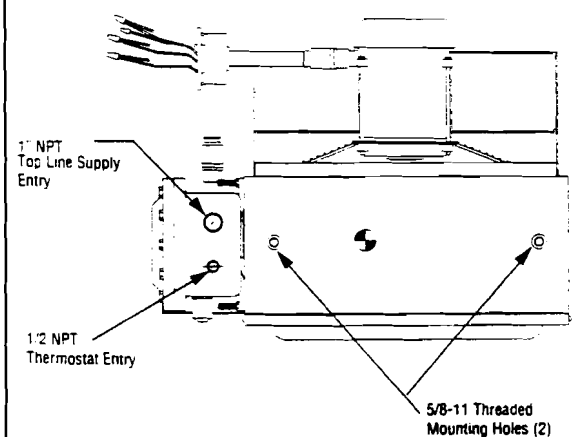


Figure 10

WIRING AND WIRING DIAGRAMS

WARNING:

1. ***To avoid possible electric shock, be sure electricity is turned off at main switch first before wiring. The heater must be grounded in accordance with the National Electric Code as a precaution against possible electrical shock.***
2. ***To prevent possible ignition of hazardous atmospheres, disconnect from the supply circuit before operating enclosures.***

WARNING: ***All electric wiring must be done by a qualified person in accordance with National Electrical Code (NEC) Standards and meet all state and local regulations relating to installations in hazardous locations.***

1. Loosen and remove bolts securing the main terminal enclosure cover on side of unit. Connect heater to line supply wires at the box lugs located on the contactor according the voltage and frequency specified on the nameplate (see Figure 9). Refer to the appropriate wiring diagram which also appears on the inside cover of this enclosure (see Table B and diagrams on page 6).

WARNING: ***Cover joints must be clean before replacing cover. Do not use any gasket material on joint surfaces.***

2. Use copper conductors only for supply wires. Refer to nameplate and Table B for size and rating required.
3. Connect supply line ground conductor to the box lug provided on the base plate below contactor input lugs.

Table B - Supply Wiring Requirements

Catalog No.	kW	Phase	Volts	Supply Wire 90°C Size (ga)	Max Fuse Amps	Wiring Diagram #
CXH-A-03	3	1	208	10	25	I
CXH-A-03	3	3	208	12	15	II
CXH-A-03	3	1	240	10	20	I
CXH-A-03	3	3	240	12	15	II
CXH-A-03	3	3	480	12	15	II
CXH-A-03	3	3	575	12	15	II
CXH-A-05	5	1	208	8	35	I
CXH-A-05	5	3	208	10	20	II
CXH-A-05	5	1	240	8	30	I
CXH-A-05	5	3	240	10	20	II
CXH-A-05	5	3	480	12	15	II
CXH-A-05	5	3	575	12	15	II
CXH-A-07	7.5	1	208	6	50	I
CXH-A-07	7.5	3	208	8	30	II
CXH-A-07	7.5	1	240	6	45	I
CXH-A-07	7.5	3	240	8	25	II
CXH-A-07	7.5	3	480	12	15	II
CXH-A-07	7.5	3	575	12	15	II
CXH-A-10	10	3	208	8	40	II
CXH-A-10	10	1	240	4	60	I
CXH-A-10	10	3	240	8	35	II
CXH-A-10	10	3	480	10	20	II
CXH-A-10	10	3	575	12	15	II
CXH-A-15	15	3	208	4	60	II
CXH-A-15	15	3	240	6	50	II
CXH-A-15	15	3	480	8	25	II
CXH-A-15	15	3	575	10	20	II
CXH-A-18	18	3	240	4	60	II
CXH-A-20	20	3	480	8	35	II
CXH-A-20	20	3	575	8	30	II
CXH-A-25	25	3	480	8	40	II
CXH-A-25	25	3	575	8	35	II
CXH-A-30	30	3	480	6	50	II
CXH-A-30	30	3	575	8	40	II
CXH-A-35	35	3	480	4	60	II
CXH-A-35	35	3	575	6	50	II

4. The fan motor is factory wired at the same voltage, and phase as the heating elements. All motors are thermally protected and connected to the main supply contactor. On three phase units, it is necessary to verify that the fan rotation is correct. Air stream discharge must be out front of unit. After connecting unit to line and closing all covers tightly, energize unit momentarily. If air does not exit front louvers, reverse any two supply leads at the box lugs on the contactor or at the supply disconnect.
5. Either of two 1" NPT rigid conduit openings with integral stops may be used for connection to supply line. (See Figure 9 and 10 for locations) Use only NEC approval hazardous locations means of wiring such as mineral insulated cable and fittings or rigid conduit and seal fittings located as required by installation codes.

WARNING: ***All unused conduit openings must be fitted with plugs NEC/U.L. approved for use in hazardous locations.***

6. Heaters may be provided with a built-in control switch and/or thermostat. If not, they should be controlled by an externally mounted disconnect switch and/or separately mounted thermostat as shown in the appropriate wiring diagram on page 6. In case of malfunction, the personnel in the area should be aware of location of heater disconnect.
7. Installation must include appropriate over current protection devices (fusing or circuit breakers) as required by the National Electric Code in the supply line to the unit. Refer to nameplate for proper current ratings.
8. To operate heaters from an externally mounted hazardous location thermostat, a terminal block is provided for connection (Figures 9 and 10). Remove the factory installed jumper across T2 and T3 on the terminal strip. Wire the thermostat contact leads to these terminals. The built in control transformer supplies the unit with either 24V or 120V for internal unit operation. This voltage will appear across the thermostat contacts when they are open. The minimum thermostat contact rating should be 1 amp @ 120 VAC. Refer to nameplate for control voltage of unit. The 1/2 NPT conduit wiring entry on top of the terminal enclosure should be used to wire the thermostat to the heater (Figure 10).
9. Protection against overheating is provided by an internal thermal cutout located within the heat exchanger wiring compartment. (Figure 9) Activation of the cutout will open the control circuit and energize the pilot lamp (if supplied). If normal airflow is restricted, or stopped, the unit will be cycled off by the manual reset cutout. The manual reset cutout is also designed to shut down the unit completely if the fluid level is low or other heater malfunction occurs.

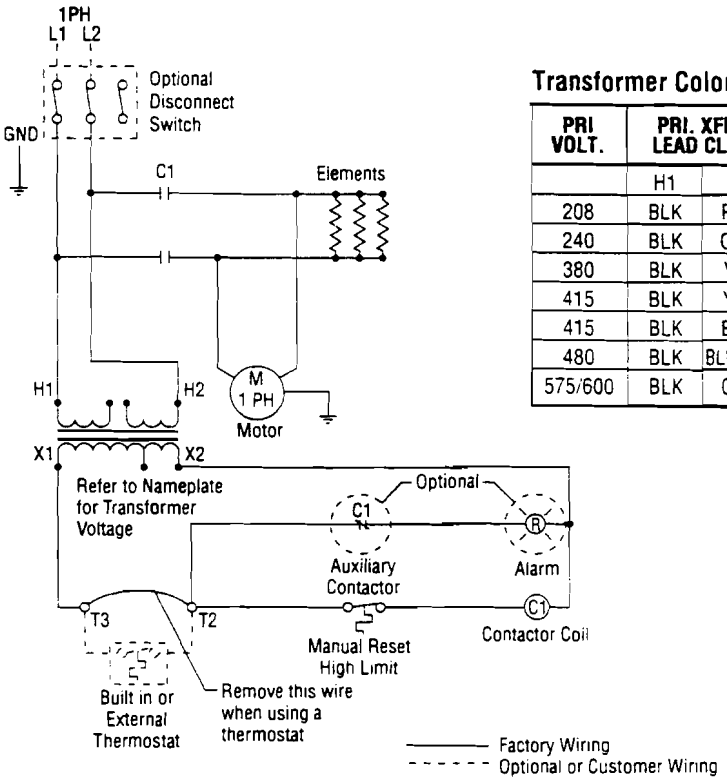
WARNING: ***High limit cutout must never be bypassed in the control circuit. If the limit actuates, shut down unit and investigate cause of abnormal operation. Do not reenergize until the problem has been corrected.***

WARNING: ***Users should install adequate back-up controls and safety devices with their electric heating equipment. If the back-up controls are to be located in the hazardous area, they must be approved for use in the class of location.***

Where the consequences of failure may be severe, back-up controls are essential. Although the safety of the installation is the responsibility of the user, Chromalox will be glad to make equipment recommendations.

DIAGRAM I

Refer to Name Plate for Input Voltage

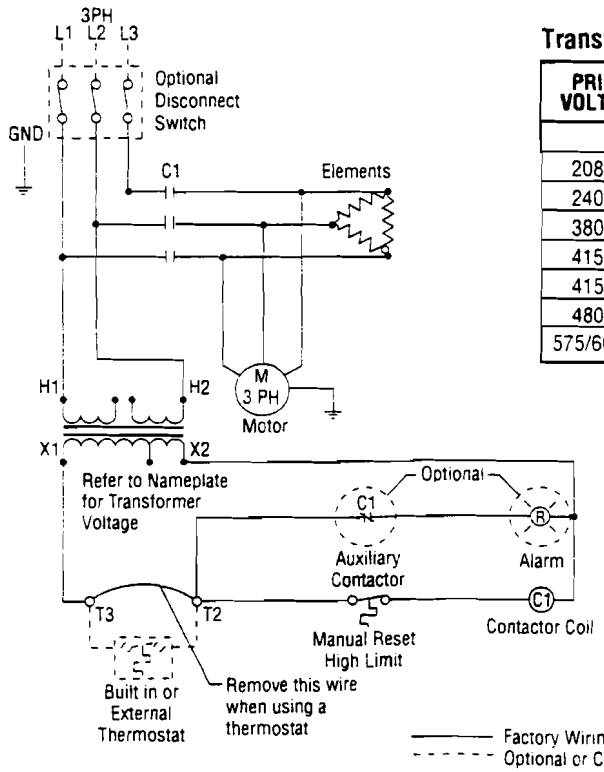


Transformer Color Code Tabulation

PRI VOLT.	PRI. XFMR LEAD CLRS.		120V SEC LEAD CLRS.		24V SEC LEAD CLRS.	
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
380	BLK	VIO	BLK	WHT	YEL	BLU
415	BLK	YEL	BLK	WHT	-	-
415	BLK	BRN	-	-	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU
575/600	BLK	GRY	BLK	WHT	YEL	BLU

DIAGRAM II

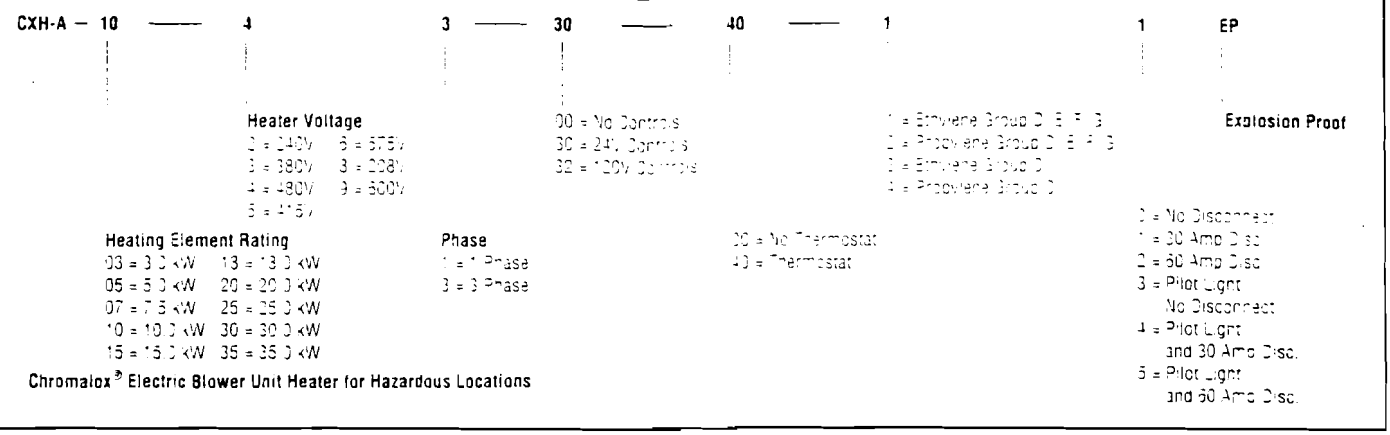
Refer to Name Plate for Input Voltage



Transformer Color Code Tabulation

PRI VOLT.	PRI. XFMR LEAD CLRS.		120V SEC LEAD CLRS.		24V SEC LEAD CLRS.	
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
380	BLK	VIO	BLK	WHT	YEL	BLU
415	BLK	YEL	BLK	WHT	-	-
415	BLK	BRN	-	-	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU
575/600	BLK	GRY	BLK	WHT	YEL	BLU

MODEL NUMBER DESCRIPTION



Chromalox® Electric Blower Unit Heater for Hazardous Locations

OPERATION

WARNING

1. *Heater should not be operated in ambient temperature higher than 40°C (104°F) or in atmospheres corrosive to the heater itself.*
2. The CXH-A unit heaters use a sealed water-glycol filled heat exchanger. The electric immersion elements transfer heat energy directly to the fluid generating a fluid/vapor mixture which releases its heat energy to the finned radiator as it rises and recondenses back to the bottom reservoir to be reheated. This cycle will continue as long as fan forced air is available on the finned structure to remove the heat to the airstream.
3. The finned structure of the heat exchanger must be kept clean and free of accumulated dust and dirt. The cabinet front panel is easily removed providing access to the heater core for periodic cleaning.
4. Unit should not be operated with louvers fully closed. Mechanical stops are incorporated into the design of the cabinet to limit the degree of closure. Do not force the louvers beyond these stops.
5. If specified, units are supplied with a built in alarm pilot lamp which will energize if the manual reset control has a been activated. During unit startup, the lamp will flash on momentarily to verify its operation.

MAINTENANCE AND REPAIR

Maintenance and repair must be performed by qualified personnel only.

WARNING: *To reduce the possibility of ignition of hazardous atmospheres, avoid possible electric shock or injury from rotating parts and hot surfaces unit must be disconnected from electrical supply circuit before servicing or opening enclosure covers.*

1. Periodically inspect all electrical connections and terminals to avoid electrical wiring difficulties. Inspect all wiring for frayed or worn insulation.
2. Periodically and before each heating season, clean the finned heat exchanger and fan inlet with compresses air, vacuum, or water jet. Be sure all electrical covers are tightly closed.
3. If heat output seems to be low, check amperage draw on each element. Compare measured values to the correct currents as listed on the unit nameplate.
4. The thermally protected fan motor is permanently lubricated and sealed. No field servicing is required or should be attempted. Replace only with a factory supplied identical motor. Failure to do so will void the factory warranty and may expose the user to risk of ignition of hazardous atmospheres.
5. Check fan blade to be sure that set screws are tight and there are no cracks or looseness in the blades. Use factory supplied replacement blade only.
6. Check for any sign of leaking from the heat exchanger. Too little fluid will cause the manual high limit to trip.
7. The sealed heat exchanger contains a glycol/water solution of propylene glycol. Ethylene glycol is supplied for arctic duty conditions only. Avoid contact with skin and eyes. If ingestion should occur, seek medical attention immediately. In case of eyes or skin contact, wash affected areas with large amounts of water. **The MSDS (Material Safety Data Sheet) for these materials is available upon request.**

I. REPLACING THE HEAT EXCHANGER

WARNING: *Be sure heat exchanger and fluid has been allowed to cool to 110°F before proceeding.*

1. Detach the cabinet front by removing screws from all sides of unit and pulling cover forward off cabinet shell. Detach bottom panel by removing two screws on each side and two screws in the rear. Remove the electrical control enclosure lid. Disconnect the heater and high limit wires from the electrical control enclosure. Loosen electrical conduit union located between the heater housing and the electrical control enclosure. Support the lower end of the heat exchanger and loosen the three hex head bolts which hold it to the sheet metal. Lower the heat exchanger away from the sheet metal. Reverse the above procedure when installing a new heat exchanger.

II. RESETTING MANUAL HIGH TEMPERATURE CONTROL

WARNING: *To reduce the possibility of ignition of hazardous atmospheres, avoid possible electric shock or injury from rotating parts and hot surfaces unit must be disconnected from electrical supply circuit before servicing or opening enclosure covers.*

WARNING: *Be sure that all enclosure covers are replaced and tightly closed before re-energizing unit after servicing electrical components.*

WARNING: *Hazard of explosion, fire and severe personal injury. High limit controls must never be bypassed in control circuit.*

The occurrence of the manual high limit control to trip is an abnormal condition. Care should be taken to determine the exact reason that the high limit control tripped. Possible problem areas could be dirty heat exchanger, blocked air inlet or outlet, motor malfunction, too high operating ambient, incorrect operating voltage, or leaking heat exchanger. In the event that the heat exchanger is defective, it must be replaced.

1. The manual high temperature control is located in the heating element hazardous location enclosure on the heat exchanger which is covered by the sheet metal housing attached to the side of the unit. To gain access, remove the four sheet metal screws holding the sheet metal cover in place and unthread the cast aluminum enclosure lid. The high limit control can now be serviced. (See Figure 11). The manual high temperature control device has a small reset button protruding from the center of its back housing. Depress this button in to reset the control. Replace the aluminum enclosure lid and sheet metal cover.

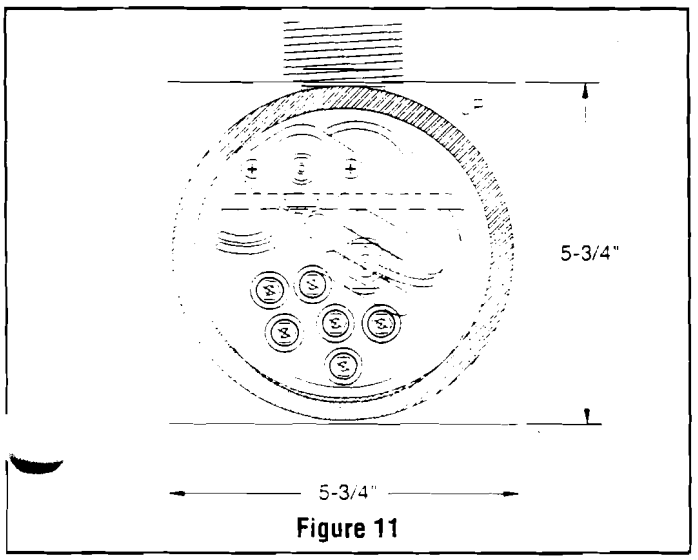


Figure 11

III. FAN MOTOR AND BLADE

1. The motor is a sealed unit that requires no lubrication. If the motor is defective, it must be replaced with an original factory supplied motor. (See renewal parts section.)
2. To replace the motor, proceed as follows:
   a. Disconnect the unit from power supply.
   b. (Units with motor splice box) Remove 4 bolts and cover of motor splice box (See Figure 12).
   c. (Units without motor splice box) Remove 16 bolts and cover of main control enclosure.

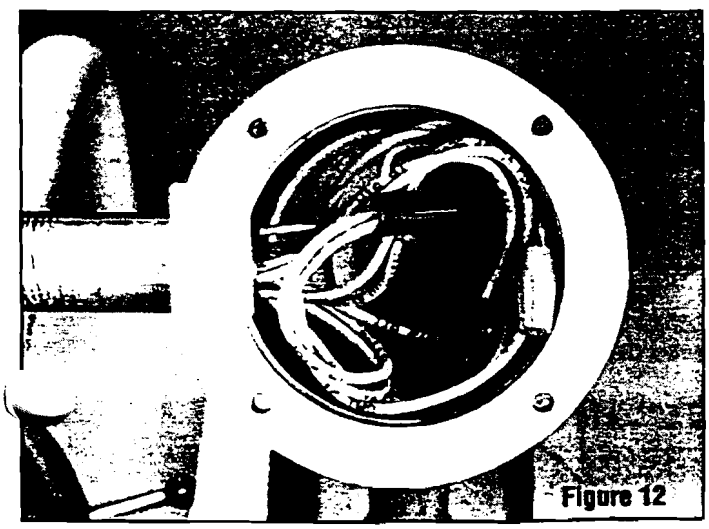


Figure 12

   d. Note wire connections for future reference and disconnect all wires leading to the motor. All motor wires are permanently marked according to the nameplate on the motor.
   e. Remove 4 bolts in motor base holding it to rear cabinet shelf. See Figure 13.

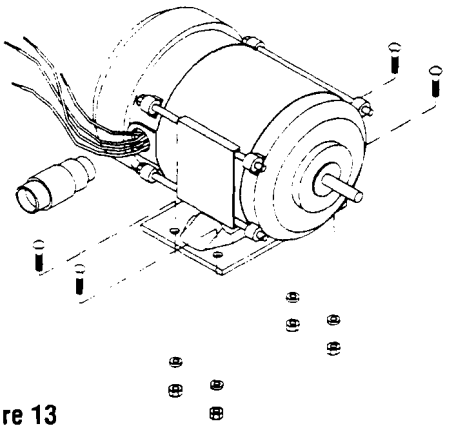


Figure 13

   f. Remove 4 screws holding fan guard to cabinet.
   g. Unthread union at motor wiring outlet nipple connection. Carefully lift the motor, fan blade, and guard off of the cabinet.
   h. Note position of fan blade on motor shaft. Loosen the two set screws to remove the fan blade and key from shaft motor.
   i. Place guard and fan blade on replacement motor shaft in same locations as original motor. Align key ways in hub and shaft. Insert key flush with fan hub and tighten the two hub set screws.
   j. Feed motor wires back into conduit and reposition motor back on unit. Center fan blade in opening and rotate to be sure that it clears housing and guard.
   k. Thread motor nipple connection into conduit union and tighten (5 threads minimum). Replace bolts in motor base and reattach fan guard to back of housing in four places. Recheck blade rotation and tighten all hardware.
   l. Trim all motor leads extending out of the conduit to 6 lengths. Strip off 3/8 of insulation at cut ends. Using the motor nameplate, previous notes, and marked wires, reconnect the motor for the unit voltage rating as indicated on the heater nameplate. Re-attach the ground wire to the connection inside the enclosure. Replace cover and tighten securely.
   m. Check fan rotation by momentarily energizing the unit. Air must exit at cabinet front. Reverse any 2 leads at contactor or line supply disconnect to reverse rotation of three phase motor.
3. Removal of fan blade does not require that the motor wiring be disturbed. To clean, service or change the fan blade proceed as follows:
   a. Remove the four carriage bolts holding the motor base in place on the cabinet platform. Mark the platform to reposition at same location.
   b. Loosen the four screws on the cabinet back holding the fan guard in place.
   c. Pull the motor to the rear extending the conduit connection at the electrical enclosure. Fan blade and hub set screws can now be accessed by tilting the guard rearward at top or bottom back over the motor shell.

IV. ELECTRICAL COMPONENT SERVICING

WARNING: To reduce the of ignition of hazardous atmospheres, avoid possible electric shock or injury from rotating parts and hot surfaces unit must be disconnected from electrical supply circuit before servicing or opening enclosure covers.

MAINTENANCE AND REPAIR (Continued)

WARNING: ***Hazard of electric shock, explosion or fire. Disconnect from supply circuit before opening enclosures, cover joints must be cleaned before replacing covers. Re-tighten all covers with original bolts after servicing components.***

When provided, the following components are located in the cast aluminum hazardous location enclosure. Remove cover and retaining bolts to gain access the following items (See Figure 15):

1. CONTROL TRANSFORMER
   This item is located in the electrical enclosure. It may be replaced while in the enclosure. To service or replace remove the quick connect wires and mark their locations. Remove two screws which hold the transformer in place. Note transformer orientation and voltage labels on top. Replace transformer in the same orientation and connect wires. Replace the cast aluminum cover and bolt down.
2. CONTACTOR
   This component can be removed from the base plate while in the enclosure. Follow the same steps as indicated for the transformer replacement.
3. ALARM PILOT LAMP (OPTIONAL)
   To replace the bulb, unscrew the red lens bezel while holding the lock ring until disengaged. Avoid turning the entire assembly which is held tight to the enclosure with a locking nut on the inside of the enclosure. It must be re-tightened if loosened before reuse. Replace the lamp with a 656 type bulb at the correct control voltage for the unit (120V or 24). Secure the lens cap (5 threads minimum) against the locking ring and tighten securely before re-energizing unit. Lamp should flash on momentarily when unit is energized. See renewal parts section for part number of replacement bulbs.

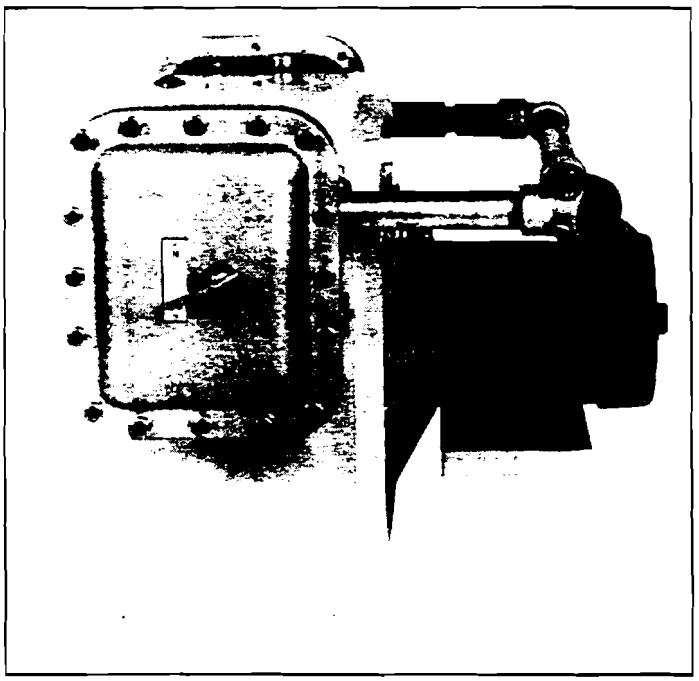


Figure 14
CXH-A Unit with Built in Disconnect Switch
(Must use HMK-00 Ceiling Mounting Kit)

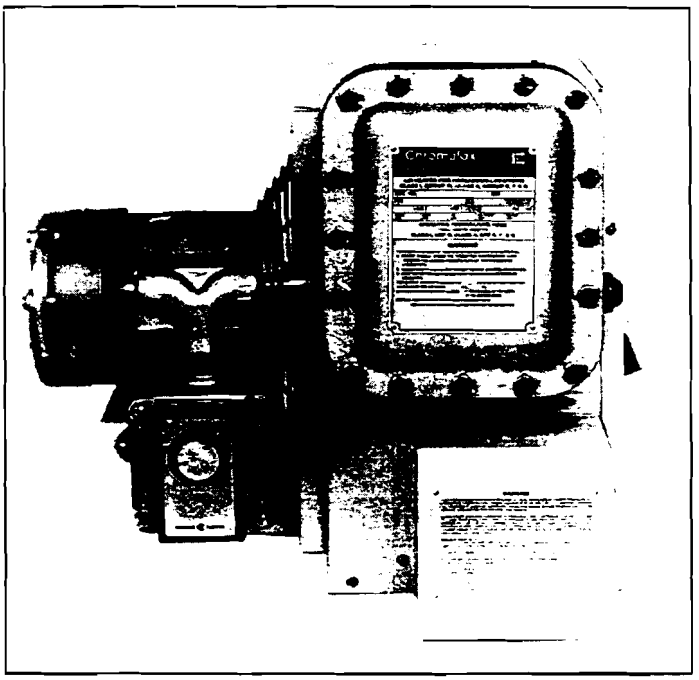


Figure 15
CXH-A Unit with Built in Thermostat

RENEWAL PARTS IDENTIFICATION

Publication Number	Title
PF458	Mounting Kits for Model CXH-EP
PF461	Material Safety Data Sheet Chromakool EG
PF462	Material Safety Data Sheet Chromakool PG

Contactor	072-303180-002	072-303180-008
Transformer 208/240/480 PRI	315-304252-002	315-304252-001
Transformer 575 PRI	315-304252-005	315-304252-003
Aux. Contactor	072-025640-102	072-025640-102

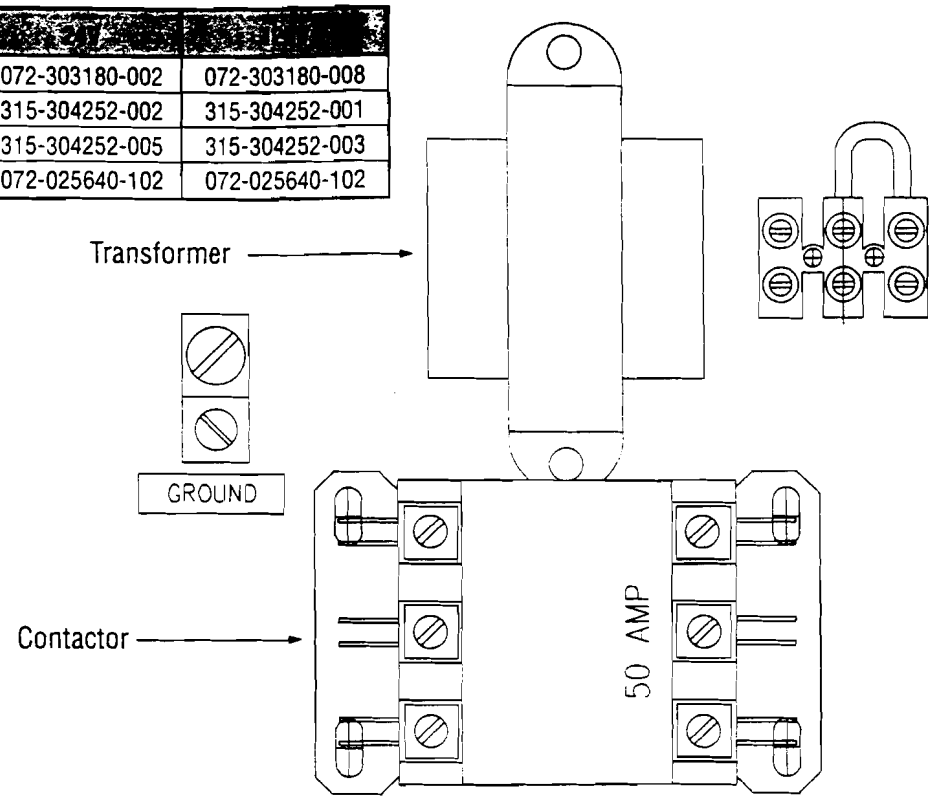


Figure 16

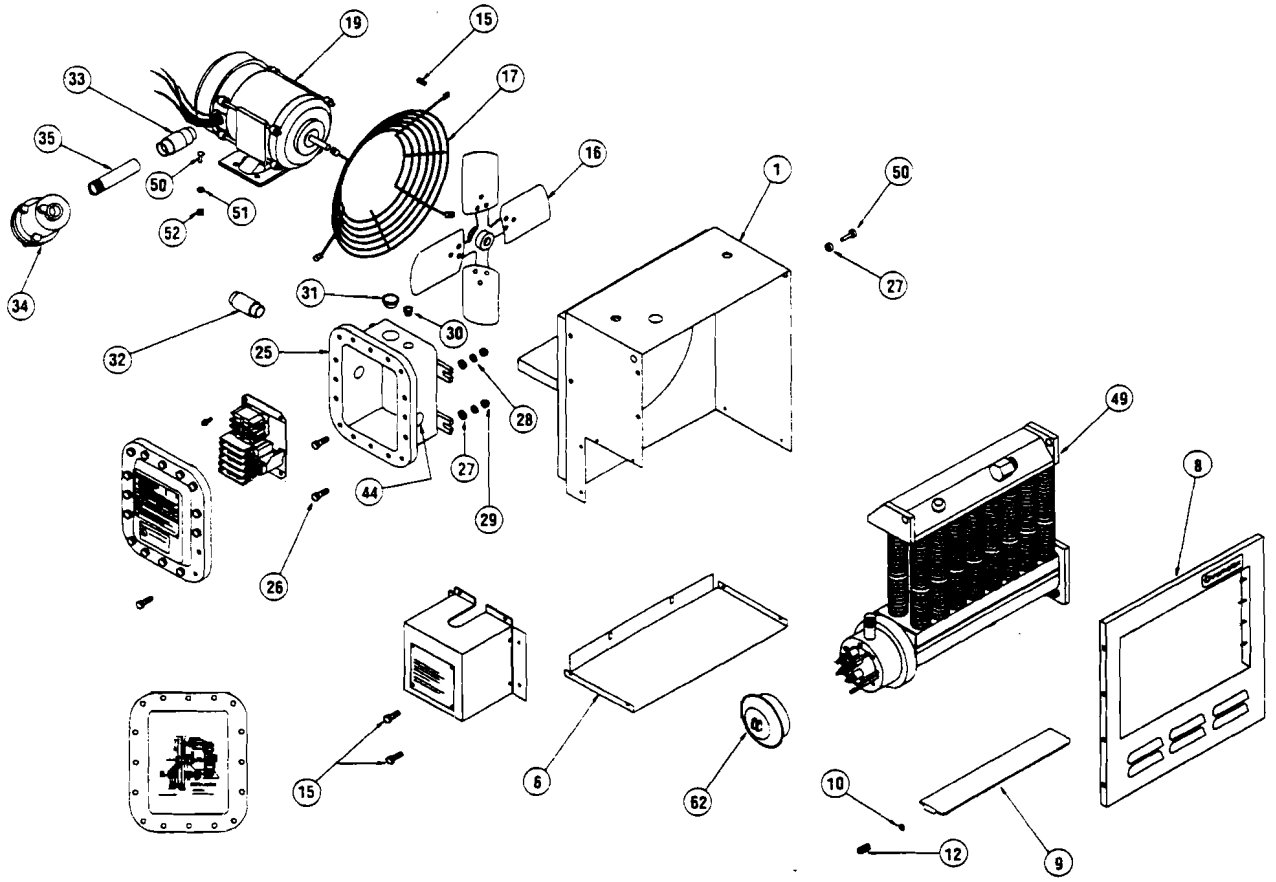


Figure 17

MANUFACTURER PART NUMBER BREAKDOWN
(LOCATED ON UNIT NAMEPLATE)

CXH-A-□□ - □□ - □□ - EP

Common Parts

Shown in Figure [illegible]

Item#	Description	Code CXH-A-03 05, 07&10 Part No.	CXH-A-15, 18 & 20 Part No.	CXH-A-25, 30 & 35 Part No.
1	Panel wrapper	207-303891-001	207-303891-002	207-303891-003
6	Panel Bottom	207-303881-001	207-303881-002	207-303881-003
8	Panel Front	207-303883-001	207-303883-002	207-303883-003
9	Louver	132-303884-001	132-303884-002	132-303884-003
10	Washer Shoulder	329-302074-002	329-302074-002	329-302074-002
12	Spring	276-130386-001	276-130386-001	276-130386-001
14	Terminal Box Cover	080-302079-001	080-302079-001	080-302079-001
15	Screw 10-32	248-073662-002	248-073662-002	248-073662-002
16	Fan Blade	Consult Factory	Consult Factory	Consult Factory
17	Fan Guard	134-302063-004	134-302063-005	134-302063-006
25	Enclosure	347-123273-131	347-123273-131	347-123273-131
26	Bolt 3/8-16, 1.5 lg	345-075603-263	345-075603-263	345-075603-263
27	Washer flat	328-075528-085	328-075528-085	328-075528-085
28	Washer lock	328-075571-011	328-075571-011	328-075571-011
29	Hex Nut 3/8-16	200-075473-044	200-075473-044	200-075473-044
30	Plug conduit 1/2"	221-302180-001	221-302180-001	221-302180-001
31	Plug conduit 1"	221-302180-003	221-302180-003	221-302180-003
32	Union conduit 3/4"	354-302165-001	354-302165-001	354-302165-001
33	Union conduit 3/4"	354-302243-001	354-302243-001	354-302243-001
34	Conduit Box	Consult factory	069-304115-002	069-304115-002
35	Conduit 3/4"	Consult factory	Consult factory	Consult factory
44	Plug conduit 3/4"	221-302180-002	221-302180-002	221-302180-002
50	Bolt 5/16-18	345-075603-218	345-075603-218	345-075603-218
51	Washer	328-075571-010	328-075571-010	328-075571-010
52	Nut 5/16-18	200-075473-039	200-075473-039	200-075473-039
62	Cover Exp. Proof	080-042350-007	080-042350-007	080-042350-007
75	Conduit 3/4	069-115087-049	069-115087-079	069-115087-093

Motor, Element and Heat Exchanger Parts

Code Nos.	1/4 HP Motor Item 19	Heat Exchanger* Item 49
CXH-A-03-81	193-302087-006	353-304167-001
CXH-A-03-83	193-302087-007	353-304167-001
CXH-A-03-21	193-302087-006	353-304167-002
CXH-A-03-23	193-302087-007	353-304167-002
CXH-A-03-43	193-302087-007	353-304167-005
CXH-A-03-63	193-302087-008	353-304167-006
CXH-A-05-81	193-302087-006	353-304167-008
CXH-A-05-83	193-302087-007	353-304167-008
CXH-A-05-21	193-302087-006	353-304167-009
CXH-A-05-23	193-302087-007	353-304167-009
CXH-A-05-43	193-302087-007	353-304167-012
CXH-A-05-63	193-302087-008	353-304167-013
CXH-A-07-81	193-302087-006	353-304168-001
CXH-A-07-83	193-302087-007	353-304168-001
CXH-A-07-21	193-302087-006	353-304168-002
CXH-A-07-23	193-302087-007	353-304168-002
CXH-A-07-43	193-302087-007	353-304168-005
CXH-A-07-63	193-302087-008	353-304168-006
CXH-A-10-83	193-302087-007	353-304168-008
CXH-A-10-21	193-302087-006	353-304168-009
CXH-A-10-23	193-302087-007	353-304168-009
CXH-A-10-43	193-302087-007	353-304168-012
CXH-A-10-63	193-302087-008	353-304168-013
CXH-A-15-83	193-302087-007	353-304169-001
CXH-A-15-23	193-302087-007	353-304169-002
CXH-A-15-43	193-302087-007	353-304169-005
CXH-A-15-63	193-302087-008	353-304169-006
CXH-A-18-23	193-302087-007	353-304169-008
CXH-A-20-43	193-302087-007	353-304169-012
CXH-A-20-63	193-302087-008	353-304169-013
	1/2 HP Motors	
CXH-A-25-43	193-302087-009	353-304170-003
CXH-A-25-63	193-302087-010	353-304170-004
CXH-A-30-43	193-302087-009	353-304170-008
CXH-A-30-63	193-302087-010	353-304170-009
CXH-A-35-43	193-302087-009	353-304170-012
CXH-A-35-63	193-302087-010	353-304170-013

* For arctic duty conditions, heat exchanger with ethylene glycol are required. Consult factory.

Optional Equipment Parts	
Description	**Part Number**
Thermostat	300-113075-003
30 Amp Disconnect	104-121867-081
60 Amp Disconnect	104-121867-082
Pilot Light Ass'y 24V	213-121103-017
Pilot Light Ass'y 120V	213-121103-018
Pilot Lamp 24V	172-052561-004
Pilot Lamp 120V	172-052561-003

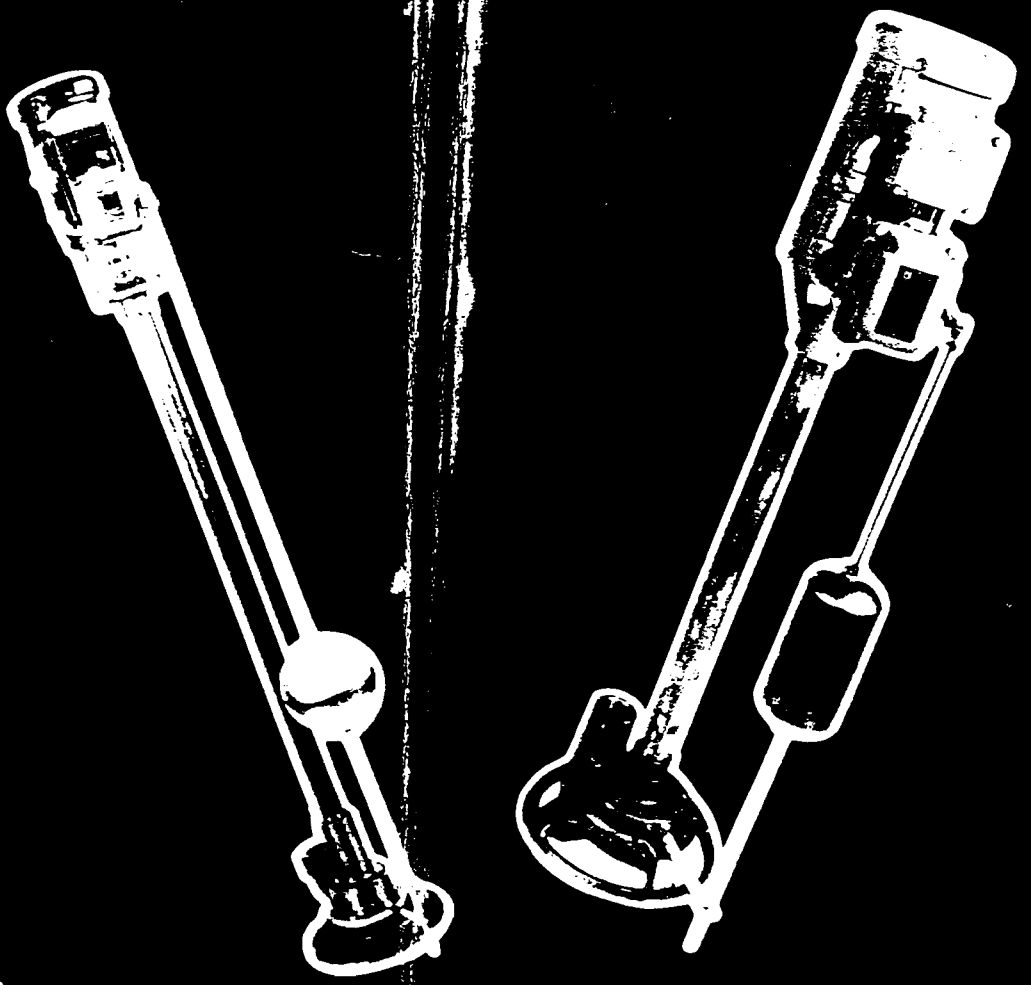
Mounting Kit Adapter	
CXH-A-03 through 10	027-302361-001
CXH-A-15 through 20	027-302361-002
CXH-A-25 through 35	027-302361-003

WARNING: ***The factory must perform the replacement of the heater or overtemperature cutout. The heat exchanger seal must not be broken. Consult factory for service.***

Sump Pump

INDUSTRIAL SUMP PUMPS

- INSTALLATION INSTRUCTIONS
- PARTS LIST
- MAINTENANCE



NEPTUNE

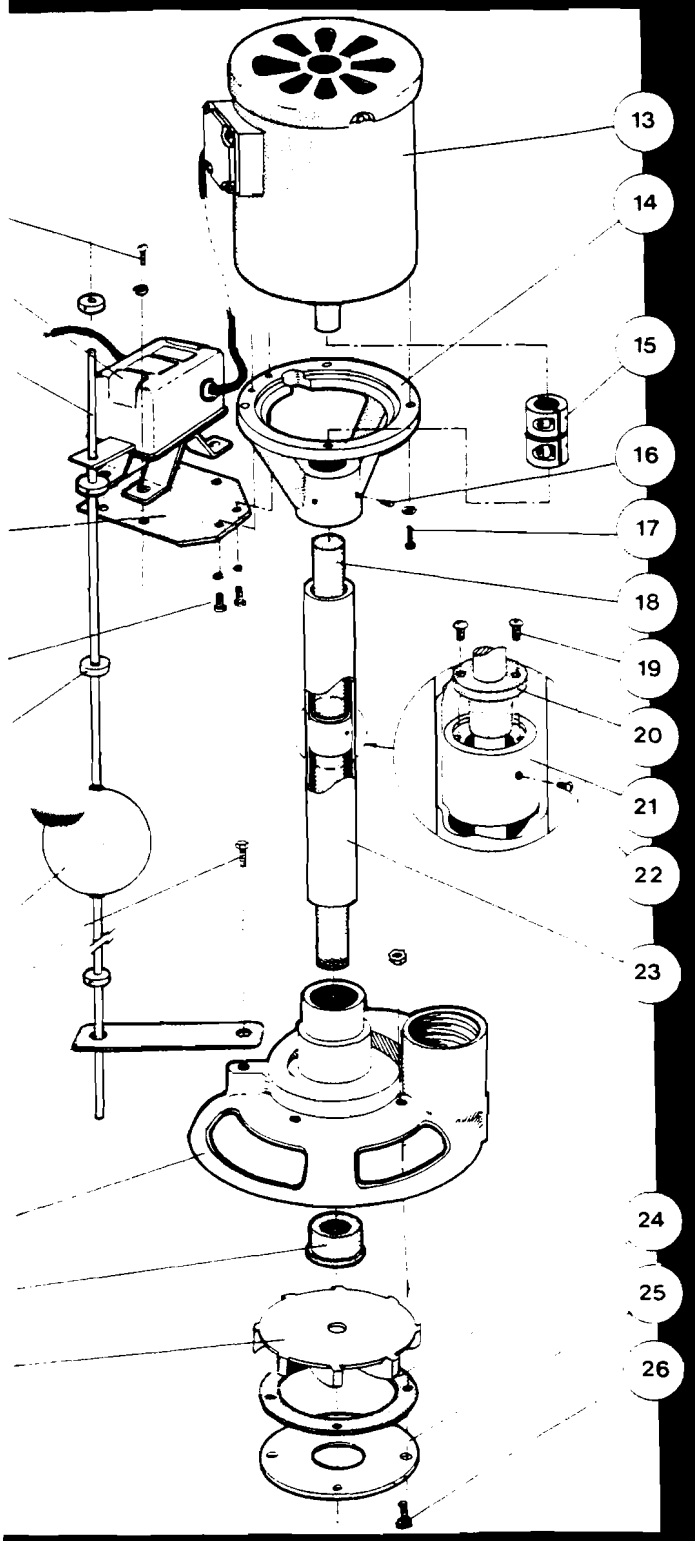
PUMP MANUFACTURING CO.

PHONE 609-228-5488

110 HARMON DRIVE, SUITE F, BLACKWOOD, NJ 08012

Model LD Heavy Duty

INDUSTRIAL SUMP PUMP



LD PARTS LIST

2. SWITCH- Open Drip/TEFC (Shown in sketch)
   (See page 3 for explosion proof configuration)
3. TRIP ROD (Brass or Stainless)
4. SWITCH MOUNTING PLATE
6. ADJUSTMENT COLLARS (4 Required)
7. FLOAT
9. TRIP ROD GUIDE
10. BASE (Cast Iron, Brass or Stainless)
11. BUSHING
12. IMPELLER (Brass or Stainless)
13. MOTOR (Specify Type)
14. MOTOR MOUNT
    (Pumps 4' height and over utilize motor mount and bearing configuration. Shown on page 3.)
15. COUPLING
18. SHAFT (Specify length)
20. INTERMEDIATE BUSHING } (on pumps 4' height and over)
21. INTERMEDIATE BUSHING HOLDER }
23. COLUMN/SHAFT HOUSING (Specify Type)
    (Steel, Brass or Stainless)
24. GASKET
25. BOTTOM PLATE
    (316 S/S or strainer 304 S/S)

HARDWARE

Below is a list of all hardware used in our LD pump. The item numbers correspond to those identified in the exploded view to the left. All items of hardware used are of standard sizes and threads, and should be available from most industrial hardware suppliers and many local retail hardware stores. These descriptions are presented for your convenience should any replacement be necessary.

#	SIZE	DESCRIPTION	REQ'D
1.	1 4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
5.	1 4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	2 SETS
8.	1 4-20 X 1/2"	HEX HEAD SCREW S/S	1 REQ'D
16.	5 16-18 X 5/16"	SET SCREWS S/S	2 REQ'D
17.	3 8-16 X 1"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
19.	6-32 X 3/8"	ROUND HEAD SCREWS	2 REQ'D
22.	8-32 X 3/8"	ROUND HEAD SCREWS	2 REQ'D
26.	10-32 X 1"	ROUND HEAD SCREWS & NUTS	4 SETS REQ'D

PRELIMINARY INSPECTION

As you uncrate your Neptune pump, check for any visible damage that may have occurred during shipping. Report any such damage to your distributor immediately.

Place the pump in an upright position, being sure not to let it tip over...it will be top heavy! Grasp the coupling just below the motor and turn the pump shaft. It should turn freely.

INSTALLATION and ELECTRICAL CONNECTION

The pump operation is controlled by a float-activated switch. Travel limits of the float are determined by the location of two adjustable collars on the trip rod. These collars should be set into position prior to final installation. To minimize wear on the starting mechanism, on/off intervals of operation should be longer than five minutes, if possible.

Only a qualified electrician should make the necessary hook-up of electric power, one familiar with the industrial wiring codes in your area. Single phase pump motors are factory wired to provide proper rotation of the pump shaft.

Three phase hook-ups must be checked for proper rotation as indicated by the arrow label on the pump shaft housing. If rotation is not correct, switch any two lead wires.

Though our single phase motors have built-in overload protection, some commercial wiring codes require an external overload relay. Three phase motors should utilize external overload and starting relays activated by the float switch. For explosion-proof installations, the external controls must be rated and classified for hazardous environments.

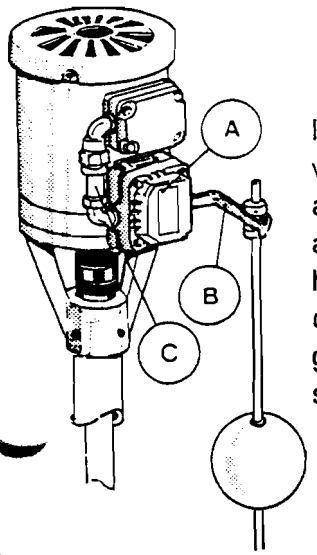
MAINTENANCE

Neptune pumps are virtually maintenance free. After prolonged use, however, the shaft's bushings may need to be replaced. Symptoms of the need to replace the bushings may be evident when a high speed vibration or chatter can be heard.

WARRANTY

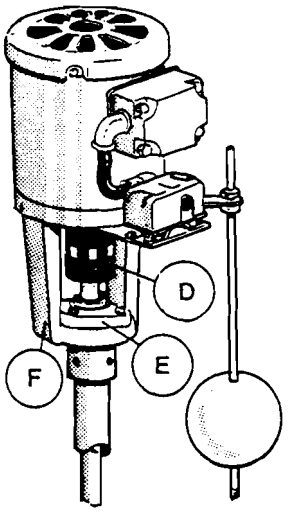
The only part of a Neptune pump that requires a warranty is the electric motor which is covered by the motor manufacturer's warranty against defect.

EXPLOSION PROOF MOTOR/SWITCH DETAIL



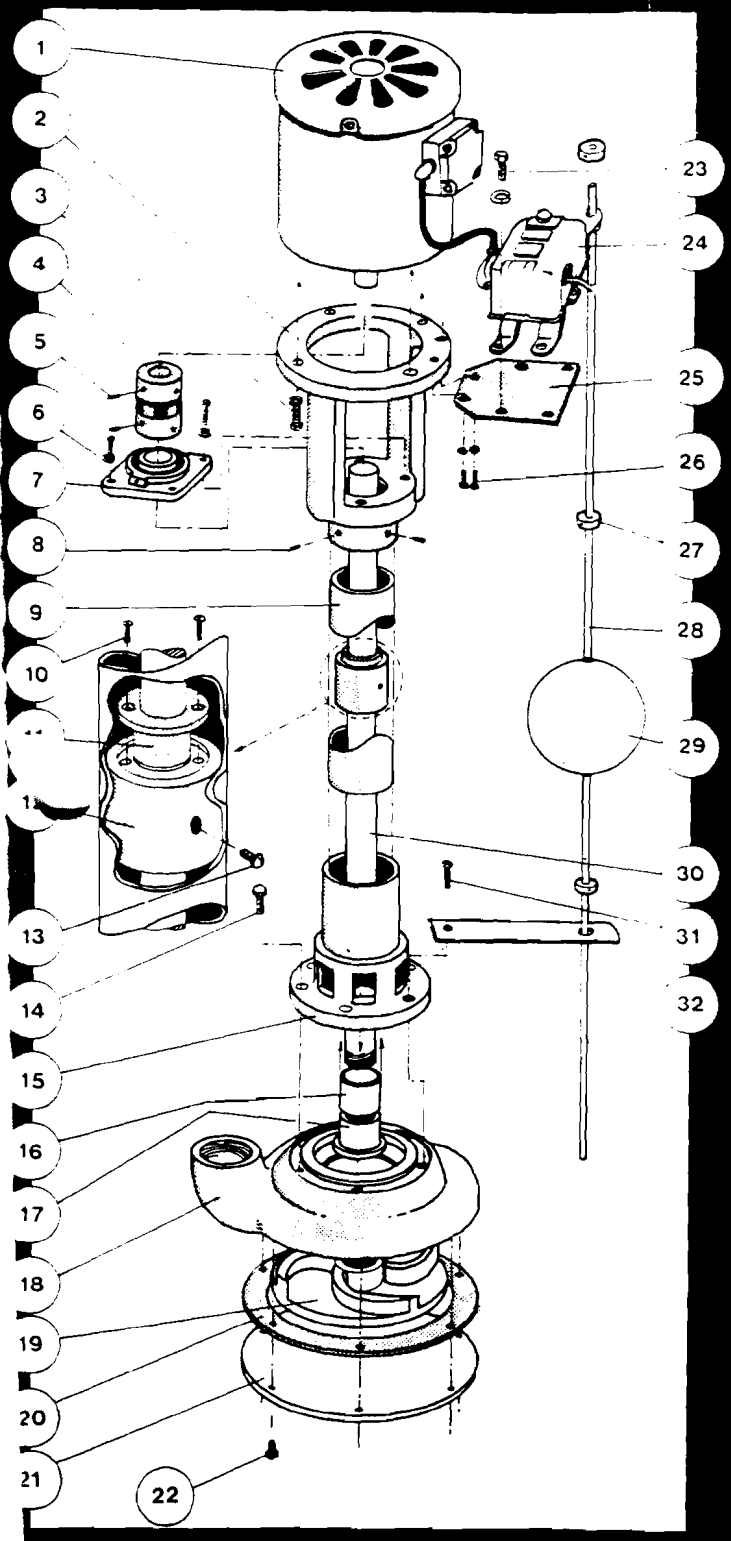
For explosion-proof installations, a totally-enclosed vertical switch "A", with an anodized float switch arm "B", and a totally enclosed wire housing "C" are used in accordance with federal safety guidlines for hazardous installations.

LD SUMP PUMP (over 4') MOTOR/MOTOR MOUNT DETAIL



For LD pumps longer than 4', the motor mount "F", flexible coupling "D", and flange mounted bearing assembly "E", as used on the HD pumps, are substituted for the motor mount and coupling shown in the LD sketch. This is done to provide extra stability to the longer shafts.

Model HD Heavy Duty INDUSTRIAL SUMP PUMP



HD PARTS LIST

1. MOTOR (Specify type)
2. MOTOR MOUNT CASTING
4. FLEXIBLE COUPLING
6. ADJUSTMENT COLLARS
7. FLANGE MOUNTED BEARING ASSEMBLY
9. COLUMN/SHAFT HOUSING (Brass or Stainless)
11. INTERMEDIATE BUSHING
12. INTERMEDIATE BUSHING HOLDER
15. INLET CASTING
16. STRAIGHT BUSHING } (Sold as sets)
17. BOTTOM FLANGED BUSHING }
18. BASE (Cast Iron, Brass or Stainless)
19. IMPELLER (Brass or Stainless)
20. GASKET
21. BOTTOM PLATE
24. SWITCH-Open Drip/TEFC
    (See page 3 for explosion proof configuration)
25. SWITCH MOUNTING PLATE
27. ADJUSTMENT COLLARS (4 req'd)
28. TRIP ROD (Brass or Stainless)
29. FLOAT
30. SHAFT (Specify length)
32. TRIP ROD GUIDE PLATE

HARDWARE

Below is a list of all hardware used in our HD pump. The item numbers correspond to those identified in the exploded view to the left. All items of hardware used are of standard sizes and threads, and should be available from most industrial hardware suppliers and many local retail hardware stores. These descriptions are presented for your convenience should any replacement be necessary.

#	SIZE	DESCRIPTION	REQ'D
3.	3/8-16 X 1"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
5.	5/16-18 X 5/16"	ALLEN SOCKET SET SCREWS	4 REQ'D
6.	5/16-18 X 1"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
8.	5/16-18 X 5/16"	ALLEN HEAD SET SCREWS S/S	2 REQ'D
10.	6-32 X 3/8"	ROUND HEAD SCREWS S/S	2 REQ'D
13.	8-32 X 3/8"	ROUND HEAD SCREWS S/S	2 REQ'D
14.	5/16-18 X 1"	HEX HEAD SCREWS S/S	5 REQ'D
22.	1/4-20 X 1/2"	HEX HEAD SCREWS S/S	7 REQ'D
23.	1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
26.	1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	2 SETS
31.	5/16-18 X 1"	HEX HEAD SCREW S/S	1 SET