OPERATION AND MAINTENANCE PLAN

VOLUME II -- SHOP DRAWINGS AND MANUFACTURER'S CATALOGS AND MANUALS

UNION ROAD SITE
333 LOSSON ROAD
CHEEKTOWAGA, NEW YORK 14227
SITE REGISTRY NO. 915128

PREPARED FOR:

AMERICAN PREMIER UNDERWRITERS, INC.
(FORMERLY THE PENN CENTRAL CORPORATION)
ONE EAST FOURTH STREET
CINCINNATI, OHIO 45202

PREPARED BY:

NES, INC.

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DOCUMENT AUTHORIZATION FORM

Operation and Maintenance Plan
Volume II -- Shop Drawings and Manufacturer's Catalogs and Manuals

Union Road Site
333 Losson Road, Cheektowaga, New York
Site Registry No. 915128

Prepared for:

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One East Fourth Street, Cincinnati, Ohio 45202

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OPERATION AND MAINTENANCE PLAN

VOLUME II -- SHOP DRAWINGS AND MANUFACTURER'S CATALOGS AND MANUALS

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OPERATION AND MAINTENANCE PLAN

VOLUME II -- SHOP DRAWINGS AND MANUFACTURER'S CATALOGS AND MANUALS

INTRODUCTION

The intent of this document is to provide a reference resource and documentation storage of the following:

Shop Drawings
Manufacturer's Owners Manuals
Other Applicable Information

SHOP DRAWING REQUIREMENTS

As part of the contract documents for remedial activities the following are the required for submittals. Review all revisions to the contract documents, change orders, and other applicable requirements prior to conducting operation and maintenance operations.

A. Shop Drawings were required for each and every element of the Work. Each shop drawing was assigned a sequential number for the purpose of easy identification and retained its assigned number, with appropriate subscript, upon required re-submissions.

B. Shop Drawings were generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists and other data prepared by the Contractor, his subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction and installation of the Work, or a portion thereof.

C. The Contractor submitted to the Project Engineer a minimum of six (6) copies of Shop Drawings and approved data. When applicable and requested, the Project Engineer submitted one of the copies to the Department for their review and approval. The Project Engineer retained three (3) copies (for Project Engineer's, and NYSDEC Representative's files) and returned three (3) copies to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor required more than three (3), then the number of copies submitted was adjusted accordingly.

D. Shop Drawings showed the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it was customary to do so, when the dimensions were of particular importance, or when so specified, the drawings were certified by the manufacturer or fabricator as correct for the Work.

E. The Contractor was responsible for the prompt and timely submittal of all shop and working drawings so that there was no delay to the work due to the absence of such drawings.

F. All material or equipment were purchased or fabricated especially for the Contract after the required shop and working drawings were submitted as specified above, reviewed for conformance to the Contract requirements, and approved. All such materials and equipment and the Work involved in their installation or incorporation into the Work were shown in and represented by said drawings.

G. Until the necessary review was made, the Contractor did not proceed with any portion of the Work (such as the construction of foundations), the design or details of which were dependent upon the design or details of Work, materials, equipment or other features for which review was required.

H. All shop and working drawings were submitted to the Project Engineer by and/or through the Contractor, who was responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. Shop drawings were of standardized sizes to enable the Project Engineer and NYSDEC Representative to maintain a permanent record of the submissions. Approved standard sizes were:

(1) 28 inches by 40 inches;
(2) 24 inches by 36 inches;
(3) 11 inches by 17 inches; and
(4) 11 inches by 8-1/2 inches.

Provisions were made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein were returned for resubmission without being reviewed.

I. Only drawings that were checked and corrected by the fabricator were submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Project Engineer, the Contractor checked thoroughly all such drawings to satisfy himself that the subject matter conformed to the Drawings and Specifications in all

respects. All drawings that are correct were marked with the date, checker's name, and indication of the Contractor's approval, and then submitted to the Project Engineer.

J. If a shop drawing showed any deviation from the Contract requirements, the Contractor was required to make specific mention of the deviations in the Contractor's letter of transmittal.

K. If the Contractor submitted equipment that required modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, the Contractor also submitted details of the proposed modifications. If such equipment and modifications were accepted, the Contractor, at no additional cost to the Project Engineer, completed all work necessary to make such modifications.

Shop Drawings and Cut Sheets Required by Contract Documents

Considering the Contact Documents for the remedial activities that were conducted at the site, a listing of the submittals as required in the Technical Specification has been formulated. The intent is to provide a general listing, each Section of the Contact Documents referenced is to be reviewed and all submittals that were made as required shall be included in the final Volume II document. In an effort to reduce the size of the document, a summary of the shop drawings and appropriate approvals are included. Actual approved shop drawing submittals are available at NES, Inc. Document Control Storage Room, 44 Shelter Rock Road, Danbury, CT 06810.

SHOP DRAWING SUBMITTAL SUMMARY INFORMATION

SHOP DRAWING SUBMITTALS LIST FROM BDR, INC.

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
01	Mirafi 500 X	02850, 2.01	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
02	Type 2 Stone - Sieve	02850, 2.02	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
03	12", 15" RCP Class V	02722, 2.02	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
04	#3 Stone - Sieve	02270, 2.06	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
05	Buffalo Crushed Stone, Item 703.02 #1 Stone	02710, 2.01	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
06	Buffalo Crushed Stone, Item 703.07 Concrete Sand	02722, 2.01	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
07	Precast Meter Pit Sanitary	11306, 2.07	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
08	Control Building	13000, 2.01	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
09	Geotextile 40/30a Dewatering Trench	02710	FURNISH AS SUBMITTED..... 7/5/95 FURNISH AS NOTED ..... REJECTED .....
10	Round 1a Gravel Gas Collection Subdrainage System	02440 02710	FURNISH AS SUBMITTED ..... 7/5/95 FURNISH AS NOTED..... REJECTED.....
11	Stone Filling (Fine) Stabilize Tar Pit Lancaster Stone	NONE	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
12	Steel (4200 Gal) Dewater Wetlands	02140	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
13	Schedule	01300	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
14	Moisture-Density Relationship Test	02221	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
15	Request To Pump Water Onto Landfill	NYSDEC LETTER TO NES, JULY 20, 1995	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 7/25/95 REJECTED.....
16	Moisture Density General Fill #2	02221	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 7/25/95 REJECTED.....
16	Ford Ball Valve Perm San. Sewer	11310	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 7/25/95 REJECTED.....

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
17	Roadway Box for Ball Valve	11310	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
18	PVC Fittings	11310	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
19	PVC Pipe SDR 26	11310	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED..... REJECTED.....
20	Blake Equipment Effluent Station	11306 11306	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 8/18/95 REJECTED..... 8/8/95
20	Valve Pit Equipment	11306	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/22/95 REJECTED..... 8/8/95
20	Well System Blake Equipment	11310	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/22/95 REJECTED..... 8/8/95
21	White Electric LA Hazard, Inc.	16050 11306	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/22/95 REJECTED..... 8/8/95
21	Load Center Safety Switches	16050 11310	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/22/95 REJECTED..... 8/8/95
22	White Electric Lithonia Lighting	16050	FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/22/95 REJECTED..... 8/8/95
23	36" X 8' Fiberglass Wet Well	11306	FURNISH AS SUBMITTED ..... FURNISH AS NOTED See Sub. 30 REJECTED..... 8/8/95

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
24	Barnes 1.0 Hp Pump EH 10221	11306	FURNISH AS SUBMITTED ..... FURNISH AS NOTE See Sub. 30 REJECTED.....9/11/95
25	Baker Monitor Well Cap	11310	FURNISH AS SUBMITTED ..... FURNISH AS NOTED.....9/11/95 REJECTED.....
26	White Electric	16050 11306 11310	FURNISH AS SUBMITTED ..... FURNISH AS NOTED.....9/12/95 REJECTED.....
27	Certification of Seed and Fertilizer	02483	FURNISH AS SUBMITTED ..... FURNISH AS NOTED.....9/15/95 REJECTED.....
28	Certification of Mirafi 40/30A	02710	SEE SUBMITTAL NUMBER 9 FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... REJECTED.....
29	Blake - Omega, Equipment Control Panel, Hoffman Cut Sheet, Warwick Controls Information, Torque Arrestor, Grundfos Information, Pitless Adapter, Heat Trace Information	13310	REFER TO MEMORANDUM ESE-1437 FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/13/95 REJECTED.....
30	Barnes Pump Station, Koester Associates	11306	REFER TO MEMORANDUM ESE-1458 FURNISH AS SUBMITTED ..... FURNISH AS NOTED..... 10/27/95 REJECTED.....

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
31	Blake Submittal, Warrick Controls	13310	REFER TO MEMORANDUM ESE-1504 FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 10/27/95 REJECTED.....
32	Subdrainage System, 6" Ads And Mirafi 140 N	02710	REFER TO MEMORANDUM ESE-1582 FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 2/6/96 REJECTED.....
32A	Subdrainage System, 6" Ads	02710	REFER TO SUBMITTAL 32 FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 7/9/96 REJECTED.....
33	Geomembrane and Geosynthetic Clay Liner	02450	FERTILIZE AS RECOMMENDED BY SERVI-TECH FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 5/22/96 REJECTED.....
34	Topsoil	02483	FERTILIZE AS RECOMMENDED BY SERVI-TECH FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 8/20/96 REJECTED.....

SHOP DRAWING SUBMITTALS LIST
FROM PINE RIDGE, INC.

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
01	Gabion Baskets And Reno Mattresses	02221 and 02275	FURNISH AS SUBMITTED ..... FURNISH AS NOTED ..... 7/25/95 REJECTED.....
02	Mirafi 700 X and Mirafi 100 X Silt Fencing	02221 and 02275	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED ..... REJECTED.....
03	Light And Fine Stone Fill and Select Fill (2" Crusher)	02221 and 02275	FURNISH AS SUBMITTED ..... 7/25/95 FURNISH AS NOTED ..... REJECTED.....

SHOP DRAWING SUBMITTALS LIST
FROM GEOCON, INC.

SUBMITTAL NUMBER	SUBMITTAL DESCRIPTION	SPECIFICATION SECTION	PROJECT ENGINEER'S DETERMINATION
01	(Geo-Con, Inc.) Addendum I to NES, Inc. Health and Safety Plan	02454, 1.03	FURNISH AS SUBMITTED ..... 10/17/95 FURNISH AS NOTED..... REJECTED.....
02	(Geo-Con, Inc.) Work Plan	02454, 1.03	FURNISH AS SUBMITTED ..... 10/17/95 FURNISH AS NOTED..... REJECTED.....
03	(Geo-Con, Inc.) Trial Mix Report	02454, 1.03	FURNISH AS SUBMITTED ..... 10/17/95 FURNISH AS NOTED..... REJECTED.....

FROM MAXIM TECHNOLOGIES, INC.

01	Maxim Technologies, Inc. Proposed Well Materials	02170	FURNISH AS SUBMITTED .....2/23/96 FURNISH AS NOTED..... REJECTED.....

Manufacturer's Owner's Manuals

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE
- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE/STRAIN FORCE
- Transducers & Strain Gages
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL
- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY
- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION
- Data Acquisition and Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

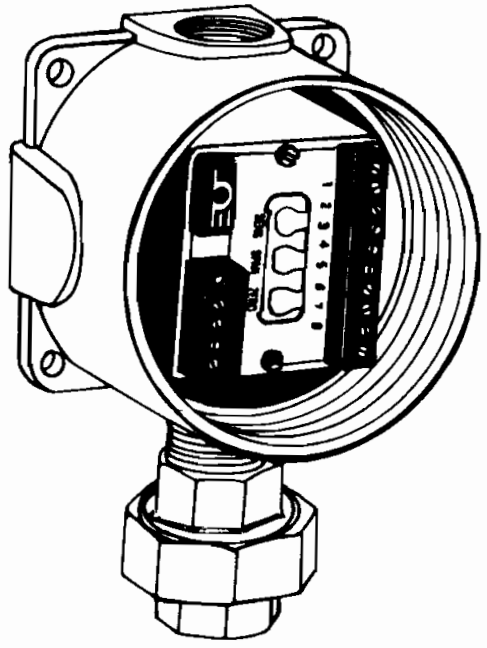
HEATERS
- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL
- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M0390/0595

FLSC-18B, FLSC-28, FLSC-34, FLSC-35B, FLSC-51/51B

Signal Conditioners



OMEGA®

An OMEGA Technologies Company

Operator's Manual

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FAX (514) 856-6886

Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA℠
Customer Service: 1-800-622-2378 / 1-800-622-BEST℠
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN℠
TELEX 996404 EASYLINK 62968934 CABLE: OMEGA

Servicing Europe: United Kingdom Sales and Distribution Center
25 Swannington Road, Broughton Astley, Leicestershire
LE9 6TU, England
Telephone: 44 (1455) 285520 FAX: 44 (1455) 283912

MADE IN USA

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

OMEGA is glad to offer suggestions on the use of its various products. Nevertheless, OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

Every precaution for accuracy has been taken in the preparation of this manual; however, OMEGA ENGINEERING, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with the information contained in the manual.

SPECIAL CONDITION: Should this equipment be used in or with any nuclear installation or activity, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:
1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATION**, consult OMEGA for current repair/calibration charges. Have the following information available BEFORE contacting OMEGA:
1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC

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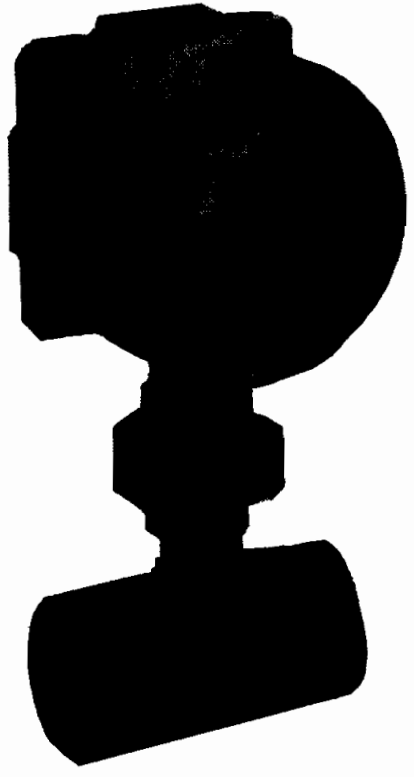
GENERAL TABLE OF CONTENTS



FLSC-35B With Explosion-Proof Housing Mounted on FTB 100 Turbine Meter

GENERAL CONSIDERATIONS

FLOWMETER INSTALLATION

Proper application of the turbine flowmeter requires a suitable piping installation in order to achieve accurate and reliable operation. (Refer to Figure 1).

The piping configuration immediately preceding and following the flowmeter is termed the meter run. Refer to the flowmeter's operators manual when installing the flowmeter and meter run.

RELATIVE — The performance of the turbine flowmeter is affected by fluid swirl and non-uniform velocity profiles. The following recommendation will reduce such flow irregularities.

It is advisable not to locate the meter run immediately downstream of pumps, partially opened valves, bends or other similar piping configurations. In addition, the area surrounding the flowmeter should be free of sources of electrical noise such as motors, solenoids, transformers and power lines which may be coupled to the pickoff device.

The metering section should not be subjected to excessive vibration or shock. Such a condition may result in a mechanically induced output signal from the pickoff device.

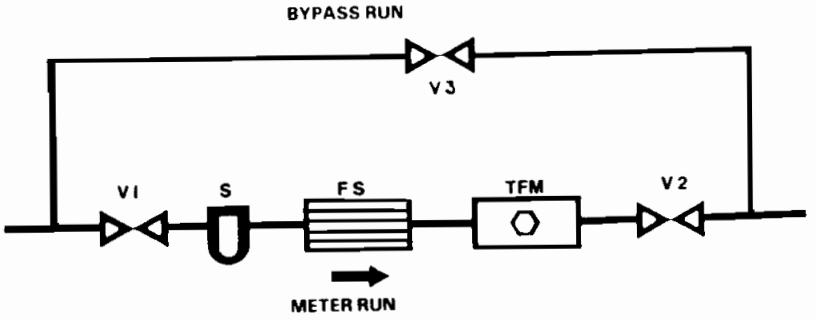
METER RUN — In general, the meter run should be chosen to have the same inner diameter as the meter bore. A minimum of 10 pipe diameters of straight pipe up stream and 5 pipe diameters downstream are required. Where this optimum line configuration can not be implemented, it is advisable to install a flow straightener properly positioned upstream of the flowmeter. Orientation is not a critical factor, however, horizontal is a preferred orientation.

BYPASS RUN — A properly sized bypass run with suitable blocking valves may be equipped where an interruption in fluid flow for turbine meters servicing can not be tolerated.

STRAINER — A strainer, filter and/or air eliminator is recommended to reduce the potential of fouling or damage.

On initial startup of a line, it is advisable to install a spool piece purging the line to eliminate damaging the flowmeter, due to flux, tape, solder, welds or other contaminates carried along by the fluid stream.

CAVITATION — Cavitation causes measurement inaccuracies in turbine flowmeters and should be avoided by suitable line and operating configurations.



V1,2	BLOCKING VALVE
S	STRAINER
FS	FLOW STRAIGHTENER
TFM	TURBINE FLOWMETER
V3	BYPASS VALVE

Figure 1. Typical Flowmeter Installation

Whenever the pressure within a pipeline instantaneously falls below the equilibrium vapor pressure of the fluid, a portion of the fluid vaporizes and forms bubbles in the pipe line. This is termed cavitation. Cavitation is eliminated by maintaining adequate back pressure on the flowmeter. A downstream valve that provides the necessary back pressure is one means for preventing cavitation in the metering run. Control valves should be located downstream, if possible. Some installations may also make use of a vapor eliminator upstream of the flowmeter.

The minimum required back pressure may be estimated using the following equation:

Min. Back Pressure = 1.3 X Vapor Pressure + 2X Pressure Drop

INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS

In considering the interconnections between the flowmeter and the flow measurement system some attention must be given to anticipated noise sources and to the coupling of these noise sources to the interconnecting wiring.

Noise signals may be coupled inductively or capacitively into the wiring between the flowmeter and the electronic measuring systems. In general, utilizing a shielded, twisted pair for the interconnection greatly reduces this coupling. The shield should be grounded on one end of the cable only. In general, grounding only on the electronic measuring system is best.

However, even with proper interconnecting cabling, cross talk with other signal lines or power lines may still occur and should be avoided. Physical isolation in the manner in which the wiring is run reduces the chance of potential problems.

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FLSC-18B SIGNAL CONDITIONER

SECTION 1 INTRODUCTION

The OMEGA® FLSC-18B High Accuracy Integral Signal Conditioner is designed for direct mounting onto OMEGA Series FTB-100 and 200 Turbine Meters.

The input circuitry of the signal conditioners has been designed to receive and condition the low level turbine meter signals while rejecting unwanted noise and spurious signals. A signal threshold control is provided which allows the user to set the input sensitivity above the ambient noise level, thereby eliminating any false signal on the output.

The output signal is a DC current (4-20 mA) which is proportional to flow rate. The FLSC-18B is powered by a user supplied, filtered DC voltage. An on board regulator provides the required regulation and noise rejection.

A zero and span potentiometer allow for simple field adjustment of the analog output from the signal conditioner.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department .

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION OF THE FLSC-18B

The FLSC-18B should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

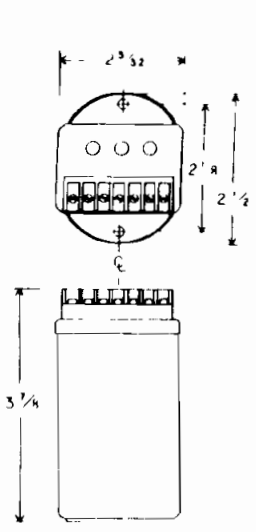
If the unit is mounted on a turbine flowmeter in an explosion proof conduit enclosure, orientate the flowmeter and run conduit to prevent the accumulation of moisture in the conduit enclosure as much as is practical. In addition, assure electronics will not be overheated by hot process lines.

Refer to Figure 2-1 for outline dimensions. Drill appropriate mounting holes as required.

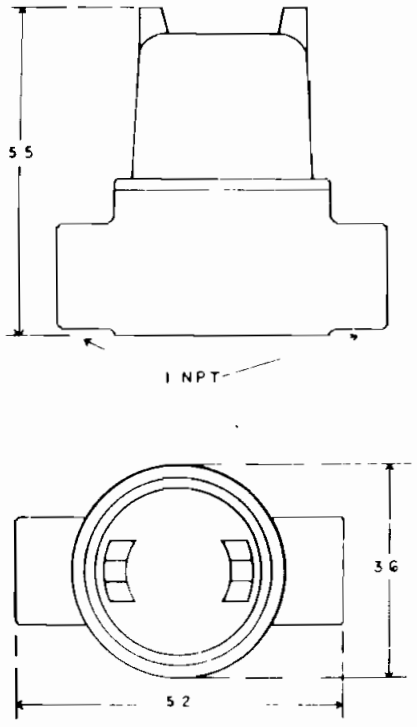
Refer to Figure 2-2, wiring installation drawing for appropriate terminals for interconnections. The signal leads from the turbine should be shielded whenever the FLSC-18B is not integrally mounted. Ground shield on one end only. If desired,use solder lug provided on ground stud. Connections to the terminal block should be carefully dressed to avoid having bare wires extending pass the screw clamp on the terminal block. This is particularly important for units mounted within the explosion proof enclosure. Wires should be neatly dressed near bottom of enclosure to assure wiring will not become fouled when cover is installed.

Connect two conductor shielded cable from flowmeter. Connect shield to FLSC-18B only.

Unit is powered by a DC voltage which must be within 8 to 40 volts. Connect power as outlined in Figure 2-2.



Dimensions without Housing



Dimensions with Explosion Proof Housing

Figure 2-1. Outline Dimensions

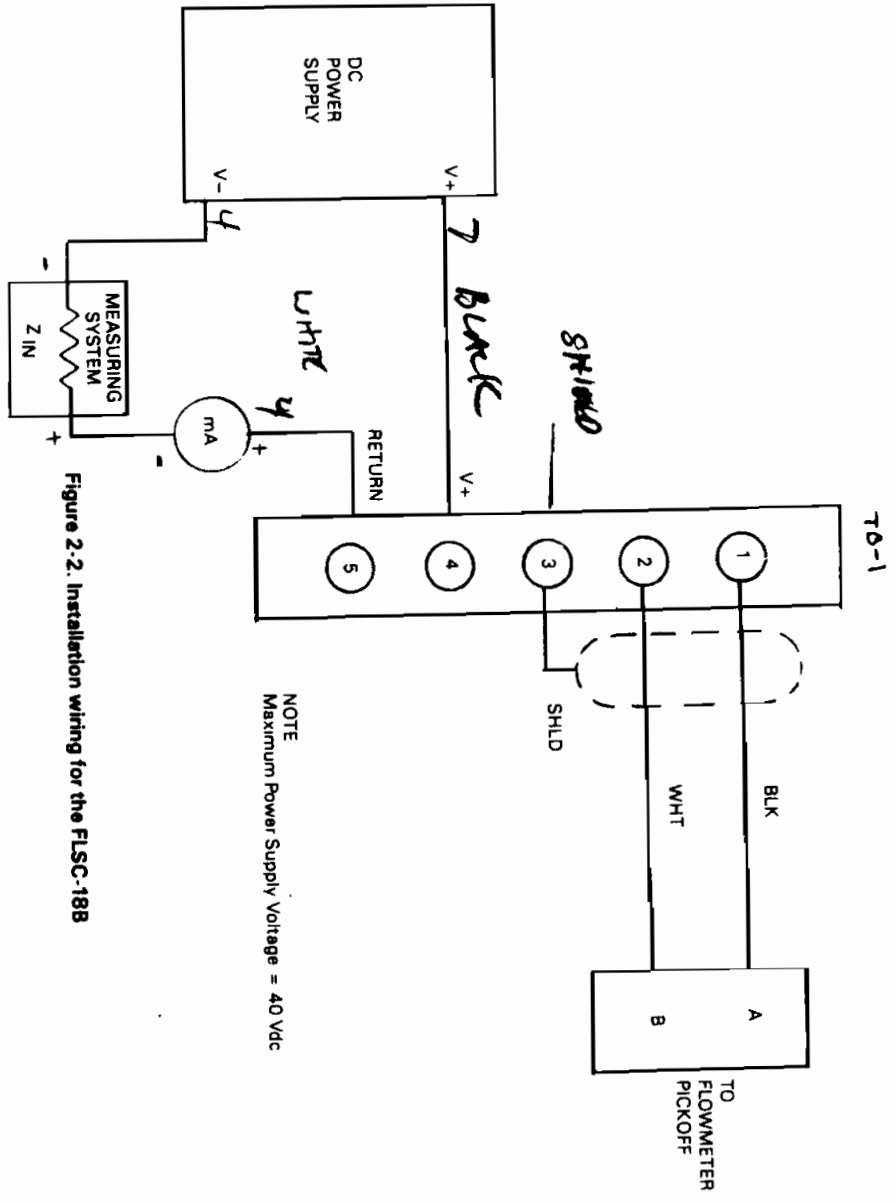


Figure 2-2. Installation wiring for the FLSC-18B

SECTION 3 OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil and power to the unit. If false indication occurs turn SENSITIVITY control counter clockwise until indication stops.

3.1 PRINCIPLE OF OPERATION

A simplified block diagram of the FLSC-18B Frequency to Current Converter is shown in Figure 3-1. Key functional blocks as well as flow information are designated. The basic operation of the system is as follows.

The frequency signal from the flowmeter is connected to the FLSC-18B with a twisted shielded pair cable. The signal enters the SENSITIVITY control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a signal conditioning chain where it is filtered, amplified and shaped into a train of digital pulses whose frequency is related to the volume flow rate and where each pulse represents a discrete volume of fluid.

The signal entering the frequency to voltage converter is passed through a combination of a divide by N and a DIP switch matrix. The ON output is chosen whose pulse rate is between 75 and 150 Hz at the maximum flow rate measured. This scaled pulse rate is then filtered into an analog voltage. This voltage is proportional to volumetric flow rate.

The resulting output voltage related to flow is then fed into the output amplifier. The output amplifier is a voltage to current amplifier and offers ZERO and SPAN adjustments in the process range of 4-20 mA.

3.2 CONTROLS AND ADJUSTMENTS (See Figure 3-2.)

SENS — A single turn control used to set the threshold sensitivity level above the ambient noise pickup.

RANGE — A dual in line (DIP) switch (see Figure 3-3 and Table 3-1.) located within the enclosure which is used to program the module to accept an input frequency range.

SPAN — A multiple turn adjustment which is used to set the voltage output signal to the desired span corresponding to the equivalent flow range (i.e., 4 to 20mA corresponding to 0-100 GPM).

ZERO — A multiple turn adjustment which is used to set output signal with no flow to the desired "zero" value (i.e., 4 mA).

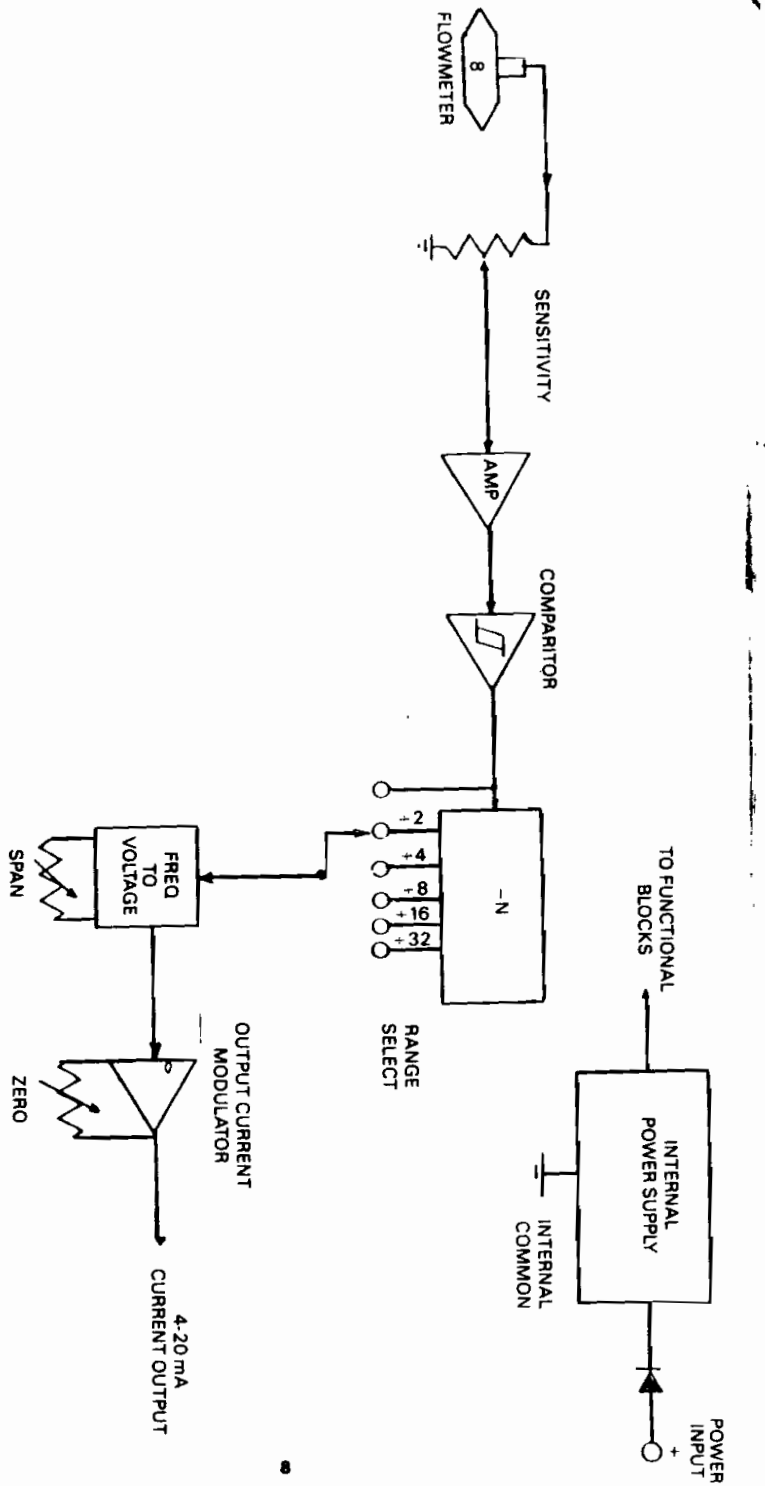


Figure 3-1. FLSC-18B Block Diagram

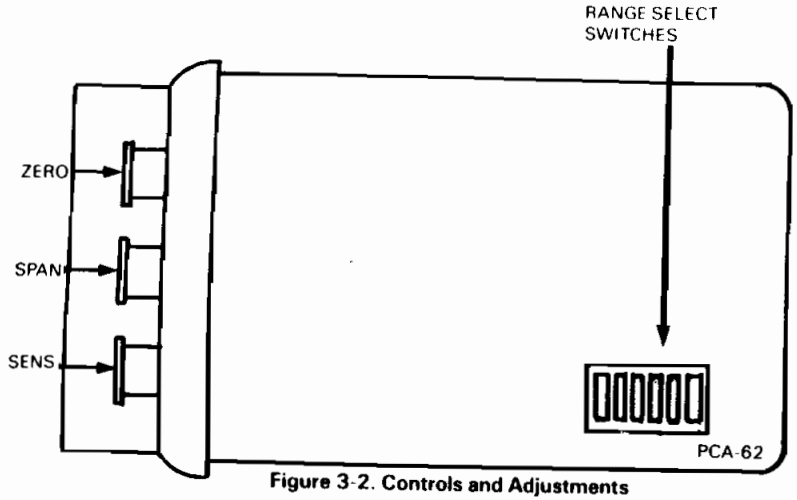
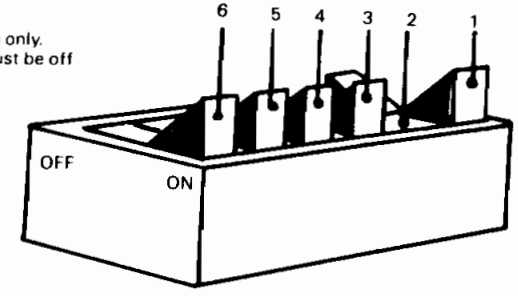


Figure 3-2. Controls and Adjustments

Switch 2 is shown depressed for illustrative purposes only

NOTE
Select one switch only.
All other switches must be off



1. Open cover by removing the two screws on the side of box. Remove printed circuit subassembly.
2. Turn on desired range position using a ball point pen or similar object.
3. Reassemble in lower case.

Figure 3-3. Range Select for Analog Output

TABLE 3-1
RANGE SELECT

Range Select Switch Position	For F Max.
1	75 to 150
2	150 to 300
3	300 to 600
4	600 to 1200
5	1200 to 2400
6	2400 to 4800

SECTION 4 CALIBRATION OF ANALOG OUTPUT

4.1 INTRODUCTION

In general, all flow measurement systems supplied by OMEGA Engineering have been factory calibrated as specified by the user, at the time of purchase.

Field calibration is only required when a change has occurred or is sought to the measuring system. Such a change may be due to repair, replacement or recalibration of the flowmeter, or perhaps a change in the analog output span.

4.2 PROCEDURE

Begin by determining the equivalent maximum volumetric flow rate in GPM, expected by the application, term this GPM (MAX). GPM (MAX) may be calculated based on the analog output scale requirements or may be the maximum flow rate listed on the flowmeter's calibration sheet.

From the calibration constant (or K Factor) listed on the data sheet for the flowmeter, obtain the frequency corresponding to GPM (MAX) using Equation #1 and designate this frequency F (MAX).

$$\text{Equation \#1 } F_{MAX} = \frac{K_{AVE} \times GPM_{MAX}}{60}$$

The analog output of the FLSC-18B may be calibrated with the aid of an external oscillator used in conjunction with a frequency counter.

The external oscillator is used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals as shown in Figure 4-1. The oscillator's output frequency is set to equal F (MAX) as indicated on the frequency counter.

1. The course range adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-62 printed circuit card. See Table 3-1 to determine required switch position and set into switch as shown in Figure 3-2. for anticipated F MAX.

   NOTE

   It is necessary to open the cover of the enclosure by removing two screws on side of box and lifting cover. Two printed circuit cards are attached. The "RANGE" Dip Switch may be programmed with a pen. Input power should be removed during this step.

2. Connect a digital milliampmeter or digital voltmeter as shown in Figure 4-1.

3. Adjust SPAN control fully counter clockwise or 20 turns.
4. Adjust ZERO control for desired zero current (i.e., 4 mA).
5. Inject the Test Frequency equal to F MAX while adjusting SPAN for current equal to desired Full Scale (20 mA). See test setup shown in Figure 4-1.)

Repeat steps 4 and 5 until no change is observed.

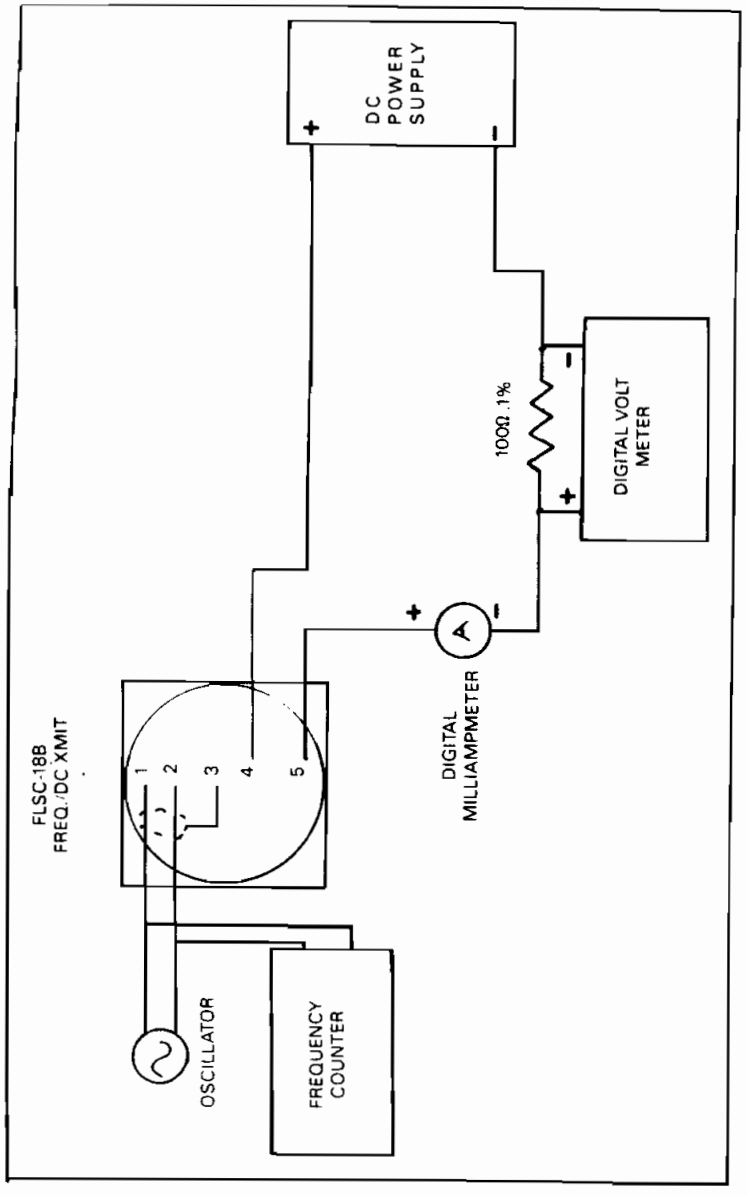


Figure 4-1. Calibration Set-up

SECTION 5 TROUBLESHOOTING

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied with the turbine flowmeter.

Factory consultation is available to assist in diagnosing problems. Please note that in some cases factory repairs can be performed more easily than can be accomplished in the field.

Failure conditions are listed and the possible corrective actions given to eliminate the observed problem.

Proper operation of the FLSC-18B can be assumed when with power applied to the unit, the analog output produces a current output signal of 4-20 mA with a span corresponding to that established by the calibration procedure.

OBSERVED CONDITION	CORRECTIVE ACTION
A. Analog Output With No Flow	1. Noise on input. Slowly turn SENS pot CCW until false indication stops. NOTE: In fully CCW position the unit will not operate. 2. Replace pickup coil 3. Defective FLSC-18B, repair or replace.
B. Incorrect Zero Reading With No Flow	1. Verify that power supply voltage is sufficient for the required load resistance. 2. Unit is out of calibration — recalibrate. 3. Defective FLSC-18B, repair or replace.
C. Current Exceeds Desired Span	1. Flowmeter being used beyond calibrated span of FLSC-18B 2. Calibration of FLSC-18B incorrect. Recalibrate. 3. Defective unit, repair or replace.

D. No Current Output at All	1. Power supply polarity is reversed. Check wiring as per wiring installation. 2. Short on flowmeter coil or shield. Replace coil and check wiring. 3. Defective unit, repair or replace.

SECTION 6 SPECIFICATIONS

INPUT: Input protected, RF and band pass filtered adjustable trigger level.

Input Impedance 40 kilohm (nominal)

Trigger Sensitivity 10 millivolt RMS (minimum) 10 to 1000 Hz

Over Voltage 120 volts RMS absolute (maximum)

CURRENT OUTPUT: Accuracy ±0.05% of full scale ±200 PPM/°C

Range 4-20 mA

Response time 0.5 seconds for 10 to 90%

Load Resistance: Dependent on excitation voltage (see Figure 5-1)

$$R_{LOAD} = \frac{V_{Ext} - 8}{I.F.S.}$$

where V_{Ext} = Excitation Voltage

I.F.S. = Full Scale Current

Output ripple less than 0.2% of F.S.

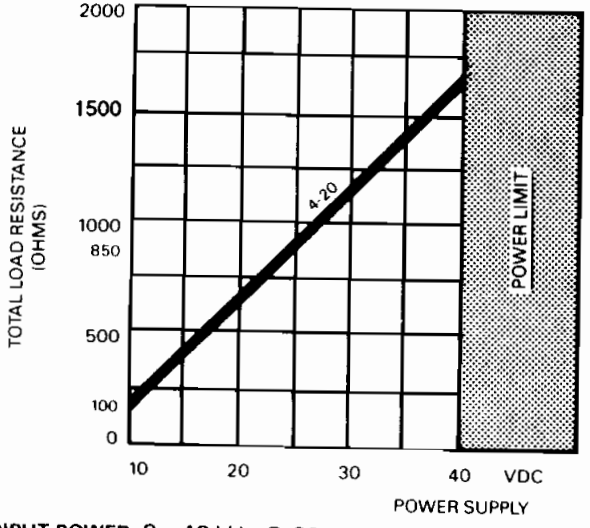


Figure 5-1. Load Resistance

INPUT POWER: 8 – 40 Vdc @ 30 mA

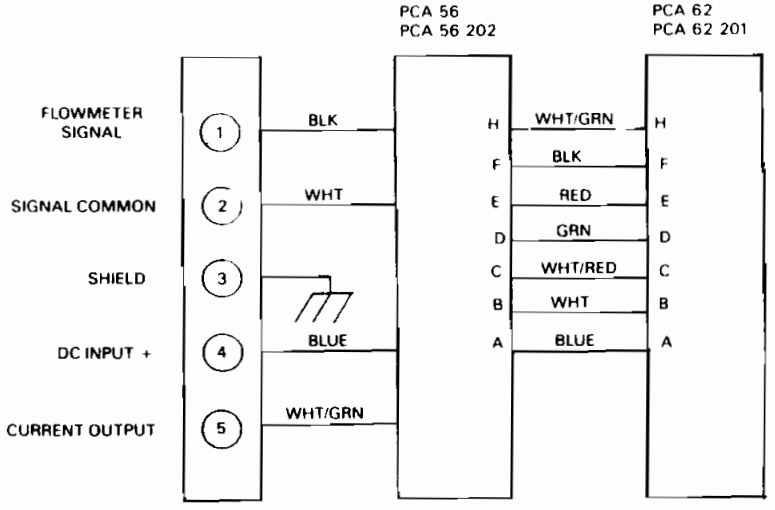
TEMPERATURE RANGE: 0°– 70°C (32° to 158°F)

ELECTRICAL CONNECTIONS: Screw Terminals

MAXIMUM LEAD LENGTH: 100 ft. of 24 gage copper wire

SECTION 6 SPECIFICATIONS (CONT.)

ELECTRICAL HOUSING: Class I, Group D
Class II Group E, F, G
Class III



INTERNAL WIRING SCHEMATIC FLSC-18B

TABLE OF CONTENTS
FLSC-28 SIGNAL CONDITIONER

SECTION 1 INTRODUCTION

The OMEGA® FLSC-28 High Accuracy Integral Signal Conditioners are designed for direct mounting onto OMEGA Series FTB-100 and 200 Turbine Meters.

The input circuitry of the FLSC-28 Signal Conditioners has been designed to receive and condition the low level turbine meter signals while rejecting unwanted noise and spurious signals. A signal threshold control is provided which allows the user to set the input sensitivity above the ambient noise level, thereby eliminating any false signal on the output.

The FLSC-28 provides a 0-5 V output that runs off user supplied 10-40 V dc power supply. A RESPONSE TIME control provides for adjustment of the response time and output ripple to suit user requirements. Non-interacting ZERO and SPAN controls allow for convenient calibration of desired analog span. These features combine to form an interface between a flow transducer and a host system.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department .

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION OF THE FLSC-28

The FLSC-28 should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

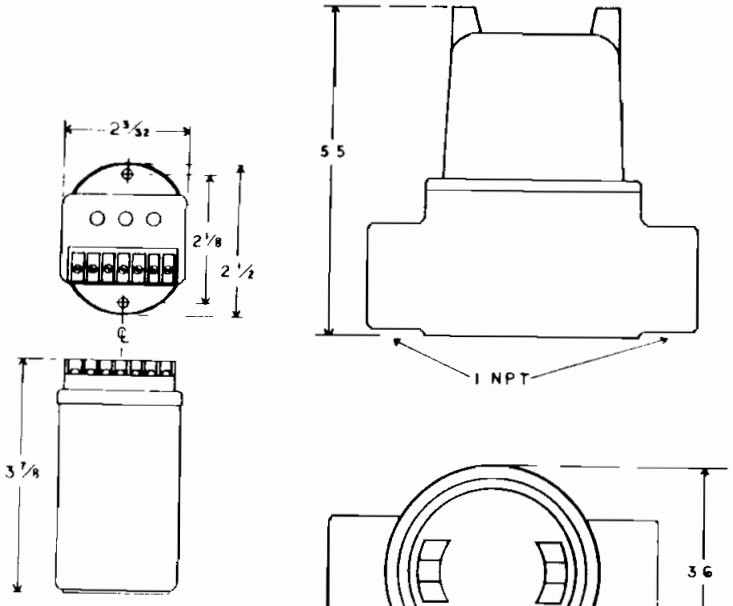
If the unit is mounted on a turbine flowmeter in an explosion proof conduit enclosure, orientate the flowmeter and run conduit to prevent the accumulation of moisture in the conduit enclosure as much as is practical. In addition, assure electronics will not be overheated by hot process lines.

Refer to Figure 2-1, outline and installation drawings. Drill mounting holes where appropriate.

Refer to Figure 2-2, wiring the FLSC-28 for the appropriate terminals for interconnections.

The signal leads from the turbine should be shielded whenever the FLSC-28 is not integrally mounted. Ground shield on one end only. If desired, use solder lug provided on ground stud.

Connections to the terminal block should be carefully dressed to avoid having bare wires extending pass the screw clamp on the terminal block. This is particularly important for units mounted within the explosion proof enclosure. Wires should be neatly dressed near bottom of enclosure to assure wiring will not become fouled when cover is installed.



Without Housing

With Explosion Proof Housing

Figure 2-1. Installation Dimensions

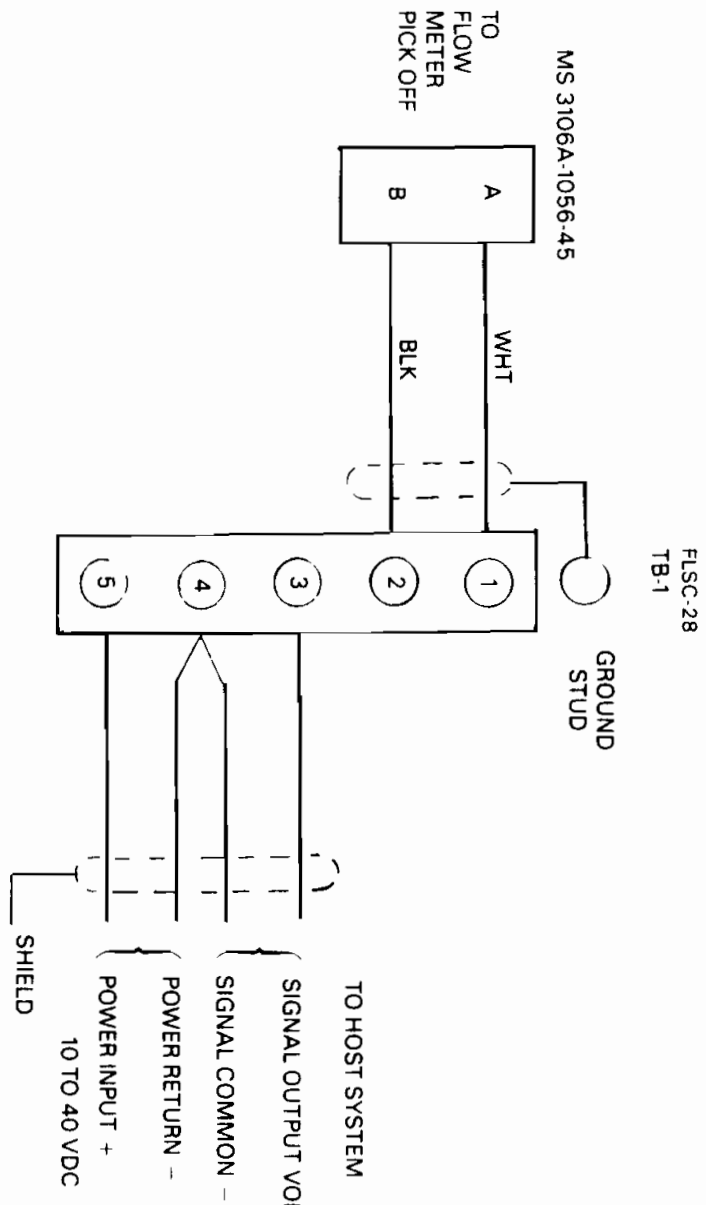


Figure 2-2. Wiring Installation for FLSC-28

The analog output signal leads may be run to the host system's signal input and power with the following options:

1. Four conductor shielded cable
2. Three conductor shielded cable (over short distances)
3. Two, two conductor shielded cables, one pair for signal output, one pair for power input.

Ground shield at one end of cable only.

The power for the FLSC-28 is provided by the Host System. 10-40 Vdc should be provided and installed with correct polarity.

SECTION 3 OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil and power to the unit. If false indication occurs turn SENSITIVITY control counterclockwise until indication stops.

The analog output commences with flow through the flowmeter.

For the analog output, the span is established by either the factory calibration or field calibration. The range is 0-5 Vdc.

3.1 PRINCIPLE OF OPERATION

A simplified block diagram of the FLSC-28 Frequency to Current Converter is shown in Figure 3-1. Key functional blocks as well as flow information are designated. The basic operation of the system is as follows.

The frequency signal from the flowmeter is connected to the FLSC-28 with a twisted shielded pair cable. The signal enters the SENSITIVITY control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a signal conditioning chain where it is filtered, amplified and shaped into a train of digital pulses whose frequency is related to the volume flow rate and where each pulse represents a discrete volume of fluid.

The signal entering the frequency to voltage converter is passed through a combination of a divide by N and a DIP switch matrix. The QN output is chosen whose pulse rate is between 75 and 150 Hz at the maximum flow rate measured. This scaled pulse rate is then filtered into an analog voltage. This voltage is proportional to volumetric flow rate.

The resulting output voltage related to flow is then fed into the output amplifier. The output amplifier is a voltage to current amplifier and offers ZERO and SPAN adjustments and is available in the process range of 0-5 Vdc.

The precision power supply filters and regulates the input power and generates the internal 7.5 Vdc power for all circuits as well as providing reverse polarity protection.

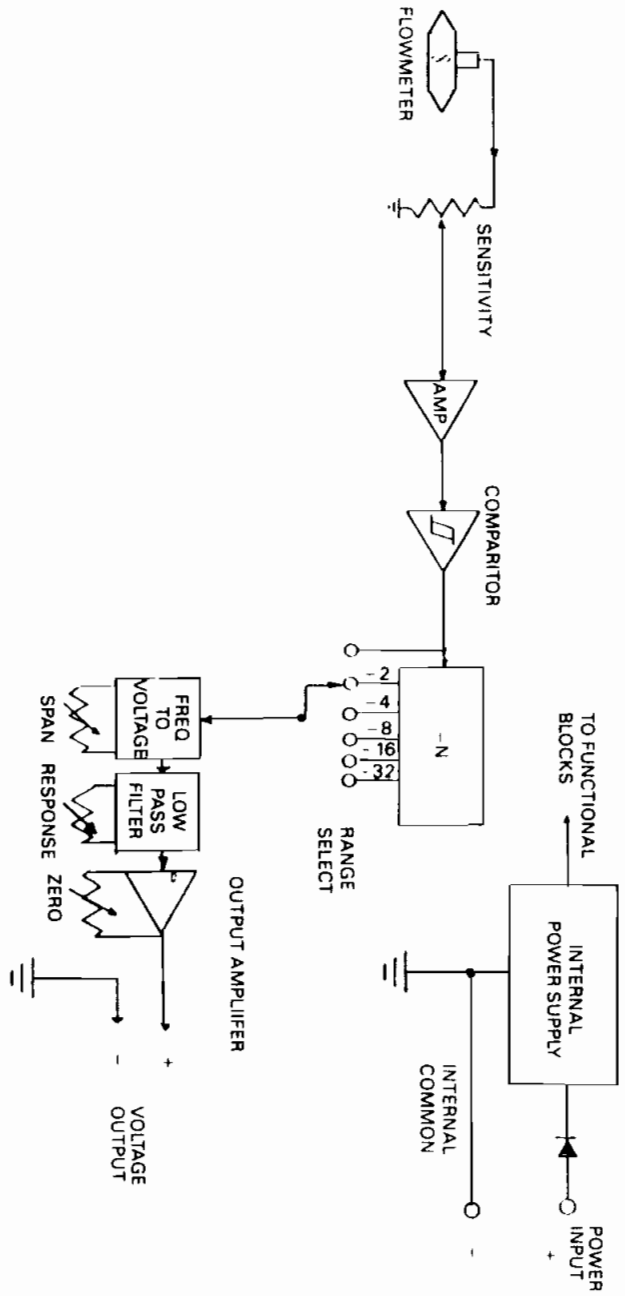


Figure 3-1. FLSC-28 Block Diagram

3.2 CONTROLS AND ADJUSTMENTS (See Figure 3-2.)

SENS — A single turn control used to set the threshold sensitivity level above the ambient noise pickup.

RANGE — A dual in line (DIP) switch located within the enclosure (see Figure 3-3 and Table 3-1) which is used to program the module to accept an input frequency range.

SPAN — A multiple turn adjustment which is used to set the voltage output signal to the desired span corresponding to the equivalent flow range (i.e., 0 to 5V corresponding to 0-100 GPM).

ZERO — A multiple turn adjustment which is used to set output signal with no flow to the desired "zero" value (i.e., 0.00V dc).

RESPONSE — A multiple turn adjustment which is used to set the response time of the analog output.

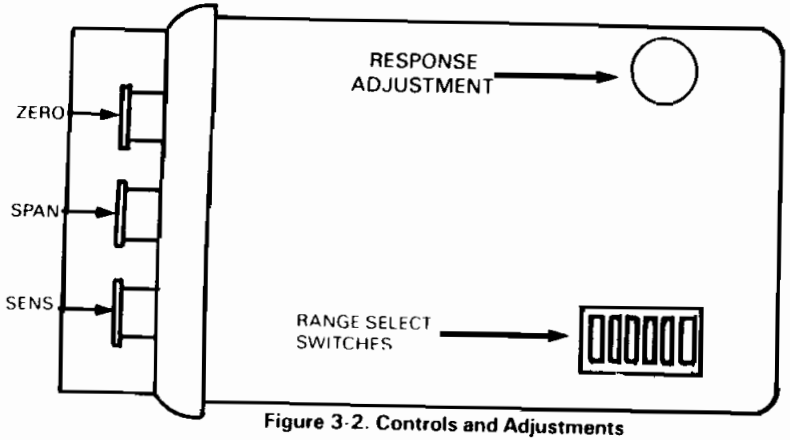
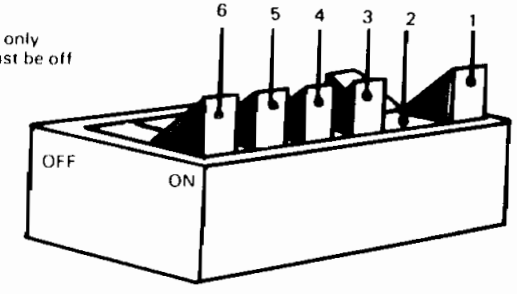


Figure 3-2. Controls and Adjustments

Switch 2 is shown depressed for illustrative purposes only

NOTE
Select one switch only
All other switches must be off



1 Open cover by removing the two screws on the side of box. Remove printed circuit subassembly
2 Turn on desired range position using a ball point pen or similar object
3 Reassemble in lower case

Figure 3-3. Range Select for Analog Output

TABLE 3-1
RANGE SELECT

Range Select Switch Position	For F Max.
1	75 to 150
2	150 to 300
3	300 to 600
4	600 to 1200
5	1200 to 2400
6	2400 to 4800

SECTION 4 CALIBRATION OF ANALOG OUTPUT

4.1 INTRODUCTION

In general, all flow measurement systems supplied by OMEGA Engineering have been factory calibrated as specified by the user, at the time of purchase.

All systems which underwent such a factory calibration have a calibration card attached prior to shipment. This card contains the details of analog outputs as well as other useful calibration data.

Field calibration is only required when a change has occurred or is sought to the measuring system. Such a change may be due to repair, replacement or recalibration of the flowmeter, or perhaps a change in the analog output span.

4.2 CALIBRATION PROCEDURE

Begin by determining the equivalent maximum volumetric flow rate in GPM, expected by the application, term this GPM (MAX). GPM (MAX) may be calculated based on the analog output scale requirements or may be the maximum flow rate listed on the flowmeter's calibration sheet (supplied with flowmeter).

From the calibration constant (or K Factor) listed on the data sheet for the flowmeter, obtain the frequency corresponding to GPM (MAX) using Equation #1 and designate this frequency F (MAX).

$$\text{Equation \#1: } F_{MAX} = \frac{K_{AVE} \times GPM_{MAX}}{60}$$

The analog output of the FLSC-28 may be calibrated with the aid of an external oscillator used in conjunction with a frequency counter.

The external oscillator is used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals as shown in Figure 4-1. The oscillator's output frequency is set to equal F (MAX) as indicated on the frequency counter. Power is supplied from a DC source and the analog output voltage is measured with a digital voltmeter.

1. The course range adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-66 printed circuit card. See Table 3-1 to determine required switch position and set into switch as shown in Figure 3-3 for anticipated F MAX.

NOTE

It is necessary to open the cover of the enclosure by removing two screws on side of box and lifting cover. Two printed circuit cards are attached. The "RANGE" Dip Switch may be programmed with a pen. Input power should be removed during this step.

2. Zero Adjustment
   a. The redual DC voltage at the output of the FLSC-28 may be reduced to a low value (a few millivolts) with the aid of the zero adjustment.
   b. Apply the proper DC voltage to the power input. Turn the input frequency off.
   c. Turn the zero control CCW until no further decrease in the output level is observed. Then turn the zero control CW until the zero voltage starts to just increase.
3. Span Adjustment
   a. Turn the input frequency on and adjust frequency to obtain FMAX.
   b. Adjust the span control to obtain the span voltage on the output (5.000 Vdc)
4. Response Adjustment (Internal — located on the PCA-66 printed circuit card, see Figure 3-2)
   a. The FLSC-28 is provided with an adjustable response trim control which allows the user to control the response time to obtain either fast response or minimum ripple.
   b. To slow down response turn the response control CCW, to speed up response turn the response control CW. The maximum number of turns is 20 on this control. The control will not be damaged if the end stops are reached and a slipping action will be felt.
5. Sensitivity Adjustment
   a. The sensitivity adjustment is generally left in the full CW position and is adjusted in the final installation only when false pickup occurs during periods of no flow. See Section 3 Operation.

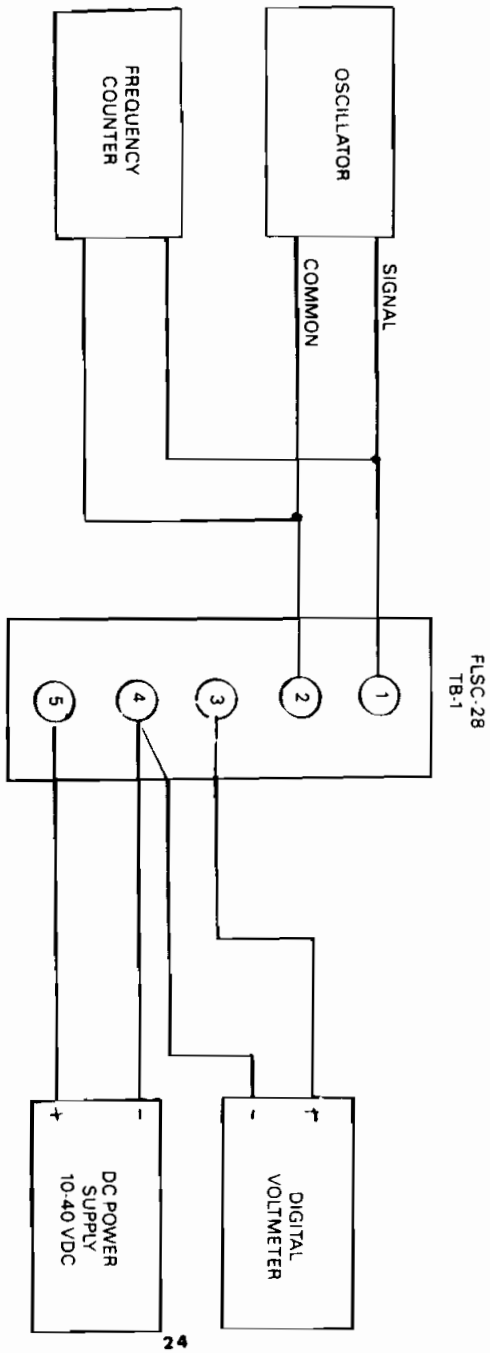


Figure 4-1. Calibration Set-up

SECTION 5 TROUBLESHOOTING

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied separately.

Factory consultation is available to assist in diagnosing problems. Please note that in some cases factory repairs can be performed more easily than can be accomplished in the field.

Failure conditions are listed and the possible corrective actions given to eliminate the observed problem.

Proper operation of the FLSC-28 can be assumed when with power applied to the unit, the analog output produces a voltage output signal of 0-5 Vdc with a span corresponding to that already established by the calibration procedure.

OBSERVED CONDITION	CORRECTIVE ACTION
A. Analog Output With No Flow	1. Noise on input. Slowly turn SENS pot CCW until false indication stops. NOTE: In fully CCW position the unit will not operate. 2. Replace pickup coil 3. Defective FLSC-28, repair or replace.
B. Incorrect Zero Reading With No Flow	1. Verify that power supply voltage is within limit. 2. Unit is out of calibration — recalibrate. 3. Defective FLSC-28, repair or replace.
C. Voltage Exceeds Desired Span	1. Flowmeter being used beyond calibrated span of FLSC-28 2. Calibration of FLSC-28 incorrect. Recalibrate. 3. Defective unit, repair or replace.

OBSERVED CONDITION	CORRECTIVE ACTION
D. Incorrect Analog Output with Flow	1. Load resistance too small. 2. Noise pickup present. Adjust Sensitivity. 3. Calibration of FLSC-28 incorrect. Recalibrate.
E. Large Ripple on Analog Output	1. Wrong "Range" switch selected. Recalibrate. 2. Flowmeter being operated below range. Adjust response control to minimize ripple.

SECTION 6 SPECIFICATIONS

INPUT: Input protected, RF and band pass filtered, adjustable trigger level.
Input Impedance — 40 kilohm (nominal)
Trigger Sensitivity — 10 millivolt RMS (minimum) 10 to 1000 Hz
Over Voltage — 120 volts RMS absolute (maximum)

VOLTAGE OUTPUT: Accuracy ±0.05% of full scale ±200 PPM/°C
Range 0-5V
Impedance less than 10 ohms.
Response time .5 — 1.5 seconds, for 10 to 90%, adjustable.
Output ripple less than 0.2% of F.S.
Load resistance output can source up to 10 mA into a grounded load only.

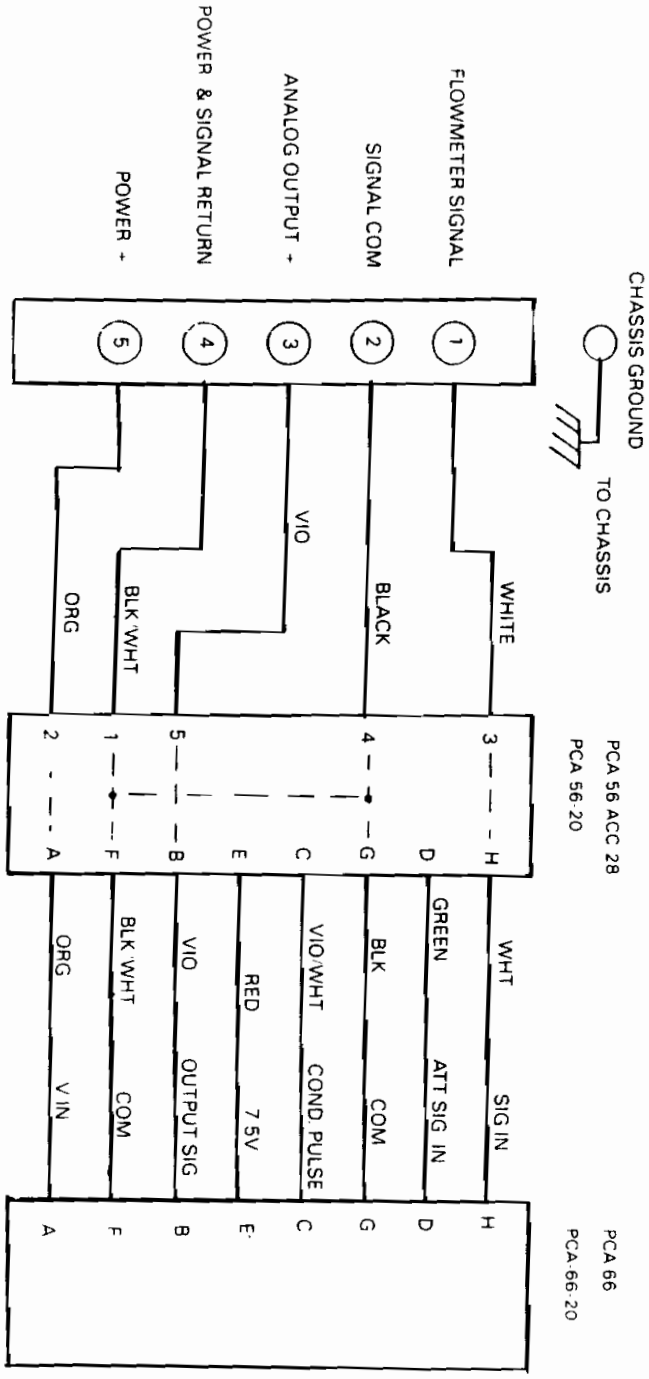
INPUT POWER: 10—40 Vdc @ 10 mA

TEMPERATURE RANGE: 0°— 70°C (32° to 158°F)

ELECTRICAL CONNECTIONS: Screw Terminals

MAXIMUM LEAD LENGTH: 100 ft. of 24 gage copper wire

ELECTRICAL HOUSING: Class I, Group D
Class II Group E, F, G
Class III



FLSC-28 INTERNAL CASE WIRING SCHEMATIC

FLSC-28 INTERNAL CASE WIRING SCHEMATIC

TABLE OF CONTENTS
FLSC-34 SIGNAL CONDITIONER

SECTION 1 INTRODUCTION

The OMEGA® FLSC-34 High Accuracy Integral Signal Conditioners are designed for direct mounting onto OMEGA Series FTB-100 and 200 Turbine Meters.

The input circuitry of the FLSC-34 signal conditioner has been designed to receive and condition the low level turbine meter signals while rejecting unwanted noise and spurious signals. A signal threshold control is provided which allows the user to set the input sensitivity above the ambient noise level, thereby eliminating any false signal on the output.

The FLSC-34 runs off 115 Vac and provides both an unscaled pulse output (CMOS, TTL compatible) and a 4-20 mA output. A zero and span potentiometer allow for simple field adjustment of the analog outputs from the signal conditioners.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION OF THE FLSC-34

The FLSC-34 should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

If the unit is mounted on a turbine flowmeter in an explosion proof conduit enclosure, orientate the flowmeter and run conduit to prevent the accumulation of moisture in the conduit enclosure as much as is practical. In addition, assure electronics will not be overheated by hot process lines.

Refer to Figure 2-1 for outline dimensions. Drill appropriate mounting holes as required.

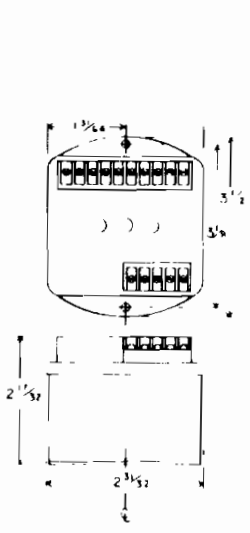
Refer to Figure 2-2, wiring installation drawing for appropriate terminals for interconnections. The signal leads from the turbine should be shielded whenever the FLSC-34 is not integrally mounted. Ground shield on one end only. If desired, use solder lug provided on ground stud. Connections to the terminal block should be carefully dressed to avoid having bare wires extend pass the screw clamp on the terminal block. This is particularly important for units mounted within the explosion proof enclosure. Wires should be neatly dressed near bottom of enclosure to assure wiring will not become fouled when cover is installed.

Connect two conductor shielded cable from flowmeter. Connect shield to FLSC-34 only.

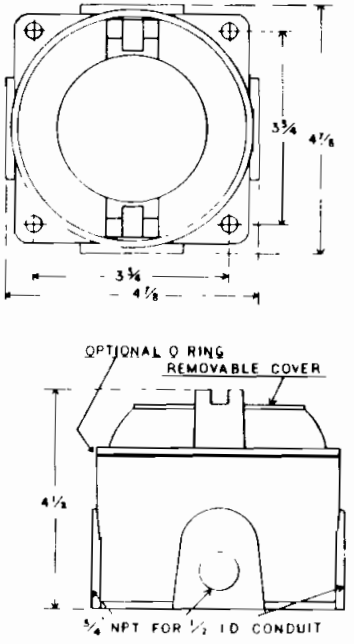
Line power connection should be made through a circuit breaker so that power can be turned off while servicing the FLSC-34. Power is 117 Vac ±10%, an earth ground connection is also required.

Pulse output is CMOS/TTL compatible. Wire to appropriate terminal, see Figure 2-2.

For Analog Output connect wiring to appropriate terminals and load. A shielded, twisted pair wire is recommended. Ground shield on one end only. Use same precautions as described for flowmeter input signal.



Without Housing



With Explosion Proof Housing

Figure 2-1. Outline and Installation Dimensions

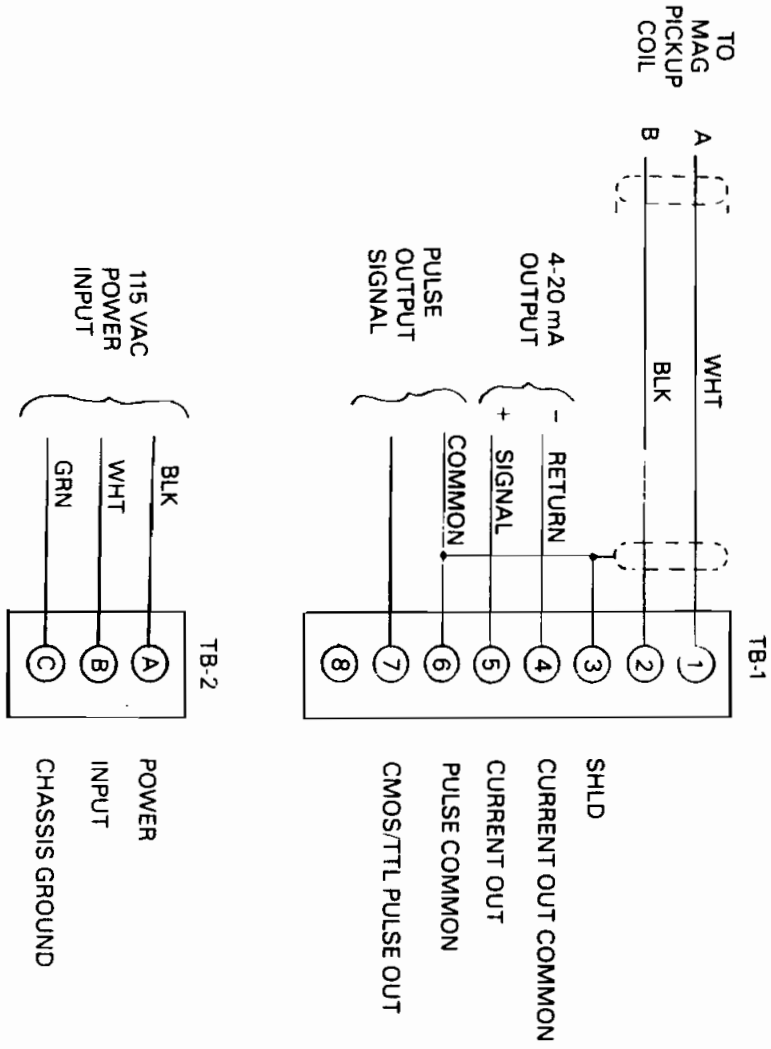


Figure 2-2. Wiring Installation for the FLSC-34

SECTION 3 OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil. If false counting action occurs turn sensitivity control clockwise.

The pulse output and analog output commence with flow through the flowmeter.

For the analog output, the span is that established by either the factory calibration or field calibration. The range is 4-20 mA DC into a maximum of 325 ohms of loop resistance.

3.1 PRINCIPLE OF OPERATION

A simplified block diagram of the FLSC-34 Frequency/Current Flow Converter Subsystem is shown in Figure 3-1. Key functional blocks as well as information flow are designated. The basic operation of the system is as follows.

The frequency signal from the turbine flowmeter is connected to the FLSC-34 with a twisted pair shielded cable. The signal enters through the SENSITIVITY control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a signal conditioning chain where it is amplified and shaped into a train of digital pulses whose frequency is related to the volume flow rate.

The signal entering the frequency to analog converter is passed through a combination of a divide by N and a DIP switch matrix. The QN output is chosen whose pulse rate is between 75 and 150 Hz at the maximum flow rate to be measured. This scaled pulse rate is fed to a precision monostable circuit. The output of the monostable circuit is then filtered into an analog voltage that is proportional to volumetric flow rate.

The output amplifier is a voltage to current amplifier. It offers zero and span available in a standard process range of 4-20 mA.

The Power Supply provides for operating bias voltage for all internal circuitry. The pulse output amplifier provides a TTL/CMOS compatible square pulse of 5V amplitude. The output amplifier is buffered from the signal driving the analog output.

3.2 CONTROLS AND ADJUSTMENTS (See Figure 3-2.)

FUSE — A circuit protection device located inside of case (see paragraph 3.2.1)

SENS. — A multiple turn control used to set the threshold sensitivity level above the ambient noise pickup.

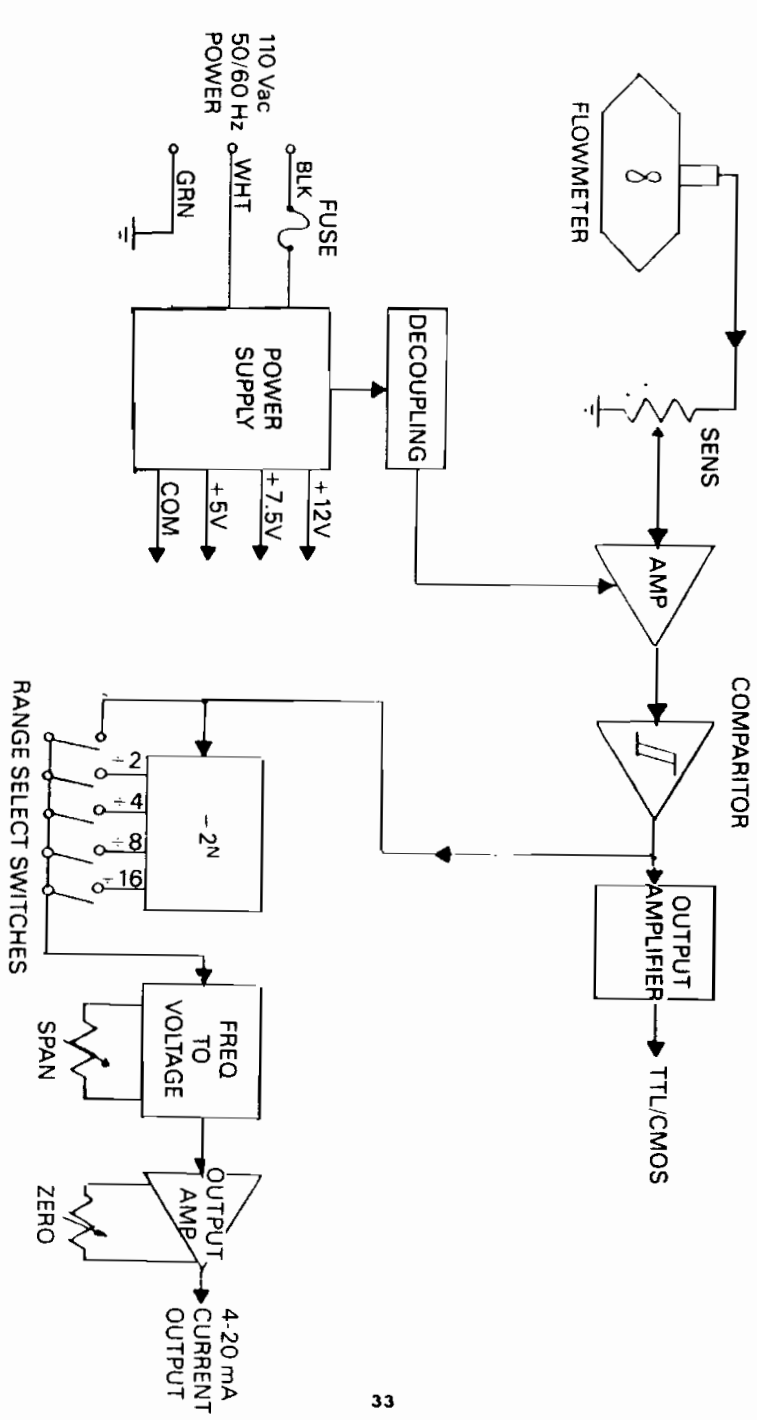


Figure 3-1. FLSC-34 Block Diagram

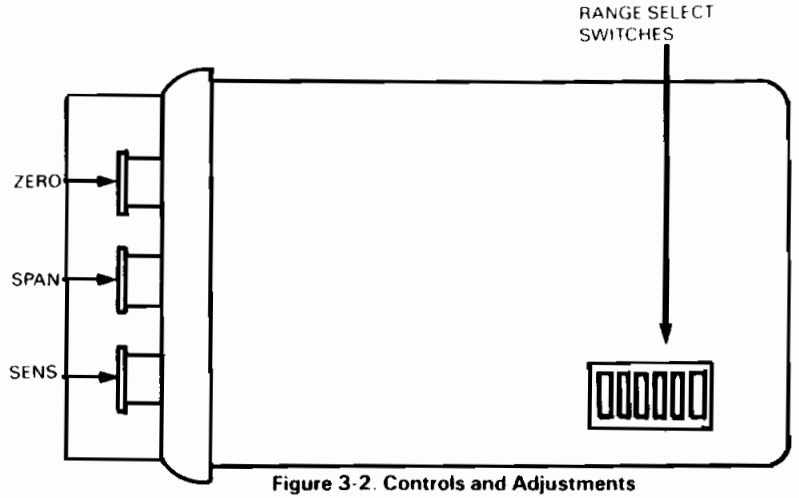
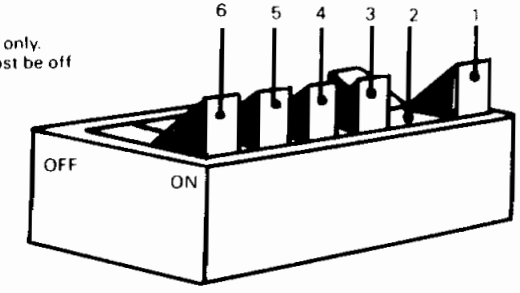


Figure 3-2. Controls and Adjustments

Switch 2 is shown depressed for illustrative purposes only

NOTE
Select one switch only.
All other switches must be off



1. Open cover by removing the two screws on the side of box. Remove printed circuit subassembly.
2. Turn on desired range position using a ball point pen or similar object
3. Reassemble in lower case.

Figure 3-3. Range Select Detail

TABLE 3-1
RANGE SELECT

Range Select Switch Position	For F Max.
1	75 to 150
2	150 to 300
3	300 to 600
4	600 to 1200
5	1200 to 2400
6	2400 to 4800

RANGE A dual in line (DIP) switch located on the PCA61 board (see Figure 3-3 and paragraph 3.2.2) which is used to program the module to accept an input frequency range.

SPAN A multiple turn adjustment which is used to set the voltage output signal to the desired span corresponding to the equivalent flow range (i.e., 4 to 20mA corresponding to 0-100 GPM).

ZERO A multiple turn adjustment which is used to set output signal with no flow to the desired "zero" value (i.e., 4 mA).

3.2.1 Replacing the Fuse (see Figure 3-2)

1. Turn off power to the FLSC-34.
2. Remove the two screws from sides of case.
3. Lift off cover and remove printed circuit sub-assembly.
4. Pull fuse from fuse socket using fingers (Pliers are not recommended).
5. Install new fuse.
6. Reassemble into lower case.

3.2.2 Range Select for Analog Output

1. Turn power to FLSC-34 off.
2. Remove the two screws from sides of case.
3. Lift off cover and remove printed circuit sub-assembly.
4. Turn "on" desired range position using a ball point pen or similar object. (Refer to Figure 3-3 and Table 3-1.)
5. Reassemble into lower case.

SECTION 4 CALIBRATION OF ANALOG OUTPUT

4.1 INTRODUCTION

In general, all flow measurement systems supplied by OMEGA Engineering have been factory calibrated as specified by the user, at the time of purchase.

Field calibration is only required when a change has occurred or is sought to the measuring system. Such a change may be due to repair, replacement or recalibration of the flowmeter, or perhaps a change in the analog output span.

4.2 PROCEDURE

Begin by determining the equivalent maximum volumetric flow rate in GPM, expected by the application, term this GPM (MAX). GPM (MAX) may be calculated based on the analog output scale requirements or may be the maximum flow rate listed on the flowmeter's calibration sheet.

From the calibration constant (or K Factor) listed on the data sheet for the flowmeter, obtain the frequency corresponding to GPM (MAX) using Equation #1 and designate this frequency F (MAX).

Equation #1: $$F_{MAX} = \frac{K_{AVE} \times GPM_{MAX}}{60}$$

The analog output of the FLSC-34 may be calibrated with the aid of an external oscillator used in conjunction with a frequency counter.

The external oscillator is used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals as shown in Figure 4-1. The oscillator's output frequency is set to equal F (MAX) as indicated on the frequency counter.

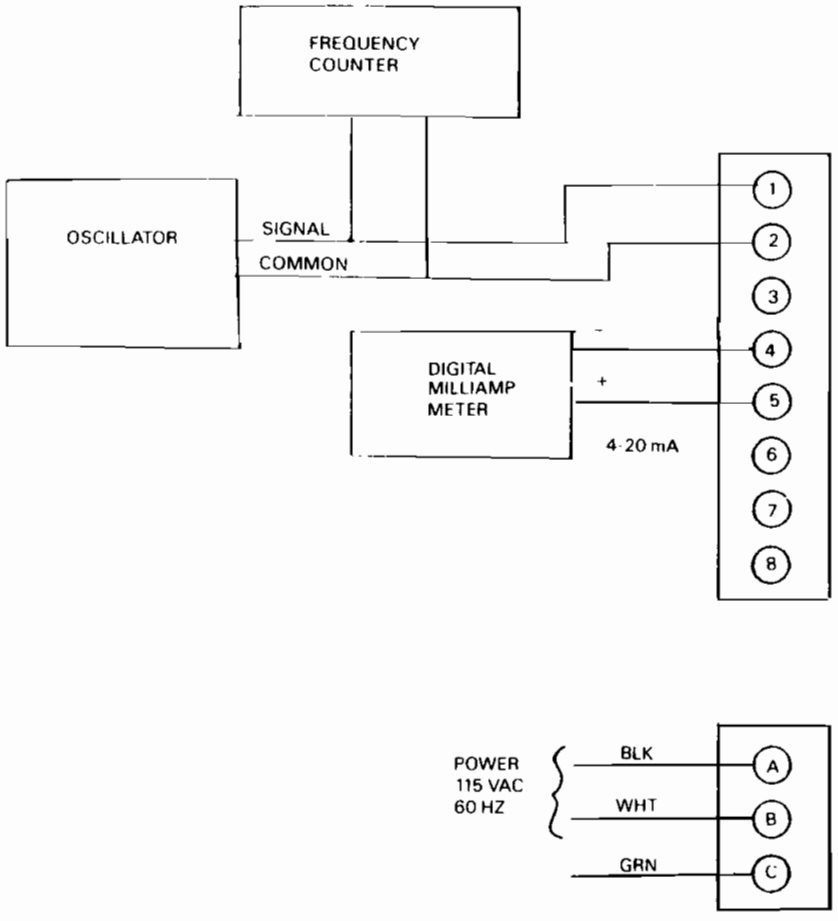
1. The course range adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-61 printed circuit card. See Table 3-1 to determine required switch position and set into switch as shown in Figure 3-3 for anticipated F MAX.

   NOTE

   It is necessary to open the cover of the enclosure by removing two screws on side of box and lifting cover. Two printed circuit cards are attached. The "RANGE" Dip Switch may be programmed with a pen. Input power should be removed during this step.

2. Connect a digital milliampmeter or equivalent across the current output terminals.
3. Adjust ZERO control for desired zero current (i.e., 4.00 mA)
4. Turn SPAN POT fully CCW until detent is felt or 25 turns.
5. Inject the Test Frequency equal to F MAX while adjusting SPAN for current equal to 20 mA ±20 mA. See test setup shown in Figure 4-1.

   Repeat steps 4 and 5 until no change is observed.



NOTES

1 USE TEST AMPLITUDE OF 100 MV RMS OR LESS. SINUSOIDAL WAVEFORM
2 REMOVE ALL OTHER INTERCONNECTIONS OTHER THAN THOSE SHOWN
3 OBSERVE CAUTION WHEN PERFORMING CALIBRATION

Figure 4-1. Calibration Set-up

SECTION 5 TROUBLESHOOTING

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied with the turbine flowmeter.

Factory consultation is available to assist in diagnosing problems. Please note that in some cases factory repairs can be performed more easily than can be accomplished in the field.

Failure conditions are listed and the possible corrective actions given to eliminate the observed problem.

Proper operation of the FLSC-34 can be assumed when with power applied to the unit:

1. The pulse ouput produces a pulse train of the desired amplitude when flow through the flow transducer occurs.
2. The analog output produces a current output signal of 4-20 mA with a span corresponding to that established by the calibration procedure.

OBSERVED CONDITION	PROBLEM/CORRECTIVE ACTION
A. No Pulse Output	1. Inspect terminal strip wiring for conformity to the installation instructions and for acceptable workmanship. 2. Verify fuse is good with an ohm meter. 3. Determine if flowmeter rotor is fouled. 4. Defective pickup coil. Replace. 5. Defective cable. Replace. 6. Defective FLSC-34. Repair or replace. 7. Sensitivity potentiometer turned fully clockwise — unit will not function properly.
B. Pulsing Output With No Flow	1. Defective pickup coil. Replace. 2. Defective cable. Replace. 3. Defective FLSC-34. Repair or replace.

OBSERVED CONDITION	PROBLEM/CORRECTIVE ACTION
C. Analog Output Malfunction	1. Improper wiring terminations. Correct wiring. 2. FLSC-34 improperly calibrated. Recalibrate. 3. Defective circuitry within the FLSC-34. Factory repair FLSC-34.

NOTE

Refer to flowmeter operator's manual for repair instructions for the turbine flowmeter.

SECTION 6 SPECIFICATIONS

INPUT: Input protected, RF and band pass filtered, adjustable trigger level.
Input Impedance 40 ohm (nominal)
Trigger Sensitivity 10 millivolt RMS (minimum) 10 Hz to 1000 Hz
Over Voltage — 120 volts RMS absolute (maximum)

ANALOG OUTPUT: Range 4 to 20 mA.
Controls — Non-interacting zero and span adjustments.
Accuracy ±0.1% F.S. 200 PPM/°C
Maximum Impedance — 325 ohms.
F.S. Frequency Range 75 Hz to 2500 Hz (DIP SWITCH SELECTABLE)

PULSE OUTPUT: TTL/CMOS COMPATIBLE
LOGIC 1; 2.4V at −.800 mA
LOGIC 0; 0.4 V maximum at 100 ma

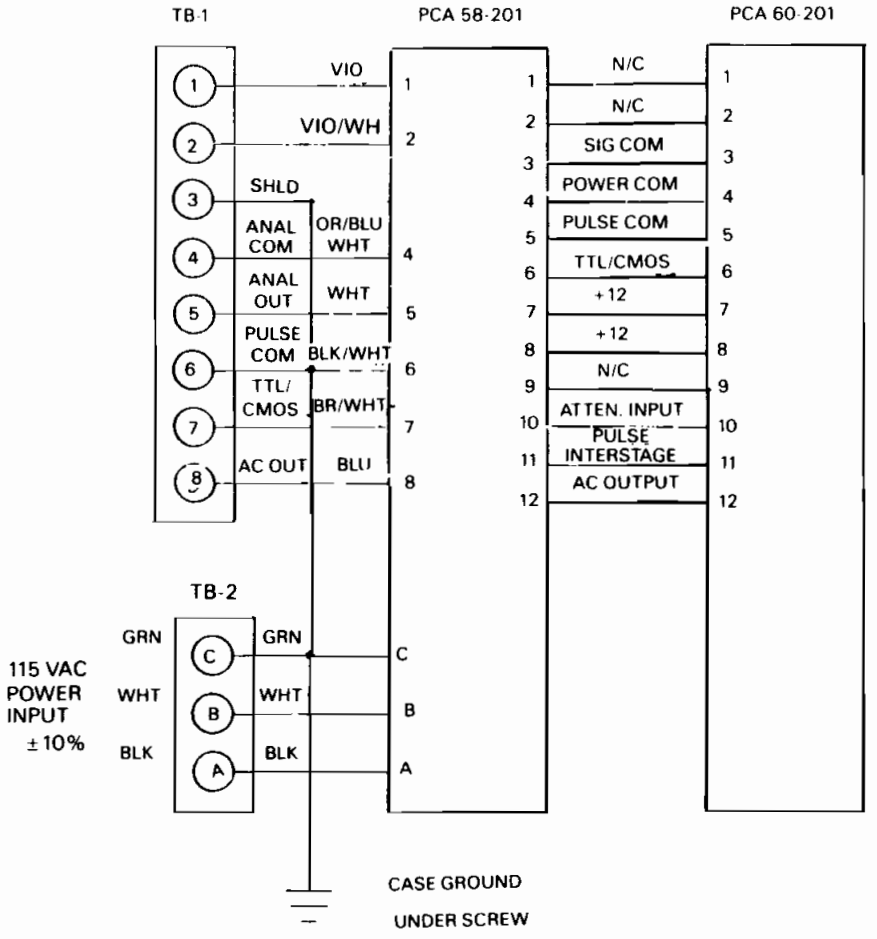
INPUT POWER: 115 Vac 50/60 Hz

TEMPERATURE RANGE: 0°–70°C (32° to 158°F)

ELECTRICAL CONNECTIONS: Screw Terminals

MAXIMUM LEAD LENGTH: 1000 ft. of 24 gage copper wire

ELECTRICAL HOUSING: Class I, Group D
Class II Group E, F, G
Class III



INTERNAL CASE WIRING SCHEMATIC FOR FLSC-34

TABLE OF CONTENTS
FLSC-35B SIGNAL CONDITIONER

SECTION 1 INTRODUCTION

The OMEGA® FLSC-35B High Accuracy Integral Signal Conditioner is designed for direct mounting onto OMEGA Series FTB-100 and 200 Turbine Meters.

The input circuitry of the signal conditioners has been designed to receive and condition the low level turbine meter signals while rejecting unwanted noise and spurious signals. A signal threshold control is provided which allows the user to set the input sensitivity above the ambient noise level, thereby elminating any false signal on the output.

The FLSC-35B runs off 115 VAC and provides an unscaled pulse output (CMOS, TTL compatible) and a 0-5 V output. A zero and span potentiometer allow for simple field adjustment of the analog output from the signal conditioner.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION OF THE FLSC-35B

The FLSC-35B should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

If the unit is mounted on a turbine flowmeter in an explosion proof conduit enclosure, orientate the flowmeter and run conduit to prevent the accumulation of moisture in the conduit enclosure as much as is practical. In addition, assure electronics will not be overheated by hot process lines.

Refer to Figure 2-1 for outline dimensions. Drill appropriate mounting holes as required.

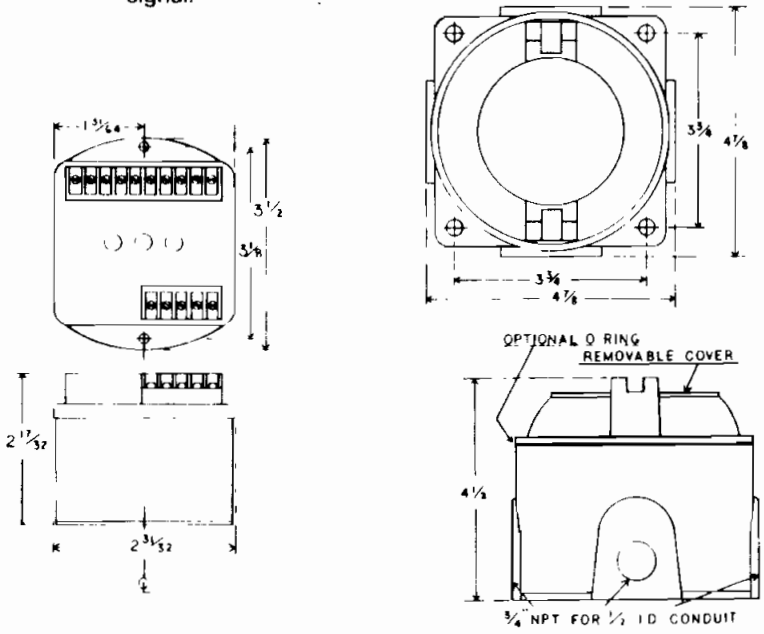
Refer to Figure 2-2, wiring installation, for appropriate terminals for interconnections. The signal leads from the turbine should be shielded whenever FLSC-35B is not integrally mounted. Ground shield on one end only. If desired, use solder lug provided on ground stud. Connections to the terminal block should be carefully dressed to avoid having bare wires extend pass the screw clamp on the terminal block. This is particularly important for units mounted within the explosion proof enclosure. Wires should be neatly dressed near bottom of enclosure to assure wiring will not become fouled when cover is installed.

Connect two conductor shielded cable from flowmeter. Connect shield to FLSC-35B only.

Line power connections should be made through a circuit breaker so that power can be turned off while servicing the FLSC-35B. Power is 117 VAC ±10%, an earth ground connection is also required.

Pulse output is CMOS/TTL compatible. Wire to appropriate terminal, see Figure 2-2.

For analog output connect wiring to appropriate terminals and load. A shielded, twisted pair wire is recommended. Ground shield on one end only. Use same precautions as described for flowmeter input signal.



Dimensions without Housing

Dimensions with Explosion Proof Housing

Figure 2-1. Outline Dimensions

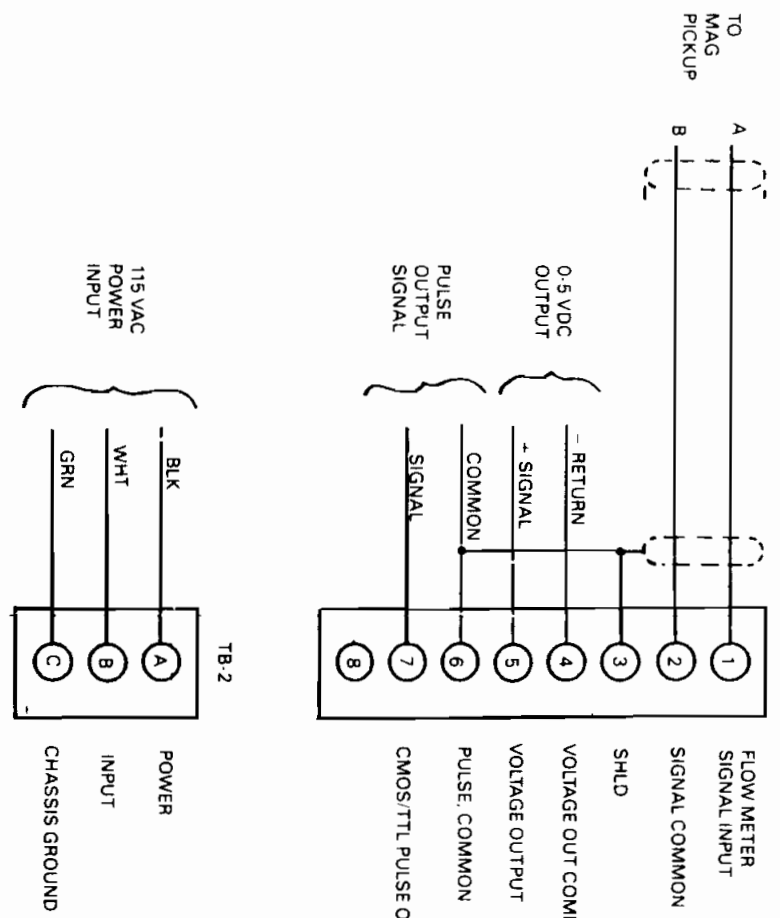


Figure 2-2. Wiring Installation for the FLSC-35B

SECTION 3 OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil. If false counting action occurs turn Sensitivity control clockwise.

The pulse output and analog output commence with flow through the flowmeter.

For the analog output, the span is that established by either the factory calibration or field calibration. The range is 0-5 Vdc into a maximum of 1000 ohms of loop resistance.

3.1 PRINCIPLE OF OPERATION

A simplified block diagram of the FLSC-35B Frequency/Voltage Flow Converter Subsystem is shown in Figure 3-1. Key functional blocks as well as flow information are designated. The basic operation of the system is as follows.

The frequency signal from the turbine flowmeter is connected to the FLSC-35B with a twisted pair shielded cable. The signal enters through the sensitivity control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a signal conditioning chain where it is amplified and shaped into a train of digital pulses whose frequency is related to the volume flow rate

The signal entering the frequency to analog converter is passed through a combination of a divide by N and a DIP switch MATRIX. The QN output is chosen whose pulse rate is between 75 and 150 Hz at the maximum flow rate to be measured. This scaled pulse rate is then fed to a precision monostable circuit. The output of the monostable is then filtered into an analog voltage that is proportional to volumetric flow rate.

The output amplifier is a voltage to voltage amplifier. It offers zero and span available in a process range of 0 to 5 Vdc.

The Power Supply provides for operating bias voltage for all internal circuitry.

The pulse output amplifier provides a TTL/CMOS compatible square pulse of 5 volt amplitude. The output amplifier is buffered from the signal driving the analog output.

3.2 CONTROLS AND ADJUSTMENTS (See Figure 3-2.)

FUSE — A circuit protection device located inside of case (see paragraph 3.2.1)

SENS. — A multiple turn control used to set the threshold sensitivity level above the ambient noise pickup.

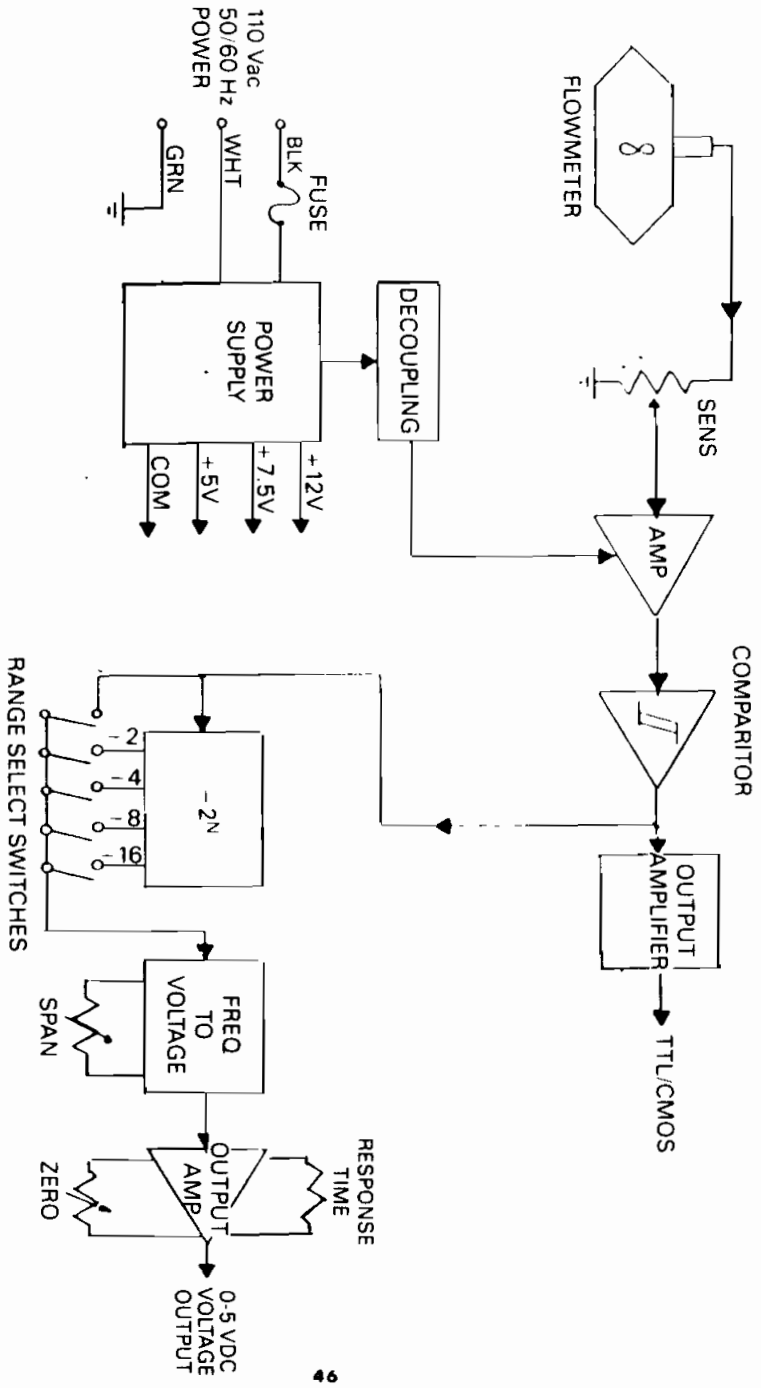


Figure 3-1. FLSC-35B Block Diagram

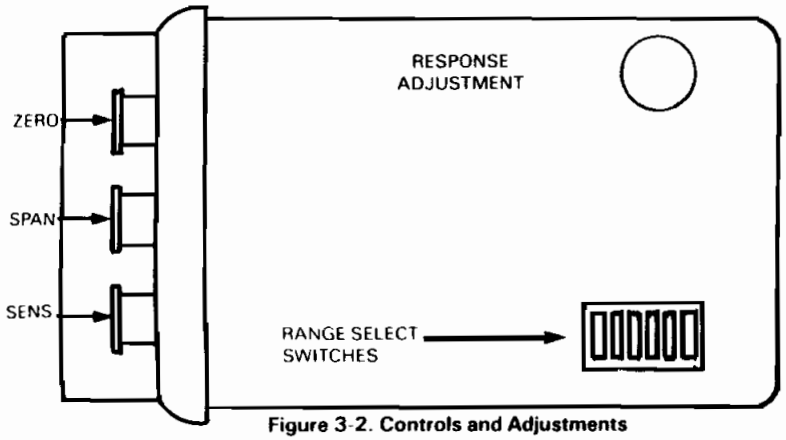
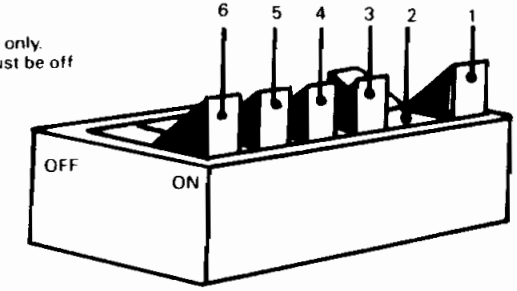


Figure 3-2. Controls and Adjustments

Switch 2 is shown depressed for illustrative purposes only

NOTE
Select one switch only.
All other switches must be off



1 Open cover by removing the two screws on the side of box Remove printed circuit subassembly
2 Turn on desired range position using a ball point pen or similar object
3 Reassemble in lower case.

Figure 3-3. Range Select Detail

TABLE 3-1
RANGE SELECT

Range Select Switch Position	For F Max.
1	75 to 150
2	150 to 300
3	300 to 600
4	600 to 1200
5	1200 to 2400
6	2400 to 4800

RANGE — A dual in line (DIP) switch located on the PCA61 board (see Figure 3-3 and paragraph 3.2.2.) which is used to program the module to accept an input frequency range.

SPAN — A multiple turn adjustment which is used to set the voltage output signal to the desired span corresponding to the equivalent flow range (i.e., 0 to 5V corresponding to 0-100 GPM).

ZERO — A multiple turn adjustment which is used to set output signal with no flow to the desired "zero" value (i.e., 0.00 Vdc).

RESPONSE — An internal, multiple turn adjustment which is used to adjust the response time of the analog output.

3.2.1 Replacing the Fuse (see Figure 3-2)

1. Turn off power to the FLSC-35B.
2. Remove the two screws from sides of case.
3. Lift off cover and remove printed circuit sub-assembly.
4. Pull fuse from fuse socket using fingers (pliers are not recommended).
5. Install new fuse.
6. Reassemble into lower case.

3.2.2 Range Select for Analog Output

1. Turn power to FLSC-35B off.
2. Remove the two screws from sides of case.
3. Lift off cover and remove printed circuit sub-assembly.
4. Turn "on" desired range position using a ball point pen or similar object (Refer to Figure 3-3 and Table 3-1).
5. Reassemble into lower case.

SECTION 4 CALIBRATION OF ANALOG OUTPUT

4.1 INTRODUCTION

In general, all flow measurement systems supplied by OMEGA Engineering have been factory calibrated as specified by the user, at the time of purchase.

Field calibration is only required when a change has occurred or is sought to the measuring system. Such a change may be due to repair, replacement or recalibration of the flowmeter, or perhaps a change in the analog output span.

4.2 PROCEDURE

Begin by determining the equivalent maximum volumetric flow rate in GPM, expected by the application, term this GPM (MAX). GPM (MAX) may be calculated based on the analog output scale requirements or may be the maximum flow rate listed on the flowmeter's calibration sheet.

From the calibration constant (or K Factor) listed on the data sheet for the flowmeter, obtain the frequency corresponding to GPM (MAX) using Equation #1 and designate this frequency F (MAX).

$$\text{Equation \#1:} \quad F_{MAX} = \frac{K_{AVE} \times GPM_{MAX}}{60}$$

The analog output of the FLSC-35B may be calibrated with the aid of an external oscillator used in conjunction with a frequency counter.

The external oscillator is used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals as shown in Figure 4-1. The oscillator's output frequency is set to equal F (MAX) as indicated on the frequency counter.

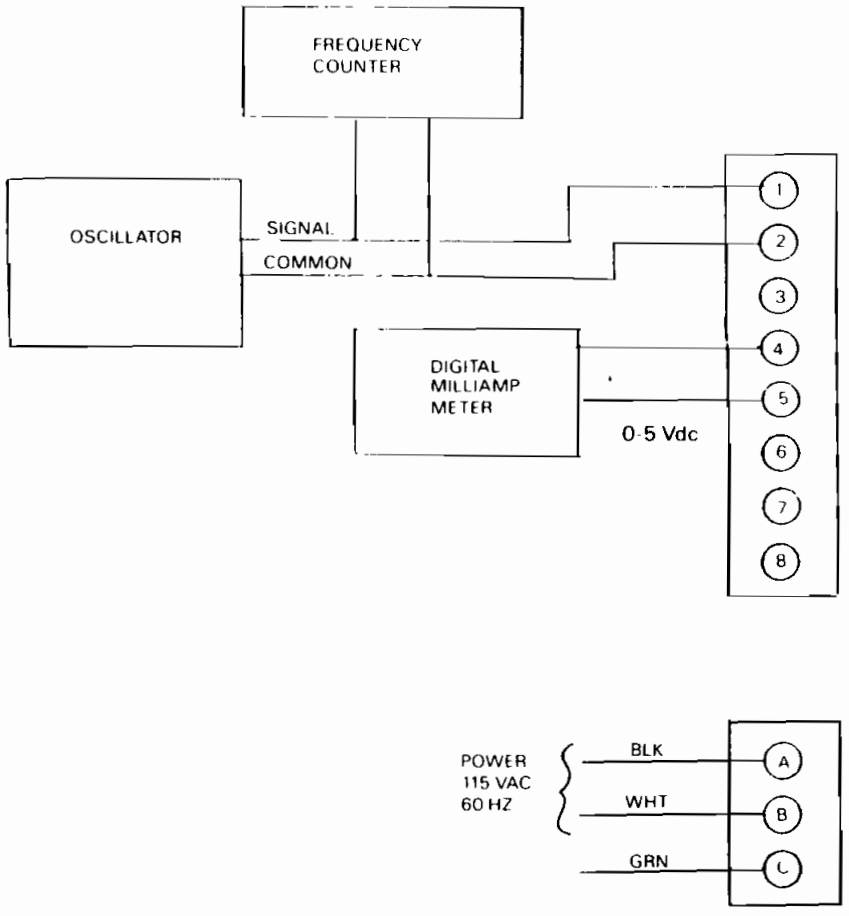
1. The course range adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-61 printed circuit card. See Table 3-1 to determine required switch position and set into switch as shown in Figure 3-3 for anticipated F MAX.

   NOTE

   It is necessary to open the cover of the enclosure by removing two screws on side of box and lifting cover. Two printed circuit cards are attached. The "RANGE" Dip Switch may be programmed with a pen. Input power should be removed during this step.

2. Connect a digital voltmeter or equivalent, across the voltage output terminals.
3. Adjust ZERO control for desired zero voltage (.000 Vdc)
4. Turn SPAN POT fully CCW until detent is felt or 25 turns.
5. Inject the Test Frequency equal to F MAX while adjusting SPAN for voltage equal to +5.000V ±1 mV. See test setup shown in Figure 4-1.)

   Repeat steps 3 and 4 until no change is observed.



NOTES
1 USE TEST AMPLITUDE OF 100 MV RMS OR LESS, SINUSOIDAL WAVEFORM
2 REMOVE ALL OTHER INTERCONNECTIONS OTHER THAN THOSE SHOWN
3 OBSERVE CAUTION WHEN PERFORMING CALIBRATION

Figure 4-1. Calibration Set-up

SECTION 5 TROUBLESHOOTING

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied with the turbine flowmeter.

Factory consultation is available to assist in diagnosing problems. Note that in some cases factory repairs can be performed more easily than can be accomplished in the field.

Failure conditions are listed and the possible corrective actions given to eliminate the observed problem.

Proper operation of the FLSC-35B can be assumed when with power applied to the unit:

1. The pulse output produces a pulse train of the desired amplitude when flow through the flow transducer occurs.
2. The analog output produces a voltage output signal of 0-5 Vdc with a span corresponding to that established by the calibration procedure.

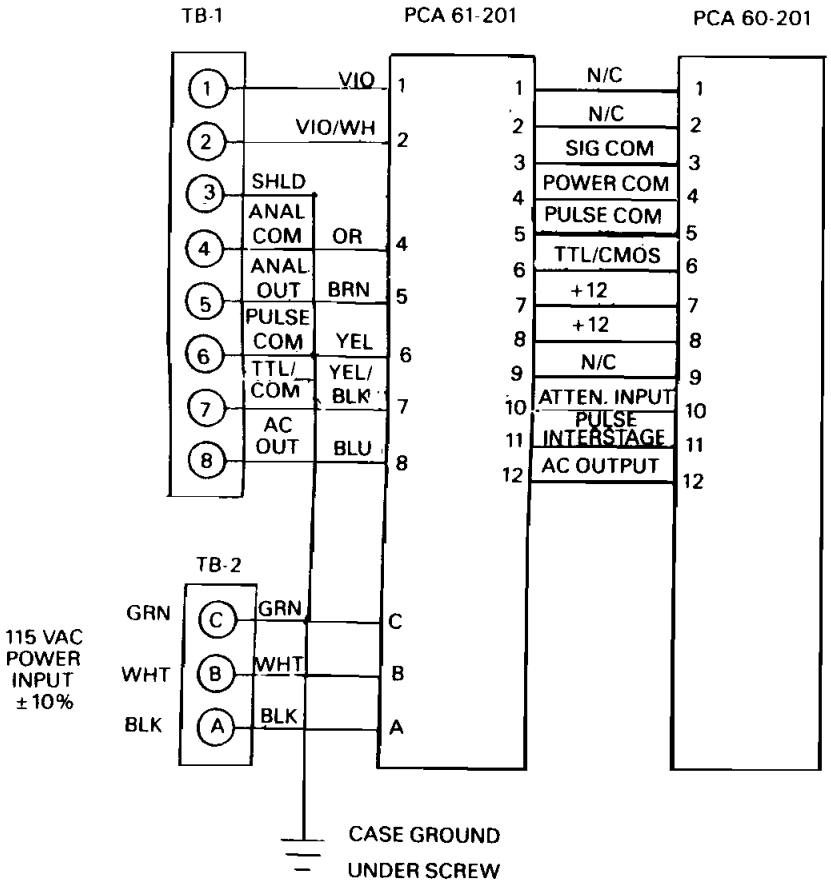
OBSERVED CONDITION	CORRECTIVE ACTION
A. No Pulse Output	1. Inspect terminal strip wiring for conformity to the installation instructions and for acceptable workmanship. 2. Verify fuse is good with an ohm meter. 3. Determine if flowmeter rotor is fouled. 4. Defective pickup coil. Replace. 5. Defective cable. Replace. 6. Defective FLSC-35B. Repair or replace. 7. Sensitivity potentiometer turned fully clockwise – unit will not function properly.
B. Pulsing Output With No Flow	1. Defective pickup coil. Replace. 2. Defective cable. Replace. 3. Defective FLSC-35B. Repair or replace.

OBSERVED CONDITION	CORRECTIVE ACTION
C. Analog Output Malfunction	1. Improper wiring terminations. Correct wiring. 2. FLSC-35B improperly calibrated. Recalibrate. 3. Defective circuitry within the FLSC-35B. Factory repair FLSC-35B. **NOTE** Refer to flowmeter user's manual for repair instructions for the turbine flowmeter.

SECTION 6 SPECIFICATIONS

INPUT: Input protected, RF and band pass filtered adjustable trigger level.
Input Impedance 40 kilohm (nominal)
Trigger Sensitivity 10 millivolt RMS (minimum) 10 to 1000 Hz
Over Voltage 120 volts RMS absolute (maximum)
Compatible with magnetic pickoffs.

ANALOG OUTPUT: The analog output is generated by passing the pulse output frequency signal to a frequency to voltage converter to generate a voltage proportional to flow rate.
Range 0 to 5 Vdc
Controls — Non interacting zero and span adjustments.
Accuracy ±0.1% F.S. 200 ppm/°C
F.S. Frequency Range 75 Hz to 2500 Hz (DIP SWITCH SELECTABLE)
Impedance less than 50 ohms
Response time 0.5 to 2 seconds for 10 to 90%. Adjustable
PULSE OUTPUT CHARACTERISTICS: TTL/CMOS Compatible option: Logic 1: 2.4V at −.800 mA; Logic 0:0.4V maximum at 100 mA
POWER REQUIREMENTS: 115 Vac 50/60 Hz
TEMPERATURE RANGE: 0°– 70°C Standard
ELECTRICAL HOUSING: Class I, Group D
Class II Group E, F, G
Class III



Internal Case Wiring Schematic for FLSC-35B

TABLE OF CONTENTS
FLSC-51 AND 51B SIGNAL CONDITIONERS

SECTION 1 INTRODUCTION

The OMEGA® FLSC-51 and 51B High Accuracy Integral Signal Conditioners are designed for direct mounting onto OMEGA Series FTB-100 and 200 Turbine Meters.

The FLSC-51/51B provides a scaled pulse output which may be field calibrated to the desired number of pulses per unit volume. Typical outputs which may be realized are one pulse per gallon, or ten pulses per liter, etc.

This interface subsystem approach allows for direct interfacing with a host system without requiring special software considerations being given to the method of input and storage of flowmeter calibration constants. Partitioning of the system by this means will also allow for easy field adjustment when such calibration constants change due to repair or replacement. The calibration scaling factor is entered into a digital thumbwheel switch matrix.

The input signal conditioning circuitry is designed to accept the low level flowmeter signal while rejecting unwanted noise and spurious signals. A signal threshold control is provided which allows the user to set the input sensitivity above the ambient noise level, thereby eliminating any false signal on the output.

Two outputs are available, providing flexibility in the interface as required by the host system. The output is available in the form of CMOS/TTL compatible pulse (for the FLSC-51) and in the form of an open collector pulse (for the FLSC-51B). The pulse duration is .2 ms for the FLSC-51 for use with digital electronics. The pulse duration is 50 ms for the FLSC-51B for use with electromechanical totalizers.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION OF THE FLSC-51/51B

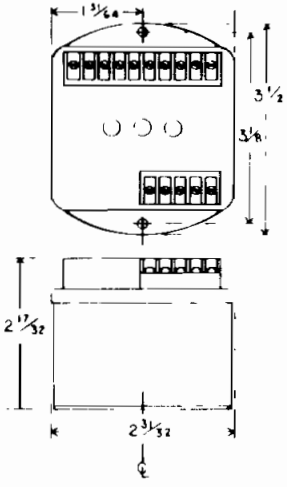
The FLSC-51/51B should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

If the unit is mounted on a turbine flowmeter in an explosion proof conduit enclosure, orientate the flowmeter and run conduit to prevent the accumulation of moisture in the conduit enclosure as much as is practical. In addition, assure electronics will not be overheated by hot process lines.

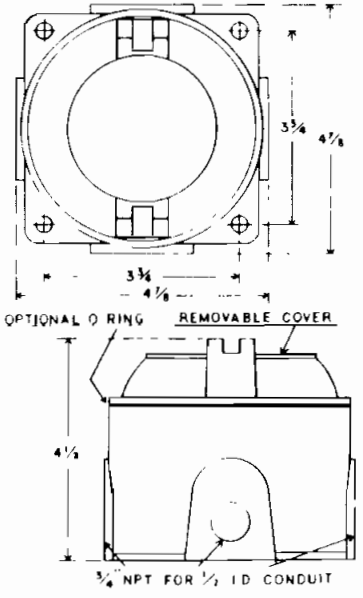
Refer to Figure 2-1 for outline dimensions. Drill appropriate mounting holes as required.

Refer to Figure 2-2, wiring installation, for appropriate terminals for interconnections. The signal leads from the turbine should be shielded whenever the FLSC-51/51B is not integrally mounted. Ground shield on one end only. If desired,use solder lug provided on ground stud. Connections to the terminal block should be carefully dressed to avoid having bare wires extending pass the screw clamp on the terminal block. This is particularly important for units mounted within the explosion proof enclosure. Wires should be neatly dressed near bottom of enclosure to assure wiring will not become fouled when cover is installed. Connect two conductor shielded cable from flowmeter. Connect shield to FLSC-51/51B only.

Unit is powered by a DC voltage, 8-35 Vdc. Connect power as illustrated in Figure 2-2.



Dimensions without Housing



Dimensions with Explosion Proof Housing

Figure 2-1. Outline and Installation Dimensions

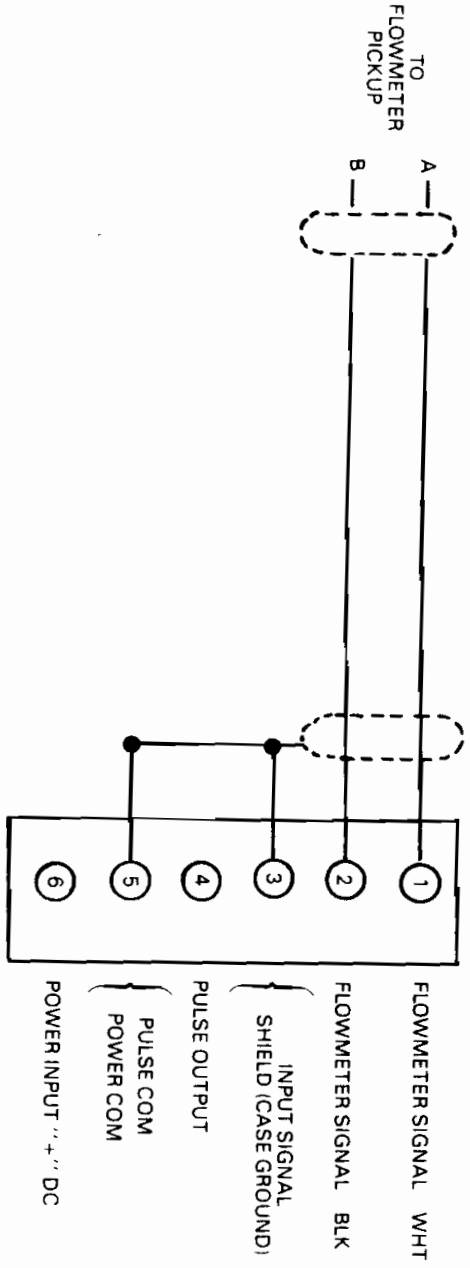


Figure 2-2. Wiring Installation for the FLSC-51/51B

SECTION 3 OPERATION

3.1 PRINCIPLE OF OPERATION

A simplified block diagram of the FLSC-51/51B is shown in Figure 3-1. Key functional blocks as well as information flow are designated. The basic operation of the system is as follows.

The frequency signal from the turbine flowmeter is connected to the FLSC-51/51B with a twisted pair shielded cable. The signal enters through the SENSITIVITY control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a signal conditioning chain where it is filtered, amplified and shaped into a train of digital pulses whose frequency is related to the volume flow rate and where each pulse represents a discrete volume of fluid.

The linear signal in the form of a pulse train is then passed to the System Factor which scales the signal for totalization.

The pulse scaling circuitry composing the System Factor affectively multiplies the pulse rate by a number set into the digital thumbwheel switch array on the PCA-62 printed circuit card.

At the output of the System Factor, each pulse represents a decimal multiple of the desired flow measurement units.

The pulse train is fed to the System Factor Multiplier which effectively multiplies the pulse rate by either 1, .1, .01, .001 or .0001 depending on the position selected on the corresponding switch.

At the output of the System Factor Multiplier block, each pulse represents one unit of flow in the desired measurement units.

The pulse train is then passed through an output drive stage which is connected to a host system. A pulse is output each time a discrete volume of fluid, represented in the desired units, passes through the flowmeter.

3.2 START-UP OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil

With the Flow Measurement System properly installed and calibrated, verify the following performance checks before placing the system into active service.

The signal conditioner is normally shipped with the SENSITIVITY pot fully counterclockwise. At start-up, turn this pot gradually clockwise until input signal is sensed.

With the power to the unit, and NO flow through the flowmeter, the pulse output frequency should be 0. If the output pulse frequency is greater than 0, input noise may be present.

Slowly turn the SENSITIVITY threshold control counterclockwise until a pulse rate of 0 is indicated.

NOTE

Turning the SENSITIVITY control fully counterclockwise will render the unit inoperative.

3.3 GENERAL OPERATION

Apply power to the unit (8-35 Vdc).

The FLSC-51/51B will output the desired units of pulses per unit volume established by the calibration setup procedure (see Section 4).

Pulses output begins automatically when flow through the flowmeter commences.

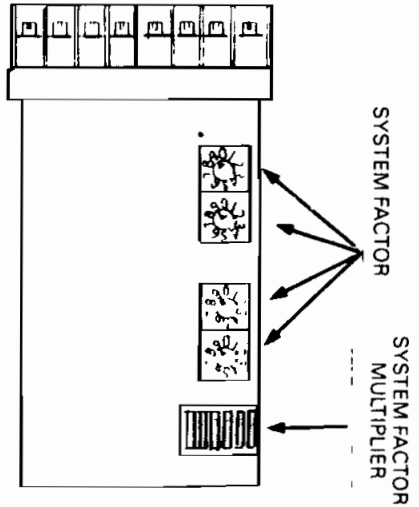
3.4 CONTROLS AND AD "ISTMENTS (See Figure 3-2.)

SENSITIVITY — A multiple turn control used to set the trigger level above the noise level.

SYSTEM FACTOR (S.F.) — A thumbwheel switch array composed of four switches which are used to set the desired scaling factor (.0000 to .9999). Used in conjunction with the System Factor Multiplier.

SYSTEM FACTOR MULTIPLIER (S.F.M.) — A dip switch used to enter the desired system factor multiplier (1, .1, .01, .001, .0001). Used in conjunction with the system factor.

$$(S.F.) \times (S.F.M.) = \frac{1}{K^1}$$



MULTIPLIER	SWITCH POSITION 1	2	3	4
X1	ON	OFF	OFF	OFF
X.1	OFF	ON	OFF	OFF
X.01	OFF	ON	ON	OFF
X.001	OFF	ON	ON	ON
X.0001	OFF	ON	OFF	ON

Figure 3-2. Controls and Adjustments

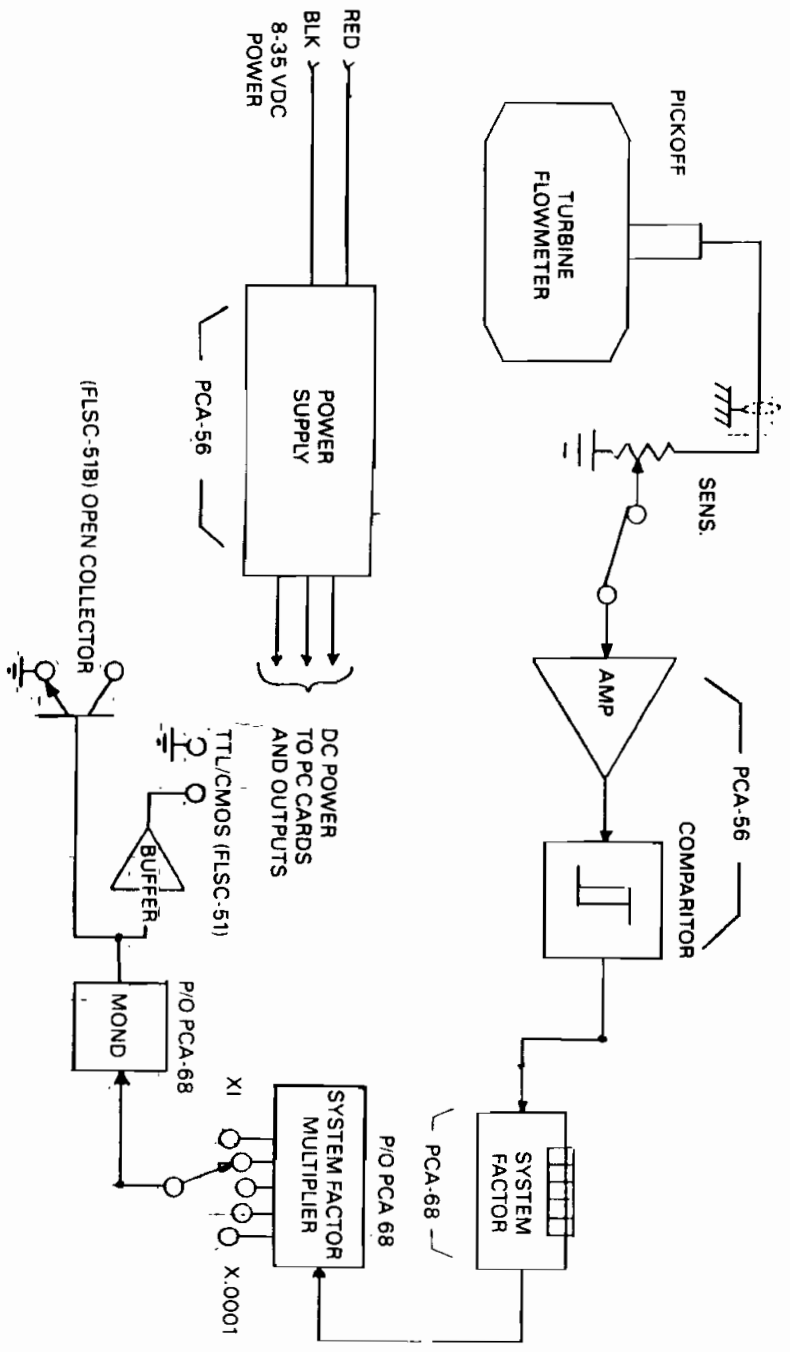


Figure 3-1. FLSC-51/51B Block Diagram

SECTION 4 CALIBRATION OF THE FLSC-51/51B

4.1 INTRODUCTION

The FLSC-51/51B Flowmeter Signal Conditioning/Interface/Subsystem has a special feature which allows the user to scale the flow information into the desired units of measurement. This feature is termed the SYSTEM FACTOR and is composed of two arrays of switches (the SYSTEM FACTOR thumbwheel switch and the SYSTEM FACTOR MULTIPLIER dip switch).

By utilizing the SYSTEM FACTOR, the total flow may be indicated as pulse outputs in gallons, pints, liters, barrels, cc's.

4.2 PROCEDURE

Begin by obtaining a copy of the calibration sheet for the flowmeter to be used with the FLSC-51/51B. Obtain the desired units of measurement from the project supervisor or equipment specification.

From the calibration sheet for the flowmeter (supplied with flowmeter) obtain the MEAN K FACTOR in cycles/gallon, designate this as the K FACTOR.

Finally, note the maximum flow rate in desired units as R (MAX) in unit volumes/minute. The value of R (MAX) should be less than the maximum count speed for the host system.

Compute the equivalent number of pulses per desired measurement unit, designed K', from the K FACTOR for the flowmeter and the conversion factor relating the gallons per user's desired measurement units. This may be done with the following equation and the aid of a conversion chart.

$K' = K\ FACTOR \times CF$

WHERE
CF is the conversion factor equal to the ratio of the number of gallons per user chosen volume unit.

Example:

Given:	200 pulses/gallon = K FACTOR Desired units of measurement = Liters
Obtain:	Conversion Factor CF = .2642 gallons/liter from Table
Calculate:	$K' = 200 \times .2642$ $= 52.84\ \frac{Pulses}{Liter}$

The SYSTEM FACTOR should be programmed with the largest number of significant figures which may be represented within the limitations of the switch array.

The SYSTEM FACTOR MULTIPLIER is then set to the position which results in the correct scale factor.

Example:
S.F. = .0189251
Dial into SYSTEM FACTOR SWITCHES .1893
SYSTEM FACTOR MULTIPLIER SWITCH to X.1 position.

SECTION 5 TROUBLESHOOTING

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied with the turbine flowmeter.

Factory consultation is available to assist in diagnosing problems. Note that in some cases factory repairs can be performed more easily than can be accomplished in the field.

Failure conditions are listed and the possible corrective actions given to eliminate the observed problem.

Proper operation of the FLSC-51/51B can be assumed when with power applied to the unit, the pulse output produces a pulse train of the desired amplitude when flow through the flow transducer occurs.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Unit does not produce pulse output with flow present	Power Loss	Check interconnecting wiring and host system.
	Bad pickup coil or signal cable	Check coil and cable for continuity and leakage. Replace if bad.
	Fouled or damaged turbine flowmeter	Remove and clean per manufacturers recommended procedure.
	Bad FLSC-51/51B	Repair or replace with new unit.
	Sensitivity Pot turned too far clockwise.	Readjust Sensitivity control.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Unit produces output pulse with no flow present	Input noise	Turn Sensitivity Pot clockwise until false output stops.
	Bad pickup coil or open signal cable	Check coil and cable for continuity and leakage. Replace if bad.
	Extreme shock or vibration of piping.	Dampen or relocate flowmeter.
	Power supply malfunction	Check and repair as required.
	Bad FLSC-51/51B	Repair or replace with new unit

SECTION 6 SPECIFICATIONS

INPUT: Input filtered, RF and Bandpass filtered adjustable trigger level; Input impedance — 10 mV RMS, 10-1000 Hz; Over voltage capability 120 V RMS (absolute)

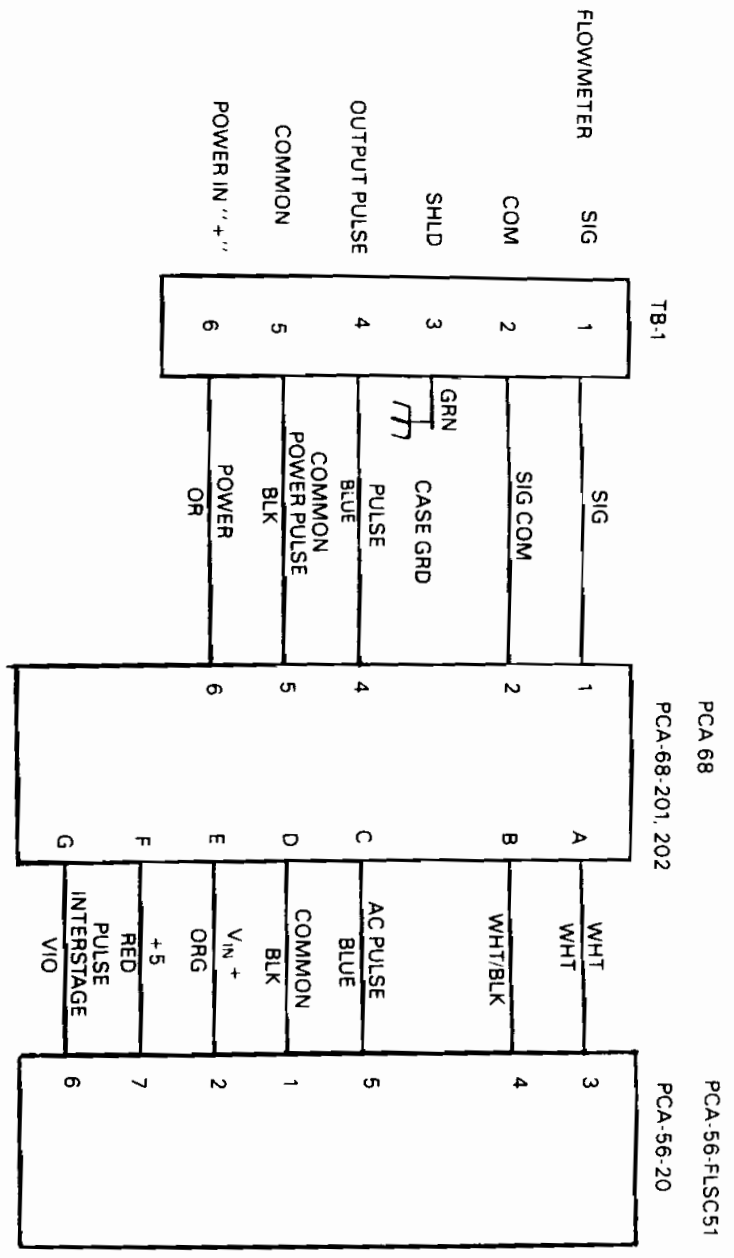
PULSE SCALING: System Factor and System Factor Multiplier provide a cascaded chain of two scaling factors. The system factor provides for scaling factors of .0000 to .9999 with four thumbwheel switches. The system factor multiplier provides additional scaling factors of 1, .1, .01, .001, .0001.

OUTPUT CHARACTERISTICS: Pulse Duration — .2 ms (FLSC-51); 50 ms (FLSC-51B)
Open Collector Type (FLSC-51B) — 2N6660
V max 60 Vdc Absolute Max.
I max 1.2 Adc Absolute Max.
CMOS/TTL (FLSC-51) Logic 1, 2.4 Vdc @ −.800 mA
Logic 0, 0.4 Vdc @ 2.6 mA
High Level Pulse Output may be provided with a pullup resistor to the input power supply.

INPUT POWER: 8-35 Vdc @ 10 mA; Reverse Polarity Protected; Input Filtered

ENVIRONMENTAL: Operating Temperature 0° to 70°C (STD); Storage Temperature −65° to 150°C

ELECTRICAL HOUSING: Class I, Group D
Class II Group E, F, G
Class III



INTERNAL CASE WIRING SCHEMATIC FOR FLSC-51/51B

Thank You
For Purchasing This Telephone

Your new telephone was made in the U.S.A. by people who take a great deal of PRIDE in producing quality products to assure you years of trouble-free service.

We want you to know all about your new telephone, how to install it, the features it provides, and the services you can expect from its use. We have included this information in your Owner's Instruction Manual.

PLEASE READ BEFORE INSTALLING AND USING YOUR NEW TELEPHONE.

CORTELCO

Limited Warranty

If this telephone was purchased by you new in the U.S. or Puerto Rico, **CORTELCO** warrants the telephone against defects in material and workmanship for a period of two (2) years* from the date of original purchase. This warranty is in lieu of all other express warranties. During the warranty period, **CORTELCO** agrees to repair or, at its option, replace the defective telephone, or any part of it without charge for parts or labor. This is your exclusive remedy. This warranty does not cover damage resulting from accident, misuse, abuse, improper installation or operation, lack of reasonable care, the affixing of any attachment not provided by **CORTELCO** with the telephone and loss of parts. The warranty is voided in the event any unauthorized person alters or repairs the telephone.

Telephone companies use different types of equipment and offer various types of services to customers. **CORTELCO does not warrant that this telephone is compatible with the type of equipment of any particular phone company or the services provided by it.**

CORTELCO DISCLAIMS ANY IMPLIED WARRANTY, INCLUDING THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AS OF THE DATE ONE YEAR FROM THE ORIGINAL PURCHASE OF THE TELEPHONE. **CORTELCO** ASSUMES NO RESPONSIBILITY FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

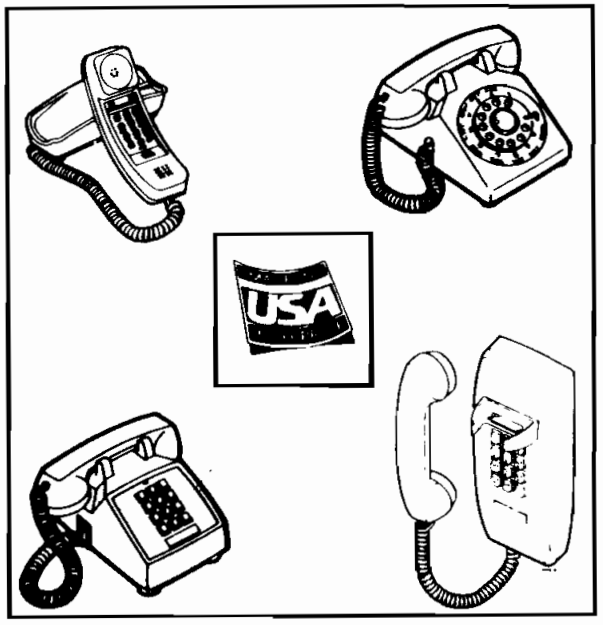
THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE EXCLUSION AND LIMITATION MAY NOT APPLY TO YOU.

If failure occurs and your telephone is in warranty, service shall be provided by returning the telephone to **CORTELCO - Repair Center, 1703 Sawyer Road, Corinth, Mississippi 38834, shipping prepaid.** The telephone will be repaired or replaced if examination by us determines the telephone to be defective. Telephones received damaged as a result of shipping will require you to file a claim with the carrier.

* Model 2500 and 2554 Warranty is for a period of five (5) years (Except -25M, -25F, -25W, -25L Models).

51-100-101
Issue 3

Owner's Instruction Manual



CORTELCO

Important Safety Instructions

Always follow basic safety precautions when using your telephone equipment to reduce the risk of fire, electrical shock, and injury.

1. **Read and understand all instructions** in the Owner's Instruction Manual.

2. **Read all warnings** and follow all instructions marked on the product.

3. **Unplug this product from the wall outlet before cleaning.** Use a damp cloth for cleaning. Do not use liquid or aerosol cleaners.

4. **Do not use the telephone near water.** For example, do not use near a bathtub, wash bowl, kitchen sink, laundry tub, swimming pool, or in a wet basement.

5. **Do not place this product on an unstable cart or stand.** The product may fall causing serious damage to the product.

6. **Do not place any objects on the telephone line cord.** Do not locate the telephone where the line cord will be walked on.

7. **Do not block or cover ventilation slots and openings** in the bottom of the telephone. The openings should never be blocked by placing the telephone on a bed, sofa, rug, or other similar surfaces. This telephone should never be placed near or over a radiator or heat register. This telephone should never be placed in a built-in installation unless proper ventilation is provided.

8. **Never spi quid on the telephone or push obj of any kind through ventilation slots.** Liquid or objects may touch dangerous voltage points or short out parts that could result in a risk of fire or electrical shock.

9. **Do not disassemble this product.** Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electrical shock when the product is subsequently used.

10. **Avoid using a telephone during a local thunderstorm.** There may be a remote risk of electrical shock from lightning.

11. **Do not use a telephone in the vicinity of a gas leak** to report the leak, or otherwise.

12. **Unplug the telephone from the wall outlet and refer servicing to qualified service personnel** under the following conditions:

    - When the line cord is frayed or plugs damaged.
    - If liquid has been spilled into the telephone.
    - If the telephone has been exposed to rain or water.
    - If the telephone does not operate properly by following the operating instructions.
    - If the telephone has been dropped or the housing damaged.
    - If the telephone exhibits distinct change in performance.

Save These Instructions

15-101-€

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: **This equipment has been tested and found to comply with the limits for a CLASS B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:**

- **Reorient or relocate the receiving antenna.**
- **Increase the separation between the equipment and receiver.**
- **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.**
- **Consult the dealer or an experienced radio TV technician for help.**

E FCC WA..TS YOU TO KNOW

GN COMPLIANCE Your telephone is designed to comply CC Rules and Regulations, Part 68. It can be connected to lephone network as FCC-registered terminal equipment. gistration number is printed on the label on the bottom of elephone.

FICATION TO THE TELEPHONE COMPANY As a mer of the local telephone company, you must, if they ask, em before connecting your telephone to the telephone any lines. The telephone company may need the FCC ration number and the ringer equivalence of the telephone. information is printed on a label on the bottom of your hone.

ER EQUIVALENCE The ringer equivalence indicates the int of power that your telephone draws from the telephone any line during ringing. The number is printed on the label e bottom of your telephone.

have more than one telephone (or other terminal device) ected to the telephone company line, you should total the r equivalence numbers (REN's), and be sure that the total is nore than five. Your telephones may not ring if the total is than five. Also, in some rural locations, your telephone may ing if the REN total is more than three.

TRICTIONS You must not connect your telephone to coin-ated lines or party lines.

ERFERENCE POTENTIAL Your telephone has a pushbutton that generates radio frequency energy. If not properly used, ay interfere with radio and television reception. If the tele-ne does cause interference with reception, move the radio or vision to another electrical circuit or another location. If ssary, you may need to seek advice from an experienced nician.

TALLATION This model telephone must be connected to the hone company lines through a modular jack. The required OC for the modular jack is RJ11C for desk mounting and 1W for wall mounting. The USOC number is printed on the on the bottom of your telephone.

E OF DIALING Your telephone has a pushbutton TONE dial. must have TONE service from your telephone company to your telephone for dialing. Note that you will usually be ged extra for TONE service.

RING-AID COMPATIBILITY The handset on your tele-ne will work with magnetically-coupled hearing aids. You can a hearing aid equipped with a T (Telephone) switch.

CASE OF TROUBLE If your telephone should cause lems on the telephone line, the telephone company can porarily disconnect your service. The telephone company t then notify and allow you to correct the problem.

telephone company may from time to time change its lines quipment. They must notify you if planned changes will affect telephone service, to allow you to take steps to prevent ruptions.

TELEPHONE SERVICE F BLEMS

If you have any problems with your telephone service, determine if the problem is with your telephone or the telephone company lines BEFORE CALLING THE TELEPHONE COMPANY, be aware that they may charge you for a service call if the problem is caused by your telephone.

NO DIAL TONE

- Unplug your telephone from the wall jack. Plug a substitute telephone that is known to work properly into the same wall jack
- If the problem persists when using the substitute telephone, notify the telephone company
- If the substitute telephone works properly, you must have your telephone repaired before reconnecting it to the wall jack.

DIAL TONE BUT NO RINGING

- Check that the RINGER VOLUME CONTROL is not set to OFF.
- Set the RINGER VOLUME CONTROL to HIGH and have someone on another line to call you Before answering the call, set the RINGER VOLUME CONTROL to the desired volume

DIAL TONE BUT NO DIALING (Your telephone has a TONE/PULSE switch.)

- Set the TONE/PULSE switch You cannot dial out in TONE position if you have Rotary Dial Service.
- For Rotary Dial Service, set the switch to PULSE position
- For Tone Dial Service, set the switch to TONE position.
- Try both positions if you are not sure.

MAINTENANCE INFORMATION

Treat your telephone with care for trouble-free performance Avoid dropping the handset. Carefully place the handset on-hook after use

Clean your telephone with a damp cloth. Stains may be removed with a mild soap Do not use liquid or aerosol detergents or cleaning agents

REPAIR OF YOUR TELEPHONE

DO NOT ATTEMPT TO REPAIR THE TELEPHONE YOURSELF. Telephones manufactured by CORTELCO must be returned to us for repair.

You can return your telephone to CORTELCO for repair or replacement in accordance with our LIMITED WARRANTY.

DATE-OF-PURCHASE CORTELCO warrants telephones against defects in material and workmanship in accordance with our LIMITED WARRANTY. If your telephone is returned for repair, include a copy of your sales receipt containing the date-of-purchase. DO NOT INCLUDE THE ORIGINAL SALES RECEIPT.

If date-of-purchase is not included, the factory date printed on the label on the bottom of your telephone will be used as the date-of-purchase. The factory date allows six months for distribution and sale of the telephone.

If you return your telephone for repair, the warranty period is not extended. The original date-of-purchase continues to apply to your warranty.

OUT-OF-WARRANTY REPAIR We will repair this telephone for a nominal fee after the LIMITED WARRANTY has expired if you send it to us in a complete and undamaged condition. The repaired telephone will be shipped to you C.O.D., freight collect.

FOREIGN ATTACHMENTS Remove all attached devices, such as adapter plugs or long cords, from your telephone before returning for repair. We do not assume responsibility for repair or return of attachments. Check our LIMITED WARRANTY.

RETURN-FOR-REPAIR PACKAGING If you are returning a telephone to us for repair, package it carefully, preferably in the original carton. Be sure to include your return address, a copy of the sales receipt showing date-of-purchase, and a note describing the problem you have with your telephone. Shipping must be prepaid. If the telephone is in warranty, it will be repaired or replaced, at our option, at no cost to you, and it will be returned shipping prepaid.

Ship telephones (shipping prepaid) to:

CORTELCO REPAIR CENTER
1703 SAWYER ROAD
CORINTH, MS 38834

Installing Your Telephone

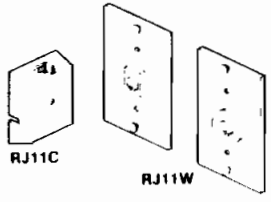
ODULAR JACKS

o Install your telephone, you must have a modular wall jack the desired location, or a 4-prong jack that can be modified ith a 4-prong adapter. If your telephone line does not have modular wall jack, or a jack that can be modified, you must ave one installed.

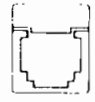
DANGER: To reduce the risk of electrical shock and personal injury, observe the following when installing station wiring:

1. ***Never install telephone wiring during a lightning storm.***
2. ***Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.***
3. ***Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.***
4. ***Use caution when installing or modifying telephone lines.***

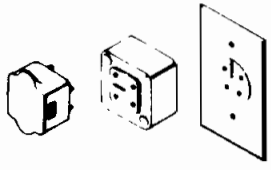
ious types of modular wall jacks shown to the right The USOC 11C modular wall jack is for desk ephones and the USOC RJ11W dular wall jack is for modular wall ephones.



e USOC RJ11W modular wall jack st be in the correct mounting sition before mounting a modular l telephone Check to make sure s in the position shown



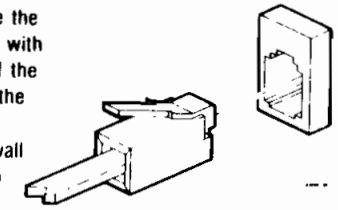
ious types of 4-prong wall jacks shown to the right along with a rong adapter The 4-prong apter plugs into the wall jack for dular wall jack service



Installing Your Telephone

DESK INSTALLATION

To install a desk telephone, use the long modular line cord supplied with your telephone Plug one end of the line cord into the connector on the back of your telephone and the opposite end into the modular wall jack. Your telephone is ready to use.



To disconnect your telephone, press the spring clip on the line cord plug and pull out

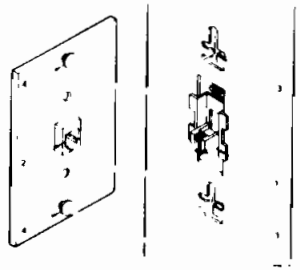
Before Using Your Telephone

1. **Set the ringer volume control.** If the control is set to OFF, you will not hear the ringer when someone calls you.
2. **If your telephone has a TONE-PULSE switch,** set the switch to match the dialing service from the telephone company.
   - **If you have pulse service,** set the Tone-Pulse switch to PULSE.
   - **If you set the switch for TONE service,** you must have TONE service or you cannot dial.
   - **If you set the switch for PULSE service and you have TONE service,** you can dial numbers, but you cannot use distant services, such as bank-by-phone, which require TONE signals.
   - **If you have PULSE service and your telephone has a TONE-PULSE switch,** you can set the switch to PULSE and dial a distant service, and then set the switch to TONE to use the service. BE SURE TO SET THE SWITCH TO PULSE WHEN YOU FINISH THE CALL.

Installing Your Telephone

WALL INSTALLATION

To install a modular wall telephone, refer to the diagram to the right

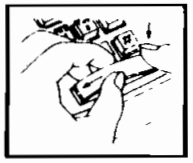


- Fit the plug (1) on the back of the telephone into the jack (2)
- Align slotted holes (3) on the back of the telephone over the mounting studs (4).
- Gently pull down on the telephone until it locks in place.

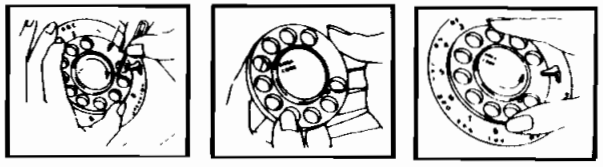
NUMBER CARD

PUSHBUTTON DIAL AND TRENDLINE TELEPHONES

Write or type correct telephone number on number card and fit into number card slot in the telephone faceplate. Insert one end of the clear plastic retainer in one end of the slot and, holding the retainer as shown at right, bend the opposite end down into the slot and let it snap into place To remove the retainer, insert a straightened paper clip into the small slot in the retainer and pry outward.



ROTARY DIAL TELEPHONES



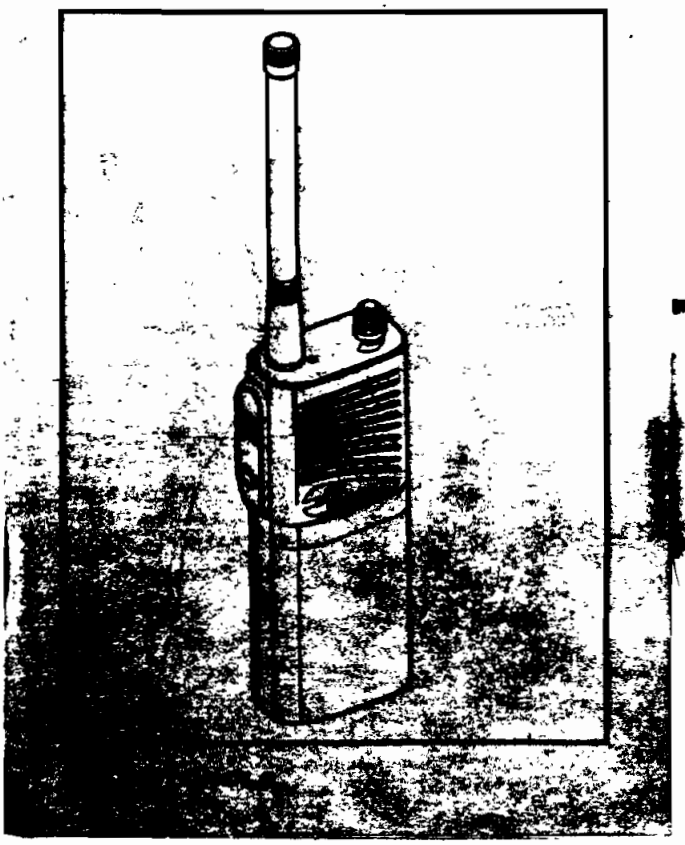
Rotate the finger wheel **clockwise** as far as it will go and hold in this position gently. Insert the straightened end of a paper clip or similar tool into the pin hole of finger wheel which is now about 1/4 inch to the left of the finger stop. Press down firmly on the paper clip and rotate the finger wheel further **clockwise** until paper clip is aligned with the "9" position on the number dial Now lift finger wheel from dial

Write or type correct telephone number on number card and fit into finger wheel, aligning notch in number card midway in the space between the "0" and the "1" hole of the finger wheel.

Position the finger wheel gently under the finger stop Align the "0" or "Operator" finger hole at the "9" position on the number dial Let the finger wheel drop into position Now rotate finger wheel **counterclockwise** until it clicks into place

HANDI-COM/SPORT
OPERATING INSTRUCTIONS

Motorola Two-Way Portable Radio



Recycling or Disposal of Batteries

This product is powered by a nickel-cadmium (Ni-Cad) rechargeable battery. At the end of its useful life, the battery can be recycled. However, recycling facilities may not be available in all areas. Under various state or local laws, the battery must be recycled or disposed of properly and may not be disposed of in landfills or incinerators.

In addition, U.S. Environmental Protection Agency (EPA) regulations classify [illegible] Ni-Cad batteries as toxic waste, unless [illegible]

Contents

Introduction

Congratulations on your purchase of a Motorola Handi-Com or Sport Series two-way radio. Your radio is a product of Motorola's 50 years of experience as a world leader in the designing and manufacturing of communications equipment. With proper care and use, these radios will give you years of reliable performance for short distance communication.

Six models are available in the Handi-Com and Sport Series: Handi-Com, Sport, Handi-Com SS, Sport SS, Handi-Com 10, and Sport 10.

Handi-Com / Sport

These basic models have 1 channel, 2 watts of power, audio accessory connector, transmit battery status indicator plus alkaline battery capability. A separate rechargeable battery kit can be purchased for use with this radio.

Handi-Com SS / Sport SS

These models add rechargeable battery and charger. SS models are packaged with stubby limited range antenna and can not not use alkaline batteries.

Handi-Com 10 / Sport 10

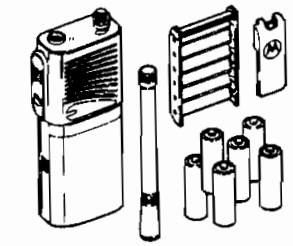
These models include 10 channels, alkaline and nickel cadmium rechargeable battery capability plus all the basic model features.

FCC Licensing

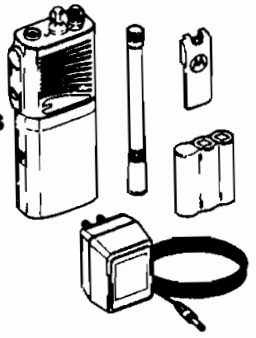
The Handi-Com and Sport Series radios transmit on General Mobile Radio Service (GMRS) frequencies which require a Federal Communications Commission (FCC) license. You must be a private U.S. citizen at least 18 years of age to qualify for a FCC license. The licensing fee is $35 per family and is valid for five years. It is your responsibility to apply for your license and operate this radio in accordance with FCC rules.

Under the GMRS, each individual can become licensed on two primary channels. In addition to these two channels, each user may also operate on seven secondary channels and the Emergency channel.

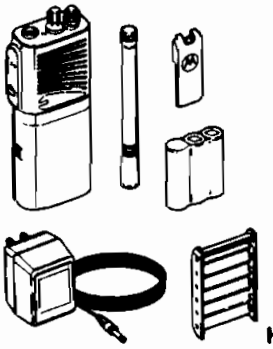
Please refer to the FCC Licensing section in the back of this manual for simple instructions to apply for your license and instructions for the proper use of GMRS frequencies. A FCC license applications is also included.



Handi-Com / Sport



Handi-Com SS / Sport SS



Handi-Com 10 / Sport 10

Initial Inspection

Your package should contain:

	Handi-Com	Handi-Com SS	Handi-Com 10	Sport	Sport SS	Sport 10
Radio	X	X	X	X	X	X
Belt Clip	X	X	X	X	X	X
Full Range Antenna	X		X	X		X
Limited Range Antenna (Stubby)		X			X	
6-AA Alkaline Batteries	X			X		
Alkaline Battery Tray	X		X	X		X
Rechargeable Battery Pack		X	X		X	X
Rechargeable Battery Tray		X	X		X	X
10 Hour Charging Adaptor		X	X		X	X
Operators Guide	X	X	X	X	X	X
FCC License Application	X	X	X	X	X	X

To insure optimum performance of this radio, **thoroughly read and understand this operating instruction manual.**

Battery Installation

NOTE

The NI-Cad rechargeable battery pack is shipped from the factory uncharged and must be charged before use. Refer to the Battery Information section of this manual for battery pack charging instructions and safety tips.

CAUTION

The plastic wrap should not be removed from the rechargeable Ni-Cad battery, as this will destroy the battery.

To Install Rechargeable Battery

1. Unlock the battery compartment by setting the battery cover latches to the release position as shown in Figure 1a. (The orange tabs should be visable.) Remove the battery cover by sliding the battery cover down about 1/4" and lifting off as shown in Figure 1b.

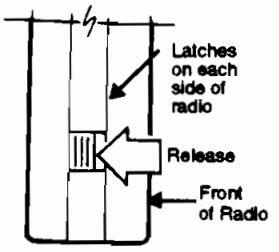


Figure 1a.

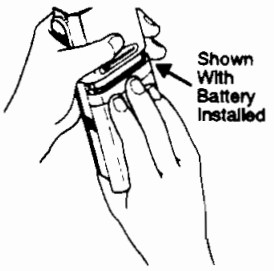


Figure 1b.

2. With the battery label facing up, align the battery and the radio contacts. Apply slight pressure to the bottom end of the battery and press the battery pack down into the compartment as shown in Figure 1c.
3. Place battery cover onto grooves above 1/4" from top of opening, then slide battery cover toward top of radio until closed.
4. Secure battery latches. (Orange tabs should not be visible.)

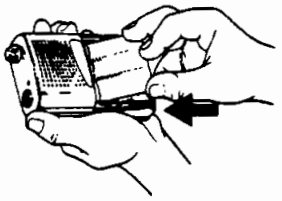


Figure 1c.

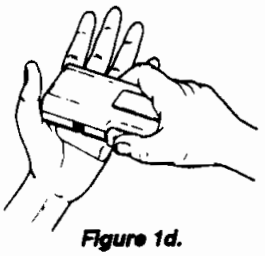


Figure 1d.

To Remove The Battery

1. Unlock the battery compartment (Figure 1a) and remove the battery cover.
2. Turn the radio over and hold it with the cover facing away.
3. Gently tap the battery end of the radio against the palm of your hand as shown in Figure 1d.

To Install Alkaline Batteries

1. Unlock the battery compartment as shown in Figure 1a.
2. Install alkaline batteries into the radio by matching the + and - signs on the battery and the battery compartment.
3. Place battery cover onto grooves above 1/4" from top of opening, then slide battery cover toward top of radio until closed.
4. Secure battery latches. (Orange tabs should not be visible.)

NOTE

When replacing the alkaline batteries, it is recommended to purchase the same brand of batteries that are supplied with the radio.

Antenna Installation

Fasten the antenna to the radio by placing the threaded end of the antenna into the large threaded antenna bushing on top of the radio. Rotate the antenna clockwise until hand tight. See Figure 2a and Figure 2b.

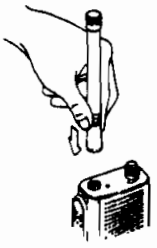


Figure 2a.

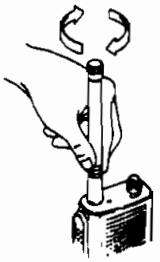


Figure 2b.

Belt Clip Installation And Removal

To Attach The Belt Clip To The Radio

1. Locate mounting rails on the back side of radio.
2. Position the belt clip, Motorola logo facing up, so the logo end of the clip is nearest the mounting rails and the other end of the clip is toward the bottom of the radio.
3. Align the mounting rails with the grooves in the belt clip. Slide the belt clip down the mounting rails until it latches into place (indicated by a click).

To Remove The Belt Clip

1. Locate belt clip release tab on the underside of the belt clip (Motorola logo end).
2. Lift the release tab by inserting a key between the release tab and the back surface of the radio.
3. While holding the key firmly under the release tab, push upward until the belt clip slides slightly toward the top of the radio. See Figure 3a.
4. With the belt clip fully released (when the release tab is pressed against the inside surface of the belt clip), slide the belt clip off the mounting rails. See Figure 3b.

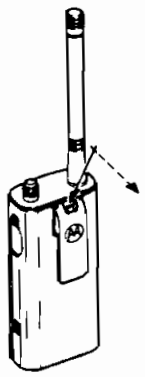


Figure 3a.

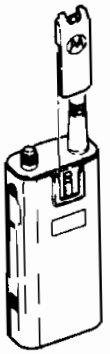


Figure 3b.

Connectors, Controls, Indicators

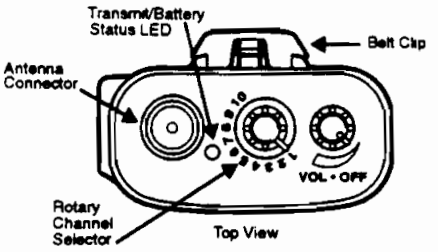


Figure 4.

Antenna Connector

Attaches the antenna to the radio.

VOL-OFF Control

Turns the radio on and off and adjusts radio volume level.

Transmit/Battery Status LED

Illuminates when the PTT switch is pressed; will not illuminate when radio is in need of charging.

Rotary Channel Selector

Selects the operating channel. (Available on Handi-Com 10 and Sport 10 models only.)

Built-in Speaker

Provides audio output when receiving.

Built-in Microphone

Speak into microphone when transmitting.

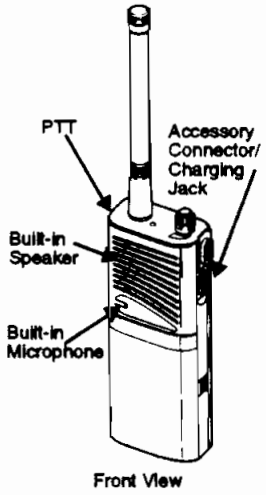


Figure 5.

Push-To-Talk (PTT)

Radio transmit button.

Coded Squelch Disable/Volume Set

If the radio is equipped with the optional coded squelch feature, pressing this button disables the code and allows you to hear any activity on the channel. If the radio is not equipped with the coded squelch feature, pressing this button opens the speaker to a rushing sound (white noise) and also allows you to determine the volume level.

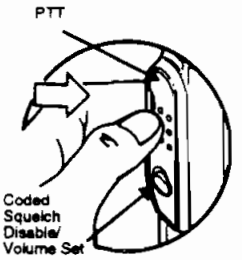
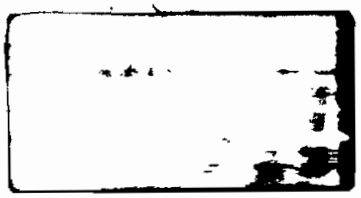


Figure 6.



Charging Jack /Accessory Connector

Allows connection of the charging adapter and audio accessories.

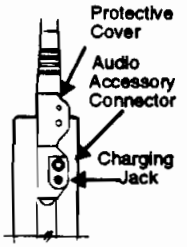


Figure 7.

NOTE

The protective cover that is fitted over the accessory connector should remain in place whenever the accessory connector is not being used.

Operation

To Receive Messages

Turn on by rotating the VOL-OFF (see Figure 4) control clockwise. To select the desired listening level, press the Coded Squelch Disable/Volume Set button while continuing to rotate the VOL-OFF control clockwise.

To Transmit

Listen for voice activity on the channel. If you attempt to talk at the same time as other users, communication will be interrupted. When the channel is busy, wait until it is clear before proceeding. To monitor the channel when operating in the coded squelch mode, press the side Volume Set/Coded Squelch Disable button. See Figure 6.

Hold the radio upright with the antenna in a vertical position and the front cover grille two to three inches away from the lips.

Press the PTT while speaking clearly into the front grille area. Shouting will not make a message easier to understand. **Release the PTT** to receive replies.

Check battery status LED while transmitting. The battery status LED should illuminate whenever the PTT is depressed. If the LED does not illuminate while the PTT is pressed, the battery pack is low and should be charged.

NOTE

Turn the radio off when operations (transmitting, receiving, monitoring, etc.) are complete in order to extend battery life.

Using 2-way radios to improve communication is becoming more common in all activities. Since radio frequencies are provided to radio users on a shared basis, there is always a possibility that you may hear someone else talking on your operating channel. Users are more likely to experience congestion in metropolitan areas than in rural areas. If you are frequently hearing others on your operating channel, you may want to consider the options listed in the following section to minimize this problem.

Change Your Operating Frequency

Handi-Com, Sport, Handi-Com SS and Sport SS Models

If you are using any of the above models, you can change your operating frequency by following these steps to remove the battery and modify the frequency setting inside the radio:

1. Release side panel battery cover latches. (The orange tabs should be visable when unlocked.)
2. Remove the battery cover by sliding the battery cover down and lift cover away from radio.
3. With battery(ies) facing down, gently tap radio against palm of your hand to remove the battery(ies).

Handi-Com and Sport Models with Alkaline Battery Tray

4. Holding the radio as shown in Figure 8, press thumb on top of alkaline tray to pop bottom edge out of radio. Then grasp bottom edge and pull the tray out of radio. Proceed to Step 5 on page 21.

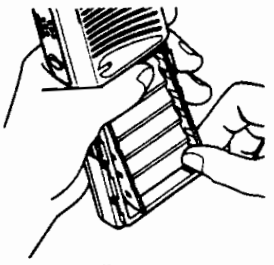


Figure 8.

Handi-Com and Sport Models with Rechargeable Battery Tray

4. Holding the radio as shown in Figure 9, grab block on the bottom of the battery tray with thumb and fingers, while pressing tab on bottom of tray with thumb. Pull tray out of radio. Proceed to Step 5.

Figure 9.

Handi-Com SS and Sport SS Models

4. Insert a coin in the gap of battery tray. Refer to Figure 10. Gently pry base of battery tray away from housing and lift battery tray out of housing. Proceed to Step 5.

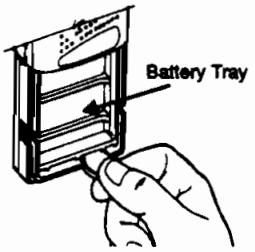


Figure 10.

5. Determine frequency to use. Refer to the Frequency Table.
6. Locate the frequency switches and set switches to the selected frequency. Refer to Figure 11.

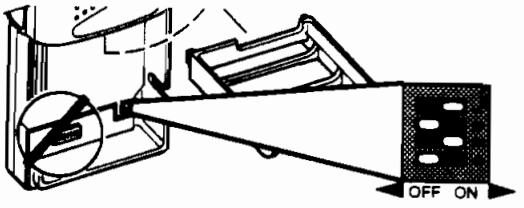


Figure 11.

Frequency Table

Freq. (MHz)	Channel Number	Switch Position			
		S1	S2	S3	S4
462.5625	1	OFF	OFF	OFF	OFF
462.5875	2	ON	OFF	OFF	OFF
462.6125	3	ON	ON	ON	ON
462.6375	4	ON	ON	OFF	OFF
462.6625	5	OFF	OFF	ON	OFF
462.6875	6	ON	OFF	ON	OFF
462.7125	7	OFF	ON	ON	OFF
462.575	8	ON	ON	ON	OFF
462.625	9	OFF	OFF	OFF	ON
462.675	E / 10	ON	OFF	OFF	ON

7. Replace the battery tray. Align the tabs on the top and sides of the battery tray, as shown in Figure 12, with the slots in the radio.

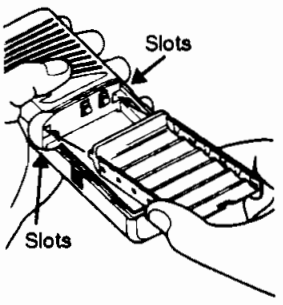


Figure 12.

8. Push bottom of battery tray into radio, as shown in Figure 13.

Figure 13.

Handi-Com 10 and Sport 10 Models

If you are using one of these models, you can change your operating channel by rotating the channel selector knob on the top of the radio. The frequency for each channel position is as follows:

Channel Number	Frequency (MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	462.575
9	462.625
10 (Emergency)	462.675

Install A Coded Squelch Module

A coded squelch module can be added to any of the six Handi-Com or Sport models at a later date. When a radio is equipped with coded squelch, the radio is given a unique code. The radio will only hear messages that are sent by other radios on the same channel with the identical code. Coded squelch ***does not*** prevent other users on the channel from hearing **your** conversation. To add this feature to your radio, contact your radio dealer for details. Installation instructions are included with the module.

Attaching Audio Accessories

The power to the radio should be turned off whenever an audio accessory item is being connected. Such items include headsets, earpieces and speaker microphones. Following this procedure insures proper operation of the PTT button and other radio controls.

To Connect Audio Accessories

1. Lift the protective covering on the audio accessory connector.
2. To plug the accessory into the connector, align the shorter pin of the accessory into the lower connector hole and the longer pin into the top connector hole before inserting.
3. Turn radio on.

You are now ready to operate the radio with the audio accessory.

Rechargeable Battery Information

Before handling the battery, read the following section carefully.

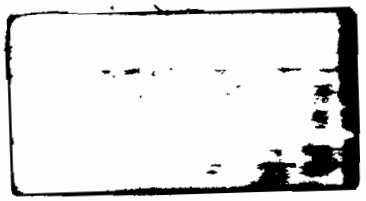
Some models of this radio use rechargeable nickel-cadmium batteries. When properly used, they provide a safe and dependable power source necessary for peak radio performance.

WARNING
Improper use of batteries may create a fire or explosion.

CAUTION
The plastic wrap should not be removed from the rechargeable Ni-Cad battery, as this will destroy the battery.

To insure peak radio performance, batteries should be fully charged before use and periodically thereafter. During standard use, the battery will last approximately 8 hours for a 2 watt radio when fully charged. (Standard use has 5-5-90 duty cycle. The radio transmits 5%, receives 5%, and is in standby mode for 90% of the time.) Transmit/battery status LED will illuminate during transmit, unless the battery is low. The following precautions should be observed while charging and handling batteries:

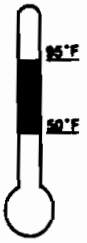
Charge batteries with Motorola series chargers only. Charging batteries with other equipment may



lead to battery damage and will void the battery warranty.

Do not replace or recharge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries from the radio and chargers and may trigger an explosion.

Charge batteries at about 77°F. Charging in cold temperatures (below 45°F) can result in electrolyte leakage and destroy the battery. Charging in hot temperatures (above 95°F) does not damage the battery, but reduced charge capacity will result.



WARNING

DO NOT DISPOSE OF BATTERIES IN FIRE. DISPOSING OF BATTERIES CAN CREATE A FIRE OR EXPLOSION HAZARD.

Charger Safety Instructions

This section contains important safety and operating instructions pertaining to charging the battery pack. Before using the battery charger, read all instructions and cautionary markings on (1) battery charger or charging adapter, (2) battery pack, and (3) radio using the battery pack.

WARNING

To reduce risk of injury, charge only Motorola nickel-cadmium type rechargeable battery packs.

WARNING

DO NOT PLUG THE CHARGING ADAPTER INTO RADIOS THAT CONTAIN ALKALINE BATTERIES! ALKALINE BATTERIES COULD LEAK OR EXPLODE!

- Do not expose chargers to rain or snow.
- Use of an attachment not recommended or sold by Motorola can result in a risk of fire, electric shock, or injury to personnel.

- To reduce risk of damage to electric plug and cord, pull by the plug rather than the cord when disconnecting the charger.
- Make sure cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
- An extension cord should not be used unless absolutely necessary. Use of an improper extension cord could result in a fire or electric shock. However, if an extension cord must be used, make sure:
  1) That pins and plug of extension cord are the same number, size and shape as those on the plug of the charger,
  2) That extension cord is properly wired and in good condition, and
  3) That cord size is 18AWG for lengths of up to 100 feet, and 16AWG for lengths up to 150 feet.
- Do not operate charger with damaged cord or plug, replace them immediately. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; take it to a qualified serviceman.
- Do not disassemble charger; take it to a qualified serviceman when repair is required. Incorrect reassembly can result in electric shock or fire.
- To reduce risk of electric shock, unplug charger from outlet before attempting any maintenance or cleaning. Turning off controls does not reduce this risk.

Battery Pack Charging

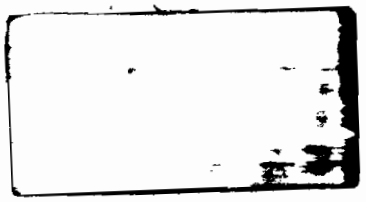
Using The Charging Adapter

The radio can be charged using the charging adapter supplied with the radio. The charging adapter is designed to charge the battery pack while it is inside the radio.

1. Turn the radio off using the VOL-OFF control.
2. Lift the protective covering on the Audio Accessory Connector.
3. Connect the charger adapter to the small size jack in the accessory connector (lower hole) on the side of the radio. Plug the charging adapter into an electrical outlet. See Figure 14.
4. Allow a 10 hour charging cycle for the battery to fully charge. The red LED on the charging adapter glows during this entire charging cycle and remains illuminated until the adapter is disconnected from the radio.

NOTE

The radio can be left on to receive messages while charging without causing harm to the battery pack or charging adapter. However, if the radio remains on while charging, it will require at least 25% more time for the battery pack to charge to full capacity.



IMPORTANT
THE CHARGING ADAPTER WILL NOT WORK WITH ALKALINE BATTERIES.

CAUTION
Do not attempt to transmit while the radio is charging. The charging adapter mutes the radio microphone.

WARNING
DO NOT PLUG THE CHARGING ADAPTER INTO RADIOS THAT CONTAIN ALKALINE BATTERIES! ALKALINE BATTERIES COULD LEAK OR EXPLODE!

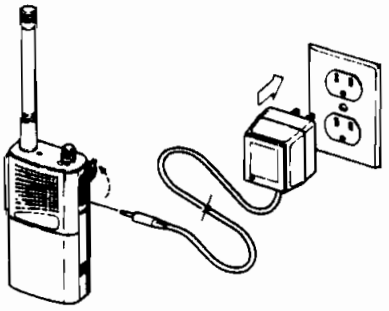


Figure 14.

Desk Top Battery Chargers

10 hour and 3 hour Quick-Rate Battery Desktop-Chargers are optional accessories that can be ordered for increased charging flexibility (not included as a standard feature). Both of these chargers are desktop models and are designed to charge a battery pack outside the radio.

The 10 hour charger uses the standard 10 hour charging adapter that is packaged with the radio. The quick-rate charging method allows you to select a 3 hour quick-rate or a 16 hour trickle-rate charge cycle at the touch of a button. The Quick-Rate Charger is packaged with a unique charging adapter.

NOTE
The charger pocket on the Quick-Rate Charger is large enough to accommodate the radio, but the battery can not be charged while in the radio.

CAUTION
To avoid damage to the battery pack, do not use the quick-rate charging method when charging the battery pack for the first time! Instead, use the standard charging rate method because it allows a proper break-in period for the battery pack.

CAUTION
Do not quick-rate charge a fully charged battery pack! Damage to the battery pack will result.

Desktop Charging Instructions

1. Connect the Desktop Charger and AC Adapter as shown in the Figure 15.
2. Remove the battery pack from the radio and place it into the charger pocket with the silver contacts facing down and the arrow facing forward as shown in Figure 15. The battery pack fully charges in approximately 10 or 16 hours, depending upon which battery charger you use.
3. If a Quick-Rate Charger is being used the yellow LED turns on when the battery is fully inserted while in the 16 hour mode. This LED continues to glow during the entire charging cycle. If the yellow LED does not come on when the battery pack is inserted into the charger, check the battery pack and charger contacts to be sure they are clean. There are no user serviceable parts in the charger.

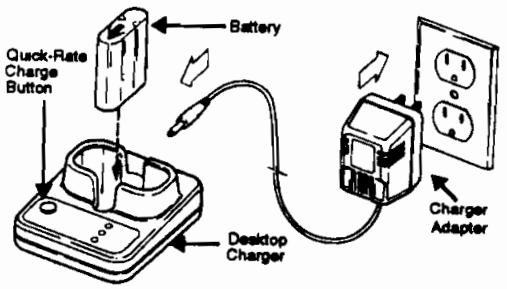


Figure 15.

4. To activate the 3 hour charging cycle on the quick-rate charger, depress the blue quick-rate charge button. Both the red and yellow LEDs glow when the battery pack is charging at the quick-rate. When charging is complete (approximately 3 hours), the red LED turns off and the green COMPLETE LED turns on.

NOTE
The green LED does not illuminate when charging at the16 hour rate.

5. When charging is complete replace the battery pack in the radio as shown in Figure 16.

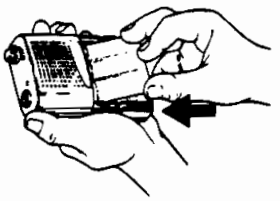


Figure 16.

Troubleshooting

In case of difficulty, review the operating instructions to insure that all instructions are clearly understood and closely followed. If difficulties persist, please review the following troubleshooting guide.

If the radio still does not work properly after following the troubleshooting guide, contact your local dealer or authorized Motorola retailer.

NOTE

Do not disassemble the radio in any way. The radio contains no user serviceable components.

Troubleshooting Guide

Symptom	Problem	Solution
1. Radio is dead.	1a. Battery may not be properly charged. 1b. Battery may not be positioned correctly in the radio.	1a. Press and hold push-to-talk (PTT) button while looking at the LED. If the LED does not light or turns off while still holding the PTT, the battery should be charged. 1b Refer to page 7 for battery installation instructions.
2. Battery does not charge or last long enough.	2a. Incorrect battery charging. 2b. Battery may not be fully charged. 2c. Standard battery life of 8-13 hours is based on a duty cycle where the radio is transmitting 5%, receiving 5%, and in standby mode 90% of the time. Usage different than this duty cycle will result in a different battery life.	2a. If an external charger is used, make sure the battery is positioned properly in the charger base. Refer to page 32 in this manual. If the wall charging adapter is used, make sure that the red LED lights on the charger indicating correct charging status. 2b. Radio should be turned "off" while using wall adapter to charge battery. Charging rate will be longer if the radio is on while charging. 2c. Heavy usage beyond the standard duty cycle may require a second battery or recharging during the day.

Troubleshooting Guide (Cont'd.)

Symptom	Problem	Solution
3. Radio will not talk to other radios in system.	3a. Radios may be on different frequencies.	3a. On Handi-Com 10 or Sport 10 models, check the channel selector knob to verify that radios are on the same channel. On all other models, look at the internal frequency DIP switch positions to verify that radios are set on the same frequency. Refer to page 21 for frequency DIP switch location.
4. Hearing other conversations on your radio.	4a. Users do not have exclusive use of radio frequencies. Frequencies must be shared using proper radio etiquette.	4a. Adding coded squelch will screen out other users conversations on your radio, but your conversations will still be heard by others sharing your frequency. Coded squelch may also be referred to as: Private-Line, PL, Quiet Call, Channel Guard, CTCSS, etc.

Troubleshooting Guide (Cont'd.)

Symptom	Problem	Solution
5. Limited talk radio.	5a. Radio usage in basements, steel structures, concrete buildings, automobiles, or heavy foliage will decrease your range. 5b. If the radio is located very close to your body, as in a pocket or on a belt when used with audio accessories, the range will be decreased due to the shielding effect of your body.	5a. These are characteristics of transmitters. For best talk range, always use the longer antenna. Stubby antennas reduce talk range by 50%. External magnetic mount antennas are recommended for best range when communicating in an automobile. 5b. The higher the radio is held, the better the talk range. Use of audio accessories is only recommended in close range situations for best communication results.
6. Constant static is heard from speaker.	6a. The battery may be discharged. 6b. When using radios around computers or electronic equipment, the radio may hear static or interference from these devices.	6a. Press and hold PTT while looking at the LED. If the LED does not light or turns off while still holding the PTT, the battery should be charged. 6b. Coded squelch can be added to screen out this type of interference. Coded squelch may also be referred to as: Private-Line, PL, Quiet Call, Channel Guard, CTCSS, etc.

Troubleshooting Guide (Cont'd.)

Symptom	Problem	Solution
7 If you have tried a solution for any of the above symptoms that has not worked.	7a. The radio may need to be repaired.	7a. If the unit is still within the warranty period, return the unit to the place of purchase or alternatively call 1-800-446-6686 for warranty details. 7b If the unit is out of warranty, call 1-800-356-1520 for out of warranty service. (Menu option #2 and #2 again).

General Radio Care

Avoid physical abuse of your radio such as carrying it by the antenna or remote microphone.

Wipe the battery contacts with a lint-free cloth to remove dirt, grease, or other material which may prevent good electrical connections.

When not in use, keep the accessory jack covered with the protective cap.

Clean the radio exterior using a cloth moistened with water.

Motorola does not represent this unit to be ***waterproof.*** This unit is water resistant per EIA spec 1P52 and EIA RS-316B. The radio can be waterproof when used with the waterproof bag HLN9985.

Safety Information

To insure proper use, follow these guidelines:

Do not hold the radio so that the antenna is close to, or touching exposed parts of the body, especially the face or eyes, when transmitting. The radio will perform best if the microphone is two or three inches away from the lips and the radio is vertical.

Do not hold the PTT switch on when not transmitting.

Do not allow children to play with any radio equipment containing a transmitter.

Do not operate radio near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use.

Do not operate the radio with a headset or other audio accessories at high volume levels. Hearing experts advise against continuous high volume operation. If you experience a ringing in your ears, reduce the volume level or discontinue use.

FCC Licensing Information

Your Motorola radio operates on FM radio communication frequencies and is subject to the Rules and Regulations of the Federal Communications Commission (FCC). The FCC requires that all operators using General Mobile Radio Service frequencies obtain a radio license before operating their equipment. Application for your FCC license is made on FCC Form 574 which is included with your radio. Additional forms as well as a booklet entitled "Form 574 Instructions" can be obtained from the FCC Supply Section, Administration Services Division, 1919 M St., NW, RM B-10, Washington DC 20554; telephone (202) 632-7272.

Eligibility

Your radio must be licensed with the FCC under the General Mobile Radio Service (GMRS). As described in FCC rule Part 95.5(a), you can qualify for a General Mobile Radio Service license if you are a private U.S. citizen, 18 years of age or older. Businesses or associations can not qualify for a GMRS license.

Under the GMRS, each individual can get licensed on two primary channels. These two primary channels on the Handi-Com and Sport Series radios are 462.575 MHz and 462.625 MHz. These are the only channels or frequencies that will be listed on your license application and your FCC license, once granted.

In addition to these two primary channels, each user may also operate on seven secondary "split" channels and the Emergency channel. These channels will not be listed on your FCC license. The "split" channels are: 462.5625 MHz, 462.5875 MHz, 462.6125 MHz, 462.6375 MHz, 462.6625 MHz, 462.6875 MHz, and 462.7125 MHz. The two primary and seven "split" frequencies are to be used to conduct an individual's personal and family communications.

The Emgergency channel (462.675 MHz), however, is to be used only for the purpose of soliciting or rending assistance to a traveler, or for communicating in an emergency pertaining to the immediate safety of life or the immediate protection of property.

The License Application

FCC Form 574 is used to apply for either new or modified radio station licenses. The following instructions tell what information is needed in each item.

General Instructions

1. Fill in the items as per following instructions. If you need additional space for any item, use the reverse side of the application.
2. Be sure to use a TYPEWRITER.
3. Make a copy for your files.

You Are Ready To Begin

ITEMS 6-11 Leave these items blank.

ITEM 12 Number of mobiles by category. On the line next to "PORTABLE" type the TOTAL number of portable units listed on all lines of ITEM 3.

ITEM 13 Area of Operation - Enter the RADIUS in MILES from the CENTER of YOUR OPERATING AREA; it's geographic coordinates (latitude and longitude in degrees, minutes, and seconds) COUNTY and STATE. For example, a 50 mile radius of 42-29-47N, 87-41-16W, Cook County, IL. You may call your county surveyor's office to obtain latitude and longitude information. If the name of the county and the abbreviation for the state can not be typed under the geographic coordinates in ITEM 13, make a reference to ITEM 13 on the reverse side of the application and type that information in the space provided for "ADDITIONAL INFORMATION".

Check the box "STATE-WIDE" for operations wholly within a single state and type the abbreviation for the state after the word "STATE-WIDE" in ITEM 13.

ITEMS 14-17 Leave these items blank.

ITEM 18 Enter the Street Address, City, State, ZIP, and Telephone number of the person responsible for the radio license and its operations. P.O. boxes or route numbers can not be accepted.

ITEM 19 Leave this item blank.

ITEM 21 Applicant Licensee Name - Enter the legal name of the applicant. Only a private individual may be license for operation on General Mobile Radio Service frequencies. The applicant name must be the same as the signature on the bottom of the application form.

ITEM 22 Applicant Licensee Mailing Address. Enter the mailing address to which the radio license and any future related correspondence, is to be mailed. Post Office box numbers or rural route numbers will not be accepted.

ITEM 23 City - Enter the city name for the licensee mailing address.

ITEM 24 State - Enter the two-letter state abbreviation for the applicant/licensee mailing address.

ITEM 25 Zip Code - Enter the Zip code for the applicant/licensee mailing address.

ITEMS 26-29 Leave these items blank.

ITEM 32 Reason for Filing - If this is your first General Mobile Radio Service (GMRS) license, check the "New Station" box and leave items 35 & 36 blank. If you already have a GMRS license check the "MOD" box. Then use item 35 to describe the changes (such as adding a frequency or purchasing additional radios) desired, and enter your current call sign in item 36. Complete the form just as if it were a new license.

ITEM 35 Specification of items modified - See Item 32.

ITEM 36 Previous Call sign - See item 32.

ITEM 37 Individual Completing Application Enter the NAME and TELEPHONE NUMBER (including area code) of the person who has completed the application.

Completion

Certification

Enter the TYPED name, telephone number (include area code), and date signed.

Place an "X" in the appropriate box to indicate the classification of the person signing the application.

Completeness

Each application should describe your entire radio communications system. If it does not, supply any additional information you feel necessary in the "Remarks" section on the back of the application form.

The FCC charges a processing fee of $35.00 for all new, modified, or renewal license applications. This fee is payable by check or money order made out to the "Federal Communications Commission" and must be enclosed with the application. Any application without a check will be returned. Upon grant, the FCC will mail your radio station license to the address shown on the application form 574.

Mail your completed application with check or money order to:

FCC General Mobile Radio Service
P.O. Box 360354-M
Pittsburgh, PA 15251-6373
Tel. (771) 337-1212

For additional licensing information, contact:

FCC
2025 M St. NW
Washington, DC 20554
Tel: (202) 632-7272.

Copyright Information

Accessories

The following optional accessories are available for use with your Motorola two-way portable radio. These accessories can be ordered through your dealer (call 1-800-356-9058 for your nearest dealer), by mail (see enclosed order form) or by calling Motorola toll-free at 800-422-4210

Model #	Description	Price
Battery & Charging Accessories		
HNN9044_	Nickel-Cadmium Rechargeable Battery Pack	$35.00
HTN9026_	117V 3 Hour Desktop Battery Charger	$54.00
HLN8371_	117V 10 Hour Desktop Battery Charger Tray	$10.00
HTN8232_	Replacement 10 Hour Charging Adapter	$6.00
HLN8251_	3 Hour Vehicular Charging Adapter/Bracket	$30.00
Carrying Accessories		
HLN8240_	Replacement Belt Clip	$3.00
HLN9985_	Waterproof Bag	$36.00
HLN8255_	Spring Belt Clip	$6.00
HLN9149_	Swivel Belt Loop Adapter (use w/HLN8253 or HLN9033)	$8.00
HLN9974_	Replacement Strap For Nylon Carry Case	$6.00
	Handi-Com, Handi-Com 10, Sport, Sport 10	
HLN9033_	Leather Carry Case	$30.00
HLN9034_	Nylon Carry Case	$25.00
	Handi-Com SS and Sport SS	
HLN8252_	Leather Carry Case	$30.00
HLN8253_	Nylon Carry Case	$25.00
Audio Accessories		
BDN6773_	Headset w/Swivel Boom Microphone (w/o VOX)	$50.00
HMN8432_	Remote Speaker Microphone	$55.00
HMN8433_	Earpiece	$25.00
HMN8435_	Surveillance Earpiece	$50.00
BDN6774_	Earpiece w/Microphone	$45.00
Antennas		
NAE6483_	UHF Antenna 462-470 MHz (standard)	$11.00
NAE6522_	*UHF Stubby Antenna 462-470 MHz (Standard on SS models)	$10.00
***Stubby antennas reduce talk-out range**		
Manuals		
HLN8428_	User Information Kit	$5.00

Prices and availability subject to change without notice.

Order by telephone using your Mastercard or VISA or personal check. Please call1-800-422-4210 or fax 1-800-576-6285. (Sorry, no business checks or C.O.D. orders accepted.) Please provide the following information for mail orders:

Quantity	Model/Description	Unit Price	Total Price

Shipping charges and applicable sales taxes will be added to your order

Please ship order to (no P.O. boxes please):

Name _____

Address _____

City _____ State _____ Zip _____

Phone # ( ) _____

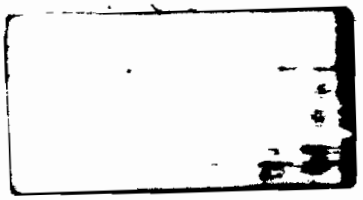
☐ I am enclosing a check or money order payable to Motorola, Inc

☐ Mastercard Card Number _____ Exp. Date _____

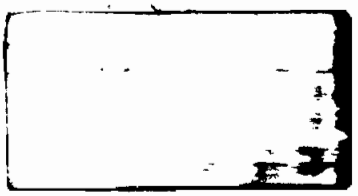
☐ Visa Card Number _____ Exp. Date _____

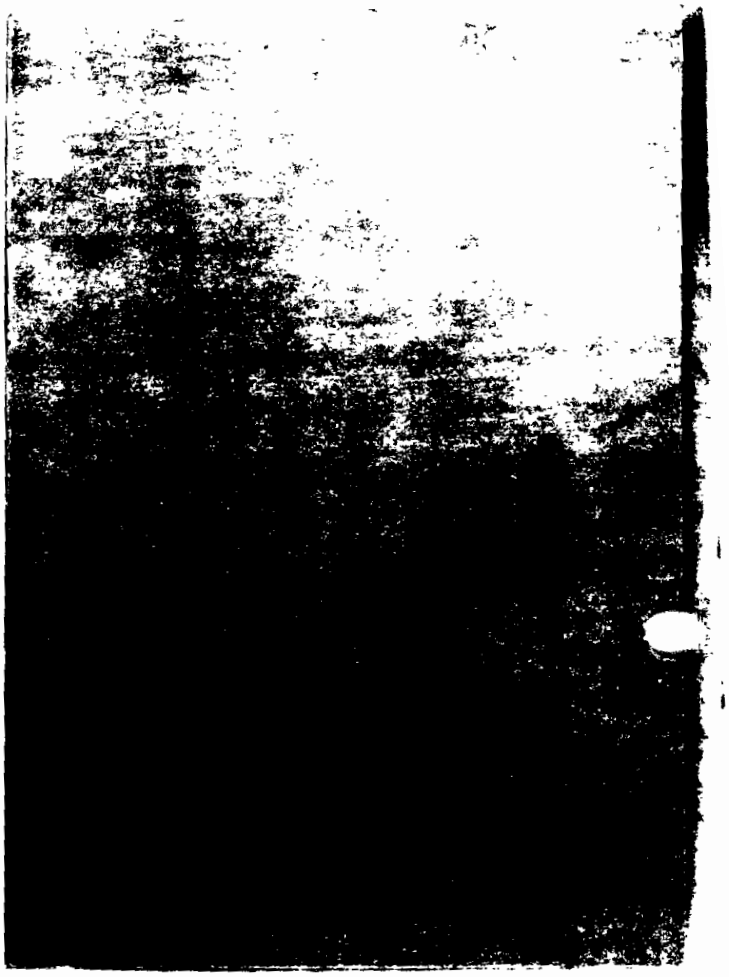
Signature\ _____

Mail To: Motorola Inc.
Worldwide System and Aftermarket Products Division
Attn: Order Processing
1313 Algonquin Road
Schaumburg, IL 60196



Handi-Com/Sport Portable Radios





Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE
- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE/STRAIN FORCE
- Transducers & Strain Gages
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL
- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY
- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION
- Data Acquisition and Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

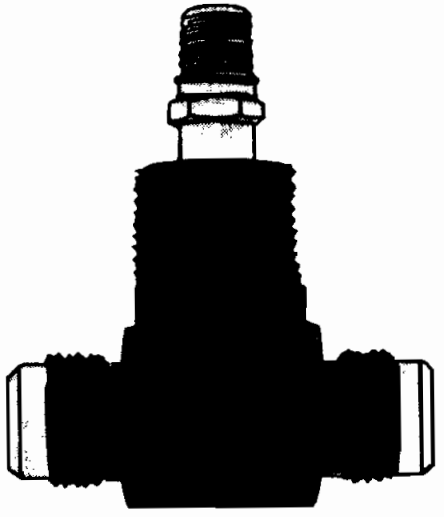
HEATERS
- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL
- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M0389/0894

FTB-100 Series & FTB-200 Series

Turbine Meters



OMEGA®
An OMEGA Technologies Company

Operator's Manual

TABLE OF CONTENTS

FTB-100 AND FTB-200 SERIES TURBINE METERS

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® FTB-100 Series and FTB-200 Series Turbine Meters have a sealed ball bearing design for high accuracy (± ½ % of reading, not full scale) performance at an economical cost. The non-metallic bearing retainers minimize friction, and therefore allow these meters to be used with clean fluids that have poor lubricating properties (i.e. water). These units are intended for clean fluid service only; when there is any doubt, strainers are recommended. In addition, when using these units for fluids with viscosities other than 1 centistoke, special calibrations and universal viscosity curves are available. Consult OMEGA's Engineering Department.

Ball bearings also give the widest linear flow range, particularly the larger turbines. Bearing replacement and clean-up are fast and easy since all the internal parts are easily accessible by removing a single nut.

These FTB-100 and 200 Series Turbine Flowmeters have a low mass rotor design which allows for rapid dynamic response, and can be used in pulsating flow applications.

The deflector cones eliminate downstream thrust on the rotor and allow hydrodynamic positioning of the rotor between the deflector cones. This provides wider rangeability and longer bearing life than that of conventional turbine flowmeters. Integral flow straightening tubes minimize the effects of upstream flow turbulence.

The FTB-100-200 Series Turbine Meters are available with integral signal conditioners which provide scaled and unscaled frequencies, 4-20 mA, or 0-5 V outputs. Units without the integral signal conditioner are supplied with their mating connector for two-wire hook-up.

The FTB-200 Series Turbine Meters have male flared end fittings for easy connections. They are built to meet the performance requirements of MS33656, though they do not carry a mil specification.

Installation kits with the required up and downstream straight pipe lengths for proper turbine operation are available to insure proper operation of the FTB-200 Series Turbine Meters.

1.2 FEATURES

- Accuracy, ± ½ % of reading
- Ball bearing design
- Non-metallic bearing retainers for long life
- Ball bearings field replaceable without loss of calibration
- Disassembles quickly for easy maintenance

- Deflector cones stabilize the low mass rotor for increased bearing life.
- Integral signal conditioners available for 4 to 20 mA, 0-5 V, scaled frequency (for FTB-100) and factored pulse outputs (for FTB-200)

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department at (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 CALIBRATION

The standard calibration provided with all OMEGA FTB-100, 200 Series Turbine Meters consists of a 10 point water calibration over the linear flow range of the meter. This is suitable for fluids with viscosities less than or equal to water (1 cp.).

Fluids other than water are used to simulate viscosity conditions from 2 to 100 centistokes. Where it is necessary to document the flowmeter's performance for viscous service, the flowmeter calibration simulates the viscosity, as well as, the flow rate anticipated in actual service.

Universal viscosity calibration (UVC) curves may be documented for each OMEGA turbine flowmeter where this information is required to achieve maximum flowmeter accuracy in medium to high viscosity service.

In general, any flowmeter size may be supplied with a universal viscosity curve (UVC). However, since smaller meter sizes (under one inch) display the largest sensitivity of calibration factor to viscosity, it is this size range which are the most likely to be considered for a universal viscosity curve (UVC).

The universal viscosity curve may be utilized to determine the K-Factor either graphically, or in the case of an intelligent instrument, algorithmically, for a measured set of flowing conditions.

OMEGA offers a standard viscosity calibration which consists of six repeated points for each viscosity required. A typical UVC curve requires three sets of six points plotted on graph paper as a continuous curve. In addition, OMEGA offers a ten point viscosity calibration and curve on a flowmeter at a single viscosity (up to 100 centistokes) at a nominal additional fee.

2.3 CAVITATION

Cavitation is the sudden bubbling of a liquid due to the loss of pressure as the fluid moves through the turbine meter. Cavitation will substantially shift the calibration of the turbine and potentially damage it as well. To avoid cavitation, the pressure downstream of the turbine meter must be above a minimum value, defined by the equation (1.25 x VP) + (2 x Δ P) = minimum downstream pressure, where VP = vapor pressure of the liquid at operating temperature, and ΔP = pressure drop through the flowmeter. To calculate ΔP, the following equation is used:

$$\Delta P = DP (\rho) .81 (\mu) .27 (Q_2/Q_1) 1.82$$

where DP = Maximum pressure drop, from range tables in Section 5. ρ = density of liquid; μ = viscosity of the liquid; Q1 = maximum linear water flowrate (from tables in Section 5); Q2 = flowrate of the actual fluid flowing through the turbine.

RECOMMENDED INSTALLATION PRACTICES

Water hammer and surges can be damaging to any flowmeter and must *always* be avoided.

Water hammer occurs when a liquid flow is suddenly stopped as with quick closing and solenoid operated valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to flowmeters if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible) and pumps should be brought up to power slowly and valves opened slowly. In addition, to avoid both water hammer and surges, a surge chamber should be installed.

2.4 GENERAL INSTALLATION PROCEDURE

1. **Flow Direction:** All flowmeters are marked 'IN' and 'OUT' and with a flow direction arrow.
2. **Mating Pipe Fittings:** Care should be taken in the proper selection for the mating fittings. Size, type of material and pressure rating should be the same as the flowmeter supplied. The correct gaskets and bolts should be utilized.

3. **Meter Location:**
   a. Relative — When it is expected that flow will be intermittent, the meter should not be mounted at a low point in the piping system. Solids which settle or congeal in the meter may affect meter performance.
   b. Tolerance to Electrical Interference — In order to achieve optimum electrical signal output from the flowmeter, due consideration must be given to its isolation from ambient electrical interference such as nearby motors, transformers and solenoids.

2.5 PIPING — TYPICAL FLOWMETER INSTALLATION

The fluid moving through the FTB-100/200 Turbine Meters engages the vaned rotor. Swirl present in the fluid ahead of the meter can change the effective angle of engagement and, therefore, cause a deviation from the supplied calibration (performed under controlled flow conditions).

Generally speaking, it is necessary that the flow pattern of the fluid be as uniform as possible. Flow straightening pipes may be necessary. See Tables 2-1 and 2-2.

2.5.1 Flow Straighteners

Proper application of the OMEGA Turbine Meter requires a suitable piping section to achieve optimum accuracy. While an inlet straight pipe run of 10 pipe diameters and an outlet straight pipe run of 5 pipe diameters provide the necessary flow conditioning in general, some applications require an upstream flow straightener (see Figure 2-1). This consists of a section of piping that contains a suitably dimensioned and positioned thin walled tube cluster to eliminate fluid swirl. A typical application requiring a flow straightener would be custody transfer.

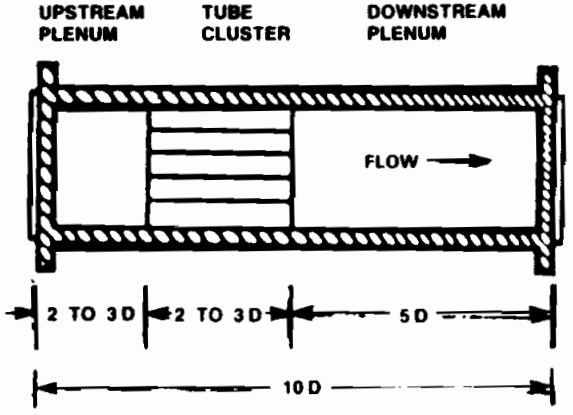
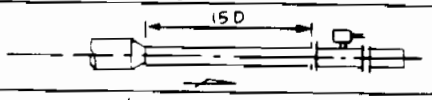
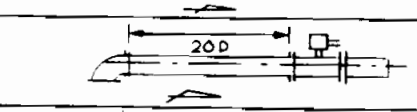
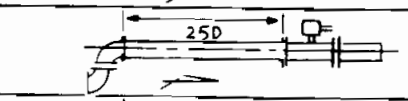
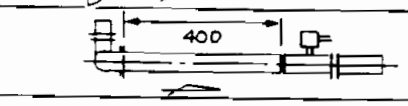
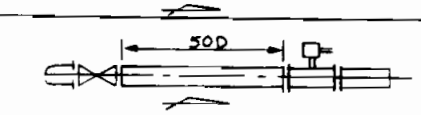


Figure 2-1. Flow Straightening

TABLE 2-1
REQUIRED STRAIGHT PIPE SECTION WITHOUT METER TUBES

	Piping Conditions	Straight Pipe Sec.	Description
Reducer		15D min.	A concentric reducer upstream of meter
Elbow		20D min.	An elbow upstream of meter
		25D min.	Two elbows horizontally upstream of meter
		40D min.	Two elbows vertically upstream of meter
Sluice Valve		50D min.	A partially open sluice valve upstream of meter

Provide at least 5D for the downstream straight pipe section.

TABLE 2-2
PIPING TABLE

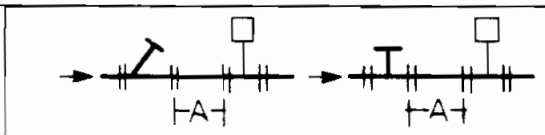
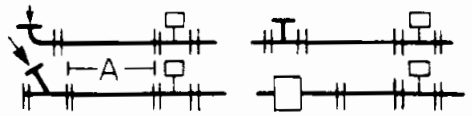
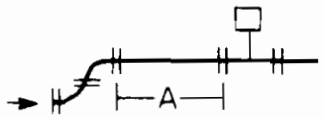
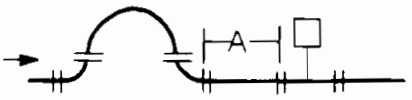
	Typical Piping	Recommended Straight Pipe Length "A"		Remarks
		Without Vanes	With Vanes	
All Fittings in Same Plane		15D *	15D	Closed branch
		20D	15D	Elbow, Tee, Branch pipe
		25D	15D	Elbow, 2 planes
		25D	15D	Long-radius bends

TABLE 2-2 PIPING TABLE (Cont.)

Fittings in Two Planes	Varied Section	Valves	Recommend Meter Be Installed Upstream	
30D 25D	20D	Regulating, reducing valves Ball, check valves Shut-off valve	15D 15D	Elbow Long-radius bends
40D 35D	20D	Elbow Long-radius bends	20D 20D	Elbow Long-radius bends
20D	15D	Contracting pipe	15D	Contracting pipe
40D	20D	Expanding pipe	20D	Expanding pipe

Note: Straight pipe length on the downstream side to be 5 pipe diameters minimum. *D – Pipe internal diameter.

2.5.2 Meter Location

A typical flowmeter installation is shown in Figure 2-2. Valves V1, V2 & V3 should be installed if it is necessary to do preventive maintenance on the flowmeter without shutting down the flow system. V3, the bypass valve can be opened before closing V1 and V2 allowing the flow to continue while removing the turbine flowmeter for service.

Figure 2-2. Typical Flowmeter Installation

2.5.3 Strainers/Filters

A strainer/filter may be required to reduce the potential hazard of fouling or damage that may be caused by foreign matter. Strainer/filters are recommended to be used with the FTB-100 and 200 Series Turbine Meters.

Meter Size	Mesh Size	Particle Size Max.
¼" to ½"	100	.0055
⅝" to 1¼"	70	.008
1½" to 3"	40	.015
4" to 12"	24	.028

If a strainer/filter is required in the system, it should be located upstream of the flowmeter taking care that the proper minimum distance is kept between the strainer and flowmeter.

2.5.4 Installation Kits, FTB-200 Series

Installation kits for the FTB-200 Series flanged end fittings consist of two lengths of stainless steel tubing cut to a length appropriate for the upstream and downstream straight pipe run and flared at one end. Mating sleeves and nuts are included. The kits may be conveniently butt welded into the user's piping.

The installation kits are available in turbine sizes from ¼" to 2".

2.6 SIGNAL CABLES

Two conductor, shielded cabling, is recommended for the OMEGA FTB-100, 200 Series Turbine. It is generally available from OMEGA, (part number is TX-4-100). Cabling is available cut to length with dressed end connections.

2.7 SIGNAL CONDITIONERS/CONVERTORS

Consideration should be given to properly interfacing the turbine flowmeter output to the host electronics. If the system is installed in an electrically noisy area or if the distance from the turbine flowmeter to the host electronics exceeds 500 feet a signal conditioner may be necessary.

OMEGA Signal Conditioners (FLSC-34, FLSC-28, FLSC-35B, FLSC-51 and FLSC-51B) for turbine flowmeter provide amplification, filtering and wave shaping of the low level flowmeter pickup signal and generate a high level pulse output signal suitable for transmission to a remote host system through a noisy environment.

Several output forms (i.e., TTL/CMOS, open collector, etc.) are available to suit various interface requirements. The pulsing output signal may be transmitted several thousand feet.

SECTION 3 PRINCIPLE OF TURBINE FLOWMETER OPERATION

The FTB-100 and 200 Series Turbine Meters are volumetric measuring flowmeters. The flowing fluid engages the vaned rotor causing it to rotate at an angular velocity proportional to the liquid flow rate. The angular velocity of the rotor results in the generation of an electrical signal (ac sine wave type). Summation of the pulsing electrical signals relates directly to total flow throughput. Frequency of the signals relates directly to flow rate. The vaned rotor is the only moving part of the flowmeter.

The low mass rotor design allows for rapid dynamic response which permits the turbine flowmeter to be used in pulsating flow applications. The deflector cones eliminate downstream thrust on the rotor and allows for hydrodynamic positioning of the rotor between deflector cones.

The hydrodynamic positioning of the low mass rotor provides wider rangeability and longer bearing life than that of conventional turbine flowmeters. Integral flow straightening tubes minimize the effects of upstream flow turbulence.

The FTB-100, 200 Series Turbine Meters have high output magnetic pickup, with a typical range of 10:1 (self generating). The flowmeter pickup senses the motion of the rotor and converts it to a pulsing electrical signal which is of a discrete, digital nature. The pickup generates a relatively high magnetic field and produces a high level sinusoidal output. The signal may be transmitted up to 500 feet without amplification.

SECTION 4 TROUBLESHOOTING AND MAINTENANCE

4.1 PICKUP COIL TESTING

Testing the coil requires checking its resistance with an ohmmeter.

1. The resistance from pin A to pin B should be approximately 2000 ohms (±300 ohms). RF type coils should be approximately 2.5 ohms.
2. The resistance from either pin to case should be greater than 1 megohm.

If either resistance measurement fails, replace the pickup coil. Firmly seat the new coil in the flowmeter and lock nut it into position.

4.2 BEARING REPLACEMENT

It is recommended that the bearing be checked periodically for wear. The type of fluid being measured, as well as temperature, has a direct relationship on the life expectancy.

It is recommended that the bearings be replaced if any signs of wear are apparent. An unexplained shift in the output accuracy could be a sign of worn bearings.

Ball bearings can be changed in the field. No special tools or skills are required.

CAUTION

If bearings are allowed to operate without replacement at the recommended interval, the accuracy of the device will drift from the original calibration and if left long enough, severe damage to the rotor may occur.

Preventive maintenance requires the turbine flowmeter undergo a general inspection, bearing replacement and cleaning. Refer to Figure 4-1 Parts Diagram and the following procedure to remove the flowmeter internals from the housing. A clean work area is required.

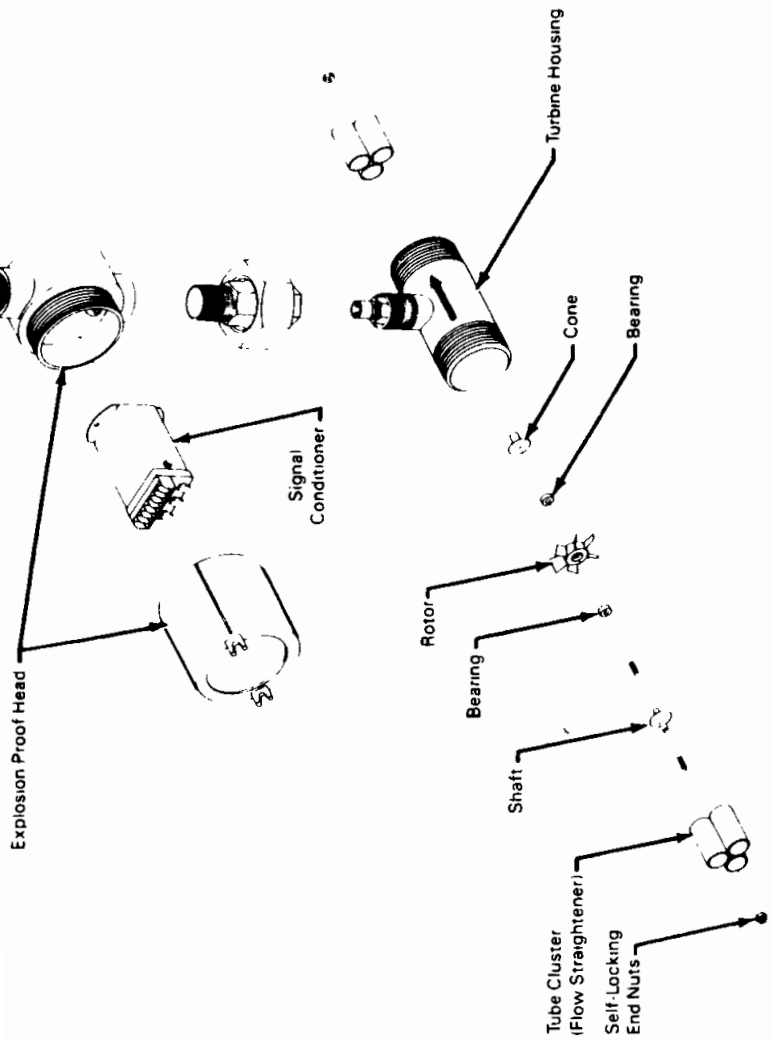


Figure 4-1. Parts Diagram

1. Using two "SPIN-TITE" wrenches, remove one end nut from the shaft.
2. Place a small stove head bolt in a vise. Guide the bolt head gently through one of the flow straightener tubes that compose the tube cluster and in a smooth firm stroke remove the tube cluster from the housing.
3. Once the shaft is placed vertically downward a cone, two bearings and the rotor will fall out.
4. Remove the other tube cluster (flow straightener tubes) in a similar manner.
5. Examine the shaft and cones for scoring. If scoring is present, replacement is necessary.
6. Obtain new bearings of the same type from stock or the manufacturer. Discard old bearings.
7. Reassemble one tube cluster into housing with shaft, cone and end nut.
8. Place the bearings into the rotor. Guide bearings and rotor on to the shaft making sure to reassemble with the "IN" side of rotor facing the "IN" side of the housing.
9. Place cone on shaft. Gently "rattle" the flowmeter to seat the internals on the journal of the shaft.
10. When properly seated, gently push the tube cluster back on to the shaft. Be sure to properly align the tube cluster on to the shaft. The tube clusters seat against a shoulder machined into the housing.
11. Gently tighten the self locking end nuts until they make contact with the tube cluster. "Two Fingers" tight on a "Spin-Tite" is more than adequate.
12. Holding the meter horizontally, blow into it. The rotor should turn freely and "quiver" to a stop with one of its blades aligning with the pickup coil.
13. Clean the flowmeter assembly with TRICHLOETHANE or an alternately approved cleaning solution.

The flowmeter is ready for operation. When installing the flowmeter be sure to orient the input and output correctly.

SECTION 5 SPECIFICATIONS

5.1 FTB-100 SERIES

RANGES:

Model No	Linear Flow Range (US GPM)	NPT End Fittings	Maximum Operating Pressure (PSIG)	Maximum Pressure Drop (PSID)	Length	Nominal K-Factor Pulses/Gal.
FTB 101	35-3 5	½"	5000	3.0	2.45"	13,000
FTB 102	.75 7 5	½"	5000	5.0	2 45"	10,000
FTB 103	1 25-9 5	½"	5000	5.2	2.45"	6,000
FTB 104	1 75-16	¾"	5000	3.0	2 75"	4,100
FTB 105	2 5-29	¾"	4250	5.0	3 25"	2,200
FTB 106	4-60	1"	3850	5.1	3.50"	640
FTB 107	6 93	1¼"	3850	4 3	3.88"	410
FTB 108	8 130	1½"	3000	3.0	4.38"	230
FTB 109	15-225	2"	2500	3.3	4.75"	120
FTB 110	25-400	2½"	2250	4 0	6.06"	62
FTB 111	40 650	3"	2000	4.0	7 50"	55

ACCURACY: ± ½ % of reading
REPEATABILITY: ±0.1% of reading
MAX. TEMPERATURE RANGE: −450° to +450F
MAX. INTERMITTENT OVERRANGE: 150% of max. range
MIN. OUTPUT AMPLITUDE: 30 mV peak to peak unscaled pulse
MATERIALS OF CONSTRUCTION: Body: 304SS; Rotor 17-4 pH steel
BEARINGS: 440C stainless steel

5.2 FTB-200 SERIES

RANGES:

Model No.	37° Flare Fitting	Linear Range (GPM)	Maximum Operating Pressure (PSI)	Length Inches	Nominal K-Factor Pulses/Gal.
FTB 201	¾-16 UNF 3A	.35-3 5	5000	2.45	13,000
FTB 202	¾ 16 UNF-3A	75-7 5	5000	2 45	10,000
FTB 203	¾ 16 UNF 3A	1 25-9.5	5000	2 45	6,000
FTB 204	⅞ 14 UNF 3A	1.75 16	5000	2.75	4,100
FTB 205	1 1/16-12 UNF 3A	2 5 29	5000	3 25	2,200
FTB 206	1 5/16-12 UNF-3A	4-60	3500	3 50	640
FTB-207	1⅝ 12 UNF-3A	6 93	3000	3.88	410
FTB 208	1⅞ 12 UNF 3A	8-130	2250	4 38	230
FTB 209	2 1/2-12 UNF-3A	15-225	1750	4 75	120

SPECIFICATIONS (continued)

ACCURACY: ± ½ % of reading
REPEATABILITY: ±0.1% of reading
MAX. TEMPERATURE RANGE: −450 to +450°F
MAX. INTERMITTENT OVERRANGE: 150% of maximum range
MAX. PRESSURE DROP: 5 psi
MATERIALS OF CONSTRUCTION: 304SS; Rotor: 17-4 pH steel;
BEARINGS: 440C stainless steel
INSTALLATION KITS: 340SS, 0.65" thick
ELECTRICAL: Two-wire connector included

NOTES

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

We are glad to offer suggestions on the use of our various products. Nevertheless, OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

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Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. Call toll free in the USA and Canada: 1-800-622-2378, FAX: 203-359-7811; International: 203-359-1660, FAX: 203-359-7807.

BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, YOU MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OUR CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

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2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems you are having with the product.

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2. Model and serial number of product, and
3. Repair instructions and/or specific problems you are having with the product.

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TABLE OF CONTENTS

DESCRIPTION & SPECIFICATIONS

Description:
Featuring 6 digits of bright, 7-segment LED displays, the Intellect-69 is an integrating totalizer/rateмeter which accepts analog signal inputs. The unit can be field programmed to accept 0-20mA, 4-20mA, 0-5V, 0-10V or 1-5V signals. An optional Square Law input is available for inputs that require square root extraction. A 4-20mA output option is available to control strip recorders or other peripherals. Two assignable set points are standard for two stage shut off. The high and low scaling settings are programmable from the front panel. By pressing the "view" button, the unit will display: integrated total, rate, peak or valley. RS422 or RS232 serial communications are available options for data communication with a host computer.

Specifications:

Display: 6 digit, .55" high, 7 segment, red orange, LED.

Input Power: 110, 220 VAC ± 15% or 12 to 24VDC.
Current: maximum 300 mA DC or 8.0 VA at rated AC voltage.

Output Power: (AC powered units only) + 24VDC @ 50mA regulated ±5%

Temperature:
Operating: +41°F (5°C) to +130°F (+54°C).
Storage: -40°F (-40°C) to +200°F (93°C).

Memory: EEPROM stores data for ten years if power is lost.

Reset:
Front Panel: resets displayed values and control outputs.
Remote: 4-30VDC positive edge, resets totalizer and control outputs.

Control Outputs:
Standard: Open collector sinks 250mA from 30VDC when active.
Optional: 2 each Form C SPDT 10Amp @ 120/240 VAC or 28 VDC. (Open collector outputs are also supplied with 10VDC provided at transistor outputs through relay coil. If greater than 2mA is used, relay will remain energized. Applying greater than 10 VDC may destroy unit. Transistor will sink 100mA in "ON" state.)

Input:
Standard: Linear 0-20mA, 4-20mA, 0-5V, 0-10V or 1-5V selectable from the front panel.
Optional: Square Law 0-20mA, 4-20mA, 0-5V, 0-10V, or 1-5V, is available for inputs that require square root extraction.

Input Impedance: Current: 100Ω; Voltage: 115KΩ

Calibration: The unit does all of the calibrations internally. There are no potentiometers to adjust and the unit never needs to be removed from the case.

Set Points: Two control set points are provided. The set point outputs can be assigned to rate or total. The unit comes standard with two open collector control outputs. Two 10 amp, Form C relays are optional. The outputs are programmable from .01 to 599.99 sec or latched until reset when assigned to the total and a hysteresis (alarm range) when assigned to the rate.

Rate Display: Updates 5 times per second, Accurate to 4.5 digits. Set "low" greater than "high" for inverted display (LINEAR ONLY).

Totalizer: Integrates from the rate reading and accumulates up to 6 digits of total count. The time base (hours, minutes or seconds) is field programmable from the front panel.

Analog Out: The unit can be ordered with an optional 4-20mA output which is proportional to the rate display. The high and low settings are programmable from the front panel. Set "low" greater than "high" for inverted output. A sinking driver generates a corresponding linear current through the external devices. The output updates with each update of the rate. Accuracy is 50uA worst case. For rated accuracy, load must be connected to the analog output before unit is powered. Compliance voltage must be 3 to 30 VDC non inductive. (The unit can provide the DC source as long as the drop across the devices being driven does not exceed 21V).

Programming: Decimal points, Scaling from 0 to 59999 units per selected time base, set points, input type, security lock code, and assigning outputs are all programmable from the front panel.

Housing: Standard 1/8 DIN, high impact ABS plastic case (NEMA 4/IP65 front panel).

Shipping Weight: 2 lbs.

Overvoltage Protection:
50 V

Overcurrent Protection:
50 mA

Resolution: 14.5 Bits

Accuracy:

RANGE	% FS ERROR (worst case)	% FS ERROR (typical)
4-20 mA	0.1%	.05%
0-10 VDC	0.2%	0.1%
0-5 VDC	.25%	.15%
1-5 VDC	.25%	.15%

Square Law: (above 5% of bottom range) 0.1%
(5V inputs .4%) Worst case over complete range: 2%

Temperature Stability: Will not drift more than 20 parts per million per °C from 5°C to 54°C

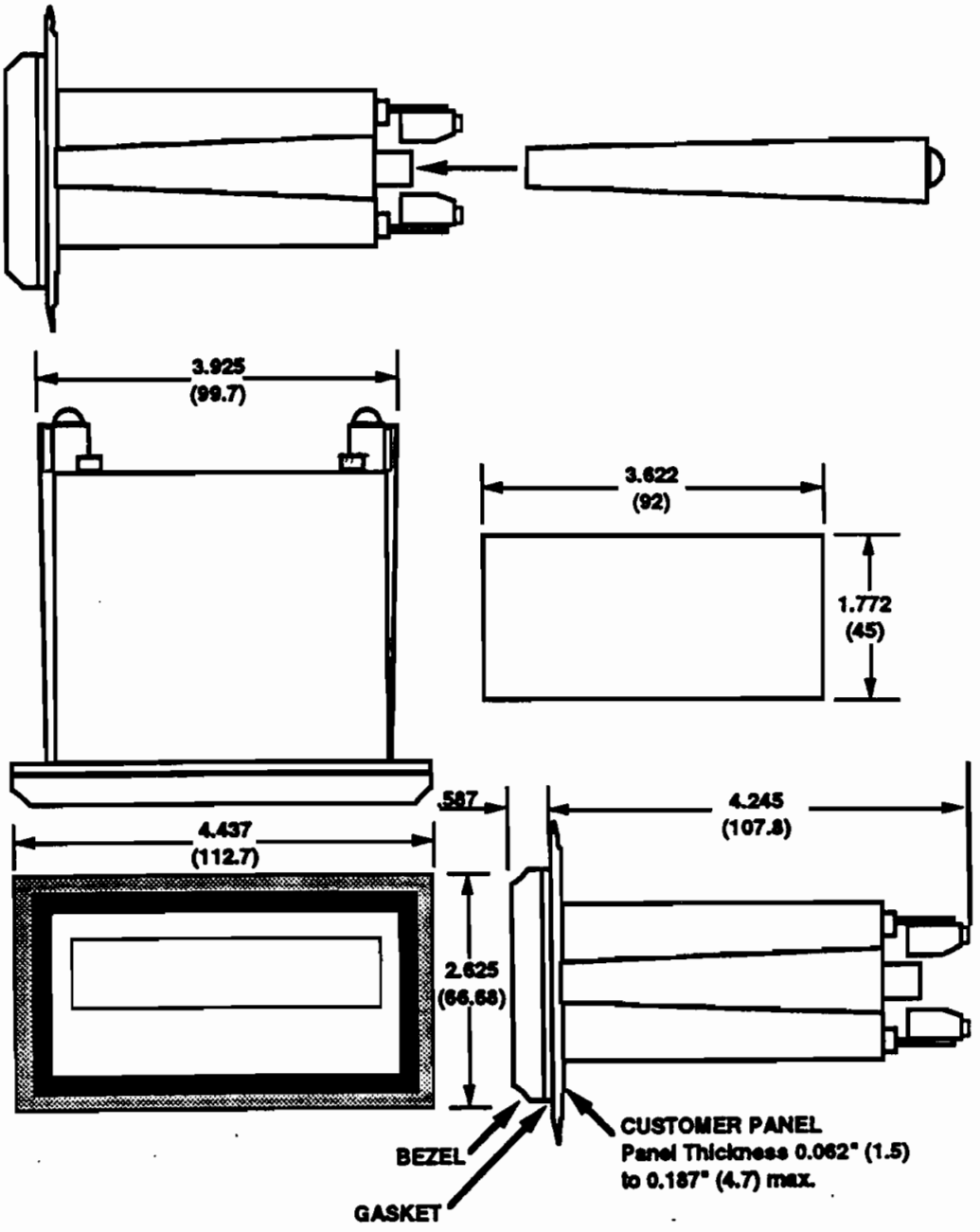
MOUNTING

HOW TO MOUNT:

Slide the body of the unit through the rubber gasket. Insert the unit into the panel. Slide the brackets up the groove to press against the back of the panel, as shown in "FIG. A". Insert the screws into the rear of the brackets.

Tighten the screws evenly and alternately. A panel less than .1" may distort if the clamps are screwed too tightly. Do not over tighten! A normal level of torque is required. Maximum torque should be 3" pounds.

FIG. A



WIRING

AC / DC CONNECTIONS:
NOTE: Connect power only after other connections are finished. Do not touch the live AC power terminals. The unit has been designed with an isolated AC input, therefore polarity is not a concern for the AC power. The chassis is plastic, therefore earth ground is not used. For DC operation, connect +DC to terminal 10 and -DC to terminal 3.

Although the unit is designed to be immune from line or RF interference, the unit is controlled by a microprocessor and an electrically "noisy" environment could cause operating problems. The input power lines should not be common to power lines for motors, pumps, contactors, etc.

Four sources of noise can occur:

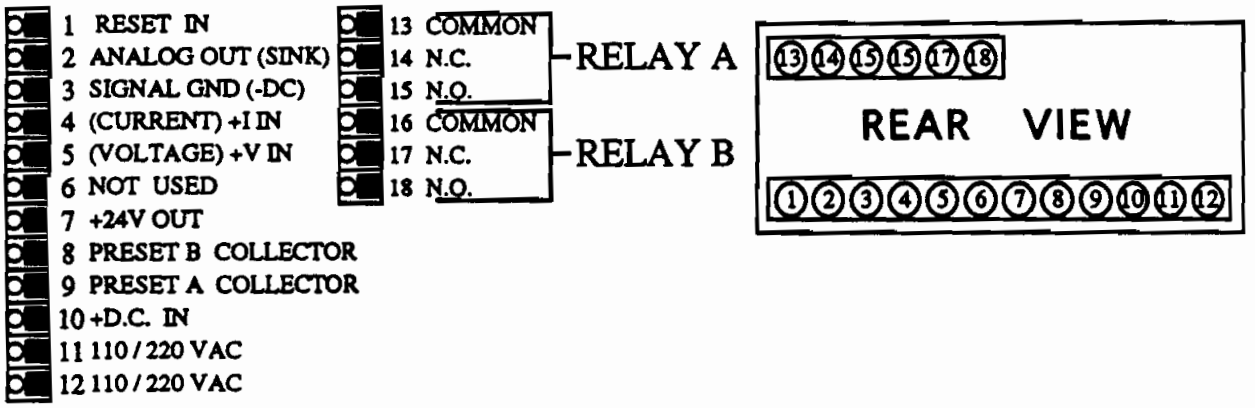
1) AC power line noise- If the unit cannot be connected to an electrically clean power source, an inductive load suppressing device (MOV as GE#V130LA1 or Resistor Capacitor as Paktron# .2uf/220 ohm @ 400V) can be installed. Although locating the suppressor across the AC supply at the unit should help, best results are obtained by connecting the suppressor across the leads of the "load" at the device causing the spikes.

2) Input line noise- The noise is carried on the input and DC ground lines. Make sure the input wires are not run into the unit in a bundle with power input lines. We recommend using shielded cable. Connect the shield to DC ground of the unit and "earth" at one point in the circuit preferably at the DC ground terminal of the unit.

3) Output lines- The unit has Two open collector outputs and two optional relay outputs. When these outputs are used to run external relays or solenoids, spikes can be generated upon activation. This noise can spread through the instrument causing operating problems. If the source is a D.C. operated device, a general purpose diode (IN4004) placed across the solenoid prevents electrical noise spikes. Connect the cathode (banded side) to the more positive side of the coil. If the source is an A.C. operated device, use a Resistor Capacitor or MOV across the coil.

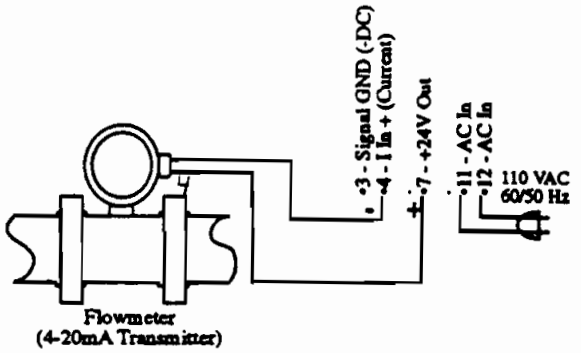
4) 24 VDC output supply- Noise can be generated on the 24 VDC output supply if it is used to drive inductive loads or if the current draw exceeds 50mA. Insure that all inductive loads have a diode (such as IN4004) across the coil and that the current does not exceed 50mA.

WIRING CONNECTIONS

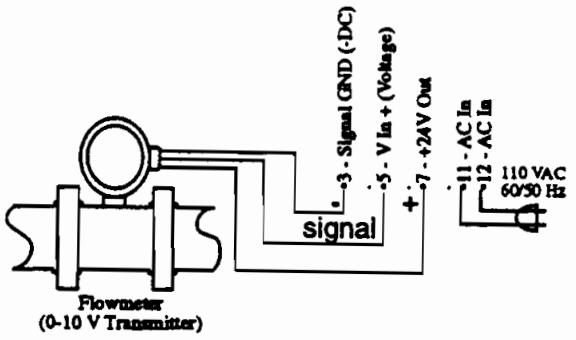


TYPICAL WIRING HOOKUPS

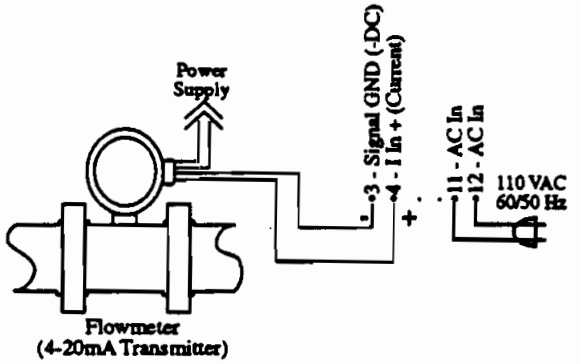
2-Wire 4-20mA Transmitter



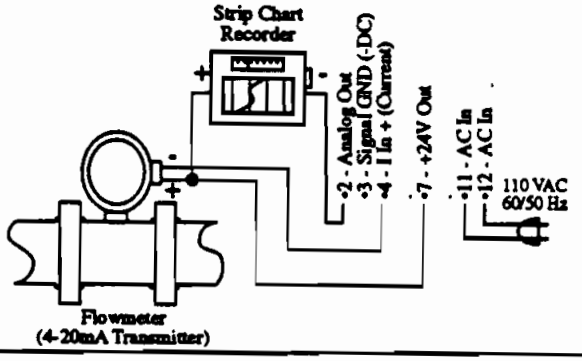
3-Wire 0-10V Transmitter



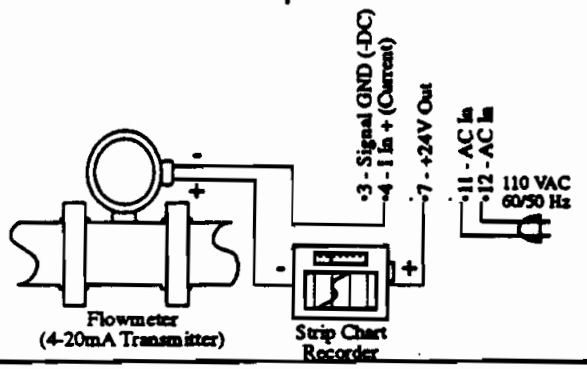
4-Wire 4-20mA Transmitter



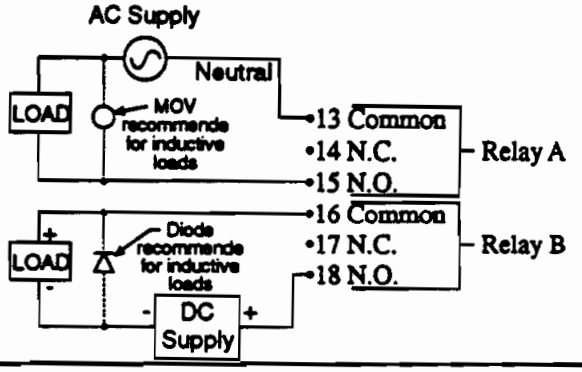
2-Wire 4-20mA Transmitter with Analog Output



2-Wire 4-20mA Transmitter with Multiple Devices



Relay Output



OPEN COLLECTOR & RELAY OPERATION

The open collector and relay outputs trigger when the total or rate (assignable; see programming step 2) equals the corresponding Preset (A or B).

When the outputs are assigned to the "total", the operator can assign a duration of time (.01 to 599.99 sec.) that the output will remain energized. If 0.00 is assigned, the output will latch until reset. If output A is set at a duration (other than 0.00), the totalizer will autorecycle when Preset A is reached. At this time, output B will de-energize (if it was energized). Preset A is the final preset and should be set higher than Preset B, when both outputs are assigned to the total. If output A is set at a duration other than 0.00 and Preset A is set less than Preset B, Preset B will be ignored (provided that they are both assigned to total). The totalizer will never autorecycle at Preset B.

When the outputs are assigned to the "rate", the outputs can be assigned a hysteresis (alarm range). The hysteresis is the number of units below the preset that the output will remain energized. EXAMPLE: Preset set @ 100; Hysteresis set @ 10. The output will energize when the rate equals 100 and de-energize when the rate falls below 90 (10 below Preset).

NOTE: If the input scaling is inverted, the control output functions are inverted (LINEAR ONLY).

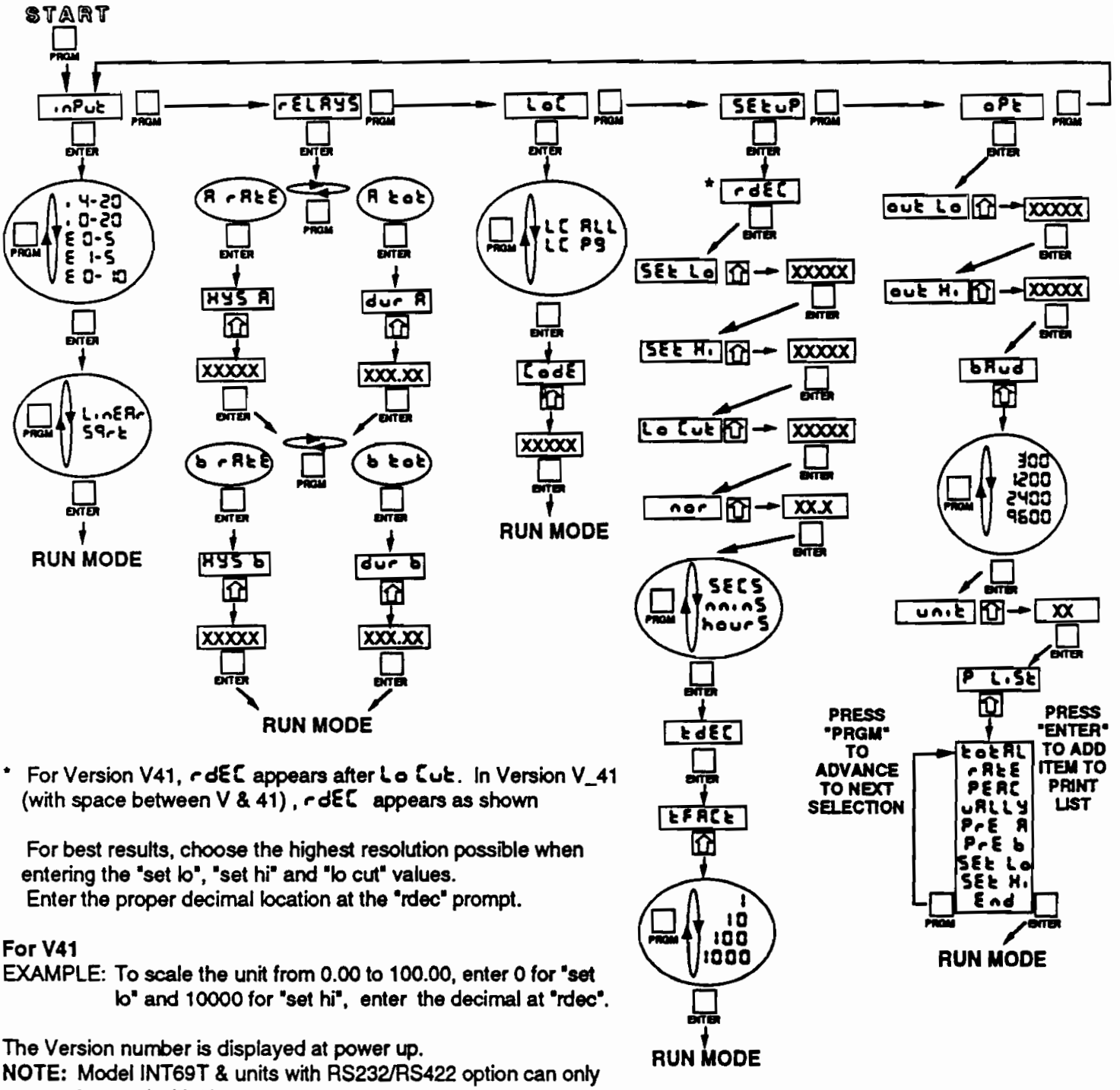
V41 & V_41 PROGRAMMING FLOWCHART

NOTE:
SEVERAL PROGRAMMING SELECTIONS WILL NOT APPEAR WITH "RATE ONLY" & "TOTAL ONLY" UNITS
OPTIONS NOT ORDERED WILL NOT APPEAR IN PROGRAM SELECTIONS

This symbol indicates any key.

PRGM Press this key to step through Menu choices

ENTER Press this key to enter displayed value.



* For Version V41, rdEC appears after Lo Cut. In Version V_41 (with space between V & 41), r dEC appears as shown

For best results, choose the highest resolution possible when entering the "set lo", "set hi" and "lo cut" values.
Enter the proper decimal location at the "rdec" prompt.

For V41

EXAMPLE: To scale the unit from 0.00 to 100.00, enter 0 for "set lo" and 10000 for "set hi", enter the decimal at "rdec".

The Version number is displayed at power up.

NOTE: Model INT69T & units with RS232/RS422 option can only be used with V_41.

DEFINITIONS

inPut - INPUT; This section of the program menu assigns the type of input the unit will be using (0-20 mA, 4-20 mA, 0-5 V, 0-10 V, 1-5 V, Linear or square root extraction).

I 4-20 - I 4-20; This sets the unit for a current input of 4 to 20 mA.

I 0-20 - I 0-20; This sets the unit for a current input of 0 to 20 mA.

E 1-5 - E 1-5; This sets the unit for a voltage input of 1 to 5 volts.

E 0-5 - E 0-5; This sets the unit for a voltage input of 0 to 5 volts.

E 0-10 - E 0-10; This sets the unit for a voltage input of 0 to 10 volts.

LinEAr - LINEAR; This sets the unit for linear input.

Sqrt - SQUARE ROOT; This sets the unit for square root extraction.

rELAYS - RELAYS; This section of the program menu sets the control output variables (relays & open collector).

A rAtE- OUTPUT A FOR RATE; This assigns the A output to the rate.

HYS A- HYSTERESIS FOR OUTPUT A; This value is the number of units below Preset A that the output will remain "ON". EXAMPLE: Preset A set at 100, Hys set at 10. Output A will activate (turn on) when the rate equals 100; Output A will deactivate (turn off) when the rate falls below 90 (10 below Preset A)

A tot- OUTPUT A FOR TOTAL; This assigns the A output to the totalizer.

dur A- OUTPUT A DURATION; This is the duration of time (.01 to 599.99 sec) that Output A will remain energized. If 0.00 is entered the output will latch until reset. If a value other than 0.00 is entered the unit will autorecycle at Preset A.

b rAtE- OUTPUT B FOR RATE; This assigns the B output to the rate.

HYS b- HYSTERESIS FOR OUTPUT B; Same as HYS A.

b tot- OUTPUT B FOR TOTAL; This assigns the B output to the totalizer.

dur b- OUTPUT B DURATION; This is the duration of time (.01 to 599.99 sec) that Output B will remain energized. If 0.00 is entered the output will latch until reset.

LoC - LOCK; This section of the program menu sets up the lockout type and code.

LC ALL - LOCK ALL; When this is selected the lockout will lock the program as well as the Presets and reset button. The presets can be viewed but not changed.

LC PG - LOCK PROGRAM; When this is selected the lockout will lock only the program. The Reset can be activated and the presets can be viewed and changed.

CodE - CODE; This is a 5-digit code which will be used to lock and unlock the front panel.

SEtuP- SETUP; This section of the program menu sets up the operating variables.

rdEC - RATE DECIMAL LOCATION; This allows the user to program a decimal point for the rate display.

SEt Lo - SET LOW; This is the rate value for the lowest input (0 or 1 Volts; 4 mA). (i.e. 4 mA = 10 lbs/hr.)

SEt Hi - SET HIGH; This is the rate value for the highest input (5 or 10 Volts; 20 mA). (i.e. 20 mA = 500 lbs/hr.)

Lo Cut - LOW CUT-OFF; This is the lowest rate value to be recognized. All rate readings below this value will assume the "set lo" value.

nor - NORMALIZING FACTOR; This is an averaging factor (00.0 to 99.9). Higher settings provide more normalizing (averaging) for a more stable display. Derived from the equation:

$$\frac{(\text{OLD DATA} \times \text{"NOR"} + \text{NEW DATA})}{(\text{"NOR"} + 1)}$$

SECS - SECONDS; This tells the unit that the High and Low input values are entered in units per second.

nnnS - MINUTES; This tells the unit that the High and Low input values are entered in units per minute.

HourS - HOURS; This tells the unit that the High and Low input values are entered in units per hours.

tdEC- TOTALIZER DECIMAL LOCATION; This allows the user to enter a decimal for the totalizer display. This decimal is not a dummy decimal and will scale the totalizer display accordingly. (i.e. if the tdec is set in the tenths position (#####.#), 100 will be displayed as 100.0)

tFACt- TOTALIZER FACTOR; This factor divides the totalizer display by 1, 10, 100 or 1000.

oPt - OPTIONS; This section of the program menu is for setting up optional features (analog out, RS232/422 serial communications).

out Lo - OUT LOW; The displayed rate value at which the unit will output 4 mA (2 lbs./hr = 4 mA out).

out Hi - OUT HIGH; The displayed rate value at which the unit will output 20 mA (2000 lbs./hr = 20 mA out).

bAud - BAUD RATE; The baud rate at which the RS232 or RS422 communications will operate.

9600 - 9600 BAUD; This sets the communications at 9600 Baud.

2400 - 2400 BAUD; This sets the communications at 2400 Baud.

1200 - 1200 BAUD; This sets the communications at 1200 Baud.

300 - 300 BAUD; This sets the communications at 300 Baud.

unit - UNIT NUMBER; This assigns the unit an ID number from 1 to 99. This number is to be addressed when the unit is to be on line. A unit with 0 assigned will never come on line.

P LiSt - PRINT LIST; This sets a list of data that will be transmitted whenever the strobe is activated.

totAL - TOTAL COUNT; When this is added to the print list, the unit will transmit the total when the strobe is activated.

rAtE - RATE; When this is added to the print list, the unit will transmit the present rate value when the strobe is activated.

PEAC - PEAK; When this is added to the print list, the unit will transmit the present peak value when the strobe is activated.

uALLEY - VALLEY; When this is added to the print list, the unit will transmit the present valley value when the strobe is activated.

PrE A - PRESET A; When this is added to the print list, the unit will transmit the Preset A value when the strobe is activated.

PrE b - PRESET B; When this is added to the print list, the unit will transmit the Preset B value when the strobe is activated.

SEt Lo - SET LOW; When this is added to the print list, the unit will transmit the Set Low value when the strobe is activated.

SEt hi - SET HIGH; When this is added to the print list, the unit will transmit the Set High value when the strobe is activated.

End - END; This is the only exit from the P List If END is not entered the unit will start at the beginning of the P List again.

PXXXXX - P; This will appear in the 6th (furthest to the left) digit when viewing the Peak. The peak value is the highest rate reading that the unit had displayed since the peak had been reset. The peak is not retained in memory when power is lost.

uXXXXX - U; This will appear in the 6th (furthest to the left) digit when viewing the Valley. The valley value is the lowest rate reading that the unit had displayed since the valley had been reset. The valley is not retained in memory when power is lost.

rXXXXX - R; This will appear in the 6th (furthest to the left) digit when viewing the Rate.

	PRESS	DISPLAY	REMARKS
STEP 3 SETTING LOCK	PRGM	inPut	
	PRGM	rELAYS	
	PRGM	LoC	This section of the menu is used to set up the lockout type and code.
	ENTER	LC PG or LC ALL	LC PG = Locks program but presets are accessible. LC ALL= Locks program & presets. Press the PRGM button to toggle between choices; Press RST/ENTER to enter displayed choice.
	ENTER	CodE Press any key to view or change the lock code	When CODE is displayed, press any key to view existing lock code. To change the code press the key under each digit to be changed. Press RST/ ENTER to enter displayed value.
STEP 4 SETTING SETUP	PRGM	inPut	
	PRGM	rELAYS	
	PRGM	LoC	
	PRGM	SEtuP	This section of the menu is used to set up important operating variables.
	ENTER	rdEC	RDEC= rate decimal location; Press the key under the digit with the desired location. Press the "E" key if a decimal is not desired. Press RST/ENTER to enter the displayed location.
	ENTER	SEt Lo Press any key to view or change existing value	SET LO= Rate value for the lowest input (0 or 1V; 4mA).(i.e. 4mA = 10 lbs/ hr.) Key in the desired low value and press RST/ENTER to enter displayed value.
	ENTER	SEt Hi Press any key to view or change existing value	SET HI= Rate value for the highest input (5 or 10V; 20mA).(i.e. 20mA = 500 lbs/hr.). Key in the desired high value and press RST/ENTER to enter displayed value.

CONTINUED ON NEXT PAGE

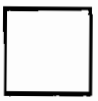
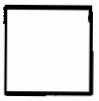
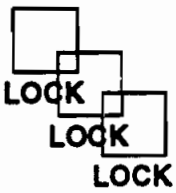
STEP 4 CONT.. SETTING SETUP

PRESS	DISPLAY	REMARKS
ENTER	LoCut Press any key to view or change existing value	LO CUT= Low cut-off; Lowest rate value to be recognized. All rate readings below the "cutoff" will assume the "set lo" value. Key in the desired value and press RST/ENTER to enter displayed value.
ENTER	nor Press any key to view or change existing value	NOR= Normalizing (averaging) factor (00.0 to 99.9); Key in the desired value and press RST/ENTER to enter displayed value. Higher settings provide more normalizing (averaging) for a more stable display.
PRGM ENTER	mins, Hours or SECS	This section tells the unit that the high & low setting are entered in units per Minutes, Hours or Seconds. Press the PRGM key to step through choices. Press RST/ENTER to enter displayed choice.
ENTER	tdEC	TDEC= Totalizer Decimal; Press the arrow keys to enter in the desired totalizer decimal. Press RST/ENTER to enter displayed choice. Entering a decimal will add resolution to the total. (i.e. tdec=#####.#; 100 will be displayed as 100.0)
ENTER	tFACt Press any key to view or change existing value	TFACT= Totalizer Factor; This factor allows you to divide the totalizer by 1, 10, 100, 1000
PRGM ENTER	1, 10, 100 or 1000	Press the PRGM key to step to the desired factor. Press RST/ENTER to enter displayed choice.

	PRESS	DISPLAY	REMARKS
STEP 5 SETTING OPTIONS	PRGM	inPut	
	PRGM	rELAYS	
	PRGM	LoC	
	PRGM	SEtuP	This section of the menu is for setting up the variables for any options which were ordered (Analog out or Serial communications).
	PRGM	oPt	
	ENTER	out Lo Press any key to view or change existing value	OUT LO= The rate value represented by the 4 mA end of the 4-20 mA output Key in the desired value and press RST/ENTER to enter displayed value.
	ENTER	out Hi Press any key to view or change existing value	OUT HI= The rate value represented by the 20 mA end of the 4-20 mA output. Key in the desired value and press RST/ENTER to enter displayed value.
	ENTER	bAud Press any key to view or change existing value 9600, 1200, 2400 or 300	BAUD = Baud rate for RS 232 or RS 422 communications option. Press any key to view existing value. Press the PRGM key to view available baud rates; Press RST/ENTER to enter displayed value.
	ENTER	unit Press any key to view or change existing value	UNIT = Unit ID number. Key in the desired unit number (1-99) and press RST/ENTER to enter displayed value.
	ENTER OR PRGM	P LiSt Press any key to enter print list	P LIST = Print list. Press RST/ENTER to add items to list; Press PRGM to remove items from list.
		totAL	TOTAL = Total
		rAtE	RATE = Rate
		PEAC	PEAC = Peak
		uALLY	UALLY = Valley
		PrE A	PRE A = Preset A
		PrE b	PRE B = Preset B
		SEt Lo	SET LO = Low Input Value
		SEt hi	SET HI = High Input Value
		End	END = Press RST/ENTER to exit (end) print list; Press PRGM to recycle through list choices.

THE PROGRAM SETUP IS COMPLETE! YOU ARE NOW READY TO SET THE PRESETS.

SETTING THE PRESETS & PANEL LOCK

	PRESS	DISPLAY	REMARKS
SETTING THE PRESETS	 **PRE A**	PrE A Press any key to view or change existing value	PRE A = Preset A (Final Preset); The set point at which output A will trigger. If the displayed value is not the desired preset, press the key(s) under the digit to be changed.
	 **PRE B**	PrE b Press any key to view or change existing value	PRE B = Preset B (Prewarn); The set point at which output B will trigger. If the displayed value is not the desired preset, press the key(s) under the digit to be changed.
SETTING THE LOCK STATUS	 **LOCK** **LOCK** **LOCK** Press LOCK 3 times within 5 seconds (If LOCK is pressed once, unit freezes display)	CodE Press any key to enter the 5-digit lock code.	Key in the lock code (see programming step 3) by pressing the keys under the digits to be changed. Each time a key is pressed the digit will increment one. Press the RST/ENTER key to enter the displayed code.
	 **ENTER**	LoC or unLoC	After the code is entered the unit will display LOC (unit is locked) or UN LOC (unit is un-locked). This message will be displayed for approximately 3 seconds before the unit returns to the run mode. If an invalid code is entered, no message is displayed; try again.

RS 232/422 OPERATIONS

This section applies to units which have the serial communications interface option. Up to 99 units can be linked together. Unit status can be accessed and many menu items can be entered through the serial port. Data is transmitted at selected baud rates using standard eight bit ASCII characters and one "stop" bit. The unit does not check or transmit a parity bit.

UNIT I.D. (DEVICE #)

Each unit in the hookup must be assigned a unit number from 1 to 99. This can be entered through the front panel (see step 5 of the programming section). If "00" is assigned, the unit can not be brought on line through the serial port. The units will remain in an "off" high impedance state until addressed by the assigned unit number. Once a unit is addressed, do not address another unit until the data has been sent and any data requested has been transmitted back.

BAUD RATE

The baud rate is the speed at which data is transmitted, expressed in bits per second. Baud rates of 300, 1200, 2400 or 9600 are available. Select the desired baud rate from the menu. (see step 5 of the programming section).

PRINT LIST

The serial interface card is equipped with a strobe line. When the strobe line is activated a user selectable set of data (print list) is transmitted. This transmission can be sent to a computer or printer. The print list consists of eight selectable items: COUNT, RATE, PEAK, VALLEY, PRE A, PRE B, LOW SET, HIGH SET. The list can be entered through the front panel (see step 5 of the programming section) or through the serial port (read on).

HELP

A help command has been installed for easy access of the command and data variables. When help is needed, type a "?" and press return (enter) whenever a unit is on line. The following list will be transmitted:

D#XX:
S Set
E Exam
R Reset
G Lock
L*List
C*Count
R*Rate
P*Peak
V*Valley
A*PreA
B*PreB
L*Lo Set
H*Hi Set
J Lo Out
K Hi Out
N Norm
D Unit
E Input
G Hy/DrA
I Hy/DrB
M Time
T Baud
W Lock
X Meter
Y A Typ
Z B Typ
O Code
F RDec
Q TDec
U TFact

The unit transmits the unit ID (D#XX) as well as the variables for the corresponding commands and data. A "*" indicates that the data is available for the print list.

COMMANDS:

Each command consists of an instruction and an address. Each instruction and address is represented by a letter. The prefix of each command must be an instruction followed by an address (and address variable if applicable).

INSTRUCTIONS (1st letter of command):

[S] Set - Used to set the value or operating parameter of an address. (i.e. "SC 5000" will set the count at 5000)

[E] Examine - Used to examine the value or status of an address. (i.e. "ER" will examine the present rate reading)

[R] Reset - Used to reset the count & control output, peak or valley. (i.e. "RP" will reset the peak value)

[G] Lock - used to lock and unlock the unit. Type "G" followed by the "lock code" to lock and unlock the unit.

[L]*List - Used to set the print list. (i.e. "LCRVA" will set the list for count, rate, valley and preset A. These values will be transmitted whenever the strobe is activated.)

ADDRESSES (2nd letter of command):

[C]*Count
[R]*Rate
[P]*Peak
[V]*Valley
[A]*PreA
[B]*PreB
[L]*Lo Set
[H]*Hi Set
[J] Lo Out
[K] Hi Out
[N] Norm
[D] Unit
[E] Input
[G] Dur A
[I] Dur B
[M] Time
[T] Baud
[W] Lock
[X] Meter
[Y] A Type
[Z] B Type
[O] Code
[F] RDec
[Q] TDec
[U] TFact

POSSIBLE COMMANDS:

Each command must be followed by a carriage return for execution.

DXX: (device "unit ID" #)- Unit XX will come "on line" and stay "on line" until another device is addressed.

SD XX: (set device "unit ID"#)- sets unit ID # at requested value

ED: (examine device)- Unit will transmit the present device (unit ID) number (i.e. d = 000000XX).

SC XXXXXX: (set count)- Sets count at requested value.

EC: (examine count)- Unit will transmit the present count value (i.e. c=00XXXXXX).

RC: (reset count)- Resets the counter and control output .

ER: (examine rate)- Unit will transmit the present rate value (i.e. r= 000XXXXX).

RR: (reset rate)- Resets the normalization

EP: (examine peak)- Unit will transmit the present peak value (i.e. p= 000XXXXX).

RP: (reset peak)- Unit will reset the peak.

EV: (examine valley)- Unit will transmit the present valley value (i.e. v=000XXXXX).

RV: (reset valley)- Resets the valley.

SA XXXXX: (set preset A)- Sets preset A at requested value.

EA: (examine preset A)- Unit will transmit present preset A value (i.e. a=000XXXXX).

SB XXXXX: (set preset B)- Sets preset B at requested value.

EB: (examine B)- Unit will transmit present preset B value (i.e. b = 000XXXXX).

SL XXXXX: (set "Low")- Sets "set low" at requested value.

EL: (examine "Low")- Unit will transmit present "set low" value (i.e. l = 000XXXXX).

SH XXXXX: (set "High")- Sets "set high" at requested value.

EH: (examine "High")- Unit will transmit present "set high" value. (i.e. h = 000XXXXX)

SJ XXXXX: (set "low out")- Sets "out low" at requested value. Only available with ANALOG OUT option.

EJ: (examine "low out")- Unit will transmit present "out low" value. (i.e. j = 000XXXXX)

SK XXXXX: (set "high out")- Sets "out high" at requested value. Only available with ANALOG OUT option

EK: (examine "high out")- Unit will transmit present "out high" value. (i.e. k = 000XXXXX)

SN XX.X: (set norm)- Sets "norm" at requested value. Must be a 3-digit number with decimal.

EN: (examine norm)- Unit will transmit present "norm" value (i.e. n = 000XX.X).

SE i 4-20, i 0-20, e 0-5, e 1-5 or **e 0-10**: (set input)- sets input to one of the 4 available types. Enter type exactly as it appears on the display.

EE: (examine input)- Unit will transmit input type (i.e. e 0-10).

SG XXXXX: (set dur A or hys A)- Sets dur A or hys A at requested value. (dur A when A is assigned to total; hys A when A assigned to rate).

EG: (examine dur A or hys A)- Unit will transmit present dur A or hys A value (i.e.g = 000XXXXX)

SI XXXXX: (set dur B or hys B)- Sets dur B or hys B at requested value. (dur B when B is assigned to total; hys B when B assigned to rate).

EI: (examine dur B or hys B)- Unit will transmit present dur B or hys B value (i.e.l = 000XXXXX)

SM secs, mins or **hours**: (set time base)- Sets time base to desired setting.

EM: (examine time base)- Unit will transmit present time base (i.e. secs).

ST XXXX: (set baud)- Sets baud at desired rate (9600, 2400, 1200 or 300).

ET: (examine baud)- Unit will transmit present baud rate (i.e. 9600).

EW: (examine lock type)- unit will transmit present lock type (i.e. lc pg).

SX linear or **sqrt**: (set meter type)- Sets meter input for linear or square root extraction. Only available with square law option.

EX: (examine meter type)- Unit will transmit present meter type (i.e. linear).

SY A tot or **A rate**: (set A type)- Assigns control output A to rate or total.

EY: (examine A type)- Unit will transmit present A type (i.e. a tot).

SZ B tot or **B rate**: (set B type)- Assigns control output B to rate or total.

EZ: (examine B type)- Unit will transmit present B type (i.e. b tot).

SO XXXXX: (set lock code)- Sets lock code at requested value.

EO: (examine code)- Unit will transmit present code (i.e. o=000XXXXX).

SF X: (set rate decimal location)- Sets rate decimal at requested location (0 to 4).

EF: (examine rate decimal location)- Unit will transmit the present rate decimal location (i.e. f = 0000000X).

G XXXXXX: (lock unit)- Locks and unlocks unit. (XXXXX = code)

SQ X: (set totalizer decimal location)- Sets totalizer decimal at requested location (0 to 4)

EQ: (examine totalizer decimal location)- Unit will transmit present total decimal location (i.e. Q = 0000000X).

SU XXXX: (set totalizer scale factor)- Sets totalizer scale factor at requested value. This factor divides the totalizer by 1, 10, 100 or 1000. (i.e. SUXXX100 sets the divider at 100 where "X" represents the required space characters.

EU: (examine totalizer scale factor)- Unit will transmit present total scale factor (i.e. U = XXX100 where "X" represents the space characters).

L CRPVABLH: (list)- The list can consist of any combination of the eight available options. Any address with a "*" next to it can be listed.

SERIAL INTERFACE OPERATION:

Data is received and transmitted over standard EIA RS232 or RS422 levels. Each ten bit character is made up of a start bit, eight bit ASCII code and a stop bit.

The input impedance of RS232 is 3KΩ to 7KΩ worst case. The terminal addressing the unit must be capable of driving all loads in the loop. The input impedance of RS422 is much higher and there should be no problem driving as many as 99 units. The transmit line remains in a high impedance "off" state until addressed. Only one unit is to be on line at a time!!! More than one unit on line could damage the unit or destroy the transmitted data.

When the unit is active (on line) it will operate in an echo back mode so that data sent from the terminal will be transmitted back for verification. When the unit is "on line", use the proper serial transmit commands to request data or set a new value. Be sure to send only one command at a time followed by a carriage return to insure proper operation. If an error is made, a correction can be made by back spacing and retyping correct data before the return (enter) is sent. Once a return (enter) is sent, the unit begins processing the data and will transmit the requested data on a non-priority basis over the data transmit line. The unit will not transmit data if the Printer Busy line is activated (high). When the Printer Busy line is activated all transmissions are halted until the line goes low or open. There should be a pause after data is requested to insure that all data has been transmitted before making another request or addressing another unit. If transmission has not started within two seconds after data is requested, it can be assumed that there is a problem. The unit transmits a carriage return and line feed after each data value. The unit will stay "on line" until another unit is addressed.

RS232/RS422 - PC INTERFACE:

The following BASIC program is for setting up RS232/RS422 on serial port (#1) at 300 baud. Run this program after connecting the serial interface connections.

```
10 SCREEN 0,0:WIDTH 80
20 CLS:CLOSE
30 OPEN "COM1:300,n,8,1,CS,DS,CD" AS #1
40 ON ERROR GOTO 110
50 B$=INKEY$
60 IF B$< >"" THEN PRINT #1,B$;
70 IF EOF (1) THEN 50
80 A$=INPUT$ (LOC(1),#1)
90 PRINT A$;
100 GOTO 50
110 RESUME
```

RS232 / RS422 WIRING

COMPUTER HOOKUP:

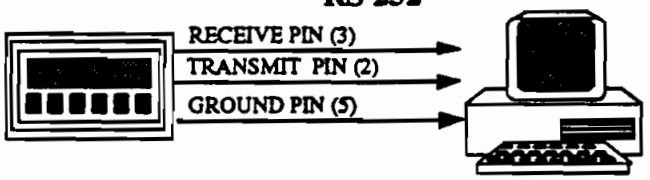
RS 232: When connecting the unit to a computer with RS 232 communication, only three connections are needed. These connections are: Receive data, Transmit data and Ground. The connections should be made as follows:

DB-9 CONNECTOR	COMPUTER
Transmit data (pin 2)	Receive data
Receive data (pin 3)	Transmit data
Ground (pin 5)	Ground

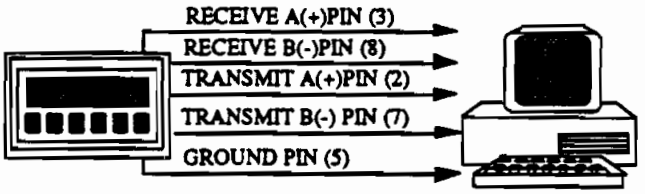
RS 422: When connecting the unit to a computer with RS 422, five connections are needed. These connections are: Receive data A (+), Receive data B (-), Transmit data A (+), Transmit data B (-) and Ground. The connections should be made as follows:

DB-9 CONNECTOR	COMPUTER
Trans. data A(+) (pin 2)	Rec. data A(+)
Trans. data B(-) (pin 7)	Rec. data B(-)
Rec. data A(+) (pin 3)	Trans. data A(+)
Rec. data B(-) (pin 8)	Trans. data B(-)
Ground (pin 5)	Ground

RS 232



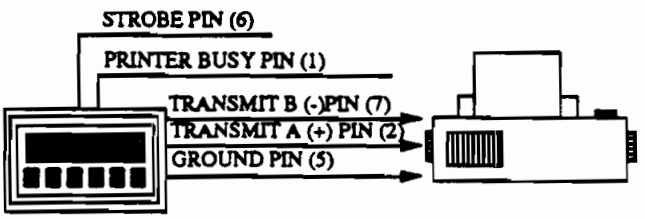
RS 422



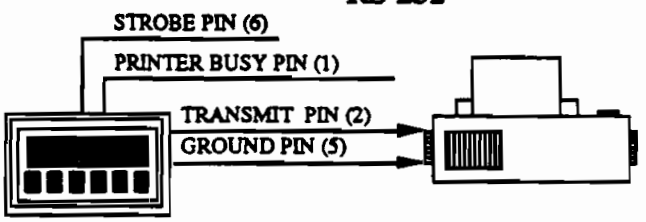
PRINTER HOOKUP:

When connecting the unit to a printer, you must first program the desired baud rate, parity and strobe list with a computer. After the unit is programmed it can be connected to the printer. Connect the transmit line(s) of the unit to the receive line(s) of the printer and be sure that both devices have common grounds. When the strobe line is triggered the unit will transmit the selected strobe list which you had previously programmed.

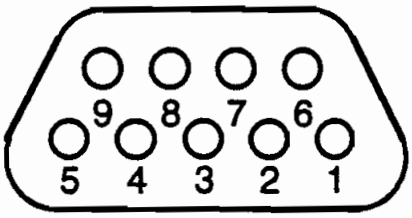
RS 422



RS 232



DB - 9 CONNECTOR



1- Printer busy: 3 to 30 VDC, Level activated.
2- Transmit A(+) (RS422); Transmit (RS232)
3- Receive A(+) (RS422); Receive (RS232)
4- Not Used
5- Ground
6- Strobe: 3 to 30 VDC Positive Edge
7- Transmit B(-) (RS422 Only)
8- Receive B(-) (RS422 Only)
9- Not Used

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES	SOLUTIONS
Power is applied to unit but the display does not light.	1. AC or DC power wiring is incorrect.	1. Recheck power wiring.
Unit works but occasionally the display freezes or skips counts.	1. Line noise is effecting the processor due to a current spike or surge.	1. Use a different power supply or install a surge suppressor.
Input signal is connected but the unit does not totalize or rate.	1. Input wiring is incorrect 2. High and low scaling settings are incorrect. 3. Transmitting device is defective. 4. Unit is defective.	1. Recheck input wiring. 2. Recheck high and low scaling settings. 3. Replace transmitting device. 4. To confirm set meter for 0-10V input, low @ 0; high @ 10. Apply a 0-10V signal to the voltage input (pin 5). When viewing the rate the meter should display the voltage value that is applied. If not call factory for an RMA#.
Display reading is inaccurate.	1. Input wiring is incorrect.	1. Be sure that voltage signals are connected to voltage input (pin 5) and current signals are connected to current input (pin 4).
Ratemeter works properly but totalizer is incorrect.	1. Time base is incorrect.	1. Recheck time base setting in setup section of the program menu.

IF YOU HAVE ANY OTHER PROBLEMS, PLEASE CALL THE FACTORY.

MADE IN USA

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gauges
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

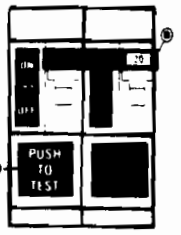
ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

SEE OTHER SIDE FOR OCCUPANT'S GENERAL INFORMATION

OCCUPANT MAKE THIS TEST EACH MONTH AND RECORD THE DATE ON THE CHART

1. With handle B in "ON" position, press PUSH TO TEST button A
2. Handle B should move to TRIP position indicating that GFCI Breaker has opened the circuit
3. To restore power, move handle B to "OFF" and then to "ON"



IMPORTANT — If handle B does not move to TRIP position when test button is pressed, the GFCI Breaker Protection is not complete. NOTIFY a qualified electrician IMMEDIATELY.

RECORD CHART

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
19												
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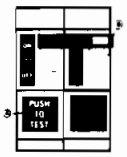
For Replacement Card, Order GEZ-6331A.

CN-N921

INSTRUCTIONS FOR THE INSTALLER

The label below should be attached to the inside surface of the trim or enclosure where it will be visible.



NP266314-B

Test each GFCI circuit breaker in this panel ONCE A MONTH.

1) With handle (B) in "ON" position, press "PUSH TO TEST" button (A).
2) Handle (B) should move to "TRIP" position to indicate GFCI circuit breaker has opened the circuit.
3) To restore power move handle to "OFF" position (to reset mechanism), then to "ON".

IMPORTANT – If handle does not move to "TRIP" position when test button is pressed, the GFCI circuit breaker protection is not operating properly and an electrician should be IMMEDIATELY notified.

GENERAL ELECTRIC

DISTRIBUTION EQUIPMENT DIVISION

INSTALL GFCI CIRCUIT BREAKERS ON GROUNDED POWER SUPPLY CIRCUITS ONLY

CLASS A GROUP I

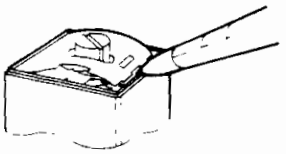
TO MINIMIZE FALSE TRIPPING:

DO NOT CONNECT TO SWIMMING POOL EQUIPMENT INSTALLED BEFORE ADOPTION OF THE 1965 NATIONAL ELECTRICAL CODE.

TIME RANGE PROGRAMMING INSTRUCTIONS

The RTE series Electronic Timers are available in two operation mode groups and two time range groups. Determine the operation mode group and time range group of your timer from the Type No. Development.

1. Removing The Face Plate



TYPE NO. DEVELOPMENT

RTE-P11-AC120V

P: Pin
B: Blade

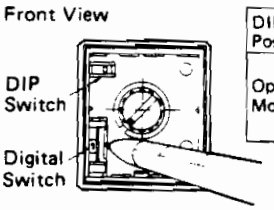
Power Voltage

Operation Mode Group
1: Interval or Delay On Make
2: Single Shot or Delay On Break

Time Range Group
1: 1 sec to 10 min
2: 1 min to 10 hr

2. Selecting The Mode of Operation

Select the operation mode by moving the DIP switch to the right or left position. (After installing the face plate, the knob set to the left position is visible through the face plate window.)



DIP Switch Position		Left	Right
Operation Mode Group	1	Interval	Delay On Make
	2	Single Shot	Delay On Break

3. Selecting The Time Range

Select the time range by rotating the digital switch.

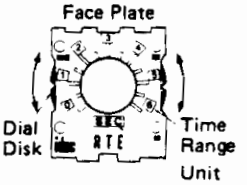
Digital Switch Position		0	1	2	3	4	5	6	7
Time Range Group	1	1 sec	3 sec	6 sec	10 sec	60 sec	30 sec	5 min	10 min
	2	1 min	3 min	6 min	10 min	60 min	30 min	5 hr	10 hr

NOTE: When the digital switch is at position 8 or 9, the time range setting is the same as at position 0 or 1, respectively.

4. Setting The Face Plate

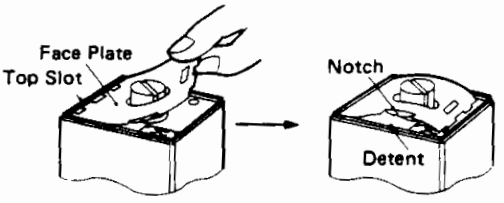
Each timer is provided with a face plate indicating the time range on both sides in different colors per time range group. The dial disk has four notches on its perimeter at every 90 degrees. Choose the top or bottom side containing your required time range and turn the dial disk to the position where the required time range figure and unit appear in the windows.

Time Range					Face Plate Color
Group 1	3 sec	6 sec	30 sec	60 sec	Yellow
	1 sec	10 sec	5 min	10 min	Pink
Group 2	3 min	6 min	30 min	60 min	Violet
	1 min	10 min	5 hr	10 hr	Blue



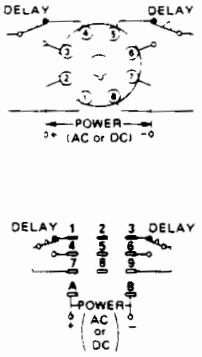
5. Installing The Face Plate

When the operation mode and time range settings are complete, place the face plate onto the timer by inserting the top edge into the top slots. Bend the face plate slightly and insert the bottom edge into the bottom slot on the timer. Make sure the dial disk notch is retained in place.

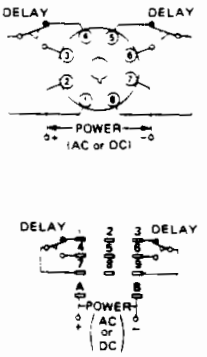


INTERNAL CONNECTIONS

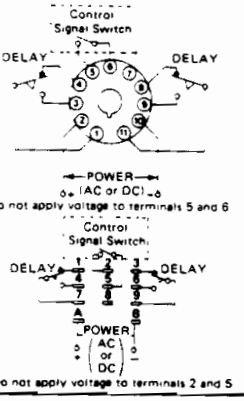
DELAY ON MAKE



INTERVAL

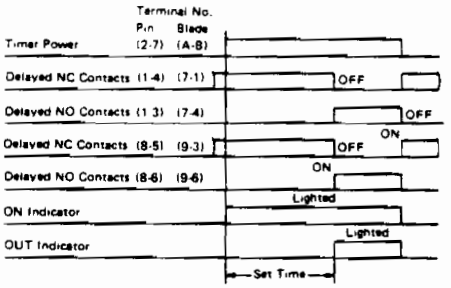


DELAY ON BREAK SINGLE SHOT

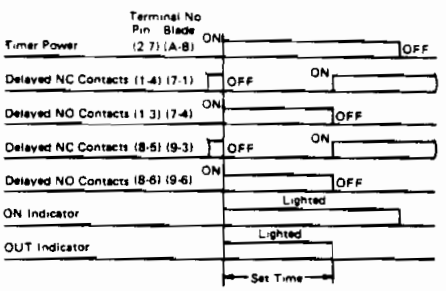


OPERATIONAL CHARTS

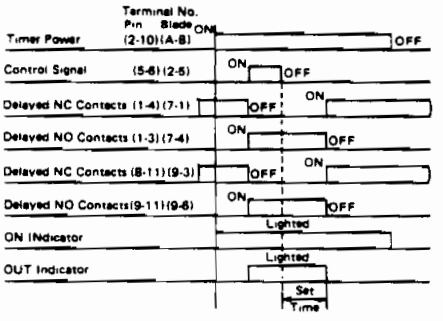
DELAY ON MAKE (RTE-P1, RTE-B1)



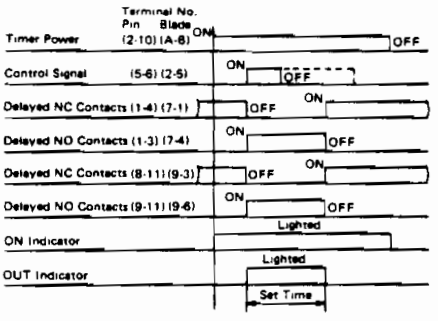
INTERVAL (RTE-P1, RTE-B1)



DELAY ON BREAK (RTE-P2, RTE-B2)



SINGLE SHOT (RTE-P2, RTE-B2)



NOTE: UL ratings for IDEC sockets to be used with these timers are "Conductor temperature rating 60 deg C, use copper conductors only, terminal torque 12 lb-in".

1213 Elko Drive, Sunnyvale, CA94089-2211
Toll Free (800) 538-0898, In California (408) 747-0550

SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE

IF287

CONDUIT SEALING IN CLASS I AND CLASS II HAZARDOUS (Classified) LOCATIONS USE ONLY CROUSE-HINDS CHICO® X FIBER FOR DAMS AND CHICO® A SEALING COMPOUND FOR SEALING

Installation & Maintenance Information

The National Electrical Code® (NEC) in Article 501, Section 501-5, Class I, Divisions 1 and 2, requires that seals be installed in specific places. This is to minimize the passage of gases and vapors and prevent the passage of flames through the conduit from one portion of the electrical installation to another portion.

While not a Code requirement, it is considered good practice to sectionalize long conduit runs by inserting seals not more than 50 to 100 feet apart, depending on the conduit size, to minimize the effects of "pressure piling".

The Code in Section 502-5 requires seals in Class II locations under certain conditions. Crouse-Hinds sealing fittings can be used to meet this requirement.

Conduit seals are not intended to prevent the passage of liquids, gases or vapors at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be a slow passage of gas or vapor through a seal and through the conductors passing through the seal.

Accumulations of water in conduit systems are apt to cause trouble and shorten the life of insulation on conductors. In ordinary locations accumulation of water usually can be prevented by drain openings located at low points.

However, in hazardous locations this procedure can be followed only if the drain openings are explosionproof. The National Electrical Code requires that conduit systems in Class I hazardous locations be provided with means by which the systems can be drained of water, if there is likelihood of water accumulation.

EYD Drain Seal Fittings, for use in vertical conduit runs, prevent accumulation of water above seals in conduit systems. Continuous draining guards against insulation failure and other defects caused by the presence of water in the conduit system.

In humid atmospheres or wet locations where it is likely that water can gain entrance in the interiors of enclosures or runs, the runs should be inclined so that water will not collect in enclosures or in seals but will be led to low points where it may pass out through ECD explosionproof drains.

Frequently the arrangement of runs makes this method impractical if not impossible. In such instances types EZD drain seal fittings should be used. These fittings prevent harmful accumulations of water above the seal. See NEC 501-5(C)(5).

In locations which usually are considered dry, surprising amounts of water frequently collect in conduit systems. No conduit system is airtight; therefore, it may "breathe." Alternate increases and decreases in temperature and/or barometric pressure due to weather changes or due to the nature of the process carried on in the location where conduit is installed will cause "breathing."

Outside air is drawn into the conduit system when it "breathes in." If this air carries sufficient moisture it will be condensed within the system when the temperature decreases and chills this air. The internal conditions being unfavorable to evaporation, the resultant water accumulation will remain and be added to by repetitions of the breathing cycle.

...d that you insure against though conditions prevailing at the time of planning or installing do not indicate their need.

Crouse-Hinds sealing fittings are listed by Underwriters' Laboratories, Inc., for use in Class I and Class II hazardous locations with Chico A sealing compound and Chico X fiber only. Chico A sealing compound, when properly mixed and poured, hardens into a dense, strong mass which is insoluble in water, is not attacked by petroleum products, and is not softened by heat. It will withstand, with ample safety factor, pressure of the exploding trapped gases or vapor.

Conductors sealed in the compound should be approved thermoplastic or rubber insulated type.

CAUTION

Refer to Table 35.1 to determine the maximum number and size of conductors allowed in a seal.

Only experienced, careful installers should be entrusted with making the dam, mixing and pouring the compound. Improperly made seals are worthless. Mixing vessel must be cleaned thoroughly before mixing new compound.

Sealing Instructions for EYS46 Series and EYS116 Series

Vertical Seals

When sealing vertical conduits, compound is poured through the pipe plug opening above the cover. (See instructions provided with Chico X Fiber.)

Horizontal Seals

For horizontal sealing of the 1/2" through 6" sizes remove both threaded plugs from EYS.

Construct dams, per instructions provided with Chico X fiber, in both ends of the EYS.

Prepare Chico A sealing compound in accordance with instructions provided with Chico A sealing compound. Pour the compound through the large opening.

Replace plugs, and screw into body.

EYS46 and 116 series (1/2" to 6"), for horizontal or vertical sealing have separate filling and damming openings.

EYS 16 series (1/2" to 1"), for vertical sealing only, have a filling opening one conduit size larger than the hub size.

Type EYS

Type EYS29 (3/4") elbow seal is intended for use with a combination vertical and

CAUTION

Type EZD and EYD fittings are suitable for sealing vertical conduit runs between hazardous and non-hazardous areas, but must be so located that hazardous gases or vapors will not vent into the non-hazardous area. Conduits leaving the hazardous area from the top should have the fitting located in the non-hazardous area. Conduits leaving the hazardous area from the bottom should have the fitting located in the hazardous area.

If any batch of compound starts to set before pouring **DO NOT** try to thin by adding water or stirring. This will spoil seals. Discard the batch and make a new one.

CAUTION

Sealing compound to be mixed **ONLY** at temperatures above 40°F/4°C and **ONLY** poured into fittings that have been brought to a temperature above 40°F/4°C. Seals must **NOT** be exposed to temperatures below 40°F/4°C for least 72 hours, Compound **MUST** be allowed 72 hours cure to full strength before energizing system.

Keep compound dry by tightly closing container cover when not in use.

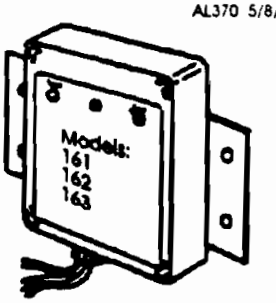
COOPER
Crouse-Hinds
Quality from
Cooper Industries

Cooper Industries Inc.
Crouse-Hinds Division
PO Box 4999
Syracuse, New York 13221

IF287
Revised 12/94

Model 160 Series Installation Instructions

AC Power Line Industrial/Residential Surge Protectors

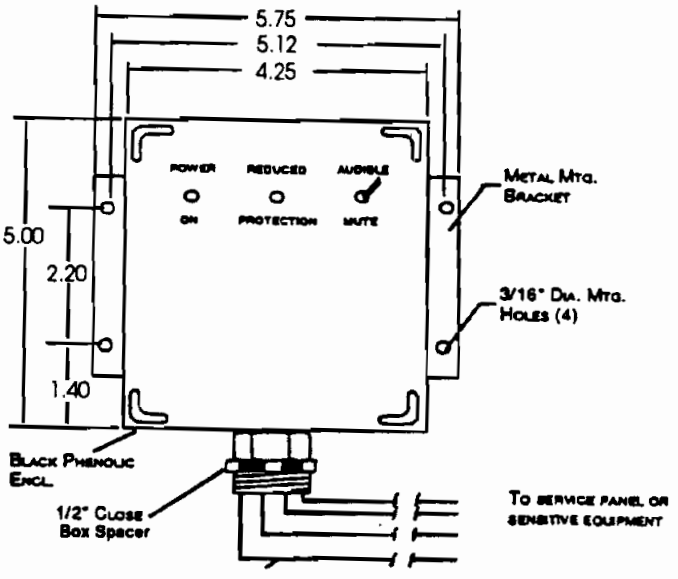


Model	Power Service	Housing & Color	Dimensions (LxWxH See Sketch Below)	Description
161	120V	Plastic/Black	5"x4-1/4"x2"	1 ph, 2w + gnd
162	120/240V	Plastic/Black	5"x4-1/4"x2"	1 ph, 3w + gnd
163	120/208V	Plastic/Black	5"x4-1/4"x2"	3 ph, 4w + gnd, wye

Additional Features:

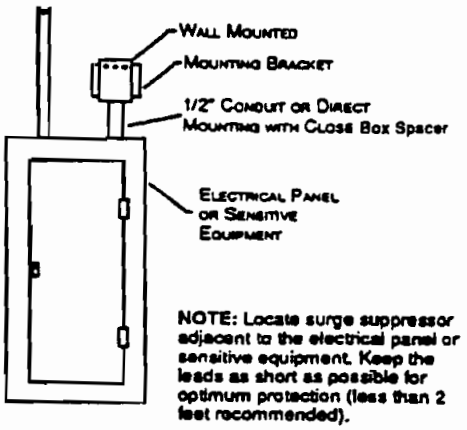
Power-on indicators, reduced protection indicator, audible alarm and mute switch.

Dimensions



Mounting Information

(Wall Mount Method Shown)



NOTE: Locate surge suppressor adjacent to the electrical panel or sensitive equipment. Keep the leads as short as possible for optimum protection (less than 2 feet recommended).

MCG SURGE PROTECTION

1-800-851-1508

12 Burt Drive Deer Park, New York 11729 Phone: 516-586-5125 Fax: 516-586-5120

INSTALLATION:

CAUTION:
Turn off power to electrical service panel or sensitive equipment to be protected prior to installation of the transient voltage surge suppressor. All wiring to be done in accordance with the NEC and local codes by qualified electricians.

1. For the best performance, all leads should be tightly taped together to reduce magnetic coupling. At this time, tape only the length required to lead into conduit. Leave remaining leads loose to allow cutting and connecting in steps 4 and 5. Run all leads through 1/2" conduit or directly into the electrical service panel.

2. For wall mounting drill 1/16" diameter pilot holes in the center of the four holes in the mounting bracket. Install four No. 8 pan head screws to secure the surge suppressor. Use 1/2" threaded coupling and conduit (customer supplied) to feed and secure to knockout in service panel. **For direct mounting** secure box spacer (provided) to knockout in service panel. (Provide spacer between wall and unit if necessary).

3. The leads are nominally 36 inches long. The green ground lead and the white neutral lead should be installed first. They must be kept as short and straight as possible. Cut both leads to proper length prior to connecting. Connect the green ground lead to service panel ground. Connect white neutral lead to the neutral bus.

4. The phase lead(s) are nominally 36 inches long. Again, keeping the leads as short and straight as possible, cut to proper length and connect to the protection disconnect circuit breaker(s).

5. Check all connections for tightness. Remove all the excess lead lengths that were trimmed.

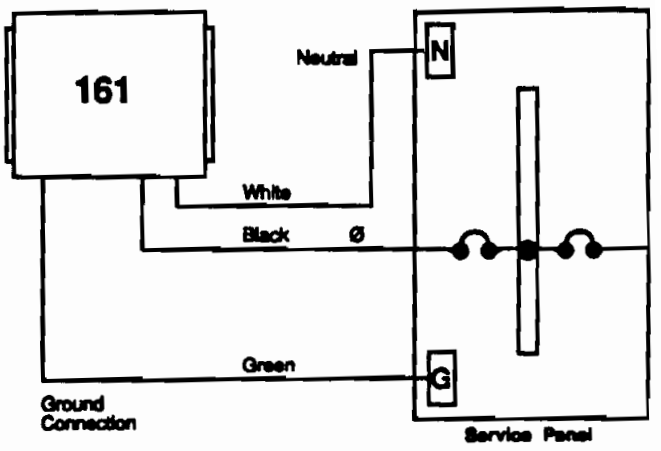
6. For best performance, tightly tape remaining lead length together if possible.

7. Restore power to the electrical service panel.

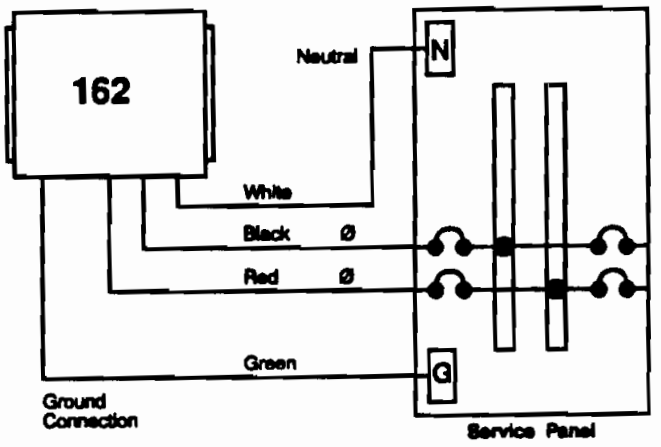
8. The green LED should be illuminated and the audible alarm quiet. The "Audible/Mute" switch should be in the audible (up) position during normal operation. A red LED and the audible alarm will activate when any of the phase suppression circuits reach end of life. When the red LED is illuminated, you must replace the unit to restore protection. The audible alarm can be silenced with the mute switch on the right side of the device's enclosure. The green LED will remain lit as long as there is power on the circuit.

If the unit is to be mounted at the sensitive equipment to be protected, follow instructions above. However, make connections at or as close as possible to the input power connections of the equipment, instead of at the service panel.

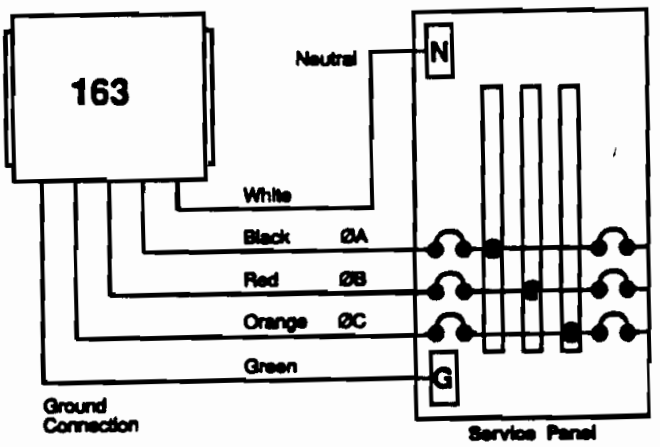
Model 161 (120V) 1 Phase, 2 wire + Ground



Model 162 (120/240V) 1 Phase, 3 wire + Ground



Model 163 (120/208V) 3 Phase, 4 wire + Ground



For all 160 Series Units:

- **Connect ground inside panel in accordance with NEC and local codes.**
- **A dedicated 15 amp circuit breaker is recommended to feed 160 series units.**

INSTRUCTIONS

GEH-433c
Rev E

Two-Pole TYPE THQL-GFCI; THQB-GFCI and THQC-GFCI Class A Group I Ground Fault Circuit Interrupter (GFCI) Circuit Breaker

Only for Systems with 120V A-c Line-to-Neutral Voltage (120/240VAC)
With or without an Equipment Ground

Installation Should Be Made Only By A Qualified Electrician

INSTALLATION TIPS

There are several installation peculiarities which may incorrectly indicate a defective GFCI. The following will aid in correctly identifying a system's problem from a defective device.

Neutral (White) Wire Is Grounded On The Load Side Of The GFCI — This device is designed to trip if the resistance between neutral wire and ground on the load side is less than 2 ohms. If the GFCI trips as soon as energized, but with no load on the circuit, this may be the problem, and the neutral ground must be cleared for proper operation of the GFCI.

Equipment Ground and Neutral Connected on Load Side — This type of wiring will cause the device to trip exactly as explained above.

System Voltage — Both sides of the 120/240 volt supply must be live, otherwise the GFCI will trip.

Excessive Leakage to Ground — Leakage currents in excess of the trip level of the GFCI 6 milliamp sensitivity between live parts of the system wiring and ground, or between the live side of wiring within equipment and its housing, will cause the device to trip.

Electric Ranges and Clothes Dryers — Appliances whose frames are grounded by connection to grounded circuit conductor should not be connected in the load circuit of this device.

Swimming Pool Circuit — Connect only to swimming pool equipment that has been installed in accordance with the 1965 or later National Electrical Code.

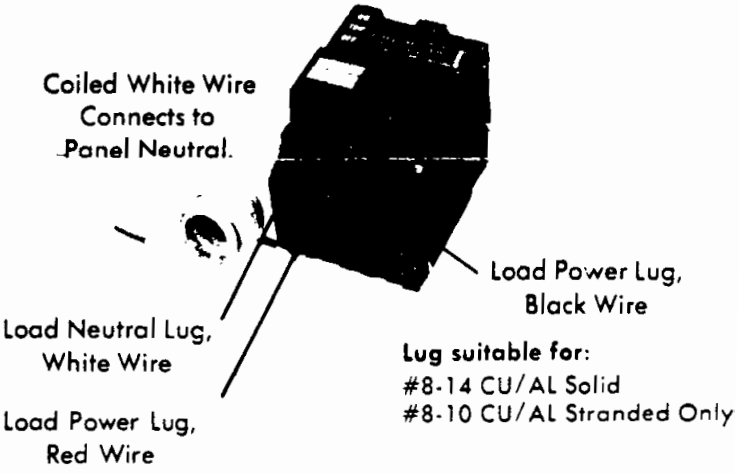
WARNINGS

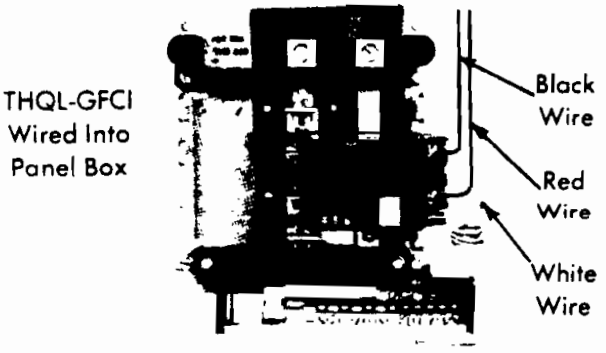
- **Turn Off Power To Panel Before Attempting Installation.**
- **Observe Markings On Breaker For Proper Wiring. Do Not Reverse Feed The Breaker.**
- **Remove All CB3 GFCI's From Circuit Before Performing Any High Voltage Systems Tests.**

1. Move handle of breaker to "OFF" position.
2. Connect the coiled white wire furnished with the GFCI Breaker to a terminal on the neutral on the panel.
3. ***On 120/240Vac load applications*** connect the **WHITE** insulated neutral load wire of the circuit to be protected to the breaker terminal lug marked **LOAD NEUTRAL.**

   On 240Vac load applications where the neutral is not required, no connection is made to the breaker terminal lug marked **LOAD NEUTRAL.**
4. Connect the BLACK insulated load wire of the circuit to be protected to the breaker terminal lug marked "LOAD POWER."
5. Connect the RED insulated load wire of the circuit to be protected to the remaining breaker terminal lug.

Check to assure the GFCI Breaker is still in "OFF" position and all wires are properly connected.





(Continued on Reverse Side)

DISTRIBUTION EQUIPMENT DIVISION
PLAINVILLE, CONNECTICUT USA

GENERAL ELECTRIC

CN-P753

11-79

FUNCTIONAL CHECKS

6. Install the wired GFCI breaker in the panel.

7. Restore power to panel.

8. Move breaker handle to the "ON" position. If the breaker trips, go to step 9. If breaker remains in the "ON" position, go to step 10.

9. If handle moved to the TRIP position in Step 8.

   -TURN OFF POWER TO PANEL.

   -Disconnect the RED and BLACK "LOAD POWER" and the WHITE "LOAD NEUTRAL" wires from the breaker.

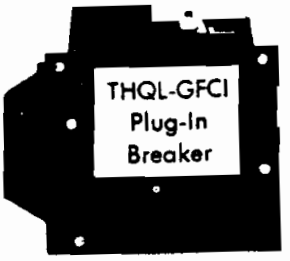
   -Restore power to panel.

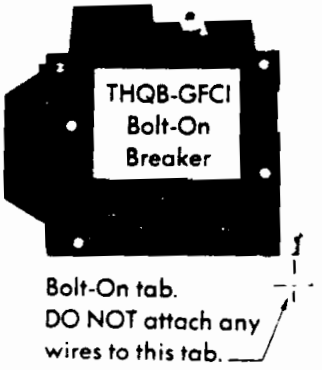
   -Move breaker handle to the "ON" position.

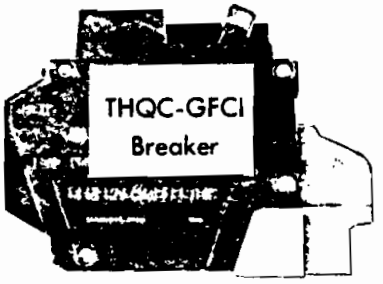
   If handle now remains in the "ON" position, and trips when the TEST BUTTON is depressed, GFCI Breaker is operating properly and fault is in the system. Remove fault and again perform installation Steps 1 through 8.

10. Push the TEST BUTTON. If the handle moves to the "TRIP" position and load is disconnected, the GFCI Breaker is operating properly. To reset breaker, move handle to "OFF" and then to "ON" for normal operation.

11. After completing installation and assuring proper operation, attach the TEST REMINDER and RECORD CHART to the installation or give to user.







Instruct occupants of the importance of performing and recording monthly tests.

DITEK's "Equipment Protection Policy"

THIS POLICY IS NOT A WARRANTY. REFER TO THE DITEK LIMITED WARRANTY FOR INFORMATION CONCERNING THE WARRANTY FOR YOUR DITEK PRODUCT. THE LIMITATIONS AND CONDITIONS CONTAINED IN THIS POLICY DO NOT AFFECT THE TERMS OF THE WARRANTY.

"Equipment Protection Policy"

In the USA and Canada Only for 120 Volt Plug-in Products

If your electronic equipment is damaged by power line transients on an AC power line while directly and properly connected to a standard DITEK product covered by the Equipment Protection Policy ("connected equipment"), and if all of the remaining conditions specified below are met, DITEK will, at DITEK's sole option, during the period specified below only, replace the DITEK product and either (a) pay for the repair of the connected equipment or (b) reimburse you for the fair market value, as determined by the then current price list of the Boston Computer Exchange (or equivalent), of the connected equipment, in an amount not to exceed the dollar limits stated below, if DITEK determines that the damage was caused by the failure of the DITEK product to protect against power line transients and/or where applicable, telephone or CATV line transients. Power line transients that DITEK products have been designed to protect against, as recognized by industry standards, include spikes and surges on AC power lines. Protection from telephone line transient applies only to DITEK products which offer modem of fax line protection, and in cases in which such protection is available, telephone service equipment must include a properly installed and operation "primary protection" device at the service entrance (such devices are normally added during telephone installation) in order to be covered for telephone line transients. Telephone Key Systems are covered when DITEK's AutoSneak SCP protection is on all exposed data and communication lines including, but not limited to, Central Office and T1. Also KSUs with chassis grounds must use the DTK-3GTP in accordance with installation instructions. Protection of CATV (Cable Television) connected equipment from transients applies only to DITEK products which offer such protection, and in such cases, the CATV service must be properly grounded according to the codes set forth in the National Electrical Code(NEC) in order to be covered for CATV transients.

DITEK reserves the right to determine whether the damage to the connected equipment is due to DITEK product failure by requesting that damaged equipment be sent to DITEK for inspection. This policy is in excess of, and applies only to the extent necessary beyond, any coverage for the connected equipment provided by other sources, including, but not limited to, any manufacturer's warranty, and any extended warranty coverage.

Equipment Protection Policy Dollar and Period Limits

For customer that meet the qualifications and conditions set forth in this policy, DITEK will provide reimbursement (cost of repair or fair market value) during the period limits and up to the dollar limits stated as follows:

Model	$	Model	$
DTK-1FX	4000	DTK-6TA1 or 6TA2	1000
DTK-3F	1000	DTK-3CFU	1000
DTK-3FX	2000	DTK-3CFF or 3CFF/2	1000
DTK-3GTP	1000	DTK-1FF	1000
DTK-3GTPX	2000	DTK-1FF/2	1000
DTK-6FX	1000	DTK-3FMF	1000
DTK-6S or 6S7 (DTK-7)	1000	DTK-3FMF/4	1000
DTK-6SX (DTK-7SF)	2000	DTK-1FC	500

Eligibility for coverage under the Equipment Protection Policy:

1. You must register the product by returning to DITEK the warranty card provided with the product within 10 days of purchase. All information must be filled in, and you should retain a copy for your records.
2. All connected equipment must be UL in the United States or CSA and cUL approved in Canada
3. The DITEK product must be plugged into properly wired and grounded outlets, no extension cords, adapters, other ground wires, or electrical connections may be used, with the sole exception of other standard DITEK 120 Volt products. The installation must not include power protection products made by any manufacturer other than DITEK. The installation must comply with all applicable electrical and safety codes set forth pursuant to the National Electrical Code (NEC)
4. Any claim under the Equipment Protection Policy must be made within 10 days of the date of alleged damage to the connected equipment
5. The Equipment Protection Policy covers only standard DITEK 120 Volt products used in the United States and/or Canada

What is not covered under the Equipment Protection Policy:

1. DAMAGE TO ELECTRONIC EQUIPMENT RESULTING FROM TRANSIENTS ON A DATA LINE ARE NOT COVERED.
2. Restoration of lost data and reinstallation of software are not covered
3. This policy does not cover damage from a cause other than AC power line transients, except for damage due to telephone line or CATV transients, which is covered only if the DITEK product offers such protection
   In addition, the following are expressly excluded from coverage.
4. DAMAGE CAUSED BY FAILURE TO PROVIDE A SUITABLE INSTALLATION ENVIRONMENT FOR THE PRODUCT (INCLUDING, BUT NOT LIMITED TO, LACK OF A PROPER SAFETY GROUND).
5. Damage caused by the use of the DITEK product for purposes other than those for which it was designed
6. Damage caused by accidents, or disasters such as fire, flood, or wind
7. Damage caused by abuse, misuse, alteration, modification, or negligence
8. This policy is null and void if, in DITEK's view, the DITEK product has been tampered with or altered in any way
9. EXCEPT AS EXPRESSLY PROVIDED IN THIS POLICY, IN NO CASE SHALL DITEK BE LIABLE UNDER THE TERMS OF THIS POLICY FOR ANY DAMAGES WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR MULTIPLE DAMAGES ARISING OUT OF THE USE OF THE DITEK PRODUCT OR DAMAGE TO THE CONNECTED EQUIPMENT, REGARDLESS OF THE LEGAL THEORY ON WHICH SUCH CLAIM IS BASED, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. SUCH DAMAGES INCLUDE BUT ARE NOT LIMITED TO, LOSS OF PROFITS, LOSS OF SAVINGS OR REVENUE, LOSS OF USE OF THE DITEK PRODUCT OR THE CONNECTED EQUIPMENT OR ANY ASSOCIATED EQUIPMENT, LOSS OF SOFTWARE, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, DOWNTIME, THE CLAIMS OF THE THIRD PARTIES, INCLUDING CUSTOMERS, AND INJURY TO PROPERTY.
10. This policy does not cover Fire and security equipment such as CCTV, Access Control, and Burglar alarm equipment.

Submitting an Equipment Protection Policy Claim:

1. If all of the conditions for coverage are satisfied, call the DITEK customer service department at (800)753-2345 and obtain an RMA (Returned Material Authorization) number. DITEK will forward to you an Equipment Protection Policy claim form, which must be completed and filed within 30 days
2. Mark the RMA number on the DITEK product you are returning
3. Pack the DITEK product in its original packaging if possible. Enclose the completed Equipment Protection Policy claim form and a copy of your sales receipt for the DITEK product
4. Mark the RMA number clearly on the outside of the box
5. Ship the product (one way shipping charges paid by you) to

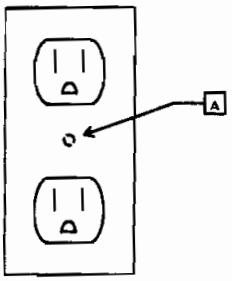
   DITEK, Inc
   12345-A Starkey Road
   Largo, FL 34643

6. DITEK will evaluate the product to determine its level of functionality, and will examine the product for evidence of damage from AC power line transients (telephone line or CATV transients, if applicable). (A) If DITEK's evaluation provides no evidence of damage from power line transients (telephone line or CATV transients, if applicable), DITEK will send to the customer (i) a report summarizing the tests performed and (ii) a rejection of claim notice. (B) If the DITEK product shows evidence of damage from power line transients (telephone line or CATV transients, if applicable), DITEK will request that all connected equipment for which an Equipment Protection Policy claim has been submitted, be sent for evaluation to either DITEK or an authorized service center. If it is determined that the connected equipment has been damaged from AC power line transients (telephone line or CATV transients, if applicable), DITEK will, in its discretion, either authorize you to have the equipment repaired or reimburse you for the fair market value of the damaged equipment, up to the dollar limits stated above
7. If you are authorized by DITEK to have the connected equipment repaired, the repair must be performed at a service center that is authorized by the manufacturer of the connected equipment. DITEK reserves the right to contact the authorized service center directly to discuss repair costs and damage to the transients (telephone line or CATV transients, if applicable) and the right to request that the service center forward the connected equipment or components of the connected equipment to DITEK for inspection
8. DITEK will, after determining that the damage was caused by the failure of the DITEK product to protect against AC power line transients (telephone line or CATV transients, if applicable), issue payment to you, in its sole discretion , for either costs of repair or the fair market value of the connected equipment, up to the dollar limits stated above. DITEK reserves the right to require you to transfer title and deliver the connected equipment to DITEK if it chooses to reimburse you for the fair market value of the connected equipment
9. Unless modified in a writing signed by DITEK and you, the terms of this policy are understood to be the complete and exclusive agreement between the parties, superseding all prior agreements, oral and written, and all other communications between the parties relating to the subject matter of this agreement. No employee of DITEK or any other party is authorized to make any representations beyond those made in this agreement concerning the Equipment Protection Policy

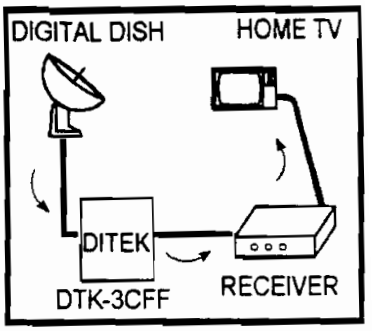
DTK-1FF, 1FF-2, 1FX, 3F, 3FMF, 3FMF/4, 3FX, 6FX, 3GTP, 3GTPX, 3CFF, 3CFF2, 1FC, 3CFU - Installation Instructions

Warning: To reduce the risk of electrical shock, disconnect power at the breaker box to the receptacle before installing or removing the unit. When removing receptacle cover screw, cover may fall across plug pins or receptacle may become dislodged. Use only with duplex receptacle having center screw.

1. move center screw (labeled **A**) from duplex outlet plate with screwdriver - ***DO NOT REMOVE PLATE.*** (Save screw for possible future use)
2. Insert DITEK unit into bottom receptacle. Fasten unit to receptacle with enclosed screw.



3. If the unit is a DTK-1FF,1FF-2,3FMF,3FMF/4 plug incoming telephone line into jack labeled **'IN'**. Plug line going to equipment to be protected in jack labeled **'out'**.
4. If the unit is a DTK-1FC, 3CFU, 3CFF, 3CFF2 connect incoming cable line into left side of protector. Connect right side to equipment to be protected.



WARNING: The DTK-1FC and the DTK-3CFU are designed for analog circuits. If used on digital circuits, extra insertion loss may be experienced. The DTK-3CFF and the DTK-3CFF2 are designed for digital circuits. If used on analog circuits, extra insertion loss may be experienced.

Diversified Technology Group, Inc.
12345-A Starkey Road Largo, FL 34643 (813) 535-6007 Toll-Free: 1-800-753-2345 FAX: (813) 539-1842

Directives de l'installation

DTK-1FF, 1FF-2, 1FX, 3F, 3FMF, 3FMF/ 4, 3FX, 6FX, 3GTP, 3GTPX, 3CFF, 3CFF2, 1FC, 3CFU-

Avertissement: Réduire le risque de choc électrique, déconnecte le pouvoir au casseur empaquete avant au récipient d'installer ou enlève l'unité. Quand enlève le récipient couvre le vis, couvre peut tomber en travers épingles du bouchon ou récipient peut devenir a délogé. Utilisez seul avec récipient double a le vis du centre.

1. Enlevez le vis du centre (a étiqueté Un) plaque de débouché double avec tournevis- N'ENLEVE PAS la PLAQUE. (Sauve le vis pour futur possible utilise)
2. Encart DITEK unité dans récipient inférieur. Attachez l'unité à récipient avec vis clos.
3. Si l'unité est un DTK-1FF,1FF-2,3FMF,3FMF/ 4 bouchon ligne du téléphone qui entre dans valet a étiqueté IN.' Allée de la ligne du bouchon à matériel est protégée dans valet a étiqueté [out'].
4. 'unité est un DTK-1FC, 3CFU, 3CFF, 3CFF2 connecte la ligne du câble qui entre dans côté gauche de dispositif de protection. Connectez d'accord à matériel est protégé.

Instrucciones de la instalación

DTK-1FF, 1FF-2, 1FX, 3F, 3FMF, 3FMF/ 4, 3FX, 6FX, 3GTP, 3GTPX, 3CFF, 3CFF2, 1FC, 3CFU-

Advertencia: Para reducir el riesgo de choque eléctrico. Desconecte la fuerza de la caja de reseptáculo antes de instalar o quitar la unidad. Coando remeuva el reseptáculo cubra el tornillo la cubierta se caeria por los alfilares del tapon o se el reseptáculo lleqara a ser desalogado. Use solamente reseptáculo doble (duplex) que tenga tornillo en el centro.

1. Remeuva el tornillo del centro.
2. In serte la unidad DITEK en el reseptáculo de abajo, ate la unidad al reseptáculo con el tornillo adjunto.
3. Si la unidad es una DTK-1FF, 1FF-2, 3FMF, 3FMF/4 conecte línea del teléfono en la etiqueta marcado "IN" conecte línea al equipo que va a progejer en la etiqueta marcada "OUT".
4. Si la unidad es una DTK-1FC, 3CFU, 3CFF, 3CFF2 conecte línea entrante en el lado izquierdo. Conecte lado derecho al equipo que va a protejer.

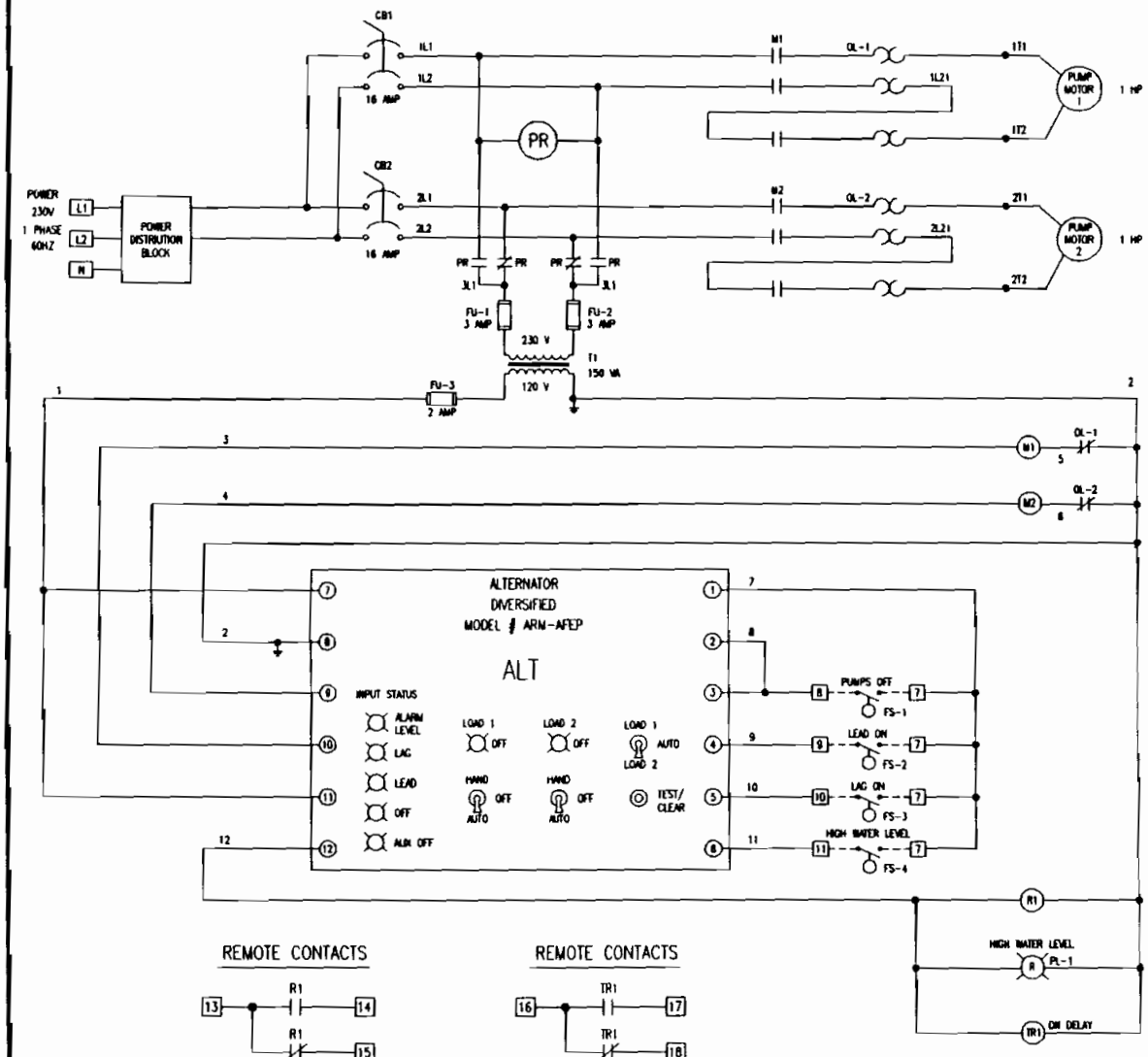
Lifetime Warranty

Diversified Technology Group, Inc. warrants this product to be free from defects in workmanship and material and to operate under normal use and conditions to the first retail purchaser. Should you need to apply this warranty **DITEK** will repair, or at its discretion, replace this unit without charge. (This warranty is restricted to the U.S. and Canada only.)

Note: This warranty does not cover:

1. Units which have been damaged by abuse, neglect, misuse or which have been modified or repaired by anyone other than Diversified Technology Group, Inc.
2. Damage to DITEK equipment if improperly connected to equipment of other manufacturers or damage if improperly connected to DITEK equipment.

NO EXPRESS WARRANTIES AND NO IMPLIED WARRANTIES WHETHER OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR USE, OR OTHERWISE, OTHER THAN THOSE EXPRESSLY SET FORTH ABOVE WHICH ARE MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, SHALL APPLY TO PRODUCTS SOLD BY DIVERSIFIED TECHNOLOGY GROUP, INC., AND NO WAIVER, ALTERATION, OR MODIFICATION OF THE FOREGOING CONDITIONS SHALL BE VALID UNLESS MADE IN WRITING AND SIGNED BY AN EXECUTIVE OFFICER OF DIVERSIFIED TECHNOLOGY GROUP, INC. DITEK PRODUCT. THE LIMITATIONS AND CONDITIONS CONTAINED IN THIS POLICY DO NOT AFFECT THE TERMS OF THE WARRANTY. THIS POLICY IS NOT A WARRANTY. REFER TO THE DITEK LIMITED WARRANTY FOR INFORMATION CONCERNING THE WARRANTY FOR YOUR 'K PRODUCT. THE LIMITATIONS AND CONDITIONS CONTAINED IN THIS POLICY DO NOT AFFECT THE TERMS OF THE WARRANTY.



ITEM	CATALOG NO.	MANUFACTURER	DESCRIPTION
ENCL	2R24208	HAMMOND	24X20X8 NEMA 12 ENCL
ENCL	SPCL	PARK	ALUM INNER DOOR
ENCL	1BP2117	HAMMOND	STEEL BACK PANEL
ENCL	20PL	HAMMOND	PADLOCK ATTACHMENT
CB-1,2	S272-K16	ABB	16 AMP 2 POLE CB
CB-1,2	S500-ME1	ABB	C.B TRIM PLATE
CB-1,2	MB-2RT	ABB	C.B. REAR LUGS
M1,M2	B9C-1	ABB	CONTACTOR
OL-1,2	T250UB.5	ABB	OVERLOAD RELAY
PB-1	CBK-PB-01	ABB	BLACK P.B. (1 N.C.)
PL-1	CBK-LF1R (NEON)	ABB	110V NEON PILOT (RED)
PL-1	CBK-LBN1	ABB	110V NEON BULB
T1	B150BTZ13RB	MICRON	150VA CPT
FU-1,FU-2	ATDR-3	GOULD	3 AMP CLASS CC FUSE
FU-3	TRM-2	GOULD	2 AMP TIME DELAY FUSE
PDB	63163	GOULD	POWER DISTRIBUTION BLOCK
ALT	ARM-AFEP	DIVERSIFIED	ALTERNATING RELAY
R1	RH2BUAC120V	IDEC	2 POLE RELAY (120V)
R1	SH2B-05	IDEC	2 POLE RELAY SOCKET
TR1	RTEP11-AC120V	IDEC	ON DELAY TIMER
PR	RR2PU-AC240V	IDEC	2 POLE RELAY (240V)
TR1,PR	SR2P-06	IDEC	8 PIN SOCKET
TB'S	3001035	PHOENIX	TERMINAL BLOCKS

☐ INDICATES TERMINAL BLOCK

KOESTER ASSOCIATES	PO# 72892
PARK ELECTRIC S.O #	J042496-BG
HP	1
RPM	
FLA	
VOLTAGE	230/1/60

FS-1 PUMPS OFF
FS-2 LEAD PUMP ON
FS-3 LAG PUMP ON
FS-4 HIGH WATER LEVEL

REV C 12/05/96	TITLE: DUPLEX CONTROL PANEL FxKOE01		
DATE 10/15/95	PAGE 1 OF 1	DRAWING NUMBER 101595-SG-1	PARK ELECTRIC SUPPLY, INC

Figure 1 - Premium Watertight Cap

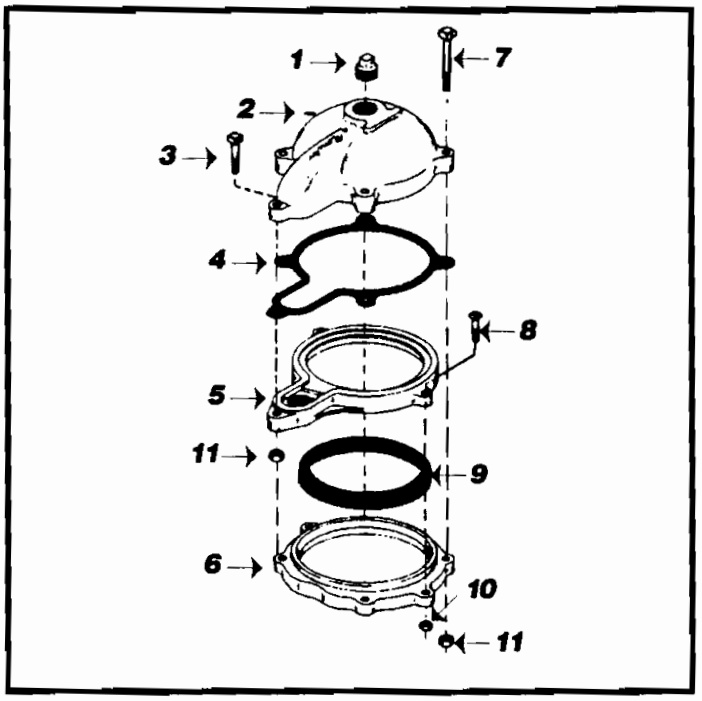


***Figure 2 -Model 12W**

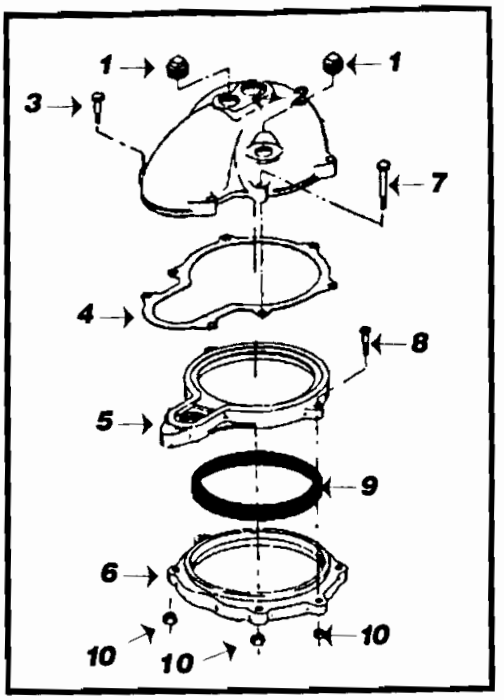


Figure 1- Premium Watertight Cap						
Model No.			**7W**	**8W**	**10W**	**12W***
Item	Qty	Description	Ord. No.	Ord. No.	Ord. No.	Ord. No.
1-2	1	Seal Cap & Plug Assembly	PS217	PS218	PS350	UK850
3	1	Bolt, 3/8 x 2-1/2" L.	PS93S			
3	1	Bolt, 1/2 x 3" L.		APC7	APC7	
3	2	Bolt, 5/8 x 4-3/4" L.				LK4
4	1	Gasket	PS197	PS198	PS342	UK72
5	1	Retainer Ring	PS377	PS178	PS341	UJ174
6	1	Depression Ring	PS187	PS188	PS189	UJ175
7	6	Bolt, 3/8-16NC x 3-1/2" L.	PS94S			
7	5	Bolt, 1/2 x 4-1/2" L.		PS221	PS221 (6)	
7	5	Bolt, 5/8 x 5-1/2" L.				KP145
8	2	Bolt, 5/16-18 NC x 2" L.	PS132S			
8	3	Bolt, 1/2 x 2-1/2" L.		PS111	PS111	
8	3	Bolt, 5/8 x 3-1/2" L.				UJ177
9	1	Seal Ring	PS167	PS168	PS170	UJ176
10	2	Nut, 5/16-18NC	PC434S			
10-11	9	Nut, 1/2 - 13NC		PC433	PC433 (10)	
10	10	Nut, 5/8 x 11NC				PC286
11	7	Hex Nut, 3/8-16NC	UB17S			

Note: ( ) designates quantity for that unit.

Figure 1 - Premium Watertight Cap

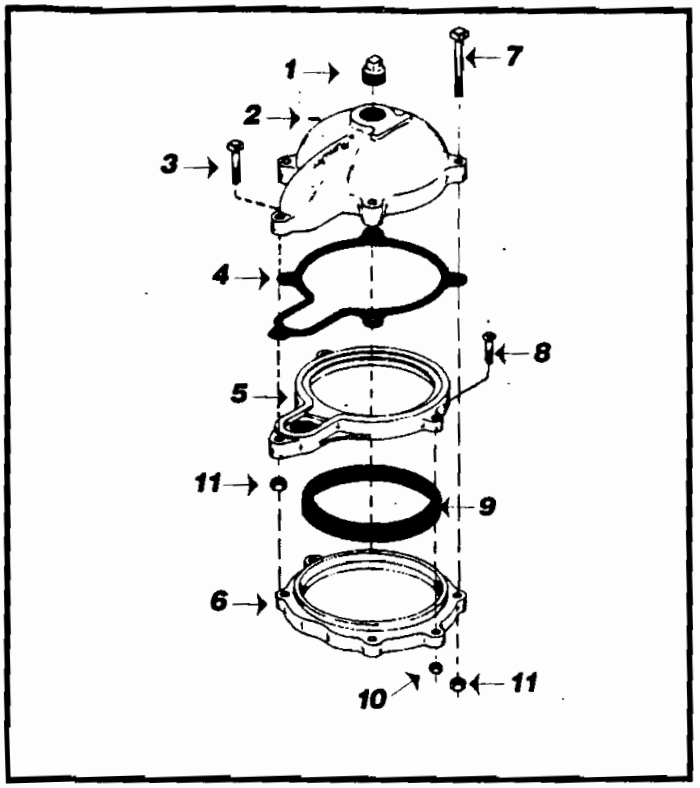
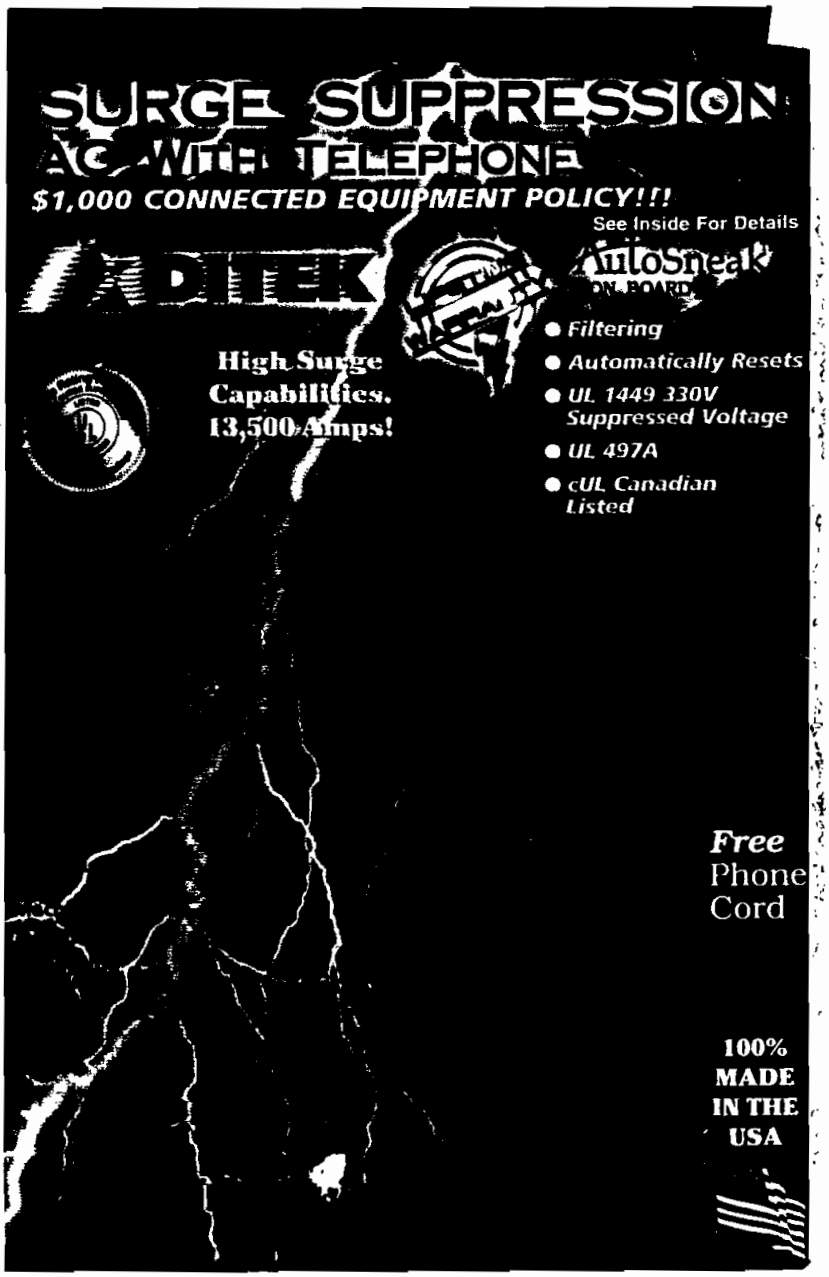


Figure 1-Premium Watertight Cap								
Model No.			**4W**	**4.5W**	**5W**	**5.6W**	**6W**	**6.6W**
Item	Qty	Description	Ord. No.	Ord. No.	Ord. No.	Ord. No.	Ord. No.	Ord. No.
1-2	1	Seal Cap & Plug Assembly	PS214	PS214.5	PS215	PS215.6	PS216	PS216.6
3	1	Bolt, 3/8 x 2-1/4" L.	PS92S	PS92S	PS92S	PS93S	PS93S	PS93S
4	1	Gasket	PS194	PS194.5	PS195	PS195.6	PS196	PS196.6
5	1	Retainer Ring	PS374	PS374.5	PS375	PS375.6	PS376	PS376.6
6	1	Depression Ring	PS184	PS184.5	PS185	PS185.6	PS186	PS186.6
7	4	Bolt, 3/8-16NC x 3-1/2" L.	PS94S	PS94S	PS94S	PS94S (5)	PS94S (5)	PS94S (6)
8	2	Bolt, 5/16-18 NC x 2" L.	PS132S	PS132S	PS132S	PS132S	PS132S	PS132S
9	1	Seal Ring	PS164	PS164.5	PS165	PS165.6	PS166	PS166.6
10	2	Nut, 5/16-18NC	PC434S	PC434S	PC434S	PC434S	PC434S	PC434S
11	5	Nut, 3/8-16NC	UB17S	UB17S	UB17S	UB17S (6)	UB17S (6)	UB17S (7)

Note: ( ) designates quantity for that unit.


SURGE SUPPRESSION
AC WITH TELEPHONE
$1,000 CONNECTED EQUIPMENT POLICY!!!
See Inside For Details
ADITEK
AutoSneak
ON BOARD
High Surge
Capabilities.
13,500 Amps!
Filtering
Automatically Resets
UL 1449 330V
Suppressed Voltage
UL 497A
cUL Canadian
Listed
Free
Phone
Cord
100%
MADE
IN THE
USA

This unit has been tested by UL at 6,000 volts and has the best let through ratings available.

Small Size equals short ground path for superior performance.

Specifications

- 110V Circuits
- UL 1449 330 V Suppressed Voltage
- UL 497A
- Joule Rating - 114 10x1000 μsec
- Response Time < 5 Nanoseconds.
- Surge Current - 13,500 AMPS 8x20 μsec.
- Complete protection between ground, neutral, and phase (L-N,L-G,N-G).

AutoSneak™ technology prevents overcurrent problems and automatically resets up to 6,000 times. AutoSneak™ is a thermally sensitive device which reacts to overcurrent by opening the circuit. When current overload subsides, AutoSneak™ resets itself to be effective again, and again, and again.

Diagnostic Light:

- Surge protection is active.
- Phase & neutral are correct.
- Ground present.

Underwriter Laboratory, (U.L.), is a not-for-profit independent testing laboratory used by responsible manufacturers for safety and standards testing. U.L. 1449 also performance rates surge suppressors by suppressed voltage. **The lower the suppressed voltage under U.L. 1449 testing, the more effective the surge suppressor.** Look for the U.L. listing and the lowest suppressed voltage rating.

DTK-1FF

7 82980 50003 8

Model

DTK-1FF

FORM P-258 (Back)

WARRICK CONTROLS

Series 67 Installation & Operation Instructions

TABLE OF CONTENTS

WARRICK CONTROLS, INC. 4237 Normandy Court Royal Oak, MI 48073
PH: 810-549-4900 / FAX: 810-549-4904

WARRICK CONTROLS

Series 67
Intrinsically Safe Multi-Function Control
Installation Instructions

Installation: Intrinsically Safe Sensing Circuits

This bulletin should be used by experienced personnel as a guide to the installation of the Series 67 intrinsically safe control. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Warrick or its local representative if further information is required.

IMPORTANT: BEFORE PROCEEDING TO INSTALL AND WIRE THE SERIES 67, READ AND THOROUGHLY UNDERSTAND THESE INSTRUCTIONS.

When installed according to these instructions, this device provides intrinsically safe sensing circuits for interface into Class I, II and III, Division I, Groups C, D, E, F, and G Hazardous locations.
Electrical equipment connected to the Series 67 control should not exceed ratings marked on control.

MOUNTING LOCATION:

The control must be situated in a non-hazardous area where an explosive atmosphere will not exist at any time unless it is mounted in a suitable U.L. approved explosion-proof enclosure with suitable U.L. approved explosion-proof seals.

WIRING: GENERAL INFORMATION

1. Intrinsically safe wiring must be kept separate from non-intrinsically safe wiring.
2. Intrinsically safe and non-intrinsically safe wiring may occupy the same raceway if they are at least 2 inches (50mm) apart and separately tied down. Inside panels, field wiring terminals for intrinsically safe circuits must be separated by at least 2 inches (50mm) from non-intrinsically safe wiring.
3. Wire the control devices to the Series 67 control as shown in **FIG. 6-1.** A separate rigid metallic conduit must be used to enclose the conductors of the intrinsically safe control circuit.
4. An approved seal should be used at the point where the intrinsically safe control circuit wiring enters the hazardous area.

For intrinsically safe output wiring use #14 or #16 AWG type MTW or THHN wire. By using these wire types in conjunction with the following distance recommendations, you will not exceed the maximum capacitance or inductance for field wiring. Use the following chart **Fig 1 - 1** as a guide for maximum wire runs.

FIG. 1 - 1

MODEL NUMBER	SENSITIVITY	DISTANCE
67AXXXA	4.7 K Ohms	4000 Feet
67BXXXA	10 K Ohms	2400 Feet
67CXXXA	26 K Ohms	1200 Feet
67DXXXA	50 K Ohms	600 Feet
67EXXXA	100 K Ohms	300 Feet

Installation: Intrinsically Safe Circuits (cont.)

GENERAL INFORMATION: (cont.)

GROUNDING:

The four mounting holes on the Series 67 provide an electrical connection for earth grounding between the control's internal solid state circuitry and the enclosure chassis. To insure proper grounding, use only 6/32 metal screws and lock washers when mounting the control. Terminal G on the supply line/load side terminal strip is a redundant system ground terminal and **must be connected to the earth ground buss of the control's AC supply line feeder.**

NOTE:

1. Intrinsically safe terminals can be connected to any non-energy generating or storing device such as a pushbutton, limit or float type switch or any Warrick electrode/fitting assembly.

2. To prevent electrical shock from supply line/load side powered connections, the Series 67 should be mounted in a tool accessible enclosure of proper NEMA rated integrity.

3. For U.L. 913 Listed panels, a metallic partition may be necessary to provide adequate spacing between non-intrinsically safe and intrinsically safe wiring and/or terminals.

4. For additional guidance on "Hazardous Location Installations" and "Intrinsically Safe Devices", consult ANSI/ISA standard RP 12-6 or NEC articles 500 through 516 and other local codes.

SENSOR WIRING:

The Series 67 control has four independent intrinsically safe channels, which can be connected to different types of sensors, including floats, conductance probes, pressure switches and other non-powered contacts or sensors. The connections of the sensor to the terminals will not vary with normally open or closed sensors. However, the Inverse/Direct dip switchs must be set to the proper mode for each channel to achieve the correct operation. Consult **TABLES 2 - 1 & 3 - 1** for the proper dip switch settings for various sensors and functions.

The following sections cover the intrinsically safe sensor connections for single and differential level service.

SINGLE LEVEL SERVICE:

All four channels can be used for single level service. Each channel is independent and can be used for its own single point function. However, only channels 3 & 4 have the alarm bell and silence capabilities. Consult the alarm sections for more information regarding the installation & operation of the alarm circuitry. The following **TABLE 2 - 1** covers the sensor style to terminal connections for all four channels.

TABLE 2 - 1

SENSOR STYLE	TERMINAL CONNECTIONS	DIP SWITCH SETTING
Normally Open - Closes on alarm condition	Channel 1 -- HS1 & G* Channel 2 -- HS2 & G* Channel 3 -- S3 & G Channel 4 -- S4 & G	Inverse Mode - Up Position
Normally Open - Opens on alarm condition	Channel 1 -- HS1 & G* Channel 2 -- HS2 & G* Channel 3 -- S3 & G Channel 4 -- S4 & G	Direct Mode - Down Position
Normally Closed - Closes on alarm condition	Channel 1 -- HS1 & G* Channel 2 -- HS2 & G* Channel 3 -- S3 & G Channel 4 -- S4 & G	Inverse Mode - Up Position
Normally Closed - Opens on alarm condition	Channel 1 -- HS1 & G* Channel 2 -- HS2 & G* Channel 3 -- S3 & G Channel 4 -- S4 & G	Direct Mode - Down Position

***Note: Channels 1 & 2 can not activate the alarm bell contacts and do not have the silence/acknowledge capabilities**

Installation: Intrinsically Safe Circuits (cont.)

DIFFERENTIAL LEVEL SERVICE:

Channels 1 & 2 are designed to provide differential on/off points to control pumps, solenoid valves or other equipment. These channels can also be used in single level service for alarms and cutoffs, however, the control's built in silence circuitry and bell contacts cannot be used. Consult the Alarm section for more information.

When channels 1 & 2 are used for differential level service the associated sensors MUST BE NORMALLY OPEN! The Inverse/Direct dip switchs must also be set to the proper mode for each channel, to achieve the correct operation. The following chart **TABLE 3 - 1** gives the correct sensor to terminal connections and dip switch settings for various applications.

FOR APPLICATIONS THAT DO NOT REQUIRE DUPLEX ALTERNATION, A JUMPER WIRE MUST BE PLACED FROM THE "G" TO "1–2" TERMINAL.

TABLE 3 - 1

APPLICATION	SENSOR CONTACT STYLE	SENSOR TERMINAL CONNECTIONS	DIP SWITCH SETTING
Simplex Pump Down or Solenoid Valve Drain**	Normally Open - Closes on Rising Level	Start Pump/Open Valve-- HS1 & G* Stop Pump/Close Valve -- LS1 & G*	Direct - DOWN Channels 1 or 2
Simplex Pump Up or Solenoid Valve Fill**	Normally Open - Closes on Rising Level	Start Pump/Open Valve-- LS1 & G* Stop Pump/Close Valve -- HS1 & G*	Inverse - UP Channels 1 or 2
Duplex Pump Down - Common Pump Stop	Normally Open - Closes on Rising Level	Duty Pump Start -- HS1 & G* Standby Pump Start -- HS2 & G* Duty and Standby Pump Stop - LS1 & G* Jumper LS1 & LS2	Direct - DOWN Channels 1 & 2
Duplex Pump Up - Common Pump Stop	Normally Open - Closes on Rising Level	Duty Pump Start -- LS1 & G* Standby Pump Start -- LS2 & G* Duty and Standby Pump Stop - HS1 & G* Jumper HS1 & HS2	Inverse - UP Channels 1 & 2
Duplex Pump Down - Seperate Pump Stops	Normally Open - Closes on Rising Level	Duty Pump Start -- HS1 & G* Standby Pump Start -- HS2 & G* Duty Pump Stop -- LS1 & G* Standby Pump Stop -- LS2 & G*	Direct - DOWN Channels 1 & 2
Duplex Pump Up - Seperate Pump Stops	Normally Open - Closes on Rising Level	Duty Pump Start -- LS1 & G* Standby Pump Start -- LS2 & G* Duty Pump Stop -- HS1 & G* Standby Pump Stop -- HS2 & G*	Inverse - UP Channels 1 & 2

*NOTE-1: If conductance probes are being used only one G connection is required. Terminal G must be grounded to the vessel if metallic. If the electrode fitting being used has a metallic body and is supported directly upon a metallic vessel, the ground connection is facilitated by securing that end of the ground connector beneath the head of one of the screws which fasten the terminal housing to the body of the fitting. When the vessel is non-metallic, terminal G must be connected to an additional electrode of length equal to or longer than, the longest electrode. If wire suspended electrodes are being used, more than one Ground/Reference probe may be required.

**NOTE-2: This setup based on the use of a Normally closed (N.C.) solenoid valve that energizes to open when power is applied to the coil circuit.

Installation: Intrinsically Safe Circuits (cont.)

ALARM CHANNEL WIRING:

SILENCE CIRCUITRY:

A normally open pushbutton is required to operate the Series 67's alarm silence circuitry. The N.O. pushbutton must be connected to the SIL & G Terminals. For more information about the operation of the silence circuitry consult the Alarm Operation section on page 9. **NOTE: THE SILENCE PUSHBUTTON IS CONNECTED TO INTRINSICALLY SAFE CIRCUITRY. THEREFORE THE PUSHBUTTON AND ITS ASSOCIATED WIRING SHOULD BE SEPARATED FROM NON-INTRINSICALLY SAFE WIRING AND DEVICES. CONSULT PAGE 1 FOR MORE INFORMATION.**

ALARM DIP SWITCHES:

The alarm dipswitches for channels 3 & 4 can be set to enable the bell contacts for one or both alarm channels. However, this does not disable the alarm contact for that channel. The following **TABLE 4 - 1** covers the dip switch settings for various alarm conditions.

TABLE 4 - 1

DIP SWITCH SETTING	BELL CONTACT STATUS
3 Off - Down 4 Off - Down	Channel 3 - Off - Disabled Channel 4 - Off - Disabled
3 On - Up 4 Off - Down	Channel 3 - On - Enabled Channel 4 - Off - Disabled
3 On - Up 4 On - Up	Channel 3 - On - Enabled Channel 4 - On - Enabled
3 Off - Down 4 On - Up	Channel 3 - Off - Disabled Channel 4 - On - Enabled

ALTERNATION CIRCUITRY:

AUTO OR MANUAL:

The Series 67 control's built in alternator can be used to automatically alternate between two loads controlled by channels 1 & 2. However, the automatic alternation may be bypassed to become a manual operation. This can be accomplished with the use of jumper wires or a three position switch connected to the 2-1, 1-2 and G terminals. The following **TABLE 4 - 2** covers the jumper connections for the manual alternation. Refer to the **FIG. 6 - 1** for more wiring information on the wiring of the three position selector switch. **NOTE: THE MANUAL ALTERNATION CIRCUITRY IS CONSIDERED INTRINSICALLY SAFE. THEREFORE THE SELECTOR SWITCH, JUMPER WIRES AND THEIR ASSOCIATED WIRING SHOULD BE SEPARATED FROM NON-INTRINSICALLY WIRING DEVICES. CONSULT PAGE 1 FOR MORE INFORMATION ON INTRINSIC SAFETY.**

TABLE 4 - 2

ALTERNATION STATUS	JUMPER REQUIRED	LED STATUS PUMP DOWN*	LED STATUS PUMP UP*
Automatic *	None	Either	Either
Manual 1 - 2	Terminals 1 - 2 to G	No. 1**	No. 1**
Manual 2 - 1*	Terminals 2 - 1 to	No. 2**	No. 2**

* NOTE: – For Non-alternation applications jumper 1–2 to G.

** NOTE – The position of the 1–2, 2–1 indicating LED's is dependent on the application. The position changes for pump up or down. Consult Control Diagram FIG. 6–1 for more information.

Installation: High Voltage Circuits

A.C. SUPPLY:

Connect the incoming supply HOT lead to the L1 terminal, NEUTRAL lead to the L2 terminal and EARTH GROUND lead to the G terminal. NOTE: The incoming power supply should have the same electrical characteristics as indicated on the control's label.

GROUNDING:

Terminal G on the supply line/load side terminal strip is a redundant system ground terminal and **must be connected to the earth ground buss of the panel's AC supply line feeder.**

OUTPUT CONTACTS:

Channels 1 - 4: Each channel has dedicated non-powered contacts. These can be either Form C or Form A & B contacts depending on the model. These contacts will change state when their respective channel activates. In DIRECT mode the relay will energize and the contacts will change state when the probe circuit sensor closes. In INVERSE mode the relay will energize and contacts will change state upon power up . The channel will then de-energize and return the contacts to their shelf state when the probe circuit sensor closes.

Form C - This contact configuration consists of (1) Normally Open contact and (1) Normally Closed contact. There are three terminals for electrical connections, N.O., N.C. and Common. Each terminal will accept up to (2) - 14 AWG wires.

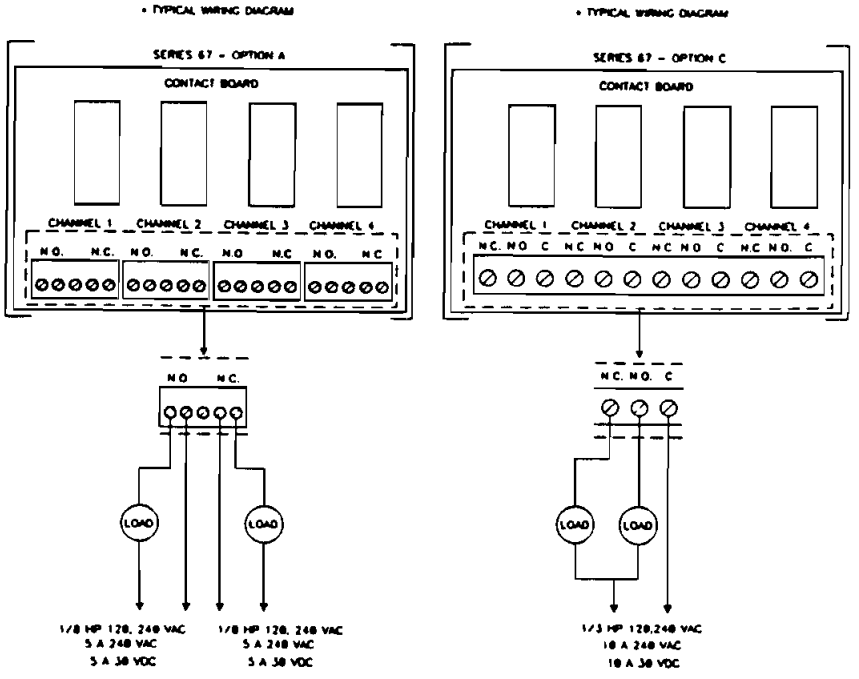
Form A & B: This contact configuration consists of (1) Normally Open contact and (1) Normally Closed contact which are electrically isolated from each other. There are two terminals for each contact. Each terminal will accept (1) - 14 AWG wire.

Alarm Bell: The alarm bell contacts are non-powered and of Form C construction. This contact configuration consists of (1) Normally Open contact and (1) Normally Closed contact. There are three terminals for electrical connections, N.O., N.C. and Common. Each terminal will accept up to (2) - 14 AWG wires.

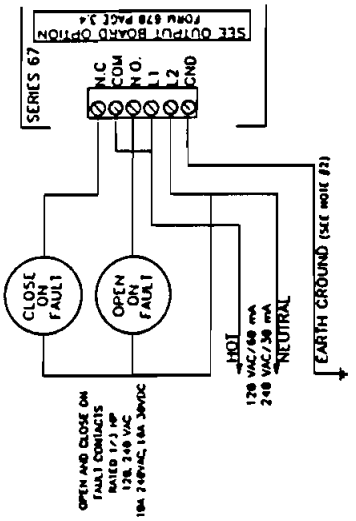
When the output contacts are used to drive loads they should be wired in series with the load. This series branch circuit should then be connected across a power source compatible with the load. See diagrams below.

FIG. 5 - 1

Load Contacts

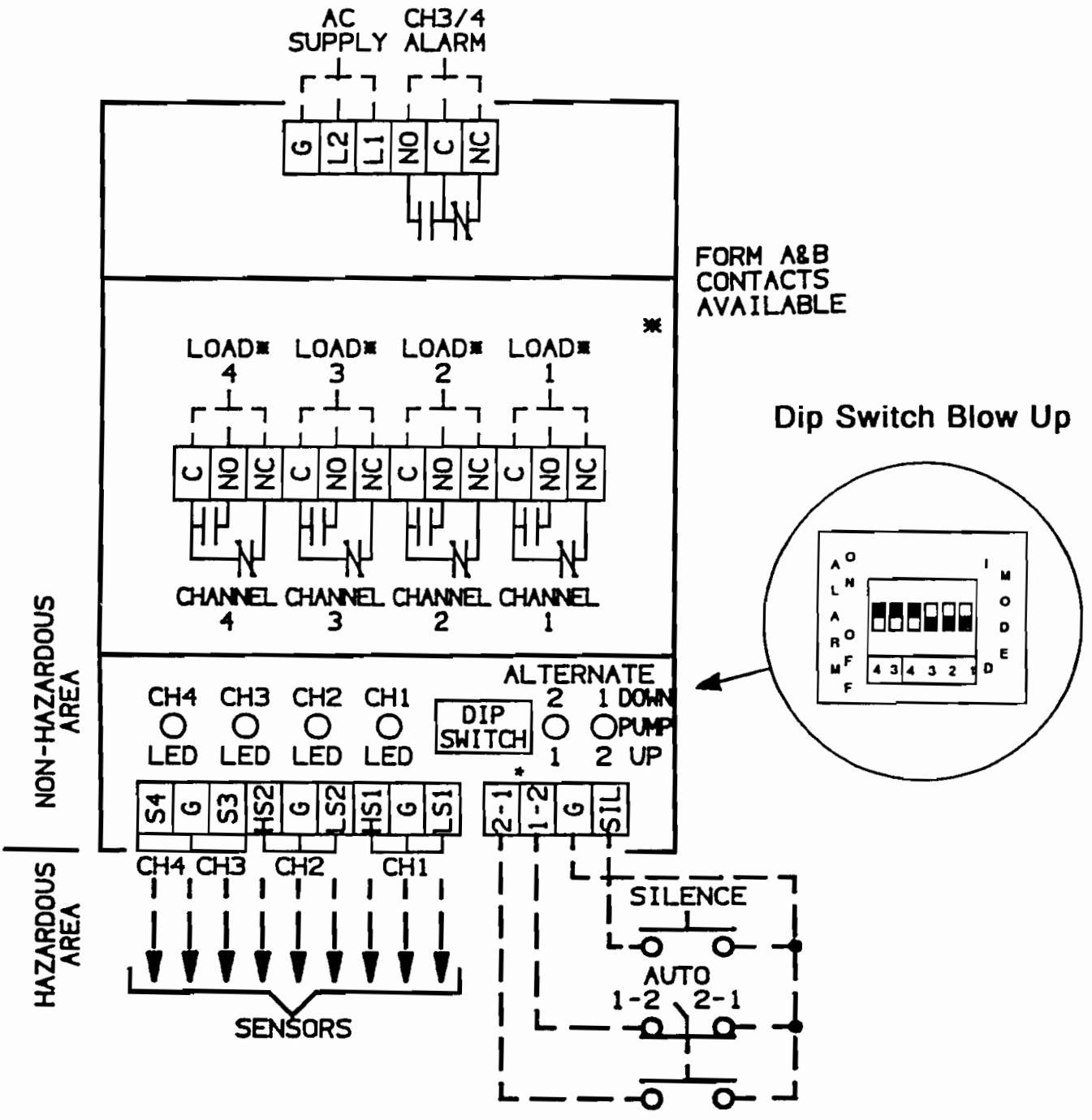


Alarm Bell Contacts



CONTROL DIAGRAM:

FIG. 6 - 1



*NOTE FOR APPLICATIONS THAT DO NOT REQUIRE DUPLEX ALTERNATION, A JUMPER WIRE MUST BE PLACED FROM THE "G" TO "1-2" TERMINAL.

Technical Information

SPECIFICATIONS:

Load Contacts: Standard - 1 Form C (N.O., N.C., C.) for each channel. Optional - 1 Form A (N.O.) and 1 Form B (N.C.) isolated.
Bell Contacts: 1 Form C (N.O., N.C., C.)
Load Contact Ratings: Standard Form C - 10A @ 120/240 VAC and 30VDC Resistive, 1/3 HP @ 120/240 VAC
Optional Form A & B - 5A @ 120/240 VAC and 30VDC Resistive, 1/8 HP @ 120/240VAC.
Bell Contact Ratings: 10A @ 120/240 VAC and 30VDC resistive, 1/3 HP @ 120/240 VAC.
Contact Life: Electrical @ rated load = 1,000,000 cycles minimum. Mechanical = 10,000,000 cycles.
Primary (A.C. Supply Line):
(a) Voltage: 120,240 VAC, plus 10%, minus 15%
(b) Frequency: 50/60 Hertz
(c) Power: Relay Energized, 60ma @ 120VAC, 30ma @ 240VAC.
Secondary (probe circuit): Nominal - 12VAC @ 6ma RMS
Senstivity Range: 4700 - 100,000 Ohms maximum specific resistance.
Temperature Rating: (minus) -40 deg. F. to (plus) +150 deg. F.
Electronics Module: Solid state components enclosed in a molded nylon housing.
Terminals: Standard Form C removable terminal strip, contains a size 4 pan head screw with a clamping plate. Will accept up to (2) - 14 AWG wires. Optional Form A & B relay board will accept up to (1) 14 AWG wire per terminal. USE COPPER (60/75 DEGREE C) WIRE ONLY. TORQUE TO 20 INCH-POUNDS.
Listing: U.L. 913 - Process Control Equipment Associated Apparatus with Intrinsically Safe Output. Class I, II and III,

ORDERING INFORMATION:

SERIES 67 X X X X A

Optional character	
Enclosure	**0** - Open **1** - Nema 1
Output Board Contact Type	**A** - 1 Form A & B (N.O. & N.C. Isolated) for each channel **C** - 1 Form C (N.O., N.C., Common)
Input Voltage:	**1** - 120 VAC **2** - 240VAC
Sensitivity:	**A** - 4.7 K **B** - 10 K **C** - 26 K **D** - 50 K **E** - 100 K

MODULE REPLACEMENT:

If the electronic module needs to be replaced, follow the procedure listed below:

1. Turn off power to the control and load devices.

2. Remove the metal partition located across the center of the module (When required).

3. Remove all field wiring terminal blocks from the electronic module. **The field wires do not need to be removed from the terminal blocks.** The terminal blocks separate from the board as shown in **FIG. 8 - 1**

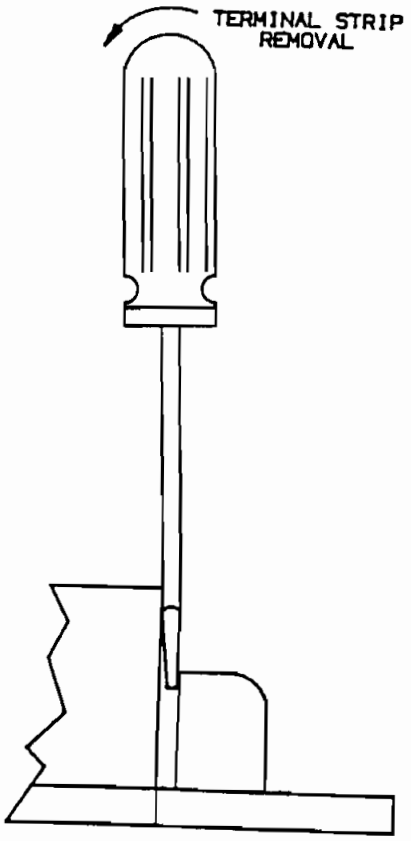
4. Remove the four (4) retaining screws from the base of the electronic module. The module can now be removed from the control panel.

5. Install a new module and reinstall all of the terminal blocks.

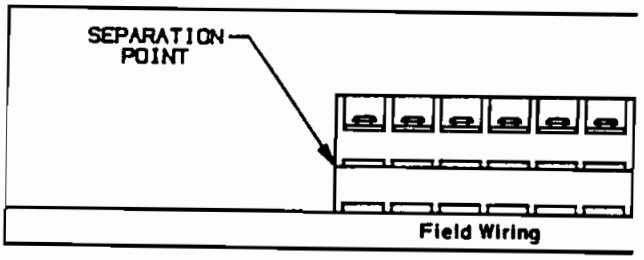
6. Reinstall the metal partition (When required).

7. Set all dip switches according to previous instructions.

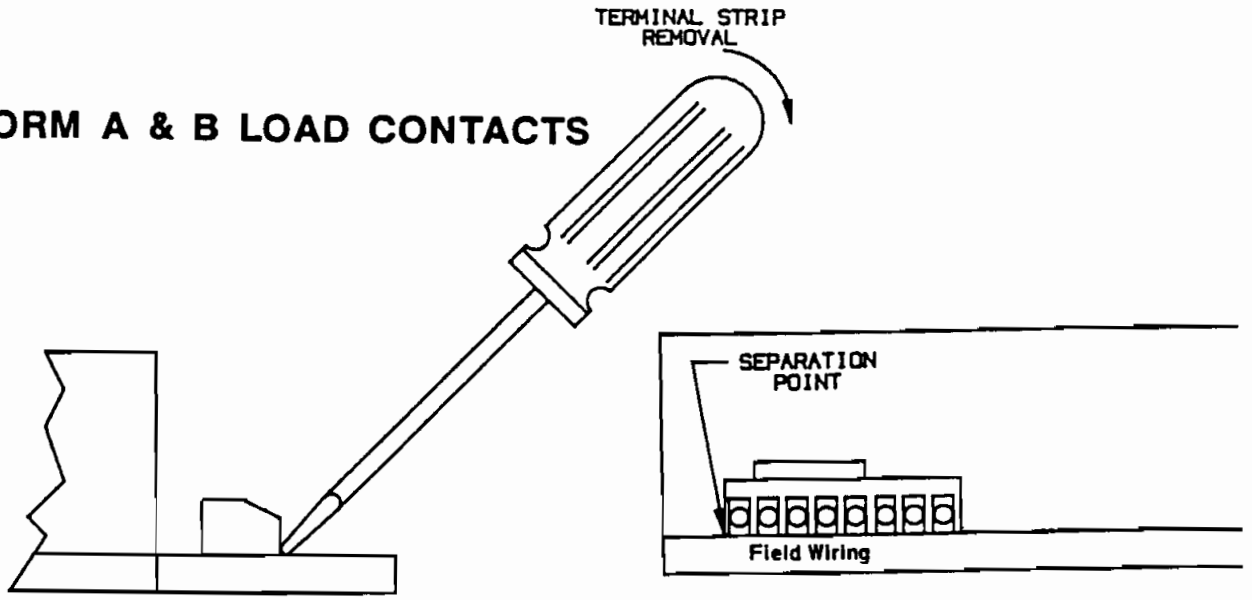
FIG. 8 - 1



A.C. SUPPLY, FORM C LOAD CONTACTS AND SENSOR TERMINALS



FORM A & B LOAD CONTACTS



OPERATION INSTRUCTIONS

The Series 67 Multi-function control can be used for many different applications including: Pump control, solenoid valve control and alarm activation. The following instructions cover the most common applications. If your application is not included, contact Warrick Controls or our authorized Representative in your area for assistance.

The operating instructions are broken up into two general categories: SINGLE and DIFFERENTIAL LEVEL SERVICE. The alarm functions are covered under the SINGLE LEVEL SERVICE heading while the pumping and solenoid valve functions are covered under the DIFFERENTIAL LEVEL SERVICE heading.

SINGLE LEVEL SERVICE: CONTACT OPERATION

LOAD CONTACTS: CHANNELS 1 - 4

The activation of these contacts is dependent upon the type of sensor (normally open or closed) and the mode of operation (direct or inverse). The following chart gives the sensor activation conditon, dipswitch setting, contact status and LED status for various applications and sensors.

TABLE 9 - 1

APPLICATION	WARRICK SENSOR	SENSOR'S ALARM ACTIVATION CONDITION	DIP SWITCH SETTING	RELAY STATUS UPON ALARM	LED STATUS UPON ALARM
High Level Alarm - Normally Open Float	FE - Reed Switch Float F - Mercury Tilt Float	Closes On Rising Level	INVERSE Up "I"	De-energized	ON
High Level Alarm - Normally Closed Float	FE - Reed Switch Float F - Mercury Tilt Float	Opens On Rising Level	DIRECT Down "D"	De-energized	OFF
Low Level Alarm - Normally Open Float	FE - Reed Switch Float F - Mercury Tilt Float	Opens On Falling Level	DIRECT Down "D"	De-energized	OFF
Low Level Alarm - Normally Closed Float	FE - Reed Switch Float F - Mercury Tilt Float	Closes On Falling Level	INVERSE Up "I"	De-energized	ON
High Level Alarm - Conductance Probes	3R, 3T, 3W, 3Y, 3H AND 3S	Probes In Contact With Conductive Liquid	INVERSE Up "I"	De-energized	ON
Low Level Alarm - ConductanceProbes	3R, 3T, 3W, 3Y, 3H AND 3S	Probes NOT In Contact With Conductive Liquid	DIRECT Down "D"	De-energized	OFF
UNKNOWN SENSOR Normally Open		Closes On Fault	INVERSE Up "I"	De-energized	ON
UNKNOWN SENSOR Normally Closed		Opens On Fault	DIRECT Down "D"	De-energized	OFF

SINGLE LEVEL SERVICE: ALARM FUNCTIONS

BELL CONTACTS:

Under **NORMAL** operating conditions the alarm bell relay is held energized. The relay will de-energize to activate an alarm device when an abnormal condition exists on either channels 3 and/or 4. Either one or both alarm bell circuits can be disabled by adjusting the alarm dip switches. Consult **Fig. 4 - 1** for more information on the alarm bell dip switch settings.

SILENCE CIRCUITRY:

Should an abnormal condition exist on either channels 3 and/or 4 the normally closed (N.C.) alarm bell relay contacts will close, activating an alarm device. The N.C. alarm bell contacts can be returned to their normal state (open) silencing the alarm, by depressing a normally open pushbutton connected to the SIL & G terminals. This will NOT affect the load contacts for channels 3 or 4 as they act independently from the alarm bell contacts.

Operating Instructions: (cont.)

DIFFERENTIAL LEVEL SERVICE:

The following operating instructions are based on correct dip-switch settings and sensor types. Any deviation from these requirements may result in incorrect system operation. Please consult the following chart

TABLE 10 - 1

APPLICATION	WARRICK SENSOR	DIP SWITCH SETTING	ACTIVATION CONDITION	CONTACT STATUS	LED STATUS SENSOR CLOSED
Simplex Pump Down or Solenoid Valve Drain	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Direct Down	Sensor Closes On Rising Level	N.O. - Closes N.C. - Opens	ON
Simplex Pump Up or Solenoid Valve Fill	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Inverse Up	Sensor Closes On Rising Level	N.O. - Opens N.C. - Closes	OFF
Duplex Pump Down - Common Pump Stop	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Direct Down	Sensor Closes On Rising Level	N.O. - Closes N.C. - Opens	ON
Duplex Pump Up - Common Pump Stop	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Inverse Up	Sensor Closes On Rising Level	N.O. - Opens N.O. - Closes	OFF
Duplex Pump Down - Seperate Pump Stop	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Direct Down	Sensor Closes On Rising Level	N.O. - Closes N.O. - Opens	ON
Duplex Pump Up - Seperate Pump Stop	Normally Open - F, FE, 3R, 3T, 3W, 3Y, 3H AND 3S	Inverse Up	Sensor Closes On Rising Level	N.O. - Opens N.C. - Closes	OFF

DIFFERENTIAL LEVEL SERVICE: SIMPLEX

Simplex Pump Down - Should the level rise to the PUMP START sensor the N.O. load contacts will close starting the pump. The pump will remain running until the level recedes below the PUMP STOP sensor and the load contacts open.

Simplex Pump Up - Should the level recede below the PUMP START sensor the N.O. load contacts will close starting the pump. The pump will remain running until the level rises to the PUMP STOP sensor and the load contacts open.

Solenoid Valve Drain - Should the level rise to the VALVE OPEN sensor, the N.O. load contacts will close energizing the normally closed valve to open. The valve will remain open until the level recedes below the VALVE CLOSE sensor and the load contacts open.

Solenoid Valve Fill - Should the level recede below the VALVE OPEN sensor, the N.O. load contacts will close energizing the normally closed valve to open. The valve will remain open until the level rises to the VALVE CLOSE

Operating Instructions: (cont.)

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP DOWN WITH ALTERNATION

Common Pump Stop - The pumps will alternate each cycle with the duty pump starting when the level rises to the DUTY PUMP START sensor, and stopping when the level recedes below the PUMP(S) STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level rises to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level recedes below the PUMP(S) STOP sensor.

Separate Pump Stops - The pumps will alternate each cycle with the duty pump starting when the level rises to the DUTY PUMP START sensor, and stopping when the level recedes below the DUTY PUMP STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level rises to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level recedes below the STANDBY PUMP STOP sensor.

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP UP WITH ALTERNATION

Common Pump Stop - The pumps will alternate each cycle with the duty pump starting when the level recedes below the DUTY PUMP START sensor, and stopping when the level rises to the PUMP(S) STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level recedes below the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level rises to the PUMP(S) STOP sensor.

Separate Pump Stops - The pumps will alternate each cycle with the duty pump starting when the level recedes below the DUTY PUMP START sensor, and stopping when the level rises to the DUTY PUMP STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level recedes below the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level rises to the STANDBY PUMP STOP sensor.

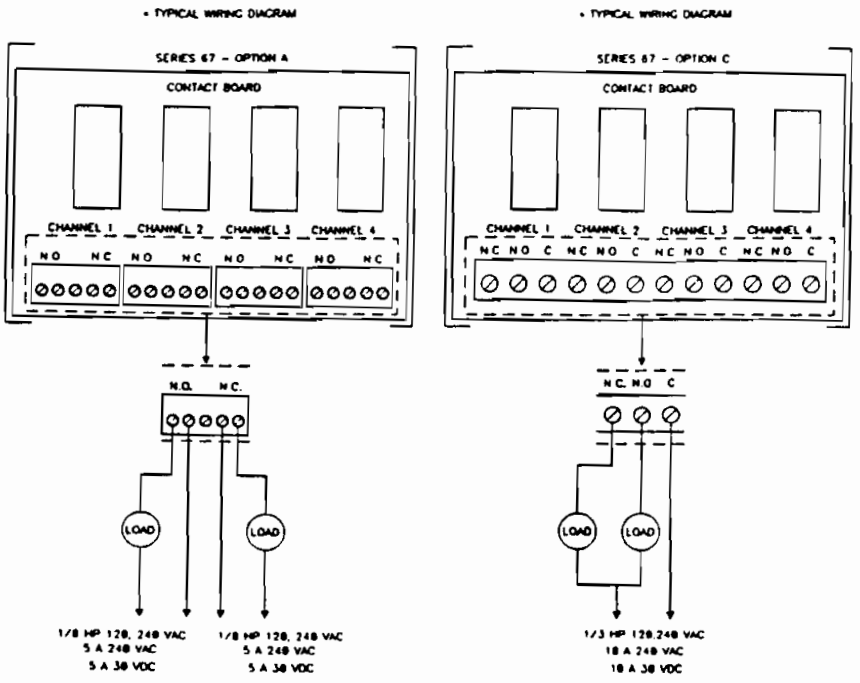
DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP DOWN WITHOUT ALTERNATION

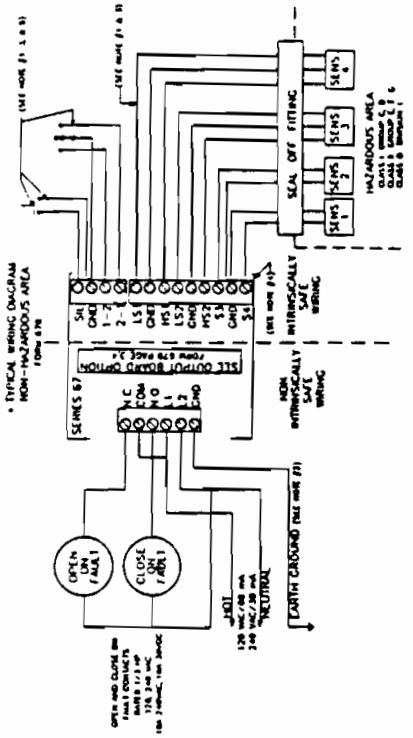
Same operation as above disregarding the alternation sequence. Use the appropriate jumper to determine manual pump start sequence. Refer to FIG. 4 - 2 for the manual alternation jumper information.

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP UP WITHOUT ALTERNATION

Same operation as above disregarding the alternation sequence. Use the appropriate jumper to determine manual pump start sequence. Refer to FIG. 4 - 2 for the manual alternation jumper information.

General Control Information: Cont.





Notes:

1) All intrinsically safe wiring must be installed in accordance with article 504 of the National Electric Code, publication ANSI/NFPA 70. or CEC, Part 1 as Applicable

2) Grounding - The four mounting holes on the Series 67 provide an electrical connection for earth grounding between the controls internal solid state circuitry and the enclosure chassis. To insure proper grounding, use only metal screws and lock washers when mounting the control.

Terminal "G" on the supply line/load side terminal strip is a redundant system ground terminal and must be connected to the earth ground buss of the controls A.C. supply line feeder. The resistance between the system ground terminals and the earth ground buss must be less than 1 ohm.

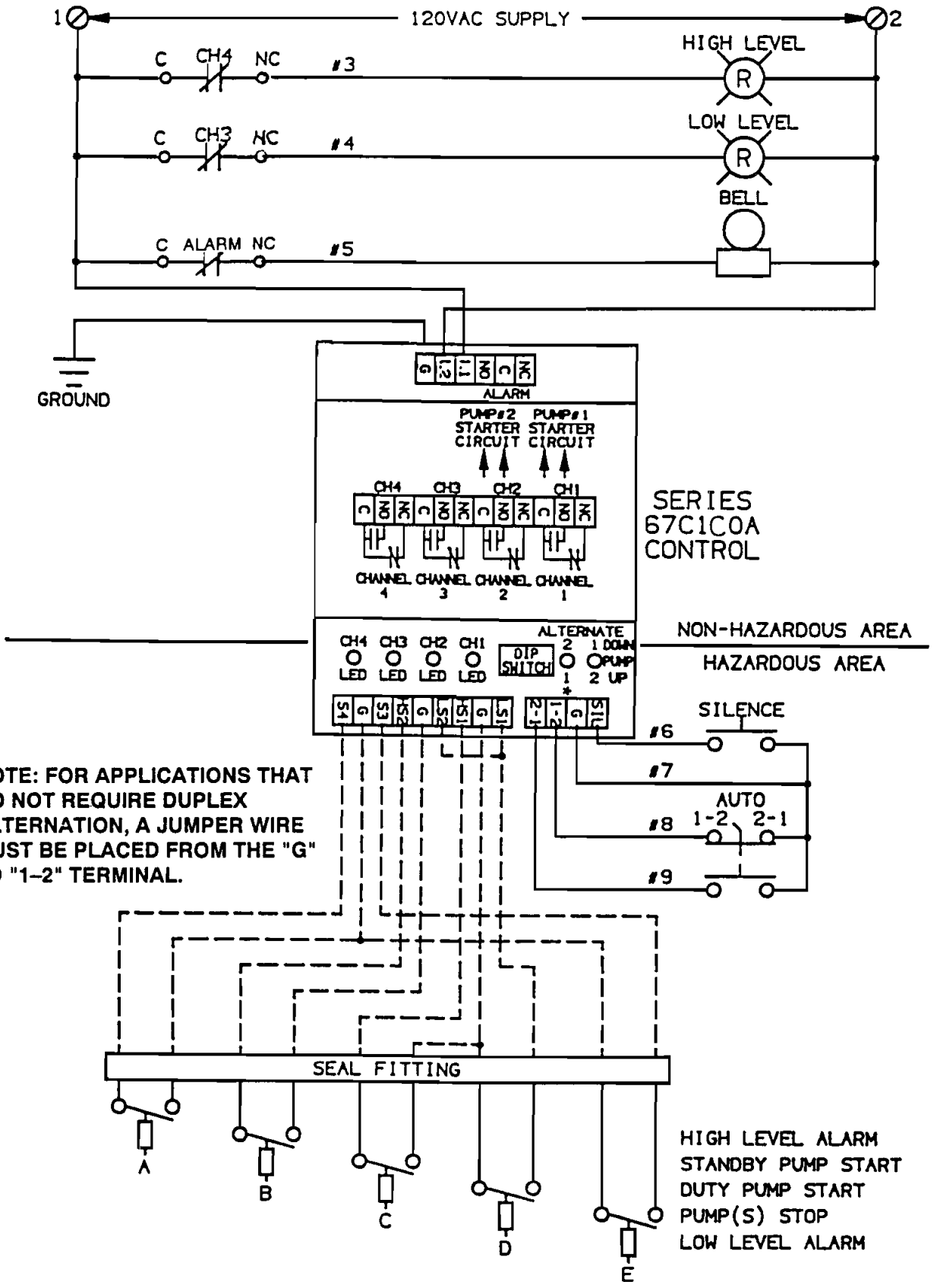
To prevent electrical shock from supply line/load side powered connections the Series 67 should be mounted in a metal enclosure of proper NEMA integrity.

3) The maximum total length of all of the intrinsically safe wiring (of each conductor) shall not exceed an accumulative value of 16,000 feet, excluding any ground wiring.

4) The intrinsically safe terminals of the series 67 can be connected to any non-energy generating or storing switch device such as a push button, a limit or float type switch or any of Warrick's electrode fitting assemblies.

5) When wiring alternation and bell silence switches, the switches and wiring must be separated from non-intrinsically safe circuits and wiring in accordance with article 504 of the National Electric Code, publication ANSI/NFPA 70. F or CEC, Part 1 as Applicable

Sample Wiring Diagram:



*** NOTE: FOR APPLICATIONS THAT DO NOT REQUIRE DUPLEX ALTERNATION, A JUMPER WIRE MUST BE PLACED FROM THE "G" TO "1–2" TERMINAL.**

NOTES

WARRICK CONTROLS

WARRICK CONTROLS, INC.
4237 NORMANDY COURT
ROYAL OAK, MI 48073
Telephone: (810) 549-4900
FAX: (810) 549-4904

When Control is Absolutely Essential

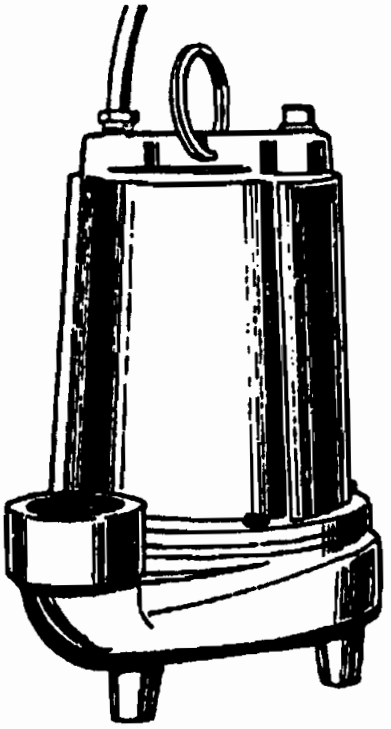
#670-A – 2M – 12/93 3RP

Printed in the U.S.A

BARNES®

INSTALLATION and OPERATION MANUAL

Submersible Effluent Pumps



SERIES: E, H & EH
0.5 and 1.0HP, 3450 RPM

CSA® Canadian Standards Association
File No. LR16567
CSA Listing on EH512L, EH522L & EH1022L
OPTIONAL on 3 Phase EH Series Units,
E & H Series Units.

IMPORTANT Read all instructions in this manual before operating pump
As a result of Barnes® Pumps constant product improvement program, product changes may occur. As such Barnes Pumps reserves the right to change product without prior written notification.

CRANE **PUMPS & SYSTEMS**

Barnes Pumps, Inc.
420 Third Street
Piqua, Ohio 45356-0603
Phone: (513) 773-2442
Fax: (513) 773-2238

Submersible Wastewater Pump Association SWPA MEMBER

Form No. 084848-0495

TABLE OF CONTENTS

SPECIAL TOOLS AND EQUIPMENT
INSULATION TESTER (MEGGER),
DIELECTRIC TESTER
OHM METER
SEAL TOOL KIT (See Parts List)
PRESSURE GAUGE KIT (See Parts List)

REVISION DATES: 0791,1291,0195

SAFETY FIRST!
PLEASE READ THIS BEFORE INSTALLING OR OPERATING PUMP.

GENERAL

1. Most accidents can be avoided by using **COMMON SENSE.**
2. Read the operation and maintenance instruction manual supplied with the pump.
3. Do not wear loose clothing that may become entangled in the impeller or other moving parts.
4. Always wear appropriate safety gear, such as safety glasses, when working on the pump or piping.

PUMPS

5. Pumps build up heat and pressure during operation-allow time for pumps to cool before handling or servicing.
6. Only qualified personnel should install, operate and repair pump.
7. Keep clear of suction and discharge openings. **DO NOT** insert fingers in pump with power connected.
8. Do not pump hazardous materials (flammable, caustic, etc.) unless the pump is specifically designed and designated to handle them.
9. Do not block or restrict discharge hose, as discharge hose may whip under pressure.
10. Make sure lifting handles are securely fastened each time before lifting.
11. Do not lift pump by the power cord (if applicable).
12. Do not exceed manufacturers recommendation for maximum performance, as this could cause the motor to overheat.
13. Secure the pump in its operating position so it can not tip over, fall or slide.
14. Keep hands and feet away from impeller when power is connected.
15. Submersible Pumps are not approved for use in swimming pools, recreational water installations, decorative fountains or any installation where human contact with the pumped fluid is common.
16. Do not operate pump without guards and safety devices in place.
17. When towing pump behind a vehicle; make sure hitch is properly attached, always attach safety chains.
18. Always replace safety devices that have been removed during service or repair.

ELECTRICAL

19. To reduce risk of electrical shock, pump must be properly grounded in accordance with the National Electric Code and all applicable state and local codes and ordinances.
20. To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing.
21. Any wiring of pumps should be performed by a qualified electrician.
22. Never operate a pump with a power cord that has frayed or brittle insulation.
23. Cable should be protected at all times to avoid punctures, cut, bruises and abrasions - inspect frequently.
24. Never handle connected power cords with wet hands.
25. Never operate a pump with a plug-in type power cord without a ground fault circuit interrupter.

GAS/DIESEL ENGINE POWER PUMPS ONLY

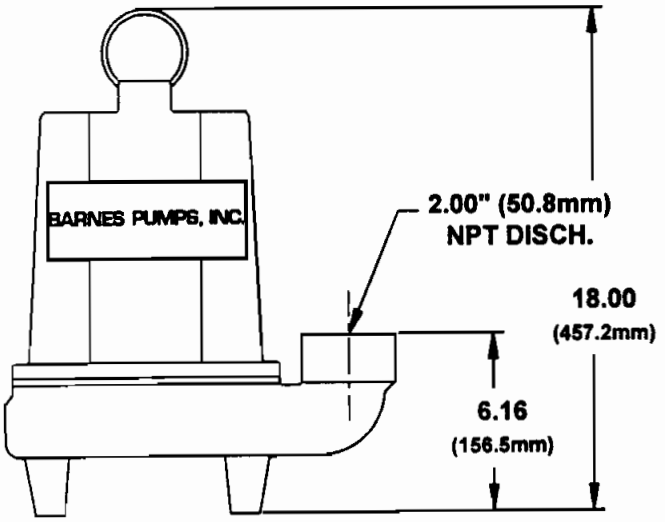
26. Never operate in an enclosed building or area where exhaust gases can accumulate.
27. Do not breath exhaust fumes when working in the area of the engine. (Exhaust gases are odorless and deadly poison.)
28. Never operate near a building where exhaust gases can seep inside.
29. Never operate in a pit or sump without making provisions for adequate ventilation.
30. Allow exhaust system to cool before touching.
31. Never add fuel to the tank while the engine is running. Stop engine and allow to cool.
32. Do not smoke while refueling the engine.
33. Do not refuel near open flame.

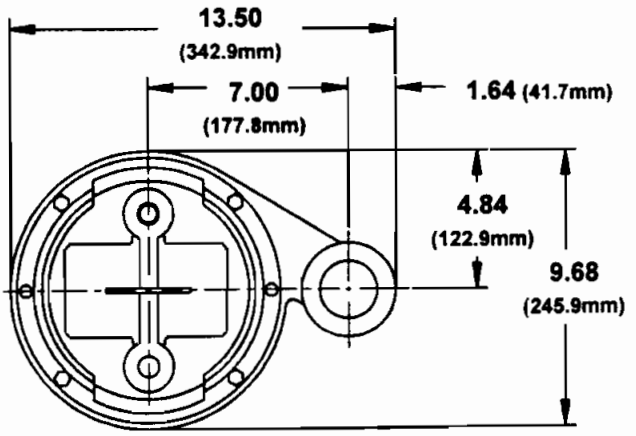
IMPORTANT! Barnes® Pumps, Inc. is not responsible for losses, injury, or death resulting from a failure to observe these safety precautions, misuse or abuse of pumps or equipment.

SECTION: A- PUMP SPECIFICATIONS

DISCHARGE:		2" (50.8mm) NPT, Vertical
LIQUID TEMPERATURE:		104° F Continuous.
VOLUTE:		Cast Iron ASTM A-48, Class 30.
MOTOR HOUSING:		Cast Iron ASTM A-48, Class 30.
SEAL PLATE:		Cast Iron ASTM A-48, Class 30.
IMPELLER:	*Design:*	**E Series** - Three Vane, Open With Pump Out Vanes On Back Side. **H Series** - Single Vane, Enclosed. **EH Series** - Two Vane, Open with Pump Out Vanes On Back Side.
	Material:	**E Series** - Cast Iron ASTM A-48, Class 30. **H Series** - Polypropylene with Threaded, 300 Series Stainless Insert. **EH Series** - 85-5-5-5 Bronze. Dynamically Balanced, ISO G6.3.
SHAFT:		416 Stainless Steel
SQUARE RINGS:		Buna-N
HARDWARE:		300 Series Stainless Steel
PAINT:		Air Dry Enamel.
SEAL:	*Design:*	Single Mechanical, Oil-Filled Reservoir, Secondary Exclusion Seal.
	Material:	Rotating Face - Carbon Stationary Face - Ceramic Elastomer - Buna-N Hardware - 300 Series Stainless
CABLE ENTRY:		15 ft. (381mm)Cord. Pressure Grommet for Sealing and Strain Relief.
SPEED:		3450 RPM (Nominal).

UPPER BEARING:		
	Design:	Sleeve
	Lubrication:	Oil
	Load:	Radial
LOWER BEARING:		
	Design:	Single Row, Ball
	Lubrication:	Oil
	Load:	Radial & Thrust
MOTOR:		
	Design:	NEMA L-Single Phase, NEMA B-Three Phase Torque Curve. Completely Oil-Filled, Squirrel Cage Induction.
	Insulation:	Class A
SINGLE PHASE:		Permanent Split Capacitor (PSC). Includes Overload Protection In Motor.
THREE PHASE:		Dual Voltage 230/460; Requires Overload Protection to be Included in Control Panel.
OPTIONAL EQUIPMENT:		Seal Material, Impeller Trims, N/C Temperature Sensors with cable for 3 phase pumps (Requires Relay in Control Panel), Additional Cable, CSA Listed.





SECTION B: GENERAL INFORMATION

B-1) To the Purchaser:

Congratulations! You are the owner of one of the finest pumps on the market today. Barnes® Pumps are products engineered and manufactured of high quality components. Over one hundred years of pump building experience along with a continuing quality assurance program combine to produce a pump which will stand up to the toughest applications.

This Barnes Pumps, Inc. manual will provide helpful information concerning installation, maintenance, and proper service guidelines.

B-2) Receiving

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

B-3) Storage:

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

Long Term- Any length of time exceeding six (6) months, but not more than twenty four (24) months. The units should be stored in a temperature controlled area, a roofed over walled enclosure that provides protection from the elements (rain, snow, wind blown dust, etc..), and whose temperature can be maintained between +40 deg. F and +120 deg. F.
If extended high humidity is expected to be a problem, all exposed parts should be inspected before storage and all surfaces that have the paint scratched, damaged, or worn should be recoated with a water base, air dry enamel paint. All surfaces should then be sprayed with a rust-inhibiting oil.

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

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

1) The pump is not installed under water for more than one (1) month.

2) Immediately upon satisfactory completion of the test, the pump is removed, thoroughly dried, repacked in the original shipping container, and placed in a temperature controlled storage area.

B-4) SERVICE CENTERS:

For the location of the nearest Barnes Pumps Service Center, check your catalog, your Barnes Pumps, Inc. representative or Barnes Pumps, Inc. Service Department in Piqua, Ohio, telephone (513) 773-2442.

SECTION C: INSTALLATION

C-1) Location:

These pumping units are self-contained and are especially designed to handle septic tank effluent. They will provide sufficient pressure to pump material through small diameter, pipe to gravity interceptors, treatment plants or remote leach fields. Never install the pump in a trench, ditch or hole with a dirt bottom; the legs will sink into the dirt and the suction will become plugged.

C-1.1) Submergence:

The pump should always be operated in the submerged condition and the sump liquid level should never be less than dimension "A" in Figure 1.

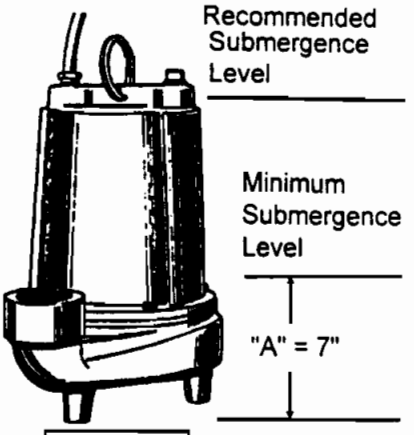


Figure 1

C-2) Discharge:

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

Barnes Effluent Pumps can be installed by one of two methods: (1) the flex hose system, most commonly used in interceptor tanks and(2) the stainless rail package and stainless rail for concrete wet wells, designed to allow the pump to be installed or removed without requiring personnel to enter the wet well.

1.) Flex Hose System (Not Shown)- Connect the flex hose assembly ,as outlined in specifications (to include at least but not limited to, flex hose, shut-off valve, check valve and fittings), to the pump discharge. Attach lifting rope, chain or cable to pump handle. Next lower pump into basin and connect flex hose assembly to discharge coupling on basin. Now connect power and control (optional) cables to junction box or control panel depending on the system design.

2.) Stainless Rail Package (Not Shown)- The package system comes complete and ready to place into ground as outlined in the project specifications. The moveable portion of the BAF, check valve, piping and guide bracket comes assembled on the pump along with the lifting cable. Insert pump bracket and moveable portion of BAF into the guide channel and lower pump into basin **(DO NOT DROP)**. Now connect power and control (optional) cables to the junction box or control panel depending on system design.

C-3) Liquid Level Controls:

The level controls are to be supported by a mounting bracket that is attached to the sump wall, cover or junction box. Cord grips are used to hold the cords in place on the mounting bracket. The control level can be changed by loosening the grip and adjusting the cord length as per the plans and specifications. Be certain that the level controls cannot hang up or foul in it's swing and that the pump is completely submerged when the level control is in the "Off" mode.

C-4) Electrical Connections:

WARNING!
ALL MODEL PUMPS AND CONTROL PANELS MUST BE PROPERLY GROUNDED PER THE NATIONAL ELECTRIC CODE ,STATE AND LOCAL CODES. IMPROPER GROUNDING VOIDS WARRANTY.

C-4.1) Power Cable:
The cord assembly mounted to the pump must not be modified in any way except for shortening to a specific application. Any splice between the pump and the control panel must be made in accordance with the National Electric Code and all applicable state and local electric codes. It is recommended that a junction box, be mounted outside the sump or be of at least Nema 4 construction if located within the wet well.
Do not use the power cable to lift pump!

C-4.2) Control Cable:
The cord assembly mounted to the pump must not be modified in any way except for shortening to a specific application. Any splice between the pump and the control panel must be made in accordance with the National Electric Code and all applicable state and local electric codes. It is recommended that a junction box, be mounted outside the sump or be of at least Nema 4 construction if located within the wet well.
Do not use the control cable to lift pump!

C-4.3) Overload Protection:

C-4.3-1) Three Phase (optional)- The normally closed (N/C) thermal sensor is embedded in the motor windings and will detect excessive heat in the event an overload condition occurs. The thermal sensor will trip when the windings become too hot and will automatically reset itself when the pump motor cools to a safe temperature. It is recommended that the thermal sensor be connected in series to an alarm device to alert the operator of an over-temperature condition and/or the motor starter coil to stop the pump. In the event of an over-temperature, the source of this condition should be determined and rectified immediately. Thermal protection shall not be used as a motor overload device. A separate motor overload device must be provided in accordance with NEC codes.
DO NOT LET THE PUMP CYCLE OR RUN IF AN OVERLOAD CONDITION OCCURS !

C-4.3-2) Single Phase (standard)- The type of in-winding overload protector used is referred to as an inherent overheating protector and operates on the combined effect of temperature and current. This means that the overload protector will trip out and shut the pump off if the windings become too hot, or the load current passing through them becomes too high. It will then automatically reset and start the pump after the motor cools to a safe temperature. In the event of an overload, the source of this condition should be determined and rectified immediately.
DO NOT LET THE PUMP CYCLE OR RUN IF AN OVERLOAD CONDITION OCCURS !

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

TEMPERATURE SENSOR ELECTRICAL RATINGS

Volts	Continuous Amperes	Inrush Amperes
110-120	3.00	30.0
220-240	1.50	15.0
440-480	0.75	7.5

MODEL NO.	HP	VOLT	PH	RPM (Nom)	NEMA CODE	FULL LOAD AMPS	LOCKED ROTOR AMPS	CORD SIZE	CORD TYPE	CORD OD	EMERSON WINDING RESISTANCE MAIN/START	G.E. WINDING RESISTANCE MAIN/START
E512L	0.5	115	1	3450	F	11.0	23.0	14/3	SJTOW	0.390	1.08 - 8.02	0.91 - 13.71
E522L	0.5	230	1	3450	F	5.0	11.5	14/3	SOW	0.560	8.09 - 8.00	9.24 - 10.03
E532L	0.5	230	3	3450	G	3.4	7.8	14/4	SO	0.600	8.57 -	8.60 -
E542L	0.5	460	3	3450	G	1.7	3.9	14/4	SO	0.600	34.28 -	34.40 -
E552L	0.5	575	3	3450	G	1.4	3.1	14/4	SO	0.600	53.56 -	53.75 -
E1022L	1.0	230	1	3450	B	8.2	13.8	14/3	SOW	0.560	3.51 - 12.07	2.89 - 15.18
E1032L	1.0	230	3	3450	K	5.4	21.2	14/4	SO	0.600	5.32 -	6.11 -
E1042L	1.0	460	3	3450	K	2.8	10.7	14/4	SO	0.600	21.28 -	24.44 -
E1052L	1.0	575	3	3450	K	2.3	8.6	14/4	SO	0.600	33.25 -	38.19 -
H512L	0.5	115	1	3450	F	11.0	23.0	14/3	SJTOW	0.390	1.08 - 8.02	0.91 - 13.71
H522L	0.5	230	1	3450	F	5.0	11.5	14/3	SOW	0.560	8.09 - 8.00	9.24 - 10.03
H532L	0.5	230	3	3450	G	3.4	7.8	14/4	SO	0.600	8.57 -	8.60 -
H542L	0.5	460	3	3450	G	1.7	3.9	14/4	SO	0.600	34.28 -	34.40 -
H552L	0.5	575	3	3450	G	1.4	3.1	14/4	SO	0.600	53.56 -	53.75 -
H1022L	1.0	230	1	3450	B	8.2	13.8	14/3	SOW	0.560	3.51 - 12.07	2.89 - 15.18
H1032L	1.0	230	3	3450	K	5.4	21.2	14/4	SO	0.600	5.32 -	6.11 -
H1042L	1.0	460	3	3450	K	2.8	10.7	14/4	SO	0.600	21.28 -	24.44 -
H1052L	1.0	575	3	3450	K	2.3	8.6	14/4	SO	0.600	33.25 -	38.19 -
EH512L	0.5	115	1	3450	F	11.0	23.0	14/3	SJTOW-A	0.390	1.08 - 8.02	0.91 - 13.71
EH522L	0.5	230	1	3450	F	5.0	11.5	14/3	SJTOW-A	0.390	8.09 - 8.00	9.24 - 10.03
EH532L	0.5	230	3	3450	G	3.4	7.8	14/4	SO	0.600	8.57 -	8.60 -
EH542L	0.5	460	3	3450	G	1.7	3.9	14/4	SO	0.600	34.28 -	34.40 -
EH552L	0.5	575	3	3450	G	1.4	3.1	14/4	SO	0.600	53.56 -	53.75 -
EH1022L	1.0	230	1	3450	B	8.2	13.8	14/3	SJTOW-A	0.390	3.51 - 12.07	2.89 - 15.18
EH1032L	1.0	230	3	3450	K	5.4	21.2	14/4	SO	0.600	5.32 -	6.11 -
EH1042L	1.0	460	3	3450	K	2.8	10.7	14/4	SO	0.600	21.28 -	24.44 -
EH1052L	1.0	575	3	3450	K	2.3	8.6	14/4	SO	0.600	33.25 -	38.19 -

Winding Resistance ± 5%
Pump rated for operation at ± 10% voltage at motor.
Standard Units:
(Optional - Temperature sensor cable for 3 phase models is 14/2 SOW, .530 O.D.)
CSA Listed Units:
(Optional - CSA Listed Power cable for 230V/1 phase E & H models is 14/3 SJTOW-A, 0.390 OD.)
(Optional - CSA Listed Power cable for 3 phase models is 14/4 SOW, 0.600 OD.)
(Optional - CSA Listed Temperature sensor cable for 3 phase models is 14/2 SOW, .530 O.D.)

C-4.4) Wire Size:
Consult a qualified electrician for proper wire size if additional power cable length is required. See table for electrical information.

SECTION: D START-UP OPERATION

D-1) Check Voltage and Phase:
Before operating pump, compare the voltage and phase information stamped on the pump's identification plate to the available power.

D-2) Check Pump Rotation:
Before putting pump into service for the first time, the motor rotation must be checked. Improper motor rotation can result in poor pump performance and can damage the motor and/or pump. To check the rotation, suspend the pump freely, momentarily apply power and observe the "kickback". "Kickback" should always be in a counter-clockwise direction as viewed from the top of the pump motor housing.

D-2.1) Incorrect Rotation for Three-Phase Pumps:
In the event that the rotation is incorrect for a three-phase installation, interchange any two power cable leads at the control box. **DO NOT** change leads in the cable housing in the motor. Recheck the "kickback" rotation again by momentarily applying power.

D-2.2) Incorrect Rotation for Single-Phase Pumps:
In the unlikely event that the rotation is incorrect for a single phase pump, contact a Barnes Pumps Service Center.

D-3) Start-Up Report:
Included at the end of this manual are two start-up report sheets, these sheets are to be completed as applicable. Return one copy to Barnes Pumps, Inc. and store the second in the control panel or with the pump manual if no control panel is used. It is important to record this data at initial start-up since it will be useful to refer to should servicing the pump be required in the future.

D-3.1) Identification Plate:
Record the numbers from the pump's identification plate on both START-UP REPORTS provided at the end of the manual for future reference.

D-3.2) Insulation Test:
Before the pump is put into service, an insulation (megger) test should be performed on the motor. The resistance values (ohms) as well as the voltage (volts) and current (amps) should be recorded on the start-up report.

D-3.3) Pump-Down Test:
After the pump has been properly wired and lowered into the basin, sump or lift station, it is advisable to check the system by filling with liquid and allowing the pump to operate through its pumping cycle. The time needed to empty the system, or pump-down time along with the volume of water, should be recorded on the start-up report.

SECTION E: PREVENTATIVE MAINTENANCE

As the motor is oil filled, no lubrication or other maintenance is required, and generally Barnes Pumps will give very reliable service and can be expected to operate for years on normal sewage pumping without failing. However as with any mechanical piece of equipment a preventive maintenance program is recommended and suggested to include the following checks:

1) Inspect motor chamber for oil level and contamination and repair as required per section F-1.
2) Inspect impeller and body for excessive build-up or clogging and repair as required per section F-2.
3) Inspect motor, bearings and shaft seal for wear or leakage, replace as required per section F-3.

SECTION F: SERVICE AND REPAIR

NOTE: All item numbers in ( ) refer to Figures 9 & 10.

WARNING !
ELECTRICAL POWER TO THE PUMP MOTORS MUST BE DISCONNECTED AND LOCKED OUT TO PREVENT ANY DANGEROUS ELECTRICAL HAZARDS OR PERSONNEL DANGER BEFORE ANY SERVICE WORK IS DONE TO THE PUMP.

CAUTION !
OPERATING PUMP BUILDS UP HEAT AND PRESSURE; ALLOW TIME FOR PUMP TO COOL TO ROOM TEMPERATURE BEFORE HANDLING OR SERVICING.

F-1) Lubrication:

Anytime the pump is removed from operation, the cooling oil in the motor housing (3) should be checked visually for oil level and contamination.

F-1.1) Checking Oil:

Motor Housing- To check oil, set unit upright. Remove pipe plug (2) or (36) from motor housing (3) With a flashlight, visually inspect the oil in the motor housing (3) to make sure it is clean, clear, light amber in color and free from suspended particles. Milky white oil indicates the presence of water. Oil level should be to the midpoint of capacitor (32) on single phase units and above motor on three phase units, see Fig. 9, when pump is in vertical position.

F-1.2) Testing Oil:

1. Place pump on it's side, remove pipe plug (2) or (36), from motor housing (3) and drain oil into a clean, dry container.
2. Check oil for contamination using an oil tester with a range to 30 Kilovolts breakdown.
3. If oil is found to be clean and uncontaminated (measure above 15 KV. breakdown), refill the motor housing as per section F-1.3.
4. If oil is found to be dirty or contaminated (or measures below 15 KV. breakdown), the the pump must be carefully inspected for leaks at the shaft seal (9),Gland Nut (28b) and (39b if equipped), O-rings (24), pipe plugs (2) or (36) before refilling with oil. To locate the leak, perform a pressure test as per section F-1.4. After leak is repaired, refill with new oil as per section F-1.3.

F-1.3) Replacing Oil:

Motor Housing- Drain all oil from motor housing and dispose of properly. Refill with (see parts list for amount) new cooling oil as per Table 1. An air space must remain in the top of the motor housing to compensate for oil expansion (see Cross-section Fig. 9). Set unit upright and fill only until the motor, as viewed through the pipe plug opening, is just covered and no more. Apply pipe thread compound to threads of pipe plug (2) or (36) and install in motor housing (3).

WARNING !
DO NOT OVERFILL OIL
OVERFILLING OF MOTOR HOUSING WITH OIL CAN CREATE EXCESSIVE AND DANGEROUS HYDRAULIC PRESSURE WHICH CAN DESTROY THE PUMP AND CREATE A HAZARD. OVERFILLING OIL VOIDS WARRANTY.

Table 1

COOLING OIL- Dielectric	
Supplier	**Grade**
BP	Enerpar SE40
Conoco	Pale Paraffin 22
Mobil	D.T.E. Oil Light
G & G	Circulating 22

F-1.4) Pressure Test:

Motor Housing- Before checking the pump for leaks around the shaft seal, square rings, and cord inlet, the oil level should be full as described in section F-1.3. Remove pipe plug (2) or (36) from motor housing (3). Apply pipe sealant to pressure gauge assembly and tighten into pipe plug hole (see Fig. 2). Pressurize motor housing to 10 P.S.I. Use a soap solution around the sealed areas and inspect joints for "air bubbles". If, after five minutes, the pressure is still holding constant, and no "bubbles" are observed, slowly bleed the pressure and remove the gauge assembly. Replace the pipe plug using a sealant. If the pressure does not hold, then the leak must be located.

CAUTION !
ALWAYS WEAR EYE PROTECTION WHEN WORKING ON PUMPS.

CAUTION !
PRESSURE BUILDS UP EXTREMELY FAST, INCREASE PRESSURE BY "TAPPING" AIR NOZZLE. TOO MUCH PRESSURE WILL DAMAGE SEAL. DO NOT EXCEED 10 P.S.I. IN MOTOR HOUSING.

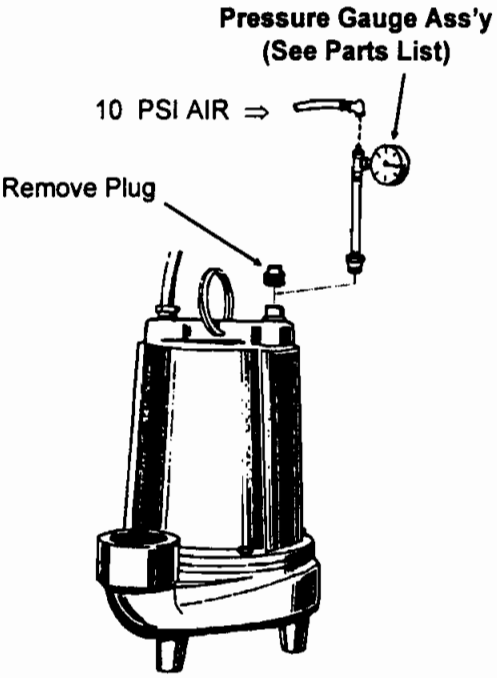


Fig. 2

F-2) Impeller, Volute and Exclusion Seal Service:

F-2.1) Disassembly and Inspection:

To clean out volute (10), or replace u-cup (20) on "H" series pumps, disconnect power, remove cap screws (11) and lockwashers (12), vertically lift motor and seal assembly from body (10). Clean out body if necessary. Inspect gasket (13) and replace if cut or damaged. Clean and examine impeller (16) for pitting, wear, cracks or breakage, replace if required. Check u-cup (20) on "H" series pumps, for damage, if u-cup (20) needs replacement, cut the u-cup from volute (10) and clean surface of bore.

E & EH Series Pumps - If impeller (16) requires replacing, remove jam nut (17) place a flat screwdriver in the slot of the end of the shaft to hold the shaft stationary while unscrewing the impeller (16). Once impeller (16) is removed, remove shims (14), (15), (25) and exclusion seal (19) if damaged or cut.

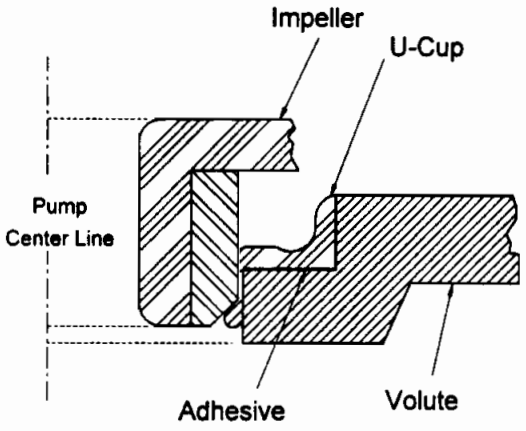
H Series Pumps - If impeller (16) requires replacing, remove cap screw (30) and washer (29) from shaft. Place a flat screwdriver in the slot of the end of the shaft to hold the shaft stationary while unscrewing the impeller (16). Once impeller (16) is removed, remove exclusion seal (19) if damaged or cut.

F-2.2) Reassembly:

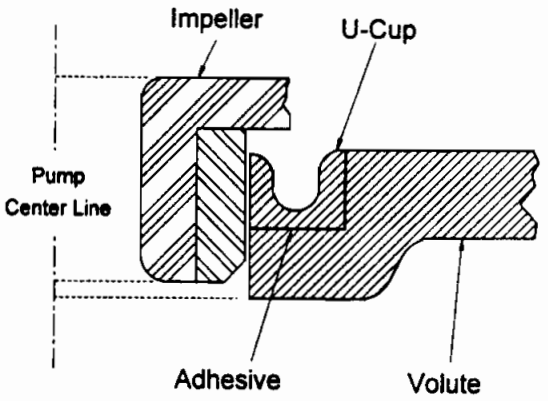
E & EH Series - Position exclusion seal (19) on shaft until it seats against the stationary portion of seal (9). Place shims (14, (15), (25) on shaft until it seats against exclusion seal (19). To install impeller (16), clean the threads with loctite cleaner and screw impeller (16) onto the shaft hand tight. Apply thread locking compound to shaft threads and install nut (17). Shim to within .005/.015 from Impeller to Volute. Torque to 40 ft. lbs. Rotate impeller to check for binding. Position impeller and motor assembly on volute (10). Apply thread locking compound to cap screw (11) and position lockwasher (12) on cap screw (11) and screw into volute (10). Torque to 8 ft. lbs. Check for free rotation of motor and impeller.

H Series - Position exclusion seal (19) on shaft until it seats against the stationary portion of seal (9). To install impeller (16), clean the threads with loctite cleaner and screw impeller (16) onto the shaft hand tight. Place washer (29) onto cap screw (30). Apply thread locking compound to the threads of cap screw (30) and insert into shaft and torque to 2 ft. lbs. Check for free rotation of motor and impeller.

Install U-cup (20) by first applying adhesive to bore of volute (10). Be sure not to get adhesive on inside diameter of U-cup (20). Position gasket (13) on volute flange and reposition volute onto motor and impeller assembly, aligning for fasteners. **CAUTION:** When assembling volute (10) to the rest of the pump be sure the inside lip of the U-cup (20) is not pushed out of place (See Figure 3). Position cap screws (11) with lockwasher (12) through motor housing (5) and volute (10). and tighten to 11 ft lbs.



IMPROPER POSITION OF U-CUP (16).



PROPER POSITION OF U-CUP (16).

Fig. 3

F-3) Motor, Bearing and Seal Service

F-3.1) Disassembly and Inspection:

To examine or replace the motor (5), bearing (8) and shaft seal (9), disassemble volute and impeller as outlined in paragraph F-2.1. Drain oil from motor as outlined in paragraph F-1.3.

Position unit upright, using blocks to avoid resting unit on shaft. Remove gland nut (28b), friction rings (28c) and grommet (28d) from motor housing (3), see Figure 7. If pump is equipped with temperature sensor, also remove gland nut (39b), friction rings (39c) and grommet (39d), from motor housing (3). Remove socket head cap screws (23) and lift motor housing (3) from lower end bell (22). Slide motor housing (3) up cable(s) (28), and (39 if pump is equipped with temperature sensor), until wire connectors and ground screw are exposed. Remove cable lead wires from motor lead wires and temperature sensor wires (if equipped) from control cable, by disconnecting wire connectors (4), (34) & (38) and ground screw (27) from motor (5). The wiring connections should be noted to insure correct connections when reassembling.

Motor- Remove the motor bolts and lift motor stator from motor rotor and lower end bell (22). Unscrew conduit bushing (6) from lower end bell (22) and lift motor rotor, shaft, bearing (8), rotating portion of seal (9), washer (7) and conduit bushing (6) from lower end bell (22). Inspect windings for shorts and check resistance values. Check rotor for wear, if rotor or the stator windings are defective, the complete motor must be replaced.

To test the temperature sensor (if equipped), check the continuity between the black and white wires. If found to be defective contact a motor service station or Barnes Pumps' Service Department. Check motor capacitor (32) on single phase units with an Ohm meter by first grounding the capacitor by placing a screwdriver across both terminals and then removing screwdriver. Connect Ohm meter (set on high scale) to terminals, if needle moves to infinity (∞) then drifts back, the capacitor is good. If needle does not move or moves to infinity (∞) and does not drift back, replace capacitor (32).

Seal- Remove rotating member (9a), spring (9c) and retaining ring (9d) from shaft. (see Figure 4). Examine all seal parts and especially contact faces. Inspect seal for signs of wear such as uneven wear pattern on stationary members, chips and scratches on either seal face. **DO NOT** interchange seal components, replace the entire shaft seal (9). If replacing seal, remove stationary (9a) from lower end bell (22) by prying out with flat screwdriver.

CAUTION !
HANDLE SEAL PARTS WITH EXTREME CARE. DO NOT SCRATCH OR MAR LAPPED SURFACES.

Bearing- Examine bearing (8) and replace if required. If replacement is required, remove bearing (8) from motor shaft using a wheel puller. Washer (7) and conduit bushing (6) can now be removed from motor shaft.

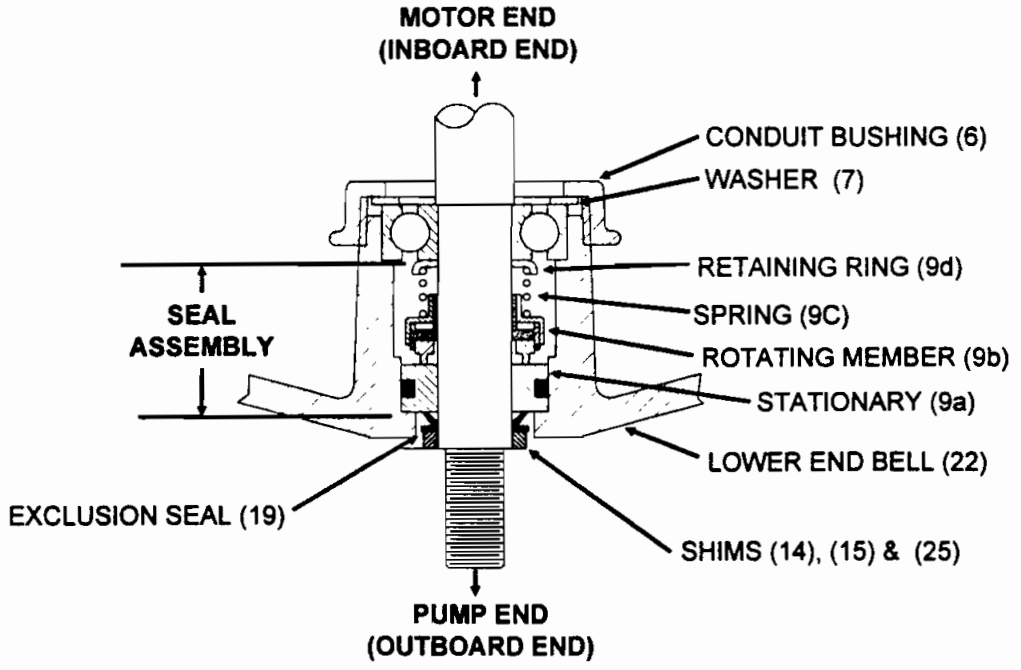


Fig. 4

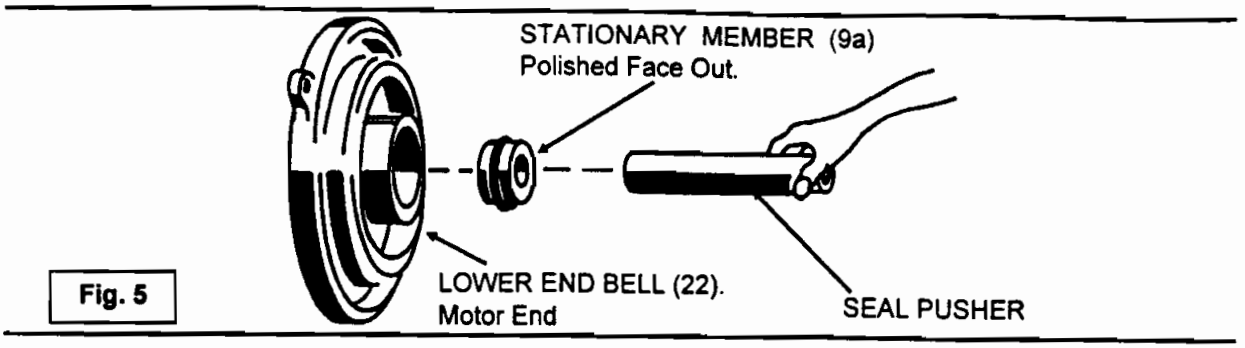


Fig. 5

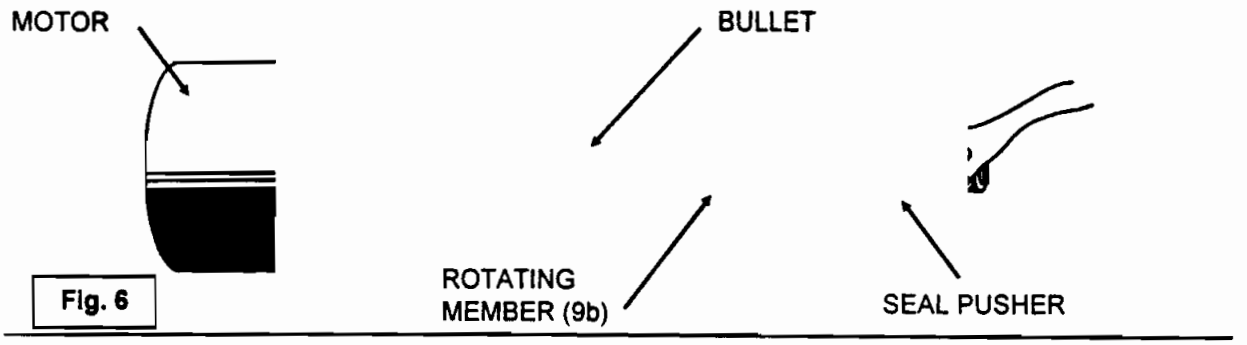


Fig. 6

IMPORTANT !
ALL PARTS MUST BE CLEAN BEFORE REASSEMBLY.

F-3.2) Reassembly:

Bearing- When replacing bearing, be careful not to damage the rotor or shaft threads. Clean the shaft thoroughly. Slide conduit bushing (6) and washer (7) over motor shaft. Apply adhesive compound to the shaft and press bearing (8) on the motor shaft, position squarely onto shaft applying force to the inner race of the bearing only, until bearing seats against shoulder of the shaft.

Seal- Clean and oil seal cavity in lower end bell (22). Press stationary member (9a) firmly into lower end bell (22), using a seal pusher (see parts list - seal tool kit), nothing but the seal pusher is to come in contact with seal face (see Figure 5). Make sure the stationary member is in straight.

IMPORTANT !
DO NOT HAMMER ON THE SEAL PUSHER- IT WILL DAMAGE THE SEAL FACE.

Slide retaining ring (9d) over shaft and let rest on bearing (8). Place spring (9c) over shaft and let rest on retaining ring (9d). Lightly oil (**DO NOT** use grease) shaft, bullet and inner surface of bellows on rotating member (9b), (see Figure 6), with lapped surface of rotating member (9b) facing outward, slide over bullet and onto shaft using seal pusher, making sure spring (9c) is seated in retaining ring (9d) and spring (9c) is lined up on rotating member (9b) and not cocked or resting on bellows tail.

IT IS EXTREMELY IMPORTANT TO KEEP SEAL FACES CLEAN DURING ASSEMBLY.
DIRT PARTICLES LODGED BETWEEN THESE FACES WILL CAUSE THE SEAL TO LEAK.

Motor- Slide motor rotor with conduit bushing (6), washer (7), bearing (8) and seal parts (9b, c, d) into lower end bell (22) until bearing (8) seats in lower end bell (22). Center washer (7) on bearing (8) and tighten conduit bushing (6) on lower end bell (22).

Lower motor stator over rotor until seated in lower end bell (22), while aligning holes for motor bolts. Insert motor bolts and torque to 17 inch pounds. If pump is a single phase unit place bracket (31) on one of the motor bolts. Insert capacitor (32) in bracket (31), attach motor leads with flag terminals to capacitor and place terminal boot (33) over terminals.

Set motor housing (3) next to motor (5) and lower end bell (22) assembly. Make wire connections per paragraph F-3.3. Set square ring (24) in groove on lower end bell (22) and lower motor housing (3) down onto lower end bell (22) while aligning holes. Place socket head cap screws (23) through lower end bell (22) into motor housing (3) and torque to 60 inch pounds. Assemble impeller and volute per paragraph F-2.2.

F-3.3) Wiring Connections:

Check power cable (28) and control cable (39) (if used), for cracks or damage and replace if required (see Figure 7). Place parts (28b, c & d) on power cable (28a), and parts (39b, c & d) on control cable (39a if equipped). Bring cord sets (28) and (39 if equipped) through openings in top of motor housing (3) and reconnect motor leads to power cable (28) and temperature sensor leads to control cable (39 if equipped) using connectors (4), and in addition use (34) and (35) for three phase units and temperature sensor leads, as shown in Figure 8. Attach ground wire to motor with screw (27).

F-3.4) Cable Assembly:

Power Cable- Make wire connections as outlined in paragraph F-3.3. Refill with cooling oil (if it has been drained) as outlined in paragraph F-1.3. Insert one friction ring (28c), grommet (28d), another friction ring (28c) into motor housing (3). Apply pipe sealant to gland nut (28b) and screw into motor housing (3). Torque gland nut (28b) to 15 ft. lbs. to prevent water leakage (see Figure 7).

Control Cable (Optional)- Insert one friction ring (39c), grommet (39d) and another friction ring (39c) into motor housing (3). Apply pipe sealant to gland nut (39b) and screw into motor housing (3). Torque gland nut (39b) to 15 ft. lbs. to prevent water leakage (see Figure 7).

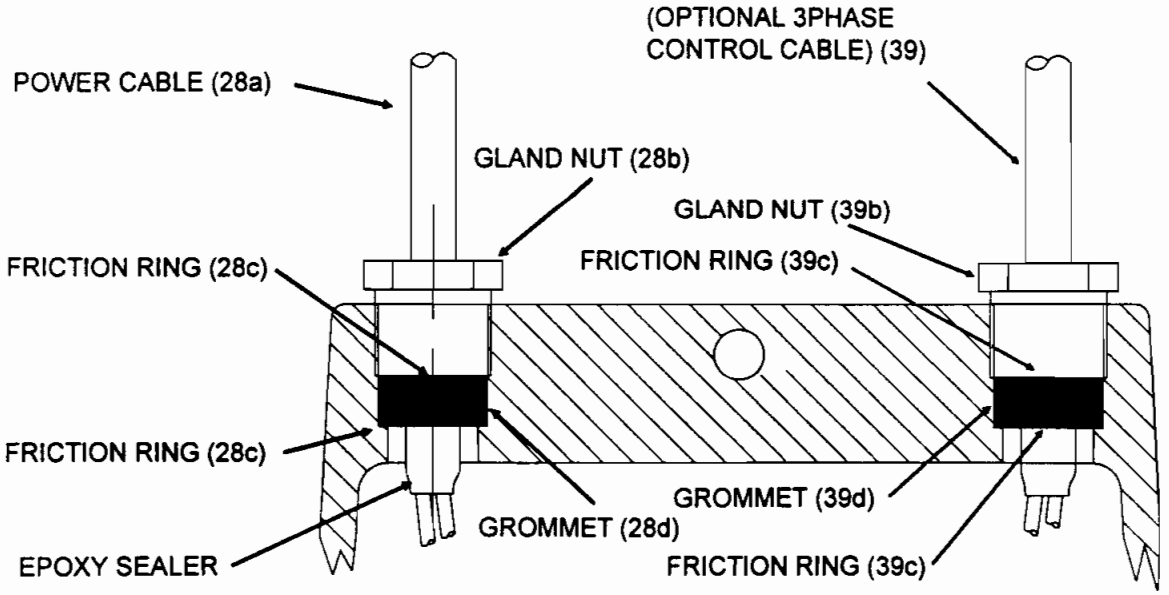
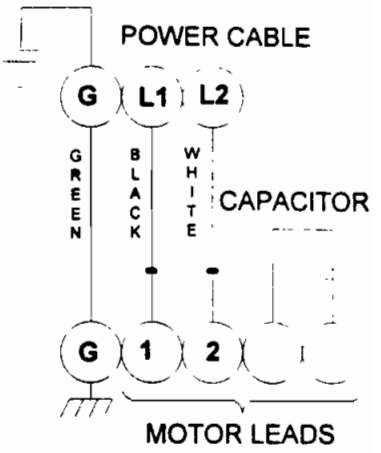


Fig. 7

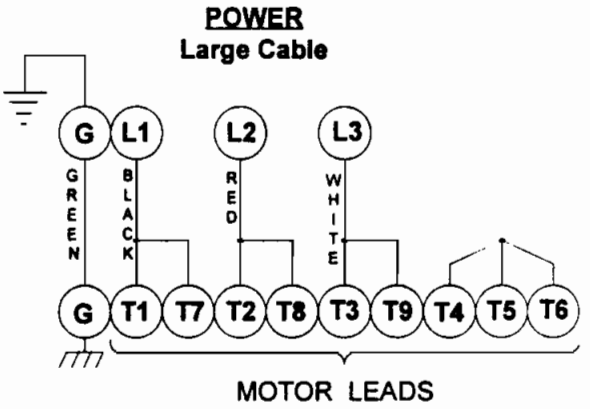
SINGLE PHASE,115/ 230 VOLT AC (PSC)

Power Cable (28a)	**Motor Lead Number**
Green (Ground)	Green
Black	1
White	2
Flag Terminal	Capacitor
Flag Terminal	Capacitor



THREE PHASE, 200/230 VOLT AC

Power Cable (28a)	**Motor Lead Number**
Green (Ground)	Green
Black	1 & 7
Red	2 & 8
White	3 & 9
	4, 5 & 6 Together



THREE PHASE, 460 VOLT AC

Power Cable (28a)	**Motor Lead Number**
Green (Ground)	Green
Black	1
Red	2
White	3
	4 & 7 Together
	5 & 8 Together
	6 & 9 Together

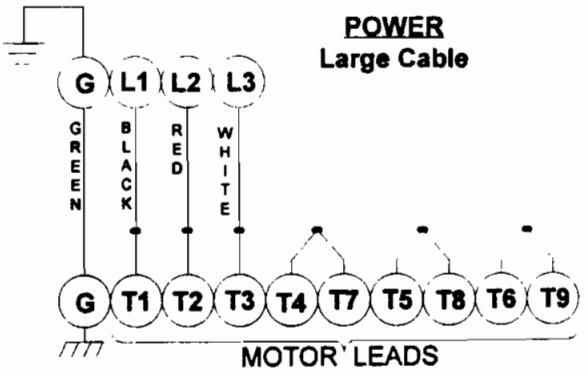
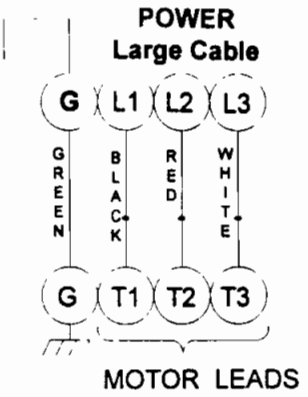


Fig. 8

THREE PHASE, 575 VOLT AC

Power Cable	Motor Lead Number
Green (Ground)	Green
White	3
Black	1
Red	2



TEMPERATURE SENSOR (Optional)

Control Cable (39a)	Lead Number
Black	P1 (Temperature Sensor)
White	P2 (Temperature Sensor)

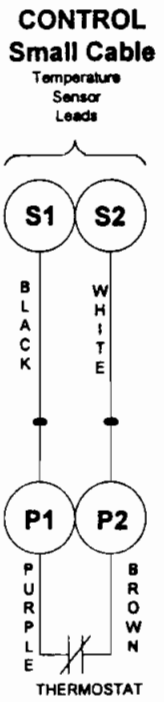


Fig. 7

TROUBLE SHOOTING

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

PROBLEM	CAUSE	CORRECTION
Pump will not run	**1.** Poor electrical connection, blown fuse, tripped breaker or other interruption of power; improper power supply. **2.** Motor or switch inoperative (to isolate cause, go to manual operation of pump). **2a.** Float movement restricted **2b.** Switch will not activate pump or is defective. **2c.** Defective motor. **3.** Insufficient liquid level.	**1.** Check all electrical connections for security. Have electrician measure current in motor leads, if current is within ±20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current. **2a.** Reposition pump or clean basin as required to provide adequate clearance for float. **2b.** Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch. **2c.** Replace per servicing instructions. **3.** Make sure liquid level is at least equal to suggested turn-on point. **4.** Recheck all sizing calculations to determine proper pump size. **5.** Check discharge line for restrictions, including ice if line passes through or into cold areas.
Pump will not turn off	**2a.** Float switch movement restricted. **2b.** Switch will not de-activate pump or is defective. **4.** Excessive inflow or pump not properly sized for application. **9.** Pump may be airlocked. **14.** Switch is in "HAND" position.	
Pump hums but doesn't run	**1.** Incorrect voltage. **8.** Impeller jammed or loose shaft, worn or damaged, impeller cavity or inlet plugged.	
Pump delivers insufficient capacity	**1.** Incorrect voltage. **4.** Excessive inflow or pump not properly sized for application. **5.** Discharge restricted. **6.** Check valve stuck closed or installed backwards. **7.** Shut-off valve closed. **8.** Impeller jammed, loose on shaft, worn or damaged,impeller cavity or inlet plugged. **9.** Pump may be airlocked. **10.** Pump running backwards.	

TROUBLE SHOOTING

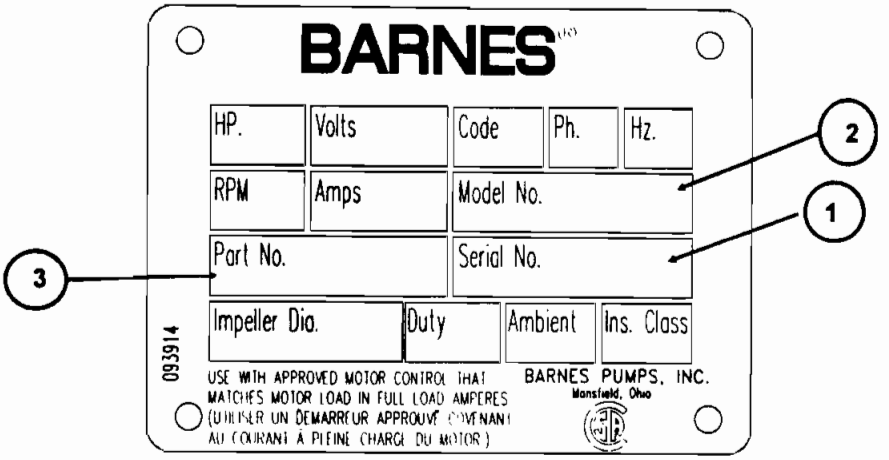
PROBLEM	CAUSE	CORRECTION
Pump cycles too frequently or runs periodically when fixtures are not in use.	**6.** Check valve not installed or leaking back into basin. **11.** Fixtures are leaking. **15.** Ground water entering basin.	**6.** Remove and examine check valve for proper installation and freedom of operation. **7.** Open valve.
Pump shuts off and turns on independent of switch. (trips thermal overload protector). **CAUTION !** Pump may start unexpectedly. Disconnect power supply.	**1.** Improper wiring or power supply. **4.** Discharge head less than minimum. **8.** Impeller jammed or rubbing. **12.** Excessive water temperature (internal protection only).	**8.** Check impeller for freedom of operation, security and condition. Clean impeller cavity and inlet of any obstruction. **9.** Loosen union slightly to allow trapped air to escape.Verify that turn-off level of switch is set so that impeller cavity is always flooded. Clean vent hole.
Pump operates noisily or vibrates excessively.	**2c.** Worn bearings, motor shaft bent. **8.** Debris in impeller cavity or broken impeller. **10.** Pump running backwards. **13.** Piping attachments to building structure too rigid or too loose.	**10.** Check rotation. If power supply is three phase, reverse any two of three power supply leads to ensure proper impeller rotation. **11.** Repair fixtures as required to eliminate leakage. **12.** Check pump temperature limits & fluid temperature. **13.** Replace portion of discharge pipe with flexible connector. **14.** Turn to automatic position. **15.** Check for leaks around basin inlet and outlets.

SECTION: G REPLACEMENT PARTS

G-1 ORDERING REPLACEMENT PARTS:

When ordering replacement parts, **ALWAYS** furnish the following information:

1. Pump serial number and date code. (G-4)
2. Pump model number. (G-3)
3. Pump part number.(G-2)
4. Part description.
5. Item part number.
6. Quantity required.
7. Shipping instructions.
8. Billing Instructions.



Name Plate Shown Is For CSA Listed Pumps Only

G-2 PART NUMBER:

The part number consist of a six (6) digit number, which appears in the catalog. A one or two letter suffix may follow this number to designate the design configuration. This number is used for ordering and obtaining information.

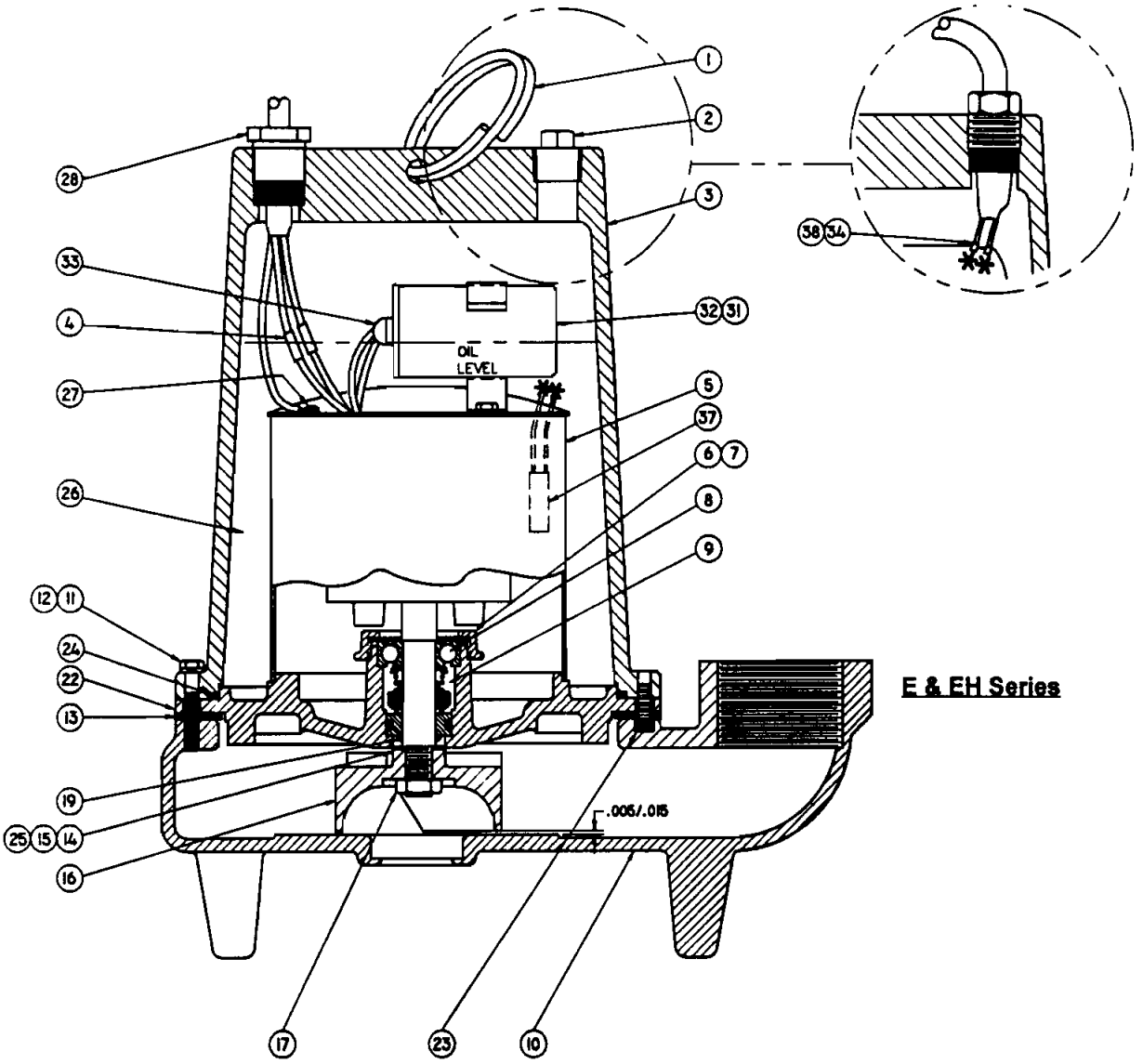
G-3 MODEL NUMBER:

This designation consist of numbers and letters which represents the discharge size, series horsepower, motor phase and voltage, speed and pump design. This number is used for ordering and obtaining information.

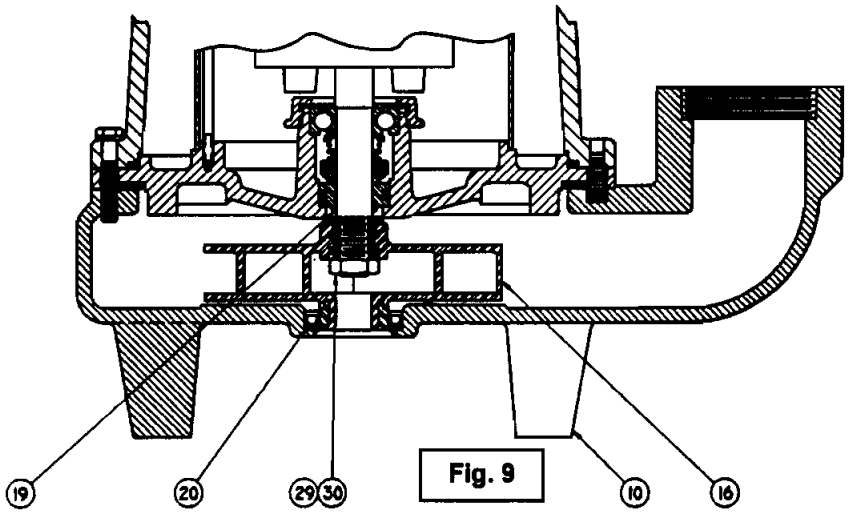
G-4 SERIAL NUMBER:

The Serial Number block will consist of a six digit number, which is specific to each pump and may be preceded by a alpha character, which indicates the plant location. This number will also be suffixed with a four digit number, which indicates the date the unit was built (Date Code).
EXAMPLE: A012345 0490.

Reference the six digit portion (Serial Number) of this number when referring to the product.

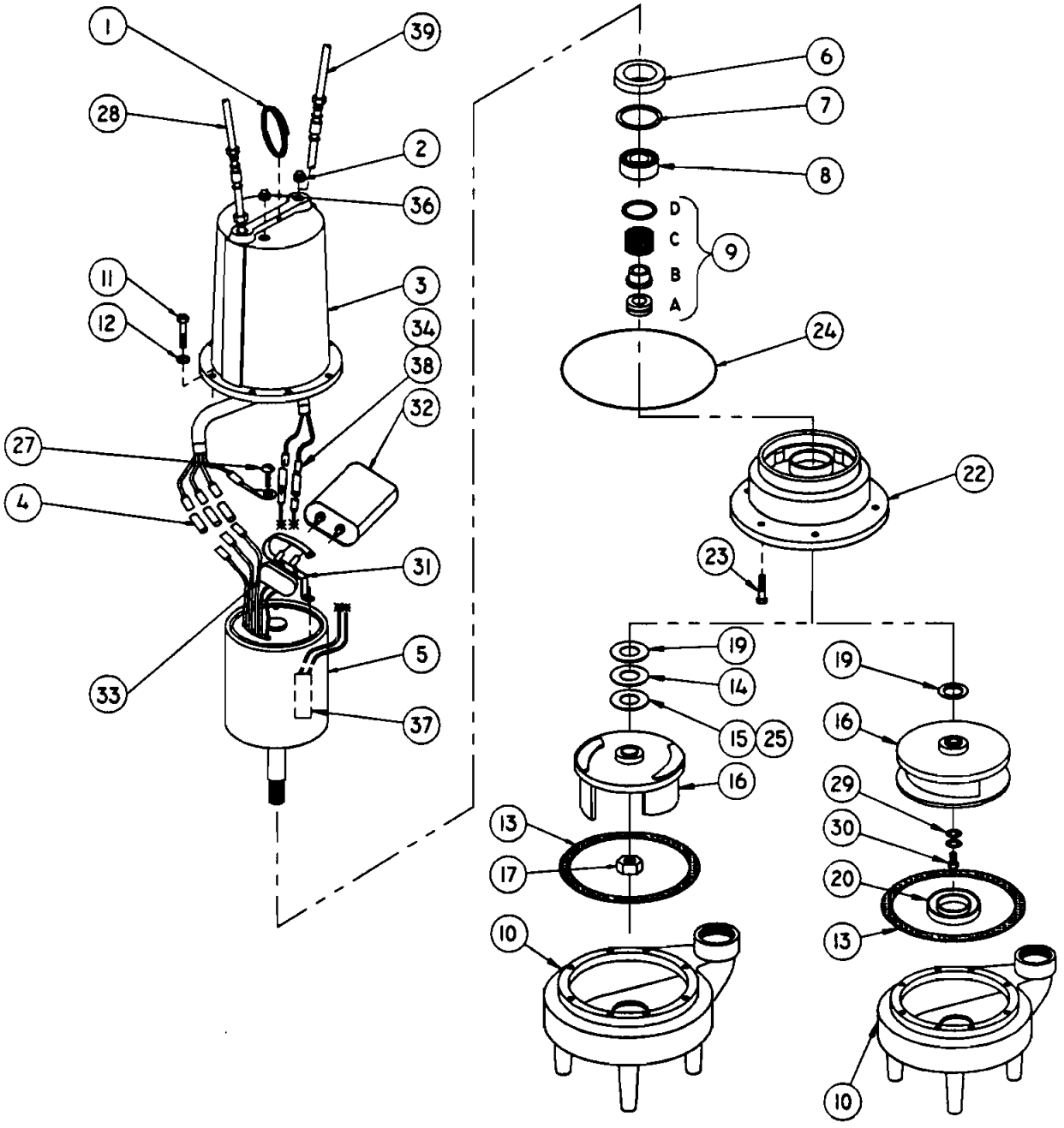


E & EH Series



H Series ONLY.

Fig. 9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E & EH Series.
H Series ONLY.

Fig. 10

PARTS KIT

Seal Repair Kit (EH)...P/N-085204 (†) 9,11,12,13,14,15,17,19,23,24,25,28D.

Overhaul Kit (EH).....P/N-085207 (✧) 2,6,7,8,9,11,12,13,14,15,17,19,23,24,25,28D,34,35,38.

Seal Tool Kit.....T/L-21355

Pressure Gauge Kit...P/N-085343

PARTS LIST

ITEM	QTY.		DESCRIPTION			PART NO.
1	1		Handle	3" OD Stainless		027271
2	2	✧	Pipe Plug			003204
3	1		Motor Housing, No Sensor (STD)			051538
	1		Motor Housing for Temp. Sensor (OPTIONAL)			051538HA
4	2		Terminal Connector	0.5HP, 1Phase		026880
	4		Wire Connector, Screw-On	230/3 Phase		055844
	3		Terminal Connector	460/3 Phase		026880
	3		Wire Connector, Screw-On	460/3 Phase		055844
	3		Terminal Connector	460/3 Phase		067491
	2		Terminal Connector	1HP, 230/ 1 Phase		079318
5	1		Motor	E512L, EH512L		068926
				E522L, EH522L		068927
				E532L, E542L,EH532L, EH542L		067462
				EH552L		088592
				E552L		088583
				E1022L, EH1022L		068928
				E1032L & 1042L,EH1032L &1042L		071355
				E1052L, EH1052L		067463F
				H512L		088596
				H522L,H1022L		088602
				H532L & 542L, H1032L & 1042L		088605
				H552L, H1052L		088607
6	1	✧	Conduit Bushing			035601
7	1	✧	Washer			084263
8	1	✧	Bearing			017414
9	1	†✧	Shaft Seal	Carbon/Ceramic/Buna-N		023701
				Tungsten/Tungsten/Buna-N		023701SB
				Silicon/Silicon/Buna-N		023701SD
				Carbon/Ceramic/Viton		023701SF
				Tungsten/Tungsten/Viton		023701SH
				Silicon/Silicon/Viton		023701SK
				Silicon/Tungsten/Buna-N		023701SM
				Carbon/Ni-Resist/Buna-N		023701SN
				Carbon/Ni-Resist/Neoprene		023701SP
10	1		Volute, H & EH Series			068540
	1		Volute w/Moveable Fitting, EH Series, (OPTIONAL)			079157E
	1		Volute, E Series			064416
11	4	†✧	Cap Screw	5/16-18 x 1-1/4" Lg Stainless		1-131-1
12	4	†✧	Lockwasher	5/16 Stainless		026322
13	1	†✧	Gasket			027344
14	A/R	†✧	Shim			017837
15	A/R	†✧	Shim	.005" Thk. x .875 OD		017109
16	1		Impeller, Cast Iron, E Series	3.90" Dia.	(1HP)	069100
			Impeller, Cast Iron, E Series	3.43" Dia.	(0.5HP)	060510

16	1		Impeller, Polypropylene, H Series	5.25" Dia.	(1HP)	064101
				5.12" Dia.		064101TA
				5.00" Dia.		064101TB
				4.88" Dia.		064101TC
				4.75" Dia.		064101TD
				4.62" Dia.	(0.5HP)	064101TE
				4.50" Dia.		064101TF
				4.38" Dia.		064101TG
				4.25" Dia.		064101TH
				4.12" Dia.		064101TJ
				4.00" Dia.		064101TK
16	1		Impeller, Bronze, EH Series	4.62" Dia.	(1HP)	068564
				4.50" Dia.		068564TA
				4.38" Dia.		068564TB
				4.25" Dia.		068564TC
				4.12" Dia.		068564TD
				4.00" Dia.	(0.5HP)	068564TE
				3.88" Dia.		068564TF
				3.75" Dia.		068564TG
				3.62" Dia.		068564TH
				3.50" Dia.		068564TJ
17	1	†◇	Jam Nut	1/2-20 Stainless		030068
19	1	†◇	Exclusion Seal			056789
20	1		U-Cup			066908
22	1		Lower End Bell			026205
23	2	†◇	Cap Screw	1/4-20 x 5/8" Lg Stainless		11-29-1
24	1	†◇	Square Ring			027269
25	A/R	†◇	Shim	.010" Thk. x .875 OD		017064
26	4-3/4 Qts.		Oil			029034
27	1		Ground Screw	#6-32 x 3/8"LG Zinc Plt. St.		038156
28	1		Cord Set Assembly			**See Table 2**

TABLE 2 - CABLE SETS

MODELS/ LENGTH	ITEM # 28 115V 1 PHASE CSA LISTED	ITEM # 28 230V 1 PHASE CSA LISTED	ITEM # 28 3 PHASE Non CSA LISTED	ITEM # 28 (OPTIONAL) 3 PHASE CSA LISTED	ITEM # 39 (OPTIONAL) TEMP. SENSOR 3 PHASE ONLY.
15 Ft. (STD)	091563	093291	051545		071769
25 Ft.	091563XB	093291XB	051545XB		071769XB
30 Ft.	091563XC	093291XC	051545XC		071769XC
40 Ft.	091563XE	093291XE	051545XE		071769XE
50 Ft.	091563XF	093291XF	051545XF		071769XF
75 Ft.	091563XJ	093291XJ	051545XJ		071769XJ
100 Ft.	091563XL	093291XL	051545XL		071769XL
125 Ft.	091563XP	093291XP	051545XP		071769XP
150 Ft.	091563XS	093291XS	051545XS		071769XS
175 Ft.	091563XV	093291XV	051545XV		071769XV
200 Ft.	091563XY	093291XY	051545XY		071769XY

28a	1	*	Cord Set	(Not Sold Separately)	
28b	1	*	Gland Nut	1 Phase	051762
	1	*	Gland Nut	3 Phase	051448
28c	2	*	Friction Ring	1 Phase	021531
	2	*	Friction Ring	3 Phase	051449
28d	1	*†✧	Grommet	1 Phase	051764
		*†✧	Grommet	3 Phase	051451
29	1		Flat Washer, H Series	#10 Stainless	20-4-1
30	1		Cap Screw, H Series	10-24 x .50"Lg. Stainless	1-336-1
31	1		Bracket	1 Phase	039858
32	1		Capacitor, E & H Series	1 Phase - 370V 20MFD	070963
			Capacitor, EH Series	1 Phase - 370V 25MFD	070965
33	1		Terminal Boot	1 Phase	034322
34	2	✧	Terminal Connector	3 Phase	071363
35	1	✧	Terminal Connector	200-230 3Phase	019212
	3		Terminal Connector	460 3 phase	019212
36	1		Pipe Plug		003217
37	1		Temperature Sensor	**(OPTIONAL)**	051621
38	2	✧	Terminal Connector	Optional Temp. Sensor	079318
39	1		Cord Set Assembly	Optional Temp. Sensor	**See Table 2**
39a	1	*	Cord Set	(Not Sold Separately)	
39b	1	*	Gland Nut		051448
39c	2	*	Friction Ring		051449
39d	1	*	Grommet		051451

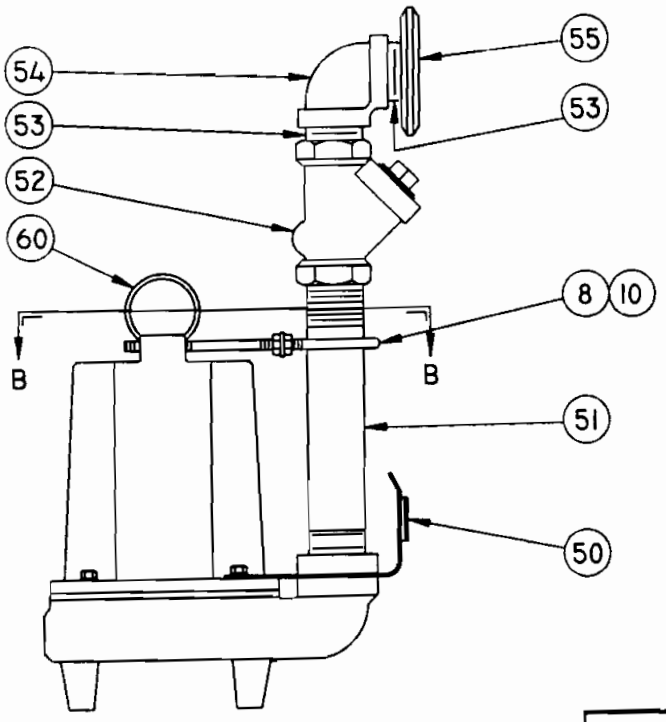
* Included with Item 28 or 39.

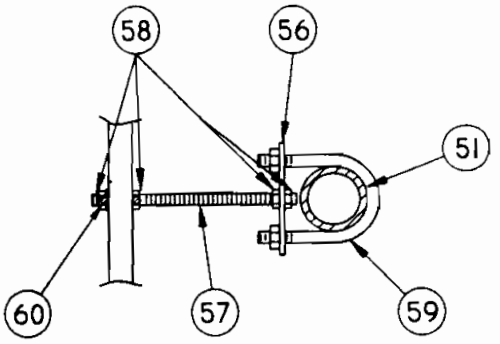
MOVEABLE ASSEMBLY
For Basin Package

PARTS LIST
For 079157E*, E, H & EH Pumps

ITEM	QTY.	DESCRIPTION		PART No.
50	1	Lower Pump Bracket, Stainless		075287
51	1	Pipe, Stainless	2" NPT x 12" Lg. Stainless	075275D
52	1	Ball Check Valve, Cast Iron	2" NPT	077882
53	2	Close Nipple, Stainless	2" NPT	075478
54	1	Elbow, Stainless	2" NPT x 90°	075483
55	1	Moveable Fitting, Cast Iron		074536
56	1	Upper Pump Bracket, Stainless		075284
57	1	Threaded Rod, Stainless	3/8" x 6" Lg.	075288
58	4	Hex Nut	3/8 -16 Stainless	018927
59	1	U-Bolt and Nuts, Stainless	3/8-16 x 2.62" Lg.	075276
60	1	Lifting Bracket, Stainless		075285

* Pump **NOT** included under this part number. The Moveable Assembly will be factory assembled to pump when a Basin Package system is ordered.





SECTION B-B

Fig. 11

IMPORTANT !
WARRANTY REGISTRATION

Your pump is covered by the enclosed Warranty. This warranty is ONLY effective provided the warranty registration is completed and returned to the Barnes® Pumps, Inc. service department.

IMPORTANT! If you have a claim under the provision of the warranty, contact your local Barnes Pumps, Inc. Distributor.

WARNING !

Products Returned Must Be Cleaned, Sanitized, Or Decontaminated As Necessary Prior To Shipment, To Insure That Employees Will Not Be Exposed To Health Hazards In Handling Said Material. All Applicable Laws And Regulations Shall Apply.

RETURNED GOODS POLICY

RETURN OF MERCHANDISE REQUIRES A "RETURNED GOODS AUTHORIZATION". CALL THE FACTORY SERVICE MANAGER, (513) 773-2442 FOR RGA NUMBER.

RETURN OF EQUIPMENT: No equipment shall be returned to us without first obtaining a written Returned Goods Authorization and shipping instructions from us. The returner must prepay the charges in full for transportation to our factory. Credit allowed for new, undamaged equipment of current standard design will be 80% of the invoiced price or current billing price, whichever is less. Equipment which has been used, however slight, will not be accepted.

Authorization will not be given for return of equipment,
(1) which would, in our opinion, result in an excess in the amount of stock we normally carry,
(2) not invoiced within the last 12 months, or
(3) which is non-standard and manufactured specifically to a buyer's specifications. For non-standard equipment not of our manufacture, the only credit allowed will be such credit as may be allowed by the manufacturer of such equipment.

Equipment must be returned within 30 days of the issuance of the Returned Goods Authorization. No item with a net value of less than $35.00 will be authorized for return. Unauthorized returns may be refused and\or returned freight collect.

BARNES®

Limited Warranty

We warrant to our immediate customer and to the ultimate consumer that products of our manufacture will be free of defects in material and workmanship under normal use and service for the following time periods, when installed and maintained in accordance with our instructions.

Pump Products: One (1) year from date of installation or (24) twenty-four months from date of shipment, whichever occurs first. Cleaning Products: Twelve (12) months from date of installation or eighteen (18) months from date of shipment, whichever occurs first. As used herein, "the ultimate consumer" is defined as the purchaser who first uses the product after its initial installation or, in the case of product designed for non permanent installation, the first owner who used the product. It is the purchaser's or any sub-vendee's obligation to make known to the ultimate consumer the terms and conditions of this warranty. This warranty gives you specific legal rights, and there may also be other rights which vary from state to state. In the event the product is covered by the Federal Consumer Product Warranties Law (1) the duration of any implied warranties associated with the product by virtue of said law is limited to the same duration as stated herein, (2) this warranty is a LIMITED WARRANTY, and (3) no claims of any nature whatsoever shall be made against us, until the ultimate consumer, his successor, or assigns, notifies us in writing of the defect, and delivers the product and/or defective part(s) freight prepaid to our factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply. **THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY AND ALL WARRANTIES WITH RESPECT TO ANY PRODUCT SHALL BE TO REPLACE OR REPAIR AT OUR ELECTION, F.O.B. POINT OF MANUFACTURE OR AUTHORIZED REPAIR STATION, SUCH PRODUCTS AND/OR PARTS AS PROVEN DEFECTIVE. THERE SHALL BE NO FURTHER LIABILITY, WHETHER BASED ON WARRANTY, NEGLIGENCE OR OTHERWISE.** Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by us, if any, are subject to laboratory tests corrected for field performance. Any additional guarantees, in the nature of performance specifications must be in writing and such writing must be signed by our authorized representative. Due to inaccuracies in field testing if a conflict arises between the results of field testing conducted by or for user, and laboratory tests corrected for field performance, the latter shall control. Components or accessories supplied by us but manufactured by others are warranted only to the extent of and by the terms and conditions of the original manufacturer's warranty. **RECOMMENDATIONS FOR SPECIAL APPLICATIONS OR THOSE RESULTING FROM SYSTEMS ANALYSES AND EVALUATIONS WE CONDUCT WILL BE BASED ON OUR BEST AVAILABLE EXPERIENCE AND PUBLISHED INDUSTRY INFORMATION. SUCH RECOMMENDATIONS DO NOT CONSTITUTE A WARRANTY OF SATISFACTORY PERFORMANCE AND NO SUCH WARRANTY IS GIVEN.**

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage (c) lightning (d) sand or other abrasive material (e) scale or corrosion build-up due to excessive chemical content. Any modification of the original equipment will also void the warranty. We will not be responsible for loss, damage or labor cost due to interruption of service caused by defective parts. Neither will we accept charges incurred by others without our prior written approval.

This warranty is void if our inspection reveals the product was used in a manner inconsistent with normal industry practice and\or our specific recommendations. The purchaser is responsible for communication of all necessary information regarding the application and use of the product. **UNDER NO CIRCUMSTANCES WILL WE BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOST PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND\OR WORKMANSHIP AND\OR DAMAGE OR DELAYS IN SHIPMENT. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

No rights extended under this warranty shall be assigned to any other person, whether by operation of law or otherwise, without our prior written approval.

BARNES PUMPS, INC. 420 Third Street. P.O. Box 603 • Piqua, Ohio 45356-0603

START-UP REPORT
FOR SUBMERSIBLE PUMPS

This report is designed to insure the customer that customer service and a quality product are the number one priority with Barnes® Pumps, Inc. Please answer the following questions completely and as accurately as possible. Mail this form to:

BARNES PUMPS, INC.
PARTS & SERVICE DEPT.
420 THIRD ST.
P.O. BOX 603
PIQUA, OHIO 45356-0603 U.S.A.
ATTN: SERVICE MANAGER

REPORTS THAT ARE NOT RETURNED CAN DELAY OR VOID WARRANTY.

1) Pump Owner's Name _____
Address _____
Location of Installation _____
Person in Charge _____ Phone _____
Purchased From (Barnes Pumps' Representative/Distributor) _____

2) Barnes Pumps Model _____ Serial No. _____
Part Number _____
Voltage _____ Phase _____ Hertz _____ Horespower _____
Rotation: Direction of Impeller Rotation (Use C/W for clockwise, CC/W for counter-clockwise) _____
Method Used to Check Rotation (viewed from bottom) _____
Does Impeller Turn Freely By Hand _____ YES _____ NO

3) Condition Of Equipment _____ GOOD _____ FAIR _____ POOR
Condition Of Cable Jacket _____ GOOD _____ FAIR _____ POOR
Resistance of Cable Jacket _____ GOOD _____ FAIR _____ POOR
Resistance of Cable and Pump Motor (measured at pump control)
Red-Black _____ Ohms, Red-White _____ Ohms, White-Black _____ Ohms
Resistance Of Ground Circuit Between Control Panel and Outside of Pump _____ Ohms
MEG Ohms Check of Insulation:
Red to Ground _____ White to Ground _____ Black to Ground _____

4) Condition of Equipment At Start-Up: Dry _____ Wet _____ Muddy _____
Was Equipment Stored: _____ Length of Storage: _____
Describe Station Layout _____

5) Liquid Being Pumped _____
Debris In Bottom of Station? _____
Was Debris Removed In Your Presence? _____
Are Guide Rails Exactly Vertical? _____
Is BAF Stationary Installed Level? _____

6) Liquid Level Controls: Model _____
Is Control Installed Away From Turbulence _____
Operation Check:
Tip Lowest Float (stop float), All Pumps Should Remain Off.
Tip Second Float (and stop float), One Pump Comes On.
Tip Third Float (and stop float), Both Pumps On (alarm on simplex).
Tip Fourth Float (and stop float), High Level Alarm On (omit on simplex).

If not Barnes level controls, describe type of controls _____
Does liquid level ever drop below volute top? _____

7) Barnes Pumps Control Panel Part No._____
Number of Pumps Operated By Control Panel _____
NOTE: At no time should holes be made in top of control panel, unless proper sealing devices are utilized.
Control Panel Manufactured By Others:_____
Company Name _____
Model No. _____
Short Circuit Protection _____ Type_____
Number and Size of Short Circuit Device(s) _____ Amp Rating _____
Overload Type_____ Size _____ Amp Rating _____
Do Protective Devices Comply With Pump and Motor Amp Rating _____
Are All Contections Tight? _____
Is The Interior of The Panel Dry? _____

8) Electrical Readings:
Single Phase:
Voltage Supply at Panel Line Connection, Pump Off, L1, L2 _____
Voltage Supply at Panel Line Connection, Pump On, L1, L2 _____
Amperage: Load Connection, Pump On, L1_____ L2 _____
Three Phase:
Voltage Supply at Panel Line Connection, Pump Off, L1-L2 _____ L2-L3 _____ L3-L1 _____
Voltage Supply at Panel Line Connection, Pump On, L1-L2 _____ L2-L3 _____ L3-L1 _____
Amperage, Load Connection, Pump On, L1_____ L2 _____ L3 _____

9) Final Check:
Is Pump Seated On Discharge Properly?_____ Check for Leaks?_____
Does Check Valves Operate Properly?_____
Flow; Does Station Appear To Operate At Proper Rate _____ Pump Down Time _____
Noise Level: High_____ Medium _____ Low _____
Comments: _____

10) Equipment Difficulties During Start-Up:_____
_____
_____
_____

11) Manuals:
Has Operator Received Pump Instructions and Parts Manual? _____
Has Operator Received Electrical Control Panel Diagram?_____
Has Operator Been Briefed On Warranty?_____
Address of Local Barnes Pumps Representative/Distributor _____
_____
_____

12) I Have Received The Above Information (Name of Operator) _____
Name of Company _____
_____
_____ Date _____

I Certify This Report To Be Accurate (Name of Start-Up Person) _____
(Employed By) _____
_____ Date _____

Date and Time of Start-Up _____
Present At Start-Up:
( ) Engineer _____ ( ) Operator_____
( ) Contractor _____ ( ) Other_____

IMPORTANT !
WARRANTY REGISTRATION

Your pump is covered by the enclosed Warranty. This warranty is ONLY effective provided the warranty registration is completed and returned to the Barnes Pumps, Inc. service department. Review the form below and fill in all information.

IMPORTANT! If you have a claim under the provision of the warranty, contact your local Barnes Pumps, Inc. Distributor.

FOLD HERE

**** IMPORTANT ! ****

THIS FORM MUST BE RETURNED TO VALIDATE THE WARRANTY

WARRANTY REGISTRATION

CUSTOMER'S NAME _____ **DATE INSTALLED** _____

ADDRESS _____

CITY _____ **STATE** _____ **ZIP** _____

PHONE # _____ **FAX #** _____

DEALER'S NAME _____

CITY _____ **STATE** _____ **ZIP** _____

PUMP MODEL NO. _____ **SERIAL NO.** _____ **VOLTAGE** _____

PART NO. _____

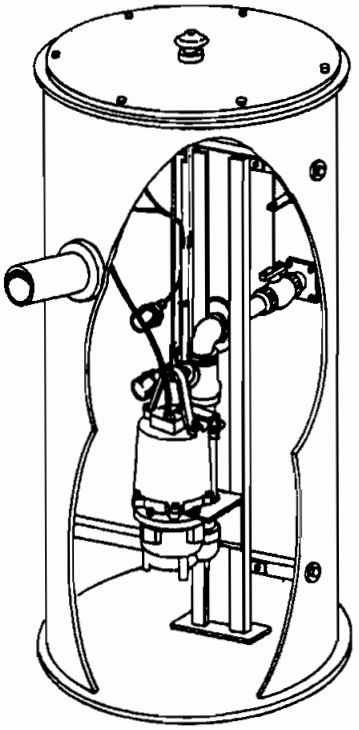
FOLD HERE AND TAPE, DO NOT STAPLE

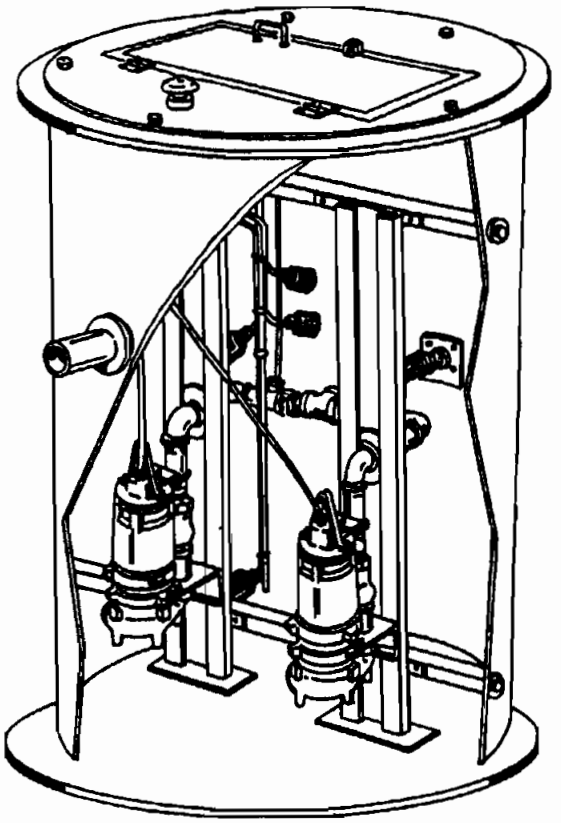
PLACE
STAMP
HERE

BARNES PUMPS, INC.
SERVICE DEPARTMENT
420 THIRD STREET
P.O. BOX 603
PIQUA, OHIO
45356-0603 - U.S.A.

BARNES®

INSTALLATION MANUAL
Package System with
Float Switches & Direct Burial Cable





Underwriters Laboratories Inc ®
File No. E151564

IMPORTANT Read all instructions in this manual before operating pump
As a result of Barnes Pumps constant product improvement program, product changes may occur. As such Barnes Pumps reserves the right to change product without prior written notification.

CRANE

PUMPS & SYSTEMS

Barnes Pumps, Inc.
420 Third Street/P.O. Box 603
Piqua, Ohio 45356-0603
Phone: (513) 773-2442
Fax: (513) 773-2238

Submersible Wastewater Pump Association SWPA MEMBER

Form No. 088314-0195

TABLE OF CONTENTS

REVISION DATES: 0493, 0194, 0195

SECTION A: GENERAL INFORMATION

A-1) RECEIVING:

Upon receiving the Basin Package System, it should be inspected for damage or shortages. **If damage has occurred, file a claim immediately with the company that delivered the basin package.**

A-2) STORAGE:

If Basin Packages are going to be stored make sure all outside openings are sealed, i.e. discharge coupling, electrical coupling (if equipped), etc., also secure access door or basin cover.

A-3) SERVICE CENTERS:

For the location of the nearest Barnes® Pumps Service Center, check your catalog, your Barnes Pumps, Inc. representative or Barnes Pumps, Inc. Service Department in Piqua, Ohio, telephone (513) 773-2442.

A-4) UNPACKAGING:

Before installing Basin Package remove the tape from all outside openings, discharge coupling, electrical inlet (if equipped), etc. Remove basin cover on simplex or open access door on duplex units being careful not to damage gasket, to unpackage anything that was secured for shipment.

A-5) LOCATION:

This basin system is intended for use with water, sewage and effluent applications. The standard basin is vented, any alterations from the standard must be in accordance with local codes. This basin system is not to be installed in locations in which the basin interior would be classified as a **HAZARDOUS** location in accordance with NEC ANSI/NFPA 70-1984.

SECTION B: INSTALLATION:

B-1) BEDDING:

Prepare the hole to the proper depth. Add and level bedding of sand, select aggregate (pea gravel - See Gravel Specifications) of 4 to 6 inches or concrete pad or a concrete donut shall be laid before basin is lowered into the ground. The aggregate must conform to the bottom of the basin and reach a compaction of 85% Standard Proctor Density. See Figure 1.

GRAVEL SPECIFICATION:

1. A naturally rounded aggregate is required, clean and free flowing with particle size not less than 1/8"or more than 3/4" in diameter. Use this description when specifying or ordering because material is known by different names in different areas. This material is commonly called pea gravel.
2. Stone or gravel crushing with angular particle size not less than 1/8" or more than 1/2" diameter washed and free flowing is acceptable as an alternate material. This material must meet ASTM C-33 paragraph 9.1 requirements for quality and soundness.

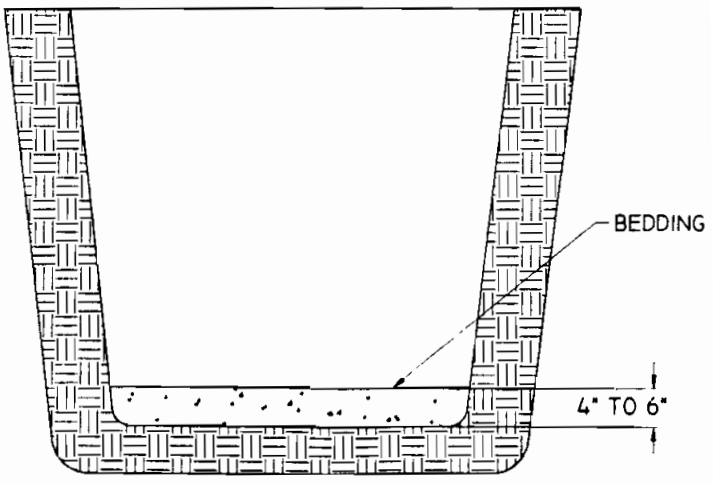


Figure 1

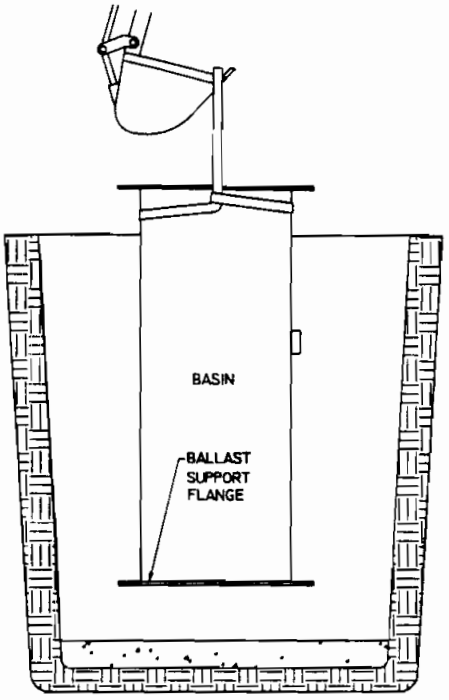


Figure 2

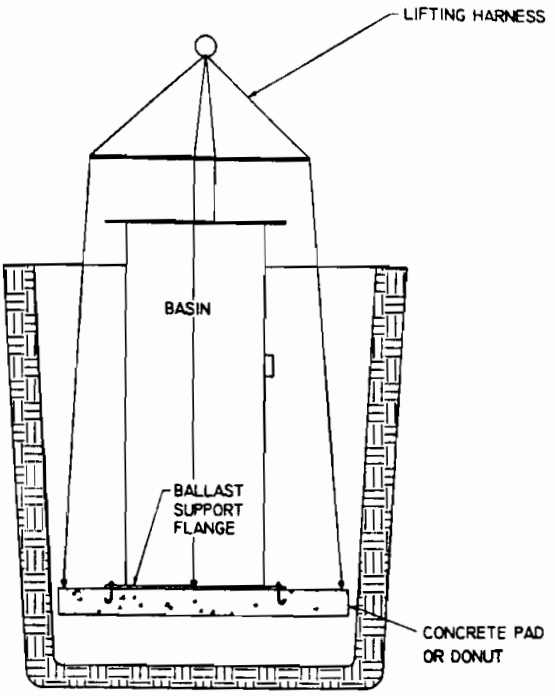


Figure 3

B-2) PLACING STATION INTO HOLE:

Lifting the basin system, into place be done with a cloth or nylon type strap around basin or by a lifting harness connected to eyebolts that are set into the concrete pad that is connected to basin by anchor bolts. Never use chain or cable type lifting device around outer basin. This can and may create a fracture in the fiberglass, See Figures 2 and 3.

Lower the basin, centering into the hole. A minimum clearance of 4 to 6 inches should be maintained between the tank wall and the surrounding earth. All OSHA procedures should be followed regarding installation of basin. The basin must be leveled after placement. At this time anchor the basin to the concrete pad if required by specifications.

B-3) LOCATING & INSTALLING INLET AND DISCHARGE:

B-3.1) Adapt-A-Flex® INLET:

The Adapt-A-Flex fitting for the inlet must be installed.

1. Find the location where the center of the coupling will be positioned on basin. Consult specifications for this location.
2. Using a hole saw, cut the hole in the basin. Refer to the chart below for hole size.
3. Install Adapt-A-Flex fitting in the opening. See Figure 4.

Adapt-A-Flex Size	Hole Size
1-1/4	3"
1-1/2	3"
2	3"
3	4"
4	5"
6	7"

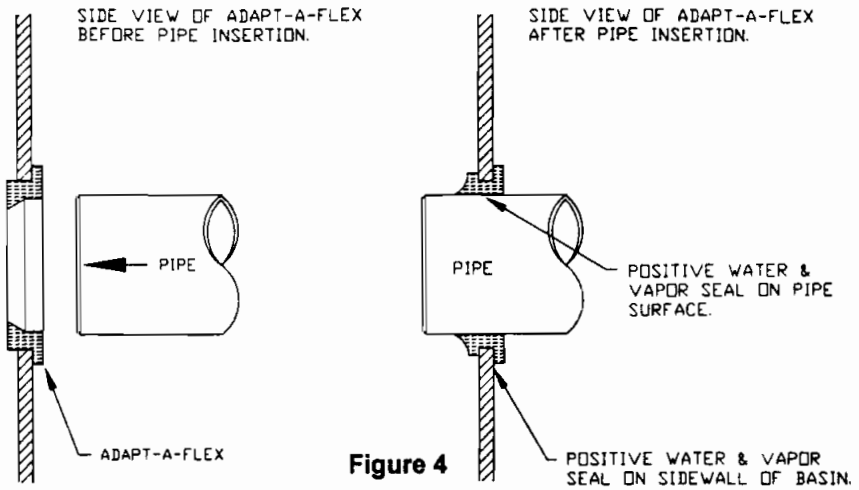


Figure 4

NOTE: Schedule 40 and SDR35 pipe require different sizes of Adapt-A-Flex fittings. Check to be sure the inlet pipe matches the Adapt-A-Flex fitting supplied.

All discharge and inlet lines should now be connected. To install the inlet pipe into the Adapt-A-Flex fitting, chamfer the end and lube the pipe with soapy water for ease of installation, see Figure 4. An **OPTIONAL** Adapter or Caulking hub may be used in place of the Adapt-A-Flex fitting, see Sections B-3.2 and B-3.3.

B-3.2) FLANGE ADAPTER INLET, (OPTIONAL):

The plastic flange adapters are used with schedule 40 pipe, to install, (See Figure 5)

1. Find the location where the center of the coupling will be positioned on basin. Consult specifications for this location.
2. Using a hole saw, cut the hole in the basin to accept the back (the portion that will be going inside the basin), outside diameter of the flange adapter.
3. Place flange adapter on basin wall and drill mounting holes in basin wall to match flange adapter base.
4. Apply gasket to back of plate, and mount plate on basin.
5. Insert bolts, washers and nuts through basin wall into adapter base, and tighten.
6. Remove flange and o-ring from adapter and place over pipe.
7. Insert pipe through base and align flange to bolts on base.
8. Tighten bolts for seal.

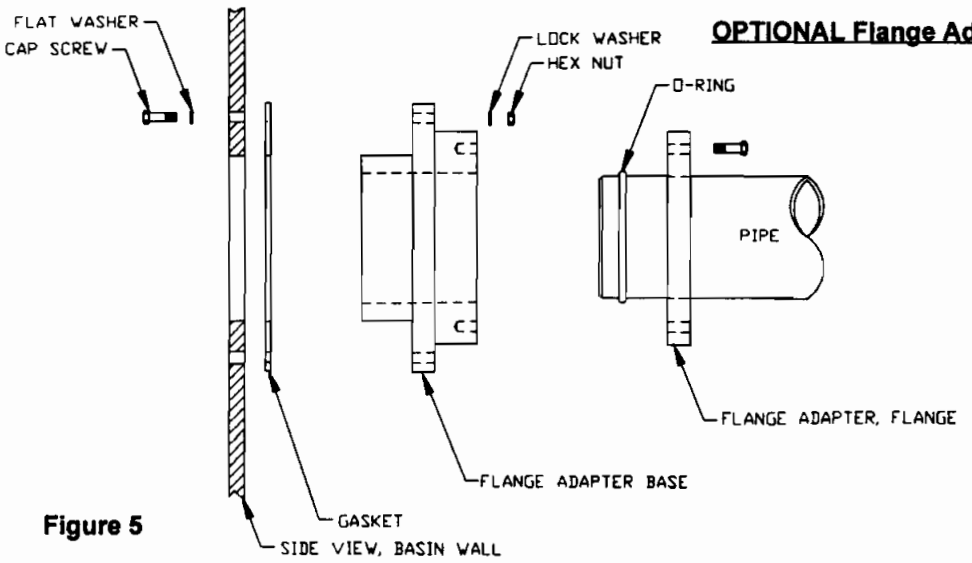


Figure 5

B-3.3) CAULKING HUB INLET, (OPTIONAL):

The hubs can be used with schedule 40 pipe, to install, (See Figure 6)

1. First locate where the inlet will be. Consult specifications for this location.
2. Using a hole saw, cut the hole in the basin to the inside diameter of the hub.
3. Place hub on basin wall and drill mounting holes in basin.
4. Apply gasket to back of hub, and mount hub on basin.
5. Insert bolts, washers and nuts through basin wall and hub, and tighten.
6. Insert pipe into hub and caulk.

OPTIONAL Cualking Hub:

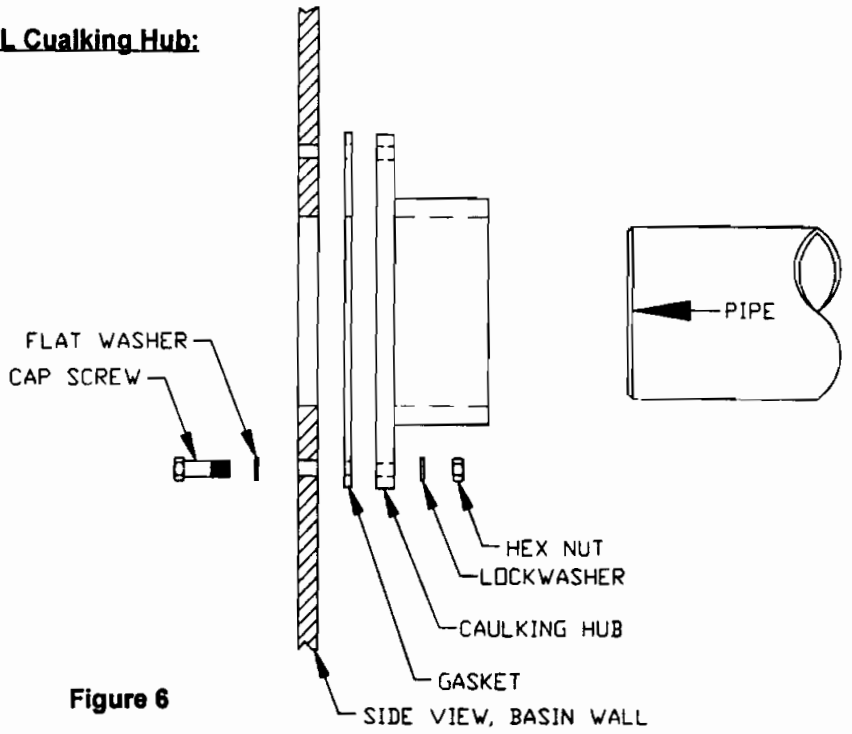


Figure 6

Next locate and mount electrical control panel, and run cable to the basin package.

CAUTION !

All model pumps and control panels must be properly connected and properly grounded per the National Electrical Code, state, and local codes. Improper grounding voids warranty.

NOTE: A proper motor controller must be provided that is compatible with the pump (s) being installed. (Motor Controller is part of control panel when factory supplied.)

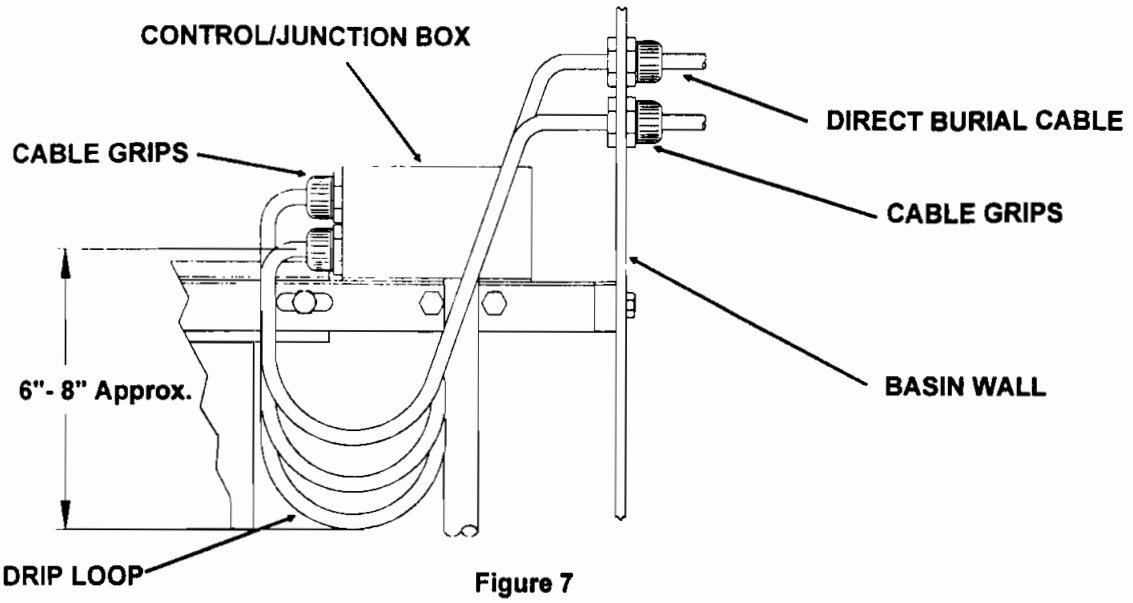


Figure 7

B-4) BACKFILLING & INCOMING CABLE LOCATION:

B-4.1) Direct Burial Cable with Cable Grips:

Backfill and compact to a convenient level to work around top of basin. Locate and drill 7/8" diameter holes for the Direct Burial cable grips in the basin wall. Feed the direct burial cable through the cable grips and into the junction box and tighten the grips on the box and the basin. It is important to leave enough cable slack between the junction box and basin wall to form a drip loop (See Figures 7).

B-4.2) Direct Burial Cable with Conduit Coupling:

Backfill and compact to a convenient level to work around top of basin. To install an **OPTIONAL** conduit coupling (see Figure 8),

1. Find the location where the center of the coupling will be positioned on basin.
2. Using a hole saw, cut the hole in the basin to the outside diameter of the coupling being installed.
3. Place coupling on basin wall and drill mounting holes in basin.
4. Apply gasket to back of coupling, and mount coupling on basin.
5. Insert bolts, washers and nuts through basin wall and coupling, and tighten.

OPTIONAL Conduit Hub Installation:

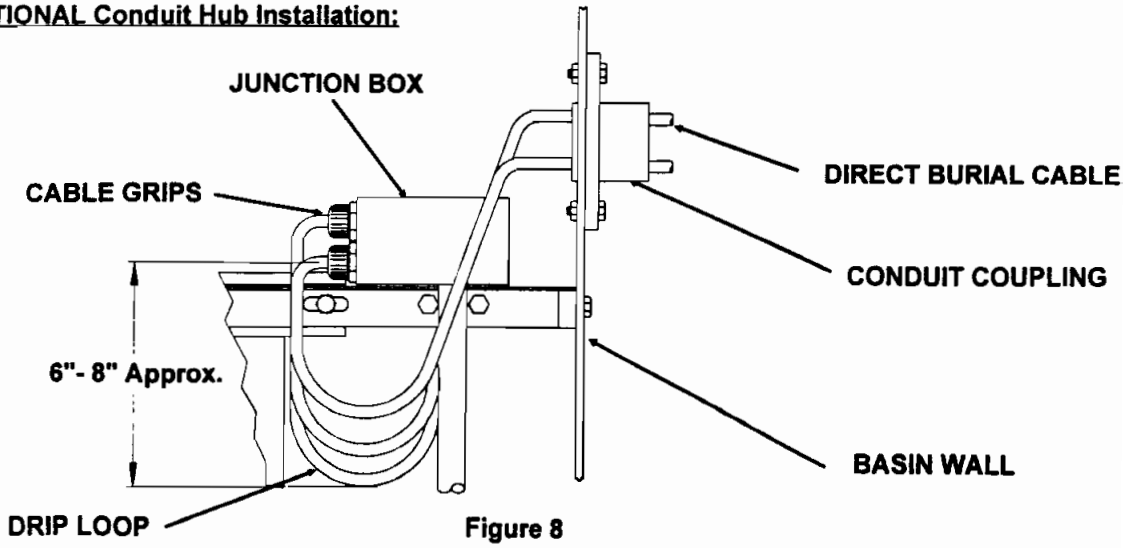


Figure 8

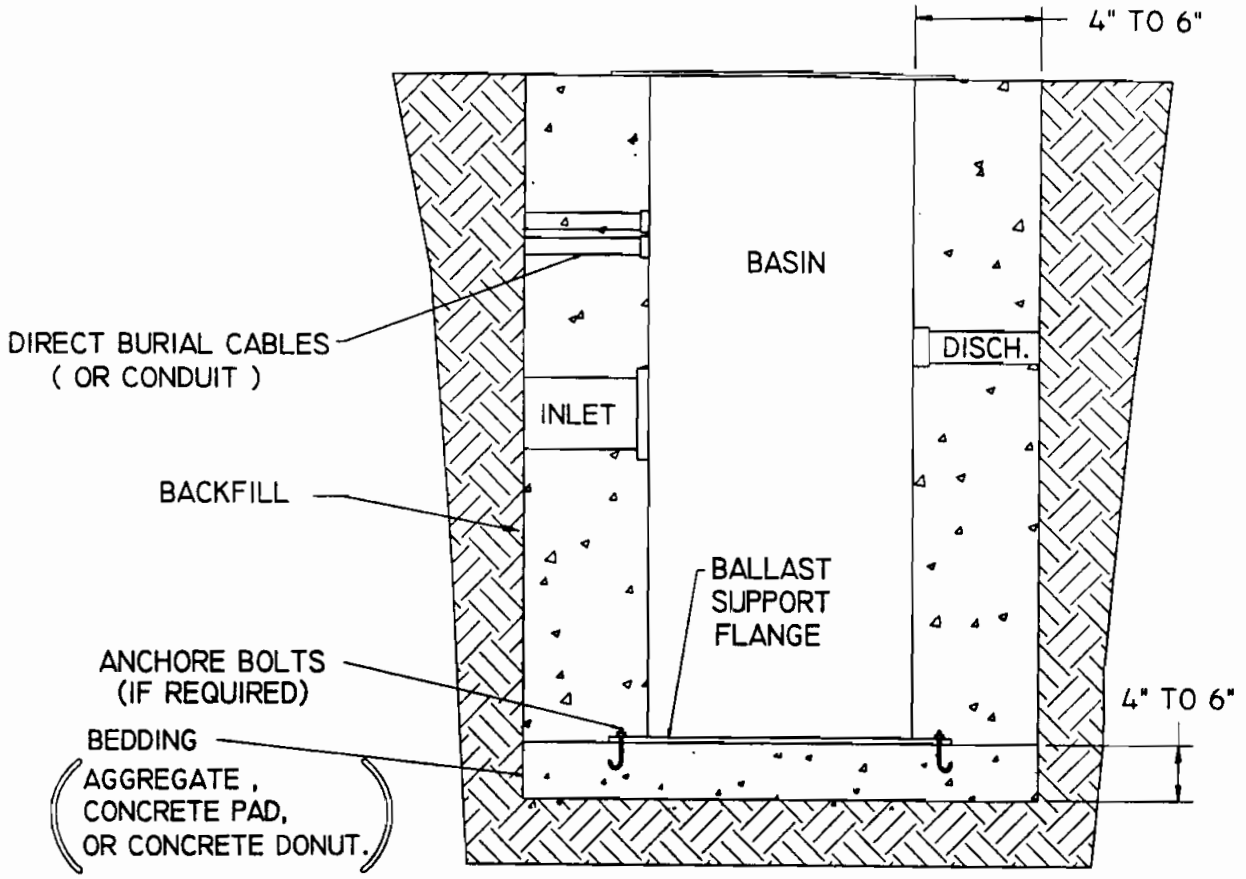


Figure 9

After coupling has been installed, run the direct burial cable through the coupling and into the junction box and tighten the grips on the box. It is important to leave enough cable slack between the junction box and basin wall to form a drip loop (See Figures 8). See Section B-6 for sealing of junction box.

Finish backfill and compaction, (See Figure 9) at least 4 inches, preferably 6 inches of aggregate should be placed in layers around the entire periphery of the basin in the ground, being careful not to damage or loosen any connections. To prevent the basin from floating upward when the ground water is high, a weight of 63 pounds per cubic foot of basin volume, must anchor the basin in place. This can be done by fastening the ballast support flange to a concrete pad or donut, or by adding the equivalent amount of gravel to the surrounding basin area.

CAUTION !
In freezing conditions backfill must be dry and free of ice.

DO NOT use backfill materials other than those specified above. In areas where specified materials are not available contact Barnes Pumps, Inc. for information on approved alternate materials.

The basin warranty is automatically voided if other than approved bed and backfill materials are employed without advance written approval.

B-5) PUMP INSTALLATION:
First attach lifting rope or chain to the pump (See Figure 10).

Remove basin cover or open access door, lower pump and movable assembly, utilizing the lifting chain or rope, down the rail slowly, **(DO NOT DROP),** not to exceed a decent speed of two (2) inches per second or ten (10) feet per minute.

CAUTION !
Risk of Electrical Shock. DO NOT Lower Pump By The Power Cord.

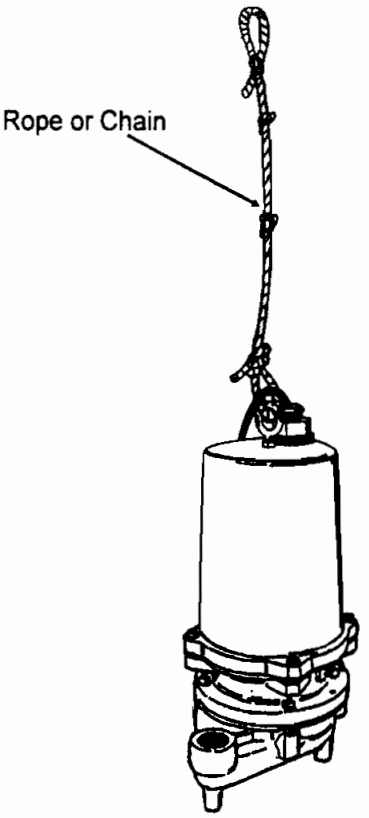


Figure 10

NOTE: A hoist or crane may be used in lowering and removing the pump. Center the pump under the hook so that the pump can be lifted straight up. Lifting a pump that is not centered will create side pulls which may strain the crane and/or cause the pump to bind in the guide rail. Follow all general precautions in the crane's manual when installing and operating the crane. See Figure 11.

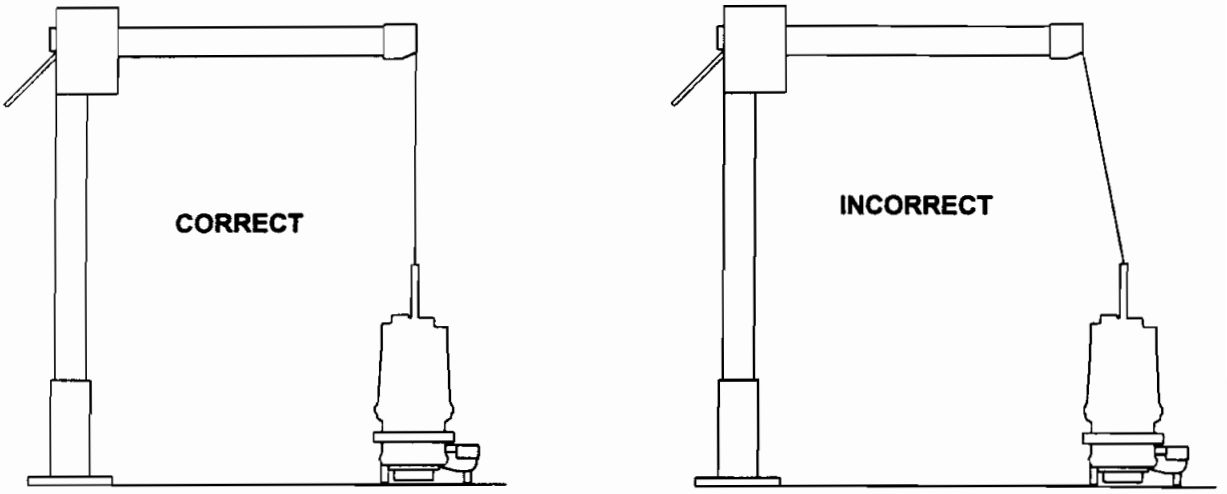


Figure 11

B-6) JUNCTION BOX CONNECTIONS:

IMPORTANT !
Check To Be Certain That All Power Is Off.

IMPORTANT !
All connections inside this tank and/or junction box, must be made with "UL" listed water tight connectors.

CAUTION !
This unit may have more than one connection to the source of supply. To reduce the risk of electric shock, disconnect all such connections before servicing.

Wire Size: - Consult a qualified electrician for proper wire size. See Pump Manual for electrical information.

For OPTIONAL conduit from the basin to the motor controller, it is recommended that a packing material be used in the conduit line, placed around the wires, either at the motor controller or at the conduit coupling to help prevent gases from entering the motor controller. It is very important to keep the conduit line dry and free from moisture during this process.

Remove junction box cover to connect pump, sensor and control cords to incoming direct burial cables. Refer to Figures 12 through 19 for your particular pump type and configuration. **NOTE:** figures 12 through 19 are for illustration purposes only, cord locations and junction box design may vary.

B= Black, **OR** = Orange (or **BL**= Blue), **R**= Red, **G**= Green, **W**=White.

To make wire connections, use the appropriate size wire nut. It is then recommended to, but not limited to one of the following.

1.) Apply dielectric grease to each connection *or*

2.) Use 3M® SCOTCHRAP™ tape around each connection, molding the tape around the wires, then apply PVC electrical tape around each connection, *or*

3.) Apply a CLEAR Silicon Rubber Sealant by DAP®, GE®, Dow Corning®, etc., then wrap with electrical tape.

B-7) LEVEL CONTROLS:

The level controls are to be supported by a float pole (or optional cable rack) that is attached to the rail assembly. Floats may be adjusted by loosening the cable ties on the float pole (or by loosening the cord grips on the cable rack). Floats are factory adjusted before shipment, re-adjustment may be required for your particular installation.

IMPORTANT !
Bottom float for "OFF" or "LOW LEVEL ALARM", must be a min. of 10" from bottom of basin to weight on suspended float, or to cable tie on pole mounted float.

Be certain that the level controls cannot hang up or foul in it's swing .

Float Pilot Switch Rating: 4.5A @ 115 Volts, 1/2 HP.
2.2A @ 230 Volts, 1/2 HP.

NOTE: Float switch activates pump contactor only and does not switch pump directly.

OPERATION SEQUENCES:

Three float switches are normally supplied with simplex systems and four with duplex systems. The lowest switch is for PUMP(s) OFF, the next highest for PUMP ON for simplex and LEAD PUMP ON for duplex, the third at still higher level for ALARM ON for simplex and LAG PUMP ON for duplex, and the fourth at the highest level for ALARM ON for duplex systems.

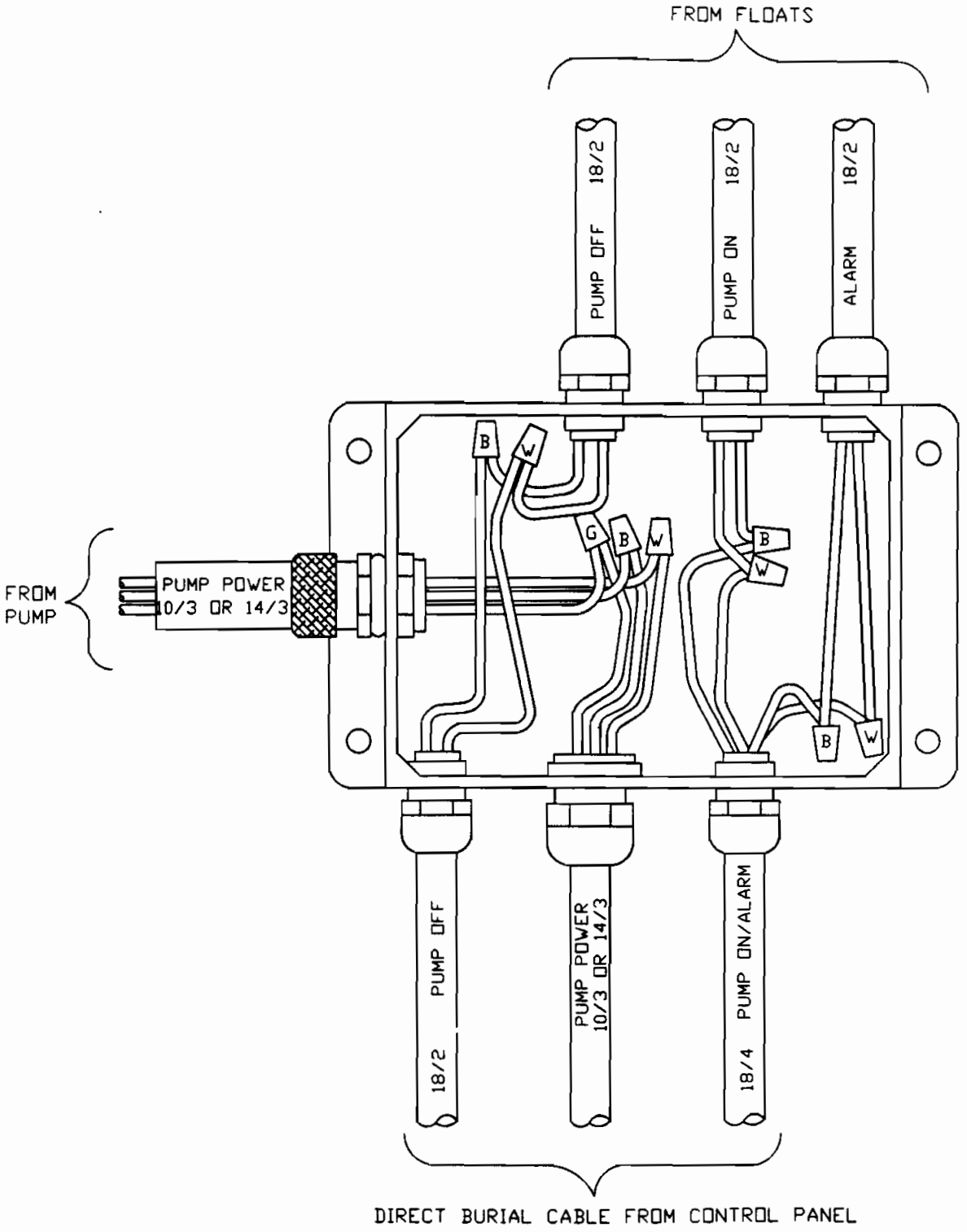
The level controls are normally open, unless otherwise specified. As the wet well level rises, the OFF float switch closes. As level continues to rise, the lead ON switch closes, completing the pilot circuit to start the lead pump. When the lead pump lowers the level and the lead ON switch opens, no action occurs due to a latching contact which keeps the circuit energized until the level is lowered to the point at which the pump OFF switch opens.

The float switches are to be connected to the pump control relay (s) in the pump motor controller.

B-7) TESTING:
After the wiring has been completed and pump has been lowered into the basin, it is advisable to check the system for proper operation and inlet and discharge line for leaks both inside and outside of basin. This is accomplished by filling the basin with liquid and allowing the pump to operate throughout it's pumping cycle. If pump does not operate properly, check the TROUBLE SHOOTING guide in pump manual. If lines are leaking, check for damage and/or proper seal and tightness.

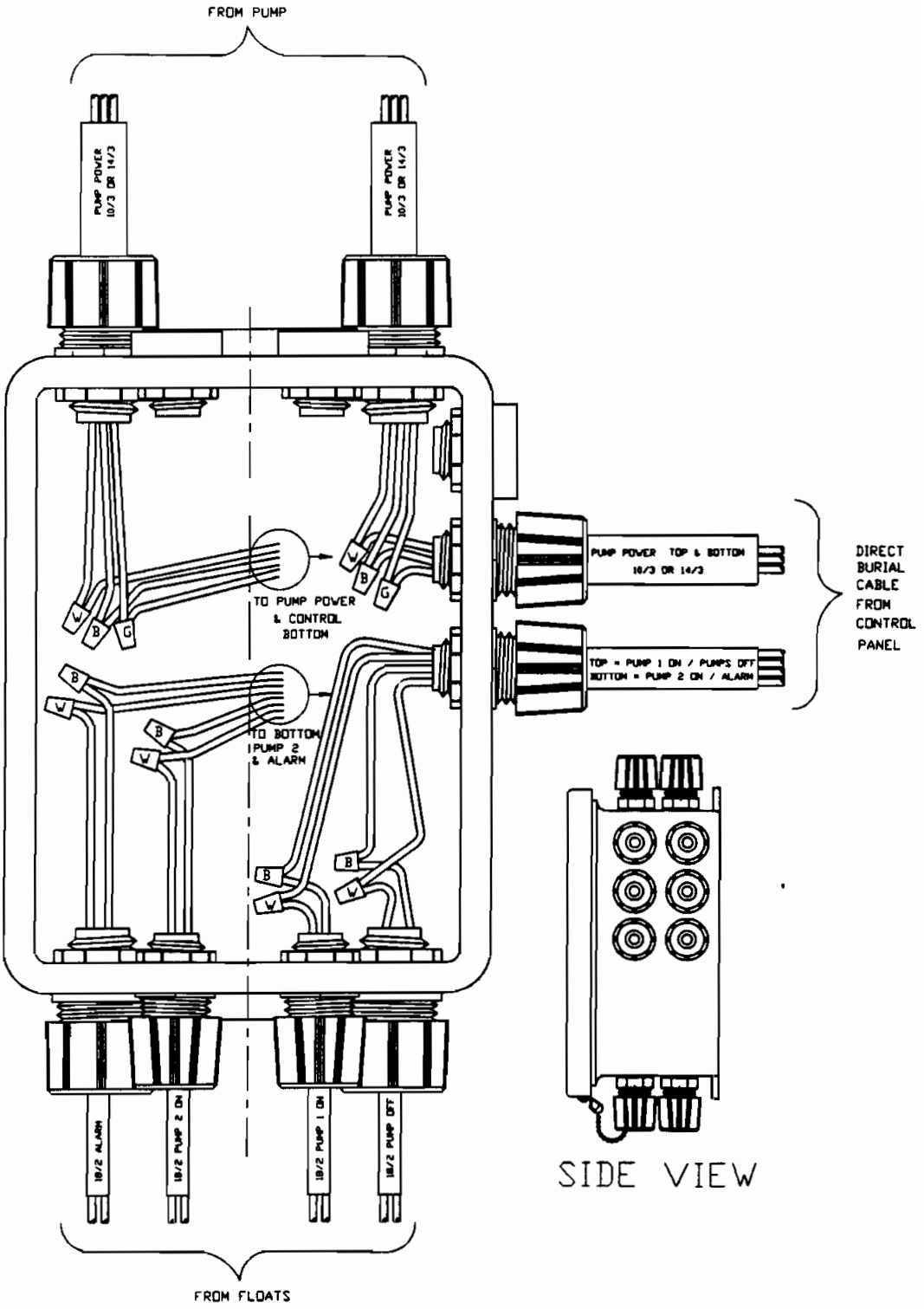
SIMPLEX - 115/230 Volt, 1Ph, PSC Motors

With 3 wire Pump Power Cable and 3 Floats.
(PSC = Permanent Split Capacitor)



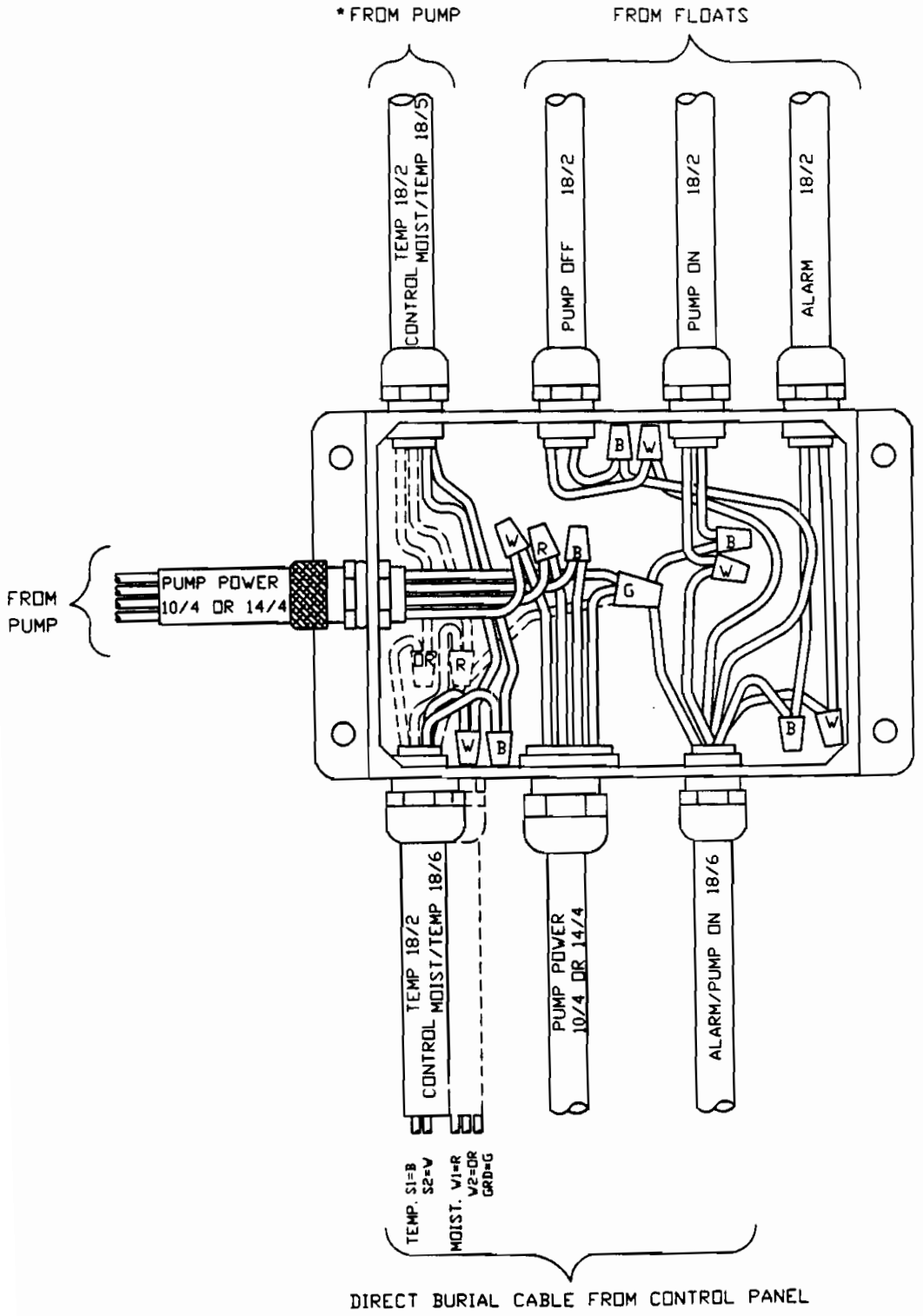
DUPLEX - 115/230 Volt, 1Ph, PSC Motors

With Two 3 wire Pump Power Cable and 4 Floats.
(PSC = Permanent Split Capacitor)



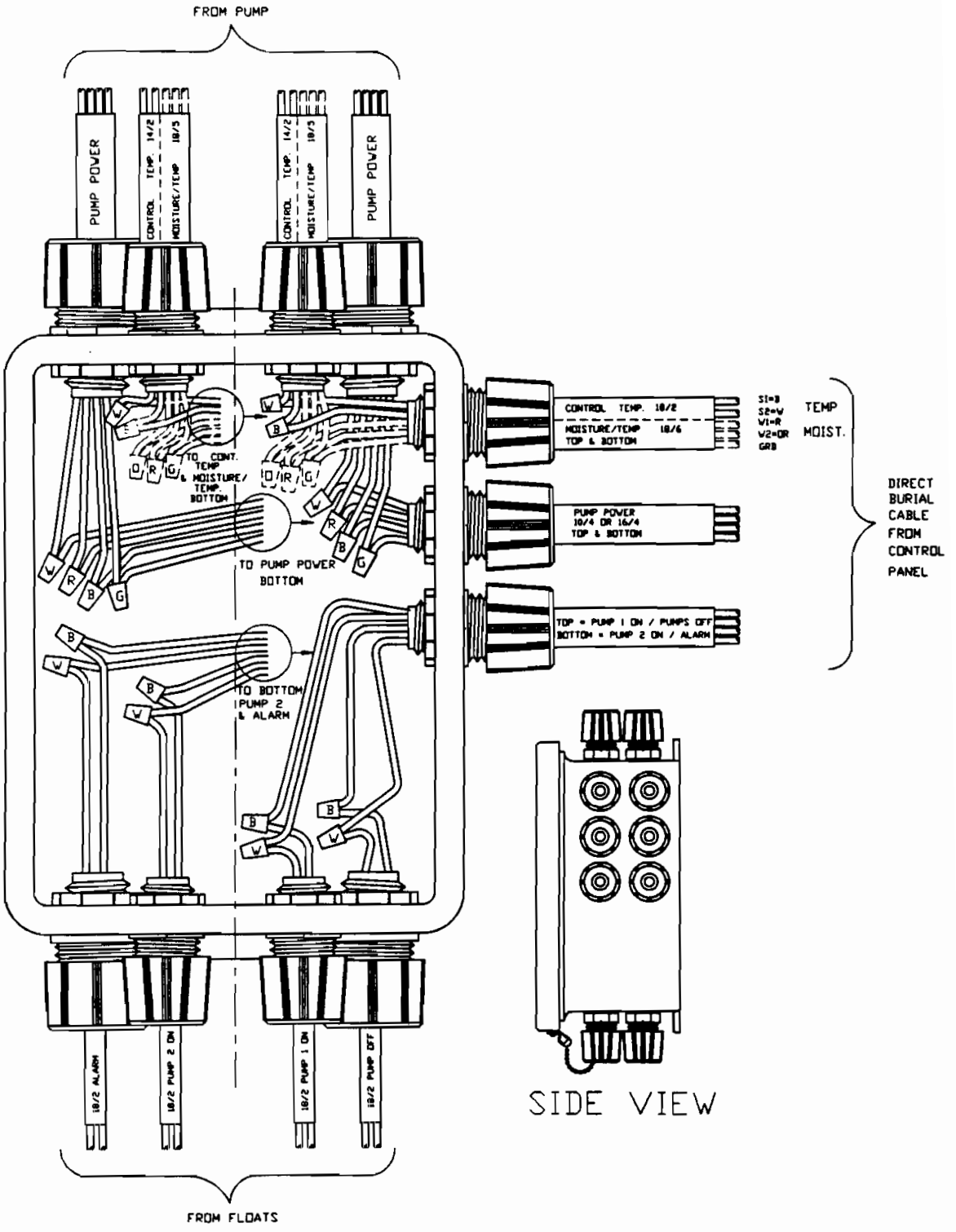
SIMPLEX - 200-230Volt, 1Ph & 200-230/460Volt, 3Ph

With 4 wire Pump Power Cable, 3 Floats and *Control Cable.
(*Control Cable may not be used on all Pump Models.)



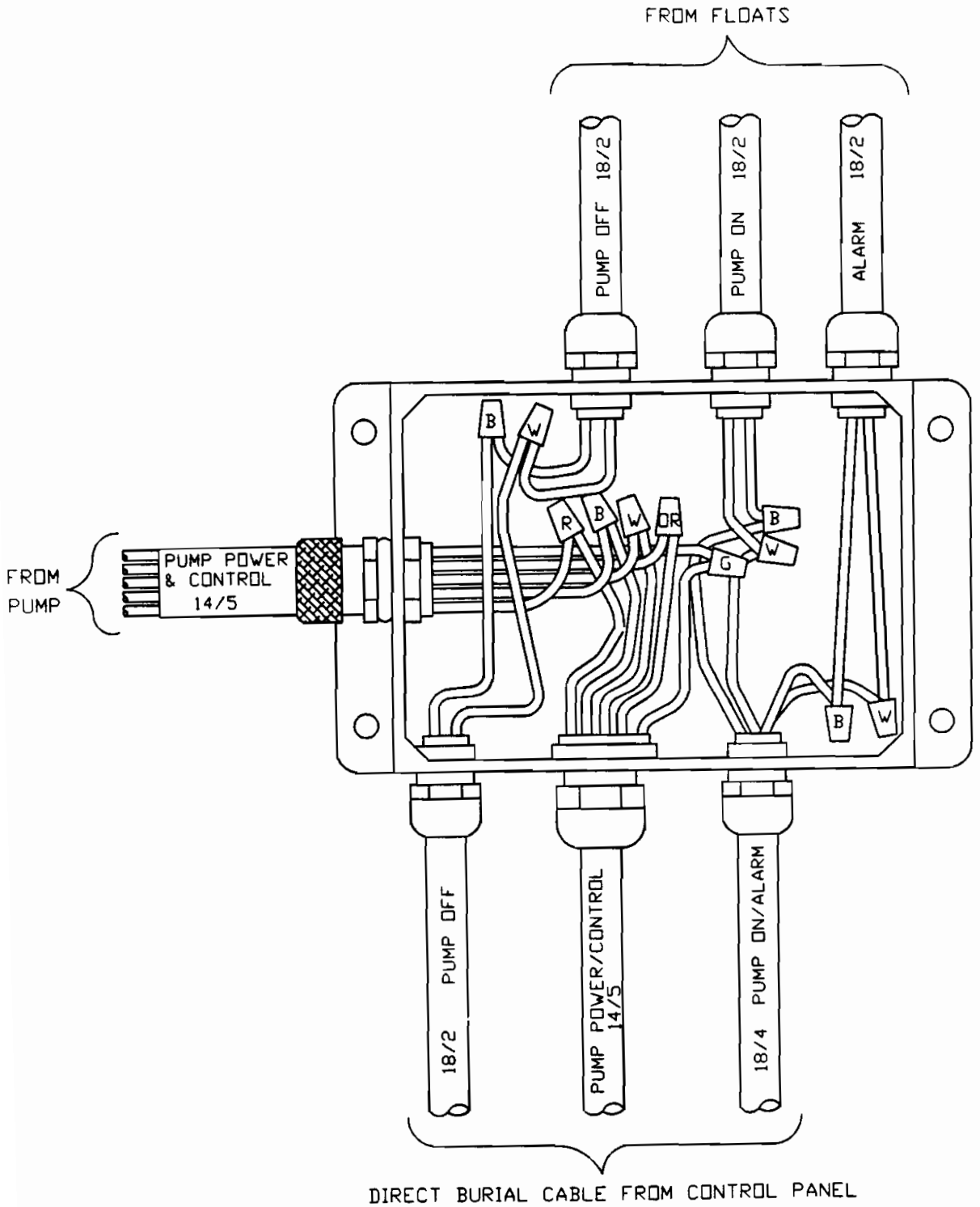
DUPLEX - 200-230Volt, 1Ph & 200-230/460Volt, 3Ph

With Two 4 wire Pump Power Cables, 4 Floats and Two *Control Cables.
(*Control Cables may not be used on all Pump Models.)



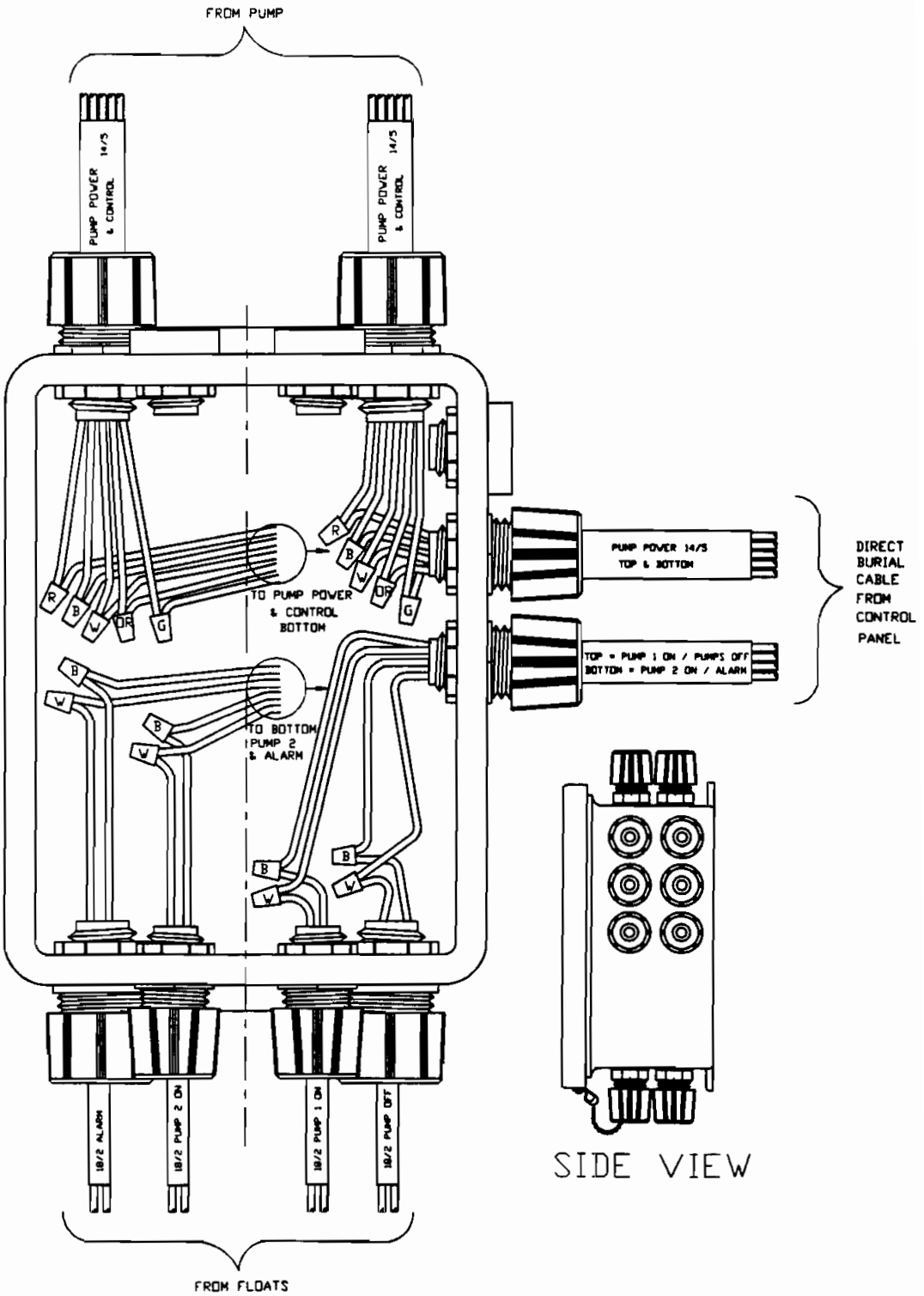
SIMPLEX - 230Volt, 1Ph

With 5 wire Pump Power/Moisture Sensor Control Cable and 3 Floats.



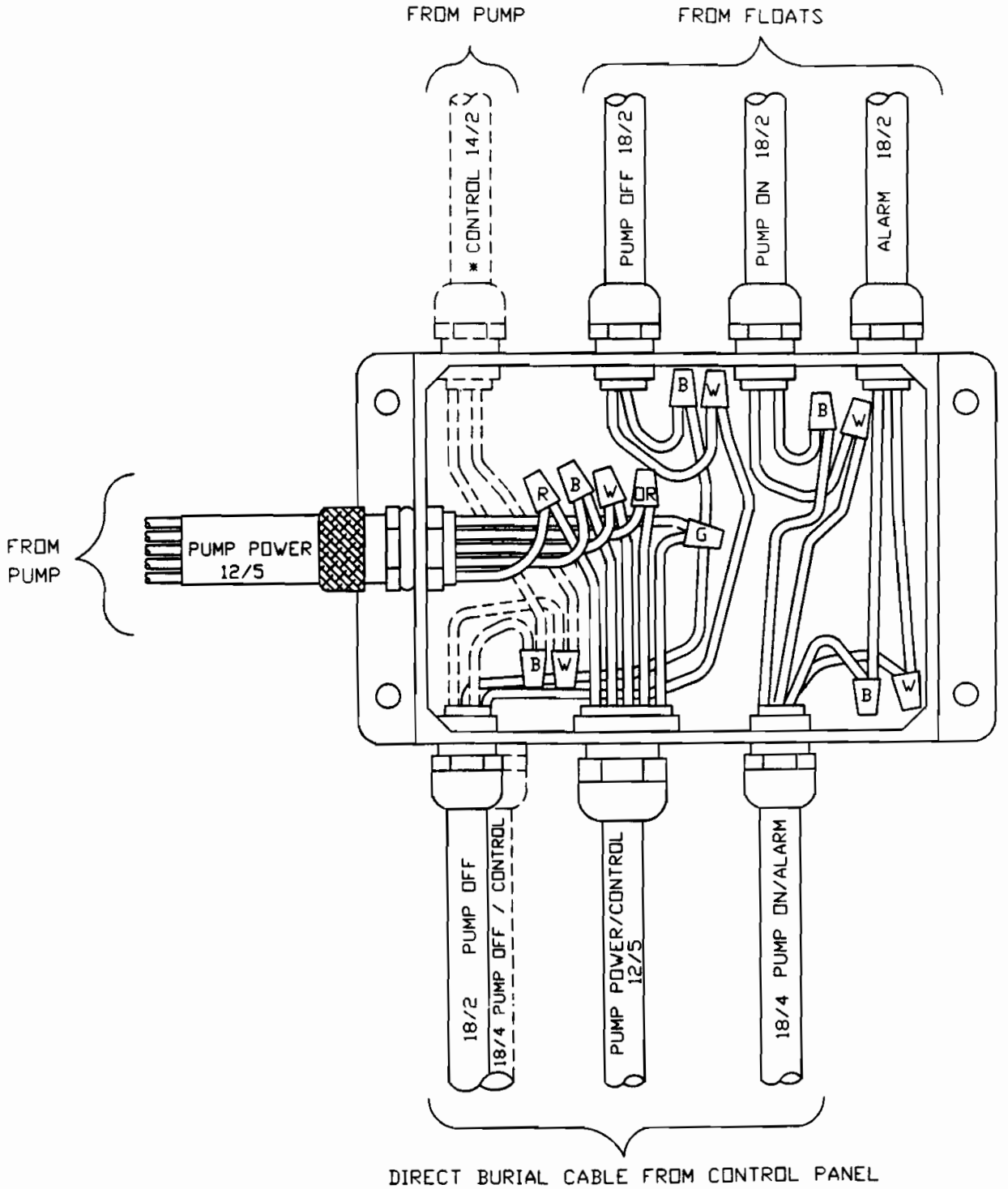
DUPLEX - 230Volt, 1Ph

With Two 5 wire Pump Power/Moisture Sensor Control Cables and 4 Floats.



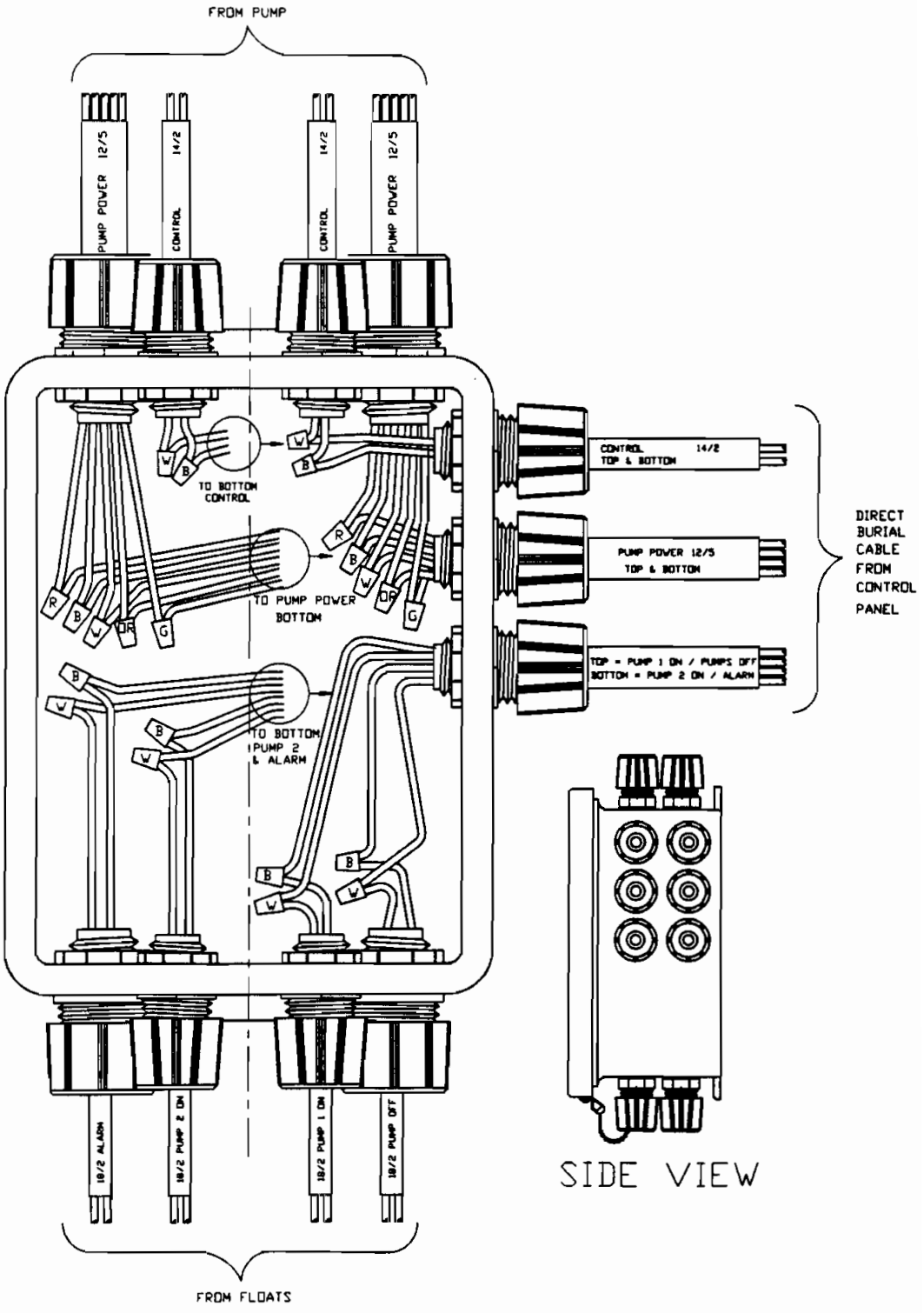
SIMPLEX - 200-230Volt, 1Ph.

With 5 wire Pump Power Cable, 3 Floats and with
*OPTIONAL 2 wire Temperature Control Cable.



DUPLEX - 200-230Volt, 1Ph.

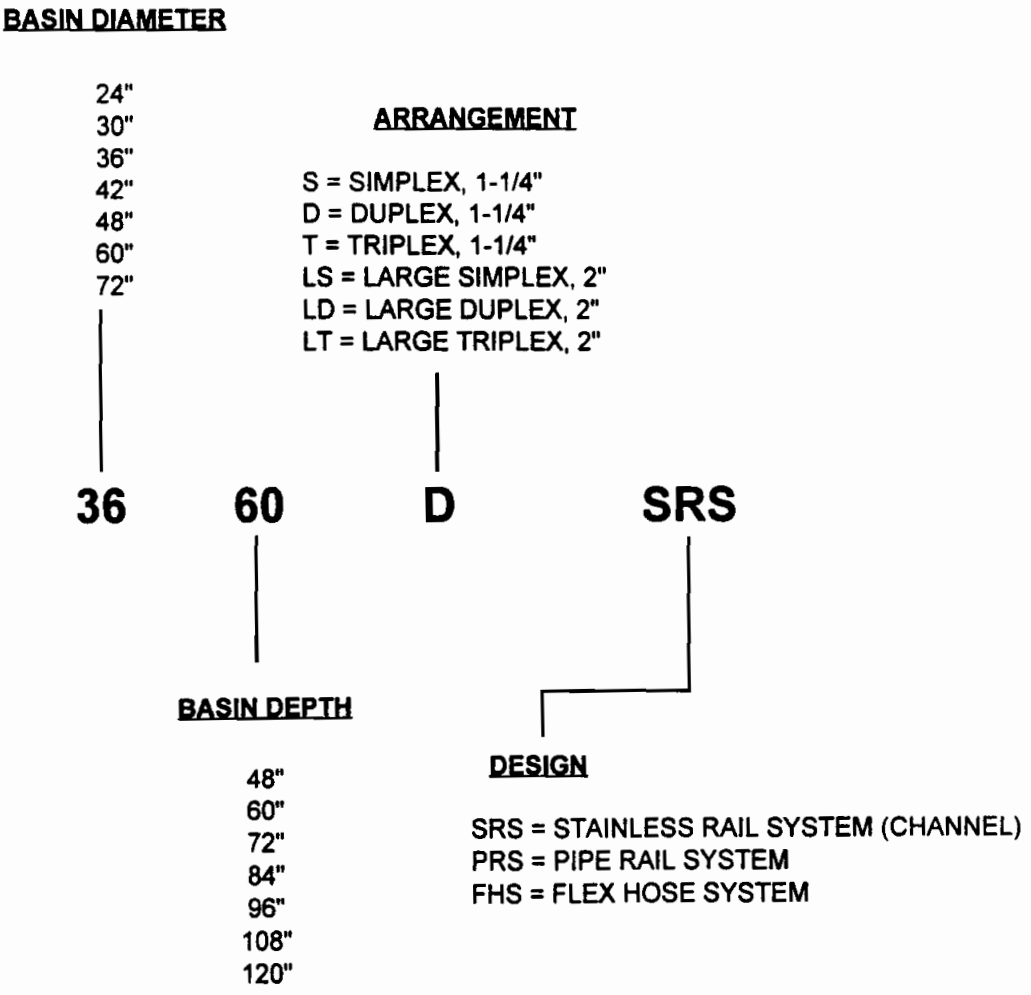
With Two 5 wire Pump Power Cables, 4 Floats and with
Two *OPTIONAL 2 wire Temperature Control Cables.



PACKAGE SYSTEM MODEL NOMENCLATURE

The following model nomenclature is used for most Basin Package Systems.

EXAMPLE MODEL: 3660DSRS



IMPORTANT !
WARRANTY REGISTRATION

Your pump is covered by the enclosed Warranty. This warranty is ONLY effective provided the warranty registration is completed and returned to the Barnes Pumps, Inc. service department. Review the form below and fill in all information.

IMPORTANT! If you have a claim under the provision of the warranty, contact your local Barnes Pumps, Inc. Distributor.

WARNING !

Products Returned Must Be Cleaned, Sanitized, Or Decontaminated As Necessary Prior To Shipment, To Insure That Employees Will Not Be Exposed To Health Hazards In Handling Said Material. All Applicable Laws And Regulations Shall Apply.

RETURNED GOODS POLICY

RETURN OF MERCHANDISE REQUIRES A "RETURNED GOODS AUTHORIZATION". CALL THE FACTORY SERVICE MANAGER, (513) 773-2442 FOR RGA NUMBER.

RETURN OF EQUIPMENT: No equipment shall be returned to us without first obtaining a written Returned Goods Authorization and shipping instructions from us. The returner must prepay the charges in full for transportation to our factory. Credit allowed for new, undamaged equipment of current standard design will be 80% of the invoiced price or current billing price, whichever is less. Equipment which has been used, however slight, will not be accepted.

Authorization will not be given for return of equipment,
(1) which would, in our opinion, result in an excess in the amount of stock we normally carry,
(2) not invoiced within the last 12 months, or
(3) which is non-standard and manufactured specifically to a buyer's specifications. For non-standard equipment not of our manufacture, the only credit allowed will be such credit as may be allowed by the manufacturer of such equipment.

BARNES®

Limited Warranty

We warrant to our immediate customer and to the ultimate consumer that products of our manufacture will be free of defects in material and workmanship under normal use and service for the following time periods, when installed and maintained in accordance with our instructions.

Pump Products: One (1) year from date of installation or (24) twenty-four months from date of shipment, whichever occurs first. Cleaning Products: Twelve (12) months from date of installation or eighteen (18) months from date of shipment, whichever occurs first. As used herein, "the ultimate consumer" is defined as the purchaser who first uses the product after its initial installation or, in the case of product designed for non permanent installation, the first owner who used the product. It is the purchaser's or any sub-vendee's obligation to make known to the ultimate consumer the terms and conditions of this warranty. This warranty gives you specific legal rights, and there may also be other rights which vary from state to state. In the event the product is covered by the Federal Consumer Product Warranties Law (1) the duration of any implied warranties associated with the product by virtue of said law is limited to the same duration as stated herein, (2) this warranty is a LIMITED WARRANTY, and (3) no claims of any nature whatsoever shall be made against us, until the ultimate consumer, his successor, or assigns, notifies us in writing of the defect, and delivers the product and/or defective part(s) freight prepaid to our factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply. **THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY AND ALL WARRANTIES WITH RESPECT TO ANY PRODUCT SHALL BE TO REPLACE OR REPAIR AT OUR ELECTION, F.O.B. POINT OF MANUFACTURE OR AUTHORIZED REPAIR STATION, SUCH PRODUCTS AND/OR PARTS AS PROVEN DEFECTIVE. THERE SHALL BE NO FURTHER LIABILITY, WHETHER BASED ON WARRANTY, NEGLIGENCE OR OTHERWISE.** Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by us, if any, are subject to laboratory tests corrected for field performance. Any additional guarantees, in the nature of performance specifications must be in writing and such writing must be signed by our authorized representative. Due to inaccuracies in field testing if a conflict arises between the results of field testing conducted by or for user, and laboratory tests corrected for field performance, the latter shall control. Components or accessories supplied by us but manufactured by others are warranted only to the extent of and by the terms and conditions of the original manufacturer's warranty. **RECOMMENDATIONS FOR SPECIAL APPLICATIONS OR THOSE RESULTING FROM SYSTEMS ANALYSES AND EVALUATIONS WE CONDUCT WILL BE BASED ON OUR BEST AVAILABLE EXPERIENCE AND PUBLISHED INDUSTRY INFORMATION. SUCH RECOMMENDATIONS DO NOT CONSTITUTE A WARRANTY OF SATISFACTORY PERFORMANCE AND NO SUCH WARRANTY IS GIVEN.**

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage (c) lightning (d) sand or other abrasive material (e) scale or corrosion build-up due to excessive chemical content. Any modification of the original equipment will also void the warranty. We will not be responsible for loss, damage or labor cost due to interruption of service caused by defective parts. Neither will we accept charges incurred by others without our prior written approval.

This warranty is void if our inspection reveals the product was used in a manner inconsistent with normal industry practice and\or our specific recommendations. The purchaser is responsible for communication of all necessary information regarding the application and use of the product. **UNDER NO CIRCUMSTANCES WILL WE BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOST PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND\OR WORKMANSHIP AND\OR DAMAGE OR DELAYS IN SHIPMENT. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

No rights extended under this warranty shall be assigned to any other person, whether by operation of law or otherwise, without our prior written approval.

BARNES PUMPS, INC. 420 Third Street. P.O. Box 603 • Piqua, Ohio 45356-0603
Ph: (513) 773-2442 • Fax: (513) 773-2238

IMPORTANT !
WARRANTY REGISTRATION

Your pump is covered by the enclosed Warranty. This warranty is ONLY effective provided the warranty registration is completed and returned to the Barnes Pumps, Inc. service department. Review the form below and fill in all information.

IMPORTANT! If you have a claim under the provision of the warranty, contact your local Barnes Pumps, Inc. Distributor.

FOLD HERE

**** IMPORTANT ! ****

THIS FORM MUST BE RETURNED TO VALIDATE THE WARRANTY

WARRANTY REGISTRATION

CUSTOMER'S NAME _____ **DATE INSTALLED** _____

ADDRESS _____

CITY _____ **STATE** _____ **ZIP** _____

PHONE # _____ **FAX #** _____

DEALER'S NAME _____

CITY _____ **STATE** _____ **ZIP** _____

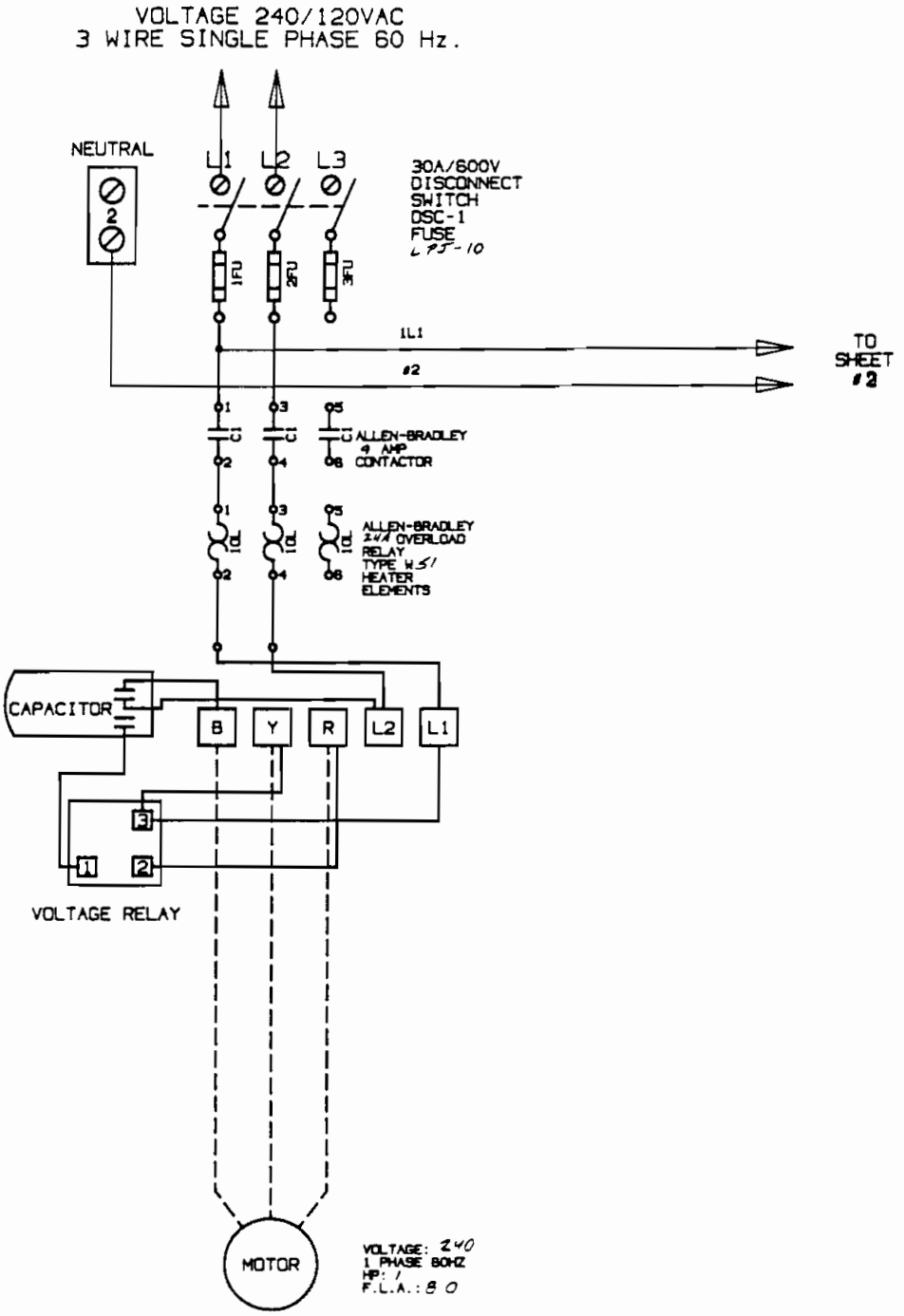
PUMP MODEL NO. _____ **SERIAL NO.** _____ **VOLTAGE** _____

PART NO. _____

FOLD HERE AND TAPE, DO NOT STAPLE

PLACE
STAMP
HERE

BARNES PUMPS, INC.
SERVICE DEPARTMENT
420 THIRD STREET
P.O. BOX 603
PIQUA, OHIO
45356-0603 - U.S.A.



DATE: 3/18/96	DRWN BY: MCM
SHEET NO: 1 OF 2	CHKD BY: WCL

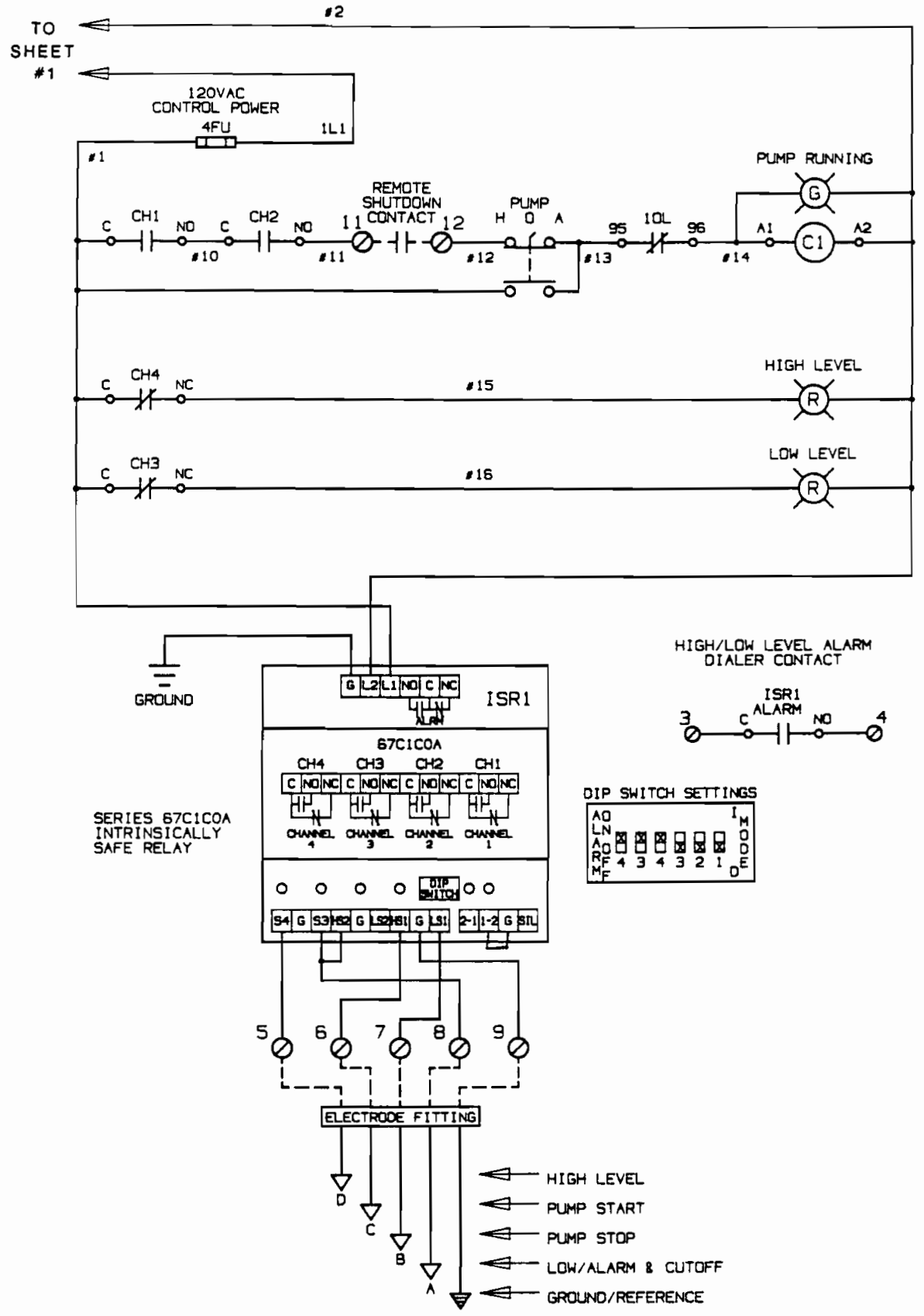
Warrick Controls, Inc.

4237 Normandy Court
Royal Oak, Michigan 48073
(810) 549-4900 Fax (810) 549-4904

WARRICK CONTROLS

TITLE: MODEL SB3728-2C4
GROUNDWATER REMEDIATION
CONTROL PANEL

DRWG NO: SB3728



DATE: 3/19/96	DRWN BY: MCM	TITLE: MODEL SB3728-2C4 GROUNDWATER REMEDIATION CONTROL PANEL	
SHEET NO: 2 OF 2	CHKD BY:		

WARRICK CONTROLS

Warrick Controls, Inc.

4237 Normandy Court
Royal Oak, Michigan 48073
(810) 549-4900 - Fax (810) 549-4904

DRWG NO: SB3728

WARRICK CONTROLS

INSTALLATION & OPERATING INSTRUCTIONS

INSTALLATION INSTRUCTION

IMPORTANT: Completely read and thoroughly understand these instructions before proceeding to install and wire the control.

Mount controlbox vertically on wall or other solid structure. The maximum distance between the controlbox and the location of the electrodes is determined by the sensitivity of the Series 67 control(s). This information is supplied on Form 670.

INTRINSICALLY SAFE GENERAL INFORMATION

IMPORTANT: BEFORE PROCEEDING TO INSTALL AND WIRE THE ALARM PANEL, READ AND THOROUGHLY UNDERSTAND THESE INSTRUCTIONS.

The following information should be used by experienced personnel as a guide to the installation of intrinsically safe alarm panels. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Warrick or its local representative if further information is required.

The control panel contains a U.L. Listed interface relay with Intrinsically Safe Sensing Circuits. The interface relay is Associated Apparatus listed under Process Control equipment, with Intrinsically Safe Outputs for Interface into Division 1 Hazardous Locations. The circuits are to be connected to any simple non-energy generating or storing device such as a pushbutton, limit, float switch, or any Warrick electrode and fitting assembly.

The control panel is preassembled and ready to wire. Locate the panel in a non-hazardous area where an explosive environment does not exist.

Cabinet and mounting plate to be connected to a good earth ground. For additional guidance on "Hazardous Location Installation," and "Intrinsically Safe Devices," consult ANSI/ISA standard RP 12-6 or NEC ARTICLES 500 through 516.

CAUTION:

Intrinsically safe wiring must be kept separate from non-intrinsically safe wiring. Special procedures have been followed during the manufacturing of these control panels to insure proper spacings. Some models incorporate isolated barriers or covers for this purpose.

A separate rigid metallic conduit should be used to enclose the conductors of the intrinsically safe circuit. Multiple runs of intrinsically safe wiring may be run in the same conduit only where at least 0.25mm (0.010 inch) thick insulation, suitable for the maximum temperature, is used on each conductor. Refer to ANSI/ISA RP 12.6 for details. Conduit or cable, containing the intrinsically safe wiring, shall be sealed in accordance with the National Electrical Code, NFPA No. 70, (approved sealing fitting), where the conduit enters or exits the hazardous locations.

INDUCTANCE AND CAPACITANCE: For intrinsically safe wiring use 16 AWG or 14 AWG TYPE THHN/THHW/THWN or MTW. By using these types of wire in conjunction with a limitation on distance, you will not exceed the maximum capacitance or inductance for field wiring.

Use the following chart as a guide for maximum total length of all the intrinsically safe wiring (of each conductor), excluding any ground wiring.

WARRICK INTERFACE RELAY

MODEL NUMBER	HAZARDOUS LOCATIONS	MAXIMUM CABLE LENGTH SHALL NOT EXCEED
47 Series	Class I, Group C & D; Class II, Group E, F & G	16,000
27 Series	Class I, Group A,B,C & D Class II, Group E, F & G	4000
67 Series	Class I, Groups C, D Class II, Groups E, F, G Class III, Division I	16,000

NOTE:

Refer to Series 27, 47 and 67 data information for distance recommendations so not to exceed the maximum capacitance or inductance limitations of the control.

Circles with diagonals (0) on wiring diagram represent terminals provided for external connections.

Connect terminal pair L1-L2 to A.C. supply line of electrical characteristics indicated on data label.

Connect the pump motors leads to terminals B, Y and R of the Start Capacitor terminals.

Connect the normally closed remote Shutdown contacts to terminals 11 and 12.

Wiring must be provided to the electrodes as shown. The electrode wiring should be thermoplastic insulated and be installed in a separate dry metallic conduit. Terminal 9 must be grounded to the vessel if metallic. If the electrode fitting used has a metallic body and is supported directly upon a metallic vessel, the ground connection is facilitated by securing that end of the ground conductor beneath the head of one of the screws which fasten the terminal housing to the body of the fitting. When the vessel is non-metallic, terminal 9 must be connected to an additional electrode of length equal to or longer than, the longest electrode.

Connect the HIGH/LOW Level contacts located between terminals 3 and 4 to the Auto Dialer.

OPERATING INSTRUCTIONS

A Hand-Off-Automatic selector switch is provided for the motor so that it can be operated by hand, automatically or turned off. This switch will normally be in the AUTO position and operation will then be as follows.

With the Remote Contacted located between terminals 11 and 12 closed, the pump will be started when the level rises to electrode C and will continue in operation until the level is reduced below electrode B.

A green PUMP RUNNING light is provided on the door of the controlbox and will be energized when the pump(s) is

operating.

Should the level rise to electrode D, a red alarm light will energize and the contacts located between terminals 3 and 4 will close.

Should the level recede below electrode A, a red alarm light will energize and the contacts located between terminals 3 and 4 will close.
Also, if the level recedes below electrode A the pump will be cutoff.

SENSAPHONE SECURITY MONITORING SYSTEMS

THE MODEL 4100

VERSION 3.00

TABLE OF CONTENTS

INTRODUCTION

SENSAPHONE MODEL 4100 CAPABILITIES

The Sensaphone model 4100 is an electronic watchman. It monitors specific environmental and operating conditions at your business facility or remote property. The model 4100 is equipped with sensors that automatically monitor the following conditions:

- AC electrical power--checks for power failure and records the total amount of time the power was off.
- Temperature--monitors temperature between -20° F and +150° F, checks to see if it exceeds or falls below user-programmed high and low limits, states actual temperature.
- High sound levels--such as smoke or burglar alarms.
- Battery--the condition of its battery back-up.

The Sensaphone model 4100 also has three digital alert inputs. Attachable dry contact sensors (see Appendix C) monitor conditions at the unit's location or other areas, such as:

- Intrusion into premises
- Water leaks or floods
- Temperature in remote areas

The use of each alert input can vary widely. One example is as follows:

- Input 1--Passive infrared sensor to detect intrusion
- Input 2--Humidistat to monitor relative humidity.
- Input 3--Magnetic reed switch for a door.

The Sensaphone also has an auxiliary temperature terminal. An auxiliary temperature probe can be attached to this terminal to monitor temperature in a second location. This second temperature will <u>not</u>

cause a dial-out, but will appear in call-in and alarm status reports. Also, the auxiliary temperature terminal can be used as a fourth alert input, but only if you are not using a second temperature probe. This fourth alert input terminal will function exactly like the other three alert input terminals.

The Sensaphone 4100 also gives you the ability to selectively disable the alert inputs, plus the high temperature, low temperature, high sound, and power failure monitors. When the monitor is disabled, the Sensaphone will not dial-out with an alarm.

There is an output terminal on the 4100. You can wire a relay (FGD-0012; see Appendix C) to the output terminal, then wire an alarm horn or light to the relay. Whenever an alarm condition occurs, the alarm horn/light will be activated.

All monitoring is a continuous process. When a problem arises, the unit will announce the alarm message locally for 30 seconds. It will then activate the output device (if connected) and sequentially dial up to four user-programmed telephone numbers with an alarm message. It will state the existing problem, disconnect from the telephone line, then wait for an acknowledging telephone call. The model 4100 will continue dialing-out until its message is properly acknowledged.

You can also call-in to the model 4100 to get a status report on the monitored conditions and listen-in through the provided microphone.

The model 4100 has a programmable keyboard security code, which adds a measure of protection to the settings. When the security code is entered, the keyboard is locked. No one can change the user-programmed data or turn off the unit without knowing the code to unlock the keyboard.

The Sensaphone Model 4100 has non-volatile memory. When AC power and the battery back-up fail, the unit will still retain all of its programmed parameters, except for time, the security code, and the power-off time accumulator.

THE SENSAPHONE MODEL 4100 OWNERS' MANUAL

This manual describes the features and operation of the Sensaphone model 4100. It provides explanations, illustrations, and examples to simplify its installation and programming.

Read this manual over at least once and experiment with the examples before starting your actual programming.

THE MODEL 4100 SPECIFICATIONS AND STATISTICS

SIZE

10 1/4 inches high, 10 1/4 inches wide, 4 inches deep.

SHIPPING WEIGHT

14 pounds

BATTERY SYSTEM

One 12 volt 1.9 Amp-hour sealed rechargeable battery with integral charger is included. The battery back-up time is approximately 8 - 10 hours with the AC power off. The battery will automatically be recharged when the AC power is restored, but it will take 48 hours for a full charge. Pressing OFF disconnects all functions, but the battery will still be drained if AC power is removed. Battery service should be performed by qualified personnel only.

AC CONNECTION

UL-listed Class 2 wall transformer with a six-foot cord. Converts 110 VAC, 60 Hz, 10 Watt input to 12 VAC, 60 Hz, 500 mA output.

TELEPHONE CONNECTION

Standard modular connector (RJ11C) with a six-foot cord. Works with standard systems that have pulse or tone dialing.

OPERATING CONDITIONS

The Sensaphone model 4100 should not be operated in temperatures less than +40° F nor more than +120° F.

Do not use the model 4100 in an environment where it is exposed to fumes or corrosive vapors. They might damage the unit, causing it to malfunction, and void the warranty.

POWER SURGE PROTECTION

Your Sensaphone Model 4100 may be affected by power surges through the telephone line or the 110 VAC power supply. Though the 4100 has built-in surge protection, **we recommend that you obtain additional protection for the 4100, and for <u>any</u> electronic equipment which is attached to your power supply and telephone lines. This is especially important if you live in a lightening-prone**

area. One protection device is the TRIPP LITE* "Isotel" Model IB-4. It is available through Phonetics (see Appendix C).

IMPORTANT!

The Sensaphone model 4100 should be periodically checked to ensure proper operation in your particular installation. If you are using external sensors, their operation must be checked periodically as well. **The system with its sensors (if any) should be COMPLETELY checked monthly to ensure proper operation.**

Always disconnect all telephone lines from wall outlets before servicing or disassembling this equipment, or replacing batteries.

FCC REQUIREMENTS

The Sensaphone model 4100 complies with Part 68 of the FCC Rules. Inside the unit's door is a label that contains, among other information, the FCC Registration Number and the Ringer Equivalence Number (REN). You must, upon request, provide this information to your telephone company.

The REN is useful for determining the quantity of devices that you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most areas, the sum of the RENs of all devices connected to one line should not exceed 5.0. To be certain of the number of devices that you may connect to your telephone line, you should contact your local telephone company.

Should the Sensaphone model 4100 cause harm to the telephone network, the telephone company shall, if possible, notify you that temporary discontinuance of service may be required. However, if such action is necessary and prior written notice is not possible, the telephone company may temporarily discontinue service without notice. The telephone company may make changes in its communications facilities, equipment, and operations procedures, where such action is reasonably required in the operation of its business and is not inconsistent with the rules and regulations of the Federal Communications Commission.

The Sensaphone model 4100 should not be used on coin telephone lines. Connection to party line service is subject to state tariffs.

If trouble is experienced, disconnect the Sensaphone model 4100 from the telephone line to determine if the unit is causing the malfunction. If the model 4100 is determined to be malfunctioning, it should be

* trademark of Trippe Manufacturing Co. (Chicago, IL)

discontinued until the problem has been corrected. We suggest that you do the following:

1) Refer to Appendices F, **MAINTENANCE**, and G, **TROUBLESHOOTING**.

2) Carefully write down your observations of the model 4100's malfunctioning.

3) Call Phonetics' Technical Service at 1-215-558-2700 if any instructions are not clear or if you have any questions.

If your Sensaphone is programmed to dial to an emergency number (i.e. the police), you must do the following when testing:

1) Remain on the line and briefly explain to the dispatcher the reason for the call before hanging up.

2) Perform such activities in the off-peak hours, such as early morning or late evening.

PART 15 - This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CHAPTER 1
INSTALLATION

MOUNTING THE SENSAPHONE MODEL 4100

The Sensaphone model 4100 is designed to mount on a wall using four screws, recommended size #10. The mounting holes are in the back panel of the unit and are accessible when the door is open (See Figure 1).

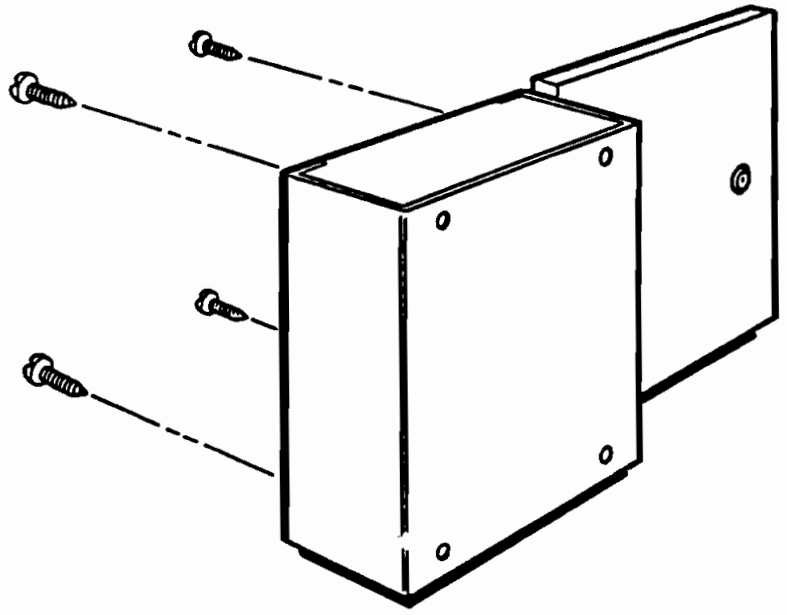


FIGURE 1: MOUNTING THE MODEL 4100

CAUTION

Do not remove the internal faceplate during installation or any other time. The Sensaphone Model 4100 is designed and manufactured for permanent mounting only. It should not be subjected to dynamic loading, vibration, or impact. The Sensaphone Model 4100 must be securely mounted to structures which will completely support the weight and sustain all other forces which the enclosure and its assembled equipment may impose.

POWER SUPPLY INSTALLATION AND TELEPHONE CONNECTION

After mounting the unit on a wall, plug the provided AC transformer into any standard 110 VAC outlet (see Figure 2). The unit will say "Hello", and state any present alarms.

Next, plug the provided modular telephone jack into any standard modular telephone outlet (RJ11W for wall-mounted phones, RJ11C for other phones). If you do not have a modular telephone extension at the model 4100's location, contact your local telephone company to have one installed (there is a nominal charge for this service). If you have four-pin jacks, adapters are readily available to convert them to the modular plugs. Contact your local telephone company or electronics parts store.

IMPORTANT!

The Sensaphone model 4100 will operate with all standard telephone systems that accept pulse or tone dialing.

Certain private telephone systems and public switching equipment may not accept pulse and/or tone dialing, or may generate an unacceptable ring signal. In those cases, a dedicated line may be required for the 4100. Consult the supplier of your telephone system if you encounter problems.

The Sensaphone model 4100 cannot be used on an extension line to dial its own telephone number. Also, it may not be installed on a party line or pay telephone line.

CAUTION

Never install telephone wiring during a lightning storm. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Use caution when installing or modifying telephone lines.

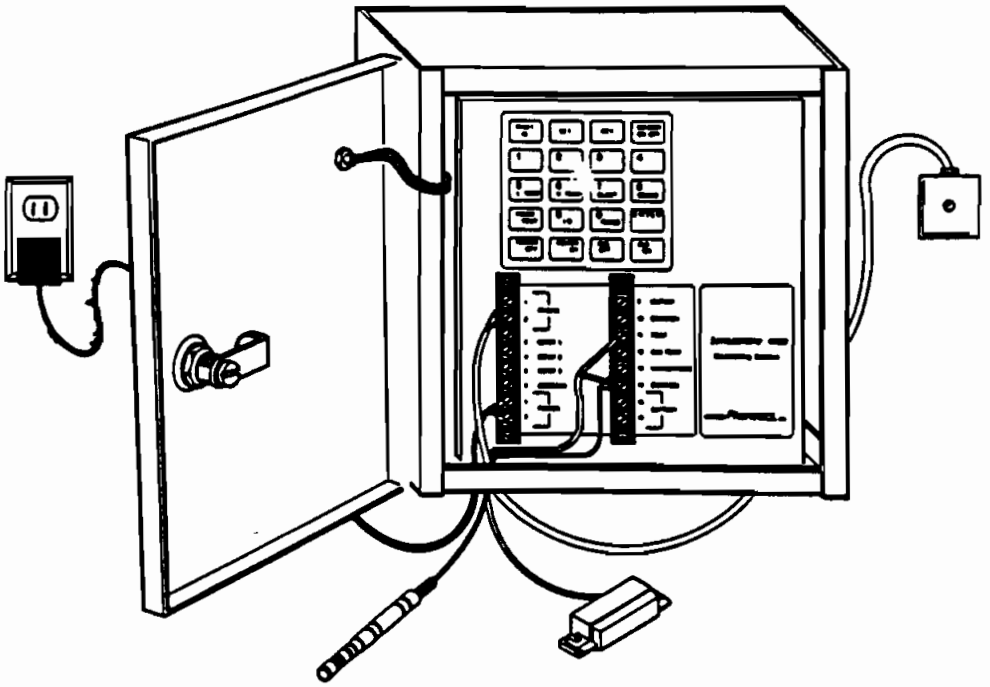


FIGURE 2: PLUGGING IN THE AC TRANSFORMER AND THE TELEPHONE JACK

You should use power surge suppression devices on both the 110 VAC power supply and the telephone line. Please refer to page 3 of the **INTRODUCTION** for further information.

THE PERMANENT BATTERY

The model 4100 is equipped with a permanent 1.9 Amp-hour gelled electrolyte battery with a constant trickle recharger. The battery is recharged whenever the AC transformer is plugged into an outlet.

A complete recharge will take approximately 48 hours. During that interval, a status report may give the "Battery condition low" alarm message.

THE BATTERY CONNECTION

Find the metal jumper that is attached to terminal 16 (marked **BATTERY**; see Figure 3) and the screw directly below it. Remove the jumper and attach it to BOTH **BATTERY** screws (terminals 15 and 16). This will connect the rechargeable battery to the Sensaphone. When the unit is in operation, this jumper must be connected to terminal 15 and 16 to ensure battery backup upon a power failure.

To disconnect the permanent battery, just reattach the jumper to the terminal 16 and the screw directly below it. If the unit is to be taken out of operation for any period of time, the battery must be disconnected.

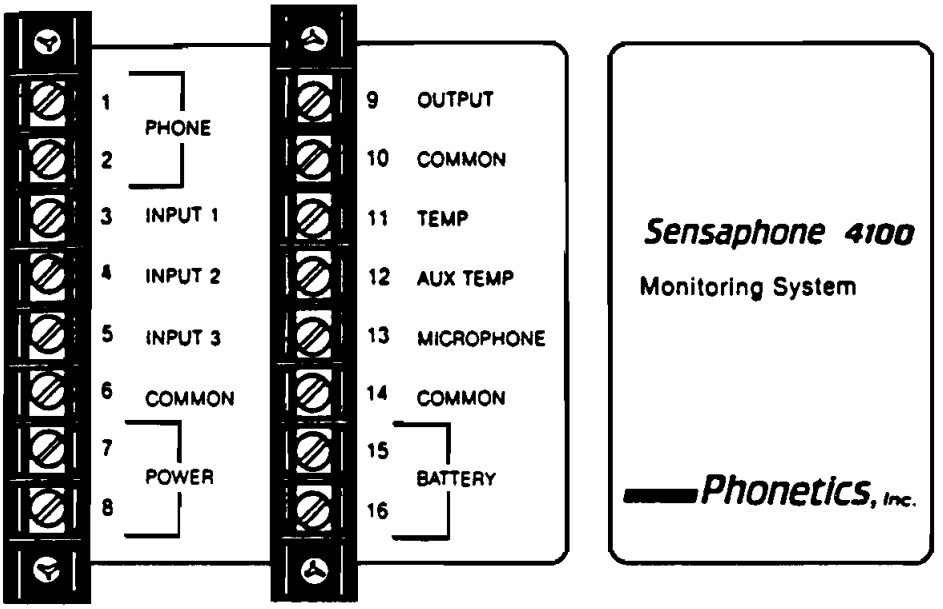


FIGURE 3: TERMINAL STRIPS

THE TEMPERATURE PROBE

The model 4100 provides a temperature probe, which is connected to terminals 10 and 11. It is used to monitor the temperature at the location of the sensor. The Sensaphone will check to see if it exceeds user-programmed high and low limits. The temperature is also given in a status report.

THE MICROPHONE

The Sensaphone Model 4100 provides a remote microphone probe, which is connected to terminals 13 and 14. It is used for both the high sound level feature and the listen-in feature.

THE ALERT INPUTS

The Sensaphone model 4100 has three digital alert input terminals (see Figure 3). They are designated Inputs 1, 2, and 3.

An alert input can be used with any *normally open* (N.O.) or *normally closed* (N.C.) *dry contact* device. *Open* is when there is no contact and *closed* is when a contact exists. The unit will adapt to N.O. or N.C. sensors when the unit's I.D. number is programmed (see Chapter 2, page 30).

CONNECTING A SENSOR TO AN ALERT TERMINAL

Each input consists of one screw, marked "INPUT (1, 2, or 3)." To the right of the screw is a small number that designates the terminal number. For example, Input 1 is terminal 3. You must determine which sensor will be connected to each specific alert input. For types, refer to Appendix C.

!!! IMPORTANT !!!

Do not use sensors, switches, or relays that supply voltage or current to the Model 4100.

Two wire leads are used to connect any monitoring sensor. Fasten one lead to the *common* and the other lead to the *input terminal*. Tighten both screws.

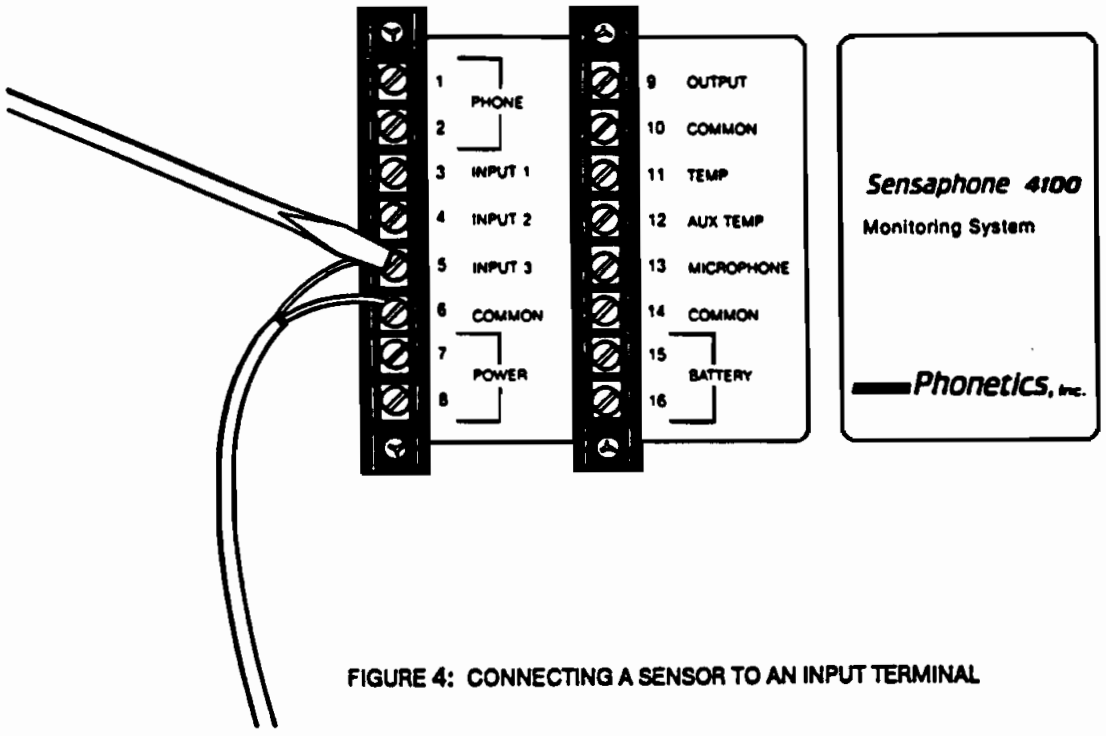


FIGURE 4: CONNECTING A SENSOR TO AN INPUT TERMINAL

NOTE:

Any N.O. or N.C. sensor can be attached to the Sensaphone model 4100 using 22 gauge wire. The sensor can be several hundred feet from the unit. The total resistance of the circuit cannot be greater than 50 ohms. Use wire appropriate for the application.

After all of the sensors are wired to the Sensaphone, and are in a normal (OK) position, the ID number must be programmed. When the ID number is programmed, the Sensaphone scans all the alert inputs, and whatever the unit sees at that time is the normal position for the inputs. This will set the normality of all the alert inputs. See Chapter 2 page 30.

MULTIPLE SENSORS ON AN ALERT INPUT

The Sensaphone model 4100 may have multiple sensors connected to the same input terminal. However, the *normal* condition for each sensor on the same terminal must be identical (either N.O. or N.C.).

MULTIPLE NORMALLY CLOSED SENSORS

To connect multiple *normally closed* sensors to one input, wire them in series. Fasten a lead from the first sensor to *common*. Connect the other lead from the first sensor to one lead from the next sensor. Continue wiring sensors end-to-end until you have wired all of your sensors. Wire the second lead from your last sensor to the input screw. Refer to Figure 5.

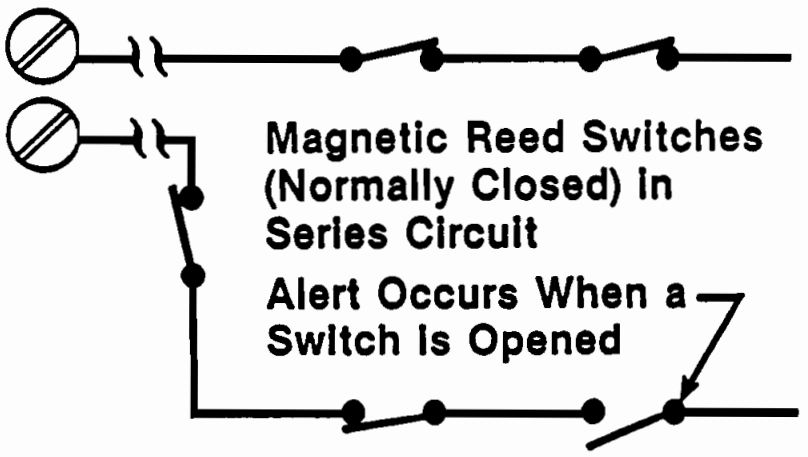


FIGURE 5: CONNECTING MULTIPLE N.C. SENSORS TO ONE INPUT TERMINAL

Multiple N.C. inputs are typically magnetic reed switches to monitor the security of windows and doors.

MULTIPLE NORMALLY OPEN SENSORS

To connect several *normally open* sensors to one input, wire them in *parallel*. Fasten one lead from each sensor to a *common*. Wire the second lead from each sensor to the corresponding *input terminal* (see Figure 6).

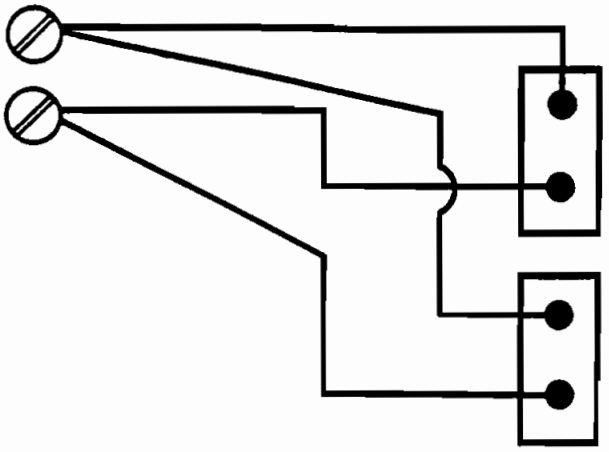


FIGURE 6: CONNECTING MULTIPLE N.O. SENSORS TO ONE INPUT TERMINAL

Multiple N.O. inputs are typically TEMP•ALERTs* to monitor the temperature in several different locations simultaneously.

AUXILIARY TEMPERATURE/ALERT 4 TERMINAL

The auxiliary temperature terminal is a dual purpose terminal. It can function as either a status-only temperature input or a fourth dry contact input. The auxiliary temperature/alert sensor is connected to terminals 12 and 14, which are marked **AUX TEMP** and *common*, respectively.

To wire the auxiliary temperature probe (FGD-0005), fasten one lead of the temperature probe to the **AUX TEMP** screw and the other lead to *common*. **The auxiliary temperature is only used in a status report and it will not cause an alarm dial-out.** If you use the terminal with an auxiliary temperature sensor, you cannot attach a dry contact sensor.

The terminal can be used as a fourth alert input terminal with a N.O. or N.C. dry contact sensor. If the status of the sensor changes, the unit will dial-out with the message "Alert condition four exists." To attach a dry contact sensor, follow the instructions in the previous sections. If you use the terminal with a fourth dry contact sensor, you cannot attach a temperature probe.

* trademark of Winland Electronics, Inc.

THE OUTPUT TERMINAL

The 4100's output is a TTL, low current signal. It can sink a maximum of 10 mA and source a maximum of 1 mA. When the 4100 starts to dial-out with an alarm message, it activates an output device. The output will deactivate when the unit hangs up the phone.

The output terminal requires a relay to control devices such as a horn or a light. We recommend that you use Phonetics' Output Controller (FGD-0012), which was designed specifically for the 4100. Contact Phonetics' Sales Department at (610) 558-2700 for details.

CHAPTER 2
KEYBOARD OPERATIONS

The Sensaphone model 4100 stores the following important programmable information in its memory.

- Time
- Four telephone numbers automatically called in emergencies
- Tone or pulse dialing
- High and low temperature alarm limits
- Disabling the high and/or low temperature alarms
- Number of rings before the Model 4100 answers the telephone to give a status report
- Length of the listen-in time
- Disabling the high sound alarm
- AC power failure recognition time
- Disabling the power failure alarm
- Disabling the alert inputs
- Keyboard lock
- The I.D. number
- Silencing the local speaker during dial-out and call-in

Set these parameters using the keyboard on the front of your Sensaphone model 4100 (see Figure 10).

The keys on the model 4100 are mentioned often in this chapter. In text, they will always be symbolized by **BOLDFACED, CAPITALIZED** letters. The sentence "Press **SET**, then **SOUND**" is read as "Press the key with the word SET on it, then press the key with the word SOUND on it."

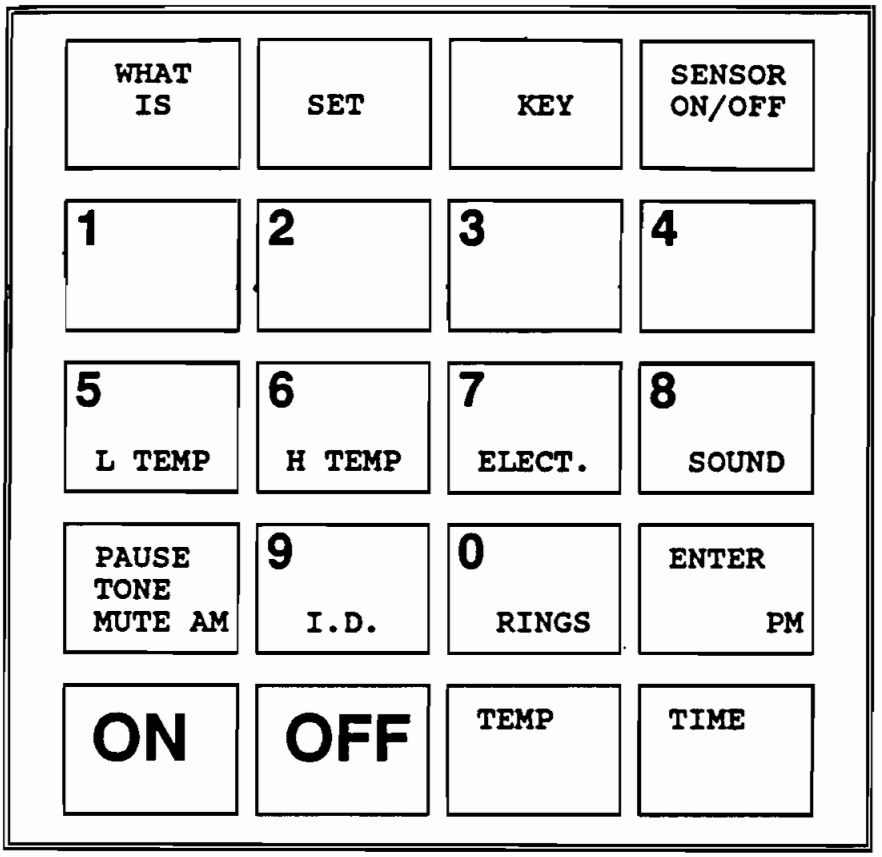


FIGURE 7: THE SENSAPHONE MODEL 4100 KEYBOARD

Several of the keys are multifunctional. In programming instructions, only the word for the specific parameter being programmed will be used. For example, the sentence "Press 9, then PAUSE." is read as "Press the key with 9/I.D. on it, then press the key with PAUSE/TONE/MUTE/AM on it." The specific parameter will also be **boldfaced** in the illustration. For example, "Press 9, then PAUSE." would be shown as follows:

Every time a key is pressed to begin programming or interrogation, the unit will beep. As data is being entered, the Sensaphone will repeat the number of the key pressed.

To begin programming your unit, make sure that the unit is installed and ON.

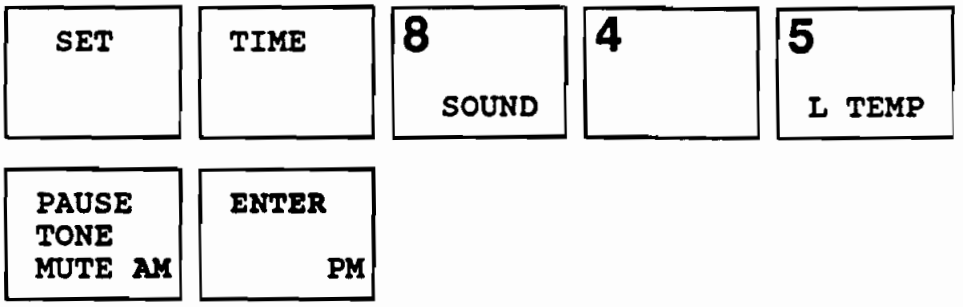
THE TIME

The Sensaphone Model 4100 has a built-in clock. When you first power-up the unit, the time will be 12 AM. It will start to keep time from 12 AM, until you program the current time. Then the clock keeps time from the new time. If the AC fails, the clock will continue to keep time until the battery back-up fails. When both the power and the battery back-up fail, the clock will reset to 12 AM. An incorrect time is a good indication that the power had failed.

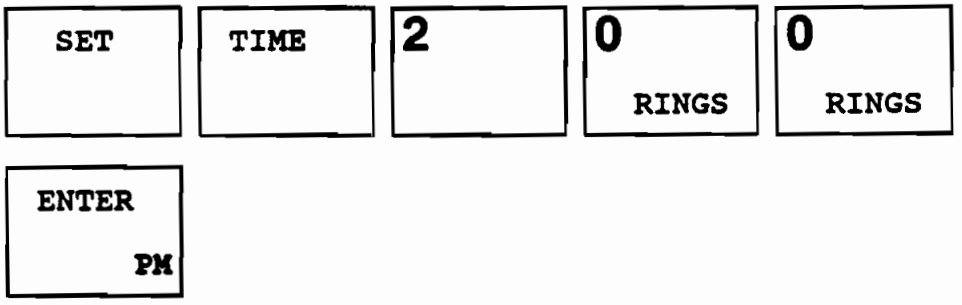
SETTING THE TIME

To set the time, press **SET**, followed by **TIME**. Enter the numbers for the correct time. If the time is AM, press **AM**, then **ENTER**. If the time is PM, just press **ENTER**.

For example, to set the time to be 8:45 AM, press the following keys:

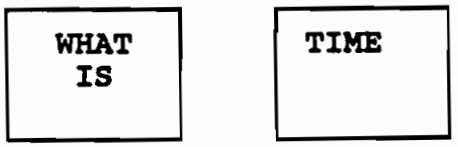


To set the time to be 2:00 PM, press the following keys:



CHECKING THE TIME

To check the time, press **WHAT IS**, then **TIME**. The unit will say "The time is (number, AM or PM).



Referring to the two previous examples, the unit should respond with "The time is 8:45 AM" and "The time is 2:00 PM," respectively.

THE TELEPHONE NUMBERS

The Sensaphone Model 4100 has the capability to store up to four, 32-digit (or smaller) telephone numbers in its memory. These telephone numbers are the alarm dial-out telephone numbers. They are known as Phones 1, 2, 3, and 4. The telephone numbers are programmed in the sequence in which you want to have them called. Therefore, the number to be called first would be Phone 1, the number to be called second would be Phone 2, et cetera. You can also program the Sensaphone to dial the Phone numbers using pulse (rotary) or tone dialing.

IMPORTANT!

Try to avoid programming dial out phone numbers that might be answered by an answering machine. There is no electrical or operational problem if an answering machine answers a phone call made by the Sensaphone, but if all the dial-out phone numbers are programmed to call answering machines, the unit can potentially dial out forever, leaving the alarm situation unacknowledged.

Instruct key people at each telephone number location about the Sensaphone Model 4100 and about what actions they should take if called with an alarm. If necessary, instruct switchboard operators to handle alarm and acknowledgement calls. Do not have the alarm call answered by a person who is unable to acknowledge the alarm or take prompt, effective action to deal with the situation. If appropriate, conduct periodic drills to familiarize personnel with the operation of the unit.

In some areas, municipal service (i.e. police, fire, medical) will not respond to automatic voice messages. Check with your local municipal services.

SETTING A DIAL-OUT TELEPHONE NUMBER

The Sensaphone can dial out using pulse dialing or touch-tones. It will normally dial-out with pulse, but can be switched to touch-tones by inserting **TONE** as the first digit of the telephone number. The PAUSE/TONE/MUTE/AM key will only indicate tone dialing when it is the first key of a telephone number. If **PAUSE** is inserted in the middle of a telephone number, it produces a 4-second pause during dial-out.

To set a telephone number, press **SET**, then the Phone number (**1, 2, 3, or 4**). Press TONE if the number should be tone-dialed. Press the

keys corresponding to the digits of the telephone number. Finally, press **ENTER**.

For example, to set Phone 1 as 1-215-555-8379, press **SET**, then **1**. Press the keys corresponding to the digits of the telephone number. Finally, press **ENTER**.

SET	1	1	2	1
5 L TEMP	5 L TEMP	5 L TEMP	5 L TEMP	8 SOUND
3	7 ELECT.	9 I.D.	ENTER PM	

To set Phone 2 as 1-215-555-9387 and tone-dialed, press **SET**, **2**, then **TONE**. Press the keys corresponding to the digits of the telephone number. Finally, press **ENTER**.

SET	2	PAUSE TONE MUTE AM	1	2
1	5	5 L TEMP	5 L TEMP	5 L TEMP
9 I.D.	3	8 SOUND	7 ELECT.	ENTER PM

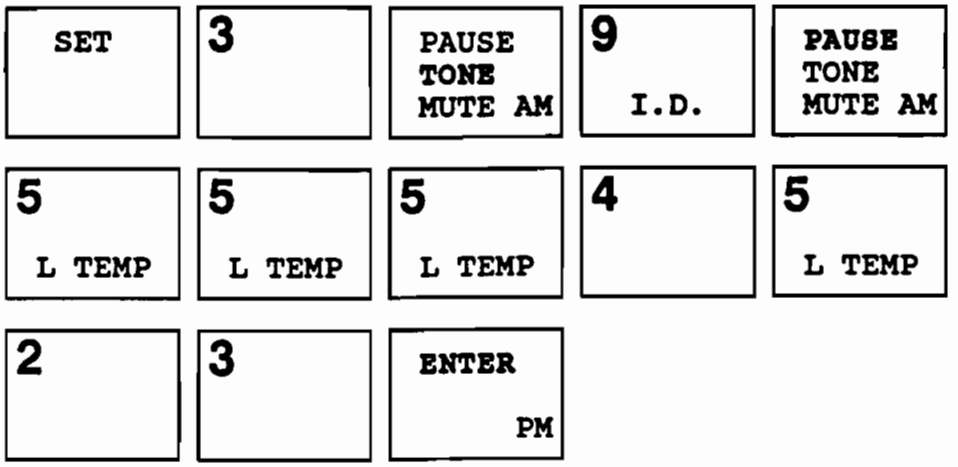
USING PAUSE

With some telephone systems, you must first dial an access number to reach an outside line, then pause for the connection before dialing a regular telephone number. The Model 4100 also has this capability.

The 4-second pause can be programmed as part of the telephone number. To do so, press **SET**, and the Phone number (**1**, **2**, **3**, or **4**) (for a tone-dialed number, then press **TONE**). Next, press the keys corresponding to the digit(s) of the access number, then press **PAUSE**.

Now press the keys corresponding to the digits of the regular telephone number. Finally, press **ENTER**.

For example, to set Phone 3 so that the Model 4100 will tone-dial 9 to access an outside line, wait 4 seconds for the dial tone, then tone-dial 555-4523, press the following keys:



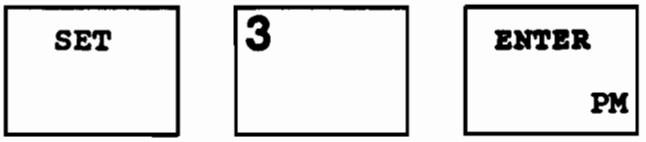
USING A POUND AND ASTERISK

When calling some phone systems or beeper systems, a pound tone or an asterisk tone may be required. To incorporate a pound tone within the dial-out phone number, press SET at the appropriate position within the phone number. To incorporate an asterisk tone within the dial-out phone number, press WHAT IS at the appropriate position within the phone number.

DELETING A PHONE NUMBER

To delete a telephone number from memory, press **SET**, the Phone number, then **ENTER**.

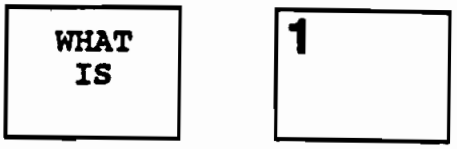
For example, to delete Phone 3 from memory, press the following keys:



CHECKING A DIAL-OUT TELEPHONE NUMBER

To check a telephone number, press **WHAT IS**, then the Phone number you want to check. The Model 4100 will state the telephone number.

For example, to check Phone 1, press the following keys:



The unit will say "One, two, one, five, five, five, five, eight, three, seven, nine."

When you check a telephone number that is tone-dialed or has a programmed pause, the Sensaphone will beep where the PAUSE/TONE key was pressed. For example, to check Phone 2 in SETTING A DIAL-OUT TELEPHONE NUMBER, press **WHAT IS** then **2**. The Sensaphone will beep, then say "One, two, one, five, five, five, five, nine, three, eight, seven." Another example is checking Phone 3 from USING PAUSE. Press **WHAT IS**, then **3**. The Model 4100 will beep, say "Nine," beep again, then say "One, two, one, five, five, five, five, four, five, two, three."

If there is no dial-out telephone number in the unit's memory, it will say "No number. For example, to check Phone 3 after it has been deleted, press **WHAT IS**, then **3**. The Model 4100 will say "No number."

When you check a telephone number, you will also be told if the corresponding Alert input is disabled (see page 28). That is, when you press **WHAT IS**, then **1**, the Sensaphone will say "Off" if Alert 1 is disabled, then state Phone 1. If Alert 1 is enabled, the 4100 will just state the Phone number.

THE TEMPERATURE LIMITS AND ALARMS

The temperature limits are the high and low readings at the temperature probe which will cause the model 4100 to automatically dial-out with an alarm message. The range of the temperature probe is -20° F to +150° F. The Model 4100 has default high and low temperature limits of +98 F and +55 F respectively, until new ones are set.

HINT:

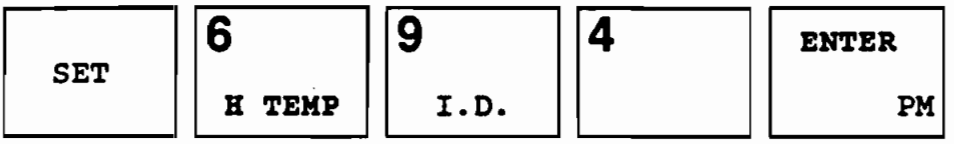
Do not set the limits too close to the normal room temperature. Minor changes in temperature would cause frequent and unnecessary alarm dial-outs.

PROGRAMMING THE HIGH TEMPERATURE LIMIT

The high temperature limit is the high reading at the temperature probe that will cause a dial-out. The model 4100's alarm message is "The temperature is high." Until you program in your own value, the unit has a high limit of +100° F.

To program the high temperature limit, press **SET**, then **H TEMP.** Press **PAUSE** if the limit is negative. Next, press the keys for temperature limit, then **ENTER.**

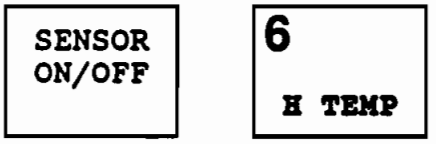
For example, to program the high temperature limit to be 94° F, sequentially press the following keys:



THE HIGH TEMPERATURE ALARM

The high temperature alarm causes the model 4100 to dial-out when the temperature exceeds the high temperature limit. It is automatically enabled when the unit is initially activated.

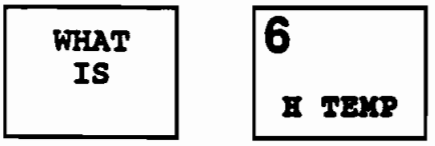
To disable the high temperature alarm, press **SENSOR ON/OFF** and **H TEMP.** The Sensaphone model 4100 will say "Off."



To re-enable the high temperature alarm, press **SENSOR ON/OFF,** then **H TEMP.** The unit will say "On."

CHECKING HIGH TEMPERATURE LIMIT AND ALARM STATUS

Check the programmed value of the high temperature limit and the status of the alarm by pressing **WHAT IS,** then **H TEMP.**



If the alarm has been disabled, the model 4100 will say "Off," then state the programmed high temperature limit. If the alarm is enabled, the unit will just state the high temperature limit.

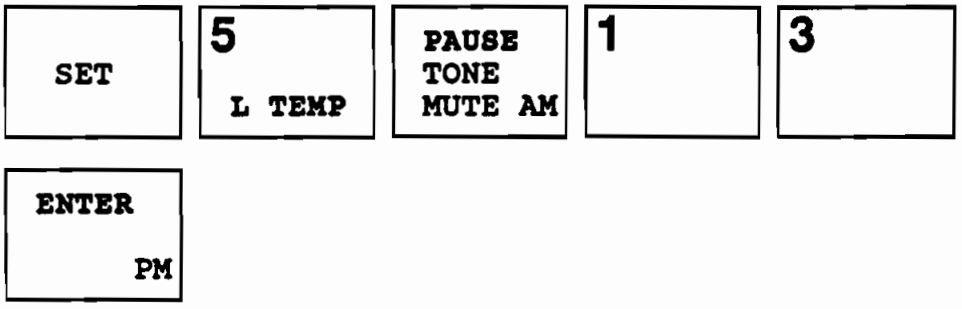
Referring to the example in PROGRAMMING THE HIGH TEMPERATURE LIMIT, the model 4100 will say "Ninety-four degrees."

PROGRAMMING LOW TEMPERATURE LIMIT

The low temperature limit is the low reading at the temperature probe that will cause a dial-out. The model 4100's alarm message is "The temperature is low." Until you program in your own value, the unit has a low temperature limit of +10° F.

To program the low temperature limit, press **SET**, then **L TEMP**. Press **PAUSE** if the limit is negative. Next, sequentially press the keys for the temperature limit, then press **ENTER**.

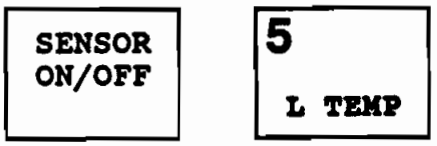
For example, to set the low temperature limit to be -13° F, press the following keys:



LOW TEMPERATURE ALARM

The low temperature alarm causes the Sensaphone model 4100 to dial-out when the temperature exceeds the low temperature limit. It is automatically enabled when the unit is initially activated.

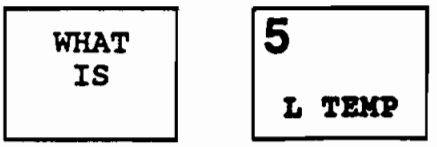
To disable the low temperature alarm, press **SENSOR ON/OFF** and **L TEMP**. The model 4100 will say "Off."



To re-enable the low temperature alarm, press **SENSOR ON/OFF**, then **L TEMP**. The unit will say "On."

CHECKING LO TEMPERATURE LIMIT AND ALARM STATUS

Check the programmed value of the lo temperature limit and the status of the alarm by pressing **WHAT IS**, then **L TEMP**.

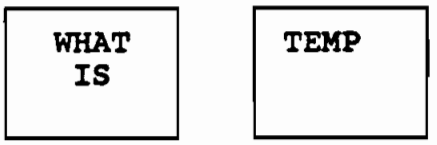


If the alarm is disabled , the Sensaphone model 4100 will say "Off," then state the programmed low temperature limit. Otherwise, the unit will just state the lo temperature limit.

For example, to check the low temperature limit programmed in PROGRAMMING THE LOW TEMPERATURE LIMIT, press **WHAT IS**, then **L TEMP**. The unit will say "Thirteen degrees belo zero."

OBTAINING A CURRENT TEMPERATURE REPORT

By pressing **WHAT IS**, then **TEMP**, you can find out the current temperature at the temperature probe's location. It is automatically updated by the model 4100 as conditions change.



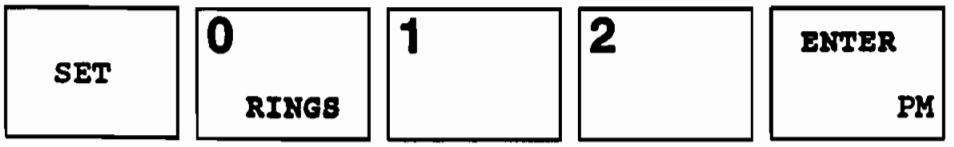
THE RINGS UNTIL ANSWER AND TAD COMPATIBILITY

The *Rings Until Answer* are the number of rings that must occur before the Sensaphone model 4100 will answer the telephone in response to a call-in. The number of rings can be from 1 to 199. Until you program your own value, the *Rings Until Answer* is set to 4.

PROGRAMMING THE RINGS UNTIL ANSWER

To program this number, press **SET**, then **RINGS**. Press the key(s) corresponding to the number of rings desired, then press **ENTER**.

For example, to program the number of rings to be 12, press **SET**, then **RINGS**, **1**, **2**, then **ENTER**.



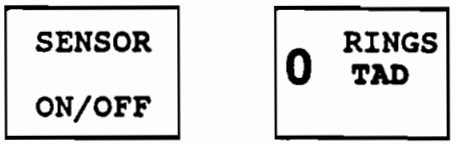
TELEPHONE ANSWERING DEVICE COMPATIBILITY

The Sensaphone model 4100 can be used on the same telephone line with a telephone answering device (TAD), such as an answering machine or modem.

HOW TO SET TAD

Program the number of rings until answer on the Sensaphone 4100 higher than that on your answering device. For example, set the Sensaphone rings for 6 and the answering device rings for 4.

Set the TAD feature on. To enable the TAD, press SENSOR ON/OFF and then TAD. The Sensaphone 4100 will say "On."



This function is automatically disabled when the unit is initially activated. If the unit is not going to be operated on the same phone line with another answering device, there is no need to program the TAD.

To disable the TAD, just repeat the above procedure so that the Sensaphone says "Off."

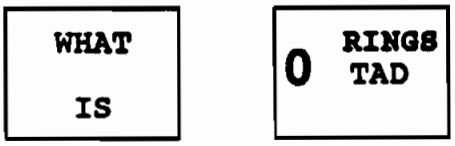
HOW TAD WORKS

When calling in for a status report, your answering device will answer the phone first, bypassing the Sensaphone. When you hang up and call again within the next three minutes, the Sensaphone will answer on the first or second ring, bypassing the answering device.

When acknowledging an alarm by calling back, the Sensaphone will answer on the first or second ring.

CHECKING RINGS UNTIL ANSWERED AND TAD COMPATIBILITY

To check the number of *Rings Until Answer*, press **WHAT IS**, then **RINGS**.



If TAD is disabled, the model 4100 will say "Off," then state the *Rings Until Answer*. If the TAD compatibility is enabled, the unit will just state the *Rings Until Answer*.

Referring to the example in PROGRAMMING THE RINGS UNTIL ANSWER, model 4100 will say "Off. Twelve."

MONITORING SOUND

The **SOUND** key has two functions. It is used to program the amount of time you can *listen-in* through the microphone probe. It is also used to disable the high sound alarm.

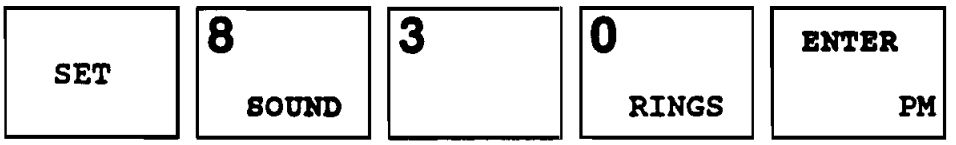
THE LISTEN-IN TIME

Listen-in time is the amount of time you can listen to the activities at the microphone's location. The range is from 1 to 199 seconds. Until you set the *listen-in time*, it will be 10 seconds.

PROGRAMMING LISTEN-IN TIME

Program the *listen-in time* by pressing **SET**, then **SOUND**. Next, sequentially press the keys corresponding to the number of seconds of *listen-in time*. Finally, press **ENTER**.

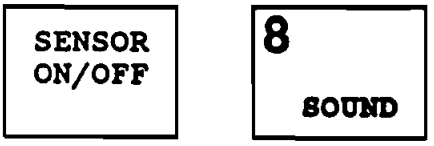
For example, to program the *listen-in time* to be 30 seconds, you would sequentially press the following keys:



THE HIGH SOUND ALARM

The high sound alarm causes the Sensaphone model 4100 to dial-out when the current sound level suddenly exceeds the normal sound level. This increased sound level must exist for at least ten seconds. The alarm is automatically enabled when the unit is initially activated.

To disable this function, press **SENSOR ON/OFF**, then **SOUND**. The unit will say "Off."

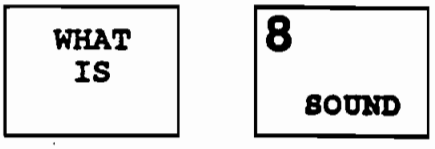


To re-enable the high sound alarm, press **SENSOR ON/OFF**, then **SOUND**. The model 4100 will say "On."

Disabling the high sound alarm **will not** affect the model 4100's listen-in function.

CHECKING LISTEN-IN TIME AND HIGH SOUND ALARM

To check the duration of *listen-in time* and the status of the high sound alarm, press **WHAT IS**, then **SOUND**.



If the alarm is disabled, the model 4100 will say "Off," then state the *listen-in time*. If the alarm is enabled, the unit will just state the *listen-in time*.

Referring to the example in PROGRAMMING LISTEN-IN TIME, the model 4100 will say "Thirty seconds."

AC POWER FAILURE

The **ELECT.** key has two functions. It is used to program the amount of continuous time a power failure must exist before causing an alarm dial-out. It is also used to change the on/off status of the power failure alarm.

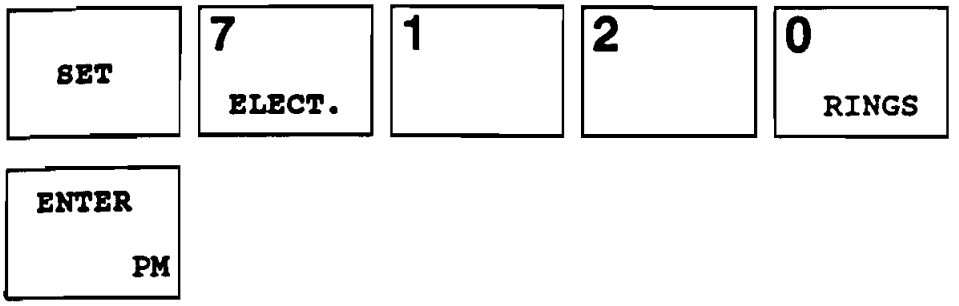
AC POWER FAILURE RECOGNITION TIME

The *recognition time* is the amount of continuous time (in seconds) that a power failure must exist before causing an alarm dial-out. It can be from 1 to 199 seconds. If you do not program a *recognition time*, the Sensaphone model 4100 will automatically set it to be 100 seconds.

PROGRAMMING THE RECOGNITION TIME

To program the *recognition time*, press **SET**, then **ELECT.** Sequentially press the keys corresponding to the number of continuous seconds an AC power failure should exist before a power failure dial-out. Finally, press **ENTER.**

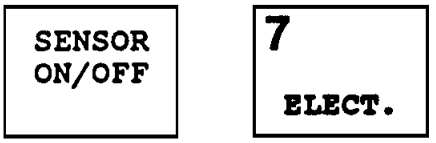
For example, to set the *recognition time* to be 120 seconds, sequentially press the following keys:



AC POWER FAILURE ALARM

The power failure alarm causes the model 4100 to dial-out when the AC power fails for a user-programmed period of time (see AC POWER FAILURE RECOGNITION TIME). It is automatically enabled when the unit is initially activated.

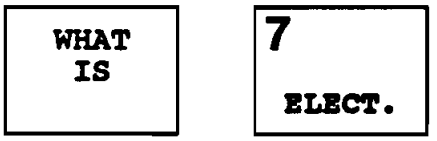
To disable the power failure alarm, press **SENSOR ON/OFF**, then **ELECT.** The unit will say "Off."



To re-enable the AC power failure alarm, press **SENSOR ON/OFF**, then **ELECT.** The model 4100 will say "On."

CHECKING RECOGNITION TIME AND ALARM STATUS

Check the *recognition time* and the power failure alarm status by pressing **WHAT IS**, then **ELECT.**



If the alarm is turned off, the model 4100 will say "Off," then state the *recognition time*. If the alarm is turned on, the Sensaphone model 4100 will just state the *recognition time*.

Referring to the example in PROGRAMMING THE RECOGNITION TIME, the unit will say "One hundred-twenty seconds."

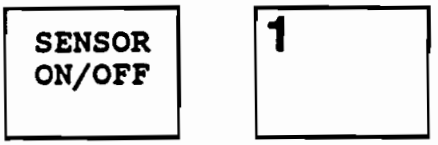
POWER-OFF TIME ACCUMULATOR

Each time the AC power fails, the Sensaphone accumulates the time in its memory. It then will state the total amount of time the power has failed in its status report (see page 34). The off-time accumulator will add up the length of power failure for 255 minutes and 59 seconds. After that, the unit will reset to 0. If the AC power and the battery back-up fail, the accumulator will reset to 0. To manually reset the power-off time, press **OFF**, then **ON**.

DISABLING/ENABLING THE ALERT INPUTS

An alert input alarm causes the model 4100 to dial-out when the status of any of the four attached alert sensors changes for at least 200 milliseconds. It is automatically enabled when the unit is initially activated.

To disable an alert input alarm, press **SENSOR ON/OFF**, then the input number (1, 2, 3, or 4). The unit will say "Off." For example, to disable Alert 1, press the following keys:



The Sensaphone will say "Off."

To re-enable an alert input alarm, press **SENSOR ON/OFF**, then the input number (1, 2, 3, or 4). The model 4100 will say "On."

Please note that if you disable Alert 4 when a temperature probe is attached to the terminal, the Sensaphone will still state the temperature in a status report.

When you check a telephone number, you will also be told if the corresponding Alert input is off. That is, when you press **WHAT IS**, then 1, the Sensaphone will say "Off" if Alert 1 is disabled, then state Phone 1. If Alert 1 is enabled, the 4100 will just state the Phone number.

THE SECURITY CODE

The Sensaphone model 4100 has a programmable security code. It ensures that unauthorized personnel cannot readily tamper with the unit's programming or turn off the unit. The security code can be any number from 1 to 9999.

LOCKING THE KEYBOARD

To set the security code, press **SET**, then **KEY**. The 4100 will say "Enter security code." Next, sequentially press the keys corresponding to the security code. Finally, press **ENTER**.

For example, to set the security code to be 33, press **SET**, **KEY**, **3**, **3**, then **ENTER**.

The keyboard will now be locked. Only someone who knows the security code will be able to unlock the keyboard. Anyone who tries to change any of the programming or tries to turn the unit off will receive the "Error" message.

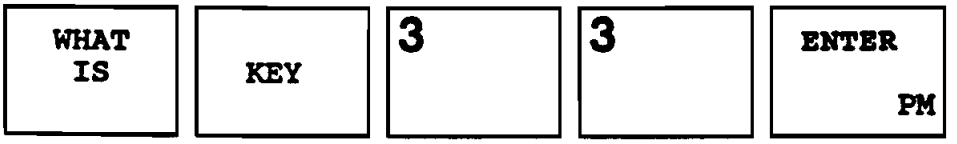
IMPORTANT!

Please note that unauthorized personnel are stopped from changing any of the model 4100's programmable parameters. They are **not** stopped from using **WHAT IS** to find out any information. Additional protection may be necessary.

UNLOCKING THE KEYBOARD

To unlock the keyboard, press **WHAT IS**, then **KEY**. The 4100 will say "Enter security code." Next, sequentially press the keys corresponding to the security code. Finally, press **ENTER**. The unit will say "Okay."

Continuing with the example above, you would unlock the keyboard by pressing the following keys:



The model 4100 will say "Okay."

NOTE:

If you enter the wrong security code, the unit will say "Error 2" after you press **ENTER.**

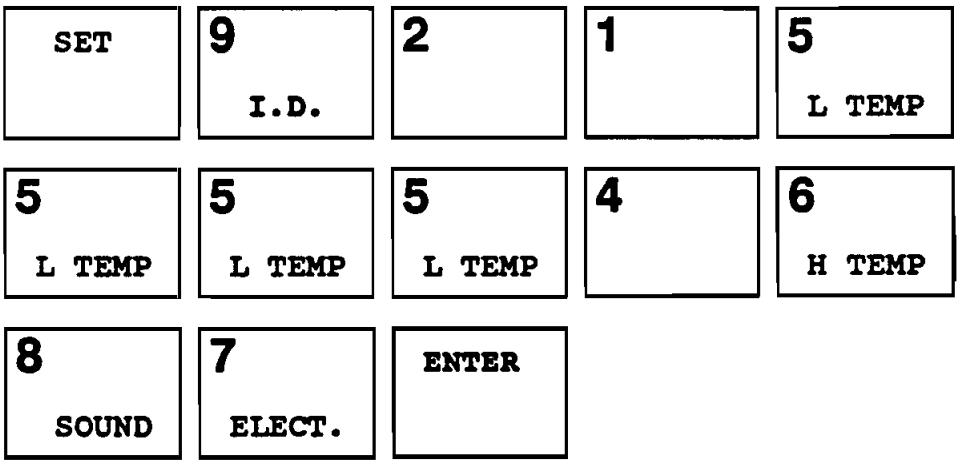
If you forget your security code, unplug the AC transformer and disconnect the battery. Next, reconnect the battery and plug the AC transformer back into the outlet. You will have to program a new security code and reprogram the time.

THE I.D. NUMBER

The unit's I.D. number can be from 1 to 32 digits long. It is usually the telephone number where the unit is located. The I.D. number should be programmed after all sensors are wired to the 4100 in their normal state. This establishes the normal condition of the alert inputs in the Model 4100's memory.

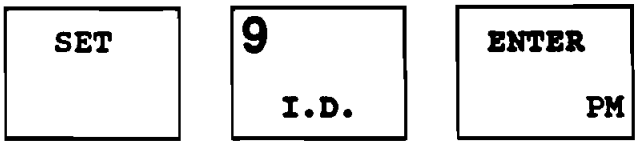
SETTING THE I.D. NUMBER

To set the I.D. number, press **SET**, then **I.D.** Next, press the keys corresponding to the digits of the I.D. number. Finally, press **ENTER.** For example, to set the unit's I.D. number to be 215-555-4687, press the following keys:



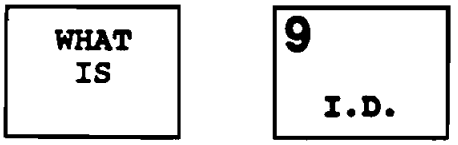
DELETING THE I.D. NUMBER

To delete the I.D. number from memory, press **SET, I.D.,** then **ENTER.**



CHECKING THE I.D. NUMBER

To check the identification number, press **WHAT IS**, then **I.D.**



The unit will repeat its I.D. number, as well as give you a status report, which follows:

STATEMENT	COMMENT
Hello	
This is telephone number _____	(the I.D. number)
The time is _____	(current time)
Alert condition _____	OKAY 1 EXISTS 2 EXISTS 3 EXISTS 4 EXISTS
The temperature is _____ degrees	(temp. at the probe)
(temperature alarm condition)	OKAY THE TEMPERATURE IS HIGH THE TEMPERATURE IS LOW
Two*	
The temperature is _____ degrees*	(temp. at the aux probe)
The electricity is _____	ON OFF
Power off time _____ minutes _____ seconds	(the total amount of time AC has failed)**
(back-up battery condition)	OKAY BATTERY CONDITION LOW REPLACE BATTERY
Sound level _____	OK HIGH
	NO NUMBER***

* *only if the optional second temperature probe is attached.*
** *up to 255 minutes, 59 seconds*
*** *only if no dial-out telephone numbers programmed*

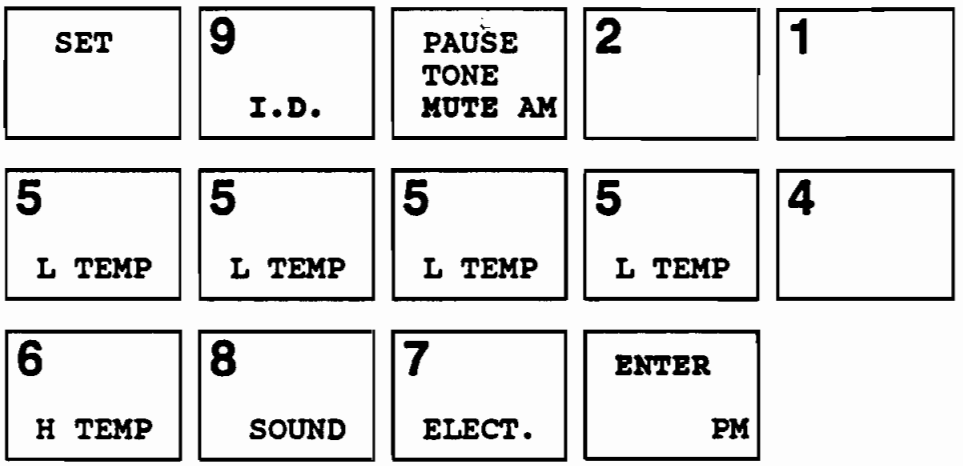
Referring to the example in SETTING THE I.D. NUMBER, the Model 4100 would say "Hello. This is telephone number two, one, five, five, five, five, four, six, eight, seven," then give the rest of the status report.

If there is no I.D. number programmed, the unit will say "No number" after the phrase "This is telephone number."

MUTING THE SENSAPHONE DURING DIAL-OUT AND CALL-IN

The Sensaphone has a programmable mute as a security feature. The mute will only be in effect during dial-out and call-in; in other words, it will not affect programming the unit. The mute turns off the local speaker when the Sensaphone is dialing out with an alarm or accepting an incoming phone call.

To program the mute, press **MUTE** before you program the I.D. number. For example, to mute the speaker while programming the I.D. number to be 215-555-4687, press the following keys:



When you check the I.D. number, the Sensaphone will say "Hello. This is telephone number," beep to indicate that the mute is programmed, then continue on with the rest of the status report.

HINT:

Sometimes, people need to use the model 4100 to monitor doors and/or windows. They find that they cannot leave the Sensaphone's location without tripping an alert condition. To leave the Sensaphone's location, press **WHAT IS**, then **I.D.** The Sensaphone will begin giving the status report, which takes approximately 30 seconds. During those 30 seconds, the 4100 will not sense any changes in the alert inputs, though it will still acknowledge high/low temperature and AC power failure. This gives you approximately 30 seconds to leave the building without tripping an alert condition.

CHAPTER 3
OPERATING FUNCTIONS

ON AND OFF KEYS

The first two keys in the fourth row of the 4100's keyboard are ON and OFF. They are used to activate and deactivate the model 4100.

ON

When you press ON, the red light on the door of 4100 will begin to glow. The unit will say "Hello" or beep if it is already on.

This state enables the model 4100 to receive incoming calls and automatically dial-out in the event of the failure of a monitored condition. The red light will always glow while the model 4100 is in the activation state.

OFF

When you press OFF, the model 4100 will say "Have a good day." and the red light will stop glowing. All functions, except battery back-up, are disabled. The batteries will still recharge if the AC transformer is plugged into 110 VAC outlet. This will also clear the power out accumulator.

It is recommended that you do not press OFF unless it is absolutely necessary. Full power is still consumed by the unit, though it cannot be programmed or interrogated. Also, the unit cannot dial-out with an alarm.

MICROPHONE PROBE

The provided microphone probe is attached to the Sensaphone model 4100 with a 25 foot wire cable. It has three important functions:

- It will continuously listen for a high sound level that increases 10 decibels over the normal sound level at a frequency of 1000 Hertz or more. If this sound level exists for 10 consecutive seconds or longer (such as a smoke alarm or burglar alarm), then the model 4100 will dial-out with an alarm message.

- During an automatic dial-out, the microphone allows four 4-second intervals to *listen-in* to the model 4100's location.

- During a call-in, the microphone allows a *listen-in* for a user-programmed interval from 1 to 199 seconds.

The location of the audible alarm in relation to the microphone is extremely important. Normally, the 4100 and the audible alarm must be in the same room. The maximum distance can vary considerably depending on the alarm, the acoustics, and the size of the room.

ALARM CHECK

After the microphone probe and the alarm have been positioned, activate the alarm for 10 seconds. The unit should say "Sound level high" and start its dial-out procedure. Stop the alarm dial-out by pressing any key.

If the model 4100 fails to respond, the microphone probe and the alarm must be moved closer together. **You should wait 60 seconds between tests.**

IMPORTANT!

The ability of the unit to react to an audible alarm must be checked upon installation and periodically verified!

Please note that short duration or intermittent alarm signals may not trigger the alarm dial-out.

THE CALL-IN STATUS REPORT

You can call-in to the Sensaphone model 4100 anytime to get a status report. The unit will answer the call-in after the number of rings programmed as *Rings Until Answer*. The unit will say the following:

STATEMENT	COMMENT
Hello	
This is telephone number _____	(the I.D. number) NO NUMBER
The time is _____	(current time)
Alert condition _____	OKAY 1 EXISTS 2 EXISTS 3 EXISTS 4 EXISTS
The temperature is _____ degrees	(temp. at probe)
(temperature alarm condition)	OKAY THE TEMPERATURE IS HIGH THE TEMPERATURE IS LOW
Two*	
The temperature is _____ degrees*	(temp. at auxiliary probe)
The electricity is _____	ON OFF
Power off time _____ minutes _____ seconds	(the total amount of time AC has failed)**
(back-up battery condition)	OKAY BATTERY CONDITION LOW REPLACE BATTERY
Sound level _____	OK HIGH NO NUMBER***
Listen to the sound level for _____ seconds.	(listen-in for user-programmed time)

* *only if the optional second temperature probe is attached.*
** *up to 255 minutes, 59 seconds*
*** *only if no dial-out telephone numbers programmed*

After the listen-in, the model 4100 will repeat the status report once more. At the end of the report, the Sensaphone will say "Have a good day," then disconnect from the telephone line.

AUTOMATIC DIAL-OUT

The Sensaphone model 4100 will automatically dial-out to the four telephone numbers you had programmed into its memory when one or more of the following conditions occurs (assuming the alarms are enabled):

- The AC power goes off for the user-programmed interval (1 to 199 seconds). The model 4100 will locally say "The electricity is off." every 15 seconds for a user-programmed period.
- The temperature varies beyond the high or low limits you have programmed. This will cause the alarm message "The temperature is high" or "The temperature is low," respectively.
- A high sound level occurs whose duration is 10 seconds or longer. The Sensaphone will say "Sound level high."
- The status of Alerts 1, 2, or 3 changes for at least 200 milllseconds or the status of Alert 4 changes for at least 3 seconds. This will cause the alert message "Alert condition (1, 2, 3, or 4) exists."

The model 4100 will announce the detected alarm condition locally through its speaker for thirty seconds, then start its automatic dial-out function. If the Sensaphone has been muted, it will still delay for 30 seconds before dialing-out.

The alarm message for AC power failure will be announced locally every 15 seconds for a user-programmed interval (see Chapter 2, page 26) before dial-out occurs. If the AC recognition is 15 seconds or less, you may not get a locally spoken message. After the recognition time has elapsed, the Sensaphone will instantly dial-out, without waiting 30 seconds.

The model 4100 will dial Phone 1 and say "Hello. This is telephone number (the ID number)." It will state the alarm message, then allow a 4-second listen-in. This sequence will be repeated three more times. **The Sensaphone begins talking after the last digit of the Phone number is dialed. Therefore, when you answer the phone, the Sensaphone could be at any point in its four repetitions, depending on how quickly you answer the phone.**

After the fourth listen-in, the Sensaphone will say "Indicate you have received warning message. Dial telephone number (the I.D. number) within thirty seconds." Finally, the unit will disconnect from the telephone line.

The unit will then wait thirty seconds for an acknowledging call-back. If the alarm is not properly acknowledged, the 4100 will call Phone 2 and go through the same procedure. If there is no call-back, it will call Phone 3 and repeat the procedure. If that call is not acknowledged, the unit will call Phone 4. If there is no acknowledging telephone call, the model 4100 will begin the entire procedure again, starting with Phone 1. If a certain Phone number is not programmed, the Sensaphone will skip to the next sequential programmed Phone number without a delay (e.g. if Phone 3 is not programmed, the 4100 will call Phone 4 if it does not receive a call-back from Phone 2).

This cycle can be stopped at any time by pressing any key.

NOTE:

If only one Phone number is in memory, the Sensaphone model 4100 will dial-out fifteen times, then stop, in accordance with FCC regulations.

ACKNOWLEDGEMENT OF ALARMS

Locally - At any time during an alarm dial out, the alarm may be acknowledged by hitting any key on the keypad twice. This will stop the dial out procedure and the unit will indicate that the warning message was received by its ID number.

Touch-Tones - At the end of the dial-out alarm message, the unit will say "Indicate you have received warning message" and then pause for five seconds. During those five seconds of silence, you may acknowledge receipt of the alarm by pressing 5, 5, 5 on any Touch-Tone telephone. This will stop the dial-out procedure. When the Sensaphone receives the Touch-Tones 5, 5, 5, it will respond by saying "Warning message received by telephone number_____." and will disconnect from the phone line. If the unit does not receive these touch tones, it will continue by stating "Dial telephone number (ID number) within 60 seconds".

Call back - To acknowledge an alarm dial-out, you must call the unit back. The first ring of your call-back must occur within 60 seconds after the model 4100 completes its alarm call and hangs up.

If TAD is enabled, the phone must ring two times. The Sensaphone will therefore answer the telephone before the TAD device. **If TAD is disabled,** the phone must ring 10 times. This is a precaution against a miscellaneous acknowledging the alarm.

When the Sensaphone answers the call-back, it will give a status report (see CHECKING THE ID NUMBER, page 31), then say "Warning message received by" and state the telephone number that

acknowledged the alarm condition. It will discontinue further dialing-out for this alarm condition.

For example, your unit (ID number 215-555-4086) dials-out with an alert condition 3 that occurred at 3:47 AM. The temperature is 75°. All other conditions are normal. There is no auxiliary temperature sensor connected to the unit. Someone at Phone 1 (1-215-555-4521) calls-in to acknowledge the alert condition. He or she would hear the following message:

Hello.

This is telephone number two, one, five, five, five, five, four, zero, eight, six.

The time is three, forty-seven AM.

Alert condition three exists.

The temperature is 75 degrees.

Okay.

The electricity is on.

Sound level okay.

Warning message received by one, two, one, five, five, five, five, four, five, two, one.

Once an alarm condition has been acknowledged, the model 4100 will return to normal functioning. The only time the Sensaphone will dial out again is if that condition disappears and then occurs again, or if any other alarm occurs.

After an alarm has occurred and been acknowledged, "Warning message received by_____." will exist within the status report. This will be present until the alarm condition goes away.

APPENDIX A: EXPLANATION OF KEYS

KEY	FUNCTION
WHAT IS	-Used in interrogation of unit.
SET	-Used in programming of unit.
KEY	-When used with **SET**, programs the keyboard lock code and locks the keyboard. -Used with **WHAT IS** to unlock the keyboard.
SENSOR ON/OFF	-Used to turn the various sensors ON or OFF.
L TEMP	-When used with **SET**, programs low temperature limit into memory. -When used with **SENSOR ON/OFF**, turns ON/OFF the low temperature alarm. -When used with **WHAT IS**, states low temperature limit and condition of the low temperature alarm.
H TEMP	-When used with **SET**, programs high temperature limit into memory. -When used with **SENSOR ON/OFF**, turns ON/OFF the high temperature alarm. -When used with **WHAT IS**, states high temperature limit and the condition of the high temperature alarm.
ELECT.	-When used with **SET**, programs the amount of time (from 1-199 seconds) the model 4100 will wait before calling out with a power failure alarm. -When used with **SENSOR ON/OFF**, turns ON/OFF the power failure alarm. -When used with **WHAT IS**, states the amount of time programmed and condition of power failure alarm (ON or OFF).
SOUND	-When used with **SET**, programs the amount of time (from 1-199 seconds) you can listen-in over the microphone probe. -When used with **SENSOR ON/OFF**, turns the high sound alarm ON/OFF. -When used with **WHAT IS**, states amount of listen-in time in seconds and the condition of the high sound alarm.
PAUSE	-When used while entering a *dial-out* telephone number, programs the model 4100 to pause while it accesses an outside telephone line.

TONE	-When used as the first digit of a *dial-out* telephone number, programs the model 4100 to dial-out using touch-tone.
MUTE	-When used as the first digit the I.D. number, programs the model 4100 to mute the speaker during call-in and dial-out.
AM	-When used while programming time, sets the time to be AM.
I.D.	-When used with **SET**, programs unit's identification number and sets the normality of the alert inputs. -When used with **WHAT IS**, gives a full status report.
RINGS	-When used with **SET**, programs the number of rings before the unit answers the telephone. -When used with **SENSOR ON/OFF**, turns ON/OFF units compatibility with an answering machine. -When used with **WHAT IS**, states the number of rings before the unit will answer the telephone.
ENTER	-Used in programming of unit to enter information into model 4100's memory.
PM	-When used while programming time, sets the time to be PM.
ON	-Used to activate the model 4100 for all operating functions.
OFF	-Used to deactivate the model 4100 and its operating functions.
TEMP	-When used with **WHAT IS**, states the current temperature.
TIME	-When used with **SET**, programs the time into the Sensaphone. -When used with **WHAT IS**, states the current time.

APPENDIX B: VALID KEYBOARD SEQUENCES

NOTE: The commands in brackets [] are optional.

INTERROGATION COMMAND SEQUENCES

WHAT IS	1	*Phone 1*
WHAT IS	2	*Phone 2*
WHAT IS	3	*Phone 3*
WHAT IS	4	*Phone 4*
WHAT IS	L TEMP	*low temp. limit*
WHAT IS	H TEMP	*high temp. limit*
WHAT IS	SOUND	*listen-in time*
WHAT IS	ELECT.	*AC recognition time*
WHAT IS	I.D.	*I.D. number*
WHAT IS	RINGS	*rings until answer*
WHAT IS	TEMP	*temperature*
WHAT IS	TIME	*time*

PROGRAMMING COMMAND SEQUENCES

SET	L TEMP	[PAUSE]	(number)	ENTER	*low temp. limit*
SET	H TEMP	[PAUSE]	(number)	ENTER	*high temp. limit*
SET	ELECT.		(number)	ENTER	*AC recognition time*
SET	SOUND		(number)	ENTER	*listen-in time*
SET	I.D.	[MUTE]	(number)	ENTER	*I.D. number and alert normality*
SET	TIME	(number)	AM	ENTER	*AM time*
SET	TIME	(number)		PM	*PM time*

SET	1	[TONE]	(number)	[PAUSE]	(number)	ENTER	*Phone 1*
SET	2	[TONE]	(number)	[PAUSE]	(number)	ENTER	*Phone 2*

SET	3	[TONE]	(number)	[PAUSE]	(number)	ENTER	*Phone 3*
SET	4	[TONE]	(number)	[PAUSE]	(number)	ENTER	*Phone 4*

ENABLING/DISABLING SENSORS

SENSOR ON/OFF	1	ENTER	*Alert 1 alarm*
SENSOR ON/OFF	2	ENTER	*Alert 2 alarm*
SENSOR ON/OFF	3	ENTER	*Alert 3 alarm*
SENSOR ON/OFF	4	ENTER	*Alert 4 alarm*
SENSOR ON/OFF	L TEMP	ENTER	*low temp. alarm*
SENSOR ON/OFF	H TEMP	ENTER	*high temp. alarm*
SENSOR ON/OFF	ELECT.	ENTER	*AC failure alarm*
SENSOR ON/OFF	SOUND	ENTER	*high sound alarm*
SENSOR ON/OFF	RINGS	ENTER	*TAD compatibility*

DELETING PARAMETERS

SET	I.D.	ENTER	*I.D. number*
SET	1	ENTER	*Phone 1*
SET	2	ENTER	*Phone 2*
SET	3	ENTER	*Phone 3*
SET	4	ENTER	*Phone 4*

SECURITY CODE

SET	KEY	(number)	ENTER	*lock keyboard*
WHAT IS	KEY	(number)	ENTER	*unlock keyboard*

APPENDIX C: ACCESSORIES

The sensors listed are the most commonly used input devices. However, there is a virtually unlimited variety of sensor/switch input devices available at commercial or industrial electrical supply houses. They can provide a device to monitor virtually any condition that might be required for your business, industrial or residential needs. Contact Phonetics' Sales department at (610) 558-2700 for more information.

MODEL NUMBER	SENSOR/SWITCH
FGD 0004	Water Detection Sensor
FGD 0005	Remote Temperature Sensor
FGD 0006	Magnetic Reed Switch
FGD 0007	Passive Infrared Motion Detector
FGD 0010	Accessory Wire (50 foot coil)
FGD 0011	Optical Pick-up
FGD 0012	4100 Output controller with cable
FGD 0022	TEMP'ALERT™
FGD 0023	ISOTEL surge protector
FGD 0027	Humidistat

APPENDIX D: APPLICATIONS

There are many ways to apply the Sensaphone model 4100 to your needs. Listed below are some of the ways our customers have used the model 4100, employing the built-in sensors for power failure, high sound level, and temperature, plus the additional sensors listed in Appendix C.

PURPOSE	LOCATION	SENSORS/INPUTS
SECURITY	RESIDENCES VACATION HOMES MOBILE HOMES BUSINESSES OFFICES BUILDINGS	MAGNETIC REED SWITCHES PASSIVE INFRARED MOTION DETECTORS
TEMPERATURE	RESIDENCES OFFICES FACTORIES REFRIGERATORS HVAC SYSTEMS GREENHOUSES ANIMAL BUILDINGS POULTRY BUILDINGS FANS/BLOWERS COMPUTER ROOMS TELECOM ROOMS	REMOTE TEMPERATURE SENSORS TEMP•ALERT™ TEMPERATURE SWITCHES POWER FAILURE ALARM
FIRE	RESIDENCES OFFICES FACTORIES REFRIGERATORS HVAC SYSTEMS ANIMAL BUILDINGS POULTRY BUILDINGS COMPUTER ROOMS TELECOM ROOMS	SMOKE/FIRE ALARMS
HUMIDITY	LABORATORIES TEST CHAMBERS FACTORIES GREENHOUSES	HUMIDISTATS

PURPOSE	LOCATION	SENSORS/INPUTS
FUMES/GASES	MINES FACTORIES LABORATORIES BOATS/SHIPS CHEMICAL PLANT FAN VENTILATORS ANIMAL BUILDINGS	FUME/GAS ALARM* POWER FAILURE ALARM
LIQUID LEAKS AND LEVELS	BOATS/SHIPS PUMPS/VALVES BASEMENTS STORAGE TANKS COMPUTER ROOMS WATER TREATMENT FACILITIES	WATER DETECTION SENSOR POWER FAILURE ALARM

* *not available from Phonetics*

APPENDIX E: ERROR MESSAGES

There are two possible error messages that the Sensaphone model 4100 will give you if you make a detectable error in programming.

NUMBER LIMIT	Too many digits entered for that particular memory location.
ERROR 1	Keys pressed in wrong order.
ERROR 2	Wrong keyboard lock code or no code entered.
ERROR HIGH	A value entered was too high.
ERROR LOW	A value entered was too low.

The model 4100 cannot detect all errors, especially ones dependent on your programming. For example, it has no way of knowing whether you have programmed the correct telephone numbers. Work carefully and check each entry by using **WHAT IS.**

APPENDIX F: MAINTENANCE

The following procedure is a condensed version of our factory test. It should be performed upon installation and repeated periodically.

1) Check to verify the correct telephone numbers for automatic dial-out are in memory by pressing **WHAT IS** and the Phone number (1, 2, 3, or 4).

2) Test the dial-out ability of the model 4100 by removing the 110 VAC power supply from the wall outlet, with the battery charged and connected. The unit should dial-out with its "The electricity is off" alarm message after user-programmed time.

3) Test the alert inputs by changing the status of the sensors connected to each alert terminal for at least 200 milliseconds. To do so, place one end of a small piece of wire on the input terminal and place the other end on *common*.

4) Check the high sound alarm by pressing the test button on your smoke alarm until the model 4100 reacts with an automatic dial-out.

5) After checking the dial-out ability, test the battery by leaving the AC plug out for at least 5 minutes. After that amount of time has elapsed, press **WHAT IS** and **I.D.** to obtain a status report. If the battery condition is fine, you will just get a regular status report. Otherwise, you will get a status report with a "Battery condition low" alarm message. If the batteries are too low, you will get the "Replace battery" message.

6) Test the call-in feature by calling the unit to get a status report and *listen-in*.

7) If the battery needs servicing or replacement, work may only be performed by a qualified service personnel.

APPENDIX G: TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Unit does not talk.	-Unit not ON. -Battery not connected. -Wall transformer not plugged into a 110 VAC outlet.
Unit does not dial out automatically.	-No telephone numbers entered in Phone 1 through Phone 4. -Unit not ON. -Telephone jack not connected. -Wall transformer not plugged into a 110 VAC outlet.
Unit does not answer incoming calls after the prescribed number of rings.	-Wall transformer not plugged into 110 VAC outlet. -Incompatibility with telephone system. -Unit not ON. -Telephone jack not connected. -Battery not connected.
Unit does not function normally.	-Unit programmed or installed incorrectly. -Unit was exposed to power surge through power and/or telephone lines. -Sensors and/or wiring damaged or defective.
Invalid low temperature alert.	-There is a bad or broken temperature connection between the model 4100 and the temperature sensor. If the temperature reads -20°F, the circuit is open. If the temperature reads +150°F, the circuit is shorted.

Before sending your Sensaphone in for service, do the following:

1) Carefully reread the instruction manual to be certain that all connections and programming were done correctly.

2) Reset the model 4100 using the following procedure:

   a) Remove the AC power supply from the 110 VAC wall outlet and disconnect the battery.
   b) Allow the unit to remain unpowered for 1 minute.
   c) Restart and reprogram the model 4100 in accordance with the instructions in this manual.
   d) Retest all functions and sensors.

APPENDIX H: RETURNING YOUR UNITS FOR SERVICE

In the event that your model 4100 does not function properly and you cannot reprogram it, we suggest that you do the following:

1) Refer to Appendix G, **TROUBLESHOOTING.**

2) Carefully write down your observations of the model 4100's malfunctioning.

3) Call Phonetics' Technical Service at (610)-558-2700 if any instructions are not clear or if you have any questions.

If the unit must be sent to us for servicing, do the following:

1) Unplug the AC power supply from the wall outlet, remove the batteries, and disconnect all sensors from the alert inputs.

2) Carefully pack unit into its original container or a sturdy shipping box. Be certain to use sufficient cushioning material to avoid damage in transit.

3) Address package to:

SERVICE DEPARTMENT
PHONETICS, INC.
901 TRYENS ROAD
ASTON, PA. 19014

4) Ship it prepaid and insured via UPS or US Mail to ensure a traceable shipment with recourse for damage or replacement.

5) Include a copy of your sales receipt, check, or charge slip to serve as your Proof of Purchase for repair under our Limited Warranty, which appears on the back cover of this manual.

6) Include a letter explaining the model 4100's problem. If the problem appears within 1 year after purchase, the repair will be done at no charge. After the first year, an estimate of the cost to repair will be sent out.

7) Under normal conditions, your Sensaphone will be in our shop for 10 to 15 working days while it is being repaired, tested, and shipped back to you.

1 YEAR LIMITED WARRANTY

1. **WARRANTOR:** Dealer, Distributor, Manufacturer

2. **ELEMENTS OF WARRANTY:** This Product is warranted to be free from defects in materials and craftsmanship with only the limitations and exclusions set out below.

3. **WARRANTY AND REMEDY:**

   One-Year Warranty -- In the event that the Product does not conform to this warranty at any time during the time of one year from original purchase, warrantor will repair the defect and return it to you at no charge

   This warranty shall terminate and be of no further effect at the time the Product is (1) damaged by extraneous cause such as fire, water, lightning, etc. or not maintained as reasonable and necessary; (2) modified; (3) improperly installed; (4) repaired by someone other than warrantor; (5) used in a manner or purpose for which the Product was not intended; or (6) sold by original purchaser.

   WARRANTORS' OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT. THIS WARRANTY DOES NOT COVER PAYMENT OR PROVIDE FOR THE REIMBURSEMENT OF PAYMENT OF INCIDENTAL OR CONSEQUENTIAL DAMAGES.

   It must be clear that the warrantors are not insuring your premises or guaranteeing that there will not be damage to your person or property if you use this Product. The warrantors shall not be liable under any circumstances for damage to your person or property or some other person or that person's property by reason of the sale of this product or its failure to operate in the manner in which it is designed. The warrantors' liability, if any, shall be limited to the original cost of the Product. The warrantors assume no liability for installation of the Product and/or interruptions of the service due to strikes, riots, floods, fire, and/or any cause beyond Seller's control.

4. **PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY:** In the event that the Product does not conform to this warranty, the Product should be shipped or delivered freight prepaid to a warrantor with evidence of original purchase.

5. **LEGAL REMEDIES:** This warranty gives you specific legal rights, and you may also have other rights which vary from state to state to the extent allowed by law expressly in lieu or any other express or implied warranty, condition, or guarantee.

Effective date 7/01/90

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MACCAFERRI GABIONS INC.

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ADMINISTRATIVE HEADQUARTERS
43A GOVERNOR LANE BLVD
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WAREHOUSES
WILLIAMSPORT, MARYLAND
CARROLLTON, TEXAS

MACCAFERRI RECOMMENDATIONS ON THE USE OF SPENAX FASTENERS

The installation of recommended fasteners should be carried out in accordance with the following recommendations:

ASSEMBLY (Gabions and Mattresses)

Fastener spacing shall be six (6) inches maximum

INSTALLATION (Gabions and Mattresses)

Fastener spacing for this operations shall be six (6) inches maximum for all types of connections:

- gabion to gabion connection
- diaphragms to lid connections
- lid to side panels

Exceptions to the above criteria apply when three or more gabions are joined together. In this case the suggested method is as follows:

Use of fasteners in a "mesh to mesh panel" connection (right next to the selvedge wires of each adjoining gabion) connecting two baskets at the time.

Acceptable rings when joining galvanized wire mesh gabions and/or mattresses shall be formed from 0.120 inch galvanized wire having high tensile strenght (260-280,000 psi).

Galvanized shall conform to ASTM A641, Class 3 coating.

Acceptable rings when joining PVC coated wire mesh gabions and/or mattresses shall be formed from 0.120 inch stainless steel wire having high tensile strength (240,000 psi).

MACCAFERRI GABIONS, INC.
Gabions & Reno Mattresses

Gabions & Reno Mattresses are. . .

. . . rectangular baskets made of heavily galvanized, double twisted, hexagonal woven steel wire mesh. The single unit constructed baskets are assembled, laced together and then filled with stone to form a monolithic structure. Gabions and Reno Mattresses are used for retaining walls, sound barriers, channel linings, slope stabilization, mechanically reinforced soils, dams and weirs. They are particularly effective in restoring the environment and promoting vegetation growth. Our mesh is also used very successfully for rock fall protection.

Please inquire about our new Terramesh System.

Fig. 1 Mechanically stabilized soil headwall structure, Columbia, TN.

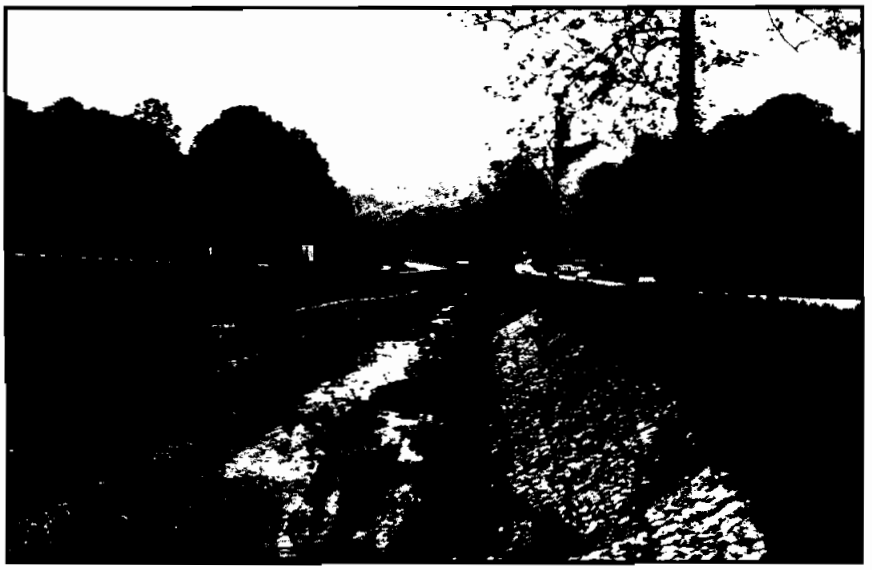


Fig. 2 Route 40, Frederick, MD.

Characteristics

FLEXIBILITY—The woven mesh system has the capability of withstanding unexpected and/or localized stresses due to ground settlement and scour by deflection while maintaining its structural integrity.

ECONOMICAL & EASY TO BUILD—Gabions and Reno Mattresses are one of the most economical methods of construction for temporary and permanent structures. Gabion construction does not require skilled labor or previous experience. Standard construction machinery can be used and work can proceed year round. Structures can be built in stages, if necessary, and baskets can be prefilled to enable installation under water.

Site assistance is available from any Maccaferri area office.

PERMEABILITY—The stone fill allows water to percolate through the structure while retaining the soil, therefore weep holes are not required to relieve hydrostatic pressures.

ENVIRONMENTALLY FRIENDLY—Gabions and Reno Mattresses are environmentally friendly products. The blending of Gabion and Reno Mattress structures into the environment is rapid and pleasing. The voids in the rockfill become progressively filled with silt promoting vegetation growth which is essential to the preservation and maintenance of the ecological balance of the surrounding environment.

Due to their proven success Maccaferri products are approved by Federal, State and Local Authorities.

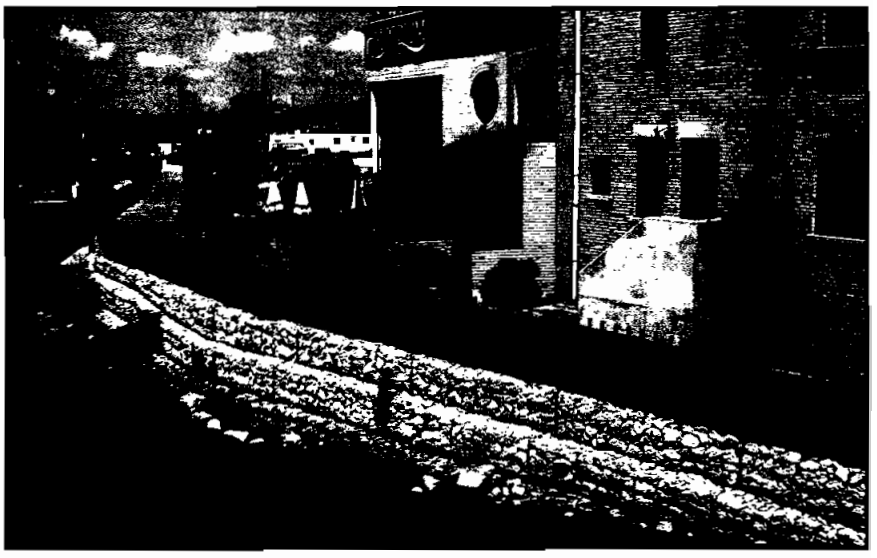


Fig. 3 River wall at South Bend, IN.

PVC Coated Wire Mesh

To extend the life span of a structure used in water, polluted or corrosive environments Gabions and Reno Mattresses can be supplied with an additional grey PVC coating.

Fastening Tools...

The ultimate alternative to hand lacing! Consider the use of pneumatic or hand fastening tools instead of lacing wire to expedite your construction operations. The time for assembly and installation operations can be reduced up to 50% with the use of our fastening tools. The rings can be either heavily galvanized or stainless steel. The latter for use with PVC coated gabions.

GABIONS — Nominal Sizes

Zinc coated and PVC coated

Letter Code	Length	Width	Height	No. of Cells	Capacity Cu. Yds.	Color Code
A	6'	3'	3'	2	2.0	Blue
B	9'	3'	3'	3	3.0	White
C	12'	3'	3'	4	4.0	Black
D	6'	3'	1.5'	2	1.0	Red
E	9'	3'	1.5'	3	1.5	Green
F	12'	3'	1.5'	4	2.0	Yellow
G	6'	3'	1'	2	0.66	Blu/Red
H	9'	3'	1'	3	1.0	Blu/Yel
I	12'	3'	1'	4	1.33	Blu/Grn
SP	4.5'	3'	3'	1	1.5	Brown

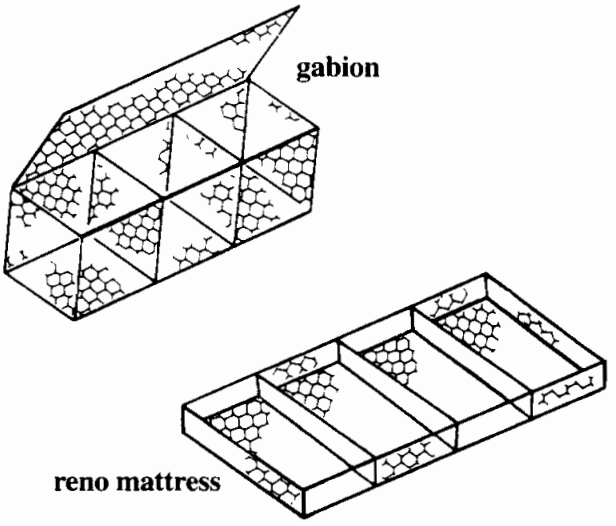
RENO MATTRESS — Nominal Sizes

Zinc coated and PVC coated

Letter Code	Length	Width	Thickness	No. of Cells	Area Sq. Yds.	Capacity Cu. Yds.	Color Code
Q	9'	6'	6"	3	6	1.00	Whi/Yel
R	12'	6'	6"	4	8	1.33	Whi/Grn
T	9'	6'	9"	3	6	1.5	Red/Yel
U	12'	6'	9"	4	8	2.	Red/Grn
Z	12'	6'	12"	4	8	2.67	Brown

Metric sizes are also available.
Please inquire about special sizes.

Fig. 4 Use of pneumatic fastening tool on job site.



THE MACCAFERRI GROUP has been manufacturing gabion products for over 100 years. As the leading manufacturer of gabion products, our experience in the area of specifications, technical publications, videos and computer aided designs are available to you by contacting the Maccaferri area office address listed below.

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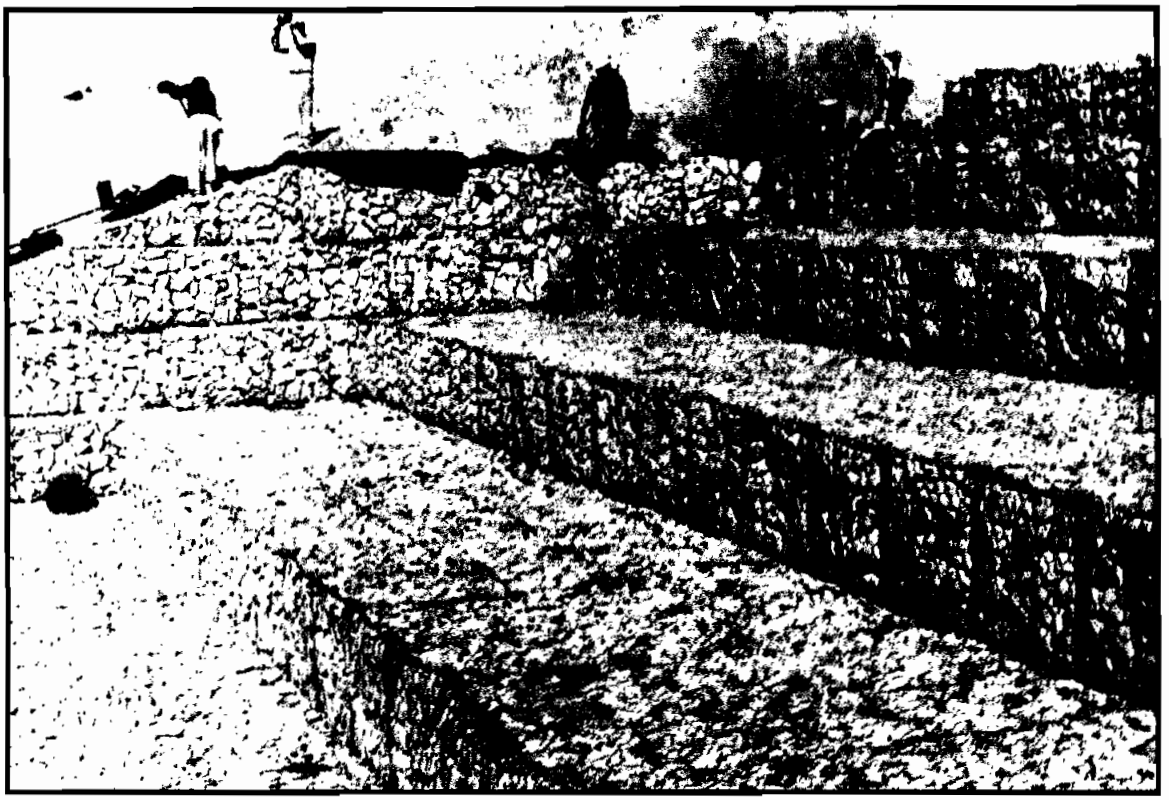
MACCAFERRI GABIONS®

We are number one!

Instructions for Assembly and Erection



This publication presents the procedure for proper gabion installation. The method is quite simple; unskilled labor can be readily trained to perform the various tasks. If the proper procedures are followed, an economical, attractive, and structurally sound gabion installation will be assured. Technical literature describing the use of gabions for various applications is available on request. Maccaferri's technical staff is available to lend any assistance that may be required.

Supply and Delivery:

Gabions are supplied folded flat, and packed in bundles. For ease in handling, the number of gabions per bundle varies according to the size of the gabion. The gabions are identified by color stripes and by labels indicating their code size and dimensions. The lacing wire is supplied in coils.

If contract specification requires additional wiring extra coils may be ordered at reasonable cost.

Stone:

Order only hard durable stone of the correct size range.

Assembly:

Remove a single gabion from the bundle and proceed to unfold it on a hard flat surface. Stretch the gabion and stamp out all kinks (See Fig. No. 1). Fold the front and back panels to a right angle by stepping on the base along the crease. Fold up the end panels and diaphragms and fasten them to the front and back panels using the heavy gauge wire projecting from the upper corners of each panel. This procedure will assure properly squared baskets with the tops of all panels even. Securely lace all vertical edges of ends and diaphragms. Use only Maccaferri connecting wire supplied for this purpose. No substitution of common wire is allowed, as this may not meet the specification requirements.

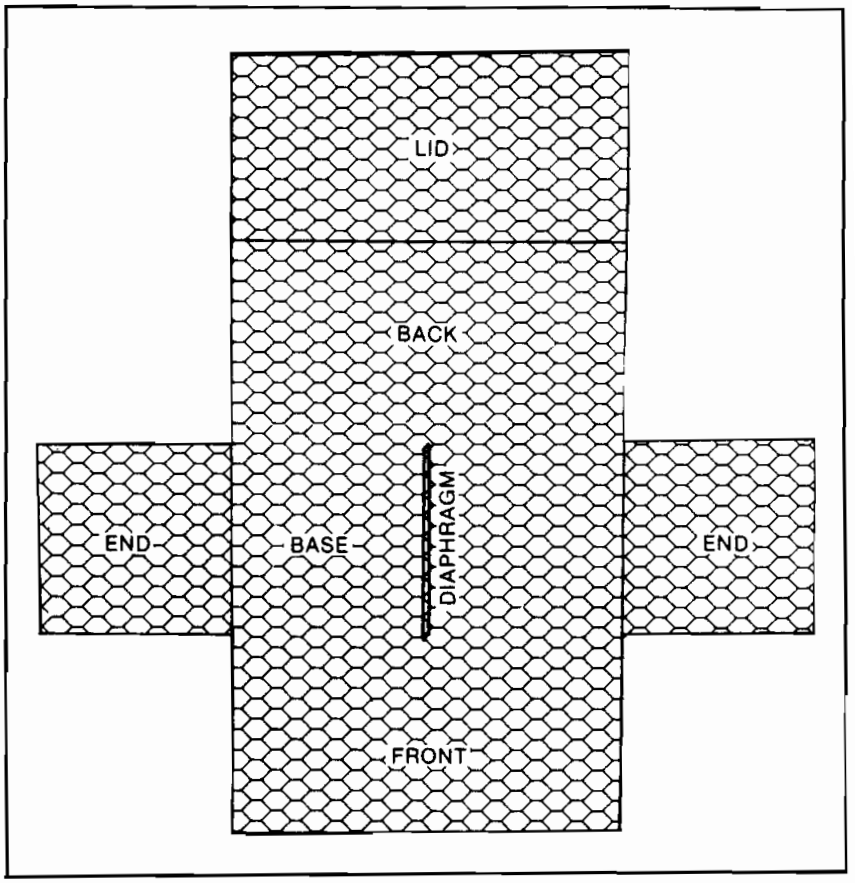


Fig. No. 1

The lacing procedure is as follows: cut a length of lacing wire approximately 1½ times the distance to be laced but not exceeding 5 feet. Secure the wire terminal at the corner by looping and twisting, then proceed lacing with single and double loops at approximately five (5) inch intervals (See Fig. No. 2). Securely fasten the other lacing wire terminal.

Note:

Alternatives to lacing wire are available. Please inquire at any Maccaferri Area Office.

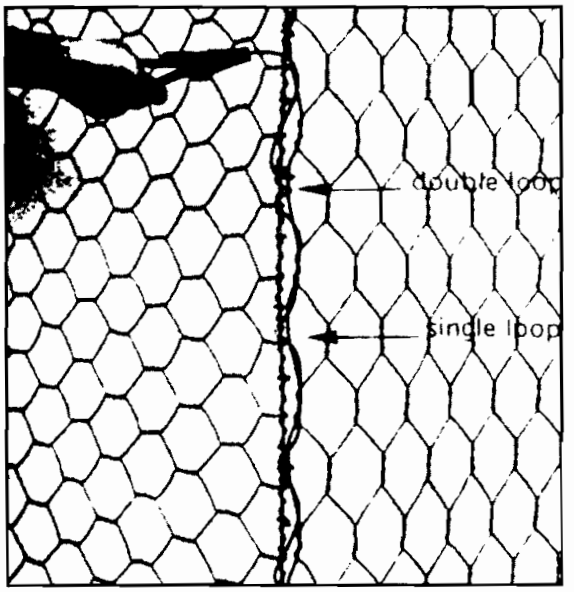


Fig. No. 2

Installation:

Before placing the gabions, it is necessary to make the ground surface relatively smooth and even.

The assembled gabions are carried to the job site and placed in their proper location. It is convenient to place the gabions front to front and back to back, as illustrated in Fig. No. 3, in order to expedite the stone filling and lid lacing operations.

For structural integrity, adjacent gabions must be laced along the perimeter of ALL contact surfaces.

To facilitate this operation it may be easier to construct sub-assemblies in the yard consisting of as many gabions as can be handled by the crew at one time. The sub-assembly is then placed at the job site and laced along the perimeter of ALL contact surfaces.

The base of the empty gabions placed on top of a completed row must also be tightly wired to the latter. (See blown up section).

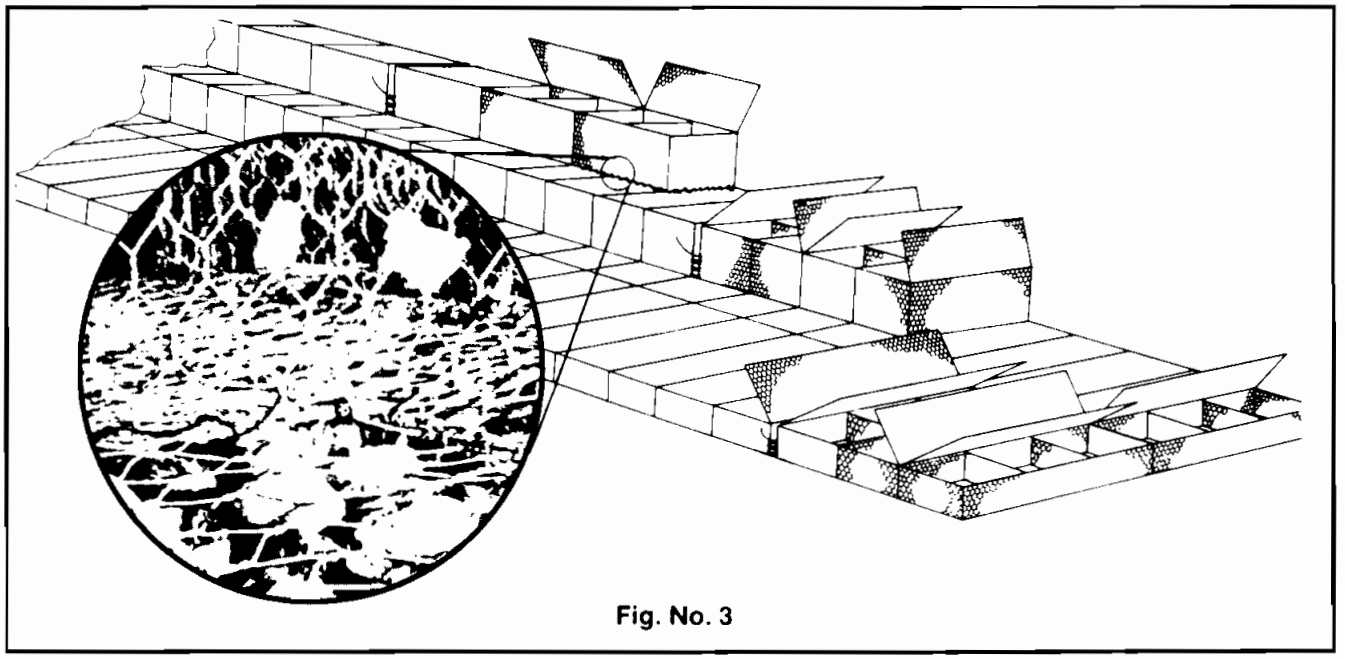


Fig. No. 3

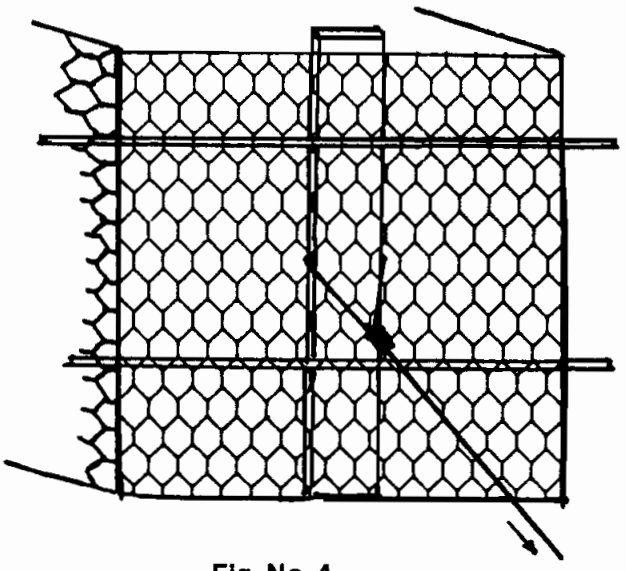


Fig. No. 4

The following method applies to three foot high gabions. Gabions should be placed empty and laced for a stretch approximately 100 linear feet. The first gabion shall be firmly anchored and tension shall be applied to the other end with a come-a-long or other means, in order to achieve the proper alignment. (See Fig. No. 4.) Anchoring can be accomplished by partially filling the first gabion with stone.

While gabions are being stretched, inspect all corners for open "V's" which will result if corners were not properly secured. Such "V's" must be closed by relacing.

Keep gabions in tension while being filled; leave the last gabion empty to allow for easily lacing the subsequent sub-assembly.

Filling:

The fill material shall consist of hard, durable stone, graded between 4 to 8 inches or as approved by the Engineer. Normally all stone should be of a size sufficient to be retained within the mesh.

Gabions shall be filled in lifts of one foot at a time. Two connecting wires shall be placed between each lift in each cell of all exposed faces and firmly wired as indicated in Figures 5 and 6. This operation is repeated until the gabions are completely filled.

It is important that the mesh forming the lid be stretched tight when the gabion is wired clos' in order that there can be no movement of the f

For coastal structures additional requirements apply to choice of fill and to workmanship. Information on these requirements will gladly be supplied on application to any Maccaferri Area Office.

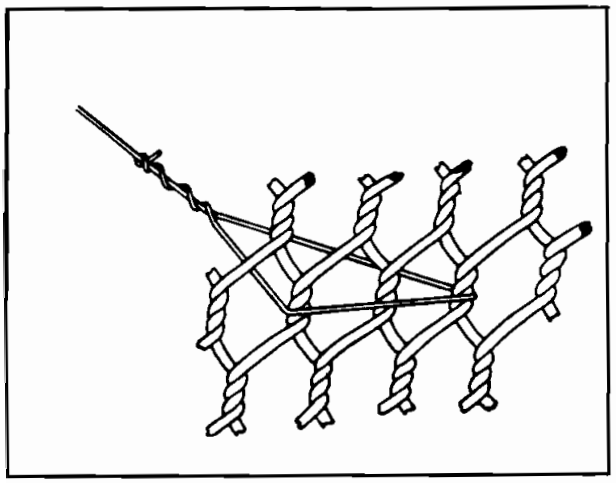


Fig. No. 5

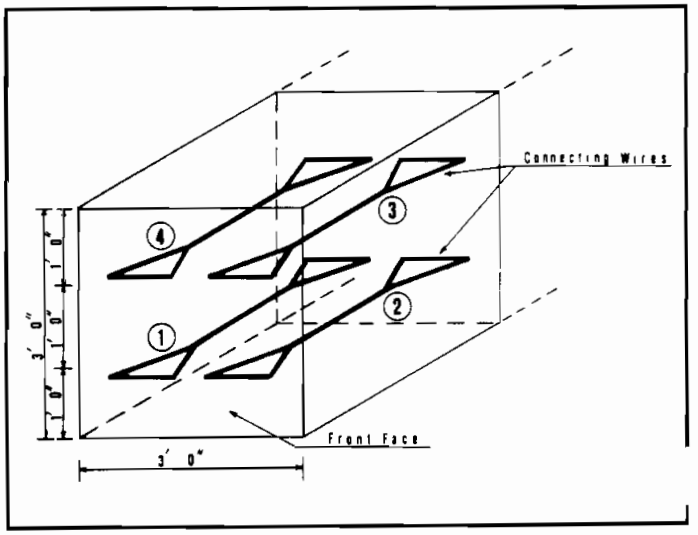


Fig. No. 6

Mechanical Filling:

As most filling operations are carried out by machine it is helpful to protect the top edges of the diaphragms and end panels from being bent or folded by the stone during placement. There are several methods by which this can be achieved.

Rebars may be temporarily placed across the top edges of each mesh panel and laced to them to prevent movement.

Alternatively lengths of pliable metal may be bent into a V shape and placed over the vertical panels to deflect the stone.

During filling the stone should be dumped from the bucket when it is in the lowest practicable position.

Gabions may be filled by almost any type of earth-handling equipment: payloader, gradall, crane, conveyor or modified concrete bucket. Some manual stone adjustment, during the filling operation is required to prevent undue voids. (See Figs. No. 7 & 8.)

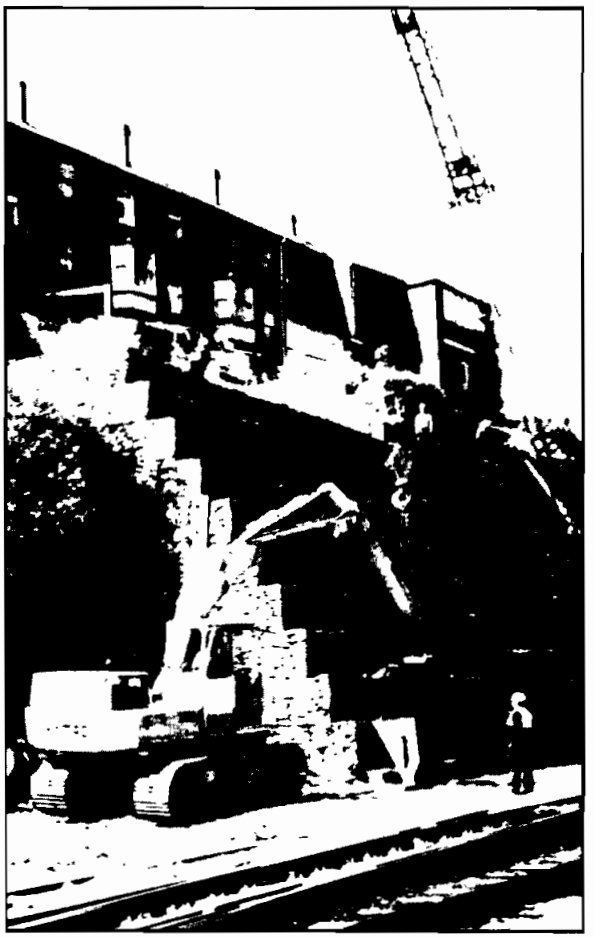


Fig. No. 7

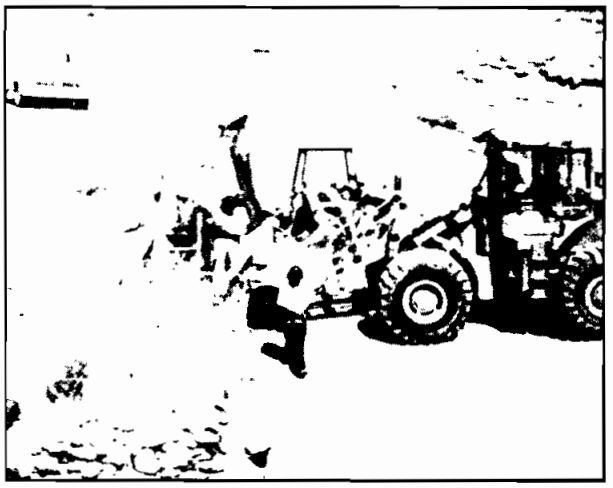


Fig. No. 8

The last lift of stone should be level with the top of the gabion to properly close the lid and provide an even surface for the next course. The mesh must be stretched tight at all times.

The exposed face may be hand-placed using selected stone. This hand placing can add to the appearance of the structure by preventing the gabions from bulging. However care should be taken to avoid oversize stone. (See Figs. No. 9 & 10.)

Fig. No. 10

Fig. No. 9

Lid Closing:

Fold the lid down along the hinge line so that the lid and gabion edges meet closely without gaps. To assist in closing and lacing the lids, a pinch bar or Maccaferri lid closer may be used. (See Figs. 11 & 12.) Secure the lid at the corners with the wire projecting from the lid. Lace the lid shut, starting with the front face and then the ends and diaphragms. A tight joint must be achieved during the lacing operation by pulling the edges together. To expedite the lacing operation, adjacent lids may be wired to the vertical panels in one operation

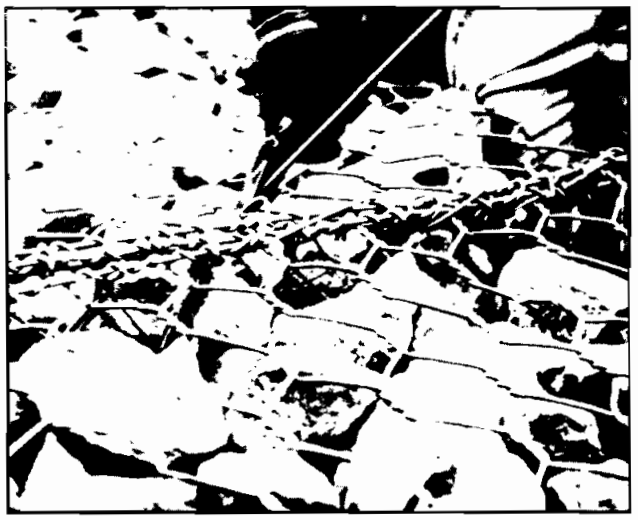


Fig. No. 11

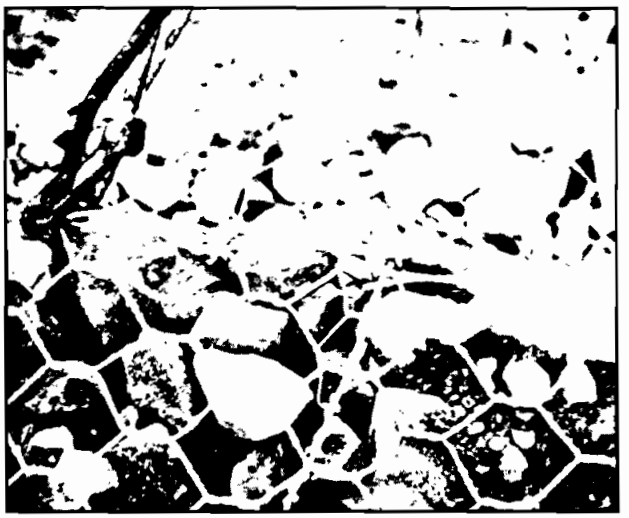


Fig No. 12

General Notes:

Gabions may be readily cut or bent to form regular shapes to fit bridge piers, culverts, transitions, etc. Part of the mesh may also be cut to allow the laying of pipelines. Where this is done the cut or bent edges of the mesh must not be left loose but shall be fastened securely to another part of the structure.

Power & hand tools are available to assist these operations. Please inquire at the Area Office listed below. Field assistance by members of our technical staff is also available on request.

The construction process is shown in a movie/ video film which is available on loan.

Corporate Offices & Plants:

MACCAFERRI GABIONS, INC.

MACCAFERRI GABIONS, INC.
10303 GOVERNOR LANE BLVD.
WILLIAMSPORT, MD 21795-9602
TELEPHONE: (301) 223-6910
FAX: (301) 223-6134

MACCAFERRI GABIONS, INC.
3650 SEAPORT BLVD.
WEST SACRAMENTO, CA 95691-0410
TELEPHONE (916) 371-5805
FAX: (916) 371-0764

MACCAFERRI GABIONS, INC.
145 North Franklin Turnpike, Suite 321
Ramsey, New Jersey 07446-1634
(201) 818-2662
FAX (201) 818-2665

A MEMBER OF MACCAFERRI INDUSTRIAL GROUP

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Spenax
DIVISION OF STANLEY-BOSTITCH, INC.

LETS YOU HOLD YOUR GROUND!

SOIL EROSION CONTROL

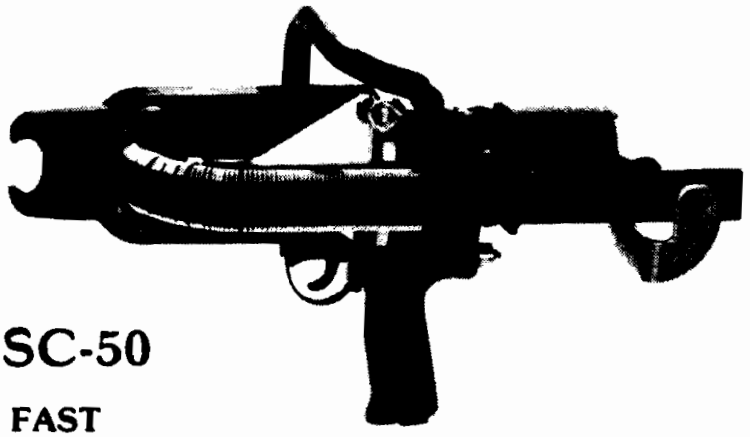
Riverbank Protection
Highway Embankments
Coastal Revetments
Retaining Walls
Channel Lining
Lake Shore
Weir, Ramp

THE SOLUTION GABIONS

- Simple & Quick to Install
- Less Expensive than Concrete
- More Stable than Riprap
- Hug natural contours

OKLAHOMA CHANNEL LINING JOB
SC-50 Tool & fasteners on
Maccaferri brand gabions
May, 1987

THE FASTENING SYSTEM — THE SC-50 TOOL



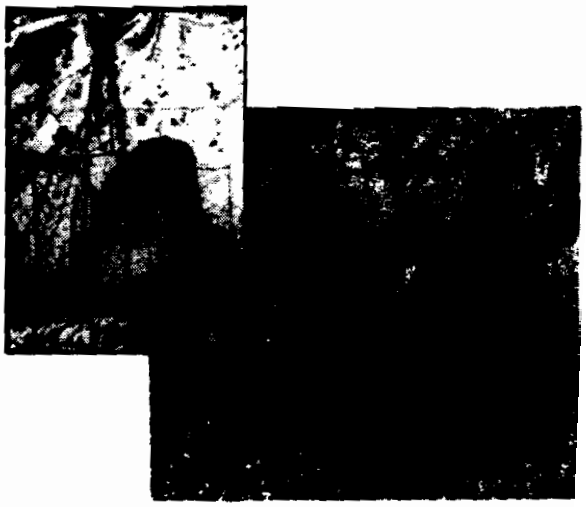
SC-50

FAST
High-speed Pneumatic Tool

EFFICIENT
Rings bind selvages *tightly* together

ECONOMICAL
Automated assembly vs. hand tie.

The SC-50 is operated with a portable air compressor or shop air at 100 P.S.I. (7.03×10^4 kg/M²) (10 cubic feet per minute, 4.7 DM³s at 40 cycles per minute).



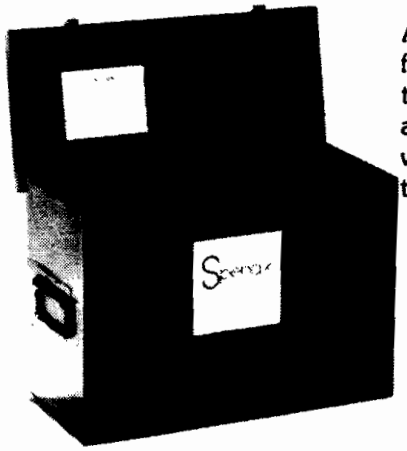
THE SC—50 FASTENERS

Available in:
Stainless Steel-for corrosive environments
High-Tensile Galvanized - heavy galvanized coating
Standard Galvanized, Brite Basic, Aluminum

11 gauge wire
1,600 pieces per box

Closure (I.D.)
9/16" - 5/8"

1-1/2" open



A durable TOOL BOX is available for the SC-50, which holds the tool securely in place. Also available is a SPARE PARTS KIT which fits neatly into the tool box.

MACCAFERRI GABIONS WEST COAST INC.

HEAD OFFICE AND FACTORY

3650 SEAPORT BLVD.
WEST SACRAMENTO, CA 95691
PHONE (916) 371-5805
FAX (916) 371-0764

Manufacturer's Warranties/ Guarantees

New England
Liner Systems

GEOMEMBRANE AND GEOSYNTHETIC SYSTEMS

35 Wooster Court
Bristol CT 06010
(203) 583-5465
FAX 582-6357

PRO RATED MEMBRANE LINER INSTALLATION WARRANTY

FOR

Union Road Site Remediation
Losson Road, Cheektowaga, New York

Subject to the terms and conditions set forth below, New England Liner Systems Inc. warrants to ***American Premier Underwriters, and / or B.D.R. Incorporated*** pursuant to ***Contract dated June 5, 1996*** for liner installation at the above referenced project, shall be free from defects in workmanship for a period of **THREE** years from ***July 25, 1996*** , the date upon which the liner installation was completed.

This warranty does not cover any damage or defects in the liner found to have been a result of misuse, abuse, faulty design, or conditions existing after installation including, malicious mischief; vandalism; sabotage; fire; acts of God; acts of the public enemy; acts of war or public rebellion; severe weather conditions of all types; damage due to ice or wind; damage due to subsidence; damage due to machinery, foreign objects, chemical attack or animals.

The warranty is subject to the following conditions:

1. The liner shall have been installed over a properly prepared subgrade, free from sharp objects or protrusions and foreign objects to a depth of 6 inches; and

2. If "fill " is used over the top of the liner it shall be free of all foreign or sharp objects.

In the event circumstances are found to exist which ***American Premier Underwriters, and / or B.D.R. Incorporated*** believe may give rise to a claim under this warranty, the following procedures shall be followed:

a. ***American Premier Underwriters, and / or B.D.R. Incorporated*** shall give New England Liner Systems, Inc. written notice of the facts and circumstances of said claim within 10 days of becoming aware of said facts and circumstances. Notice shall be by registered or certified mail, return receipt requested, addressed to New England Liner Systems, Inc., 35 Wooster Court, Bristol, Connecticut 06010.
The words "Warranty Claim" shall be clearly marked on the face of the envelope in the lower right hand corner. Said notice shall contain at a minimum the name and address of the owner, the location, name, address and date upon which the liner installation was completed. Claim shall include the facts known to ***American Premier Underwriters, and / or B.D.R. Incorporated*** upon which the claim is based. Failure to provide New England Liner Systems, Inc. with timely notice shall bar ***American Premier Underwriters, and / or B.D.R. Incorporated*** from any remedy under this warranty.

b. Within twenty days after receipt of the notice described in paragraph a, above, New England Liner Systems, Inc. shall inspect the alleged defect and determine whether there has been a violation of this warranty. ***American Premier Underwriters, and / or B.D.R. Incorporated*** shall pay the expenses incurred by New England Liner Systems, Inc. in making the inspection, including current per diem rates for personnel involved, in the event that New England Liner Systems, Inc. determines that the claim is not covered under this warranty.

c. ***American Premier Underwriters, and / or B.D.R. Incorporated*** **shall not repair, or attempt to repair, replace, remove, alter or disturb any liner, nor allow anyone else to repair, attempt to repair, replace, remove, alter or disturb any liner prior to such inspection provided, however, that *American Premier Underwriters, and / or B.D.R. Incorporated* may take emergency action necessary to prevent injury to persons, or damage to property or the environment. Failure to strictly comply with this paragraph shall bar *American Premier Underwriters, and / or B.D.R. Incorporated* from any remedy under this warranty.**

d. If New England Liner Systems, Inc. determines that the alleged defects are covered by this warranty, New England Liner Systems, Inc. shall either repair or replace only so much of the liner as is defective. The remedies provided herein are the exclusive remedies available under this warranty. Any determination as to whether the liner has performed satisfactorily or whether a particular defect is covered under this warranty or what constitutes the appropriate remedy for a particular defect shall be made by New England Liner Systems, Inc. after consultation with ***American Premier Underwriters, and / or B.D.R. Incorporated***

e. ***American Premier Underwriters, and / or B.D.R. Incorporated*** agree that it shall provide New England Liner Systems, Inc. with clean, dry and unobstructed access to the damaged or defective liner , in order for New England Liner Systems, Inc. to perform inspections and / or repairs which may be required under this warranty. New England Liner Systems, Inc. shall not be liable for any costs relating to providing clean, dry and unobstructed access to the liner.

The remedies provided to *American Premier Underwriters, and / or B.D.R. Incorporated* herein are the exclusive remedies available under this warranty and are intended for the sole benefit of *American Premier Underwriters, and / or B.D.R. Incorporated* . Neither this warranty nor any rights hereunder shall be assignable without the express written consent of New England Liner Systems, Inc. New England Liner Systems, Inc. shall have no liability under this warranty to third parties or strangers to this agreement. The warranty set forth above is the only warranty applicable to the liner installation, and all other installation warranties, expressed or implied, including, but not limited to, any warranty of merchantability or fitness for a particular purpose are hereby disclaimed. In no event shall New England Liner Systems, Inc. be liable in contract or in tort (including negligence) for any direct, incidental, special or consequential damages resulting from the use of ,or defects in the liner materials or installation thereof. Except for the warranties set forth above, no representation or warranty made by any sales or other representative of New England Liner Systems, Inc. or any other person, concerning the installation of the liner shall be binding upon New England Liner Systems, Inc.

This warranty shall not be effective unless full and timely payment has been made to New England Liner Systems, Inc. for materials and services provided in connection with the above referenced project.

Any waiver of the terms and conditions of this warranty shall be in writing, signed by New England Liner Systems, Inc. The failure to insist upon strict compliance with any of the terms and conditions contained herein shall not act as a waiver of strict compliance with all of the remaining terms and conditions of this warranty and shall not operate as a waiver of strict compliance with the terms and conditions of this warranty as to future claims.

New England Liner Systems, Inc.

By: _____ Date: September 18, 1996

James E. Magnoli
Vice President

I have read, and hereby agree to the terms and conditions of the foregoing warranty.

B.D.R. Incorporated

By: _____

Title: _____

Date : _____

I have read, and hereby agree to the terms and conditions of the foregoing warranty.

American Premier Underwriters

By: _____

Title: _____

Date : _____

URSWAR.WPS

LIMITED MATERIAL WARRANTY

Warranty No: UNI6015
Project No.: DS3280
Effective Date: SEPTEMBER 1, 1996

PURCHASER NAME: AMERICAN PREMIER UNDERWRITERS
ADDRESS:
CITY, STATE, ZIP, COUNTRY_ CINCINATTI, OHIO

PROJECT NAME: UNION ROAD SITE REMEDIATION
ADDRESS/LOCATION:
CITY, STATE, ZIP, COUNTRY CHEEKTOWAGA, NEW YORK
GEOMEMBRANE TYPE/DESCRIPTION HD 60 mil

GSE Lining Technology, Inc. ("GSE") warrants each GSE geomembrane to be free from manufacturing defects (as defined by the contract's material specifications) and to be able to withstand normal weathering for a period of 5 years from the above effective date for normal use in approved applications.

This Limited Warranty does not include damages or defects in the GSE geomembrane resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of GSE geomembranes to harmful chemicals, abuse of GSE geomembranes by machinery, equipment or people; improper site preparation or covering materials, excessive pressures or stresses from any source. GSE geomembrane material warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson Moss Warranty or any similar federal, state, or local statutes. The parties expressly agree that the sale hereunder is for commercial or industrial use only.

Should defects or premature loss of use within the scope of the above Limited Warranty occur, GSE will, at its option, repair or replace the GSE geomembrane on a pro-rate basis at the current price in such manner as to charge the Purchaser/User only for that portion of the warranted life which has elapsed since purchase of the material. GSE will have the right to inspect and determine the cause of any alleged defect in the GSE geomembrane and to take appropriate steps to repair or replace the GSE geomembrane if a defect exists which is covered under this warranty. This Limited Warranty extends only to GSE geomembrane, and does not extend to the installation service of GSE or third parties.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail, to the President of GSE within ten (10) days of becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obliged to perform repairs or replacements under this warranty unless and until the area to be repaired or replaced is clean, dry, and unencumbered. This includes, but is not limited to, the area made available for repair and/or replacement of GSE geomembrane to be free from all water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this Limited Warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a retur the purchase price for so much of the material as GSE determines to have violated the warranty provided herein. GSE shall not be liable for dir.. , indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to, damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alteration in advance of them having been made. GSE's liability under this warranty shall in no event exceed the replacement cost of the material sold to the purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than the undersigned of GSE to assume for it any other or additional liability in connection with the GSE geomembrane made on the basis of the Limited Warranty. The Limited Warranty on the GSE geomembrane herein is given in lieu of all other possible material warranties, either expressed or implied, and by accepting delivery of the material, Purchaser waives all other possible warranties, except those specifically given.

Limited Warranty is extended to the purchaser/owner and is non-transferable and non-assignable; i.e., there are no third party beneficiaries to this warranty.

Purchaser acknowledges by acceptance that the Limited Warranty given herein is accepted in preference to any and other possible materials warranties.

GSE LINING TECHNOLOGY, INC. MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN ABOVE AND HEREBY DISCLAIMS ALL WARRANTIES, BOTH EXPRESSED OR IMPLIED, OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

GSE LINING TECHNOLOGY, INC.'S WARRANTY BECOMES AN OBLIGATION OF GSE LINING TECHNOLOGY, INC. TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.

I hereby state that I have read and understood the above and foregoing Limited Material Warranty and agree to such by signing hereunder.

DATE: AUGUST 28, 1996

GSE LINING TECHNOLOGY, INC.: _____
President or Authorized Representative

PURCHASER NAME: _____

SIGNATURE: _____

TITLE: _____