

UMC ELECTRONICS CO.  
NORTH HAVEN, CONN.

TECHNICAL MANUAL

LOAD BANK, A-C  
0-33KW RESISTIVE

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UMC ELECTRONICS CO.  
460 Sackett Point Road  
North Haven, Conn. 06473

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SECTION I  
INTRODUCTION

1-1 GENERAL

a. This Technical Manual is intended to provide the necessary information for the installation, operation and maintenance of the Model PLB, Type 33 A-C Load Bank.

1-2 PURPOSE

a. The Model PLB, Type 33 A-C Load Bank is a portable skid mounted test unit fully self-contained and enclosed in a weather proof enclosure.

b. The Load Bank is designed to provide resistive loading for the testing of electrical generating sets or applying parasitic loading to electrical generating sets up to the capacity of the load bank.





SECTION III  
INSTALLATION

3-1 SERVICE UPON RECEIPT

- a. The Load Bank is shipped completely assembled and enclosed in a shipping container. The base of the container is provided with skids such that tongs of a fork lift may be used to transport the load bank to the site of operation or storage.
- b. Remove the shipping container from the unit noting if the shipping container or unit has been damaged while in transit.
- c. Inspect the Load Bank for damage.

WARNING

DO NOT CONNECT THE LOAD BANK TO A POWER SOURCE UNTIL  
INSPECTION FOR DAMAGE HAS BEEN COMPLETED.

- (1) Check chassis and cabinet for possible damage.
- (2) Open exhaust door and control panel door and visually check for damage.
- (3) Inspect interior components for damage, inspect for damaged wiring or loose connections.
- (4) Clean the load bank of any dust or foreign particles by the use of low pressure air.

3-2 OPERATING SITE

- a. Locate the load bank in an area free of hazardous, combustible, or volatile materials, which will insure free circulation of air around the unit and with sufficient working area for operating and service. The area beneath and around the unit should be free of dust, foreign particles, etc., which may be drawn into the air intake of the load bank.
- b. The load bank should be positioned such that the cooling air exhaust is in the direction of any prevailing wind.
- c. Protection again inclement weather and temperature extremes should be considered during installation and use of this equipment.
- d. Tiedown holes for insertion of tiedown rods are provided through the base of the load bank. These holes are 1-1/2-inch in diameter and on 28-3/4-inch centers.



### 3-3 GROUNDING

a. A grounding stud is located behind the air exhaust door near the input terminals. To minimize shock hazards, this stud must be connected to a reliable ground such as a metallic water pipe or a copper ground rod.

SECTION IV  
DESCRIPTIVE

4-1 LOAD BANK, A-C, 0-33 KW RESISTIVE

a. The Load Bank is a portable unit consisting of three load modules, three transformer-rectifier units, load contactors, variable load transformer, system input receptacles, input binding posts, system link selector, voltage transfer/protective assembly and a recessed control panel all mounted on a skid base and enclosed in a removable weatherproof cabinet.

b. The cabinet has two access doors, one of which allows access to the recessed control panel and the other allows access to the input terminals, system link selector, electrical connectors, ground stud and also allows for the exhaust of load bank cooling air. A hand-book compartment is located on the inner side of the control panel door.

c. The louvered side panel and rear panel are removable from the cabinet assembly by the use of one-quarter turn quick disconnect fasteners. The louvered panels allow for the load bank cooling air intake.

d. The skid base has tiedown holes of 1-1/2-inches in diameter which will accept tie rods suitable for securing the unit to a skid, pallet or trailer.

e. Carrying handles are located on both sides of the unit. These handles are approximately 24-inches long, of a U-configuration and are retractable. A retaining lock screw is provided to lock the handle in the open or closed position.

4-2 CONTROL PANEL - The control panel contains all controls necessary for the control, application and removal of desired loads. Loads may be selected independently or in additive increments to obtain any load between zero and 33 KW at each of the following input voltages:

120 Volts, 1-Phase, 2-Wire  
240 Volts, 1-Phase, 2-Wire  
240 Volts, 3-Phase, 3-Wire  
120/208 Volts, 3-Phase, 4-Wire  
240/416 Volts, 3-Phase, 4-Wire

a. Load Selector Switches - All load selector switches are located on the control panel and are used to control load contactors for the application or removal of the desired loading. There are five switches each controlling an increment of load as follows:



4-2 (Continued)

0-3 KW  
3 KW  
6 KW  
9 KW  
12 KW

The 0-3KW load switch is used in conjunction with the 0-3 KW variable control.

b. Variable Control - The 0-3 KW variable control is used in conjunction with the 0-3 KW load switch. The variable control allows for a continuously variable load from 0 to 3 KW.

c. Master Load Switch - The master load switch controls all functions of the load bank. This switch when positioned to the ON position applies all control power to the load contactors and energizes all load module cooling fan motors.

d. System Selector Switch - The system selector switch is a three position rotary switch which interlocks the load contactors control circuitry with the system link selector and system voltage electrical receptacles. The three positions of this system selector switch are as follows:

- 120 V - 1-PH  
120/208 V - 3-PH
- 240 V - 1-PH  
240/416 V - 3-PH
- 240 V - 3-PH

e. Circuit Breakers - There are three circuit breakers nomenclatured CB1, CB2 and CB3. These circuit breakers are located in the primary line of each control transformer.

f. Control Power Switch - The control power switch is used for the desired mode of controlling the load relays.

- 1- In the INT mode, the control power is connected internally to the main bus.
- 2- In the EXT mode, the control power leads are transferred to the External Control Power binding posts located above the receptacle panel. This allows for the use of an external 3-pole contactor which may be inserted between the generator set under test and the load bank main power input. External



#### 4-2 (Continued)

power control leads may then be connected from the generator side (Line Side) of the external contactor and the External Control Power input binding posts.

3- This will allow to preset the desired load, load switches and master load switch such that all load contactors selected are energized by the external power.

4- It may then be possible to apply and remove the selected load by use of the external 3-pole contactor and external ON-OFF switch which actuates the contactor. Refer to 5-1, for typical arrangement.

4-3 LOAD MODULES - There are three load modules each rated for 11 KW. Each module contains its own cooling fan, overheat sensor and loss of cooling air switch.

a. The loading for each load module consists of the following load elements:

- 4 Elements rated at 0.5 KW at 120 Volts
- 2 Elements rated at 1.0 KW at 120 Volts
- 2 Elements rated at 1.5 KW at 120 Volts
- 2 Elements rated at 2.0 KW at 120 Volts

4-4 RECEPTACLES AND PLUG - There are two electrical receptacles and one plug used for converting the interconnection of load elements, control transformers and system interlocking.

a. Receptacle J1A, 120 V, 1-PH, 120/208V, 3-PH - The J1A receptacle is used for the insertion of Plug P1 when testing systems of 120 volts, 1-Phase, 2-Wire or 120/208 Volts, 3-Phase, 4-Wire. This receptacle, J1A connects each stepload in parallel arrangement to obtain the required stepload at 120 volts, line-to-neutral and also reconnects the primary windings of the control transformers in parallel for operation at 120 volts line-to-neutral.

b. Receptacle J1B, 240V, 1-Ph, 240V, 3-Ph, 240/416V 3-PH - This J1B receptacle is used for the insertion of Plug P1 when testing systems of 240 volts, 1-phase, 2-wire; 240 volts, 3-phase, 3-wire, or 240/416 volts, 3-phase, 4-wire. This receptacle, J1B, connects each step load in series arrangement to obtain the required step-load at 240 volts, line-to-neutral and also reconnects the primary windings of the control transformer in series for operation at 240 volts line-to-neutral.



4-4 (Continued)

c. Plug, P1 - The P1 Plug is used in conjunction with the system selector switch and system link selector to program the loads and control transformers for the appropriate interconnection for the desired test system input voltage. This plug is inserted either into receptacle J1A or J1B.

4-5 INPUT BINDING POSTS - There are four input binding posts located behind the air exhaust access door. These are nomenclatured L1, L2, L3 and L0.

a. Three Phase, Four-Wire Systems - When testing three phase, 4-wire systems the input power is connected to L1, L2, L3 and L0.

b. Three Phase, Three-Wire Systems - When testing three phase, 3-wire, systems, the input power is connected to L1, L2 and L3.

c. Single Phase, Two-Wire Systems - When testing a single phase, 2-wire system the single phase (1-PH) link is inserted on to the input terminals L1, L2 and L3 and input power is connected to L2 and L0.

d. External Control Power Binding Posts - When it is desired to control the application and removal of a desired load by use of an external 3-pole contactor, external power connections from the generating systems under test are made to these binding posts.

4-6 SYSTEM LINK SELECTOR - The system link selector consists of three copper bus links mechanically interlocked and pivotal horizontally to the left or to the right for mating to either of two sets of studs and also activating either of two switches. This system link selector arranges the individual phase loads into a wye configuration for use on 3-phase 4-wire systems and 1-phase 2-wire systems or a delta configuration for use on 3-phase 3-wire systems.

4-7 PROTECTION/TRANSFER ASSEMBLY - The Protection/Transfer Assembly consists of the 416 volt protection relay, the 240 volt transfer relay and load interlock relay. This assembly in conjunction with the system link selector, Receptacle J1A/J1B and system selector switch afford protection against overvoltage conditions.

a. The mating plug as used with receptacles J1A or J1B essentially arranges the primary windings of the control transformers and load elements in parallel or series arrangement.

g. The system Link Selector arranges the three-phase configuration of the control transformers and loads into a wye connected load for three-phase four-wire system or into a delta connected load for a three-phase three-wire system.

4-7 (Continued)

c. The System Selector Switch in conjunction with the J1A/J1B receptacles and system link selector switches, interlocks the control circuit of the load relays.



## SECTION V

### OPERATION OF EQUIPMENT

#### 5-1 GENERAL

- a. The instructions in this section are for information and guidance of personnel responsible for the operation of the load bank.
- b. The operator must know how to perform operations for which this load bank is capable. Instructions for starting and stopping, operational mode set-up, and operation of controls are herein given, however specific test sequence may vary dependent upon the procedures applicable for the equipment under test.

#### 5-2 OPERATION - INTERNAL CONTROL POWER

##### WARNING

USE OF THIS EQUIPMENT INVOLVES HIGH VOLTAGES.  
AVOID CONTACT WITH CONDUCTING PARTS AND CONNECT  
GROUND STUD TO EARTH GROUND. FAILURE TO OBSERVE  
THIS WARNING MAY PROVE FATAL.

##### CAUTION

BE CERTAIN THAT SYSTEM SELECTOR LINK, SYSTEM  
SELECTOR SWITCH AND RECEPTACLE INPUT CORRESPOND  
TO THE SYSTEM VOLTAGE UNDER TEST.

- a. Perform the necessary daily maintenance services.
- b. Position the equipment in an area which will not restrict cooling air intake and exhaust.
- c. Open exhaust door and swing onto top of unit.
- d. Position Master and Load Switches to OFF and 0-3 KW variable control fully counterclockwise.
- e. Position Control Power switch to the INT position.
- f. Position System Selector Link, System Selector Switch and insert Plug P1 into proper receptacle for the system voltage under test in accordance with Table 5-1, Operational Mode Set-Up.



5-2 (Continued)

CAUTION

ALWAYS BE CERTAIN THAT THE SINGLE PHASE (1-PH) LINK IS REMOVED FROM INPUT TERMINALS L1, L2, L3 WHEN USING EQUIPMENT FOR THREE-PHASE OPERATION.

- g. Connect input leads to the unit being certain that all connections are securely made.
- h. Apply input power to the unit.
- i. Close the Master Load Switch and apply the desired load by use of the individual load switches and variable control.
- j. Shock Loading is accomplished by use of the Master Load Switch to apply or disconnect preselected loads.
- k. At completion of test, position all load switches to the OFF position and variable control fully counterclockwise.
- l. Allow cooling of load ducts.
- m. Position Master Load Switch to the OFF position.
- n. Be certain that all electrical power is OFF before disconnecting input power leads.

5-3 OPERATION - EXTERNAL CONTROL POWER - Refer to Figure 5-1.

WARNING

USE OF THIS EQUIPMENT INVOLVES HIGH VOLTAGES. AVOID CONTACT WITH CONDUCTING PARTS AND CONNECT GROUND STUD TO EARTH GROUND. FAILURE TO OBSERVE THIS WARNING MAY PROVE FATAL.

CAUTION

BE CERTAIN THAT SYSTEM SELECTOR LINK, SYSTEM SELECTOR SWITCH AND RECEPTACLE INPUT CORRESPOND TO THE SYSTEM VOLTAGE UNDER TEST.

NOTE

THE USE OF EXTERNAL CONTROL POWER MODE IS LIMITED TO 3-PHASE, 4-WIRE AND 1-PHASE, 2-WIRE SYSTEMS. THIS MODE OF OPERATION IS NOT APPLICABLE TO 3-PHASE, 3-WIRE SYSTEMS.



5-3 (Continued)

- a. Perform the necessary daily maintenance services.
- b. Position the equipment in an area which will not restrict cooling air intake and exhaust.
- c. Open exhaust door and swing onto top of unit.
- d. Position Master and Load Switches to OFF and 0-3 KW variable control fully counterclockwise.
- e. Position the Control Power switch to the EXT position.
- f. Position System Selector Link, System Selector Switch and insert Plug P1 into proper receptacle for the system voltage under test in accordance with Table 5-1, Operational Mode Set-Up.
- g. Connect the external load 3-pole contactor between generator under test and the load bank making provisions to externally operate the contactor. (Refer to Fig. 5-1)
- h. Connect the external control leads from the generator side of the external contactor to the external power binding posts. (Refer to Fig. 5-1).

CAUTION

ALWAYS BE CERTAIN THAT THE SINGLE PHASE (1-PH)  
LINK IS REMOVED FROM INPUT TERMINALS L1, L2, L3  
WHEN USING EQUIPMENT FOR THREE-PHASE OPERATION.

- i. Apply input power.
- j. Energize the external 3-pole contactor.
- k. Close the Master Load Switch and apply the desired load by use of the individual load switches and variable control.
- l. Shock loading is accomplished by use of the external 3-pole contactor and contactor control switch. This mode will improve the response time of load application and removal.
- m. At completion of test, position all load switches to the OFF position and variable control fully counterclockwise.
- n. Allow cooling of the load ducts.



5-3 (Continued)

- o. Position Master Load Switch to the OFF position.
- p. De-energize the external 3-pole contactor and de-energize the generator set under test.
- q. Be certain that all electrical power is OFF before disconnecting input power.



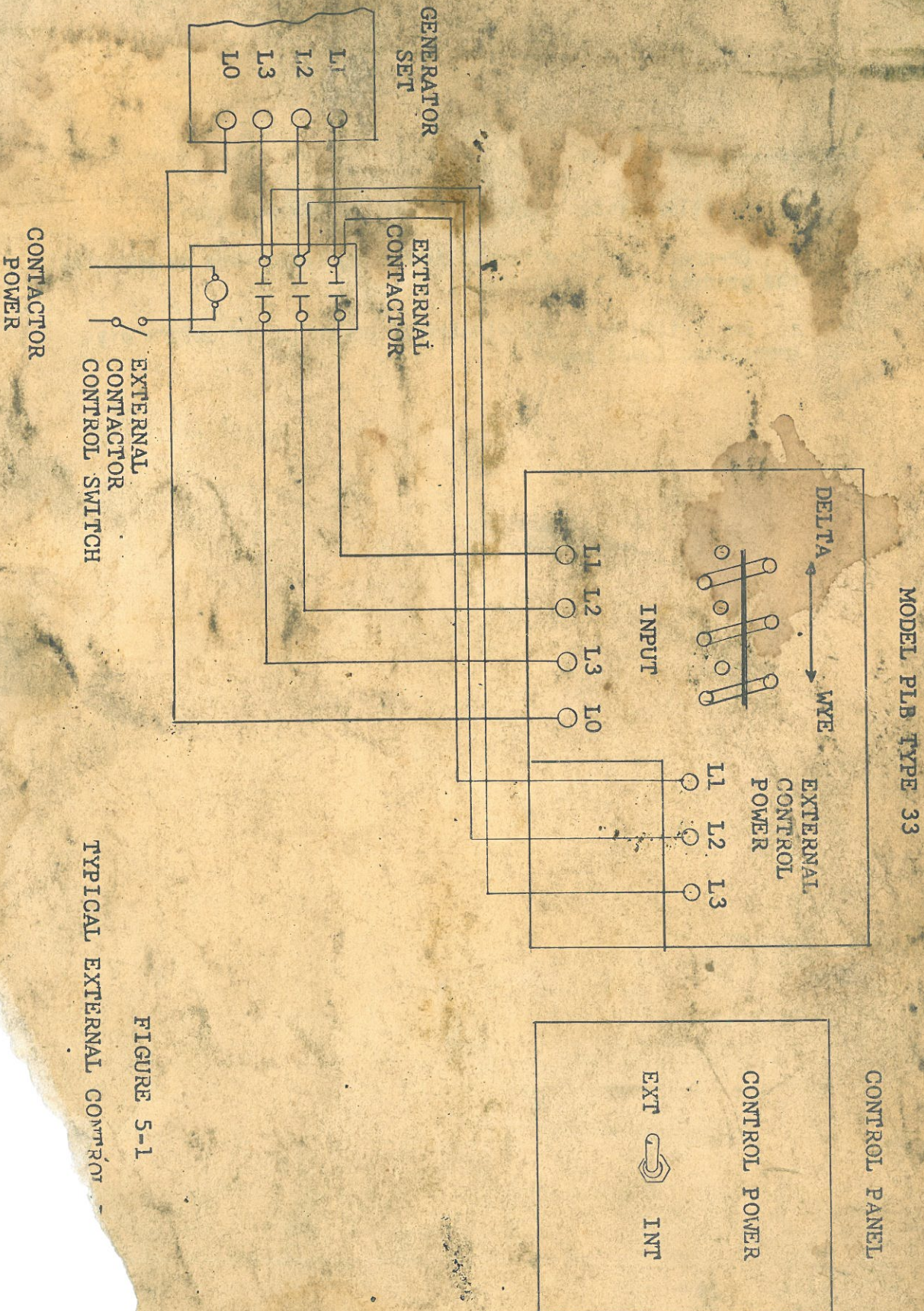


FIGURE 5-1  
TYPICAL EXTERNAL CONTROL



SYSTEM VOLTAGE	SYSTEM SELECTOR LINK	SYSTEM SELECTOR SWITCH	INSERT P1 INTO	1-PH LINK	SYSTEM INPUT
120V 1-PH 2-Wire	WYE	120V 1-PH	J1A	Connect L1-L2-L3	L2-L0
120/208V 3-PH 4-Wire	WYE	120/208V 3-PH	J1A	NOT USED	L1-L2-L3-L0
240V 1-PH 2-Wire	WYE	240V 1-PH	J1B	Connect L1-L2-L3	L2-L0
240/416V 3-PH 4-Wire	WYE	240/416V 3-PH	J1B	NOT USED	L1-L2-L3-L0
240V 3-PH 3-Wire	DELTA	240V 3-PH	J1B	NOT USED	L1-L2-L3

TABLE 5-1  
OPERATIONAL MODE SET-UP.



## SECTION VI

### • MAINTENANCE

#### 6-1 GENERAL

a. To insure that the Load Bank is ready for operation at all times it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. Defects discovered during operation of the unit shall be noted for future correction, to be made as soon as possible after operation has ceased. Stop operation immediately if a deficiency is noticed during operation which would damage the equipment if operation were continued.

#### 6-2 LUBRICATION

a. No lubrication of the components in the load bank is required. An occasional drop of lubricating oil should be applied to the cabinet door hinges and carrying handles.

#### 6-3 PREVENTIVE MAINTENANCE

a. To maintain optimum operating capabilities and to prolong the service life of the load bank, inspect the equipment periodically in accordance with the Preventive Maintenance, Table 6-1. All defects noted should be corrected before they result in serious damage or failure.

#### 6-4 REMOVAL OF ACCESS PANELS

a. The rear and right louvered panels are removable by the quarter-turn fasteners.

#### 6-5 REMOVAL OF CABINET

a. The load bank cabinet is removable as an assembly by removing the 1/4-20 screws and lockwashers from the perimeter of the base.

#### 6-6 COMPONENT REMOVAL

a. Should it be necessary to remove and/or replace any of the components or subassemblies, disassembly can be performed readily with common hand tools. Access to all components and subassemblies is gained by removal of the cabinet. With the cabinet removed, any of the components can be removed and replaced without the need for special tools, techniques or instructions.



ITEM	ACTION	INTERVAL	PROCEDURE
General	B0	D	Inspect to be certain that there is no obstruction to the flow of load bank cooling air.
Input Binding Posts	B0	D	Clean corroded or oxidized binding posts and inspect for stripped or damaged threads.
Electrical Connectors and Plug	B0	D	Inspect connectors and plug for damaged pins or inserts.
System Link Selector	B0	D	Clean corroded or oxidized links and inspect binding posts for stripped or damaged threads.
Enclosure and Panels	B0	D	Remove ordinary dirt and dust from all exterior surfaces
Fan Motor and Fan Blade	D0	D	Listen for excessive hum or vibration
	B0	Q	Inspect fan motor for excessive end play in shaft and inspect that fan blade is secured to shaft.
Load Banks	B0	W	Clean load bank elements of accumulated dust by use of low pressure air.
Relays	B0	M	Clean relay contacts of dust by use of low pressure air
	B0	Q	Inspect relay contacts. Clean and burnish corroded or pitted contacts
Switches	B0	Q	Check all switches for sluggish operation and sticking contacts.
B0 - Before Operation D0 - During Operation			D - Daily W - Weekly M - Monthly Q - Quarterly

TABLE 6-1

## PREVENTIVE MAINTENANCE



ITEM	ACTION	INTERVAL	PROCEDURE
Variable Transformer	B0	Q	Check variable transformer for ease of rotary movement and condition of brushes.
B0 - Before Operation D0 - During Operation			M - Monthly Q - Quarterly

TABLE 6-1

PREVENTIVE MAINTENANCE



SECTION VII  
TROUBLESHOOTING

7.1 GENERAL

- a. Troubleshooting is a systematic determination of malfunctions and defects by indication and symptoms.

WARNING

OPERATION OF THE LOAD BANK WITHOUT THE ENCLOSURE WILL EXPOSE ELECTRICALLY LIVE PARTS AND LEAVE THE FAN BLADE WITHOUT ANY PROTECTIVE GUARDS. AVOID CONTACT WITH ELECTRICALLY LIVE PARTS AND KEEP CLEAR OF ROTATING FAN BLADES. FAILURE TO OBSERVE THIS WARNING MAY CAUSE DISMEMBERMENT OR MAY PROVE FATAL.

CAUTION

OPERATION OF THE LOAD BANK WITHOUT PRELIMINARY EXAMINATION CAN CAUSE FURTHER DAMAGE TO A MALFUNCTIONING COMPONENT. BE CAREFUL DURING INSPECTION AND TROUBLESHOOTING SO THAT DAMAGE MAY BE AVOIDED.

7.2 PROCEDURE

- a. Malfunctions which may occur are listed in Table 7-1. Upon observing any of these malfunctions, take immediate steps to locate and correct the cause.



TROUBLE	PROBABLE CAUSE	REMEDY
Load Bank Fails to Start	Incorrect System Voltage Selection	Position System Selector Switch, System Link Selector and P1 Plug to the proper arrangement for the power system under test.
	Defective Master Load Switch, S1	Replace Master Load Switch
	Defective High Voltage Protective Relay, K1	Replace High Voltage Protective Relay, K1.
	Defective Voltage Transfer Relay, K2.	Replace Voltage Transfer Relay, K2.
	Tripped Circuit Breaker	Perform continuity of circuit corresponding to the specific circuit breaker and correct fault. Reset circuit breaker.
Fixed Load Segment Switch ON but no Load	Defective Air Flow Switch/s	Replace Air Flow Switch/s
	Defective Over-Temperature Switch/s.	Replace Over-Temperature Switch/s.
	Defective Fan Motor/s.	Replace Motors/s.
	Defective Load Switch/s.	Replace Switch/s.
	Defective Load Relay/s.	Replace Relay/s.
	Defective Load Interlock Relay, K3.	Replace Load Interlock Relay, K3.

TABLE 7-1  
TROUBLESHOOTING CHART



TROUBLE	PROBABLE CAUSE	REMEDY
Variable Load Switch ON but no Variable Load Control	Defective Variable Load Switch	Replace Variable Load Switch
	Defective Variable Load Relay/s.	Replace Variable Load Relay/s.
	Worn/damaged brushes on variable transformers	Replace Worn or Damaged Brushes.
Load Bank Overheats	Inadequate Air Flow	Remove foreign objects from air intake.
	Cooling Fan Motor Defective	Replace Fan Motor.
	Damaged or Distorted Fan Blade	Replace Fan Blade.

TABLE 7-1  
TROUBLESHOOTING CHART



## SECTION VIII

### PARTS LIST

#### 8-1 GENERAL

a. The Repair Parts List gives a listing of the major components which comprise the load bank. This listing is shown in tabulated form in Figure 8-1, Load Bank, Model PLB.

#### 8-2 ITEM NO.

a. The item number is a sequential listing of parts comprising the load bank and is tabulated numerically in the listing with like number showing the item in the illustration.

#### 8-3 REFERENCE DESIGNATOR

a. The Reference Designator defines the electrical symbol of the item as used on the electrical schematic and wiring diagram.

#### 8-4 PART NUMBER

a. The part number of the item lists the contractor's part number, except where Government standards or vendor part numbers are used.

#### 8-5 DESCRIPTION

a. The Description Column gives the noun description of the item.

#### 8-6 FSCM

a. The Federal Supply Code for Manufacturers, FSCM, is the vendors code as obtained from the cataloging handbook H4-1 and H4-2. The manufacturer's complete name and address for the FSCM code are listed in 8-8.

#### 8-7 QUANTITY PER UNIT

a. The Quantity per Unit gives the total quantity of each item used on a per load bank basis.

#### 8-8 FSCM

a. The following is the Code to Name for FSCM's as used in this manual:

CODE	NAME AND ADDRESS
01963	Cherry Electrical Products Corp. 3600 Sunset Avenue Waukegan, Illinois 60085



8-8 FSCM (Continued)

CODE	NAME AND ADDRESS
04713	Motorola Inc. Semiconductor Products Division 5005 E. McDowell Road Phoenix, Arizona 85008
10104	Tenna Corporation 19201 Cranwood Parkway Cleveland, Ohio 44128
12697	Clarostat Manufacturing Co., Inc. Lower Washington Street St. Dover, New Hampshire 03820
19220	Eberhard Manufacturing Co. 2734 Tennyson Road Cleveland, Ohio 44104
27193	Cutler Hammer Inc. Specialty Products Division Milwaukee, Wisconsin 53216
28455	Hevi-Duty Electric Division Highway 117 S. Goldsboro, North Carolina 27530
<sup>A</sup> <del>285</del> 78	Deltrol Controls 2745 S. 19th Street Milwaukee, Wisconsin 53215
44655	Ohmite Manufacturing Co. 3601 West Howard Street Skokie, Illinois 60076
56289	Sprague Electric Co. North Adams, Massachusetts 01247
58474	Superior Electric Co. 383 Middle Street Bristol, Ct. 06010
71590	Centralab Electronics Division 5757 North Greenbay Avenue Milwaukee, Wisconsin 53201
74924	Industrial Engineering and Equipment Co. 425 Hanley Industrial Court St. Louis, Missouri 63144



8-8 FSCM (Continued)

CODE	NAME AND ADDRESS
75382	Kulka Electric Corporation 633-643 S. Fulton Avenue Mount Vernon, New York 10550
79405	Wood Electric Corporation Danvers Industrial Park Danvers, Massachusetts 01923
80813	Dimco Gray Co. 207 E. Sixth Street Dayton, Ohio 45402
83008	STACO Inc. 2240 East Third Street Dayton, Ohio 45403
91929	Micro Switch Division Chicago and Spring Streets Freeport, Illinois 61032
94222	Southco Inc. Lester, Pennsylvania 19113
95933	Revcore Inc. 251 Edwards Avenue Caprentersville, Illinois 60110
96906	Military Standards Promulgated by Military Departments Under Authority of Defense Standardization Manual 4120-3M