LOAD BANKS DIRECT

Instruction Manual

LP Series

Portable Resistive Load Bank

Quick Start Guide and Overview

IMPORTANT: These instructions and the full detailed LBD model specific manual and drawing set should be read thoroughly prior to installation and operation of the Load Bank. All warnings and precautions should be observed for personal safety, proper equipment performance and longevity. Failure to follow these instructions could result in equipment failure, serious injury to personnel, and/or property damage. Load Banks contain lethal voltages when connected to the power source. It is very important to remove all sources of power to the load circuits, resistors, blower motor circuits, and control circuits before installing, operating, or servicing this unit. Always allow adequate time after removing power before touching any system components.

Table of Contents

Safety Precautions

This manual contains various **Warning** and **Caution** statements. Personal injury or death may occur to an operator and/or technician if a warning statement is ignored. Equipment damage or hazardous conditions for personnel could result if caution or warning statements are ignored. Carefully read and review this and the detailed instruction manual supplied with the load bank, supplemental manuals, and all electrical schematic/interconnection drawings provided with the Load Bank prior to installation and operation.

Keep Away From Live Circuits

Operating and Maintenance personnel must at all times observe normal safety regulations. Do not replace components or make adjustments to equipment with power turned on. To avoid casualties, always remove power to the entire system. Turn off and disconnect the main-power source under test. Disconnect all sources of power to the Load Bank (Main input load bus, blower motor circuit, and 120 VAC control circuits).

Shock Hazard

Load Banks contain lethal voltages when connected to the power source. Power to the load resistors (main input load bus), power to fan motor circuits, and power to 120 VAC control circuits must be removed before servicing. Allow adequate time after removing power before servicing or touching any components. .

Do Not Service or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

Safety Earth Ground

An uninterruptible and approved earth ground must be supplied from the main power source. Serious injury or death can occur if this grounding is not properly supplied. Grounding of this equipment should be done by qualified personnel only and must be installed in accordance with all applicable national and local electrical codes and regulations.

Potentially Hazardous Operator Conditions

- Heavy duty caster wheels are provided for easy positioning and movement on a flat level surface only! Forklift channels are provided in the base for lifting and movement by fork lift truck on unleveled surfaces. Never attempt to move the unit on a ramp, incline or any unleveled surface as this could cause serious injury, equipment damage, and property damage. Always engage the caster locking brake mechanism when unit is in place and during operation.

- Always run an approved ground conductor from the load bank frame to the power source under test which in turn must be properly earth grounded.
- Do not operate the unit unattended. Access to an approved electrical fire extinguisher should be on hand at all times.
- *Do not operate the Load Bank with access panels removed or doors open. Doing so would expose personnel to potential injury from electrical shock or from a moving fan blade.*
- Careful consideration needs to be taken during installation and equipment location during operation. Hot exhaust air can cause damage to other installed equipment. Do not direct hot exhaust in this direction.
- Do not allow hot-air exhaust to recirculate through the cold-air intake.
- Do not allow objects to enter or block the cold-air intake or hot-air exhaust.
- Do not install any external cold-air intake or hot-air exhaust duct work to the Load Bank for ventilation. The Load Bank must be installed and operated in a cool, well-ventilated area with adequate clearance for both intake and exhaust air. Do not allow hot air exhaust to recirculate into the cold-air intake.
- The unit should always be operated in a clean, cool, well-ventilated area free of dust and debris.
- Operating personnel should avoid and never come in contact with the hot-air exhaust and/or surrounding covers during operation and for some-time after operation as these surfaces become hot and may result in serious burn injury.
- Never bypass any blown fuse.
- Replace any indicator lamps on the operator control panel as required. Each indicator is important to the protection of the unit and safety of the operator, and is an indication of proper system operation or failure.
- Do not bypass any safety circuit including but not limited to; air-safety switch, fan motor overload, exhaust over-temperature switch.
- Always short/shunt current transformer secondary circuits when troubleshooting metering and instrumentation circuits.
- Operating personnel should not come in contact with hot air exhaust opening, outside panels, system components, and load resistors for some time after operation.

A recommended 3-5 minute cool down period of the blower motor circuit, with no load applied is recommended as best practice and will protect operating personnel from possible burn injuries. A 5 minute cool down should adequately remove any residual heat from the Load Bank and system components.

Emergency Shut-Down: The Emergency STOP pushbutton will immediately turn off control power to the load step application circuits, blower motor circuits and control/instrumentation circuits. In a controlled emergency stop condition, turn the “Master Load” switch to the “OFF” position first (allowing fan motor to run while all load steps are disconnected). Turning the “Power On” switch to the “OFF” position will then turn off all control and blower circuits. Turn off and disconnect the main-power source under test. Disconnect all sources of power

to the Load Bank (Main input load bus, blower motor circuit, and 120 VAC control circuits).

Maintenance should always be done only by qualified personnel and with all sources of power disconnected from the unit (main input load bus power, power to all blower fan and control circuits).

Always follow The National Electric Code (NEC), local electrical safety codes, and the Occupational Safety and Health Act (OSHA) when handling, installing, and operating equipment to reduce hazards, personal injury, property damage.

Safety Symbols

This symbol indicates that a shock hazard exists if the precautions in the instruction manual are not followed.

The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area.

This symbol indicates that the unit radiates heat and should not be touched while hot.

NOTE: Calls attention to supplemental information.

Warning Statements

WARNING

Disconnect unit from all power sources before any disassembly or service. Main input Load Bus, Blower Motor circuits, 120 VAC control circuits.

WARNING

Do not insert a screwdriver or any thin metal objects through the perforated cooling air grilles while the load bank is in operation. The fan blade and power within the unit could cause serious injury to personnel and damage to the unit.

WARNING

Do not remove the enclosure covers while unit is in operation or operate with covers removed. Unit will not properly cool without all covers in place and pose a shock hazard to personnel.

WARNING

Do not touch the enclosure surfaces while the unit is in operation. Enclosure surfaces are hot and exhaust temperatures can reach in excess of 500ºF when unit is under load and in operation.

WARNING

Do not position the exhaust to blow on other equipment or material susceptible to excessive heat. Never direct exhaust air towards flammable materials.

WARNING

Never attempt to move the unit on a ramp, incline, or any unleveled surface as this could cause serious injury, equipment damage, and property damage.

Caution Statements

CAUTION

Air enters through the bottom/side cold-air intake of the enclosure and exhausts at the top or side hot-air exhaust end of the enclosure. Blocking these openings will cause overheating and unit failure.

CAUTION

Do not apply more than the rated Voltage or exceed the power rating of the Load Bank. Excessive power will damage the internal resistor banks.

CAUTION

Confirm all control voltages before operation. Improper Voltage or Over-Voltage will damage load resistors, fan motors, and control components.

CAUTION

Confirm that all cam-lock load connections are securely attached, turned, and tightened, and that the unit is properly grounded prior to operation. Failure to do so may result in equipment damage and harm to personnel.

CAUTION

Heavy duty caster wheels are provided for easy positioning and movement on a flat level surface only! Forklift channels are provided in the base for lifting and movement by fork lift truck on unleveled surfaces.

Lingual General Safety Statements

USAGE: ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENTS SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIES GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N`EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE LINSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

SERVICE: SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERIO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL. ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRENTIEN

LE'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ETRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PREVENIR UN CHOC ELECTRIQUE DANGEREUX NE PAS EFFECTUER D'ENTRENTIEN SI L'ON N'A ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

Product Overview

Load Banks Direct (LBD) LP Series of Resistive Load Banks are portable industrial power test units designed for indoor operation. The units are designed to absorb a balanced resistive load at unity power factor.

The Load Bank is a self-contained unit that includes an Operator Control Panel which allows the user to control and monitor individual-discrete load steps, blower motor circuits, control circuits, and safety circuits. Electrical energy from the power source under test is absorbed by the load bank resistors and converted into heat. The blower motor provides the necessary cooling airflow to cool the resistor load elements.

The Load Bank Unit contains all of the necessary principle system components:

- **Load Circuits**: Including load power resistors, load step switching and main input load bus.
- **Cooling System**: Including integrally powered blower motor and controls.
- **Control Circuits**: Including 120 VAC controls, load application circuits, blower circuits, and indicators.
- **Safety Circuits**: Including branch circuit fuse protection for load power resistor circuits, fuse protection for blower and control circuits, motor overload protection, exhaust over temperature protection, cooling air-loss protection, wrong voltage protection, load dump indication, and E-Stop.

CAUTION

The Load Bank should never be used without the Fan Blower Motor operating. Inadequate cooling airflow will result in resistor load elements overheating, fire hazard, and danger to personnel.

CAUTION

Never exceed the rated voltage of the unit as this will cause the Load Bank to overheat.

An AIRFLOW switch is provided to monitor the flow of cooling air through the load power resistor section of the enclosure. If there is inadequate cooling airflow, or an obstruction sensed at the air-intake or air-exhaust, all load is removed.

An Over Temperature switch is provided to monitor the temperature of the enclosure hot-air exhaust. If an over temperature condition is sensed, all load is removed.

Lower Voltages and variation in Frequency may be applied to the Resistor Load Bank load circuit (main input load bus). Frequency change causes no de-rating of the load. Application of lower voltages causes a de-rating of power (KW) from designed nameplate rating. The applied KW with a lower voltage is de-rated from its rated KW value. The actual applied KW when operated at a lower voltage is computed using the following formula:

$$kW_{Applied} = kW_{Rated} \times \frac{(\text{Voltage Applied})^2}{(\text{Voltage Rated})^2}$$

The Operator Control Panel provides the user control of the Load Bank. Main Power ON switch and indicator tell the operator control power circuits are energized and ready for operation. Blower Motor START/STOP push buttons activate and energize the Load Bank cooling system. The Blower Power On lamp indicates blower motor is energized and in operation. Load step application circuits include individual load step switching (one switch provided for each load step). Switched load steps (KW) are additive such that the desired amount of load can be achieved. The Master Load step switch allows a pre-selectable amount of load to be applied when the Master Load step switch is turned on. Dual Voltage Units feature a Load Voltage Selector Switch which selects "System" operational Voltage, a Blower Voltage Selector switch which selects blower operational voltage, and a Fan-Phase reversal switch for selection of fan phasing ABC – ACB.

Definitions and Formulas

KW = Kilowatts (Watts x 1000)

KVA = Kilo Volt Amperes

KVAR = Kilo Volt Amperes Reactive

PF = Power Factor

HP = Horse Power

BTU = British Thermal Unit

KW = KVA x PF

PF = KW / KVA

KVA = KW / PF

KVA = $\sqrt{KW^2 + KVAR^2}$

1 KW = 3412.14 BTU/Hour

$\sqrt{3}$ = 1.7321

1 HP = .746 KW

1 KW = 1.34 HP

Volts (L-L) is expressed as 3-phase System Voltage (Line to Line).

Amps is expressed as phase Amperes.

PF is expressed as Power Factor and is unity (1.0) in a Resistive Load Bank.

	3 Phase	Single Phase	DC
KW	$\frac{\text{Volts (L-L)} \times \text{Amps} \times \sqrt{3} \times \text{PF}}{1000}$	$\frac{\text{Volts} \times \text{Amps} \times \text{PF}}{1000}$	$\frac{\text{Volts} \times \text{Amps}}{1000}$
KVA	$\frac{\text{Volts (L-L)} \times \text{Amps} \times \sqrt{3}}{1000}$	$\frac{\text{Volts} \times \text{Amps}}{1000}$	
Amps	$\frac{\text{KW} \times 1000}{\text{Volts (L-L)} \times \sqrt{3} \times \text{PF}}$	$\frac{\text{KW} \times 1000}{\text{Volts} \times \text{PF}}$	$\frac{\text{KW} \times 1000}{\text{Volts}}$
Amps	$\frac{\text{KVA} \times 1000}{\text{Volts (L-L)} \times \sqrt{3}}$	$\frac{\text{KVA} \times 1000}{\text{Volts}}$	
HP	$\frac{\text{Volts (L-L)} \times \text{Amps} \times \sqrt{3} \times \text{PF}}{746}$	$\frac{\text{Volts} \times \text{Amps} \times \text{PF}}{746}$	

Theory of Operation

General

Load Banks are precision test and measurement instruments designed to provide discrete, selectable, electrical loads for testing mission critical power sources. They can be utilized for production testing and/or periodic maintenance testing of back up (standby) generators and Uninterruptible Power Supply (UPS) systems.

Equipment Cooling

The power resistors used within the Load Bank are LBD-*PowerDyne*™ resistor load elements situated within the "Resistor Assembly" (RA) frame. The resistor load elements are forced air cooled designed for continuous operation at rated voltage. The blower motor draws cooling air into the air intake openings and forces air flow across the entire resistor bank network. Hot-air exits the unit through the hot-air exhaust opening located at the opposite end of the unit.

WARNING

Do not look into enclosure exhaust while in operation. Exhaust temperatures can reach temperatures in excess of 500ºF when unit is under load and in operation. Dust and or debris may also be present.

Environmental Parameters

Wind Loading:	75 MPH
Seismic Zone Rating:	Zone 4
Ambient Temperature:	-20°F to +120°F
Altitude:	5,000 feet above sea level

- Careful consideration to surrounding equipment is required as hot-air exhaust temperatures can be in excess of 500ºF when the unit is operated under load.
- The unit should be placed in an open air environment where adequate space is available for air circulation. Do not enclose the unit in a small confined area with obstructions, or with nearby equipment in close proximity to the air intake or hot-air exhaust. A minimum of 3-4 feet of clearance should be provided for cold-air intake and 10-12 feet of clearance at hot-air exhaust. A minimum of 36 inches of clearance should be provided for equipment maintenance on each side of the enclosure. Never vent cold-air intake or hot-air exhaust.

WARNING

Do not touch the enclosure surfaces while the unit is in operation. Enclosure surfaces are hot and exhaust temperatures can reach in excess of 500ºF when unit is under load and in operation.

Equipment Installation

Equipment Placement and Location

- Diligent care is required for proper installation of the Load Bank. The National Electric Code, all local installation codes, all electrical and safety codes, Occupational Safety and Health Act codes (OSHA) are required to be followed when installing this equipment to reduce any hazards to persons, personal property, and injury to any installation and operating personnel.
- Failure to follow installation guidelines will void the warranty.
- Installation, hook-up and operation should only be done by certified, qualified, licensed contractor technicians, which are trained and familiar with installation practice, operation of Load Banks and industrial electrical equipment.
- Prior to equipment placement and installation, inspect the Load Bank for any enclosure damage, broken wires, cracked or broken ceramic insulators, or any other component damage that may have occurred during shipment. Immediately report any damage claims to the freight carrier, contact factory.
- Do not install the Load Bank where standing water can accumulate. Installation should be above grade.
- The unit is equipped with locking casters and should always be utilized for equipment placement prior to start-up and operation. Never attempt to move the load bank on a ramp, incline or any unleveled surface.

- The Load Bank must be operated in a cool well ventilated open area where hot-air exhaust cannot be recirculated to the cold-air intake. Hot-air exhaust can exceed 500°F when operated under full load conditions.
- The enclosure should be mounted on a level and solid surface, minimum clearances of 36 inches on sides for service and maintenance, 3-4 feet of clearance for cold-air intake, 10-12 feet of clearance at hot-air exhaust.
- The hot-air exhaust should blow to open air with no restrictions, redirection, or threat to personnel or other equipment.
- Never vent the cold-air intake or hot-air exhaust.

☞ NOTE: This Resistor Load Bank is designed for indoor use. Due to heat produced and generated during operation, careful consideration should always be taken when operated in close proximity to other industrial equipment. Hot-air exhaust can damage temperature equipment up to 15 feet from hot-air exhaust.

☞ NOTE: All clearances are recommended factory minimums. Clearances less than specified should be discussed with the factory prior to installation.

CAUTION

Air enters through the cold-air intake sides of the enclosure and exhausts at the hot-air exhaust at the opposite end of the enclosure. Blocking these openings will cause overheating and unit failure.

☞ NOTE: The enclosure is portable and on casters for ease of positioning. The unit is designed to be lifted from the base. Fork-Lift channels provided in the base for ease of lifting. Locking casters secure the unit in place during operation.

☞ NOTE: To avoid damage to the enclosure and internal components, do not lift the enclosure in any manner with covers removed.

Equipment Mounting

CAUTION

Heavy duty caster wheels are provided for positioning and movement on a flat level surface only! Forklift channels are provided in the base for lifting and movement by fork lift truck on unleveled surfaces. After proper placement, activate the locking casters top secure the unit in place. Not utilizing the locking casters while unit is in place could cause the unit to roll, causing damage or harm to other equipment and/or personnel.

WARNING

Never attempt to move the unit on a ramp, incline, or any unleveled surface as this could cause serious injury, equipment damage, and property damage.

Power Connection Considerations

Reference the Electrical Schematic for the Total Power Ratings of; Main Input Load Bus (KW, Voltage, Phase, Frequency), Blower Motor Circuit Ratings, and Control Circuit Ratings.

Load cable conductors from the power source to the load bank should be adequately sized and protected to handle the maximum rated load, and in accordance to the National Electric Code and any local codes.

In order to adequately protect the conductors to the Load Bank, an approved, lockable, and properly sized main circuit breaker and/or disconnect switch should be mounted as close to the power source as possible. Always refer and adhere to National Electric Code and any local codes.

Load Power Connections

- Load connections from the power source under test are made to the respective color coded Cam-Lok power receptacles located on the bottom front of the Load Bank enclosure. Cam-Lok Power connectors are color coded for safety and ease of phase identification.
  [BLACK = A Phase] **[RED = B Phase]** **[BLUE = C Phase]** **[GREEN = Equipment Ground]**
- Cam-Lok Power Connectors are rated 400 Amps and should be de-rated not to exceed 350 Amps per conductor. Do not exceed cable runs of 200 feet.
- Quality solid cable connections are critical for conductivity and load sharing.
- Load test cables must always be of same conductor rating and equal length.
- Never bundle multiple cables in parallel with the same phase together
- Always run multiple parallel conductors in groups with Phase (A-B-C) together

Grounding

An uninterruptible and approved earth ground must be supplied from the main power source which in turn must be connected to a solid earth ground. The ground connection at the load bank is made to the “Green” Cam-Lok receptacle on the bottom front of the enclosure. Serious injury or death can occur if this grounding is not properly supplied. Grounding of this equipment should be done by qualified personnel only and must be installed in accordance with all applicable National Electric Code, local electrical codes, and regulations.
The ground conductor must be sized and connected to the Load Bank enclosure per the National Electric Code and any local codes. The ground connection at the load bank is made to the “Green” Cam-Lok receptacle on the bottom front of the enclosure which is provided for this connection. The Load Bank receptacle ground terminal must be solidly connected to both the power source frame and in turn, connected to solid earth ground.

Blower and Control Power Connections

- Blower Motor requires a 3-phase power source that can be derived internally from the main input load bus (source under test), or from an external power source.
- Internal/External blower power is selected by the connection of the "blower power terminal plug" P2 to the terminal block receptacle jack J2A - [internal blower power], or to the terminal block receptacle jack J2B - [external blower power]. Location is within the load bank relay panel compartment. Reference Electrical Schematic.
- The Blower Motor circuit consists of a motor starting relays for energizing the blower motor. Short circuit protection for the motor circuit is provided by fast-acting current limiting fuses and thermal protection by overload relays.
- If the load bank is provided with a dual voltage blower motor circuit, a "Blower Voltage" selector switch is provided on the operator control panel.
- A Fan-Phase reversal switch is provided for phase selection ABC or ACB.
- The Load Bank Control circuits require 120 Volt AC, 1-phase, 60 Hertz power for proper operation of load bank controls, instrumentation, and safety circuits. A 15 foot detachable power line cord with mating plug is provided with the Load Bank. Connect the power cord mating plug to the Load Bank receptacle first (located on the bottom of the unit), and then connect the power cord to a grounded 120 VAC, 1-phase, 60 Hertz source.
- Control Power Transformer: If the unit is provided with a control power transformer, the line cord for external 120 VAC control power is not necessary and is not provided. Control power is derived internally from the blower motor power circuit which is either connected to the main input load bus for internal power connection or to the external power connection terminal block.
- Blower Motor circuits, Control circuits, Load Circuits, Instrumentation circuits, and Safety circuits are branch circuit fuse protected.
- Reference Electrical Schematic for blower motor and control circuit power ratings, as well as location and size of blower circuit fuses, motor overloads, control circuit fuses, instrumentation and safety circuit fuses.

Operator Controls

The Load Bank is supplied with an integral Operator Control Panel that is utilized for local control and monitor of the Load Bank control circuits, load application circuits, instrumentation/metering circuits, blower circuits, and safety circuits.

Multi-Power Meter

If the Load Bank Operator Control unit is supplied with a multi-function Multi-Power Meter Display, all meter input wiring for Voltage and Current is factory complete within the Load Bank. With the Load Bank in operation and under load, the Multi-Power Meter allows the operator to monitor, measure, display, and record electrical load parameters such as 3-Phase System Volts, Phase Amperage, Frequency, and Power Functions.

- Voltage inputs are sensed from the main input load bus and are fuse protected wired direct to the meter.
- Current Transformers are located within the Load Bank enclosure and sense primary phase current. Secondary connections are made direct to the meter.
- Reference Electrical Schematic for terminal locations and fuse location of metering/instrumentation circuit.

☞ Note: Always short/shunt current transformer secondary circuits when servicing or troubleshooting metering and instrumentation circuits. Primary current flowing through an un-shunted open secondary of a current transformer will destroy the current transformer with possible danger and harm to personnel.

☞ ***Note: Complete details, functions, and operation of the Multi-Power Meter are described in the supplemental Multi-Power Meter Manual.***

CAUTION

Confirm all external blower and control voltages before operation. Over or under voltage will damage blower and control components.

CAUTION

Confirm all main input load bus and ground connections are properly connected, turned, and tightened. Confirm external blower and control power connections. Loose connections will result in damage and danger to personnel.

Operating Instructions

General

- All installation should be reviewed and checked by a qualified technician with all local and National Electric codes observed.
- Ensure all connections are properly tightened and all covers are installed.
- Never operate the unit un-attended.
- All wiring from external power sources to Load Bank Unit (including; main input load bus, blower motor circuits, and 120 VAC control circuits) should be verified and checked by a qualified technician with all local and National Electric codes observed.
- The following Cautions and Warnings should be strictly enforced:

CAUTION

Operation of the unit with any covers removed will disrupt air flow and allow debris to pass through resistors possibly damaging equipment.

WARNING

Operation of the unit with any covers removed will pose a shock hazard and danger to personnel.

WARNING

Do not look into the exhaust of the enclosure while in operation. Exhaust temperatures can reach temperatures in excess of 500ºF when unit is under load and in operation. Dust and or debris may also be present.

WARNING

Do not touch the enclosure surfaces while the unit is in operation. Enclosure surfaces are hot and exhaust temperatures can reach in excess of 500ºF when unit is under load and in operation.

WARNING

Do not insert a screwdriver or any thin metal objects through the perforated cooling air grilles while the load is in operation. The power within the unit could arc over and will cause serious injury to personnel and damage to the unit.

WARNING

Do not operate under load without fan blower in motion. Immediate equipment damage may result.

Operation

- Select/Connect proper Blower Voltage, Internal/External Blower Power, and Control Power as reviewed and described in Installation section of this manual.
- Connect the power source under test to main input load bus as described in the Installation section of this manual.
- Verify – Check Emergency Stop Button is in the "Closed" operating position.
- Verify – Check Blower Voltage Selector Switch is in the proper position (dual voltage units).
- Verify – Check the Load Voltage Selector Switch is in the proper position and matches the System Voltage applied to the Load Bank main input load bus terminals (dual voltage units).
- With Operator control panel switches in the OFF position, place Control Power switch to the ON position (control power on indicator will illuminate).
- Press Blower Start push button. Blower Power indicator will illuminate. When blower fan motor reaches proper speed, the air-flow failure indicator will de-energize.
- **Note**: Ensure and check for proper airflow, blower motor and direction of airflow from cold-air intake out of the hot-air exhaust.

CAUTION

DO NOT operate the Load Bank over rated nameplate Voltage as this will cause catastrophic failure.

The operation of the blower motor circuit is critical for safe operation. If the air-flow failure and/or over-temp lamp is illuminated, all load steps are disabled and load cannot be applied.

DO NOT attempt to bypass the air switch or over-temperature switch as this will cause catastrophic damage to the unit.

- With Master Load and KW load step switches in the OFF position, pre-select a KW load using one or any additive combination of load step increments by turning the switches to the ON position.
- Turning the Master Load step switch to the ON position, the pre-selected amount of load KW will be applied to the power source under test.
- Any available combination of incremental KW load values can be turned ON/OFF during operation to achieve the desired load on the power source under test.

- Shut-Down: Turn the "Master Load" switch, and all load step switches to the "OFF" position first (allowing fan motor to run while all load steps are disconnected). Press the Blower STOP push button. Turning the "Power On" switch to the "OFF" position will then turn off all control and blower circuits. Turn off and disconnect the main-power source under test. Disconnect all sources of power to the Load Bank (Main input load bus, blower motor circuit, and 120 VAC control circuits).
- A recommended 3-5 minute cool down period of the blower motor circuit, with no load applied, should adequately remove any residual heat from the Load Bank and system components.

WARNING

DO NOT touch the exhaust louver during operation. Hot-Air exhaust will cause serious burns
DO NOT allow objects to enter or block air intake or exhaust louvers.
DO NOT operate the Load Bank over rated nameplate Voltage as this will cause catastrophic failure and danger to personnel.
DO NOT apply DC voltages to main input load bus.
Refer to Safety section of this manual

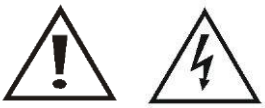
Safety and Shut-Down Indicators

- "Emergency Stop" Pushbutton disables 120 VAC control power to all control circuits (blower circuit, load application circuit, instrumentation, control and safety circuits)
- "Air-Failure" lamp indicates a loss of cooling airflow (all load is removed).
- "Over-Temperature" indicates an exhaust over-temp condition (all load is removed).
- "Wrong Voltage" indicates Load Voltage Selector Switch does not match System Voltage applied to main input load bus terminals (load steps disabled).
- "Load Dump" indicates removal of all loads due to one or all of the above conditions
- "Motor Overload" lamp indicates motor thermal overload and motor shut-down.

Maintenance

Maintenance personnel must always exercise caution when access panels are removed. Personal injury from electrical shock or from moving fan blades could result unless all sources of power are completely disconnected before servicing. Maintenance must always be done by qualified technician. Maintenance procedures must be followed to provide longevity of equipment life, and to reduce the probability of electric shock hazard, fire, personal injury, or property damage.

Before servicing this equipment, completely review the "**Safety Points**" and "**Potentially Hazardous Operator Conditions**" sections of this manual. Maintenance must always be done by a qualified and certified technician. Proper protective arch-flash clothing, eye protection, ear protection, gloves, and hard-hat should be worn when servicing or maintaining the unit.



WARNING

Disconnect from all sources of power to the unit (Main input Load Bus, external Blower Power, External Control Power) prior to any inspection, service, or cleaning. Electric Shock Hazard exists while connected.

For optimum performance and service life, preventative maintenance is a key factor. It is recommended that during scheduled inactiveness, reactivation from storage, or unit relocation the following maintenance steps are performed:

Daily Maintenance Prior to Operation

1. Inspect and remove any restrictions and/or obstructions to cold-air intake and hot-air exhaust of the Load Bank unit.
2. Check screens to make sure objects have not blocked/entered openings.
3. Verify the direction of the airflow is in the proper direction from cold-air intake to hot-air exhaust.
4. Verify no possibility of re-circulation of hot-air exhaust to cold-air intake.

Quarterly Maintenance (every three months)

1. Remove all exterior access panels to Load Bank enclosure (including air intake and exhaust covers).
2. Inspect the intake and exhaust covers. Blow or brush away any noticeable dirt or debris from air intake and exhaust openings. Ensure covers are functional and free of debris. Replace any damaged or compromised panel.
3. Clean any and all dirt and/or debris from the interior of the entire Load Bank. Do not exceed 40 PSI when using clean, dry, compressed air for blowing and removing dust and debris.
4. Inspect blower motor and fan blade, clearing any debris or removing any obstruction. Check fan blade for balance and all respective fan blade and motor mounting hardware for tightness. Torque to proper values of tightness as required.
5. Inspect all resistor elements ensuring all hardware is tightened and elements are clear and free of debris.
6. Inspect all resistors for mechanical and structural integrity and location. Replace any excessive sagging resistor elements, ceramics and support rods. Replace any and all broken or cracked termination ceramics, and ceramics on resistor support rods as required.

7. Inspect all termination ceramic insulators at resistor case ends (both sides) for breaks or cracks and replace as necessary.
8. Inspect all support rod ceramic insulators for breaks or cracks and replace as necessary.
9. Inspect the entire inside of the enclosure for loose hardware or loose connections and tighten to proper torque values as required.
10. Inspect all load and control wiring for signs of insulation failure or breakdown.
11. Inspect for any signs of heat stress on connections and terminals. This could be a sign of loose hardware or corroded/oxidized connections. Repair and replace connection hardware as required.
12. Inspect all electrical connections to terminal blocks, main input load bus bars, fuses mounted to bus bars, Cam-Lok power receptacle connections, all resistor connections for corrosion and oxidation. Clean connections and replace hardware as required. Tighten as necessary.
13. Inspect all load step contactors. Inspect magnetic contactor coils for oxidation and rust. Inspect contacts that carry load if pitted, rusted or corroded. Contacts must all move freely and properly seal when closed. Replace as necessary.
14. When replacing current transformers, mark all leads before removing to ensure proper phasing of new current transformer. Never leave the secondary of a current transformer un-shunted.
15. Reinstall all covers ensuring all materials are in place, and all hardware is properly tightened.
16. Verify Airflow protection circuit. This can be done when unit is powered up for operation with all access panels closed and in place, and blocking off the cold-air intake and/or hot-air exhaust.
17. Check all indicator lamps on Operator Control unit (replace as necessary).
18. Blower motor to be lubricated per manufacturer's requirements as noted on motor nameplate.

CAUTION

Do not pressure wash the inside component terminal compartment (relay panel) as damage may occur to electro-mechanical load step relays, motor and control circuits, safety circuits, and terminal strip wiring. If splashed, ensure entire compartment is dry before covering.

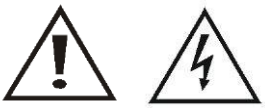
WARNING

Pressure washing terminal compartment (relay panel) may lead to condensation and promote internal arching.

Additional Preventative Maintenance Measures (as required)

1. The outside surface of the unit should be wiped or blown free of dust and dirt. Careful consideration to controls, metering and relay compartment must be taken into account when pressure washing the exterior of the enclosure. Ensure air intake and exhaust areas are clean and debris free. Blast or sand any noticeable corrosion areas and cover with a suitable paint or coating.
2. Remove both side access panels and ensure all resistor terminal connections including wire, bus jumper, and bushings are tightened to 50 ft/lb. Inspect all ceramic bushings and insulators for cracks. Replace all broken or cracked ceramic insulators. Ensure all fan and safety component connections are tight. If required, it is safe to blow any dust from this compartment using 40 PSI or less of clean, dry, compressed air. Replace any broken or failed components. Reinstall access panel cover before proceeding with any enclosure maintenance.
3. If resistor elements are extremely dirty, elements can be pressure washed. Pressures up to 400 PSI at a distance of two feet or greater may be used when cleaning the resistor elements. Pressure should be reduced for the connection points and the distance from the nozzle to any insulator should not be closer than four feet to prevent damage.

Troubleshooting Guide



WARNING

Disconnect all sources of power to the unit (Main input Load Bus, external Blower Power, External Control Power) prior to any inspection, service, or cleaning. Electric Shock Hazard exists while connected.

For corrections requiring repair or replacement of components, contact the factory immediately for further instruction. Only those functions within the scope of normal maintenance are listed. This manual cannot list all malfunctions that may occur, or corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify the factory.

☞ Note: When checking fuses for continuity, remove all fuses from fuse blocks, bus bars, fuse holders, and disconnect switch. Test each fuse individually and out of circuit. A blown fuse left in the circuit may check out OK with false reading of continuity due to feedback and return paths within the circuit.

1) No Main Power to 120 VAC Control Circuits

- Emergency Stop / “E-STOP” push button is in the open position.
- Terminals damaged during shipment.
- External Control Power Main Switch or circuit breaker is not closed.
- Control Power Transformer failure (primary or secondary control power fuse is blown (check and replace as required).
- Control Circuit Fuse is blown (check and replace as required).
- Dirty or loose connections or faulty Main Power Switch.

2) Blower Motor Not Operating

- No External Power to Motor Circuits.
- Main Power switch is in the off position.
- Emergency Stop / “E-STOP” push button is in the open position.
- External Blower/Control Power Main Switch or circuit breaker is not closed or power source is disconnected.
- Blower Motor is internally wired to main input load bus with no main input load bus voltage applied.
- External power source is inadequate
- Loose or broken connection at terminal block, motor starter, motor starting coil or on operator control unit (main power, blower start/stop pushbuttons)
- Blower Motor fuse is blown (check and replace as required).
- Motor Over-Load relay is tripped.
- Motor starting relay failed.
- Fan blade obstruction, motor winding failure, or shaft does not turn to improper lubrication

3) Blower Motor Circuit energized but Fan Blade is not turning

- Fan blade motion is obstructed or broken.
- Fan blade is loose at hub or is not keyed properly.

4) Air Failure Lamp Illuminated

- Obstruction or restriction of air flow at Load Bank cold-air intake or hot-air exhaust.
- Blower motor phasing is incorrect causing rotation of fan blade and wrong direction of cooling air flow. Check motor power connections for proper phase sequence.
- Exhaust over-temperature switch is activated. Sign of resistor over-temperature. Verify and ensure air intake and exhaust openings are clear of any debris, blockage or obstruction. Check for proper blower operation and proper direction of airflow.
- Air switch or Air failure auxiliary relay is malfunctioning or not operating correctly.

- Air switch high pressure intake tubing obstruction. Remove, clean and replace tubing as necessary.

5) Over-Temp Lamp Illuminated

- Obstruction or restriction of air flow at Load Bank cold-air intake or hot-air exhaust.
- Blower motor phasing is incorrect causing rotation of fan blade and wrong direction of cooling air flow. Check motor power connections for proper phase sequence.
- Airflow switch is activated indicating a loss of cooling airflow. Sign of resistor over-temperature. Verify and ensure air intake and exhaust openings are clear of any debris, blockage or obstruction. Check for proper blower operation and proper direction of airflow.
- Over-Temp switch or Over-Temp auxiliary relay is malfunctioning or not operating correctly.
- Air switch high pressure intake tubing obstruction. Remove, clean and replace tubing as necessary.

6) Wrong Voltage Lamp Illuminated (dual voltage units)

- Load Voltage Selector Switch is in the wrong position
- Load Voltage Selection does not match the applied System Voltage sensed at main input load bus terminals.
- Wrong Voltage Relay (K-VCR) failure or R100 dropping resistor failure/open.

7) Load Dump Lamp Illuminated

- Indication that all load steps are removed due to Air-Failure, Over-Temp, Wrong Voltage, Motor Overload condition, or motor shut down condition.

8) Motor Overload Lamp Illuminated

- Motor Thermal Overload Relay tripped. Check ambient air intake temperature and for re-circulation of hot air. Motor windings running hot. Blower motor winding failure (replace if necessary). Reset Overload relay.

9) Resistor Open or Phase Imbalance

- Blown load step fuse in branch load circuit (check and replace as necessary).
- Loose bus bar or loose connection at resistor terminal or fuse (tighten all bus bar and connection points as required).
- Resistor element failure and burned open (replace as necessary).

10) Load Step or Load step application circuit cannot be energized

- Blower Failure, Air failure, Over-Temp, Wrong Voltage, Motor Overload, Load Dump, (see item 2 thru 8 above).
- Master Load Step switch is in the OFF position or not functioning.
- Load Step toggle switch is inoperative.
- One or more of the branch circuit load step fuses for the load step in question is blown (check and replace as necessary).
- One or more of the load step resistor for the load step in question has failed or burned open (check and replace as necessary).
- Load step contactor has failed or is inoperative due to loose connection or failed-open coil.

11) Load Step energized without rated load, or un-balanced load

- Applied main input bus voltage from power source under test is de-rated, low, imbalanced or inadequate.
- Contactor failure or not closing properly. Loose connection.
- One or more of the branch circuit load step fuses for the load step in question is blown (check and replace as necessary).
- One or more of the load step resistor for the load step in question has failed or burned open (check and replace as necessary).

12) Load Step contactor or relay chattering

- Contacts are pitted or oxidized.
- Magnetic core and coil are dirty or corroded.
- Coil connections to the contactor are loose.
- 120 VAC control circuit line voltage is low and/or inadequate.

13) Switchgear Circuit Breaker trips or Main Disconnect fuses are blown

- Fuses and/or circuit breaker trip settings are undersized.
- A short circuit exists at the Load Bank Resistor (main input load bus or blower circuit).
- A short exists in the power conductors feeding the Load Bank Resistor.

☞ Note: When checking fuses for continuity, remove all fuses from fuse blocks, bus bars, fuse holders, and disconnect switch. Test each fuse individually and out of circuit. A blown fuse left in the circuit may check out OK with false reading of continuity due to feedback and return paths within the circuit.