AVTRON POWER SOLUTIONS

LC20 Series Load Bank

User's Guide

Part Number: 1 6 0 1 9 3 5
Revision Date: October 2025 V1

AVTRON MODEL LC20
INDOOR LIQUID COOLED LOAD BANK
Part Number 1601935

Cleveland, Ohio

October 27, 2025

PROPRIETARY NOTE

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AVTRON POWER SOLUTIONS, LLC
Cleveland, Ohio

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SECTION I

SAFETY CONSIDERATIONS

Throughout this manual, you will find **WARNING** and **CAUTION** statements. Personal injury or death may occur to an operator using or repairing the equipment if a **WARNING** statement is ignored. Damage to the equipment and potentially hazardous conditions for personnel may occur if a **CAUTION** statement is ignored.

Each unit is safety checked for opens and shorts, and the insulation is high potential tested to ensure safe operation. All fuses, safety interlocks, and related safety equipment have been proven reliable as part of the testing procedure of each unit.

As part of the safety program, an initial inspection after receiving the unit(s) and periodic preventive maintenance and safety inspections should be conducted to ensure the reliability and safety built into your equipment.

The LCLB is an industrial test unit designed to be used indoors only. However, because the function of the LCLB is to dissipate electrical energy, there are inherent dangers to operators and equipment. These dangers are outlined in this section.

Electrical energy is transformed into heat by the resistors. This heat must be removed from the Load Bank by the cooling liquid. If there is any restriction or stoppage of liquid flow, the LCLB will overheat.

Electrical energy is transformed into heat by the resistor elements It is recommended that:

1. The operator should read the manual before using the LCLB.

2. Read and heed all **WARNING** and **CAUTION** statements in the manual.

3. Run an approved ground wire to the LCLB ground Cam Lock connector. Run an approved ground wire from the unit under test (UUT) to a good earth ground. Size ground wire in accordance with National Electrical Code and any local codes.

4. Do not bypass any of the INLET FLOW, OVER PRESSURE or OVER TEMPERATURE switches to prevent nuisance tripping. These features are monitored by the RxMS system.

5. Replace any burned out bulbs on the control panel. Each lamp is an indication that a system is active or has failed and is important to the operation of the LCLB and safety of the operator.

6. Maintenance personnel must always exercise caution when the access panels are removed or the enclosure doors are open. Personal injury from electrical shock may result if all sources of power are not disconnected before servicing. Maintenance work must be done only by qualified personnel.

7. The LCLB must be used in a cool, well-ventilated area as described in the INSTALLATION section of this manual.

8. Promptly repair liquid leaks. The cooling liquid used in the LCLB is a possible hazard, both electrically and mechanically. Maintenance must be performed with no power on the unit.

9. After running a load test, residual heat may be removed from the LCLB by allowing the liquid to flow through the piping system for several minutes or to drain the LCLB tanks. This procedure is not required for maintaining LCLB integrity, but it may guard operating personnel from possible burn injuries.

10. The operator should avoid coming in contact with the resistor element terminals or surrounding covers during and for some time after operation. Check the temperature readings via the temperature transducers located inside the LCLB tanks. These portions of the LCLB become quite hot and may result in a serious burn should contact be made with them.

11. Operators must not operate the LCLB with the access panels removed and/or doors open. To do so exposes the operator and other persons to possible personal injury from electrical shock.

12. Emergency Shutdown Procedure

    A. In an emergency, turn off the MASTER LOAD switch. The MASTER LOAD switch will allow disconnection of all load steps.

    B. The power ON/OFF switch will disconnect both load steps and all power to the Load Bank.

13. An approved fire extinguisher suitable for electrical fires should be on hand at all times.

14. It is the responsibility of the customer to take diligent care in installing the LCLB. The National Electrical Code (NEC), sound local electrical and safety codes, and the Occupational Safety and Health Act (OSHA) should be followed when installing the equipment to reduce hazards to persons and property.

15. Do not let the LCLB sit idle with liquid in the tanks for prolonged periods of time.

SECTION II

DESCRIPTION

The Liquid Cooled Load Bank (LCLB) is designed to provide a balanced resistive load of unity power factor, at a specified 3-phase voltage. The total load capability is 540 kW at 415 VAC, 3-phase, 50/60 Hz and 720 kW at 480 VAC, 3-phase, 50/60 Hz. Load steps are 3.75, 7.5, 11.25, 22.5, 45, 90, 90, 90, 90, and 90 kW for 540 kW. Load steps are 5, 10, 15, 30, 60, 120, 120, 120, 120, and 120 kW for 720 kW. The Load Bank is controlled with a control panel (Reference the schematic diagram) or using Ethernet ports on the control panel with a laptop using the Intelligent Load Bank software.

The control panel contains a POWER ON-OFF switch with a CONTROL POWER light, a REMOTE light, an INLET FLOW light, OVERTEMP lights, OVER PRESSURE lights, an INT/EXT CONTROL POWER switch, two RJ45 ETHERNET PORTS, a DIGITAL METER, a MASTER LOAD ON-OFF switch, and individual KW LOAD STEPS switches. All Load step switches are the toggle type with metal levers. The control panel also contains a FUSE for protection of the control circuit.

The LCLB is fabricated using heavy-gauge aluminized sheet steel, making a rigid structure. Mounted within the structure are (2) stainless steel vessels that house the load element resistors, piping, and enclosure assembly cooling fan(s). Mounted on a separate panel are the safety transducers, load step contactors, the RxMS control system, current transformers, fuses and bus bars. Also mounted in the ENCLOSURE ASSEMBLY are the Cam Locks for the load connections.

The LCLB consists of a free-standing enclosure that houses two 45 gallon stainless steel vessels rated at 365 KW and 355 KW, stainless steel inlet and outlet piping, internal resistor elements, flow meter located in the inlet piping, pressure and temperature transducers located on the top of the vessels, temperature transducers located on the inlet and outlet piping spools, Intelligent Load Bank Software system for manual/remote operation, and alarm and shutdown circuits. Control power is provided by an internal 415/480:115 VAC, 50/60 Hz, 750 VA control transformer that obtains power from the load bus.

Each stainless-steel welded vessel is comprised of inlet and outlet ports, plus (13) 2" NPT threaded vertically mounted stainless steel screw plugs, Incoloy 800 Immersion heaters. The individually replaceable immersion heaters are rated for 5, 10, 15, 30, 60, 120, 120, 120, 120, and 120 KW @ 480V, 3-phase. Liquid flow is controlled by a single 321-gallon capacity flow meter located on the inlet piping spool. Filtered cooling liquid enters the two

vessels at the bottom and exhausts at the top. The air eliminator located at the high point of the system allows air to be removed, while preventing contained liquid from escaping the tank and piping during the filling process. See detail explanation later in the operation section of this manual.

Each vessel is protected by the following:

1. Relief Valve is set at 125 PSIG for over pressurization due to human error.
2. Flow Meter is set to alarm and shutdown the resistor elements below 60 GPM and higher than 300 GPM. In "remote control" operation a new minimum flow requirement can be set. Reference the LB-View manual for more information.
3. Pressure Transducers are set to alarm and shutdown the resistor elements at 0 and 70 PSIG.
4. Temperature Transducers on the two tanks are set to alarm and shutdown the resistor elements at 180° F.
5. All alarms and shutdowns are operated and viewable on the Intelligent Load Bank software that is included with the LCLB.
6. Also, there are (2) Temperature Transducers located in the inlet and outlet piping spools for Delta T considerations.
7. In the event of an alarm, the alarm will drop all load. Once the alarm is cleared the load will automatically be reapplied.
8. Temperature Transducers on the outlet are set to shutdown the resistor elements at 180°F.
9. Temperature Transducers on the inlet are set to shutdown the resistor elements at 140°F.

Instrumentation

10. Pressure Transducers (2) will be of stainless-steel construction on the wetted parts, 0-200 PSIG, 1-5V.
11. Temperature Transducers (4) will be of stainless-steel construction on the wetted parts, 0-482 F. Thermowell will be stainless-steel.
12. Flow Meter (1) will be an electromagnetic flowmeter. 150# flanged welded steel epoxy coated with liner, 0 - 321 GPM capability.
13. The liquid for the Flow Meter must have a conductivity greater than 20 microsiemens/cm.
14. Relief Valve (one per tank) are set (125 PSIG) to protect the individual tanks from over pressure and human error.

C A U T I O N

The LCLB should never be used without liquid. Inadequate cooling will result in the resistor elements causing overheating and a fire hazard

W A R N I N G

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

Do not apply DC voltages as the contactors do not have arc blowout magnets.

W A R N I N G

When the resistor elements are shut down due to overtemperature, the liquid flow will need to be manually shut down. DAMAGE MAY OCCUR TO THE FLOW METER IF IT IS SUBJECTED TO INLET TEMPERATURES ABOVE 140°F.

SECTION III

INSTALLATION

LOCATION

Passageway interference can cause structural damage to the LCLB. The LCLB may be too large to fit through existing man doors with or without the skid attached so care must be taken to make sure the unit fits through the doors. Check the dimensions of the LCLB and doorways to make sure it fits through them.

Improper forklift lifting can cause damage to the LCLB. Care must be taken to make sure the tines of the forklift are level and at an appropriate height to fit below the skid or inside of the rectangular holes that are provided with the LCLB structure.

CONTROL CONNECTIONS

The control panel is mounted to the ENCLOSURE ASSEMBLY and wired to the load bank.

Control power is obtained from a 415/480:115 volt, 50/60 Hz control transformer mounted in the ENCLOSURE ASSEMBLY and wired to the load bus bar. Reference the schematic diagram.

Control power can also be provided from an external source. Connect a 120V, 1 PH, 50/60 Hz source to the plug located near the Cam Locks located on the ENCLOSURE ASSEMBLY.

For the Ethernet communication connection, refer to the schematic diagram.

LOAD CONNECTIONS

Load connections are made to the (13) thirteen Cam Locks located on the connection panel. There are (4) four Cam Locks per phase plus one ground. (Refer to the outline drawing.) The connections are marked A, B, C, and GND. Cables to the Load Bank should be of adequate size to handle maximum rated load according to the National Electrical Code and any local codes.

The ampacities of these load connections are shown on LCLB the schematic diagram.

After installation/connections are complete, verify proper phase to phase clearances on all load wiring and hardware. Adjust or insulate to suit if required.

GROUNDING

A permanent ground conductor must be connected to the Load Bank enclosure by an individual ground wire to prevent a potential above ground on the enclosure. There is a ground stud in the base of the LCLB frame for this connection. This ground conductor should be run with the load power conductors to provide the lowest impedance fault path. The ground bus bar must be connected to both the power source frame and to a good earth ground. The ground conductor should be sized per the National Electrical Code Table 250.122, if not superseded by local codes.

SECTION IV

OPERATION

Piping and Valves

1. All the tanks and piping have been hydrostatically tested at the factory to 105 PSIG. Operating pressure is 70 PSIG.
2. Connect the LCLB to the customers unit under test (UUT) using customers supplied piping/hoses/fittings and necessary valves.
3. Fill the LCLB with liquid by opening the manual 4" inlet flanged ball valve.
4. A continuous high-pitched whistle will be heard at the container; this indicates that air is actively escaping through the vent until the whistle stops.
5. Close the 4" inlet ball valve. Tanks are now filled with liquid.
6. Turn on the UUT and make sure the 4" inlet and outlet valves are opened.
7. Check for leaks.
8. If no leaks are present, then proceed to turn on the necessary loads to test the UUT.
9. Connect relief valves to suitable drain per local practices.

D A N G E R

While attempting to drain the LCLB tanks, DO NOT drain with the liquid supply on.

Drain liquid through the inlet valve. Once the liquid has been drained under the outlet piping, it can be opened to speed up draining. Make sure connections are leak tight.

Remember to check internal temperatures of tanks before draining. EXPOSURE TO THIS LIQUID COULD CAUSE HARM.

C A U T I O N

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

Do not apply DC voltages as the contactors do not have arc blowout magnets.

LOCAL OPERATION PROCEDURE

1. Place all switches on the control panel to the OFF position.
2. Connect the power source to be tested to the LCLB as described in the INSTALLATION section.
3. Place the INT/EXT CONTROL POWER selector switch to the proper position.
4. Start the unit under test (UUT).
5. Place the POWER ON/OFF switch to the ON position. The CONTROL POWER light will be energized, indicating control power is present.
6. With the MASTER LOAD switch in the OFF position, energize power source under test. Check for proper phase sequence.
7. The resistive loading is selected by toggle switches, using any one or combination of the toggle switches to make up a given load.
8. By placing the MASTER LOAD switch to the ON position, the preselected load will be applied to the power source.
9. Any load switch can be added or removed as required while the MASTER LOAD switch is closed (ON).
10. To remove the load, open the MASTER LOAD switch by placing it in the OFF position.

SHUTDOWN

1. Place the MASTER LOAD switch to the OFF position.

NOTE

After running a load test, residual heat may be removed from the LCLB by allowing the liquid to flow for a few minutes after load is removed. This procedure is not required for maintaining LCLB integrity, but it is recommended for best practice.

2. Place the control POWER ON/OFF switch to the OFF position, and other switches on the control panel should be turned OFF.
3. Shut down the power source/sources.
4. Disconnect the LCLB from the power sources.

REMOTE OPERATION PROCEDURE

1. Place all switches on the control panel to the OFF position.
2. Connect the power source to be tested to the LCLB as described in the INSTALLATION section.

C A U T I O N

DO NOT operate the LCLB over the rated voltage as this will cause catastrophic failure in the Load Bank.

3. Place the INT/EXT CONTROL POWER selector switch to the proper position.
4. Connect Ethernet cable from laptop to Ethernet port located on the control panel.
5. Connect second Ethernet cable from WI-FI router LAN port to Ethernet port on the control panel.
6. Using the USB power from laptop, power up WI-FI router.
7. Start the unit under test (UUT).

8. Place the POWER ON/OFF switch to the ON position. The CONTROL POWER light will be energized, indicating control power is present. The GREEN REMOTE light will blink if Ethernet is connected.

9. Open the Intelligent Load Bank software on the laptop.

10. Click refresh networks, select network connection, then click scan network. GREEN REMOTE light stops blinking and remains ON.

11. First tap control on, then pick switches. Refer to Intelligent Load Bank user manual for more information.

C A U T I O N

Voltage must not be connected to the LCLB resistive elements if any fault (INLET FLOW, OVERTEMPERATURE, OVER PRESSURE) is indicated.

SECTION V

MAINTENANCE

The Avtron LC20 is designed using corrosion-resistant 304 stainless steel for a long service life. Depending upon actual usage and cooling liquids used, periodic re-passivation may be beneficial to maintain the corrosion resistant properties of the load bank components. The LC20 and its components perform best when clean, as cleanliness is essential for maximum resistance to corrosion. Refer to standard, "Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts, ASTM A967-01, ASTM International". It is recommended that the appropriate Material Safety Data Sheets (MSDS) data sheets be consulted to determine the hazards of handling chemicals during the passivation process.

To provide a long equipment life and to reduce the chance of electric shock, fires, and personal injury, good maintenance procedures must be used. Before servicing, review the SAFETY CONSIDERATIONS section of this manual.

The following examples of scheduled maintenance procedures are not intended to be all-inclusive, but must be accomplished to maintain the equipment in a good, safe condition. All maintenance work must be performed only by qualified personnel.

W A R N I N G

Personal injury from electrical shock may result if ALL sources of power are not disconnected. Refer to the SAFETY CONSIDERATIONS section of this manual.

Eye protection should be worn when cleaning the unit with compressed air.

BEFORE EACH REUSE

a) **Drain the Tanks**
Drain the LCLB tanks. Make sure to dispose of the liquid properly, especially if it contains contaminants or sediments.

b) **Flush the Tanks**

Flush with clean purified water until all residual liquid has been purged from the LCLB.

NOTE

Water is used for hydrostatic & heat load testing and subsequent flushing. The potable water source is treated with a water softener prior to entry into test system storage reservoir. The softened water in the reservoir is UV disinfected, filtered, and chemically monitored in a closed-loop circuit. The treated water from the reservoir is distributed through the LCLB by a closed-loop circuit. The treated water from the reservoir is distributed through the LCLB by a closed-loop pumping circuit for testing and returned to the storage reservoir after use. Test water loss is minimal since both circuits are closed loop. Make-up softened water is automatically replenished as needed in the storage reservoir.

When testing/flushing is complete, the test water is pumped back from the LCLB to the reservoir through a third closed-loop circuit. The LCLB internal fluid circuit is then dried using heated dewpoint-monitored air. The entry/exit points are then capped and secured for shipment.

SIX MONTHS

1. Inspect for loose hardware or loose connections. Tighten where required.

2. Inspect all connections for oxidation or corrosion. Clean the connection or replace the hardware where required.

3. Inspect all magnetic contactors to make sure that the contacts are not severely pitted or corroded. The contacts must move freely and be properly seated.

4. Clean all dirt and debris out of the LCLB. This can be accomplished by blowing the inside of the units with clean, dry compressed air (not to exceed 40 PSIG). Eye protection should be worn when cleaning the LCLB with compressed air.

5. Inspect all the wiring for any sign of insulation failure.

6. Replace all access panels. Tighten all the fastening hardware securely.

7. Check the indicator lamps on the control panel.

c) **Schedule**:
Inspect and maintain regularly all valves, components and tanks. Replace or repair as necessary.

d) If the Load Bank has been idle for more than two months consult factory and refer to Maintenance section of this manual. Perform the check out and maintenance procedure required.

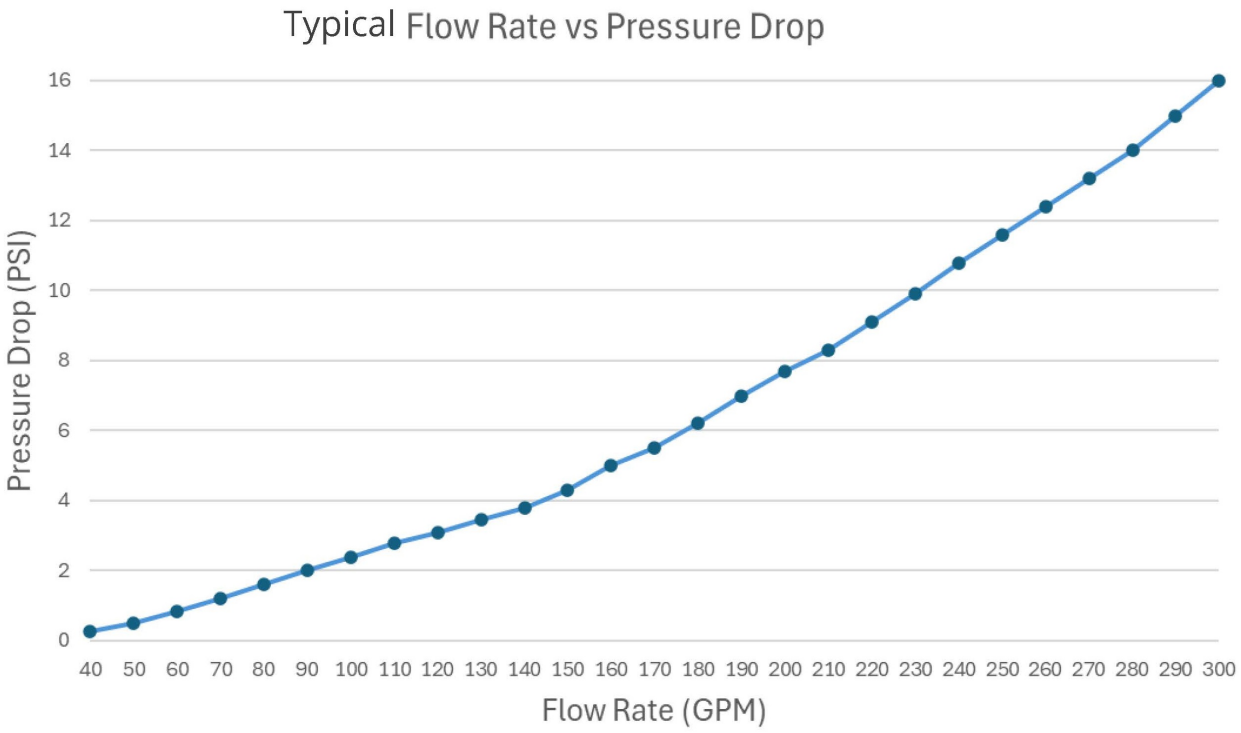


Figure 5-1. Typical Flow Rate vs Pressure Drop

NOTE

Pressure drop will be 0.2 PSI approximately for low flow modes of 20 and 30 GPM

SECTION VI

REPLACEMENT PARTS LIST

INTRODUCTION

The parts list in this section contains the description, quantity required, and part numbers for each listed part. The list also includes schematic reference designators to facilitate parts identification.

NOTE

Every effort has been made to ensure the accuracy of this information. However, changes are sometimes necessary and revisions to the parts list may be made at any time without notice.

REFERENCE DESIGNATORS

Service personnel may use this parts list along with the system schematics to identify and order replaceable parts. The reference designators were carefully selected and matched to those on the schematic diagrams and equipment to simplify the troubleshooting and repair process.

NOTE

When ordering replacement parts, be certain to state the part's description, part number, and the schematic reference designator number if one is available. Also include the model and serial number of the equipment.

REPLACEMENT PARTS LIST

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	QTY/ UNIT
	MODEL LC20 1601935	LC20/ 1601935	
	.SCHEMATIC	1601883	REF
	.ENCLOSURE ASSEMBLY	1601887	1
	..RELAY PANEL	1601884	1
K5-15	...RELAY	AVT-351885	11
F1-3	...FUSE, 10A	324480	3
F4-6	...FUSE, 20A	324482	3
F10-12	...FUSE, 45A	324485	3
F13-45	...FUSE, 90A	AVT-325035	33
XF1-9	...FUSEHOLDER (30A)	324977	3
XF10-12	...FUSEHOLDER (60A)	324660	1
F100-102	...FUSE, 1A	324449	3
F103-104	...FUSE, 6A	324204	2
F105-106	...FUSE, 4A	324454	2
F107-108	...FUSE, 10A	324709	2
XF100-108	...FUSEHOLDER, 3-POLE	324998	3
M2	...CONTROLLER, MAIN	1600934	1
M3-8	...CONTROLLER, EXTENSION	1600935	6
PS1-PS2	...POWER SUPPLY, 24VDC, 2A	EI01681	2
CT1,2	...TRANSFORMER, CURRENT(1000:5)	371262	2
F7-9	...FUSE, 25A	324483	3
T40	...TRANSFORMER, 100VA	970485	1
XF440	...FUSEHOLDER	325065	1
F440	...FUSE, 5A	324211	1
VSR1	...RELAY, VOLTAGE SENSOR	1340574	1
K415, K480	...RELAY, 24 VDC	1351010	2
	..CONTROL PANEL	1601881	1
S100	...SWITCH, SELECTOR	362993	1
M1	...METER, DIGITAL	338344	1
R101	...RESISTOR, 120 OHM	110014	1
F109	...FUSE, 10A	324763	1
XF109	...FUSEHOLDER	324985	1
S1,2,101-109	...SWITCH, TOGGLE	360589	11
IND01	...LIGHT, INDICATOR, GREEN	1532461	1
IND03-07	...LIGHT, INDICATOR, RED	1532462	5
K99	...RELAY	350525	1
IND02	...LIGHT, INDICATOR, GREEN	1536963	1
	..CONNECTION PANEL	1601226	1
J1-4(Ph A)	...CONNECTOR, RECP, 400 AMP(BROWN)	315577	4
J5-8(Ph B)	...CONNECTOR, RECP, 400 AMP(ORANGE)	315576	4

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	QTY/ UNIT
J9-12(Ph C)	...CONNECTOR, RECP, 400 AMP(YELLOW)	315575	4
J13(GND)	...CONNECTOR, RECP, 400 AMP(GREEN)	315064	1
XJ1-13	...COVER, CAM LOCK, CLEAR	1298506	13
P1	...CONNECTOR, RECEPTACLE	314431	1
T4	..TRANSFORMER,CONTROL,750VA	1601595	1
B1,2	..FAN, TUBEAXIAL, AC, 290 CFM	322932	2
	..RELAY PANEL SMALL	1601917	1
K1-3	...RELAY	B14795	3
K4	...RELAY	B14796	1
	.TANK ASSEMBLY	1601885	1
	..ELEMENT, 5KW, 480V, 3PH, 60Hz	1600730-005	1
	..ELEMENT, 10KW, 480V, 3PH, 60Hz	1600730-006	1
	..ELEMENT, 30KW, 480V, 3PH, 60Hz	1600730-012	23
PT1,2	..TRANSMITTER, PRESSURE 0-200 PSI	1600954	2
TC1,2	..SENSOR, RTD, SPRING LOADED, 6" -30-200C	1600955	2
XTC1,2	..CONNECTOR, CABLE, MOLDED, M12	1600988	2
XTC1,2	..THERMOWELL	1601087	2
RV1,2	..RELIEF VALVE	1601285	2
	..ELEMENT, 15KW, 480V 3HP, 60HZ	1600730-011	1
	.INLET MANIFOLD ASSEMBLY	1601176	1
	..FLOW METER	1600953	1
	..FLEX HOSE, 9"LONG, 6" FLANGE	1601094	1
	..GASKET, PIPE SIZE 2	1601132-002	2
	.OUTLET MANIFOLD ASSEMBLY	1601793	1
	..FLEX HOSE, 9"LONG, 6" FLANGE	1601094	1
	..GASKET, PIPE SIZE 2	1601132-002	3
	..GASKET, PIPE SIZE 1	1601132-001	1
	..THERMOWELL, 4"LG.	1601086	1
	..SENSOR RTD SPRING LOADED, 2.5"	1600987	1
	..MOLDED M12 CABLE CONNECTOR	1600988	1
	..AIR ELIMINATOR	1601785	1
	.VALVE BALL, 1/4", BRASS	1601789	1
	.CASTER, RIGID	1600950	2
	.CASTER, SWIVEL	1600951	2
	.VALVE, BALL, 4", STAINLESS STEEL	1601097	2
	.GASKET, PIPE SIZE 4,	1601132-004	2
	.HOSE FITTING, PUSH TO CONNECT	1601790	1
	.HOSE FITTING, 1/4" NPT PUSH TO CONNECT	1601788	2
	.HOSE FITTING, THREADED	1601786	1
	.HOSE, AIR, 0.25INCH	1601787	62"
	.GASKET, PIPE SIZE 2	1601132-002	4
	.HOSE FITTING, 1", BARBED	1601472	2
	.HOSE, WATER, LOW PRESSURE	1601147	225"
	.HOSE FITTING, 1" x 1"	1601287	2
	.THERMOWELL, 4"LG.	1601086	1
	.SENSOR RTD SPRING LOADED, 2.5"	1600987	1
	.MOLDED M12 CABLE CONNECTOR	1600988	1

APPENDIX

LIQUID COOLED LOAD BANK TROUBLESHOOTING GUIDE

NOTE

Servicing should always be done only by trained, qualified service technicians.

W A R N I N G

Be sure that all sources of power to the Load Bank are disconnected before servicing.

PROBLEM	POSSIBLE CAUSES/REMEDIES
1. Pressure Transducer Low Alarm.	a. Possibly a leak in the system – check for leaks in LCLB. b. Pressure Transducer is out of range – should recalibrate it. c. Pressure Transducer not functioning properly – clean pressure element or replace it. d. Customers system is malfunctioning – check entire system to determine what is happening. Shutdown/Fix/Replace/Install. e. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system.

PROBLEM	POSSIBLE CAUSES/REMEDIES
2. Pressure Transducer High Alarm	a. Possibly a valve is closed – Verify all valves are opened while using the LCLB. b. Pressure Transducer is out of range – should recalibrate it. c. Pressure Transducer not functioning properly – clean pressure element or replace it. d. Customers system is malfunctioning – check entire system to determine what is happening. Shutdown/Fix/Replace/Install. e. Resistor Elements malfunction – Verify resistor elements are off. Shutdown to determine if resistor element is functioning correctly. f. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system.
3. RTD/Temperature Transducer Low Alarm – For LCLB Tanks and Delta T Measurements	a. Possibly a valve is closed – Verify all valves are opened while using the LCLB. b. Temperature Transducer is out of range – should recalibrate it. c. Temperature Transducer not functioning properly – replace it. d. Customers system is malfunctioning – check entire system to determine what is happening. Shutdown/Fix/Replace/Install. e. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system.

PROBLEM	POSSIBLE CAUSES/REMEDIES
4. RTD/Temperature Transducer High Alarm - For LCLB Tanks and Delta T Measurements	a. Possibly a valve is closed – Verify all valves are opened while using the LCLB. b. Temperature Transducer is out of range – should recalibrate it. c. Temperature Transducer not functioning properly – replace it. d. Customers system is malfunctioning – check entire system to determine what is happening. Shutdown/Fix/Replace/Install. e. Resistor Elements malfunction – Verify resistor elements are off. Shutdown to determine if resistor element is functioning correctly. f. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system.
5. Flow Meter Low Alarm	a. Customers pumps are malfunctioning – check pumps for causes. Fix. b. Possibly a leak in the system – check for leaks in LCLB system. c. Flow Meter is not working properly – check Flow Meter functionality to determine what is the issue. Shutdown/Fix/Replace/Install. d. Flow Meter is Clogged with debris – Shutdown and remove flow meter from system and check/clean. e. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system. f. LCLB/Customer system valves are possibly closed. Verify all valves are opened. g. Loose wire connection and or ground wire connection – check all wires going to and from Flow Meter.

PROBLEM	POSSIBLE CAUSES/REMEDIES
6. Flow Meter Hight Alarm	a. Customer pumps are malfunctioning – check pumps for causes. Fix. b. Flow Meter is not working properly – check Flow Meter functionality to determine the issue. Shutdown/Fix/Replace/Install. c. RxMS software is malfunctioning – shutdown and reboot. Check RxMS system. d. Loose wire connection and or ground wire connection – check all wires going to and from Flow Meter.
7. Load Bank main power fails to come on.	a. Customer main switch or circuit breaker is not closed. b. Unit is not connected according to the Schematic/Interconnection Diagram. c. Camlocks were damaged during shipment. d. Fuses are blown. (Check and replace as required.)* e. Fuse is blown in Load Bank control circuit. (Check and replace as required.)* f. Dirty or loose connection at Main Power Switch. g. Loose connection on camlocks

*When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

PROBLEM	POSSIBLE CAUSES/REMEDIES
8. Load step(s) cannot be energized.	a. Load step switch is inoperative. b. MASTER LOAD Switch is inoperative. c. RxMS software is malfunctioning - shutdown and reboot d. Control power is inadequate. e. Fuse is blown in Load Bank control circuit or individual branch circuit load fuse (if so equipped) is blown. (Check and replace as required.)* f. Safety Relay K99 is malfunctioning. g. Load step contactor is inoperative. h. Magnetic contactor has an open coil. i. Load step resistor is open.
9. Contactor "chattering" exists.	a. Contacts and/or core are dirty or corroded. b. Connections to contactor coil are loose. c. Control circuit line voltage is too low.
10. Load Bank or load step does not give rated load.	a. Applied load voltage is either derated (below rated) or inadequate. b. Contactor does not close properly. c. Load step resistor element is open. d. One of the individual load branch circuit fuses is blown (if so equipped).

*When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

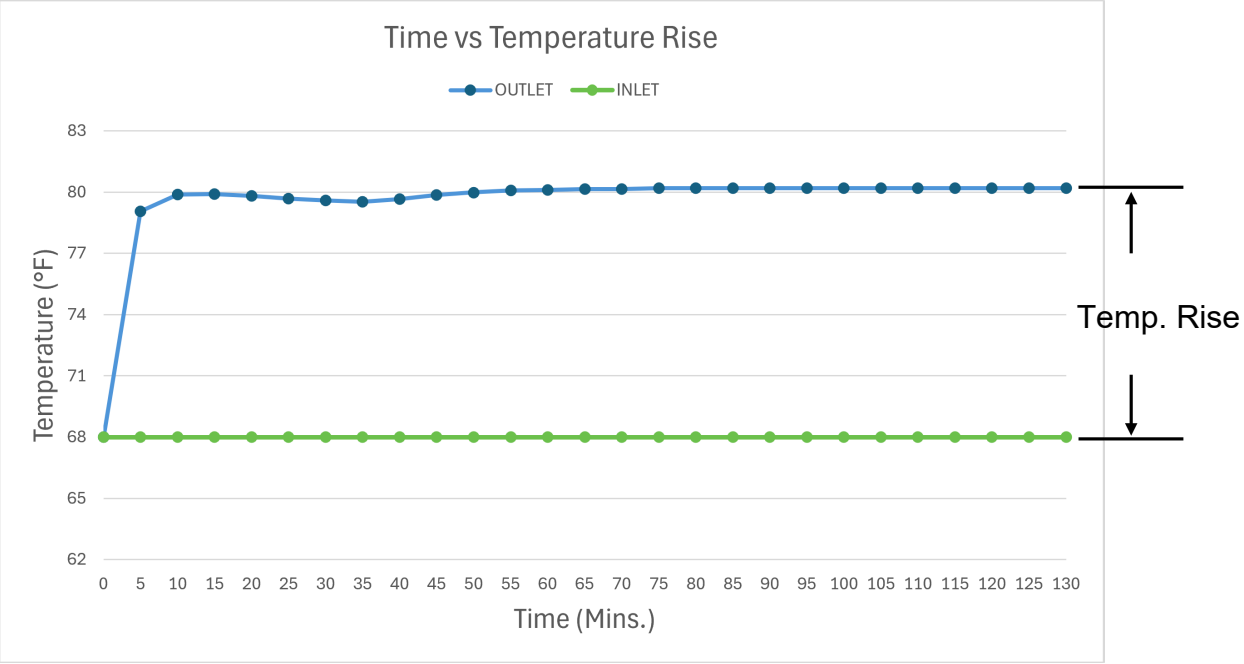
PROBLEM	POSSIBLE CAUSES/REMEDIES
11. Malfunctioning Controls/Alams	a. CPU not in RUN MODE b. Loose RJ45 connection to CPU or RxMS board. c. Malfunctioning remote I/O module. d. Shorted output on remote I/O. e. Loose wiring to RxMS board. f. Bad 24 VDC power supply.

*When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

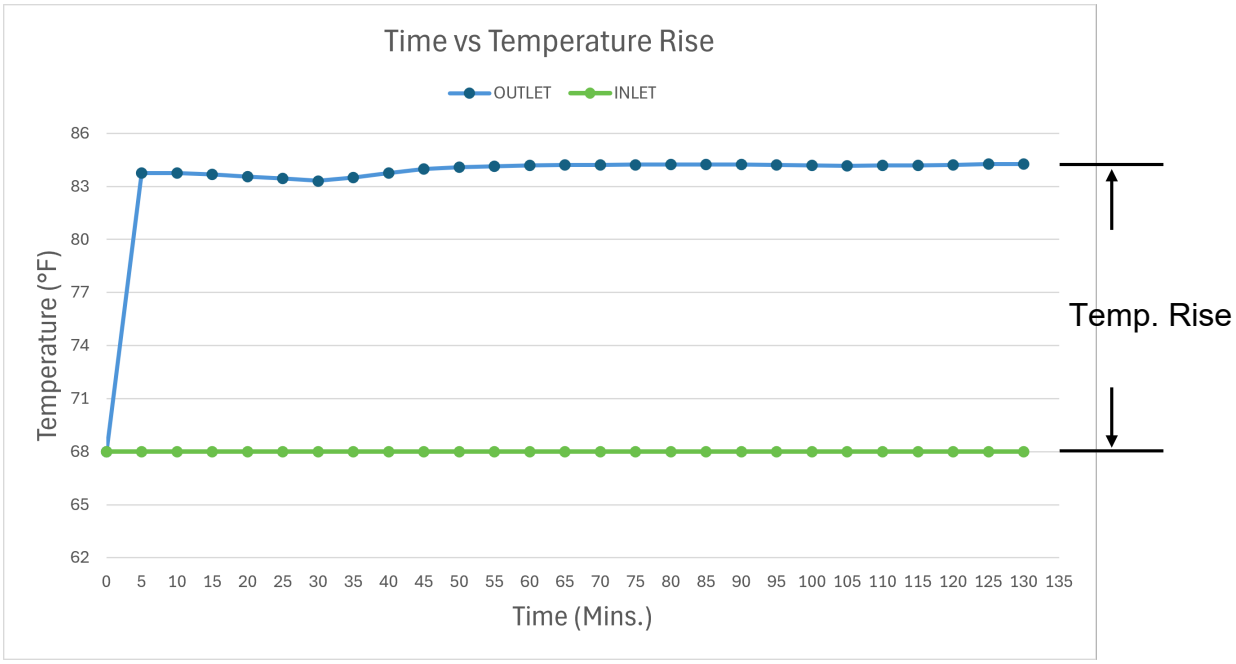
APPENDIX

LIQUID COOLED LOAD BANK
TIME VS. TEMPERATURE RISE
(DELTA T) GRAPHS AT VARIOUS GPM'S

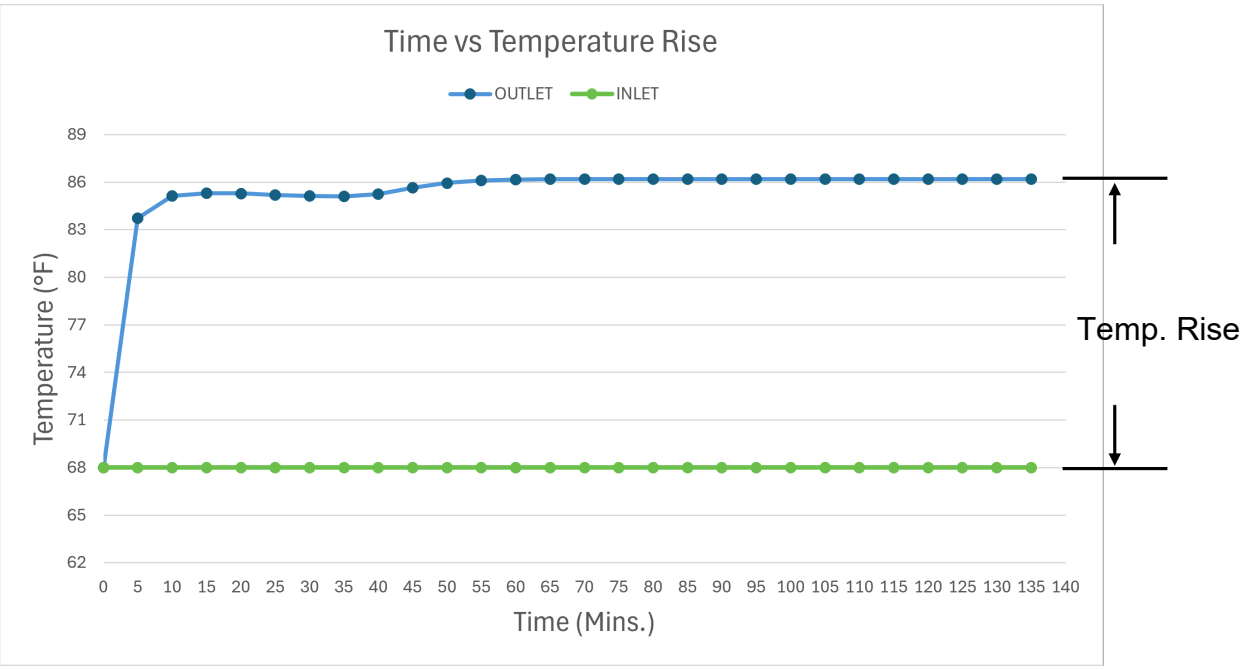
LC20 LOAD BANK
540kW, 415V, 300GPM



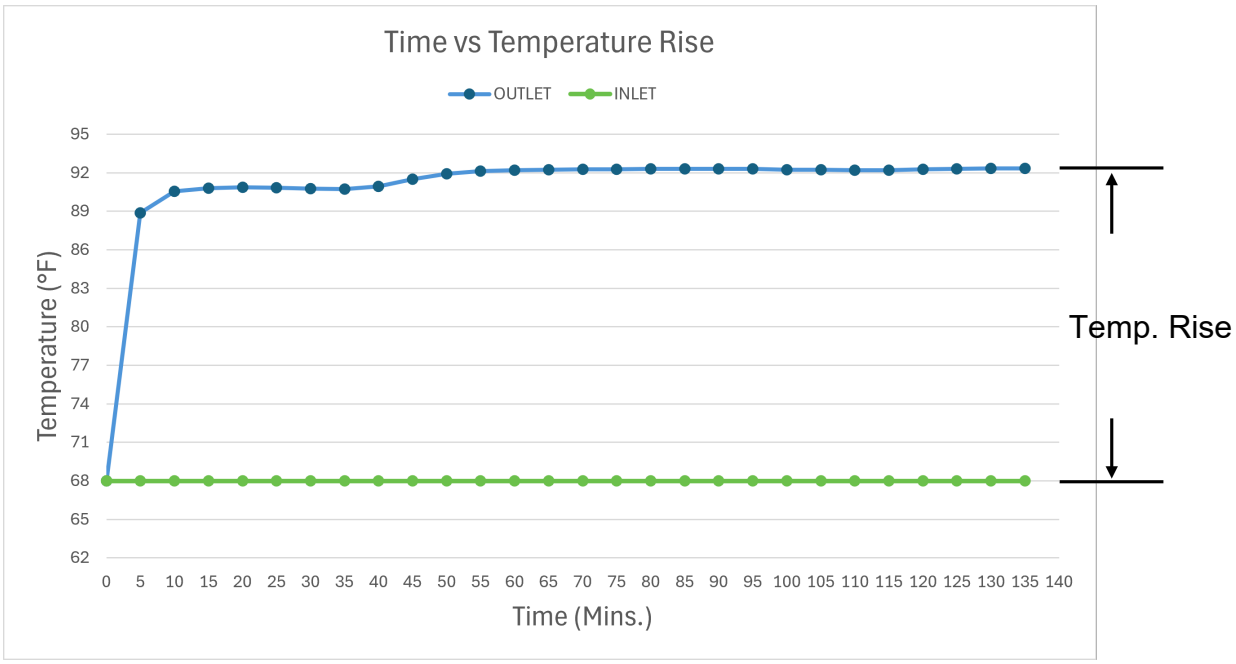
LC20 LOAD BANK
720kW, 480V, 300GPM



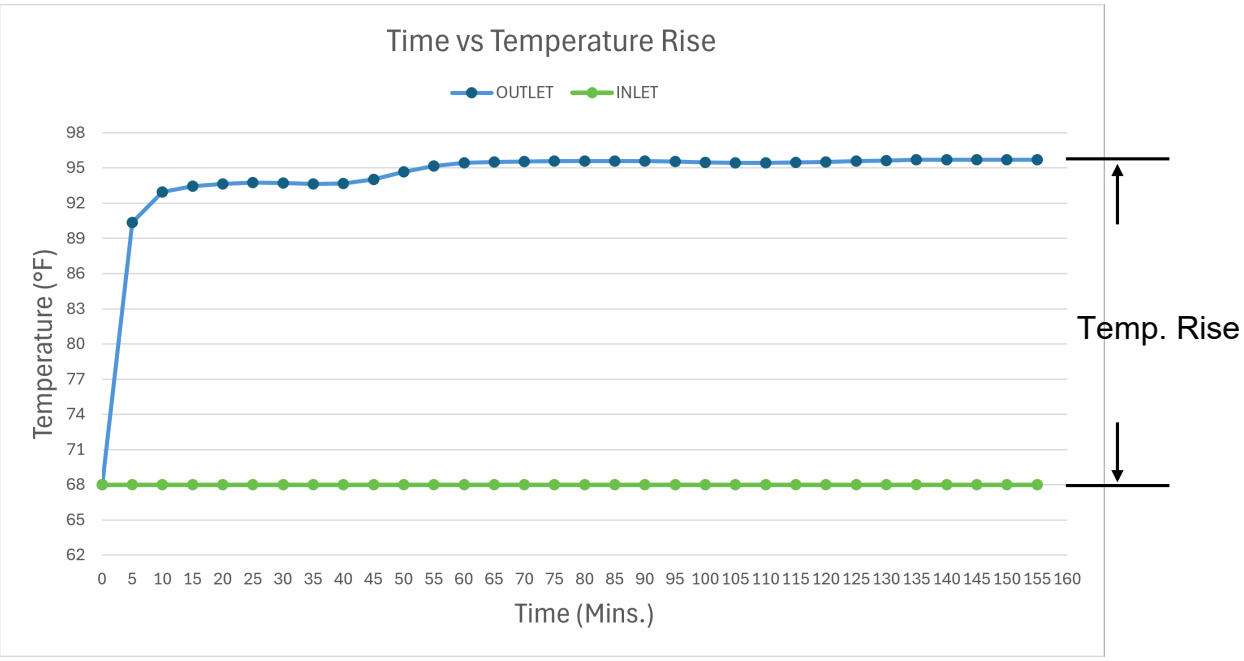
LC20 LOAD BANK
540kW, 415V, 200GPM



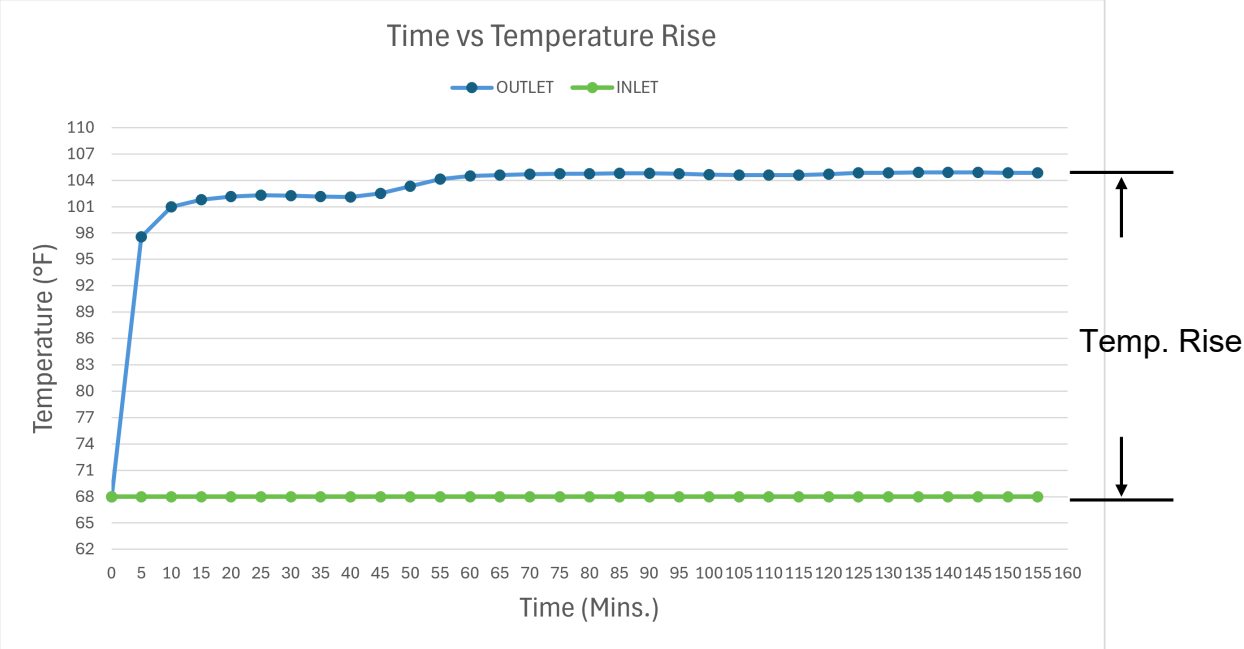
LC20 LOAD BANK
720kW, 480V, 200GPM



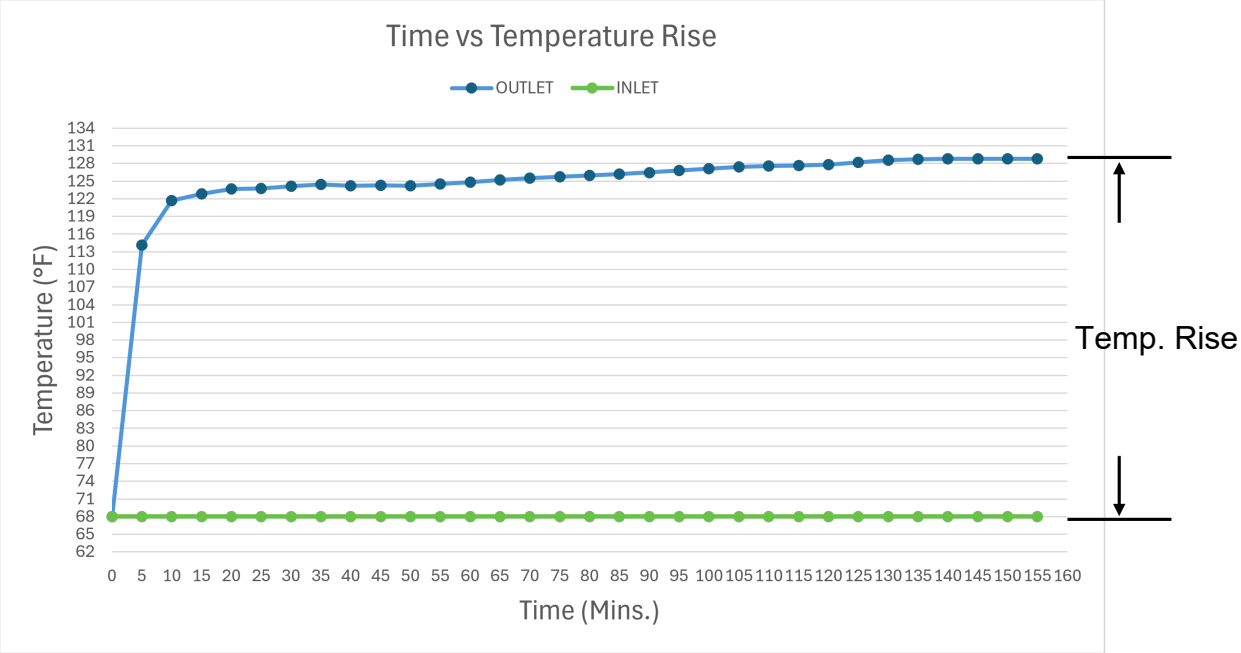
LC20 LOAD BANK
540kW, 415V, 132GPM



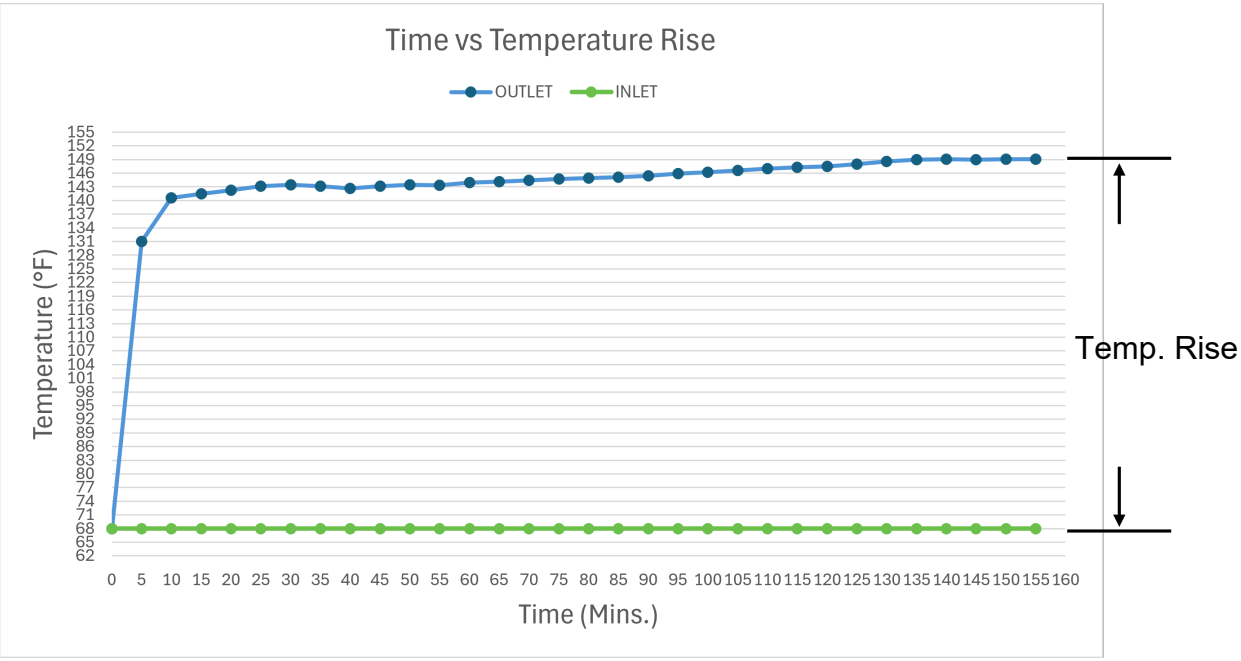
LC20 LOAD BANK
720kW, 480V, 132GPM



LC20 LOAD BANK
540kW, 415V, 60GPM



LC20 LOAD BANK
720kW, 480V, 60GPM



DRAWINGS
PROPRIETARY NOTE

This document contains information PROPRIETARY TO Load Bank products and systems by Avtron Power Solutions, LLC. It is furnished solely to provide information sufficient for instruction, operation, maintenance, evaluation, and testing of the equipment herein disclosed; is not to be used for manufacturing or procurement; and is not to be disclosed to anyone other than persons in the Division, or the Company, or the Government, as the case may be, responsible for action relating to this document without the express written permission of Avtron Power Solutions, LLC.

California Proposition 65 Warning - DINP and DIDP
Advertencia de la Proposición 65 de California - DINP y DIDP
Avertissement concernant la Proposition 65 de Californie - DINP et DIDP

⚠**WARNING:** This product can expose you to chemicals including DINP, which is known to the State of California to cause cancer, and DIDP which is known to the State of California to cause birth defects or other reproductive harm. For more information go to: www.P65Warnings.ca.gov.

⚠**ADVERTENCIA**: Este producto puede exponerle a químicos incluyendo DINP, que es (son) conocido(s) por el Estado de California como causante(s) de cáncer y DIDP, que es (son) conocido(s) por el Estado de California como causante(s) de defectos de nacimiento u otros daños reproductivos. Para mayor información, visite : www.P65Warnings.ca.gov.

⚠**AVERTISSEMENT**: Ce produit peut vous exposer à des agents chimiques, y compris DINP, identifiés par l'État de Californie comme pouvant causer le cancer et DIDP, identifiés par l'État de Californie comme pouvant causer des malformations congénitales ou autres troubles de l'appareil reproducteur. Pour de plus amples informations, prière de consulter: www.P65Warnings.ca.gov.

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www.avtronpower.com

California Proposition 65 Warning - Lead and Lead Compounds

Advertencia de la Proposición 65 de California - Plomo y compuestos de plomo

Avertissement concernant la Proposition 65 de Californie - Plomb et composés de plomb

⚠ **WARNING:** This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: www.P65Warnings.ca.gov.

⚠ **ADVERTENCIA**: Este producto puede exponerle a químicos incluyendo plomo y compuestos de plomo, que es (son) conocido(s) por el Estado de California como causante(s) de cáncer y defectos de nacimiento u otros daños reproductivos. Para mayor información, visite : www.P65Warnings.ca.gov.

⚠ **AVERTISSEMENT**: Ce produit peut vous exposer à des agents chimiques, y compris plomb et composés de plomb, identifiés par l'État de Californie comme pouvant causer le cancer et des malformations congénitales ou autres troubles de l'appareil reproducteur. Pour de plus amples informations, prière de consulter: www.P65Warnings.ca.gov.

Avtron Power Solutions
www.avtronpower.com

Limited Warranty

AVTRON POWER SOLUTIONS

Loadbank Warranty

This Warranty is given ONLY to purchasers who buy for commercial or industrial use in the ordinary course of each purchaser's business.

General
Avtron branded products and systems by Avtron Power Solutions, LLC, are in our opinion the finest available. We take pride in our products and are pleased that you have chosen them. Under certain circumstances we offer with our products the following Two-Year Limited Warranty against defects in material and workmanship.

Please read your Warranty carefully. This Warranty sets forth our responsibilities in the unlikely event of defect and tells you how to obtain performance under this Warranty.

TWO YEAR LIMITED WARRANTY
AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP

Terms of Warranty:

As provided herein, the Avtron Power Solutions product is warranted to be free of defects in material and workmanship for a period of two (2) years from the date of shipment. The product shipment date will be determined only from the Avtron Power Solutions bill of lading.

The foregoing Limited Warranty is conditioned upon User's compliance with the following:

1. The Avtron Power Solutions product is deployed in accordance with Avtron Power Solutions specifications and state and local codes and standards, including installation by an electrician licensed in the state where used, if required.

2. The Avtron Power Solutions product is maintained in accordance with Avtron Power Solutions instructions and used under normal conditions for the purposes intended by Avtron Power Solutions.

All warranty field-related repairs, replacements or adjustments must be made by Avtron Power Solutions or its duly authorized representative(s).

Warranty Extends to First Purchaser for Use, Non-transferable:
This Warranty is extended to the first person, firm, association, or corporation for whom the Avtron Power Solutions product specified herein is originally deployed for use (the "User") in the fifty United States or Canada. This Warranty is not transferable or assignable without the prior written permission of Avtron Power Solutions.

Assignment of Warranties:
Avtron Power Solutions assigns to User any warranties which are made by manufacturers and suppliers of components of, or accessories to, the Avtron Power Solutions product and which are assignable, but Avtron Power Solutions makes NO REPRESENTATIONS as to the effectiveness or extent of such warranties, assumes NO RESPONSIBILITY for any matters which may be warranted by such manufacturers or suppliers and extends no coverage under this Warranty to such components or accessories.

Drawings, Descriptions:
Avtron Power Solutions warrants for the period and on the terms of the Warranty set forth herein that the Avtron Power Solutions product will conform to the descriptions contained in the certified drawings, if any, applicable thereto, to Avtron Power Solutions' final invoices, and to applicable Avtron Power Solutions product brochures and manuals current as of the date of product shipment ("Descriptions"). Avtron Power Solutions does not control the use of any Avtron Power Solutions product. Accordingly, it is understood that the Descriptions are NOT WARRANTIES OF PERFORMANCE and NOT WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE.

Warranty Claims Procedure:
Within a reasonable time, but in no case to exceed thirty (30) days, after User's discovery of a defect, User shall contact Avtron Power Solutions product service department at **www.avtronpower.com** and select the support tab or by phone at **(216) 573-7600.**

Subject to the limitations specified herein, the Avtron Power Solutions remote support team will first assist User with the defect inquiry for the Avtron Power Solutions product warranted hereunder, without charge. Warranty coverage will apply only after the Avtron Power Solutions support team confirms, either via remote support or, in the discretion of Avtron Power Solutions, an in-person visit, the claimed defect and there are no signs of treatment or use that would void the coverage of this Warranty. If there is a need for in-person visit, Avtron Power Solutions reserves the right to charge for travel, labor and other related costs associated with a visit prior to

visiting User's site in the event warranty coverage does not apply or only applies partially. If warranty coverage applies, Avtron Power Solutions will repair or replace the non-conforming product without charge. All defective products and component parts replaced under this warranty become the property of Avtron Power Solutions.

Warranty Performance of Component Manufacturers:
It is Avtron Power Solutions' practice, consistent with its desire to remedy Warranty defects in the most prompt and effective manner possible, to cooperate with and utilize the services of component manufacturers and their authorized representatives in the performance of work to correct defects in the product components. Accordingly, Avtron Power Solutions may utilize third parties in the performance of Warranty work, including repair or replacement hereunder, where, in Avtron Power Solutions' opinion, such work can be performed in less time, with less expense, or in closer proximity to the Avtron Power Solutions product.

Items Not Covered By Warranty:
THIS WARRANTY DOES NOT COVER DAMAGE OR DEFECT CAUSED BY misuse, improper application, wrong or inadequate electrical current or connection, negligence, inappropriate on site operating conditions, repair by non-Avtron Power Solutions designated personnel, accident in transit, tampering, alterations, a change in location or operating use, exposure to the elements, water, or other corrosive liquids or gases, Acts of God, theft, installation and/or deployment contrary to Avtron Power Solutions' recommendations or specifications, or in any event if the Avtron Power Solutions serial number has been altered, defaced, or removed.

THIS WARRANTY DOES NOT COVER shipping costs, installation costs, or maintenance or service items and further, except as may be provided herein, does NOT include labor costs or transportation charges arising from the replacement of the Avtron Power Solutions product or any part thereof or charges to remove or reinstall same at any premises of User.

REPAIR OR REPLACEMENT OF A DEFECTIVE PRODUCT OR PART THEREOF DOES NOT EXTEND THE ORIGINAL WARRANTY PERIOD.

THE PRODUCTS LISTED IN THIS WARRANTY ARE NOT FOR USE IN THE CONTROL AREA OR ANY REACTOR CONNECTED OR SAFETY APPLICATIONS OR WITHIN THE CONTAINMENT AREA OF A NUCLEAR FACILITY OR FOR INTEGRATION INTO MEDICAL DEVICES.

Limitations:
THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

USER'S SOLE AND EXCLUSIVE REMEDY IS REPAIR OR REPLACEMENT OF THE AVTRON POWER SOLUTIONS PRODUCT AS SET FORTH HEREIN.

IF USER'S REMEDY IS DEEMED TO FAIL OF ITS ESSENTIAL PURPOSE BY A COURT OF COMPETENT JURISDICTION, AVTRON POWER SOLUTIONS' RESPONSIBILITY FOR PROPERTY LOSS OR DAMAGE SHALL NOT EXCEED THE NET PRODUCT PURCHASE PRICE.

IN NO EVENT SHALL AVTRON POWER SOLUTIONS ASSUME ANY LIABILITY FOR INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES OF ANY KIND WHATSOEVER, INCLUDING WITHOUT LIMITATION LOST PROFITS, BUSINESS INTERRUPTION OR LOSS OF DATA, WHETHER ANY CLAIM IS BASED UPON THEORIES OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, OR OTHERWISE.

Miscellaneous:
NO SALESPERSON, EMPLOYEE OR AGENT OF AVTRON POWER SOLUTIONS IS AUTHORIZED TO ADD TO OR VARY THE TERMS OF THIS WARRANTY. Warranty terms may be modified, if at all, only in writing signed by an Avtron Power Solutions officer.

Avtron Power Solutions obligations under this Warranty are conditioned upon Avtron Power Solutions timely receipt of full payment of the product purchase price and any other amounts due. Avtron Power Solutions reserves the right to supplement or change the terms of this Warranty in any subsequent warranty offering to User or others.

In the event that any provision of this Warranty should be or becomes invalid and/or unenforceable during the warranty period, the remaining terms and provisions shall continue in full force and effect.

This Warranty shall be governed by, and construed under, the laws of the State of New Jersey, without reference to the conflict of laws principles thereof.

This Warranty represents the entire agreement between Avtron Power Solutions and User with respect to the subject matter herein and supersedes all prior or contemporaneous oral or written communications, representations, understandings, or agreements relating to this subject.

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